10 years of flood events, study of the adaptation capacity of the people living in the Riparian Area of the Madiun River

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Abstract. The flood disaster is a severe threat to households living in the riparian area of the Madiun River. The flood proved the threat in Madiun River in 2007. For more than 10 (ten) years they remained in settlements in the riparian area of the Madiun River, this situation caused them to adapt to their environmental conditions. The purpose of this study was to determine the characteristics of the community, measure the level of knowledge of floods, find out public perceptions, the adaptive capacity of the household occupants of the riparian area of the Madiun River and the local wisdom of the community when facing the threat of floods. Retrieval of data using a questionnaire that was addressed to 100 respondents in the riparian area population randomly selected. The results showed that the knowledge level (94%) and perception (90%) of the public against high floods. The capacity of community adaptation to flood hazards consists of 89% low, 10% moderate, and only 1% which has a high level of adaptation. The local wisdom of the residents of the riparian area with a flood-prone environment consists of wisdom in aspects of value, aspects of a building structure, and aspects of local intelligence in recognizing signs of flooding.

1. Introduction
Flooding is a type of natural disaster that often occurs throughout the world and causes many casualties. Flooding has harmed more than 1.4 million people in the last few decades [7]. According to data from the United Nations International Strategy for Disaster Reduction (UNISDR) in 2012, flood disasters ranked first based on the number of climate-related natural disasters in the world for 32 years (1980-2011) [27]. In the same rank [4], floods also occurred in Indonesia with 6,239 incidents over the past 10 (ten) years (2010-2019).

Flood disasters have a negative impact on developing countries (such as Indonesia), especially for people who suffer from material losses [14]. Mistra explained that the negative impacts of flooding could occur in five aspects, namely, demographic aspects, governance aspects, economic aspects, aspects of facilities and infrastructure, and environmental aspects [17]. Because flooding has many negative impacts, efforts are needed to minimize the risk of losses due to flooding.

Massive floods have also been experienced by communities living in the Madiun River riparian area in 1966 and 2007. The Madiun River is part of the Solo River. The Madiun River passes through Ponorogo Regency, Madiun Regency, Madiun City, Magetan Regency and Ngawi Regency with an area of ± 3,755 km² [2]. According to the Balai Besar Wilayah Sungai (BBWS) Bengawan Solo (2012), the incident was caused by several factors, namely the continued decline in the condition of the forest, damage to the watershed due to illegal logging and land conversion, weak law enforcement against illegal logging, and the still low awareness of the community environmental maintenance.

According to Ismoyojati, the causes of flooding in addition to very high rainfall are also affected by changes in land use [10]. This opinion is also supported by Priyana et al., which explains that the leading causes of floods that have occurred lately are more caused by human treatment of the surrounding environment [21]. The threat of future flood risk is expected to increase due to climate...
change and the intensity of rainfall that occurs due to anthropogenic ([6]; [3]); land use and land cover factors ([29]; [20]); and population-level factors and human presence ([5]; [16]; [12]). Considering the risk of flooding, it is undoubtedly our responsibility to minimize the risk of future floods.

Republic of Indonesia Government Regulation No. 38 of 2011 concerning rivers stipulates that rivers are natural and / or artificial water flows or containers in the form of drainage networks with water in them, ranging from upstream to estuary, bounded right and left by riparian lines. The river riparian line is the virtual line on the left and right of the riverbed, which is designated as the river protection limit [22]. River space consists of riverbed and river boundary. Riparian zones are buffer zones between aquatic (river) and land ecosystems that help prevent sediments, nitrogen, phosphorus, pesticides and other pollutants from entering the river.

Naiman and Dekamp explain that river riparians play several ecological functions; protection of local biodiversity, filtration of water and nutrients, protection of river flow and maintaining river productivity, as well as maintaining river climate and flood buffer [18]. Riparian river can cause the sustainability of the river is maintained, so that along the river will become a habitat of a kind ecosystem.

