

# The Right to Live Dangerously: Public Perceptions of Extreme Water Events in Urban Areas

Intan Adhi Perdana Putri  
*Research Center for Population  
 Indonesian Institute of Sciences Jakarta  
 Indonesia  
 inta005@lipi.go.id*

Syarifah Aini Dalimunthe  
*Graduate School of Environmental Studies  
 Nagoya University  
 Nagoya, Japan  
 syar008@lipi.go.id*

Ari Purwanto Sarwo Prasajo  
*Research Center for Population  
 Indonesian Institute of Sciences  
 Jakarta, Indonesia  
 arip002@lipi.go.id*

**Abstract**—The rising risks of climate change and Indonesia’s dynamic urban and industrial development has meant that many areas have become vulnerable to flood. Historical data from 1811 to 2017 clearly shows how floods have causing major disasters across Indonesia’s archipelago, and data from 1990 indicate that the number of deaths due to floods and heavy rains has risen far faster than any other hydroclimatic disasters in the same period. As the intense urban and floodplain development in Indonesia shows no sign of slowing down, it is possible the Indonesia could expect an increase in the number of people being exposed to flood risks. Therefore, the trade-offs between flood protection and the relocation of economic activities to safer areas are likely to remain a major public debate (Strauss, Kulp, & Levermann, 2015). However, when urban areas repeatedly suffer from floods, why don’t the people and businesses move to safer areas or even leave the city, and why do they tend to restore these vulnerable locations? This paper seeks to understand the public’s perceptions regarding the social construction of risk and the degree to which these perceptions are harnessed to develop a sustainable resilience. This paper explores the public perceptions of 926 urban residents in Indonesia, the data for which were extracted from the 4,985-person nationwide Climate Asia survey in Indonesia. This study aims to contribute to future urban development, population studies, and disaster risk. To urban Indonesian, religious and moral beliefs was the most important value. This value lead to people’s higher susceptibility towards risk. In daily basis, risk perception translated to the higher value of worries on not having clean water, the urgency of having enough access to health care and adequate food for the family. Current flood management tends to be focused more on structural measures, very little attention is paid to the social processes involved in building a resilient society This study emphasis on the fact that to build sustainable resilience, it is essential to understand the public’s perception of the social construction of risk.

**Keywords**—*flood hazard, extreme weather, public perception, resilience*

## I. INTRODUCTION

Indonesia is one of the five countries that are most frequently struck by many types of natural disasters such as earthquakes, tsunamis, floods, landslides, volcano eruptions,

and whirlwinds. Indonesian Disaster Data Information (DIBI) recorded 25,293 disaster events from 1811 to 2017, with the most frequent being floods (BNPB, 2018), which are also the most frequently experienced extreme events in the world (World Meteorological Assessment, 2016) especially in urban areas. The UNISDR (2009) reported that since 1990, the losses caused by floods and heavy rain have been growing faster than any other extreme weather hazards.

However, extreme weather has been experienced since the dawn of civilization. For example, ancient Sumerian and Babylonian writings tell stories of a great flood that destroyed the world (Etkin, 2016). Flood-prone areas often have a mix of housing and economic activities (World Meteorological Assessment, 2016), and pressures such as demographic changes, environmental degradation, climate variability, and increased economic and social activities affect the degree of flood impact on households and commercial activities (WMO, 2009); therefore, floods have become a major risk in urban areas.

Risk is related to the probability of a hazard and its consequences (Helm, 1996). As populations grow, there has been a commensurate rise in the number of people who are at risk, with the UN reporting that the numbers are increasing by 70 to 80 million per year. Unfortunately, almost 90 percent of population growth has been in the developing world where people have few resources to combat the effects of a disaster (United Nations, 2004), such as in the urban areas in Indonesia. As most flood management focuses on structural measures, there has been little attention paid to the vulnerabilities or resilience of the flood-affected populations (Adelekan & Asiyandi, 2016). Advanced flood management relied on bayesian forecasting system (BFS). It was a method to quantify probabilistic flood forecasting via any deterministic hydrologic model.

