THESIS

COMMUNITY BASED APPROACH TO ASSESS FLOOD RISK PERCEPTION AND COPING MECHANISM ALONG CODE RIVER, YOGYAKARTA MUNICIPALITY

Thesis submitted to the Double Degree M.Sc. Programme, Gadjah Mada University and Faculty of Geo-Information Science and Earth Observation, University of Twente in partial fulfillment of the requirement for the degree of Master of Science in Geo-Information for Spatial Planning and Risk Management

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DISCLAIMER

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Diah Noor H.

Abstract

Yogyakarta City is one of municipalities in Special Province of Yogyakarta. It is crossed by Code River which part of Boyong River flowing from the Merapi summit at the upper stream. Following the Mt. Merapi eruption in October – November 2010, lahar flood was struck several times in Code River. As reported by BNBP (2010), the first lahar flood happened on Monday, 29 November 2010. The flood was triggered by the heavy rains which happened all day long at the upper course of Code River. The floodwater reached 1.5 m in some parts of the riverbank (Fieldwork 2011) and inundated more than 300 houses (BNBP 2010).

This research tries to assess community-level of flood risk perception and coping mechanism on Code River by reffering the situational and cognitive factors of the respondents. The binary logistic regression was conducted to examine the causal relationship between the situational and cognitive factors (social-economic characteristics, location of the residents, flood experience and knowledge of flood) and both flood risk perception and coping mechanism. The result show that five variables have a relationship with the perception of threat: gender, length of stay, RW's risk level and distance between respondents' house and river and impact level of flood.

On the authority level, two mitigation measurements are conducted to reduce the impact of flood in Code River: structural and non-structural measures. Through the public works agency, local government built flood infrastructure such as repairing sabo dam at the upper part of the river, raising river dike and strengtening the river embankment. Meanwhile Non structural measurements including the developing of early warning system called EWWS (early wireless warning system), preparing evacuation site, and held evacuation drill to increase people's knowledge to encounter of flood threat.

Keywords: Flood, Risk perception, Coping Mechanism, Mitigation Measurements.

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Yogyakarta, February 2012

Diah Noor Heryanti

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List Of Abbreviations

AS/NZS 4360	Australian Standard/New Zealand Standard 4360 (Guide to Risk Management)
ADPC	Asian Disaster Preparedness Center
BNPB	*Badan Nasional Penanggulangan Bencana* The National Disaster Management Agency
BPS	National Berau of Statistic *Badan Pusat Statistik*
CODE-X	Community on Dial 2010
EWWS	Early Wireless Warning System
FGD	Forum Discussion Group
GMU	Gadjah Mada University
RW	*Rukun Warga* (sub area of village)
SAARC	The South Asian Association for Regional Cooperation
SPSS	Statistical Product and Service Solution (software)
UN-ISDR	United Nations International Strategy for Disaster Reduction
UTM	Universal Transverse Mercator
WGS	World Geodetic System

1. General Introduction of Research

This chapter elaborates the general overview of the research comprising the background of the research, problem statement, objectives of the research, research questions and benefit of the research.

1.1. Background

Knowing people perception and behavior toward risk is an important part in the communication process between authorities and public in the management of risks related to natural hazards. Indigenous knowledge and behavior concerning with the hazards should be taken into consideration by the authorithies when formulating the action plan for the implementation of disaster risk reduction.

The word "risk" has been difined differently among individual, groups or institutions. Described as the combination of the probability of an event and its negative consequences (UNIDSR, 2009), risk is deemed to be both as a way of expressing uncertainty, and as a collection of perception (Raaijmakers et al., 2008). This means that risk is more related with a judgement rather than a fact (Aven & Kristensen, 2005). Risk perception itself, basically means the recognition of potential threat of disaster by individuals or groups (Dahal, 2008), which involves the process of collecting, selecting and interpreting signals about uncertain impacts of events, activities or technologies (Wachinger & Renn, 2010).

In the field of natural hazards, indigenous knowledge is referred to knowledge system, skills and technologies of local people who living in hazard prone areas for years. The implementation of indigenous knowledge in the context of hazards and other threats is referred as "coping mechanism" or "coping strategy" (Twigg, 2004). Coping mechanism is mitigative behavior which applied in order to reduce the impact of the disaster. This is divided into structural and non-structural activities.

In order to improve the preparedness for natural disaster, a better contextualization of factors related to risk perception and coping mechanism associated with the hazards is necessary. They way people perceived and behave toward risk will give an important input when developing and applying disaster risk management.

Yogyakarta is one of municipalities in Special Province of Yogyakarta. It is crossed by Code River which part of Boyong River flowing from the Merapi summit at the upper stream. Following the Mt. Merapi eruption in October – November 2010, lahar flood was struck several times in Code River. As reported by BNBP (2010), the first lahar flood happened on Monday, 29 November 2010. The flood was triggered by the heavy rains which happened all day long at the upper course of Code River. The floodwater reached 1.5 m in some parts of the riverbank (Fieldwork 2011) and inundated more than 300 houses (BNBP 2010).

There were two different combination of floods happened in this area: lahars flood and localized (urban) flood. The lahar flood occurred because of the high-prolonged rainfall which brought volcanic material of Mt. Merapi eruption at the uppert stream of Code River. While the localized (urban) flood occurred due to the high-prolonged rainfall in Yogyakarta City and trapped water in bad drainage system in the area.

To minimize the impact of flood, the local authority has applied several mitigation measurements both in structural and non-structural forms of mitigation such as levees construction, river dredging, early warning system and evacuation drill. Meanwhile, at the community level, social behavior such as gotong royong to clean up the river and to raise the river dike is the prominent activities among the residents to cope with flood.

This research emphasizes on assessing flood risk perception and identifying the coping mechanism of people living in Code Riverbank in Yogyakarta Municipality. People's perception and attitude to risk will be analyzed by exploring the combined effect of socio-economic status, location of the residents, people knowledge and experience, information sufficiency and cognitive factors. The assessment is applied for both lahar and localized(urban) floods which happened on Code River. The result of risk perception assessment and coping mechanism can be used as an input for improving the flood risk management in Yogyakarta Municipality.

1.2. Problem Statement

BNPB through its website, www.bnbp.go.id, 1 November 2011, stated that there are still 90 millions cubic material remain at the Mt. Merapi after the last eruption in 2010. This threaten areas surrounding Mt. Merapi, including Yogyakarta Municipality, from lahar floods in the

future. In another situation, the main causal factor of localized (urban) flood in Yogyakarta Municipality, bad drainage system, still become a tough propotion by the local government.

Both of local government and community have applied coping strategies to deal with flood in Code River, but it seems working separately. Government has done physical development along the river and non physical activities such as developing early warning system for the lay people. The implementation of this flood risk reduction of Code River is more likely concentrated only on the authority level. What have been largely ignored by the local government are the local perceptions of flood risk, experiences and historical processes that have been used to mitigate floods by the community. The people living there have been settled for many years and share a uniform linguistic and cultural background, making it easier for deep local knowledge and coping strategies to emerge and be transmitted from generation to generation.The ability of the local people to resist the impacts of flood disasters has not been given prominence.

The assessment of flood risk perception based on community, including the coping mechanism of the community hasn't been done yet in the study area. Therefore, this research is addressed to assess the people risk perception on flood and identify the coping mechanism/mitigative behavior applied in the community.

1.3. Research Objectives

Main Objectives

The main objective of the study is to assess community-level flood risk perception and coping mechanism on Code River. The assessment is applied for both lahar and localized (urban) floods.

Sub Objectives

1. To assess the people's perception about flood risk after 2010 Mt. Merapi eruption.
2. To identify the current coping mechanism employed by the local people.
3. To identify the flood hazard management of the local goverment.

1.4. Research Questions

To achieve the research objectives, some research questions are formulated as shown in Table 1.1. The method used to achieve the research objectives are described in Table 1.2.

Table 1.1. Research objectives and research questions.

No	Research Objectives	Research Questions
1.	To assess the people's perception about flood risk after 2010 Mt. Merapi eruption	a. What are the risk perceptions of flood of the local people? b. Are there any differences of flood risk perception in the different level of risk zone of flooding on Code River? c. What are the influencing factors for the variation of the flood risk perception of the local people?
2.	To identify the current coping mechanism employed by the local people	a. What are the coping mechanism applied at the community level? b. What are the coping mechanism applied at the household level? c. What are the infuencing factors to select the coping mechanism at household level? d. How is the flood risk perception and the coping mechanism related to each other?
3.	To identify the flood hazard management of the local goverment	a. What is the government done so far to handle the lahar and localized(urban) floods on Code River?

Table 1.2. Research questions and roposed methods

Research aims	Data Sources	Method	Data analysis
To assess the people's perception about flood risk after 2010 Mt. Merapi eruption	Households	Questionnaire survey of households	Qualitative analysis and Descriptive analysis Quantitative analysis using SPSS software
To identify the current coping mechanism employed by the local people	Community leaders, Households	Discussion with community leaders and key informants Questionnaire survey of households	Qualitative analysis and Descriptive analysis Quantitative analysis using SPSS software
To identify the flood hazard management of the local goverment	Sub-districts offices	Officer in charge interview, study the existing policies and regulations	Descriptive analysis

1.5. Research Conceptual Framework

The conceptual framework for this study is illustrated in Figure 1-1. In general, the risk perception is conducted through the perception of threat or perception of future flooding.

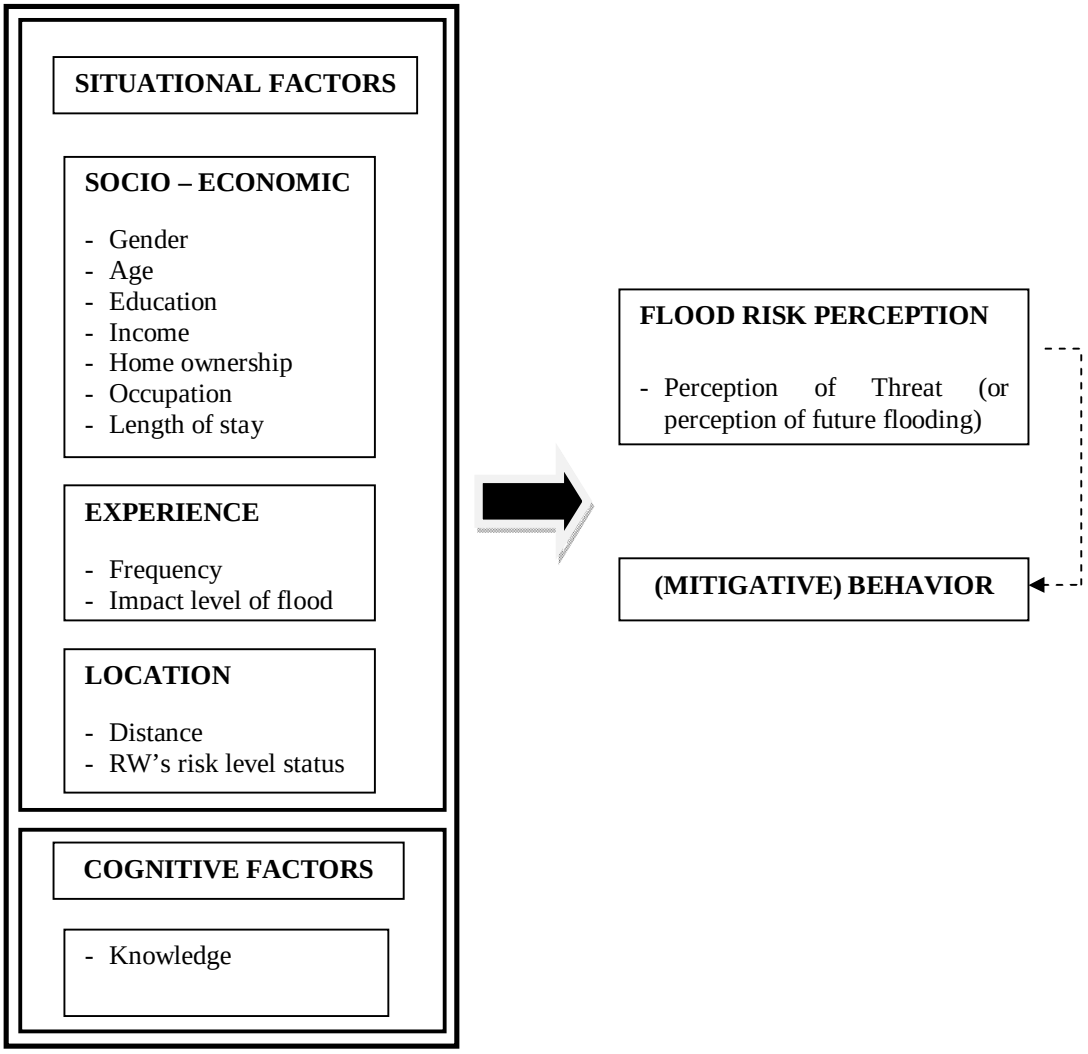


Figure 1-1. Research Conceptual Framework

Referring to Tobin & Montz (1997), perception is influenced by two categories of components: situational factors and cognitive factors. Situational factors include variables of socio-economic environments, flood experience, and respondents' location. Whereas, cognitive factors only consist of people's knowledge related with flood event. The word "cognitive" itself, based on oxford dictionary, is the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses. "Cognitive" is related with the mental processes of perception, memory, judgment, and reasoning, as contrasted with emotional and volitional processes.

Figure 1.1 outlines relationships identified in the literature between three sets of situational and cognitive factors and flood risk perception and (mitigative) behavioral outcomes. These relationships were modeled and the combined influences of variables were explored through the use of binary logistic regression. Table 1.3. describes which predictor variables were used in analysis and how they were measured. Table 1.4. describes outcome variables and how they were measured.

Table 1.3. Predictor variables and their measurements

Factors And Variable	Measuring Variable (S)	Measuring Scale
Socio-Economics		
Gender	Female is 1; Male is 0	Binary
Age	Age in years	Ordinal
Education	Elementary school/Junior high school/senior high school/bachelor/graduate school	Ordinal
Income	Income per month in rupiah	Ordinal
Home ownership	Own house is 1; Rent is 0	Nominal
Occupation	Gov. Officer/merchant/entrepeneur/etc...	Nominal
Length of stay	Years in current home	Ordinal
Location		
Distance between respondent's house and the river	Distance in kilometers	Ordinal
RW's risk level status	Zone 1(high risk) is 1; Zone 2 (Moderate risk) is 2; Zone 3(Low risk) is 3	Ordinal
Experience		
Frequency	# Times Property Flooded	Ordinal
Impact Level of Flood	Low impact is 1;	Ordinal

	Moderate impact is 2; High impact is 3	
Cognitive Factors		
Knowledge	Flood Depth	Ordinal
	Causal factors of flood	Nominal

Table 1.4. Outcome variables and their measurements

Factors And Variable	**Measuring Variable (S)**	**Measuring Scale**
Perception		
Perception of threat	High risk is 1; Moderate risk is 2; Low risk is 3	Ordinal
Behavior		
Technological	Yes (1); No (0)	Binary
Social	Yes (1); No (0)	Binary
Economical	Yes (1); No (0)	Binary

1.6. Benefits of the study

This research will give a valuable input for local government for improving flood risk management in order to respond lahar and localized (urban) floods on Code River.

1.7. Limitations

The situational factors which influence the perception of threat and mitigative behavior is defined only from three categories of variables: socio-economic, experience, and location. Whereas cognitive factors consist of people's knowledge of flood.

The process of collecting data did not include FGD (Focus Discussion Group), but only based on the depth interview with the respondents.

1.8. Thesis structure

This research has a structure as follows:

Chapter 1 – Introduction

This chapter will give a briefly description about the research background, the research problems, the research objectives, the research questions and proposed methods, the conceptual framework, the benefits of the research, the limitations of the research, and thesis structure.

Chapter 2 – Literature Review

This chapter provides the literatures which support the research. Terminologies and concepts related to the study will explain in this chapter.

Chapter 3 – Study Area and Methodologies

This chapter highlights the characteristic of the study area including the sampling method and research methodology.

Chapter 4 – Situational and Cognitive Factor

This chapter describes the factors that pre-assumed has a correlations with the variation of flood risk perception and the applied coping mechanism in Code Riverbank. These factors include situational and cognitive factors of the residents represented by the respondents.

Chapter 5 – Flood Risk Perception

This chapter discussess perception of flood risk of local community in Code Area. People knowledge of flood risk was described including their knowledge of risk zonation and their perception of causes of flood. The influence of situational and cognitve factors to perception of flood risk were analyzed by using regression analysis.

Chapter 6 – Coping Mechanism

This chapter discussed coping mechanism to deal with flood applied within local communities along Code River and the local goverment. Further explanation related with the activities will be chategorized based on activities before, during, and after flood.

Chapter 7 – Conclusion and Remark

General conclusion of the result of this study and the suggestion for future study will be explained in this chapter.

2. Literature Review

This chapter reviews the related literatures used to support the discussion of the research. It elaborates the definitions of hazard, disaster, flooding, flood hazard management, risk perception, coping mechanism, and participation of the community in flood risk management as well as mitigation measures.

2.1. Flood Hazard

Flood is defined as high-water stages in which water over flows its natural or artificial banks onto normally dry land, such as a river inundating its floodplain (SAARC, 2005). Floods are among the most destructive natural hazards causing extensive damage to the built and natural environment, and devastation to human settlements (ADPC, 2005).

Hazard is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR,2009).

Flood hazard in (Alkema, 2005) is defined as the chance that a flood event of a certain magnitude will occur in a given area within a given period of time.

According to ADPC (2005), there are two types of flood:

1. Riverine floods, also called as monsoon floods in Asia. These occur when major rivers and their side channels overflow, causing extensive inundation. The rivers rise slowly and with slow recession may remain high for many weeks. Flood peaks may occur simultaneously on many interconnected rivers, which can cause particularly extensive flooding.

   Riverine floods consist of two types of river flooding: slow-onset floods and rapid onset/flash floods.

   - Slow-onset floods. Occurs slowly and causes may consist of snowmelt and steady ongoing rainfall. This can happen in a long period (for weeks or months). Rising water level is predictable, giving people a chance to evacuate themselves.
   - Rapid onset/flash floods. Occurs mainly in steep rivers with small and steep mountainous catchments after periods of intense rainfall. A rapid rise and fall of water level with little or no advance warning.

2. Localized and urban floods. Intense local rainfall in areas with inadequate drainage, stormwater management and flood evacuation systems tend to result in localized flooding. Floodwater collects in particular areas and may remain for a long duration of time.

There is a spesific type of flash floods so-called lahars flood. This flood considered as the secondary impact of volcanic eruption. Lahars (Indonesian term) are flows including debris of volcanic rocks of every size which frequently affect the steep and unconsolidated slopes of volcanoes (Schneider, 2005). Lahar generation is complex, resulting from a combination of volcanic and climatic processes (Lavigne, 1999). A lahar is a rapidly flowing mixture of volcanic rock debris and water, typically with 40-90 percent sediment by weight, and thus having a consistency ranging from muddy water to a dense slurry (UNISDR, 2004).

At Mt. Merapi, lahar is triggered by two main processes (Lavigne, 1999): (1) eruption-induced lahars or primary lahars from the admixing of pyroclastic flows, or less frequently, from debris avalanches, with running water; (2) rain-triggered lahars or secondary lahars from heavy rainfall upon recently erupted volcaniclastics, usually during the rainy season.

The disposition factors of lahars are :

- Water, availability and amount of water
- Slope, a critical slope and channel gradient (gravitational transport)
- Loose rock material, availability of potentially erodible and debris. Volume and thickness of source deposits. Physical characteristics of pyroclastic deposits such as grain size, permeability, pore pressure, cohesion, and angle of friction.