The use of river riparian areas for settlements is a form of violation of government regulations, besides that it is also a form of human threat to river sustainability. The construction of settlements in the river riparian area makes it difficult for water to infiltrate and have a high risk of flooding. Law Number 7 of 2004 concerning water resources, states that rivers are one form of surface water flow that must be managed in a comprehensive, integrated, environmentally sound manner by realizing sustainable use of water resources for the greatest prosperity of the people. Therefore, in various planning documents starting from the regional level up to the national level, there are policies regarding river riparian areas.

The 2007 major flood event on the Madiun River did not cause people living in the Madiun River riparian area to move to safer places. This condition indicates that people tend to choose to adapt to flooding. Adaptation according to McEvoy, et al., is a long-term activity to avoid social and economic losses [15], while Janssen et al., added that adaptation is related to processes, actions, and outputs in a system that aims to form a management that adapts to changes in conditions, pressures, threats, risks and opportunities [9]. Ritohardoyo explained that adaptation is the capacity of individuals to overcome environmental conditions based on psychological factors that aim to anticipate the future [23]. The more adaptive a person or society is, the more likely they will be able to survive the possible changes [25]. Physical, socio-economic and cultural variables are factors that influence understanding while understanding and preparing mitigation infrastructure are factors that influence perception. This perception can later be used as a basis for consideration of people's adaptation in preparing themselves and their families to deal with disasters [23]. The contribution to the adaptation of the people living in the river riparian area in the face of flooding needs to be done to formulate a flood disaster management policy as well as sustainable management of the Madiun River.

2. Method
2.1. Study Area
This research was conducted at the riparian of the Madiun River. Madiun River administratively passes through Ponorogo Regency, Magetan Regency, Madiun Regency, Madiun City, and Ngawi Regency. The area of this research unit is the villages that are passed by the Madiun River, while the analysis unit is the household that inhabits the riparian area. Data retrieval was carried out in 2017, which is 10 (ten) years after a major flood in Madiun River on December 26, 2007. The research area is the Madiun River riparian area that is outside the embankment and the urban area. Pursuant to the Regulation of the Minister of Public Works and Housing number 28 / PRT / M / 2015 concerning Determination of River Riparian and Lake, if the watershed is greater than 500 km² (five hundred square kilometres), the riparian line is at least 100 m (one hundred meters) from the edge left and right of the riverbed along the river. The location of the Madiun River in this study is depicted in a red circle, as shown in Figure 1.
2.2. Data Source and Analysis

This study is a survey research using a quantitative descriptive approach, surveys conducted by observation and interviews in the field. Primary data is in the form of household characteristics data of residents of the Madiun River riparian area. Quantitative analysis is used to understand the level of knowledge, perception, and adaptation of the community in dealing with flood hazards.

| Data Type         | Indicators                                      | Data retrieval                      |
|-------------------|-------------------------------------------------|-------------------------------------|
| public knowledge  | definition of flood cause of flooding           | guided interviews using a questionnaire |
|                   | flooding impact                                 |                                     |
|                   | flood control                                   |                                     |
| people's perception | definition of flood cause of flooding          | guided interviews using a questionnaire |
|                   | flooding impact                                 |                                     |
|                   | flood control                                   |                                     |
| adaptive capacity | form of physical adaptation                     | Subsubsection headings should end with a full stop (period) and run into the paragraph text |
|                   | form of social adaptation                       |                                     |
|                   | form of economic adaptation                     |                                     |
| local wisdom      | aspects of values, aspects of norms,            | an in-depth interview with a key person |
|                   | aspects of building structures,                 |                                     |
|                   | aspects of culture                              |                                     |

Data on population distribution and riparian of the Madiun River were obtained from the analysis using ArcGIS-10. Satellite imagery was analyzed by buffering 100 meters of the river. From this analysis, data obtained on the border area as far as 100 meters on the right and left sides of the Madiun River. The flow of spatial data acquisition in the Madiun River riparian area, as shown in Figure 2.
3. Results and Discussion

3.1. Socio-Economic Characteristics of Madiun River Occupants

Socio-economic conditions are all things related to meeting the needs of the community, including clothing, food, housing, education, health and others. Meeting these needs is related to income while employment is usually a result of education, and is one of the determining factors. The socio-economic conditions of the people measured in this study are the level of formal community education, employment and income.