The growing attention to urban flood risk in the scientific literature mainly focuses on physical vulnerability rather than social vulnerability. The study on flood perception has been an advanced study on Europe with lacks of inclusion

of study on individual behaviours (Terpstra 2011; Wachinger and Renn 2010; Wachinger et al. 2013). Risk can be thought of a way of expressing uncertainty or as a collection of perceptions (Raaijmakers et al., 2008). Aven & Kristensen (2005) claimed that this was why risk should be seen as a judgment rather than a fact and that beyond the recognition of the physical hazard, it was important to identify that many risks are inherent within social systems (United Nations, 2004). However, people’s risk perceptions and the causes of these risks vary widely, which is why it is important to consider the social processes associated with these risks.

Therefore, the public perceptions regarding the social construction of risk need to be considered so that policy makers can make proper risk management and safety decisions when developing flood preparation measures. Understanding and improving public risk perceptions has become an important element in flood risk management worldwide (Pagneux, et al., 2011). In 2015, 53.3 % of the Indonesian population were living in urban areas, with 60% of these living on Java Island<sup>1</sup>. The question that remains, however, is that when floods hit urban areas, why don’t the people and businesses move to safer areas or different cities rather than attempting to restore these vulnerable locations? As flood management tends to only focus on flood protection measures, little attention has been paid to the social processes involved in developing a resilient society. Therefore, this paper seeks to determine the public’s perceptions regarding the social construction of risk and the degree to which these perceptions are harnessed to develop a sustainable resilience

A. Risk and Risk Perception

Risk is generally seen as;  $Risk = Hazards \times Vulnerability$ ; although some disciplines also include the concept of *exposure* to express the physical aspects of vulnerability. Through a conventional lens, however, ‘risk’ is regarded as being quantifiable (Raaijmakers et al., 2008). In social science, Ulrich Beck (1986), a German Sociologist, was the first to employ the notion of the “risk society” and attempt to consider the media, political, and scientific characteristics surrounding the social production of the risk. Social science discussions have also been focused on determining the capacity of the social actors in knowing the risks, characterizing the settings in which they live, and the subjectivity involved in the so-called “objective” risks. With this increased attention on the public/social awareness and perception of risk, there have been efforts to better explain people’s responses to disaster, as risk is no longer considered an entity distinct from individual/society but an entity that is also embedded in human actions and perceptions. Perception of risk research has found that human judgments regarding hazards and their benefits involve several related qualitative dimensions (Aven & Kristensen, 2005).

Risk perception is the main factor when assessing the susceptibility of an individual or social group to changes that may lead to disaster (Adelekan & Asiyambi, 2016). Samuels and Gould by (2009) described risk perception as

“a pre-scientific” process that was heavily influenced by attitudes, intuition, expectations, and information and experiences with hazards.

Research on risk perception (RP) can be tracked to a study published in 1945 by Gilbert White which was focused on the capability of people to make some adjustments for flooding in the United States (White, 1945). White (1945) believed that the experiences people had when faced with a disaster like a flood directly influenced their behavior when the flood event occurred. Based on his findings, White became a pioneer in multi-hazard studies on the human dimension (Bird, 2009; Brilly, 2005). In the 1960s, RP became part of the political agenda and was considered a primary determinant for the advances in new technology and particularly high-risk technology (Sjoberg, 2004). Over the subsequent decade, RP evolved through psychological experimental studies and public surveys that measured public perceptions based on their expressed preferences or stresses from a qualitative approach (Petts, 2008).

II. METHOD

Indonesia has a total surface area of about 1,916,862.20 sq.km, 16,056 islands, and a population of approximately 261.9 million people (Badan Pusat Statistik, 2018). Indonesia has 34 Provinces, within which there are 416 regencies and 98 cities, in which more than half the population lives. This paper using the BBC Climate Asia data surveys from Indonesia for which 4,985 people had been randomly selected from across Indonesia. A 2,140 respondent sample was selected based on whether they had experienced extreme weather in the past 10 years, from which 926 urban dwelling respondents were selected.