(Verstappen, 1992) on (Schneider, 2005) divides primary and secondary lahars based on the volcanic activity and trigger mechanisms. Primary lahars are directly related to volcanic eruptions :

a. Derived from pyroclastic flows by mixing with water.
b. Formed by water from an eruptively blown-out crater lake.
c. Caused by melting of snow and ice during an eruption

Secondary lahars develop at some later stage and can be favoured by seismicity

a. Resulting from rain percolating into unconsolidated pyroclastic deposits
b. Related to seasonal snow/ice melting.
c. Initiated by lake water outbursts.

Debris flow in Indonesia can be triggered by several conditions such as topography, geology, rainfall, and environment (Sumaryono&Hilda, 2010). The mountainous topography condition of the Indonesian islands, heavy rainfall, steep slope of river bed, and the steep slope of land surface are the main causes of debris flow occurrence in the country. A debris flow disaster is caused by loose sediment and high intensity of rainfall. Debris flow is a very typical phenomenon that occurs after or during heavy rainfall.

2.2. Flood Hazard Management

Disaster risk management consists of three aspects, which are mitigation, preparedness and prevention (Twigg, 2004). Tran et al. (2008) applied Risk Management Framework (Standards Australia 1999) to help decision makers more effectively to achieved flood risk reduction (see Figure 2-1).

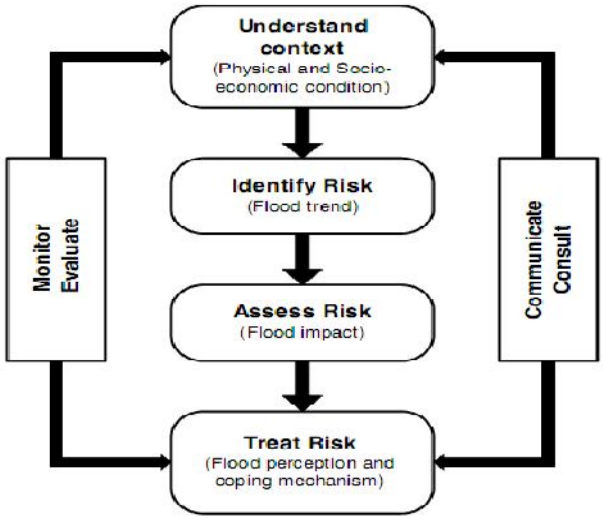


Figure 2-1. Flood Risk Management framework adapted from the Risk Management Standard AS/NZS 4360:1999 (Tran et. al., 2008).

2.3. Risk Perception

The word “risk” has been difined differently among individual, groups or institutions. Described as the combination of the probability of an event and its negative consequences (UNIDSR, 2009), risk is deemed to be both as a way of expressing uncertainty, and as a collection of perception (Raaijmakers et al., 2008). This means that risk is more related with a judgement rather than a fact (Aven & Kristensen, 2005).

Risk perception itself, basically means the recognition of potential threat of disaster by individuals or groups (Dahal, 2008), which involves the process of collecting, selecting and interpreting signals about uncertain impacts of events, activities or technologies (Wachinger & Renn, 2010). Palp & Werner (2006) defines risk perception as an everyday subjective assessment process that is based on experience and on available information without referring to reliable data, series and complex models. In more sociological terms, risk perception is a construction process embedded into and determined by society and culture. Therefore, risk perception implies value judgments. These judgements vary among individuals due to different levels of information and uncertainty, due to different intuitive behaviour, and also due to specific power constellations and positions of interest (Messner&Meyer, 2005). As a consequence, the individuals of a community may assess the risk of being flooded very differently, because they do not have the same information about the probability of flood hazard events in their region, about flood mitigation measures and their effectiveness, and they perhaps have a different historical background regarding the experience of living in a floodplain and of being flooded.

2.3.1. Influencing Factors of Risk Perception

Tobin and Montz (1997) identify two categories of components that influence perception: situational factors and cognitive factors (Figure 2-2). Situational factors include variables of the physical and socio-economic environments. Meanwhile, cognitive category consists of psychological and attitudinal variables.

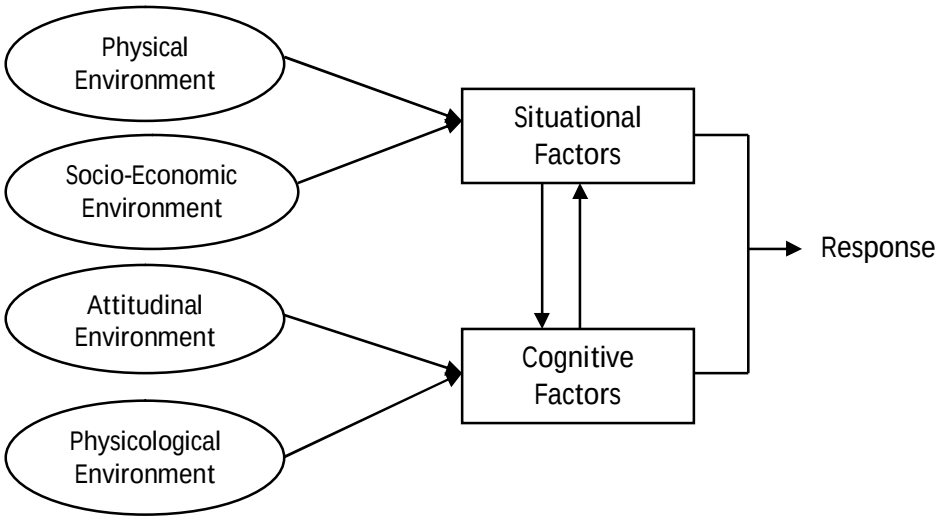


Figure 2-2. Influences on perception. Different variables influence the sets of situational and cognitive factors. (Source : Tobin & Montz, 1997).

The first, 'situational factors' – are physical and socio-economic environments that affect a persons range of choices and responses to the risk – such as characteristics of events (the magnitude, frequency, and duration) and demographic variables (education, employment, income, religion, and family ties). These factors do not always play the same role (in one case, hig income may be associated with accurate perception of hazard, but in another may not).

The second, 'cognitive factors' – are attitudinal and physicological environments that influence risk perception – such as religious beliefs, political ideologies, and personality traits.

2.3.2. Four Context Levels of Risk Perception

Wachinger & Renn (2010) proposed a structured framework which provides an integrative and systematic four context levels of risk perception.

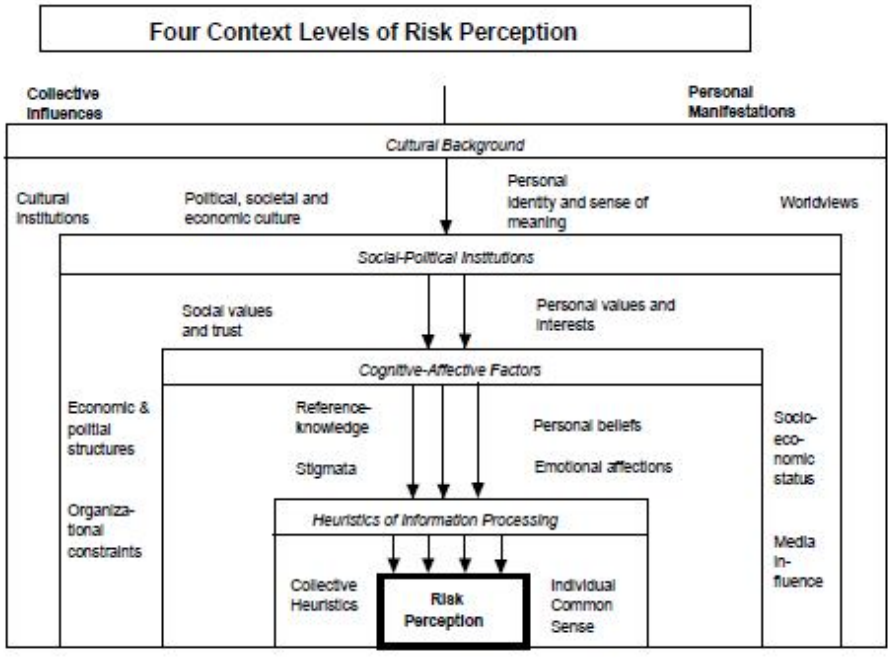


Figure 2-3. Four contet level of risk perception. (Source : Wachinger & Renn, 2010).

Each level represents individual and collective manifestations of risk perception.

Level 1: Heuristics of Information Processing. The collective and individual heuristics are independent of the nature of the risk in question or the personal beliefs, emotions or other conscious perception patterns of the individual. Improved knowledge and expertise in logical

reasoning and inferential statistics, as well as a conscious awareness of these heuristics, can help individuals to correct their intuitive judgments or to apply these heuristics to situation where they seem appropriate.

Level 2: Cognitive – Affective Factors. This level refers to the cognitive (knowledge-based) and affective (emotion-based) factors which affect the perception of specific interest of the risk in question.

Level 3: Social and political institutions. Institutions which individuals or groups related to either the cause of risk or the risk itself. Trust in institutions, personal and social value commitments, organizational costraints, social and political structures and economic status are the main focus of the discussion at this level.

Level 4: Cultural background. Cultural institutions, polital, societal and economic culture, personal identity and sense of meaning, and worldviews are taken into account when defining the cultural background of risk perception.

2.4. Coping Mechanism

Twigg (2004) refers a 'coping mechanism' or 'coping strategy' (sometimes known as an 'adjustment' mechanism or strategy, and in some circumstances as a 'survival' strategy) as the application of indigenous knowledge in the face of hazards and other threats. This are coming from the process of experiments and innovation of people by developing their skills, knowledge, and self-confidence to shape and respond to their environment (Heijmans, 2004).

Twigg (2004) categorized four types of coping mechanism :

1. Economical/material; which is emphasizing on economic diversification, e.g. having more than one source of income (or food) will be invaluable during the hazards, when some economic activities become impossible
2. Technological; which is related with structural, engineering, and technical measures which have function to: control hazard, protect private or public facilities, and provide people with places of safety at times of disaster (e.g. flood and cyclone shelters).
3. Social/organisational; which includes kinship networks, mutual aid, and self-help groups. The family is a fundamental social mechanism for reducing risk
4. Cultural; which relates to risk perception and religious views.

2.5. Disaster Risk Management

Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness (UNISDR, 2004). Those disaster management terminology has been described by Twigg (2004) as follows:

- Prevention. Activities to ensure that the adverse impact of hazards and related disasters is avoided. As this is unrealistic in most cases, the term is not widely used nowadays.
- Preparedness. Specific measures taken before disasters strike, usually to forecast or warn against them, take precautions when they threaten and arrange for the appropriate response (such as organising evacuation and stockpiling food supplies). Preparedness falls within the broader field of mitigation.
- Mitigation. Any action taken to minimise the extent of a disaster or potential disaster. Mitigation can take place before, during or after a disaster, but the term is most often used to refer to actions against potential disasters. Mitigation measures are both physical or structural (such as flood defences or strengthening buildings) and non-structural (such as training in disaster management, regulating land use and public education).

SAARC (2005) elabore the activities for each mitigation measures as follows :

1. Structural measures
   a. Watershed management: Timely cleaning, de-silting and deepening of natural water reservoir and drainage chanels (both urban and rural) must be taken up.
   b. Reservoirs: The entire natural water storage place should be cleaned on a regular basis. Encroachments on tanks and ponds or natural drainage channel share to be removed well before the onset of monsoon
   c. Natural water retention basins: Construction and protection of all the flood protection embankments, ring bunds and other bunds. Dams and levees can also be constructed which can be used as temporarily storing space which reduced the chances of lower plains getting flooded.
   d. Buildings on elevated area: The buildings in flood prone areas should be constructed on an elevated area and if necessary on stilts and platform

2. Non – Structural
   a. Flood plain zoning: Flood plain zoning, which places restrictions on the use of land on flood plains, can reduce the cost of flood damage. Local governments may pass laws that prevent uncontrolled building or development on flood plains to limit flood risks and to protect nearby property. Landowners in areas that adopt local ordinances or laws to limit development on flood plains can purchase flood insurance to help cover the cost of damage from floods.
   b. Flood forecasting and warning: These are issued for different areas mostly by the Central water Commission/ Meteorological department and by the State Irrigation/ Flood Department.

3. Study Area and Research Methodology

This chapter introduces the general overview of the study area. It also describes the methods applied in the research.

3.1. General Information of Yogyakarta Municipality

Yogyakarta Municipality is one of the five regencies of the Special Province of Yogyakarta. It is located between 10°24'19" - 110°28'53" E and 07°49'26" - 07°15'24" S with total area of 32,5 km^2. Yogyakarta Municipality has a relatively flat area located on an average elevation of 114 m above the sea level. This area comprises of 14 districts and 45 sub-districts (Table 3.1), and has direct boundary with two regencies: Sleman and Bantul Regencies. Figure 3-1. shows the location of Yogyakarta Province in Java island. Three main rivers flow in this area (Figure 3-2). Gajahwong River on the east part, Code River on the middle part and the Winongo River on the west part of the City.

Table 3.1: Administrative subdivision in Yogyakarta Municipality
(Source: BPS, Yogyakarta)

No	District	Total Area (Km^2)
1	Mantrijeron	2.61
2	Kraton	1.40
3	Mergangsan	2.31
4	Umbulharjo	8.12
5	Kotagede	3.07
6	Gondokusuman	3.99
7	Danurejan	1.10
8	Pakualaman	0.63
9	Gondomanan	1.12
10	Ngampilan	0.82
11	Wirobrajan	1.76
12	Gedongtengen	0.96
13	Jetis	1.70
14	Tegalrejo	2.91

Figure 3-1: The location of Yogyakarta Province in Java island

(Source: http://1.bp.blogspot.com/)

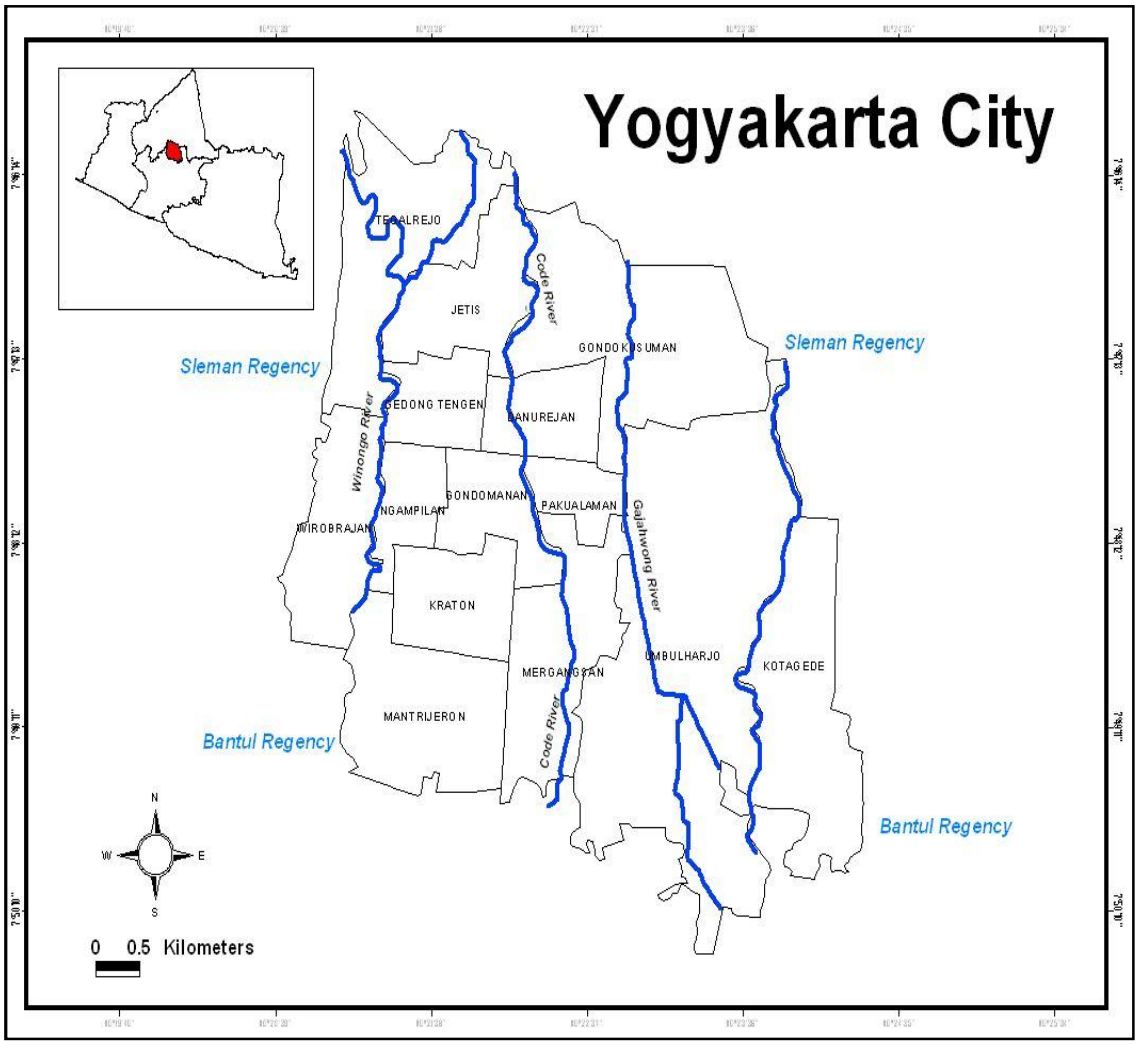


Figure 3-2: Administrative map and main rivers of Yogyakarta

3.2. Code River

Code River splits the Yogyakarta area down the middle and runs from the north to the south of the city (Figure 3-2). It flows through three districts of Yogyakarta: the District of Sleman (on the upper northern course), Yogyakarta City (middle course), and the District of Bantul (southern lower course). This river originates in the southern part of Mount Merapi (the Boyong river), and passes through the Opak River and ends at the Parangtritis coast off the Indian Ocean. Overall, the length of the river is ± 41 km and it consists of Code river at the downstream, 17 km, and Boyong river at the upperstream, 24 km.

3.2.1. Flood Events in Code River

Code river has three historical events of flooding in 1984, 2005, and 2010. Flood in 1984 and 2005 were mainly caused due to the high rainfall intensity and the lack of embankments along the river. On February 4th, 1984, Code river overflown and inundated some parts of Yogyakarta City. Yogyakarta authority through its offficial website (http://dibi.jogjaprov.go.id/) states that 8 people were sick, 4.465 people flooded out, 59 houses were inundated, 125 houses hard broken, 112 houses collapsed, and 4 bridges were damaged. Total economic loss caused by the event came out at 600 million rupiah. According to Widiyanto (2007), flood on 23 February 2005 inundated 62 houses in Pakualaman, 26 houses in Kotagede, 68 houses in Umbulharjo, 184 houses in Gondomanan, and 115 houses in Mergangsan.

Meanwhile, flooding in November 2010 was a lahars flood due to the materials deposition from the 2010 Merapi eruption. Heavy reainfall on the top of the mountain had triggered a cold lahar flood in the middle and lower segments of the river course. The 2010 flood also caused some damage and destroyed property. As reported by BNPB per 30 November 2010 total loss caused by cold lahar flood as follows (Table 3.2):

Table 3.2. Total houses inundated by the 2010 flood (BNPN data per 30 Nov 2010).

No.	Location (District)	Inundated houses
1.	Danurejan	48
2.	Gondokusuman	54
3.	Mergangsan	107
4.	Pakualaman	121
5.	Umbulharjo	20

3.3. Research Process

The research is concerned on analysing people's perception of flood risk, analysing the coping mechanism in household and community level, analysing the influence of contributing factors to the perception of flood risk and mitigative behavior (coping mechanism) of lay people, and identifying the local government strategy in order to reduce the impact of flood. All those objectives are accomplished through three different stages: (1) Pre-fieldwork, (2) Fieldwork, (3) Post-fieldwork. Figure.3-3. depict the process of the research.