The characteristics of the inhabitants of the Madiun River border are known from data collection in the field, and the data is as in Table 2.

| Characteristics | Classification | Percentage\(^{(n = 100)}\) |
|-----------------|----------------|--------------------------|
| Gender          | Male           | 68                       |
|                 | Female         | 32                       |
| Age             | 18-44          | 29                       |
|                 | 45-60          | 43                       |
|                 | >60            | 28                       |
| Length of stay  | 0-10           | 2                        |
|                 | 11-20          | 4                        |
|                 | 21-30          | 10                       |
|                 | 31-40          | 18                       |
|                 | >40            | 66                       |
| Education       | No school      | 40                       |
|                 | Elementary     | 25                       |
|                 | Junior high    | 10                       |
|                 | High           | 24                       |

Table 2. Socio-economic characteristics of the residents of the Madiun River riparian
Based on Table 2, it can be seen that the percentage of characteristics of the inhabitants of the Madiun River riparian population are mostly men with a portion of 68%, while female respondents are 32%. The age of the respondents also varied, i.e. from the ages of 18-44, amounting to 29%, ages 45-60 years amounting to 43%, age over 60 years amounting to 28%.

Length of stay is one of the indicators asked in this study because the length of stay affects the experience of respondents in facing floods. In Table 2, it can be seen that those who have lived in their homes for more than 40 years amounted to 66%. Respondents who lived for 31-40 years were 18%. And only 2% of respondents have lived less than the last 10 (ten) years. From these data, it can be concluded that the respondent had a considerable amount of time in occupying the riparian area of the Madiun River. While inhabiting the riparian area, 94% of respondents claimed to have experienced a flood, and 6% had never experienced a flood. From the survey results, it is known that 74% of respondents claimed to have experienced flooding in 2007, and the rest experienced flooding last in 2016. 94% of respondents stated that they had experienced flooding, and only 6% did not experience flooding. Based on the flood event, it can be concluded that the residents of the Madiun River riparian are areas prone to flooding.

Educational background of respondents in this study was divided into; no school, the elementary school not finished, elementary school, junior high school, senior high school, senior high school. From respondents or people who live in the Madiun River riparian area, 40% of them have never attended school. During their lives, they never experienced formal education. 24% of respondents said they were in elementary school. The percentage of graduates of Junior High School 10% and Senior High School (SMA) 24%. Whereas those who attended higher education, only 1% of the total respondents. From these data, it can be concluded that the majority of respondents have a low level of education, namely elementary school and non-school 65%.

In fulfilling their daily needs, the Madiun River riparian community works as labourers, masons, farmworkers, farmers, traders, civil servants, TNI / Police, private employees, and others. From Table 1, it can be seen that the respondents' work is 32% of farm labourers. 24% of jobs are not categorized, 12% of traders, 9% of side jobs, 4% of private employees and respondents who work as civil servants.
and the military/police 2%. The condition of the borders of the Madiun River illustrates that most of the people living in the area are families with jobs as farm labourers and low-income earners.

2.3 Knowledge level and Perception Level

The level of community knowledge about floods is included in the high category (94%). This is known from the results of the analysis, which shows that the community understands flooding well. They can explain the causes of floods, the effects of floods, and how they are taken when they are flooded. This great knowledge was gained from their experience of dealing with floods. Knowledge about floods is an excellent cognitive capital to develop community capacity in dealing with floods.