The survey locations were distributed across five areas; Eastern Java, Western Java, Northern Sumatera, Kalimantan, and East Timor. Respondents in three cities (Blitar, Kediri, and Magelang) of the 16 cities sampled in Eastern Java had experienced extreme weather events, respondents in nine cities in Western Java; Bandung, Bekasi, Bogor, Jakarta Pusat, Jakarta Utara, Serang, Tangerang, and Tasikmalaya; had experienced extreme weather events, and respondents in three cities in Northern Sumatera; Banda Aceh, Padang Pariaman, and Pekanbaru; had experienced extreme weather events. In each of Kalimantan and East Timor, respondents in only one city; Pontianak in Kalimantan and Denpasar in East Timor; had experienced extreme weather events. Fig 1. shows the respondent distribution based on location in Indonesia.

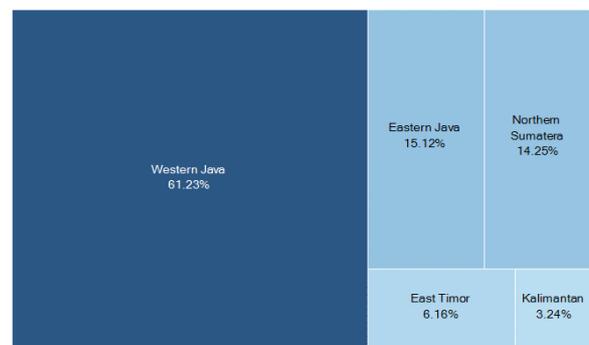


Fig. 1. Respondent Distribution Based on Location

<sup>1</sup> Most populated island in Indonesia

This paper used 67 respondent answers from the Climate Asia survey that were related to awareness, level of knowledge, current actions, and the likelihood to take action to respond in the future. The respondents' characteristics were used to develop the socio-economic profile. The data were then analyzed using descriptive statistics.

### III. RESULT AND DISCUSSION

A sample of the respondents who had experienced extreme weather events based on their socio-economic characteristics is shown in Table 1. Most respondents were aged 25–44 years (52.3%), the gender was equal, and more than half were married and living with their spouses. Most lived at home (50.9%) with 3–4 people, and a significant majority could read (97.1%). The highest level of schooling was primary and secondary level, and 46.5% claimed they

were capable of buying home appliances but could not afford to buy either a car or a house.

It was necessary to identify those things that were most valued so as to understand the protection priorities when developing disaster policies and plans (Rawluk et al., 2017). More than half the respondents (54%) said that following their religious and moral beliefs was their most important value in life (see Fig. 2). In Indonesian society, religious belief is an embedded social characteristic (Adisaputri, 2016), and it has been found that religious belief is possibly a component in people's susceptibility toward risk and disaster perception and can also greatly assist them in coping with disaster.

TABLE I. RESPONDENT CHARACTERISTICS

No	Characteristic		Percentage (%)
1	Age	15–24	17.5
		25–34	26.2
		35–44	26.1
		45–54	17.0
		55–64	9.6
		65+	3.6
2	Gender	Female	49.5
		Male	50.5
3	Marital Status	Single	18.6
		Married, living with spouse	69.3
		Married, not living with spouse	5.3
		Divorced/ separated	0.5
		Widowed	6.2
		Refused/ no answer	0.1
3	Number of people lived in household	< 2 people	14.7
		3–4 people	50.9
		5–8 people	31.3
		> 9 people	3.1
4	Religion	Muslim	94.7
		Christian	1.3
		Hindu	3.9
		Buddhist	0.1
5	Reading Ability	Easy	97.1
		Difficult	1.9
		Do not read at all	1.0
6	Highest level of Schooling	Have never attended school	1.4
		Did not complete primary education	11.0
		Primary	37.9
		Secondary	39.6
		College	2.2
		University	7.7
6	Household income	Don't know	0.1
		Refused/no answer	0.1
		We don't have enough money, even for food	3.3
		We can afford food but purchasing of clothes is a serious problem	13.9
		We can afford food and clothes, but purchasing of durables such as TV set or a refrigerator is difficult for us	21.8
		We can afford main household appliances, but purchasing a car is beyond our means	46.5
		What we earn is sufficient to buy anything except such expensive purchases as an apartment or house	8.0
We do not face financial problems	5.0		
Refused/ no answer	1.4		