3.3.1 Pre-fieldwork

The first activity of this stage was strengtening the concept and methodology which will be applied in this research through an intensive literature review from related books, journals, reports and previous studies. Identification of data needed and its measurement was done for designing the questionnaire. The available spatial data were converted to the same coordinate system (WGS-84, UTM 49S). The data availability for this research is given in Table 3.3.

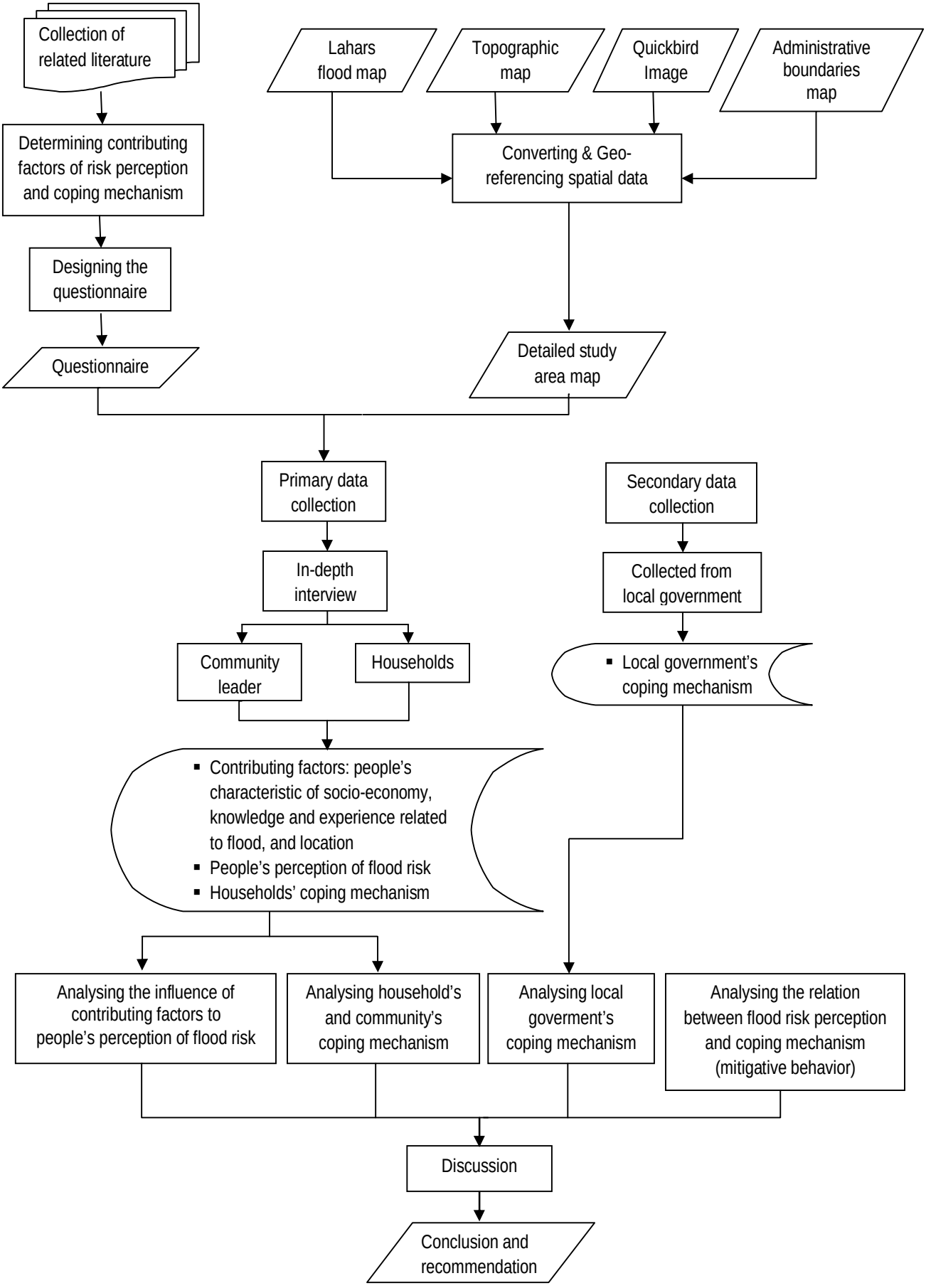


Figure 3-3: Research Process

Table 3.3 Data Availability

No.	Research Activities	Data Requirement	Source
1.	Determine sampling technique, population, and samples	▪ Topographic Map (1:25.000) ▪ Lahar Flood Map	GMU Departement of Geodesy, GMU
2.	Flood risk perception analysis	Perception of threat or perception of future flooding	Fieldwork
3.	Coping mechanism analysis at household's and community's level	Technological, Social, Economic and Cultural coping mechanism	Fieldwork
4.	Local government's coping mechanism	Local governement policies or regulations related with flood hazard management	Fieldwork Institutional Data

3.3.2. Fieldwork

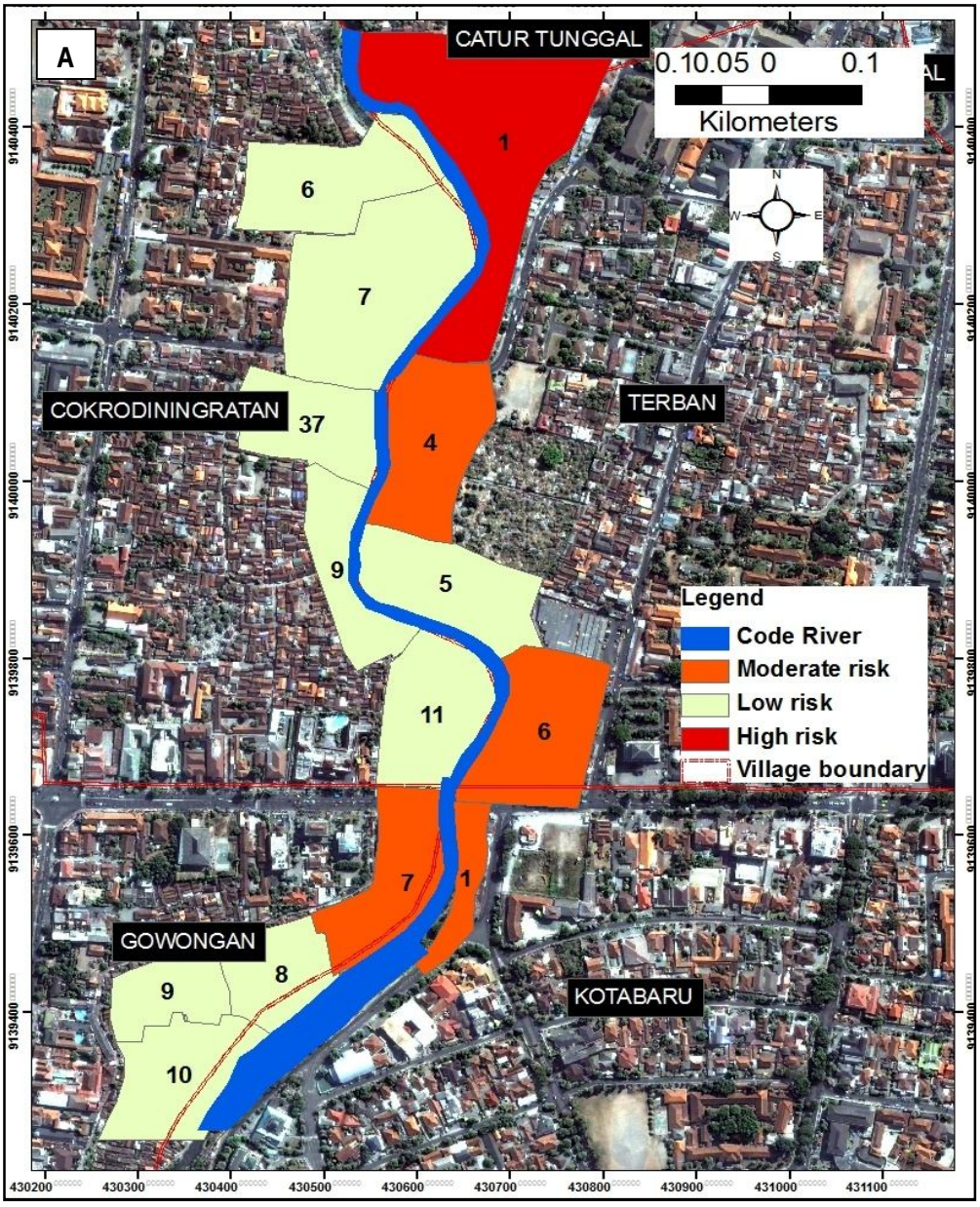
Fieldwork stage were done to collect both primary and secondary data from the local community and government. The field survey was carried out from October until December 2011 in 6 RW situated at Code Riverbank.

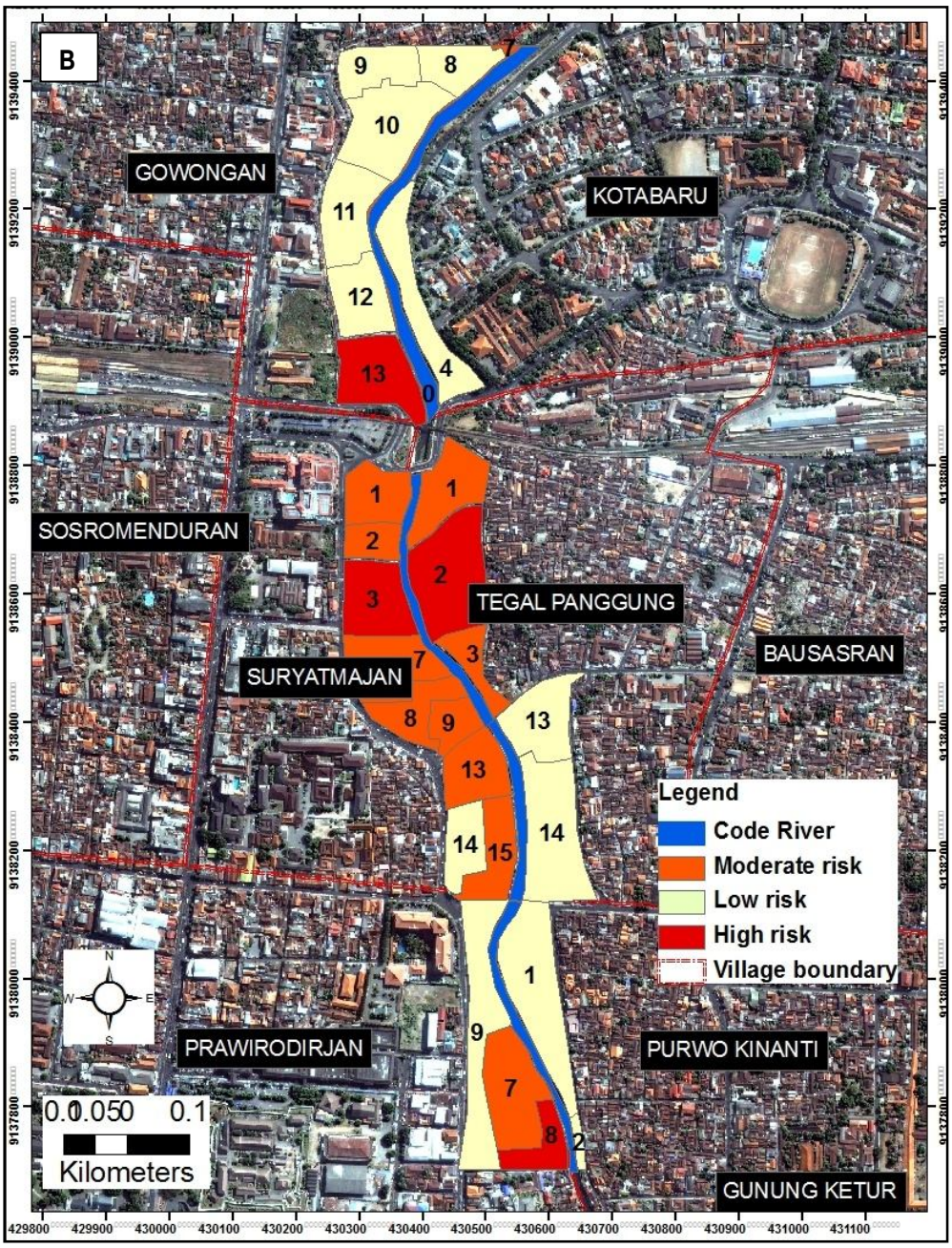
Two main activities were employed during the fieldwork:

1. Primary data collection was conducted through in-depth interview with 90 households and community leaders by using questionnaires. Data related with socio-economic condition, flood experience including flood depth and the causal factors of flood, flood risk perception and community coping mechanism were recorded from the lay people and the community.
2. Secondary data collection through collecting data and information from related local government offices such as village offices, fire and disaster management agency, and public works agency.

Selection of Study Area

The selection of study area is based on lahar flood risk map 2010 issued by Faculty of Geodesy, Gadjah Mada University, Yogyakarta (Figure 3-4). The map shows the RW-based risk level of lahar flood along Code riverbank at Yogyakarta Municipality. The risk level is divided into three categories: high, moderate, and low risk.





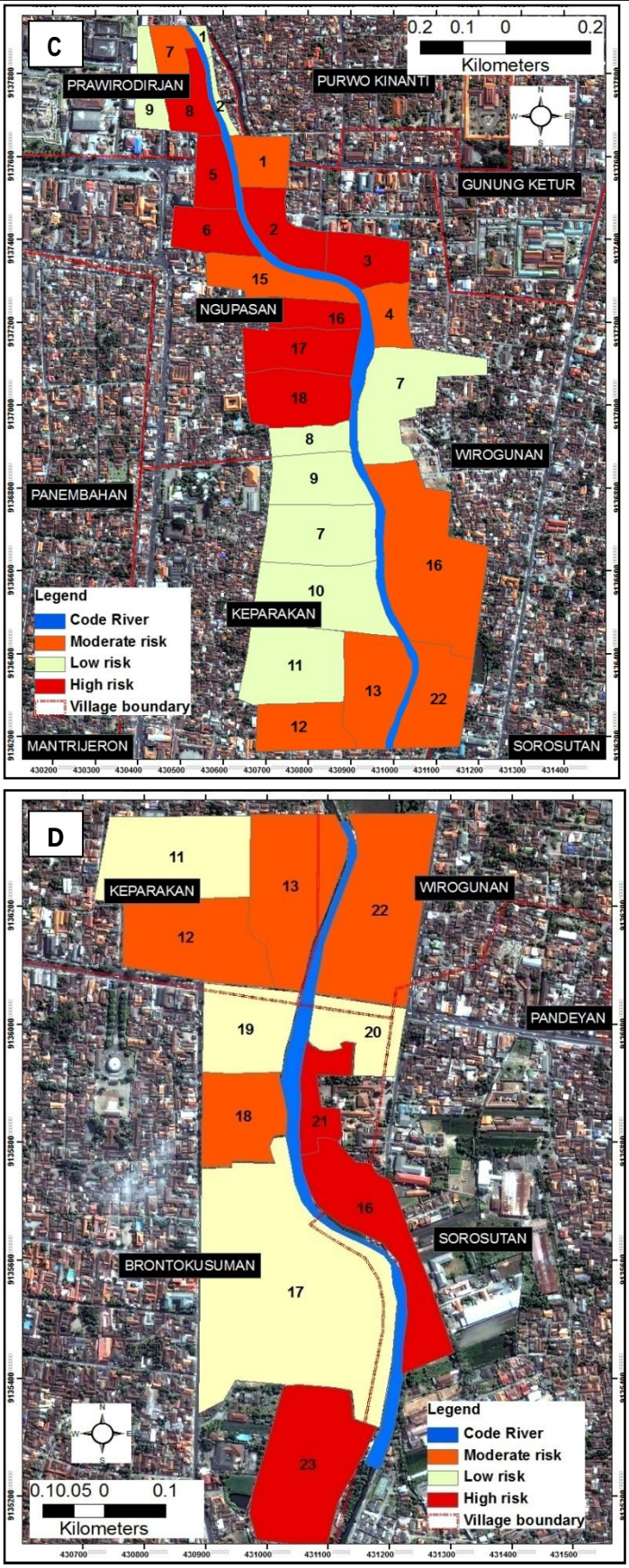


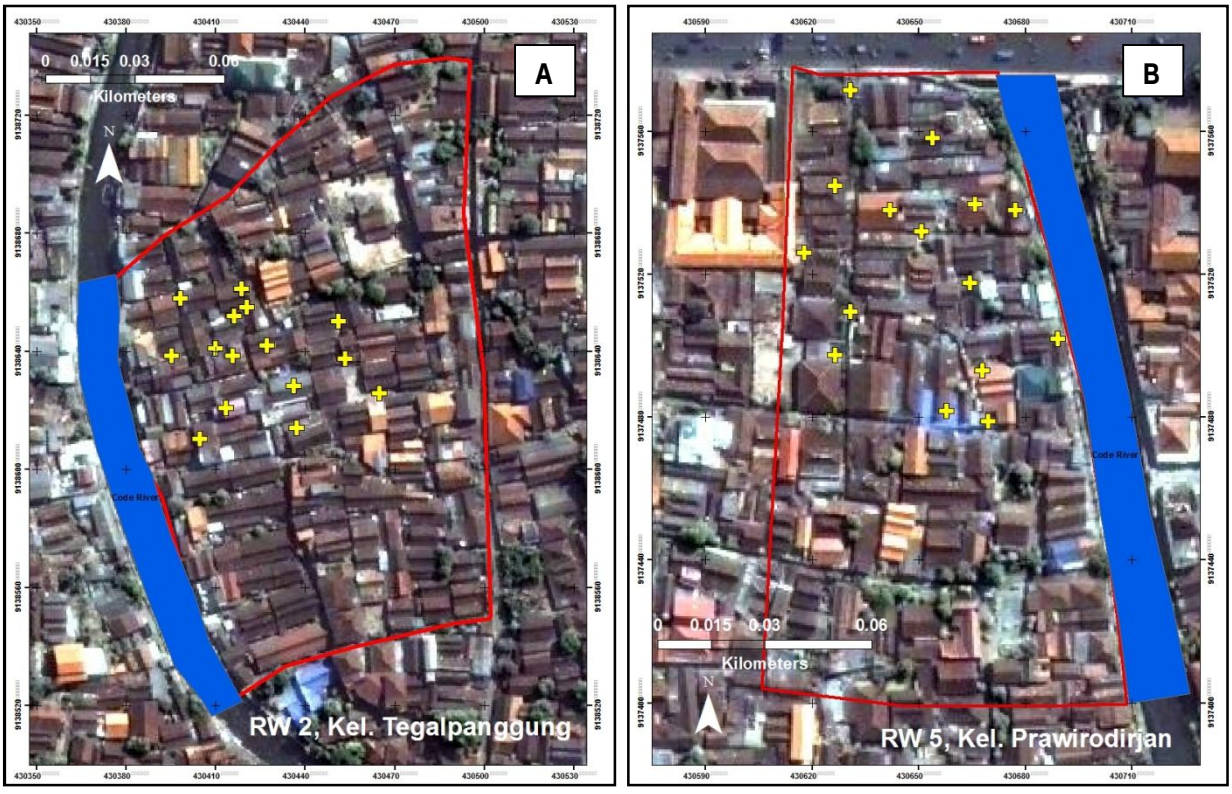
Figure 3-4. Map of study area. a) Part I of the study area, b) Part II of the study area, c) Part III of the study area, d) Part IV of the study area

From total 61 RW located on 14 villages along the Code riverbank, 6 RW were chosen as the study area. Stratified random sampling was applied to choose the RW samples based on the level of risk. For each level of flood risk will be represented by 2 RW (Table 3.4)

Table 3.4: RW samples

Level of Risk	Area
High	RW 2, Kelurahan Tegal Panggung
	RW 5, Kelurahan Prawirodirjan
Moderate	RW 1, Kelurahan Suryatmajan
	RW 15, Kelurahan Prawirodirjan
Low	RW 5, Kelurahan Terban
	RW 10, Kelurahan Gowongan

From each RW sample, 15 households was randomly selected as the respondents. Total 90 respondents were selected as the household respondents. Figure 3-5 describes the spatial distribution of the respondents for each RW.