The level of community perception of floods is high (90%); this is known from the results of the analysis, which shows that the community has excellent views and thoughts about flooding. From the interview results, respondents understood in detail how to deal with flooding in the Madiun River. Communities can also reflect on flood events that they have experienced with an opinion on how to appropriately respond to flood disasters. The community perception is formed from the knowledge and experience experienced by the community, thus forming a positive perception of floods.

2.4 Adaptive Capacity

Adaptation strategies of the inhabitants of the Madiun River analyzed quantitatively in this study, namely physical, social, and economic adaptation. From the analysis, the physical adaptation measures of the community revealed that only 25%, while 75% did not take these actions. This physical adaptation by repairing the structure of the house is to repair the wall with a stronger wall. In this physical adaptation, respondents also measured the actions of building a house into two floors with the aim that the house is safe in case of flooding. Only 2% of respondents responded to construct a two-story house, and 98% of them chose not to raise the house building. The high cost of building a two-story house is the reason they did not take these actions. Another action of physical adaptation is to create flood retaining embankments around the affected houses so that flooding does not occur to the land around their houses. The data shows that only 11% of those who did the action and the remaining 89% did not make the flood retaining embankment.

The second act of adaptation is social adaptation. These social adaptation actions are social actions taken by families and communities to cope with floods by avoiding or getting around. Actions in social adaptation are disaster mitigation training, creating an early warning system, and creating a disaster evacuation route. The results showed that only 8% of respondents did flood disaster mitigation training. 18% of respondents made flood warning systems with other communities. Another social adaptation action is to make an evacuation route, which is carried out by 24% of respondents. The third act of social adaptation is the formation of a flood rescue team. The results showed that 9% of respondents claimed to make a flood rescue team while the remaining 91% did not. The community in case of flooding needs evacuation process assistance. The need to form a rescue team is to save residents who are trapped by flooding in their homes. The rescue team is considered necessary because, in the process of flood evacuation, it takes swimming skills, adequate equipment, strong mentality and courage to deal with flood currents.

Economic adaptation is an effort made by respondents to stay afloat and anticipate risks due to flooding in the future. Efforts made can be done by joining flood insurance and savings for future needs. Based on the results of the study, it is known that none of the respondents took part in flood insurance. The results of the analysis note that 100% of respondents have savings to prepare one day if needed. Flood insurance is something they have never known, and this is because no insurance company promotes insurance to the public. Savings are something that they have in the form of money or gold, and this savings is an asset of the residents of the river border to be used as savings if needed.
Based on the adaptation level of the Madiun River population, it can be concluded that the level of adaptation of the population in the riparian river of the Madiun river to flooding is low (89%). The low adaptation of this community is due to the low level of income and education of riparian residents of the Madiun River. With low education, people will find it challenging to get decent jobs. The average job as a farm labourer cannot provide many choices to the community. In the end, their income level is low. The high cost of home repairs is one of the causes of the low level of community adaptation to flooding. And only 10% have a moderate level of adaptation, while the remaining 1% has a high adaptation (Figure 2).

2.5 Local wisdom

Wisdom is generated because of the continuous process of human adaptation to the environment. Humans who reside need to adjust to their environment to survive. Wisdom is obtained by the river riparian residents from generation to generation without a written agreement between the community and each other.

In epistemology, flooding according to the community is a warning from God for humans. This warning is a form of advice to humans to always maintain the river properly. In terms of structural aspects of the building, riparian river dwellers have the characteristic of making relatively large houses in the form of joglo. The roof of the house is not installed ceiling, this according to them as an anticipatory step in case of flooding so they can store essential items on the wooden roof of the house.

The local intelligence of the residents of the river riparian residents is known to recognize the danger of the Madiun River flood. Disasters do not occur suddenly; natural signs are recognized before a flood occurs. In recognizing the signs of floods, the inhabitants of the Madiun River riparian use natural signs, namely the occurrence of continuous rain for more than two days, the change in colour of previously clear river water becomes cloudy and fast river currents. Fast river currents make the sound of the river became noisy and heard until the houses of the residents. These signs are used as a reference by residents of the Madiun River riparian to be alert to floods by preparing to secure essential items and prepare for evacuation.