Art, music, dance	3.24%
Being able to voice my opinions on issues that concern me	4.54%
Being well respected in my neighbourhood	3.13%
Buying a car or motorcycle	0.11%
Continuing to learn new things	4.32%
Drawing on traditional values and ways of life	2.81%
Earning as much money possible	14.36%
Enjoying being in the outdoors	2.27%
Fitting in with people around me	10.26%
Following my religious and moral beliefs	54.00%
Using technology to make my life easier	0.97%

Fig. 2. Most Important Value for Indonesian Urban Dwellers

Don't know	0.11%	0.43%	<b>First biggest worry</b> 0.11% 29.05% <b>Sec and biggest worry</b> 0.43% 23.76%
Not being able to buy the latest model of mobile phone	0.76%	0.54%	
Not being healthy	27.11%	19.01%	
Not having a suitable shelter/house	5.94%	11.23%	
Not having enough clean water to drink	17.71%	20.63%	
Not having enough electricity	0.76%	2.59%	
Not having enough food to eat	29.05%	23.76%	
Not having enough money to spend on items for me and my family (clothes, furniture etc.)	9.61%	11.23%	
Not sending my kids school/saving money for my children's future	8.86%	9.94%	
Refused/no Answer	0.11%	0.65%	

Fig. 3. Biggest Worry at The Moment

Worry has also been recognized as a RP characteristic (Raaijmakers et al., 2018) as it can affect the way people react to risks and hazards (Costas et al., 2015). Respondents were asked about their first and second biggest life worries (See fig. 3), from which it was found that not having enough food to eat (29.0%) and not being healthy (27.11%) were the first and not having enough food (23.8%) or clean water to drink (20.6%) were the second; therefore, disasters were not primary worries. Bliss (2015) found that as most people rarely worry about things that are not imminent, food, clean water, and health tended to be most imminent concerns. Respondents were asked to compare their life now to 5 years ago, and 36% felt that their life was a bit better and 32% felt that it was about the same (see Fig. 4).

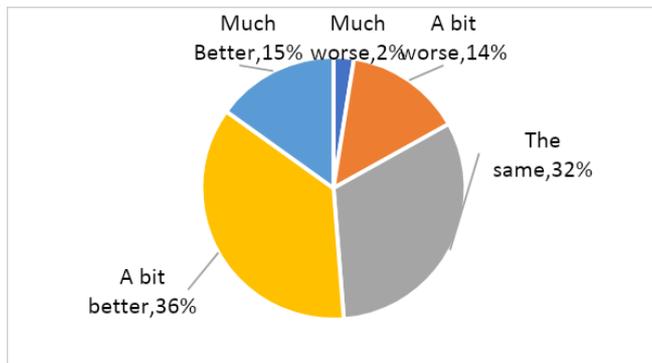


Fig. 4. Life of Urbanite now Compared to 5 Years Ago

When the urban respondents were asked about the changes in extreme weather events and rainfall over the previous 10 years, most felt that it was about the same (Fig. 5), and half felt that the perceived rainfall had decreased a little. Both extreme weather events and rainfall were less predictable in the last 10 years (Fig. 6).