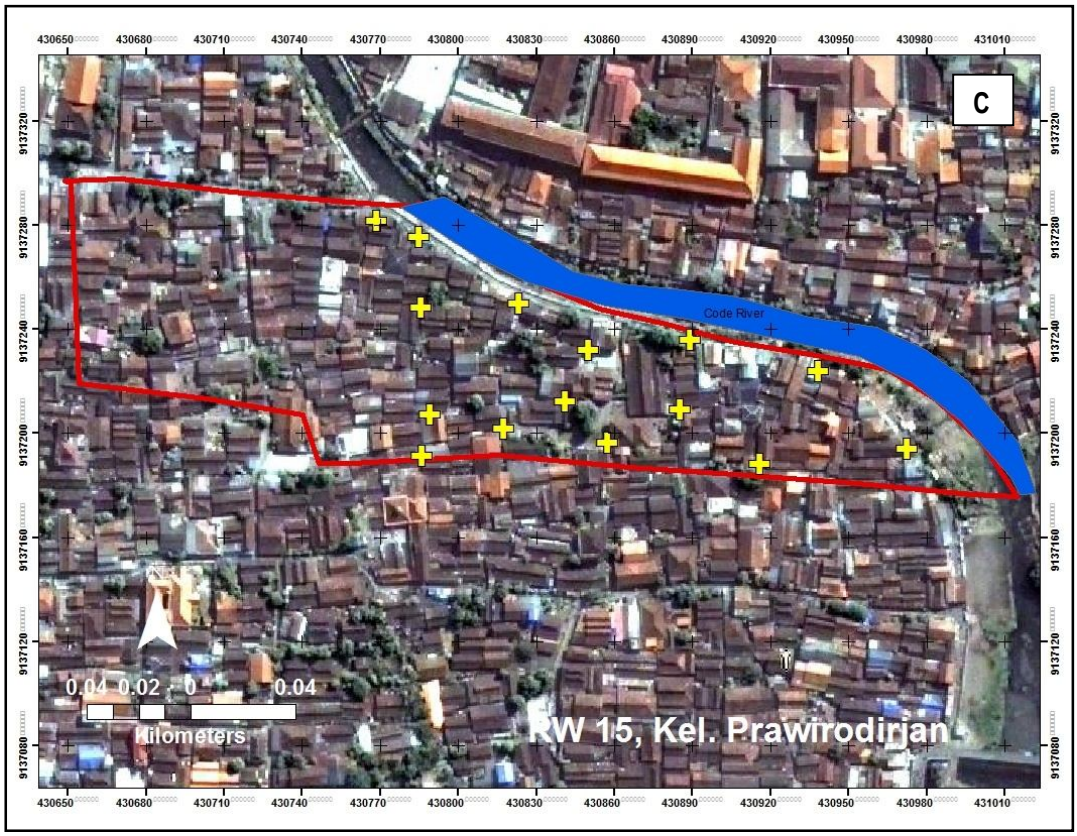


Figure 3-5 Spatial distribution of the respondents at a). RW 2, Kel. Tegalpanggung, b). RW 5, Kel. Prawirodirjan, c). RW 15, Kel. Prawirodirjan, d). RW 1, Kel Suryatmajan, e). RW 5, Kel. Terban, f). RW 10, Kel. Gowongan.

Households Interview

A total of 90 respondents were interviewed and asked to fill in questionnaire of open and closed questions (see appendix 1). Information about social-economic characteristic, flood experience, location of the respondent, knowledge of flood, risk perception reagarding flood in this area and households' strategy to deal with flood were explored. After that, the level of flood depth inside the house, if inundated during the flood, were measured. All these activities lasted in a 30 minutes time approximately. Generally, the respondents were welcomed and willing to share the information to the author. Figure 3-6 shows the process of households interview.

Figure 3-6. Interview and measuring flood mark during the fieldwork

Interviews with Officials

Interviews with officials were mostly related with the coping strategy in order to reduce the impact of flood. From the Public work agency, the author got the information about the physical infrastructure of Code River. Meanwhile information about early warning system was obtained from Fire, disaster control and public protection departement. More detail about local government coping mechanism will be discussed in Chapter 6.

3.3.3. Post-fieldwork

All data gathered from fieldwork were processed spatially and statistically using ArcGIS 9.3 and SPSS 13 software. The data collected were analyzed in three parts: contributing factors analysis, risk perception assessment and coping mechanism analysis. All these three part of analysis were done by using statistical analysis in SPSS. Descriptive analysis was used to describe the contributing factors such as: socio-economic profile and flood experience. Logistic regression was used to analyze the relationship between contributing factos and flood risk perception and coping mechanism.

Identification of contributing factors of flood risk perception will be discussed in Chapter 4, flood risk perception in Chapter 5, and coping mechanism analysis discussed in Chapter 6.

4. Contributing Factors of Flood Risk Perception and Coping Mechanism

This chapter describes the factors that pre-assumed has a correlations with the variation of flood risk perception and the applied coping mechanism in Code Riverbank. These factors include situational and cognitive factors of the residents represented by the respondents.

4.1. Introduction

In the conceptual framework (see Figure 1-1), risk perception has been influenced by two groups of variables: situational factors and cognitive factors. Situational factors includes variables of the socio-economic and physical environments. Whereas, people knowledge related to flood is under heading of cognitive factors.

4.2. Situational Factors

4.2.1. Social – Economic Environment

The socio-economic environment has been explored based on: gender, age, education, length of stay, as well as economic condition of the respondents. The economic condition can be determined by respondent's income and building ownership.

Gender of respondent

Gender of respondents is considered as one variable that influencing the variation of flood risk perception within community. Gender is assumed to have a correlation with people's attitude and response toward flood.

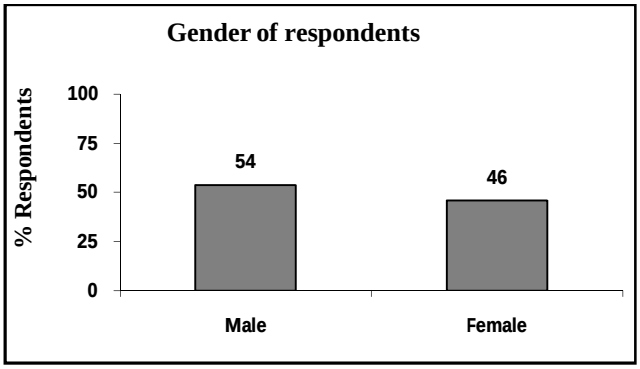


Figure 4-1. Distribution of respondents based on gender

As described in Figure 4-1, the number of males interviewed was slightly bigger at 49 (54%) than females at 41 (46%). This can be understood that most male household members were

having own business at their home whereas most females interviewed were worked as housewife who stand by at home.

Age of respondents

Age of respondents is considered as one variable that influencing the variation of flood risk perception within community. Age is assumed to have a correlation with people's attitude and response toward flood. Respondents of all ages were represented in Figure 4-2 and Table 4.1

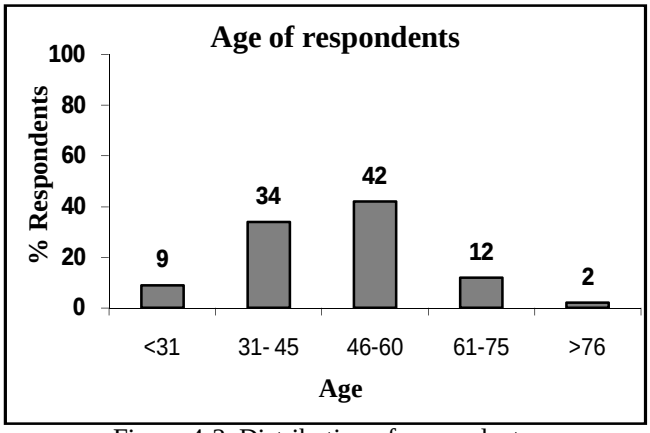


Figure 4-2. Distribution of respondents based on age

The age is ranging from 17 to 83 years and the average of age is 48 years old. The lowest age bracket was <31 years which accounted for 8 (9%) of the respondents.

Most of respondents are at productive age with age bracket 31-45 and the 46-60 categories accounting for 31(34%) and 38 (42%) respectively.

Only 2% of the respondents were having age bracket 76 and above years.

Table 4.1. The average of age of respondents

Total (N)	Min	Max	Mean	Std. Dev
90	17	83	48.6	12.9

Education of the respondents

As pre-assumption, educational level is having a correlation with the way people assess their own risk perception. This assessment is considered to have indirect relationship with the way people react toward flood. Well educated people also assumed to have a better life and a higher income which influence the strategies applied to cope the flood.

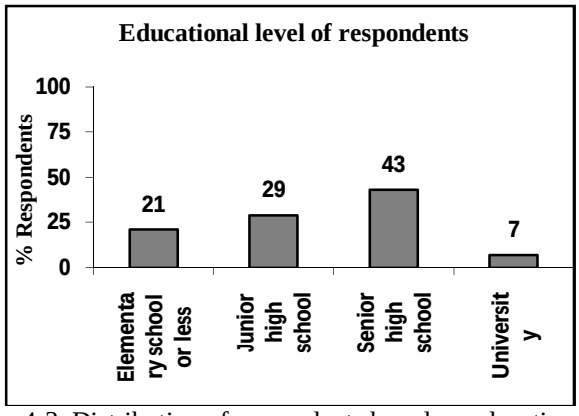


Figure 4-3. Distribution of respondents based on education level

Figure 4-3 shows the educational level of respondents at Code River Area; whereas majority of respondents are graduated from the high school (43% from senior high and 29% from junior high), 21% respondents are graduated from elementary school or less, and only 7 respondents obtained education up to university level.

Occupation of the respondents

The biggest portion of the respondents' occupation was an employee (34%). This consist of respondents who work as government officer or private worker such as lawyer and consultant. A further 25 (28%) were entrepreneur, 19 (21%) were housewife, 10 (11%) were non-permanent job, while 5 (6%) were unemployed such as student and jobless (Figure 4-4)

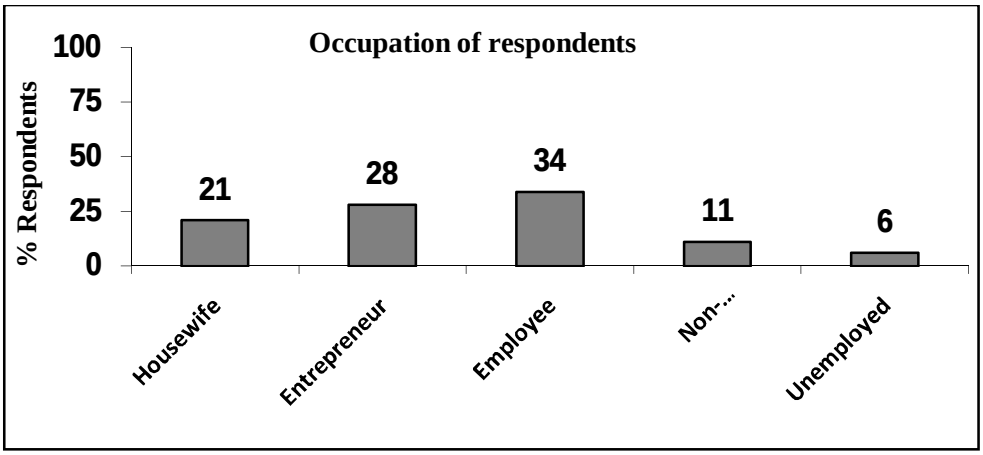


Figure 4-4. Distribution of respondents based on occupation

4.2.2. Economic condition of the respondents

Income per-month

As describes in Figure 4-5, most of respondents are having income less than Rp. 750.000 (43%) which is less than minimum wage for Yogyakarta Province. About 36% of the total respondents have income ranged from Rp. 750,000 – Rp. 1,500,000 and 21% of respondents have income more than Rp. 1,500,000.

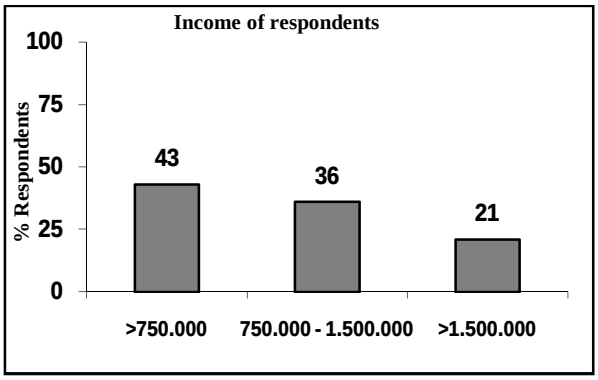


Figure 4-5. Distribution of respondents based on income

Building Ownership

Figure 4-6 shows the building ownership of the respondents. Most of respondents in Code Area have their own houses (87%). House from their ancestral is included on this category. The figure indicates that only 13% of the total of 90 respondents is living in a rent house.

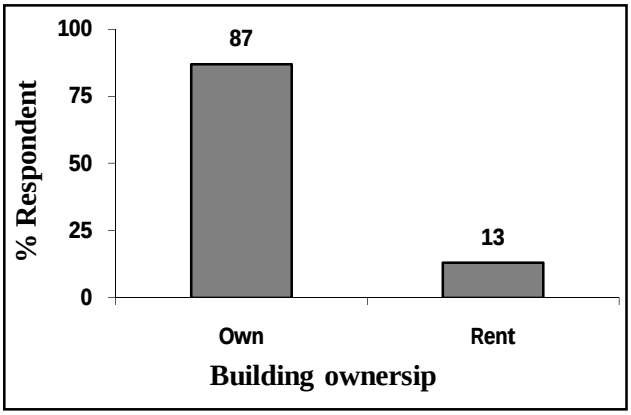


Figure 4-6. Distribution of respondents based on building ownership

Building ownership is assumed to have correlation with the way people preparing their house for flood event.

Length of Stay

From data collected during fieldwork, most of respondents has been living in Code Area for 31 – 45 years (30%), 46 – 60 years (23%), less than 15 years (20%), 15 – 30 years (19%) and over 60 years (8%). This factor related with flood experience which happened in Code River in the past. Figure 4-7 shows the distribution of respondents based on length of stay.

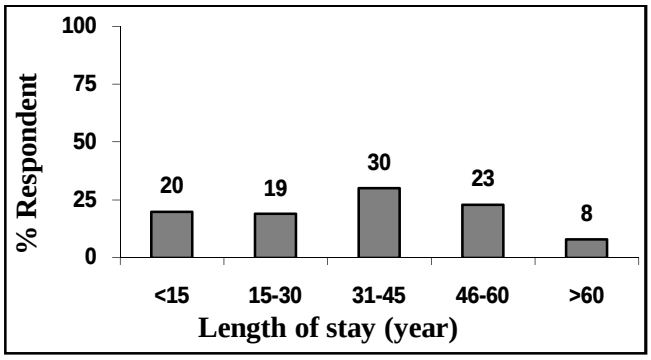


Figure 4-7. Distribution of respondents based on length of stay

4.2.3. Location

Location environment has been explored based on: RW's risk level status and distance between respondents' house and the river.

RW's Risk Level Status

In the Lahar Flood Risk Map (see Figure 3-4), each RW in the study area is assigned with one level of risk: low, moderate, or high risk. Each respondents was assigned with one level of risk depend on their RW's location.

Distance Between Respondents' House and The River

Distance was measured by using the measurement tools in ArcGIS 9.3 from respondents' house coordinate obtained during fieldwork to Code River. The nearest distance betwen house and the river were used for the analysis. Distance result are presented in Figure 4-8.

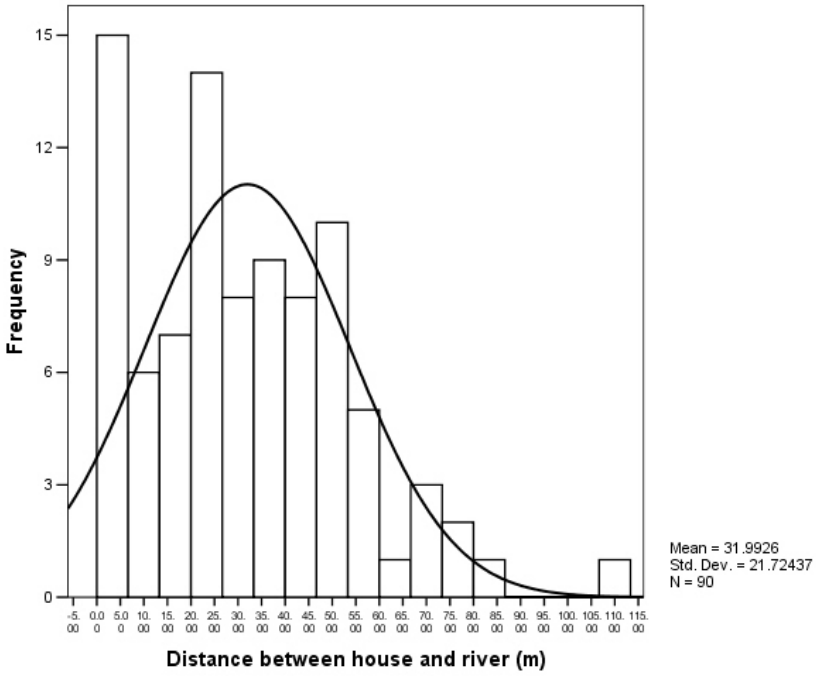


Figure 4-8. Distance between respondents' house and the river

4.2.4. Experience

Bell (2007) indicated that experience was the most influential factor in shaping the perception and (mitigative) behavior. From people's experience, we can obtain information about : the date, frequency, and the depth of flood event. During fieldwork, respondents were asked was if they had ever been affected by flooding after Mt. Merapi eruption in 2010. The question was focusing on the worst flood they had been affected by speciffically for the date and the depth of flood. The answers were used to create a three point scale of impact severity.

Frequency of Flood

Frequency, number of flood event, is about how many times the respondents' house were inundated. Based on interviews, more than 50% of the respondents did not have an experience with the flood.