4. Discussion

This study aims to determine how the characteristics of the Madiun River riparian population. This study also aims to determine the level of knowledge, perceptions and adaptive levels of the Madiun River riparian population to the threat of flood hazards. Local wisdom in this study emerged after the adaptation process of the inhabitants of the Madiun River border to the floods that occurred repeatedly. Knowledge of the population of the Madiun River riparian regarding floods is high. The community understands how the process of flooding, the causes of flooding, and what actions must be
taken when a flood occurs. They gained this knowledge from the flood experience they had experienced in 2007. Nakanishi and Black investigated public knowledge about the disaster in Takamatsu, Japan. The results of the study indicate that implicit knowledge about the history of typhoons and coastal inundation is information that is trusted and can be built by residents to prepare for future disasters [19]. This knowledge is precious to make citizens aware of vulnerabilities and take action to evacuate when a disaster strikes.

Community perceptions in dealing with disasters, especially floods, are factors that influence actions in the face of disasters. Perception is the process of someone becoming aware of everything in his environment through the senses he has, or environmental knowledge obtained through an interpretation of sensory data [10]. The results of the measurement of people's perceptions of the inhabitants of the Madiun River riparian on floods indicate that the community has a high perception. The facts of local wisdom of the inhabitants of the Madiun River border are manifestations of the knowledge, response, and attitude of the community towards the flood disaster that they have experienced so far. In general, they know that floods are disasters caused by natural and human factors. Flood disasters can harm the respondent's life, and the disaster will have the effect of fear if repeated. The results of this study are in line with the results of the research of Slovic, et al. [24] and Wachinger, et al. [28] which determined that local communities responded sincerely based on previous experience. And their judgment depends on qualitative aspects such as exposure, threat control, and perceived danger. This condition was also stated by Anilan [26] in his study, and disaster experience was a good predictor of many risk perceptions. Adelekan [1] and Lechowska [13] once analyzed the community's experience of flooding by asking for their assessment of flooding, and the results concluded that the community's experience with flooding was strictly related to the level of perceived risk. Individual experiences such as suffering damage or loss of assets are known to cause an increase in risk perceptions and experience shaping people's attitudes and responses to future flood events.

Adaptive capacity from the results of this study is low, based on research data, it is known that 89% do not adapt to the threat of the flood threat of the Madiun River. And only 10% have a moderate level of adaptation, while the remaining 1% has a high adaptation. This means that 89% of the residents in the riparian area have not adapted to the flood. This condition can not be separated from the experience of the flood that they experienced, and the floods do not hit them every year. Before 2007, they never experienced flooding, then after 2007 they also did not experience floods every year. This gives the public peace of mind that floods do not come every year. This makes perfect sense if they do not take physical adaptation actions by raising the foundation, raising the floor, or making a dyke in front of the house. Nor was social adaptation carried out by some respondents by making flood relief groups, or evacuation teams as well as no extraordinary investment allocated to anticipate the impact of the impending flood disaster.

The results of this study differ from studies related to adaptation that has been carried out by Ritohardoyo, in the flood-prone area for tidal flooding in Pekalongan, Central Java. The results of Ritohardoyo's research explained that the adaptation strategy undertaken by the family was to place items in a higher place, raise the foundation of the house, make a dike in front of the house, and install a net [23]. The adaptation actions of the inhabitants of the Madiun River border are also not the same as the findings of the Khadiyanta & Dewantari (2016) study which found that the adaptation measures were sequentially raising the yard, raising the living room, raising the bathroom and toilet, raising the floor, raising the kitchen, and building two floors [10]. The results of these research findings are rarely carried out by residents of the Madiun River border. That difference occurs because of the characteristics of the threat of disasters to different communities. The level of intensity of disaster events in one year, the level of income and the level of education also influence the actions taken in the process of adapting.