Tendency	Extreme water events (%)	Rainfall (%)
Decreased a lot	8.40	21.40
Decreased a bit	12.90	51.60
Stayed the same	37.00	15.80
Increased a bit	27.00	9.70
Increased a lot	7.30	1.50
Don't know	2.90	
Refused to answer	4.40	

Fig. 5. Perceptions Regarding Extreme Weather Events and Rainfall

Predicted	Extreme water events (%)	Rainfall (%)
Not at all	48.80	37.60
Not very	28.60	32.70
Neither/nor	3.30	1.40
Quite	14.00	22.00
Very	0.90	5.50
Don't know	2.40	0.50
Refused to answer	1.90	0.20

Fig. 6. Prediction On Extreme Weather Events and Rainfall in the Past 10 Years

Respondents were asked about how they felt about unpredictable extreme weather events and rainfall (Table 6). Overall, 46.2% felt quite worried, 43.3% were not very angry, 37.7% did not feel guilty, 37.1% did not feel happy, and 41.1% did not feel helpless. Because most were not worried about the possibilities, they may not have felt the need to decrease their risk to the possible impacts of the weather changes (Raaijmakers et al., 2008; Wachinger et al., 2013). The scale of the impact of the changes in weather on access to food/water was seen to be a bigger problem in

the future than in the present (Fig. 7), which was in line with their feelings about the possible weather changes.

Although the impact perception in both the present and in the future were quite large (scale 6 to 8), respondents did not feel that this would not affect; their ability to earn money, their health, their way of living, or being able to live the life they wanted to; however, they did think that these changes could affect their choice of livelihood/job (Table 2).

Feel about the changes	Worried (%)	Angry (%)	Happy (%)	Guilt (%)	Helpless (%)
Not at all	4.00	25.40	38.10	36.30	41.10
Not Very	22.40	43.30	26.40	37.70	32.30
Neither/Nor	9.30	16.90	21.00	18.70	14.70
Quite	46.20	11.50	12.70	6.50	10.50
Very	18.10	2.40	0.80	0.80	0.80
Don't know		0.60	1.00		0.60

Fig. 7. Feelings About the Weather Changes

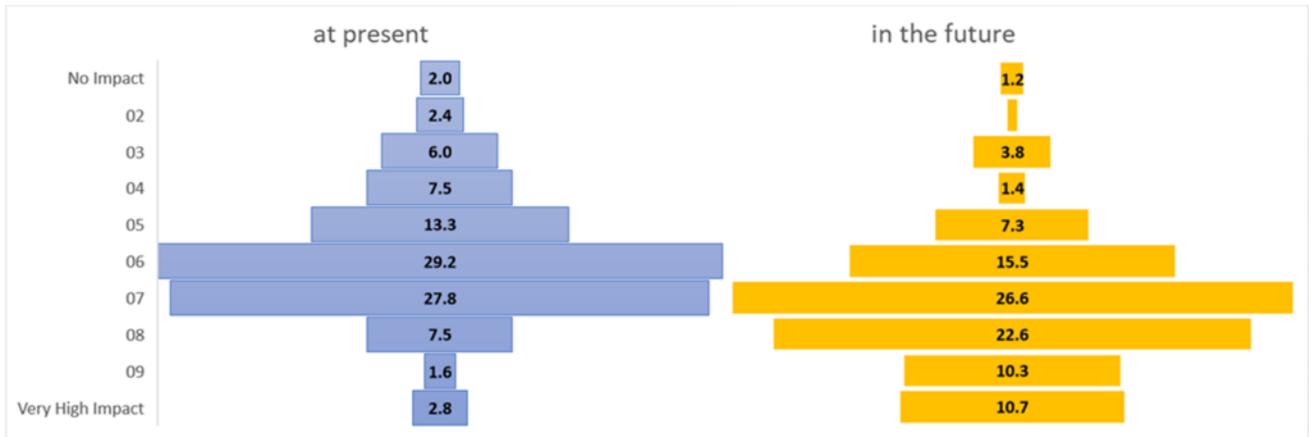


Fig. 8. Scale of the Impact of the Changes at Present and in the Future

TABLE II. EFFECT OF THE CHANGES ON RESPONDENT ABILITIES

No	Ability	Very	Quite	Not very	Not at all	Neither/Nor	Don't know	Refused to answer
		%	%	%	%	%	%	%
1	Earn money	4.4	18.5	2.4	45.4	29.4		4.4
2	My choice of livelihood/job	5.4	30.4	2.6	41.3	20.0	0.4	5.4
3	Keep healthy	0.6	5.0	0.8	39.9	53.8		0.6
4	Maintain your current lifestyle/way of living	3.6	11.3	3.0	50.4	31.3	0.4	3.6
5	Live the live you would like to	3.4	12.3	4.0	55.4	24.6	0.4	3.4