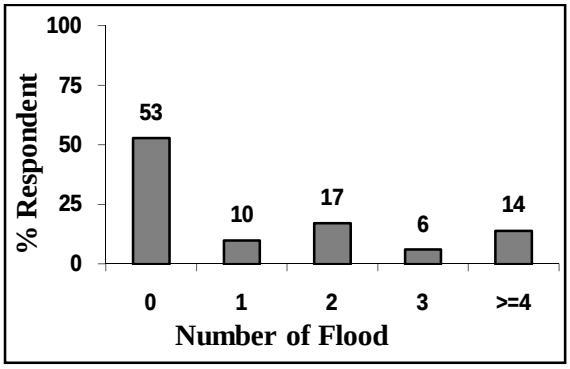
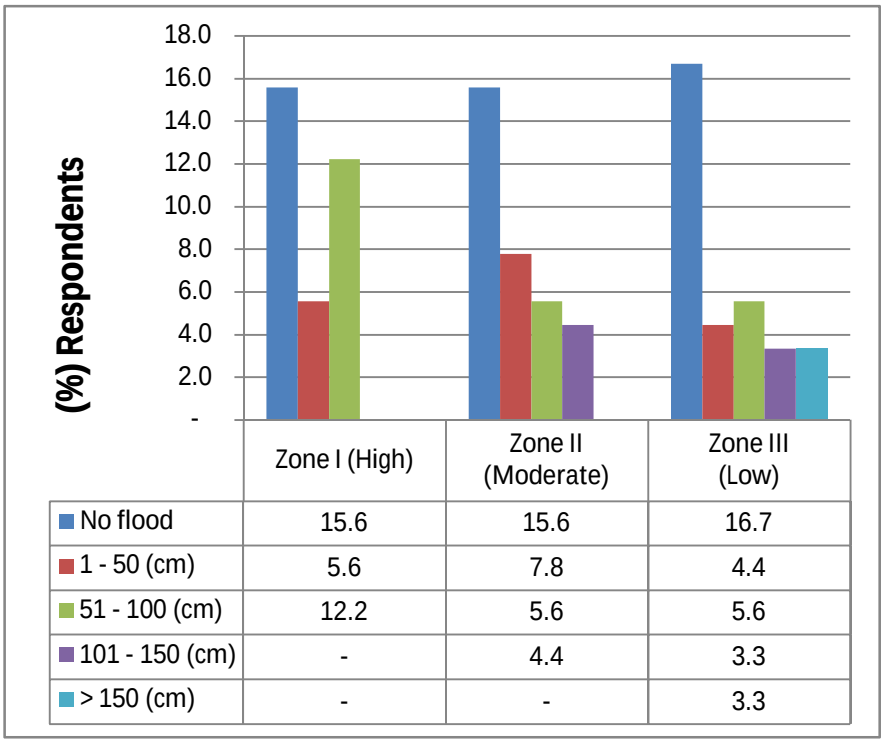


Figure 4-9. Number of flood

People Knowledge of Historical Inundations

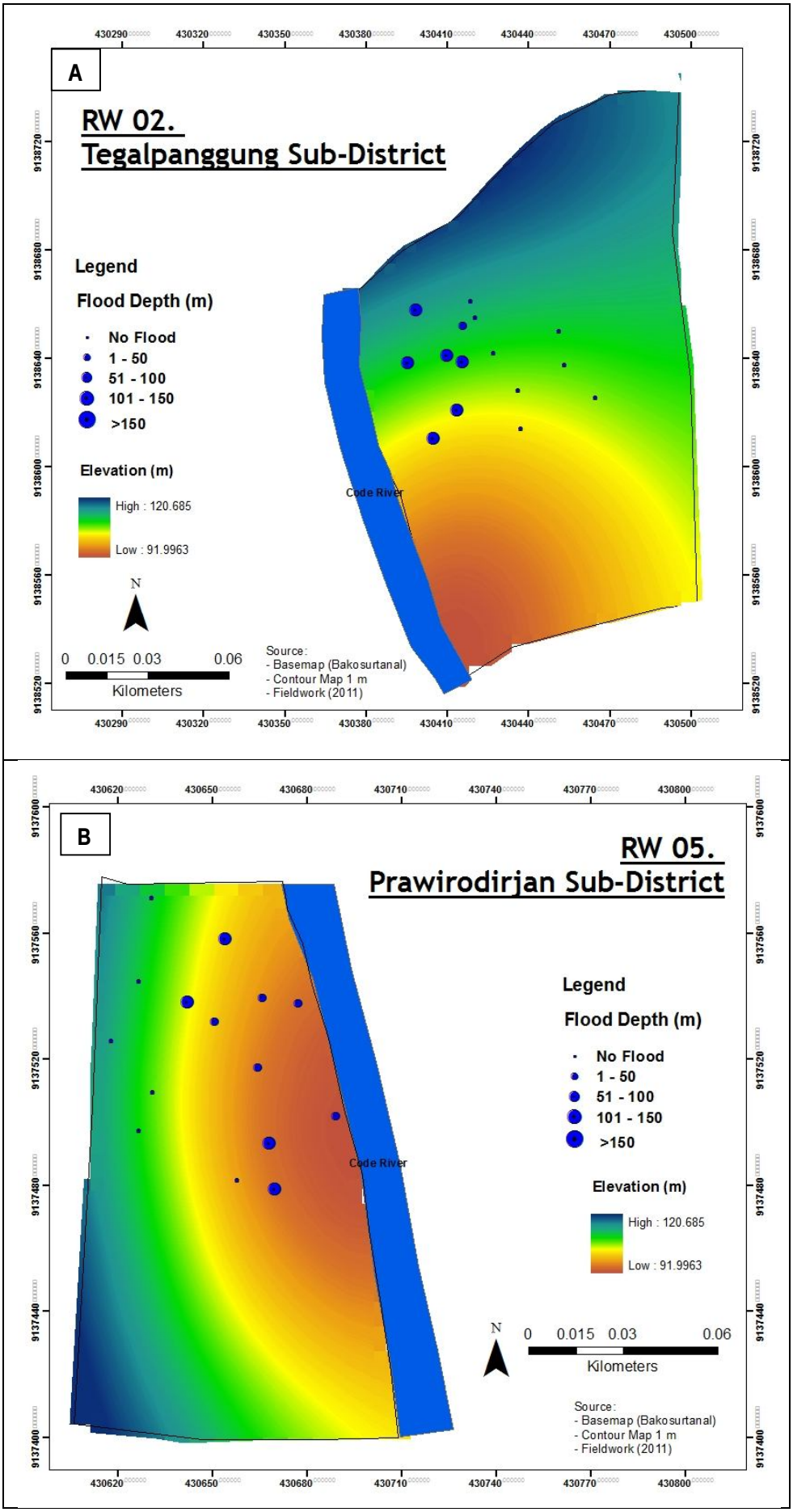
People knowledge of historical inundations is related with the people perception of flood depth. Interesting result was found. Low risk zone more inundated rather than high and moderate risk zone.

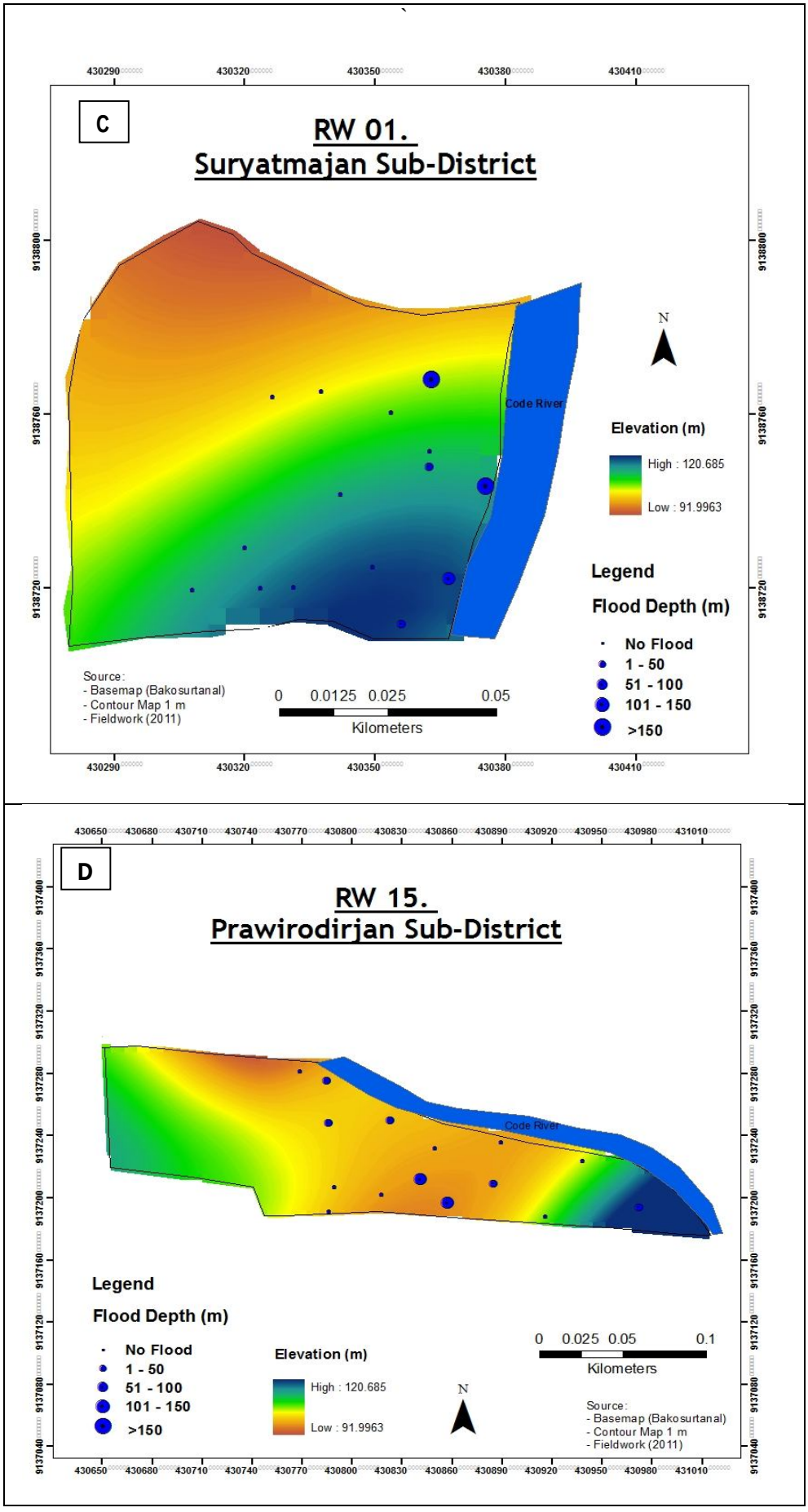


	Zone I (High)	Zone II (Moderate)	Zone III (Low)
No flood	15.6	15.6	16.7
1 - 50 (cm)	5.6	7.8	4.4
51 - 100 (cm)	12.2	5.6	5.6
101 - 150 (cm)	-	4.4	3.3
> 150 (cm)	-	-	3.3

Figure 4-10. People's knowledge of historical inundation

Spatial distribution of historical inundation are shown at Figure 4-11 as follows.





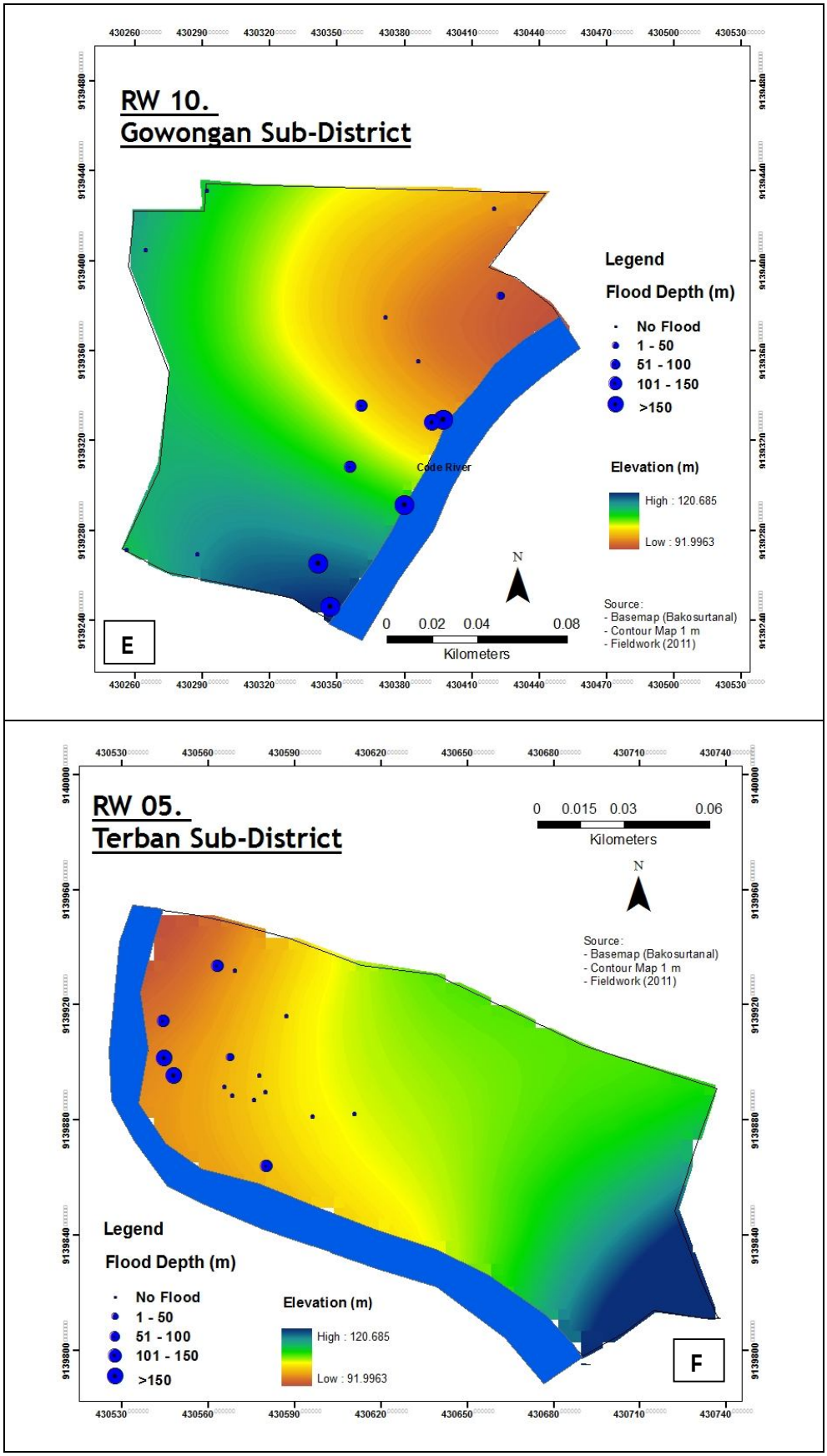
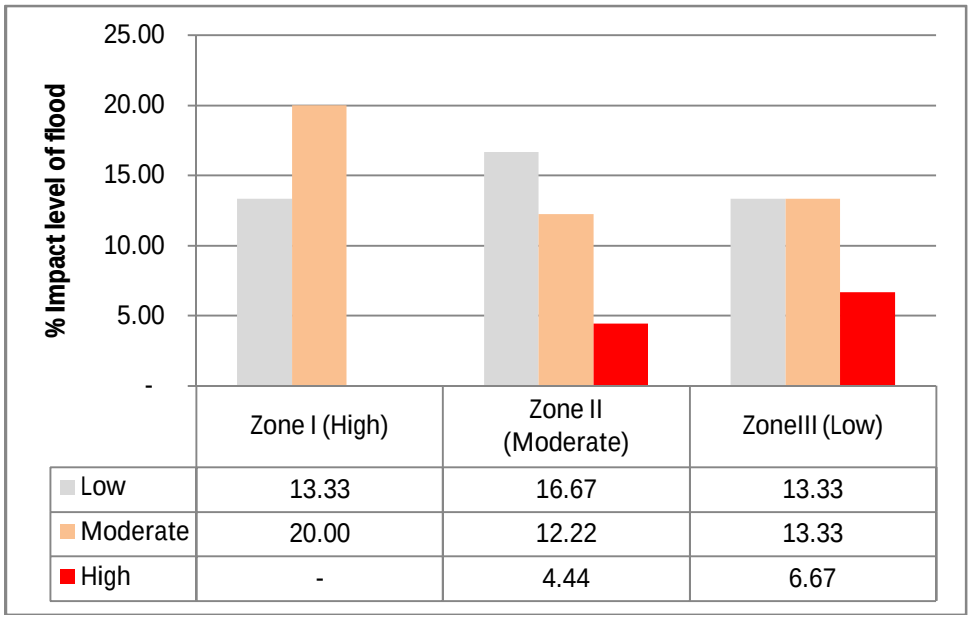


Figure 4-11. Spatial distribution of historical inundation at a). a). RW 2, Kel. Tegalpanggung, b). RW 5, Kel. Prawirodirjan, c). RW 1, Kel Suryatmajan, d). RW 15, Kel. Prawirodirjan, e). RW 10, Kel. Gowongan, f). RW 5, Kel. Terban.

Impact Level of Flood

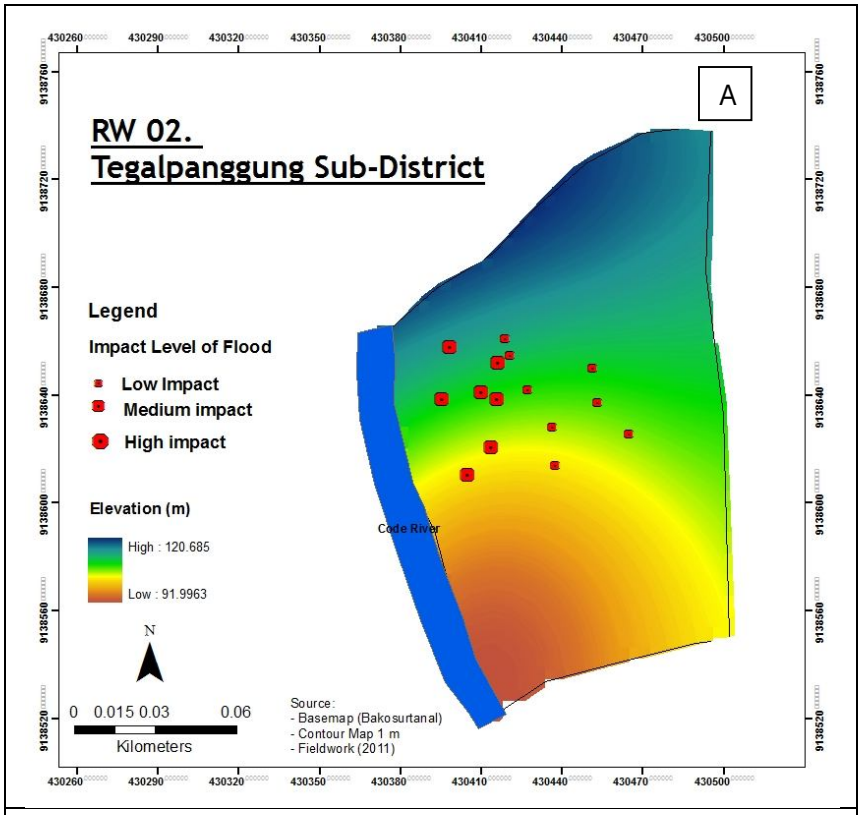
The classification of impact severity was based on flood depth and evacuation. The first question survey participants were asked was if they had ever been affected by flooding. If the answer was yes, they were requested to think back to the worst flood they'd been affected by and describe how it affected them. The question was open ended and answers were used to create a three point scale of impact severity. Flood duration is not used as a factor to determine the level of impact severity because flood in this area is happened no longer than 5 hours.