The results of this study support previous research conducted by Suhelmi (2013) in Semarang, which shows that some of the coastal areas of Semarang have low to moderate levels of adaptive capacity. Villages that have low capacity are 58 villages (58.62%) of the total coastal sub-districts in Semarang City. This low capacity indicates that the ability of village governments to deal with disaster
risk is low. The research concluded that the government's adaptive capacity would have an impact on the adaptive capacity of households in dealing with disasters.

Conclusion
The Madiun River flood in 2007 provided new knowledge to the residents of the riparian area. Community knowledge of floods is known to be high, and public perceptions of flooding are also in the high category. Even though the residents of the Madiun River riparian have low levels of education and income, they have high flood knowledge and perception. However, the high level of knowledge and perception is not matched by high adaptation measures. This low adaptive capacity is influenced by low levels of income and education so they have difficulty if they have to change the shape of an existing building into a flood-resistant building. The adaptation strategies that have been carried out so far are tend to be reactive, ie they will leave or evacuate to a safe place for several days, after the flood recedes they will return to their homes and restore the flood-affected conditions as before. The residents of the Madiun River riparian area prefer not to carry out adaptation actions both physically, socially and economically because the threat of flooding does not come every year. So that they are more concerned with their daily needs than doing adaptive actions for flood disasters. The results of this study indicate that the adaptation options that have been studied in previous studies were not carried out by many residents of the Madiun River riparian even though they lived in flood-prone areas. Local knowledge of the community in recognizing floods in the form of recognizing the weather if there will be a flood, recognizing changes in color and flow of water, and sound to identify the level of threat they will face in deciding whether they need to evacuate or not.

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References
[1] Adelekan I O & Asiyanbi A P 2016 Flood risk perception in flood-affected communities in Lagos Nigeria Natural Hazards, 80 (1) 445–469 https://doi.org/10.1007/s11069-015-1977-2
[2] Balai Besar Wilayah Sungai Bengawan Solo 2012 Profil Pengelolaan Sumber Daya Air Wilayah Bengawan Solo Surakarta Balai Besar Wilayah Sungai Bengawan Solo
[3] Blöschl G, Gall L and Hall J et al 2015 Increasing river floods: fiction or reality? Wiley Interdiscip Rev Water 2 (4) 329–344
[4] BNPB 2019 Data Kejadian Banjir Indonesia http://dibi.bnpb.go.id/ Accessed 3 Mei 2019
[5] Bouwer L M 2011 Have disaster losses increased due to anthropogenic climate change? Bull. Am Meteorol Soc 92 (1) 39-46
[6] Collins M, Knutti R and Arblaster J et al 2014 Chapter 12 Long-Term Climate Change: Projections, Commitments and Irreversibility Climate Change 2013-the Physical Science Basis. Intergovernmental Panel on Climate Change Cambridge University Press pp 1029–1076
[7] Ezemonye M & Emeribe C 2011 Flood Characteristics and Management Adaptations in Parts of the Imo River System Ethiopian Journal of Environmental Studies and Management 4(3) 56–64 https://doi.org/DOI: http://dx.doi.org/10.4314/ejesm.v4i3.8
[8] Ismoyojati G, Sujono J Jayadi R 2018 Studi pengaruh perubahan tataguna lahan terhadap karakteristik banjir Kota Bima Jurnal Geografi Lingkungan Tropik 2 (2) 14-27
[9] Janssen M A, M L Schoon W Ke and K Börner 2006 Scholarly networks on resilience, vulnerability and adaptation within the human dimensions of global environmental change. Global Environmental Change 16(3) 240–252
[10] Kartono dan Gulo 1987 Kamus Psikologi Bandung Pionir Jaya
[11] Khadiyanta P & Dewantari S 2016 Settlement adaptation by reshaping dwellings in the degrading area at Genuk District of Semarang City Indonesia *Procedia - Social and Behavioral Sciences* 227 (November 2015) 309–316.https://doi.org/10.1016/j.sbspro.2016.06.076