Most respondents were not willing to change their current lifestyles regardless of the uncertainty of the availability of water, food, and energy supplies in the future (Fig. 9). However, the cross tabulation using worry and willingness to introduce changes in current lifestyles as the variables found that more than half (57.5%) of the respondents who were worried tended to be quite well prepared.

In general, of the respondents who perceived that there were changing weather events, 35.2% were quite prepared and 29.9% were not very well prepared. The cross tabulation between those who felt worried and those who were prepared to deal with such changes indicated that there were 37.9% who were somewhat prepared and 25.9% who were not too prepared.

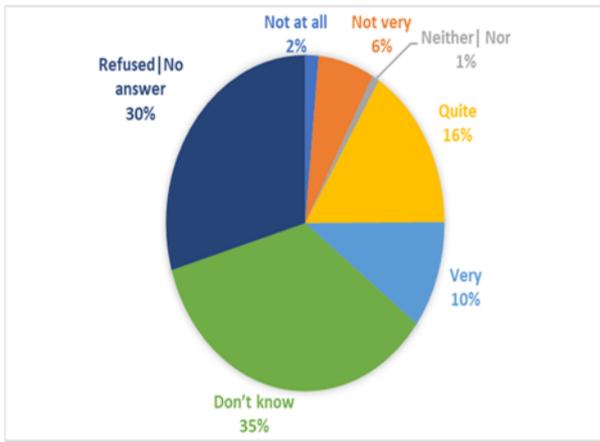


Fig. 9. Willingness to Introduce Changes in Current Lifestyle

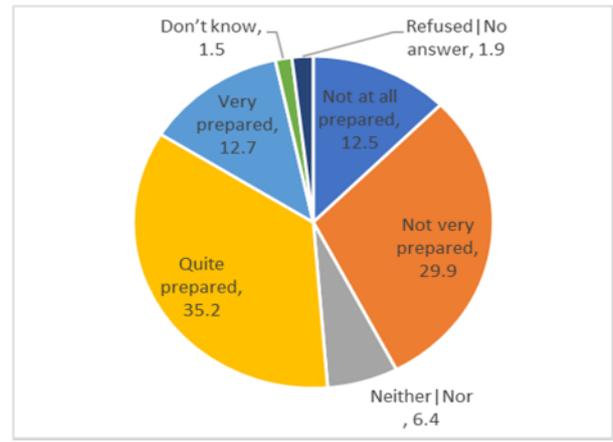


Fig. 10. Preparation for an Extreme Weather Event

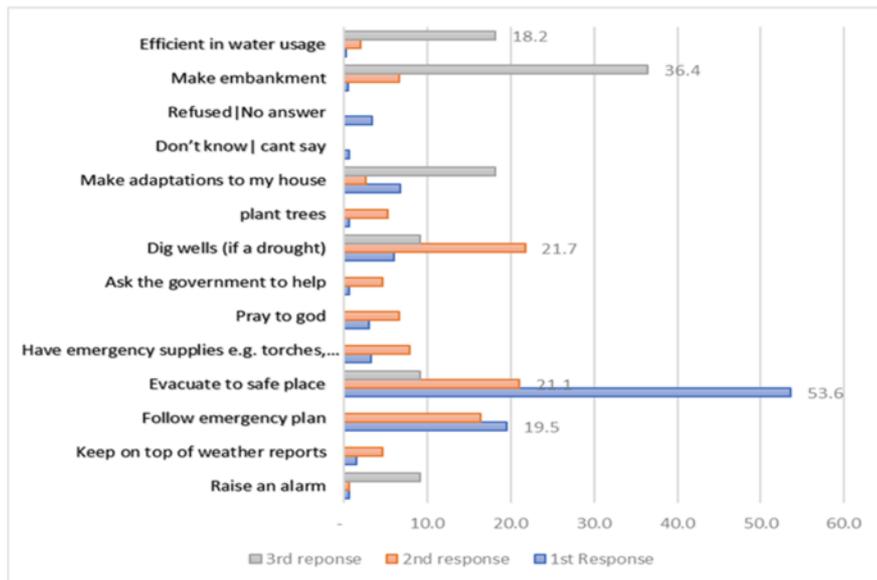


Fig. 11. Willingness to Introduce Changes in Current Lifestyle

Respondents were asked what their first, second or third responses would be to an extreme weather event (Fig. 11). For the first response, most claimed that they (53.6%) would evacuate to a safe place and 19.5% claimed they would follow the emergency plan. For the second response, 21.7% claimed they would dig wells if a drought occurred and 21.1% said they would evacuate to a safe place. However, the third response was slightly different from the first, with 36.4% saying they would make an embankment and 18.2% choosing efficient water usage.

Respondents were asked what they could do to prepare for extreme weather events (Fig. 12). Thirty-nine point six percent said that they would make permanent adjustments to their homes, 38.6% said they would listen to the weather forecast, 30.3% said they would learn first aid, 27.8% said they would learn to swim, and 22% said they would develop a disaster preparedness plan, all of which indicated that most respondents were not involved in current actions to help them deal with possible extreme weather events.