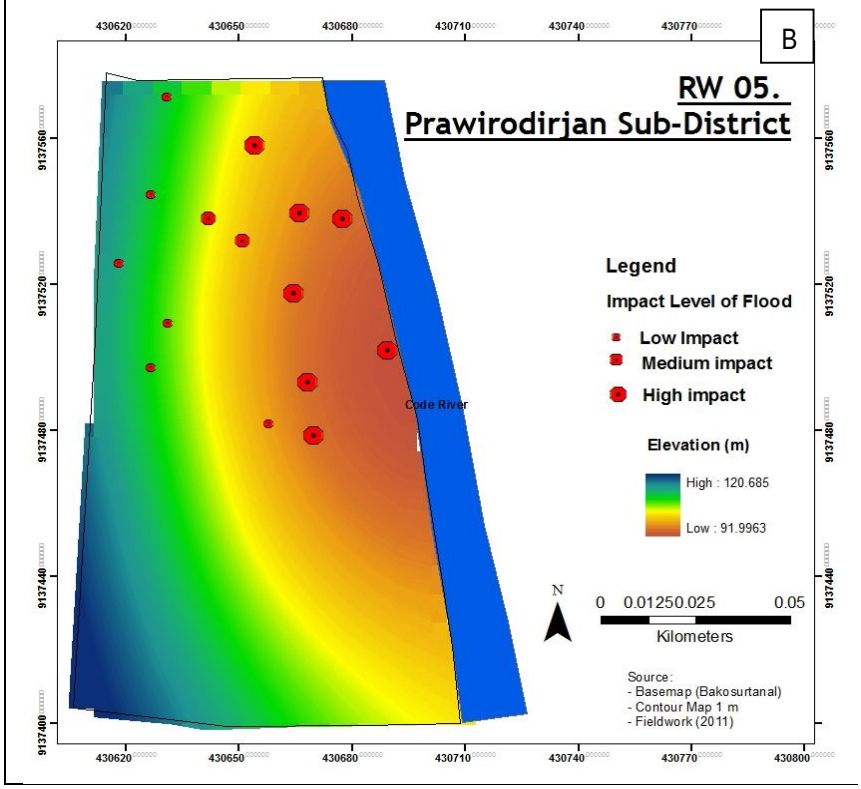


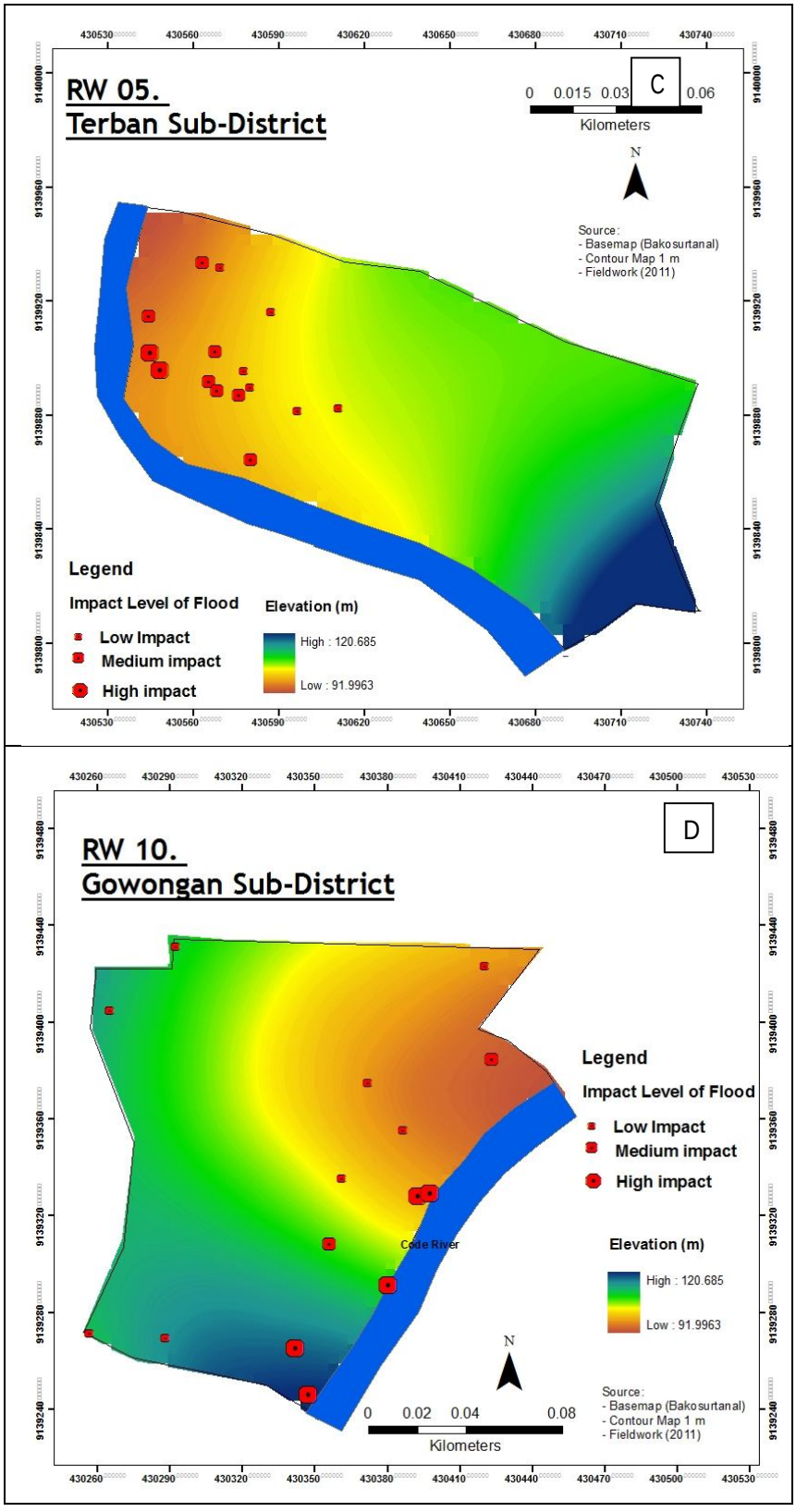
	Zone I (High)	Zone II (Moderate)	ZoneIII (Low)
Low	13.33	16.67	13.33
Moderate	20.00	12.22	13.33
High	-	4.44	6.67

Figure 4-12. Impact level of flood

Spatial distribution of impact level of flood are shown at Figure 4-13 as follows.







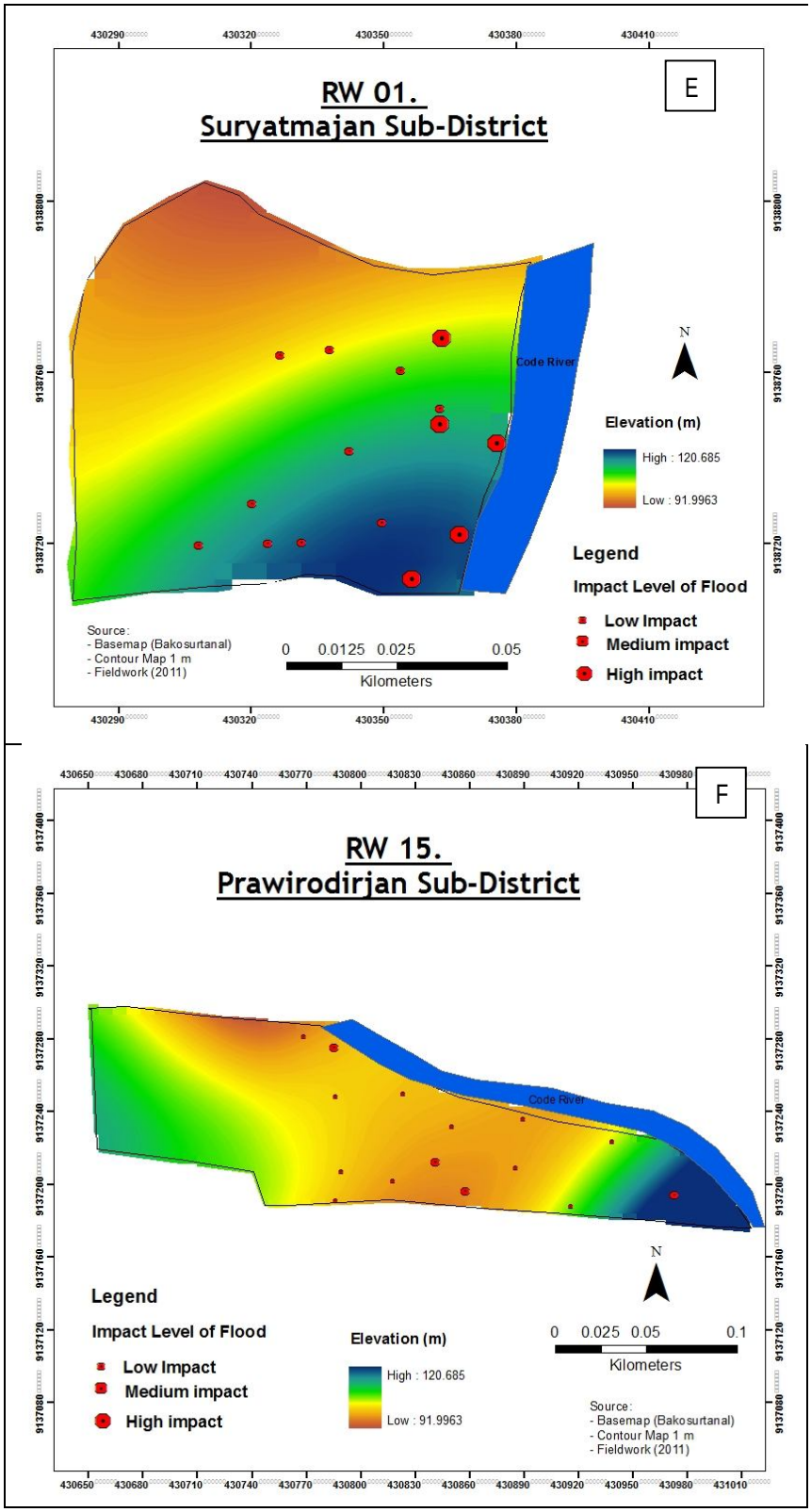
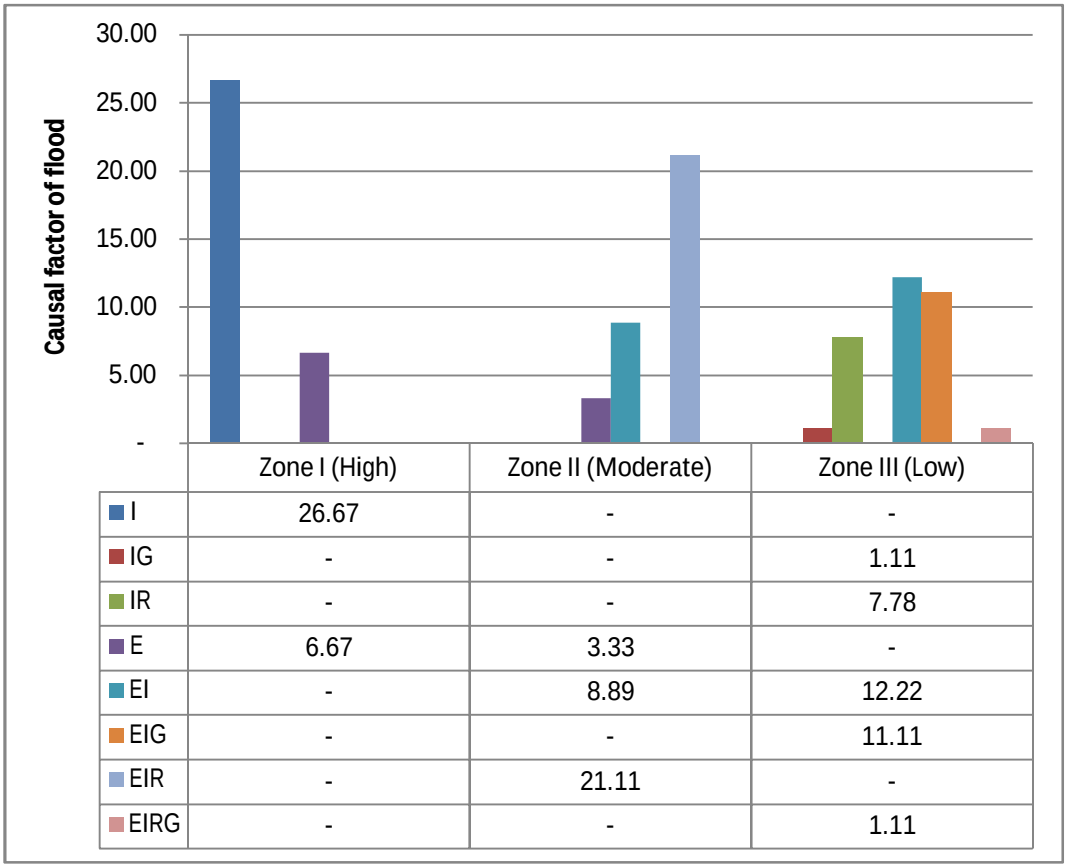


Figure 4-13. Spatial distribution of impact level of flood at a). RW 2, Kel. Tegalpanggung, b). RW 5, Kel. Prawirodirjan, c). RW 5, Kel. Terban, d). RW 10, Kel. Gowongan, e). RW 1, Kel Suryatmajan, f). RW 15, Kel. Prawirodirjan.

4.3. Cognitive Factors

Cognitive factors was measured using people knowledge about factors believed to contribute to flooding at Code River. The open ended question was asked of all respondents, regardless of experience. The answers of the questions than grouped into four categories of flood causal factor: excessive rainfall at the upper part of Code River, infrastructure, garbage, and river aggradation (Figure 4-14).

Infrastructure include the following: bad drainage system and river dike. Meanwhile, river aggradation is related with the effect of lahar flood from Mt. Merapi in 2010.



	Zone I (High)	Zone II (Moderate)	Zone III (Low)
I	26.67	-	-
IG	-	-	1.11
IR	-	-	7.78
E	6.67	3.33	-
EI	-	8.89	12.22
EIG	-	-	11.11
EIR	-	21.11	-
EIRG	-	-	1.11

I=Infrastructure, G=Garbage, R=River aggradation,
E=Excessive rainfall at the upper course of Code River

Figure 4-14. Causal factors of flood on Code River

Infrastructure is considered to be the main factors causing the flood in Zone I (RW 2, Tegalpanggung and RW 5, Prawirodirjan Sub districts). Respondents at this area stated that bad drainage system gives prominent contribution of flooding event which happened at their environment.

Excessive rainfall at the upper course of Code River, infrastructure's problems and river aggradation are deemed to be the combination of causal factors of flood in zone II. Excessive rainfall at the upper course of Code River with certain duration can trigger the lahars flood of volcanic material from the last Mt. Merapi eruption 2010. River aggradation as the impact of the lahars flood in 2010 is also believed gives the contribution of flood. Finally, the unsolved problems of flood infrastructure such as drainage system is adding the factors that caused flooding in RW 1, Suryatmajan and RW 15, Prawirodirjan Sub districts.

In Zone III (RW 5, Terban and RW 10, Gowongan Sub districts), the respondents have variation answers related the causal factors of flood at their village. Excessive rainfall at the upper course of Code River and infrastructure's problems are the considered to be the main cause of flooding in this zone.

4.4. Summary and Conclusion

This chapter has explored the contributing factors of flood risk perception and coping mechanism. Socio-economic of the household in the study area related with flood risk is discussed in this chapter include age, gender,education, income, home ownership, occupation, and length of stay. A high-density low-income population resides along the riverbank of Kali Code. They usually work informal jobs as such street vendors, petty traders, domestic helpers, and other casual work. Most of respondents are at productive age with age bracket 31-60 years old and taking an education until senior high school (43%).

Another factors discussed are experience, location, and knowledge which are embedded with the respondents. More than 50% of the respondents do not have an experience with flood, whereas they are living in the flood prone areas. This situation will influence their judgement towards the flood risk of their environment and indirectly affected the way they behave towards flood event. The way contributing factors influence the flood risk perception will be discussed in Chapter 5. Meanwhile the influence of contributing factors to the coping mechanism will be discussed in Chapter 6.

5. Flood Risk Perception of Local Community

This chapter discussess perception of flood risk of local community in Code Area and its contributing factors. The influence of situational and cognitve factors to perception of flood risk were analyzed by using binary logistic regression analysis.

5.1. People Perception of Flood Risk

The flood risk perception were measured based on the perception of threat or perception of future flooding. Figure 5-1 indicates that 47% of the respondents living in Zone I (high risk) have high perception of threat. Meanwhile, most of respondents in Zone II (moderate risk) perceive that their area is having low level of flood threat with 47% of the respondents. Interesting result is showed in Zone III (low risk), the percentage of respondents who have a perception of high level and low level of flood threat is almost the same. As many as 50% of respondents have low perception of flood threat in the future, and 40 % of respondents stated that their area is having a high level of flood threat. Overall, the variation of flood risk perception for each level of risk (low risk, medium risk, high risk) among three zones is not too different. To prove this ,chi-square test is needed.

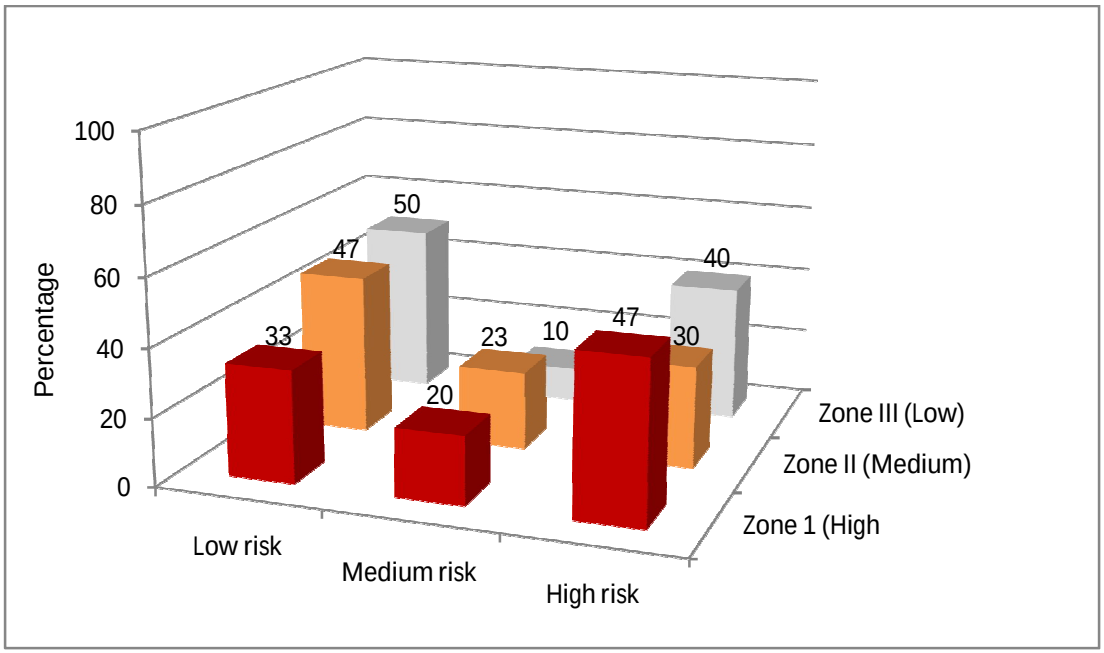


Figure 5-1. Comparison of flood risk perception among different zones

Chi-Square Test

Chi-square test was used to determine association and difference between variables (Nyakundi et.al, 2010). Here, chi-square was used to determine the difference of risk perception among people within three different zones. The null hypothesis (Ho) stated that there is no difference between the people perception in zone I and people risk perception in zone II and III. The result from the test as mentioned below.

- *Output perception of threat* zone cross tabulation and chi-square test*:

Table 5.1. Perception of threat * Zone Crosstabulation

			Zone			Total
			I (High)	II (Moderate)	III (Low)	
Perception of threat	Low risk	Count	10	14	15	39
		% of Total	11.1%	15.6%	16.7%	43.3%
	Medium risk	Count	6	7	3	16
		% of Total	6.7%	7.8%	3.3%	17.8%
	High risk	Count	14	9	12	35
		% of Total	15.6%	10.0%	13.3%	38.9%
Total		Count	30	30	30	90
	% of Total		33.3%	33.3%	33.3%	100.0%

Table 5.2. Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.788[a]	4	.436
Likelihood Ratio	3.999	4	.406
Linear-by-Linear Association	.985	1	.321
N of Valid Cases	90		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.33.

From the result of chi-squre test, it can be inferred that the difference in perception of threat within the zone categories was not statistically significant (X2=; 3.788 df =4; *p*=.436). Probability (p)>0.05 means that there is no differences between the people risk perception in zone I and people risk perception in zone II and III. Ho is accepted.