[12] Kundzewicz Z W, Kanae S and Seneviratne S I et al 2014 Flood risk and climate change: global and regional perspectives *Hydrol Sci J* 59 (1) 1–28

[13] Lechowska E 2018 What determines flood risk perception? A review of factors of flood risk perception and relations between its basic elements *Nat Hazards* 94 (3) (2018) pp 1341-1366

[14] Manandhar S, Vogt D S Perret S.R and Kazama F 2011 Adapting cropping systems to climate change in Nepal: a cross-regional study of farmers’ perception and practices *Reg Environ Chang* 11(2) 335–348 doi: 10.1007/s10113-010-0137-1

[15] McEvoy D, Matczak P, Banaszak I & Chorynski A 2010 Framing adaptation to climate-related extreme events *Mitigation and Adaptation Strategies for Global Change* 15(7) 779–795 http://doi.org/10.1007/s11027-010-9233-2

[16] Merz B, Kundzewicz Z and Delgado J et al 2012 Detection and attribution of changes in flood hazard and risk: changes in flood risk in Europe *IAHS Spec. Publ.* 10 435–458

[17] Mistra 2007 Antisipasi Rumah di Daerah Rawan Banjir Depok: Penebar Swadaya

[18] Naiman J R & Decamps Henri 1997 The Ecology of Interfaces: Riparian Zones. *Annual Review of Ecology and Systematics* 28 10 1146/annurev ecolsys 28 1 621

[19] Nakanishi Hitomi & Black John 2018 Implicit and explicit knowledge in flood evacuations with a case study of Takamatsu Japan *International Journal of Disaster Risk Reduction* Volume 28 Pages 789-797 ISSN 2212-4209 https://doi.org/10.1016/jijdrr.2018.02.008

[20] Pattison I and Lane S N 2012 The link between land-use management and fluvial flood risk: a chaotic conception? *Prog Phys Geogr* 36 (1) 72-92

[21] Priyana Y, Anna A N & S A A 2014 Model Simulasi Luapan Banjir Sungai Bengawan Solo Untuk Optimalisasi Kegiatan Tanggap Darurat Bencana Banjir *Forum Geografi*, 28 no 1 pp 21–34

[22] Republik Indonesia 2011 *Peraturan Pemerintah Nomor 38 Tahun 2011 tentang Sungai Jakarta*: Sekretariat Negara

[23] Ritohardoyo S 2014 *Aspek Sosial Banjir Genangan (ROB) di Kawasan Pesisir Yogyakarta*: Gadjah Mada University Press

[24] Slovic P, Finucane M L Peters E and MacGregor D G 2004 Risk as Analysis and Risk as Feelings: Some Thoughts about Affect Reason Risk and Rationality *Risk Analysis* 24: 311-322. DOI:10.1111/j.0272-4332.2004.00433.x

[25] Suhelmi I R & Triwibowo H 2018 Coastal Inundation Adaptive Strategy in Semarang Coastal Area *Forum Geografi* 32(2) 195–203

[26] T Anilan and O Yuksek 2016 Perception Of Flood Risk and Mitigation: Survey Results From the Eastern Black Sea Basin Turkey *Nat. Hazards Rev.* 18 (2) (2016) Article 05016006

[27] UNISDR 2012 *How to Make Cities More Resilient a Handbook for Local Government Leaders* Geneva

[28] Wachinger G, Renn O, Begg C and Kuhlische C 2013 The Risk Perception Paradox Implications for Governance and Communication of Natural Hazards *Risk Analysis*, 33 1049-1065. DOI:10.1111/j.1539-6924.2012.01942.x

[29] Wheater H and Evans E 2009 Land use water management and future flood risk *Land Use Policy* 26 (Suppl. 1) S251-S264