Flood experiences may vary across different urban's cultural group. The marginalized group with lower SEC

were more likely to report contaminating streams as a result of flooding. This experience reflected the current environmental concerns due to degrading streams quality. Respondents were then asked why they were not taking any actions to respond to the changes/impact, to which many (82.5%) slightly and strongly agreed that they needed the government to respond/take action, with many claiming that they did not have the resources, money, or equipment to take action. They also felt that as it was not a problem now (35%), they did not need to take measures. However, around one third (34%) said that they did not know how to respond to prepare for extreme weather events.

The main reason that most (75.8%) strongly agreed to as to why they had responded (Fig. 14) was they wanted a better future for their children, with other reasons being that they cared about the natural environment and they wanted to make/save money; however, health was not a main motivation even though a previous study found that most Indonesians had health as their key motivation (Copsey et al., 2013).

Action	Currently doing			Likelihood of doing					
	Yes (%)	No (%)	Already done (%)	Not at all (%)	Not very (%)	Neither/Nor (%)	Quite (%)	Don't know (%)	Refused/no answer (%)
Disaster preparedness plan	16.30	61.70	22.00	1.00	11.30	2.70	57.70	24.10	1.00
Learn first aid	12.30	57.40	30.30	6.60	9.60	4.10	55.00	21.40	1.10
Learn to swim	7.60	64.60	27.80	17.40	19.00	10.20	40.00	9.20	0.70
Listen to weather forecasts	19.10	42.40	38.60	2.00	6.00	4.00	53.50	32.50	0.50
Permanent adjustment to my home	12.90	47.50	39.60	8.50	17.40	5.40	52.70	12.50	0.40
Sign up for early warning alerts	10.80	71.80	17.40	4.40	12.10	5.60	48.40	27.10	0.90
Take out insurance	6.80	82.60	10.60	17.20	25.40	4.10	34.10	9.50	4.10
Temporary adjustment to my home	7.40	79.70	12.90	9.00	18.10	5.10	43.10	22.30	0.80