5.2. The Relationship Between Contributing Factors and Flood Risk Perception

To identify the relationship between contributing factors and flood risk perception. Binary logistic regression was applied on flood risk perception for all samples.

All contributing factors were derived from raw data presented in Chapter 4. For analysis purpose, two socio-economic and one location variables were modified. The measurement for age, length of stay in Code Area, and distance between respondents' house and the river were classified into five groups.

Variable measuring risk perception were also modified into binary scale. In the survey, respondents were asked whether their place of living were at low, medium, or high risk of flooding in the future. In the anaysis process, measurement of flood risk perception is divided into two groups: low risk or high risk. For the answer of medium risk will be assigned as high risk. The results of the regression analysis are summarized in Table 5.3.

Table 5.3.Regression coeficients and p values (in parentheses). Asterisks indicate significance.

Predictor variables	Dependent variables (Perception of Threat)
Age	.132 (.785)
Gender	-1.989* (.019)
Education	.393 (.326)
Occupation	-.366 (.278)
Income	-.910 (.054)
Building ownership	-.852 (.368)
Length of Stay	-1.022* (.011)
RW's risk level	-1.255* (.007)
Distance between respondents' house and river	-.605* (.025)
Number of flood	1.298 (.167)
Knowledge related to causal factors of flood	(.055) .765
Impact level of flood	1.547* (.009)

*p≤0.05

Findings from this study indicated that five predictor variables have a relationship with the variation of flood risk perception ($p < .05$). Four of them have negative correlation: gender, length of stay, RW's risk level, distance between respondents' house and river, and only variable of impact level of flood which have positively correlated with perception of threat.

Most of the social-economic factors tested in this study show little to no significant influence on risk perception. Only gender and length of stay are the only variables of social-economic characteristic which play a role of the variability of people perception towards flood risk.

Gender is shown to have a significant causal relationship with perception of threat. That is, the female respondents perceived a higher degree of threat perception in relation to flood rather than male respondents.

Decreasing perception of risk with length of stay is arising. People with longer time of stay in this area perceived a lower degree of threat perception. The explanation for this is that older people have more experience and they consider that flood is usual event when living on the riverbank.

The respondents are not totally agree with the stamp of their RWs' status. This is proved by the negative correlation between RW's risk level with the flood risk perception. Respondent who lives in RW which assigned with low risk area perceived high level degree of flood risk or vice versa.

Distance between respondents' house and the river has a negative correlation with risk perception. The closer distance between house and the river, the higher people perceived the level of flood risk.

Finally, impact level of flood appeared to be positively related to perception of threat. The higher impact of flood the respondents had, the higher they perceived the level of flood threat.

The final model of relationship between contributing factors and perception of threat described in Table 5-4.

Table 5.4. Logistic Regression for Low-High Flood Risk

Model Utility	**% Correct Categorization**			**Model**		
N R^2	Low Risk	High Risk	All	Predictor variables	Beta	Exp
.549	76.9	80.4	78.9	Gender	-1.989	.137
				Length of stay	-1.022	.360
				RW's risk level	-1.255	.285
				Distance between respondent's house and river	-.605	.546
				Impact level of flood	1.547	4.696
				Constant	8.322	4114.523

*p≤0.05

The model shows Nagelkerke R Square was .549 for a whole sample. This means variability of outcome variable, flood risk perception, which could be influenced by predictor variables were 54.9%. The rest 45.1% was influenced by other variables outside the research. 76.9% respondents with low risk perception of future flooding were classified correctly. Meanwhile, 80.4% respondents with high risk perception of future were correctly classified.

5.3 Summary and Conclusion

Result from this study indicate that there is no differrent with the degree of flood risk perception among respondents in the high risk, moderate risk and low risk areas (X2=; 3.788 df =4; *p*=.436).

The binary logistic regression models for the flood risk perception in Code areas account for 54.9% of variance explained by five variables of contributing factors: gender, length of stay, RW's risk level, distance between respondents' house and river, and impact level of flood.

Most of the social-economic factors tested in this study show little to no significant influence on risk perception. Only gender and length of stay are the only variables of social-economic characteristic which play a role of the variability of people perception towards flood risk.

Many studies indicate that the flood risk perception depends on the place of residence (areas with frequent floods versus rare floods) (Heitz et al., 2009). This study also show the same result. Both location variables: RWs' status and distance between respondents' house and the river have influenced the variation of risk perception.

6. Coping Mechanism

This chapter discussess the coping mechanism employed at the household and community level. The coping mechanism will be categorized based on types of coping mechanism: technology, social, economy, and cultural. The influence of contributing factors and flood risk perception to coping mechanism behavior were analyzed by using binary logistic regression analysis.

6.1. Household and Community Coping Mechanism

The discussion of coping mechanism at the household and community levels will be separated into four types of coping mechanism as proposed by Twigg (2004): technology, economy, social, and cultural. To make better understanding related with application time for each type of coping mechanism, the discussion will be divided into three different stage of flood: before, during and after floods. Cultural coping mechanism will be discussed separately. Table 6.1, shows the type of coping mechanism applied by household and community along the Code riverbank. The cross tabulation between zone (RW's risk level) and type of coping mechanism shows that technological coping mechanism is dominant rather than the other types (economical and social, see Table 6.2.)

Table 6.1. Household and community coping mechanism

TECHNOLOGICAL/ STRUCTURAL	ECONOMIC	SOCIAL
BEFORE FLOODING		
1. Build a ceiling platform to store valuable properties and food 2. Build a second floor 3. Changing floor from cements into ceramics 4. Build door protection from concrete materials 5. Strengthen house's foundation 6. Raising the house 7. Move house property and valuable things in the higher place (second floor or in the top of shelf) 8. Keep clothes and valuable things in the plastic bag or container 9. Placing properties in relative's or neighbor's	1. Build a ceiling platform to store valuable properties and food 2. Build a second floor 3. Changing floor from cements into ceramics 4. Build door protection from concrete materials 5. Fixing damage in the house 6. Fixing damage appliances 7. Borrowing money from bank or relatives 8. Planting vegetables 9. Build water depth measurement** 10. Raising the river embankment** 11. Repairing/raising the drainage canal** 12. Equipping drainage canal with	1. Discuss the best action to protect the community from flood** 2. Check the water level in Boyong and Code River** 3. Sharing flood information obtained from monitoring post** 4. Night patrol**

TECHNOLOGICAL/ STRUCTURAL	ECONOMIC	SOCIAL
house 10. Build water depth measurement** 11. Raising the river embankment** 12. Repairing/raising the drainage canal** 13. Equipping drainage canal with filter**	filter**	
DURING FLOODING		
1. Put water barrier in front of the house by using sand bags or planks of wood 2. Put water barrier behind the door using fabric or plastic 3. Save the important documents		1. Evacuate the elderly, children, and women 2. Stay at safer place (evacuation shelter /neighbors/relatives) 3. Guard the house or the community from outsider while the hosts were staying at the evacuation shelter
IMMEDIATE POST – FLOOD		
1. Cleaning the house and the property 2. Fixing damage in the house 3. Fixing damage appliances 4. Built new MCK**	1. Fixing damage in the house 2. Fixing damage appliances 3. Built new MCK**	1. Cleaning the river channel and drainage system** 2. Cleaning the neighborhood **

** : done by the community

Table 6.2. Cross tabulation of zone (RW's risk level) and type of coping mechanism

Zone	Technology		Economy		Social	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
I (High)	25,6	7,8	12,2	21,1	18,9	14,4
II (Moderate)	18,9	14,4	7,8	25,6	12,2	21,1
III (Low)	22,2	11,1	15,6	17,8	21,1	12,2
% of Total	66,7	33,3	35,6	64,4	52,2	47,8

It can be concluded that the most common type of coping mechanism applied by the community is technology. As shown in Table 6.1, the percentage of technological/structural coping mechanism is relatively higher (66,7%) comparing to economical coping mechanism

(35,6%) and social coping mechanism (47,8%). Of the total of 66,7% of technological coping mechanism employed by the community, people living in the high risk zone of flood has the highest proportion (25,6%) and only about 18,9% of people who live in moderate risk zone of flood tend to employ technological coping mechanism such as strengtening or modifying the house. Of the total 35,6% of economical coping mechanism, 15,6% is people living in the low risk zone of flood, 12,2% of high risk zone of flood, and 7,8% of people living in moderate risk zone of flood. Of the total of 47,8% of social coping mechanism, similar with economical coping mechanism, the highest proportion of people who applied the social coping mechanism is people who lived in the low risk zone area, which is 21,1% , followed by high risk zone of flood (18,9%) and moderate risk zone of flood (12,2%).

In order to identify the dominant type of coping mechanism for each zone, the number of responses for each coping mechanism were ranked from the most applied to the least applied at the household level. Table 6.3, Table 6.4 and Table 6.5 present the household's coping mechanism before, during, and post-immediate flooding respectively.

Table 6.3. Households' coping mechanism before flooding

Coping mechanism applied	**Zone I (High) ***		**Zone II (Moderate) ***		**Zone III (Low)***	
	NoR	**Rank**	**NoR**	**Rank**	**NoR**	**Rank**
- Build a ceiling platform to store valuable properties and food	2	8	1	8	1	11
- Build a second floor	0	11	0	9	2	8
- Changing floor from cements into ceramics	1	9	0	10	3	7
- Build door protection from concrete materials	5	5	2	6	2	9
- Strengthen house's foundation	0	12	1	7	1	12
- Raising the house or its foundation	2	6	3	5	7	4
- Move house property and valuable things in the higher place (second floor or in the top of shelf)	12	2	6	4	11	3
- Keep clothes and valuable things in the plastic bag or container	19	1	12	2	16	1
- Placing properties in relative's or neighbor's house	7	4	8	3	4	6

Coping mechanism applied	Zone I (High) *		Zone II (Moderate) *		Zone III (Low)*	
	NoR	Rank	NoR	Rank	NoR	Rank
- Borrowing money from bank or relatives	2	7	0	12	5	5
- Planting vegetables	0	10	0	11	1	10
- Do nothing	11	3	18	1	14	2

NoR = Number of responses, * : (N = 30 Respondents)

The most common coping mechanism applied by the households living in the zone I and III before flooding is keep clothes and valuable things in the plastic bags or container. Meanwhile, most of the households living in the zone II is done nothing in order to prepare themselves from flooding.

Table 6.4. Households' coping mechanism during flooding

Coping mechanism applied	Zone I (High) *		Zone II (Moderate) *		Zone III (Low)*	
	NoR	Rank	NoR	Rank	NoR	Rank
- Stay at safer place (evacuation shelter/neighbors/relatives)	16	1	14	1	17	1
- Put water barrier in front of the door by using sand bags, planks of wood, fabric or plastics	15	2	14	2	15	2
- Save the important documents	14	3	11	3	15	3
- Do nothing	10	4	9	4	9	4
- Guard the house or the community from outsider while the hosts were staying at the evacuation shelter	7	5	5	5	6	5

NoR = Number of responses, * : (N = 30 Respondents)

During flooding, the households at all zones prefered to stay at safer place such as evacuation shelter or relatives' houses. To put the water barrier in front of the door is the most common coping mechanism applied by the households living in all zones.

Table 6.5. Households' coping mechanism post-immediate flooding

Coping mechanism applied	Zone I (High) *		Zone II (Moderate) *		Zone III (Low)*	
	NoR	Rank	NoR	Rank	NoR	Rank
- Cleaning the house and the property	16	1	16	1	14	1
- Fixing the damage (house and its appliances)	0	3	0	3	2	4
- Rent a house or room	0	4	0	4	3	3
- Do nothing	14	2	14	2	16	2

NoR = Number of responses, * : (N = 30 Respondents)

Cleaning the house and the property is the most common activities post-immediate flooding at all zones.

Figure 6-1. Shows the coping mechanism done by the households. Figure 6-2. Shows the coping mechanism done by the community.

Figure 6-1. Households' coping mechanism. a). Move house property and valuable things in the higher place, b).Build door protection from concrete materials, c). Build a ceiling platform to store valuable properties and food, d). Raising the house. Source: Fieldwork (2011).

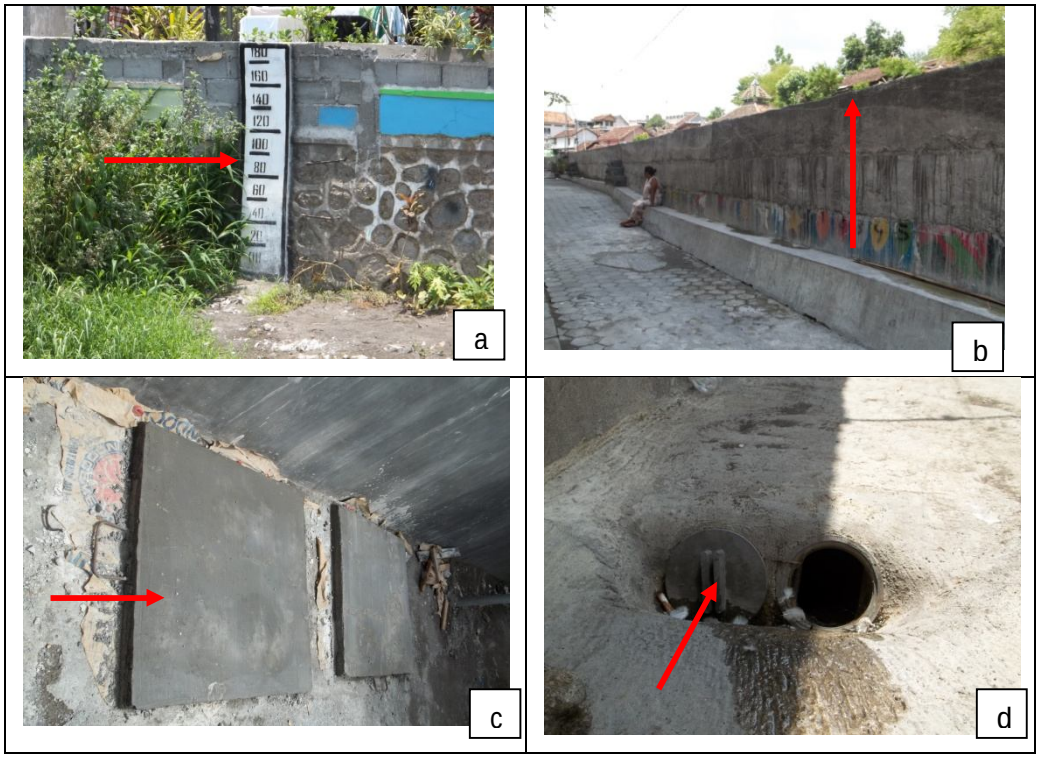


Figure 6-2. Community coping mechanism. a). Build water depth measurement, b). Raising the river embankment, c) and d). Repairing/raising the drainage canal
Source: Fieldwork (2011).

Another form of social coping mechanism on Code Riverbank is a community-based of handy talky in Yogyakarta which cares with the lahar flood in Code River as the impact of Mt.Merapi eruption 2010. At this moment, two communities are exist :

1. Code-X

Code X, Community On Dial Emergency 2010, was established on 29 November 2010. The members use handy talky as the equipment to share the information about the condition of Boyong and Code River such as weather condition, rainfall intensity, duration, and water level. This information is based on the visual report from the field observer or information tapped from other community. They use frequency of 14.194 to communicate among the members. The information is disseminate to the dwellers through the Head of RW or RT. The office centre of Code X located in Prawirodirjan village. Figure 6-3 shows the CODE-X office centre and the member of CODE-X.

Figure 6-3. CODE- X office centre

2. Pareanom

Pareanom is also community-based of handy talky in Yogyakarta. This group established in 2008 and it is focusing on communication and rescue services. The home base of Pareanom located in Juminahan, Yogyakarta. Same with Code X, Pareanom is also giving information about the condition of Boyong and Code River.

Cultural Coping Mechanism

Cultural Coping Mechanism is more related with religion views and risk perception. This gives a picture about local knowledge related with flood. Local knowledge is also referred to as folk knowledge, traditional knowledge, indigenous knowledge, traditional environmental knowledge, indigenous traditional knowledge, indigenous agricultural knowledge, farmers' knowledge, rural people's knowledge, peasants' knowledge, ethno-science, etc. It is based on experience, often tested over centuries of use, and entails many insights, perceptions, and intuitions relating to local culture and the environment.

The cultural coping mechanism at Code River is employed on the form of *River Festival of Merti Code*, which is celebrated annually, (normally in the month of June) (API Handbook,

2011). This event is organized by the Code Forum in cooperation with the Dinas Pariwisata (tourism department) and other related stakeholders

Merti Code: A Traditional Ritual for Human and Environment Coexistences *Merti* is short for *memerti,* which in Javanese means to 'take care of' or 'maintain'. The *Merti* ritual is one of many traditional Javanese rituals that make the connection between humans, natural resources, and supernatural entities. There are a number of *Merti* rituals practiced by the Javanese people for example *Merti Belik* (for water springs), *Merti Bumi* (for earth), *Merti Desa* (for settlement), and so forth.

The essence of these rituals is a tribute to nature, expressions of gratitude to The Creator, and praying for the preservation of natural resources and the wellbeing of people. *Memerti Kali Code* or *Merti Code* is a traditional ritual carried out by Yogyakarta communities who have settled on the Code riverbank. This ritual is conducted to offer respect and maintain the important role the Code has on their environment and their lives. The *Merti Code* ritual was established as an annual cultural event by the community in 2002. The ritual is held in the first month of Javanese calendar or *Sura, and has become* a tourist attraction in Yogyakarta. The Merti Code is usually organized collaboratively by people from several settlements such as Cokrosuman, Jetisharjo, Turban, Gondola, and Blimbingsari. Some of these settlements are located on the east and west side of the river, which flows through the Cokrodirjan and Turban administrative villages. The sacred process of the Merti Code is taking water from six spring sources (*belie*) located along the Code by different groups of people who represent the elders of each villages, as well as men, women, and youth groups.

6.2. Contributing factors influence on coping mechanism

To identify the relationship between contributing factors and certain coping mechanism (technology, economy, social). Binary logistic regression was applied on coping mechanism behavior for all samples. Cultural coping mechanism does not include in the analysis process.

All contributing factors were derived from raw data presented in Chapter 4. For analysis purpose, two socio-economic and one location variables were modified. The measurement for age, length of stay in Code Area, and distance between respondents' house and the river were classified into five groups. The results of the regression analysis are summarized in Table 6.6.

Table 6.6 .Regression coeficients and p values (in parentheses). Asterisks indicate significance.

1. Technology

Predictor variables	Dependent variables (Coping Mechanism)
Length of Stay	-.860* (.035)
Number of flood	2.997* (.014)
Impact level of flood	1.305* (.020)

*p≤0.05

2. Economy

Predictor variables	Dependent variables (Coping Mechanism)
Distance between respondents' house and river	-.793* (.014)
Impact level of flood	1.078* (.026)

3. Social

Predictor variables	Dependent variables (Coping Mechanism)
Impact level of flood	3.483* (.000)

We can infer from the result that impact level of flood is influenced the people to do all coping mechanism: technology, economy and social. Having positive relationship with the coping mechanism, it means that the higher impact of flood perceived by the people, the higher chance for them to apply some technological, economical, and social coping mechanism in order to reduce the impact of flood.

The result of the regressian analysis are shown as follows:

- Technological coping mechanism is influenced by three variables: length of stay, number of flood, and impact level of flood.

- Economical coping mechanism is influenced by distance between respondents' house and river and the impact level of flood.
- Social coping mechanism is only influenced by impact level of flood.

6.3. Relationship between risk perception and coping mechanism

The relationship between risk perception and behavior is still debatable. (Palm and Hodgson, 1992) found that awareness and knowledge of risk are connected to both increased perception of threat and, in turn, increased purchase of insurance or other pro-active behavior. (Slovic, 2000; Bell and Tobin, 2007) indicates that understanding of uncertainty and perception of risk does not always translate into action; behavior change may precede attitude adjustment or understanding (Valente and Schuster, 2002).

In the conceptual framework (Figure 1-1), it is shown that there is a relation between risk perception and behavior. Is is assumed that risk perception influences people's attitude's to risk. To prove this, regression analysis between risk perception and coping mechanism was done. The results from regression analysis are described in Table 6.7.

Table 6.7 .Regression coeficients and p values (in parentheses). Asterisks indicate significance.

	Technology	**Economy**	**Social**
Perception of Threat	2.201* (.000)	2.035* (.000)	1.594* (.001)

The result above indicated that perception of threat has a significant correlation with all type of coping mechanism. In the case of flood risk perception of people living in Code area, it can be concluded that the way they apply some type of coping mechanism is strongly effected by the way they perceived of flood threat in their area.

6.4. Summary and Conclusion

There are four type of coping mechanism employed by the local community at Code Area: technological, economical, social and cultural coping mechanism. Generally, all the six RW at three different zones applied the same coping strategy. In fact, technological coping mechanism is the most prominent among all RW at all zones.

The existence of CODE-X and Pareanom community to monitor the condition of Code and Boyong Rivers and disseminate information about the river is the shape of social bond on each residents living at Code Riverbank.

During flooding, besides prefer to stay at safer place such as evacuation shelter or relatives' houses, to put the water barrier in front of the door is the most common coping mechanism applied by the households living in all zones. At the post-immediate flooding, cleaning the house and the property is the most common activities at at all zones.

The coping mechanism applied by people living at Code Riverbank is affected by :

- Technological coping mechanism is influenced by three variables: length of stay, number of flood, and impact level of flood.
- Econonomical coping mechanism is influenced by distance between respondents' house and river and the impactlevel of flood.
- Social coping mechanism is only influenced by impact level of flood.

Another findings from the analysis, the perception of threat has a significant correlation with all type of coping mechanism. In the case of flood risk perception of people living in Code area, it can be concluded that the way they apply some type of coping mechanism is strongly effected by the way they perceived of flood threat in their area

7. Local government flood management

The last section will describe local government flood management. Identification of mitigation strategy related with flood for both structural and non structural will be presented.

7.1. Local government mitigation plan

Based on the hierarchy of water resource management, Code River become under the management of local government of Yogyakarta Municipalities. During the fieldwork, author did not find an integrated flood management for Code River. The management of Code River is done by several institutions on the municipalities authority level such as Public works agency and Fire, disaster control and public protection departement.

To response the flood in the city after Mt. Merapi eruption in 2010, local authorities of Yogyakarata Municipality has developed and applied mitigation activities to cope with the flood. This actions are included structural and non-structural measurement as shown in Table 7.1.

Table 7.1. Strucutural and non structural measurement

Structural	Repairing sabo dam Raising river dike Strengtening river embankment
Non-structural	EWWS Preparing evacuation site Evacuation drill

7.1.1. Structural Measurement

Most of the structural measurements is developed by public work agency.

1. Repairing of Sabo Dam

Sabo Dam is a control structure (overflow weir) that reduces the flow felocity and retains the mud flowm. Sabo dam built in the upstream areas of mountain streams accumulate sediment and surpress production and flow of sediment.

2. Raising River Dike

To protect the Code riverbank from the future flood, public work agency of Yogyakarta municipality has built some physical infrastructure. Raising the dike and strenghtening the river embankment (Figure 6-4).

Figure 6-4. a). Raising the dike at Gowongan Subdistrict,
b). Strenghtening the river embankment at Terban Subdistrict

7.1.2. Non Structural Measurement

1. Early Wireless Warning System (EWWS)

To anticipate lahar flood event in Code River, in March 2011, local government of Yogyakarta Municipality has developed wireless-based early warning system for lahar flood called Early Wireless Warning System (EWWS). This instrument is operated by Fire, Disaster Control and Public Protection Departement (Kantor Penanggulangan Kebakaran, Bencana dan Linmas).

EWWS was developed by using telemetry technology which use radio communication as the trasmission system. EWWS consists of two subsystems: river subsystem and control office subsystem.

River subsytem, this subsytem located at Ngentak Monitoring Station at southern part of Boyong River, Sleman Regency. The telemetry device at this station will detect and record the water level of Boyong River. This information will be trasmitted every few minutes to control office located at Fire, Disaster Control and Public Protection Departement through radio communication.

Control office subsytem, all data trasmitted from the river subsystem will be stored at the database at the computer device at the office subsystem at Fire, Disaster Control and Public Protection Departement. If rainfall duration and water level meet the critical condition (rainfall duration more than 2 hours and water level reached the level of 150 m), the system automatically warns the operator. The person in charge forwards the condition at the Boyong River to the settlements along Code Riverbank through the speaker which directly connected with the EWWS device at the control office. The instrument of early warning system at the Code Riverbank has been installed in five areas: 1. Jetis, 2. Jotoyudan, 3. Ledok Macanan, 4. Ledok Tukangan, 5. Surokarsan. The area coverage of sirens of each EWWS instrument is 500 m.

Figure 6-5. Instrument of EWWS at the Code Riverbank

From that information, the people in Code Riverbank have time to prepare themselves for evacuation before the flood happens. The time to prepare for flood is 45 minutes after the warning. The early wireless warning system is illustrate in the figure 6-6.

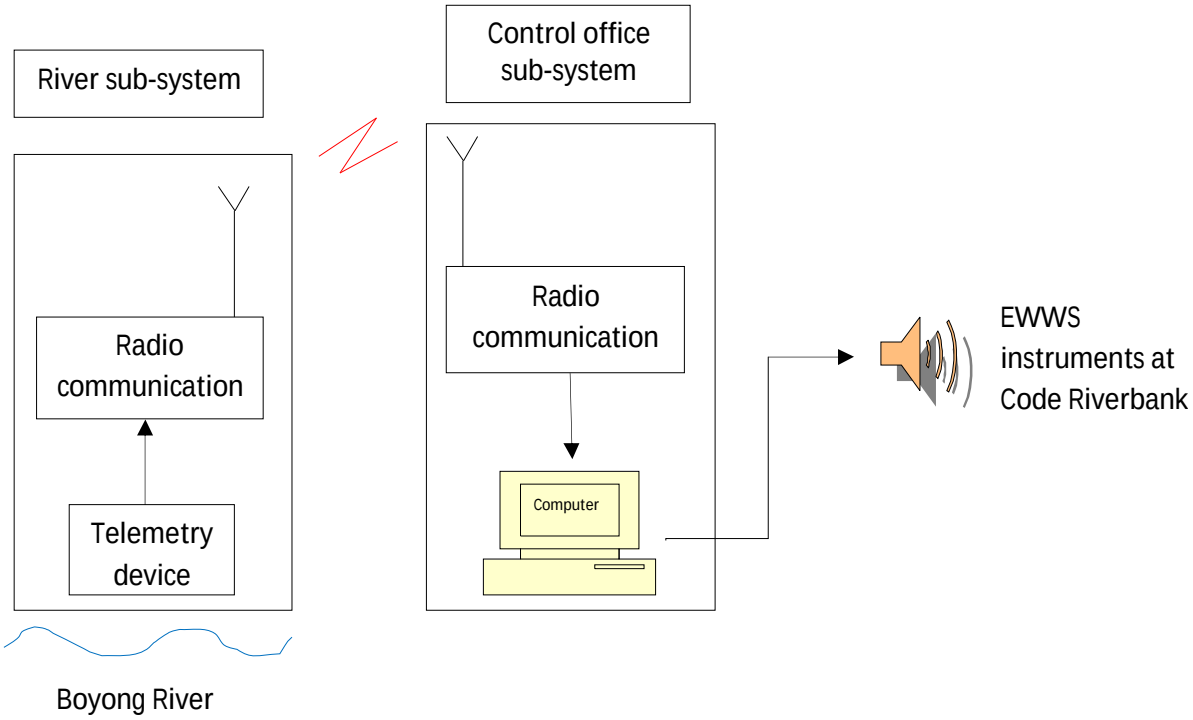


Figure 6-6. Illustration of Early Wireless Warning System (EWWS).

2. Preparing Evacuation Shelter

Evacuation is one of the crucial activities when the flood happens. Preparing the escape routes and evacuation shelter is important. Usually, each RW at Code Riverbank has its own evacuation shelter. The shelter does not always specially constructed, but it employs the public buildings such as schools, mosques and town halls. Figure 6-7 shows the evacuation shelter.

Figure 6-7. Evacuation centre at a). RW 01 Kel. Suryatmajan, b). RW 05 Kel. Prawirodirjan.

3. Evacuation Drill

Local government of Yogyakarta Municipalities held evacuation drill for flood through flood simulation to overcome flood event on Code River. The simulation was guided by Fire, Disaster Control and Public Protection Departement. The simulation was done three times in RW 4 Terban village, Danurejan subdistricts with participation of residents from Tegal Panggung and Suryatmajan villages, and also RW 20 Brontokusuman village. The scenarios of the simulation was set as if the discharge of Boyong River increased significantly. The EWWS sirens rang out and the announcement for evacuation were issued. Figure 6-8. shows the condition during the evacuation drill.

Figure 6-8. Evacuation drill at a). Suryatmajan Sub district, b) Brontokusuman Sub district
(Source: krjogja.com)

The drill also gives an understanding to the dwellers, what should they do if the discharge of Code River suddenly increased,which routes are safe to use for escape and where to go in case of hazard event.

7.2. Summary and Conclusion

To reduce the impact of flood in Code River, local government has been done some structural and non-structural measurements. Structural measurements consist of repairing sabo dam at the upper part of the river, raising river dike and strengtening the river embankment. Non structural measurements including the developing of early warning system called EWWS (early wireless warning system), preparing evacuation site, and held evacuation drill to increase people's knowledge to encounter of flood threat.

8. Conclusion And Recommedation

This chapter provides the final conclusion and contributions of this research related with the objectives of this thesis.

8.1 Conclusion and Main Findings

The main objective of the study is to assess community-level flood risk perception and coping mechanism on Code River. The assessment is applied for both lahar and localized (urban) floods. Following discussions are based on the spesific objectives in the first chapter of this thesis.

The first sub objective is to assess the people's perception about flood risk after 2010 Mt. Merapi eruption. The flood risk perception was measured through the perception of threat or perception of future flooding. In this case, people give their own judgement related with flooding in the future which they consider to be levels that are: "low risk", "moderate risk" and "high risk". It is found that 43,3% of the respondents consider living in the area with low risk of flood, 17,8% with moderate risk of flood and 38,9% with high risk of flood (table 5.1).

Findings from this study indicated that there is no difference of risk perception among people within three different zones of flood risk in Code Riverbank. The result of Chi-square test was not statistically siginificant with (p)>0,05 which means there is no differences between the people risk perception in zone I (RW 2, Tegalpanggung and RW 5, Prawirodirjan Subdistricts) and people risk perception in zone II (RW 1, Suryatmajan and RW 15, Prawirodirjan Subdistricts) and III (RW 5, Terban and RW 10, Gowongan Subdistricts).

Meanwhile, the flood risk perceptions of people living in Code area are influenced by these factors: gender, length of stay, RW's risk level, distance between respondents' house and river and impact level of flood.

Most of the social-economic factors tested in this study show little to no significant influence on risk perception. Only gender and length of stay are the only variables of social-economic characteristic which play a role of the variability of people perception towards flood risk. Economic factors do not seem to play a significant role in risk perception. Both income and home ownership have no influence on risk perception.

The second sub obejctives is to identify the current coping mechanism employed by the local people. There are four type of coping mechanism employed by the local community at Code Area: technological, economical, social and cultural coping mechanism. Generally, all the six RW at three different zones applied the same coping strategy. In fact, technological coping mechanism is the most prominent among all RW at all zones.

Before the flooding, keeping the clothes and valuable things in the plastic bags or container is the most common coping mechanism applied by the households at all zones. Some people move house properties and valuable things such as television, radio, clothes to the higher place as the preparation before flooding. In technological/physical coping strategy, raising the house or strengtening its foundation is applied especially for those whose house has been inundated by the lahars flood.

In social coping strategy, the people living in the Code Riverbank still have a good social bonding each other. This conditon is also pointed out in the cooperation when dealing with the flood problems. Activites such as discussing the best action to protect the community from flood, sharing flood information obtained from monitoring post, and night patrol are common activities in the Code Riverbank community. The most well known social activities related to flood at the community along Code Riverbank is the existence of CODE-X and Pareanom community which actively monitoring the condition of Code and Boyong Rivers and disseminating information about the river. These two communities are self supporting fund organizations.

During flooding, besides prefer to stay at safer place such as evacuation shelter or relatives' houses, to put the water barrier in front of the door is the most common coping mechanism applied by the households living in all zones. At the post-immediate flooding, cleaning the house and the property is the most common activities at at all zones.

Meanwhile, the influencing factors to select the coping mechanism at households level are explored through binary logistic regression. The result of the regressian analysis are shown as follows:

- Technological coping mechanism is influenced by three variables: length of stay, number of flood, and impact level of flood.

- Econonomical coping mechanism is influenced by distance between respondents' house and river and the impactlevel of flood.
- Social coping mechanism is only influenced by impact level of flood.

Another findings from the analysis, the perception of threat has a significant correlation with all type of coping mechanism. In the case of flood risk perception of people living in Code area, it can be concluded that the way they apply some type of coping mechanism is strongly effected by the way they perceived of flood threat in their area

The third sub objectives is to identify the flood hazard management of the local goverment. To reduce the impact of flood in Code River, local government has been done some structural and non-structural measurements. Structural measurements consist of repairing sabo dam at the upper part of the river, raising river dike and strengtening the river embankment. Non structural measurements including the developing of early warning system called EWWS (early wireless warning system), preparing evacuation site, and held evacuation drill to increase people's knowledge to encounter of flood threat.

8.2. Recommendation

- For further study, people knowledge related with the characteristics of lahars flood and localized (urban) flood should be more explored during the interview. This will give a chance to explore about the difference of people's attitude when dealing between lahars flood and localized (urban) flood in Code Area.
- People risk perception can be assessed through many contributing factors. Trust with the institution or protective measurements can be used as the predictor variables for assessing the risk perception. Information infrastructure which gives the description about the River condition is also important factors for assessing people risk perception.
- To get more precise data about the flood history in the study area, FGD (Forum Discussion Group) can be employed in order to get a better description about the flood event such as the boundary of the inundation, the date, the main causal factors, and how the community cope with the situation.
- Referring with the flood hazard management proposed by Tran et. al., 2008 (Figure. 2-1), developing flood hazard management should involve the local people or lay population in order to help the decision makers more effectively to achieved flood risk reduction.

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Appendix 1 : The Questionnaire

Questionnaire for : "A Community-based Approach To Assess Flood Risk Perception and Coping Mechanism Along Code River, Yogyakarta Municipality"

(Adopted and modified from Bell (2007) and Marschiavelli (2008)

This information will only be used for scientific purpose

Questionnaire no. : Interviewer : Date : Time :

Researcher : Diah Noor Heryanti

Contact : heryanti27680@itc.nl

Geo Information for Spatial Planning and Disaster Risk Management. UGM - ITC

I. PROFILE OF RESPONDENT

1. Name : .....
2. Age : .....
3. Sex : ☐ Male ☐ Female
4. Status : ☐ Married ☐ Single
5. Education : ☐ ES ☐ JHS ☐ SHS ☐ B ☐ GS
6. Living in this place since : .....
7. Occupation : ☐ Government officer ☐ Labour
   ☐ Merchant ☐ Retired
   ☐ Entrepreneur ☐ Others .....
   ☐ Housewife
8. Income : ☐ < Rp. 750.000,- ☐ Rp. 750.000,- s/d Rp. 1.500.000,-
   ☐ >Rp. 1.500.000,-
9. Total Family Member : people

II. BUILDING INFORMATION

10. RT : ..... RW : ..... Sub-district : .....
11. GPS no. : ..... Lat : ..... Long : .....
12. Building no. : .....

13. Building size : .....

14. Building age : ☐ 0 – 10 years ☐ 10 – 20 years ☐ 20 – 30 years ☐ >30 years

15. Ownership : ☐ Own ☐ Rent

16. Wall material : ☐ Brick ☐ Wood ☐ Plywood ☐ Bamboo
☐ Zinc ☐ Mix ☐ Other.....

17. Floor material : ☐ Ceramic ☐ Cement ☐ Ground ☐ Mixed
☐ Other .....

18. Roof material : ☐ Clay ☐ Zinc ☐ Asbestos ☐ Mixed
☐ Other .....

19. Number of floor : ☐ 1 ☐ 2 ☐ 3 ☐ > 3

III. FLOODS

A. General questions about your experience with the 2010 flood

20. Have you affected by the 2010 flood? Yes/No..... *If no, skip to part B (Flood History).*

21. How did it affect you? .....

22. Did your house get inundated? Yes/ No.....
If Yes, how many times has your home or property been flooded? .....

23. Please describe the 2010 flood's characteristic :
- What was the highest of water level during the flood?.....
- How long was the flood duration? .....
- How long was the area get inundated? .....
- When did the maximum flood happen? .....
- In your opinion, what kinds of things contribute to flooding? (choose one)

☐ Heavy/prolonged rain at the Merapi summit
☐ Climate change
☐ Construction
☐ Political decisions
☐ Lack of dredging
☐ Lack of maintenance
☐ Lack of flood infrastructure
☐ Loss of natural deterrents
☐ Poor sewer system
☐ Others
.....

24. Can/Could you imagine that such a flood as 2010 is/was possible? Yes / No

------begin questions here after skips-----

B. Flood History

Year	Cause of flood	Water level	Duration

IV. FLOOD INFORMATION

25. During the 2010 floods, what sources, if any, did you go to for information? ***Use table below***.
26. What kind of information did you look for from each source?

Source (Q27-29)	*Info Type*	*Searched or Received*

27. Using this scale, how would you rate the credibility of flood related information from each of the following sources?

	Not Credible at All						Completely Credible
Family	1	2	3	4	5	6	7
Friends	1	2	3	4	5	6	7
Local Authority	1	2	3	4	5	6	7
Province	1	2	3	4	5	6	7
Central government	1	2	3	4	5	6	7
Newspapers	1	2	3	4	5	6	7
TV News	1	2	3	4	5	6	7
Others....	1	2	3	4	5	6	7

28. On a scale of 1 to 7, how would you rate your overall satisfaction with available flood information?

Completely Dissatisfied						Completely Satisfied
1	2	3	4	5	6	7

V. FLOOD RISK PERCEPTION

29. Do you think that this place save from flooding ? Yes/no
30. How high or low do you estimate the probability of future flood in your home?

☐ Low ☐ Moderate ☐ High

Your reason.....

.....

31. Did the 2010 flood alter your perceptions of flood risk?

☐ Yes ☐ No

VI. COPING MECHANISM

32. What is your reason living in this area ?

☐ Ancestral properties ☐ Easy access (to business center, educational place, work place, etc)

☐ Cheap price ☐ Others.....

33. During the 2010 floods, what activities, if any, did you take to protect yourself and your property from flood damage? *(Prompt, if necessary, using the following)*

Sandbagged property	Yes	No
Moved belongings to higher ground	Yes	No
Evacuated	Yes	No
Other (please describe)	Yes	No
None	Yes	No

34. After the 2010 flood, have you applied any activities listed in the table below for reducing the possibility of flood damages?

Raised house above designated flood level	Yes	No
Raised utilities above designated flood level	Yes	No
Purposely bought/rented outside the floodplain	Yes	No
Checked with neighbors regarding past flood levels	Yes	No
"Floodproofed" home	Yes	No
Other (please describe)	Yes	No
None	Yes	No

35. Have your community applied any activities to prepare for the rainy season? Yes/No

If Yes, What kinds of activities ?.....

-----Thanks for your help and cooperation-----

Note :

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