Fig. 12. Action People Can Take to Help Them Deal With Extreme Weather Events

Reason for not taken action	Strongly disagree (%)	Slightly disagree (%)	Neither agree nor disagree (%)	Slightly agree (%)	Strongly agree (%)	Don't know (%)	Refused/no answer (%)
I don't have access to information	16.50	39.00	5.20	28.70	10.20	0.30	0.10
I don't have enough resources (money and equipment) to respond/take action	5.60	19.30	6.30	47.10	21.70		
I don't know how to respond/take action	13.10	38.20	7.30	34.00	7.00	0.30	
I don't think taking any action/responding will make a difference	24.70	38.80	6.70	21.50	8.20	0.10	
I have other priorities	13.10	34.10	5.80	36.20	10.70	0.10	
I need support from the Government to respond/take action	2.20	9.90	4.60	39.30	43.50	0.40	
It does not fit with my religion or beliefs	40.50	27.50	4.00	15.30	12.40	0.20	
It is not a problem for me now	17.60	33.40	5.00	35.00	8.60	0.30	0.10
It is not my responsibility to respond/take action	33.20	38.10	6.90	17.10	4.20	0.50	
My family wouldn't approve if I responded/took action	39.30	34.60	5.80	13.80	6.20	0.20	0.10
No one I know is responding/taking action e.g., neighborhood, friends/relatives	36.10	31.40	2.30	23.50	6.30	0.40	

Fig. 13. Reasons Why They Have Not Taken Action to Respond to Changes/Impacts

Reasons why they responded to the impacts	Strongly disagree (%)	Slightly disagree (%)	Neither agree nor disagree (%)	Slightly agree (%)	Strongly agree (%)	Don't know (%)	Refused/no answer (%)
I care about the natural environment	0.50	3.20	3.70	39.10	53.50		
I have enough information to respond/take action	1.90	16.20	8.20	49.80	23.40	0.40	
I need to do something to maintain my lifestyle/ way of living	0.20	7.30	1.50	46.70	44.10	0.20	
I need to survive	0.40	7.80	2.10	41.60	48.20		
I want a better future for my children	0.20	3.80	1.20	18.60	75.80	0.30	0.10
I want to be healthy	17.60	33.40	5.00	35.00	8.60	0.30	0.10
I would feel guilty if I didn't take action	2.70	10.80	7.10	46.70	32.60	0.10	
It's something that everyone else is doing	0.60	15.10	5.10	51.70	25.20	2.30	
To make/save more money	1.00	7.20	3.80	40.10	47.60	0.30	

Fig. 14. Reasons Why They Responded to the Impacts

Various study has used sociodemographic variables primarily as statistical control to understand risk tolerance across demographic group (Cutter et al. 2003; Elrick-Barr et al. 2015). For example, with higher trust to flood manager, the risk perceptions is decreasing. Although we did not measure such variable in this study, vulnerable groups with less income and lower education are expected to have less trust in authority than the higher socio-economic group. Fewer resources and limited access to information and political network in this case will generate the risk among marginalized community. Those group likely to see the world as a dangerous place (Finucane et al, 2000).

#### IV. CONCLUSION

While the role of floodplain exposure has been well studied, there is a limited amount of study on social aspect of flood risk. This study provided information on the perceptions of the Indonesian urban public who had experienced extreme events regarding flood disasters in an attempt to determine the most effective risk communication to improve the public awareness of hazards. As religious and moral beliefs were found to the most important values, these could be seen to be related to an individual coping capacity during a disaster because these values would provide the necessary emotional and social support through the disaster and recovery phases (Adisaputri, 2016). However, overall, it was found that this urban population was not very worried about disasters, with their greatest concerns being the availability of food and clean water, and their health. Few were found to be worried about the changing weather or the affect this might have on their livelihood/job option, which meant that many were relatively unprepared.

The respondents' first responses were to evacuate to the safe place, which could be seen to be a spontaneous action rather than an emergency plan. This was probably because most were relying on the government to take action; therefore, public government messaging remains important in reducing disaster risk. These results indicated that the government needs to provide a program or policy to increase the urban population awareness of disaster preparedness and risk. Given the varied understanding and social construction of flood risk in urban areas, a future work is needed. Our current flood risk limited to flood exposure to traditional floodplain. Therefore, an investigation to full range of natural and built source of flooding is necessary. Particularly linking it to specific proxies of social vulnerability related to exposure, experiences and concerns as well as critical local mechanism.

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