FLOOD RISK PERCEPTION AND COPING MECHANISM OF A LOCAL COMMUNITY: A Case Study in Part of Surakarta City, Central Java Province, Indonesia

by:

Fetty Febrianti

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

by:

Fetty Febrianti

08/276589/PMU/05637-UGM
22617-ITC
febrianti22617@itc.nl

Supervisor:

Dr. rer. nat. Muh Aris Marfai, S.Si., M.Sc (UGM)

Drs. Nanette C. Kingma (ITC)

GRADUATE SCHOOL
GEOGRAPHY FACULTY OF GADJAH MADA UNIVERSITY
ITC - FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION OF THE UNIVERSITY OF TWENTE

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THESIS

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Fetty Febrianti
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22617-ITC

Has been approved in Yogyakarta
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By Team of Supervisors:

Chairman

_____

External Examiner

Prof. Freek Van der Meer _____

Supervisor 1: Supervisor 2:

Dr. rer.nat. Muh Aris Marfai, S.Si, M.Sc **Drs. Nanette C. Kingma**

Certified by:
Program Director of Geo-Information for Spatial Planning and Risk Management,
Graduate School Faculty of Geography, Gadjah Mada University

Dr. H.A. Sudibyakto, M.S.

DISCLAIMER

This document describes work undertaken as part of a program of study at the Double Degree International Program of Geo-information for Spatial Planning and Disaster Risk Management, a Joint Education Program of ITC Faculty of UT, the Netherlands and UGM, Indonesia. All views and opinions expressed there in remain the sole responsibility of the author, and do not necessarily represent those of the institute.

Febrianti, F.

Abstract

Surakarta City, well known as Solo City, is located in Central Java Province and is a part of downstream areas of Bengawan Solo River Basin, which has frequently been struck by flood events in recent years. Although he local authority has implemented several mitigation measurements to minimize the flood risks, the flooding remains difficult to handle and the application of flood risk management are far from adequate to reduce flood risks. Integrated flood risk management is necessary to be implemented to support the efforts of local government in reducing the impact of flooding. This research focuses on identifying the community risk perceptions and coping mechanism of people living in flood-prone area in Surakarta City by using participatory approach. This study also compares the current research with the result from the previous one, which was done by Dewi (2007) in Semarang City, another city in Central Java Province which is frequently influenced by the coastal floods. Finally, the study expected to come up with a proposed mitigation plan formulated by the local people in the prone village.

Primary data was collected through interviews to 150 respondents and focus group discussion as well as participatory mapping. The respondents are taken in three villages (Kelurahan Serengan, Kelurahan Joyotakan and Kelurahan Sangkrah) which were chosen purposively to represent three level of flood susceptibility in Surakarta City (less susceptible, susceptible and very susceptible to flood areas). It is found that the flood risk perception among the local communities are varied. The frequency of flooding which occurs every year is different in every villages ranging from 0 – 7 times every year. The flood depth inside the house with the reference from the ground floor ranging between 0 – 4 meters high. The flood duration also varies from 1 – 7 days of inundation. The level of 2007 flood severity classified into three levels (normal, nuissance and disastrous). The flooding in 2007 perceived as nuisance by most of respondents. Most of the local people think that the main cause of the floods is the prolonged high rainfall followed by backwater from the canals to the city as well as dike failures and the overflow of the river.

Generally, the local people living in study area usually cope with the flooding mostly by doing physical and social cultural coping strategies. It is also found that there are similarity and difference of coping strategies employed in Semarang and Surakarta City. The significant difference is observed from the physical and social coping strategies. It was found that the local people in those two cities are tend to economically and physically unprepared since most of them are lack of capacity in financial aspect. Most of the local people do not really have a special budget to prepare if the flooding occurs. However, the local people in those cities have social capacity in dealing with flooding in their own neighborhoods.

The proposed mitigation plan comprises two measures: structural measures and non-structural measures. The structural measures are proposed to be conducted through the improvement of water canals in the village and preparing the common kitchen during the flooding occurrence. The non-structural measures can be realized through the waste disposal management and continue socialization of flood handling and simulation, as well as domestic waste handling.

Key words: The local people, Surakarta City, Semarang City, interviews, focus group discussion, participatory mapping, flood characteristics, coping mechanism, proposed mitigation plan.

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F. Febrianti

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List of Abbreviations

ADPC	Asian Disaster Preparedness Centre
APBD	*Anggaran Pendapatan dan Belanja Daerah* Local Budget
APBN	*Anggaran Pendapatan dan Belanja Nasional* National Budget
AS/NZS 4360	Australian Standard/New Zealand Standard 4360 (Guide to Risk Management)
Bakosurtanal	*Badan Koordinasi Survey Pemetaan Nasional* The National Coordinating Agency for Survey and Mapping
Bappeda	*Badan Perencanaan Pembangunan Daerah* Regional Development Planning Agency
BBWS Bengawan Solo	*Balai Besar Wilayah Sungai Bengawan Solo* The Main Office of Bengawan Solo River Region
BNPB	*Badan Nasional Penanggulangan Bencana* The National Disaster Management Agency
BPS	*Biro Pusat Statistik* The Central Bureau of Statistics
BUMN	*Badan Usaha Milik Negara* State Enterprise
DEM	Digital Elevation Model
Desa Siaga	A program for preparing the village to be ready for any hazard including health and disaster
Dinkes	*Dinas Kesehatan* The Health Agency
DKPP	Dinas Kesejahteraan Sosial dan Pemberdayaan Perempuan The Social Welfare and Women empowerment Agency
DPU	*Dinas Pekerjaan Umum* The Public Work Agency
FGD	Focus Group Discussion
Gapensi	*Gabungan Pelaksana Konstruksi Nasional Indonesia* The Indonesian Construction Organizer Association
GIS	Geographic Information System
Gerakan Sayang Ibu	A program/movement to support the mothers' welfare through the improvement of health services
Gotong Royong	Community's activities to work together and to help each other
GPS	Global Positioning System
Jimpitan	Certain contribution (usually money) taken from community member for a certain purpose e.g. security, waste disposal management etc.
Karang Taruna	Neighbourhood youth association
Kecamatan	Sub district
Kelurahan	Village
Koperasi	Economic enterprise conducted by the community
Kantor Kesbangpollinmas	*Kantor Kesatuan Bangsa, Politik dan Perlindungan Masyarakat* The Nation Unity, Politics and Community Protection Office
LPMK	*Lembaga Pemberdayaan Masyarakat Kota* The Institute of Urban Community Empowerment

LP2A	*Lembaga Pendidikan dan Pengembangan Agama Islam* *The* Institute of Islamic Education and Development
Musrenbangkel	*Musyawarah Perencanaan Pembangunan Kelurahan* Conference of Village's Development Planning
NGO	Non-Governmental Organization
Padat Karya	Intensive program to fix and to clean up water canals by involving community in the implementation
Paguyuban Becak	Association of pedicab drivers in the neighbourhood
Paguyuban Kejawen	Association of people who believe in mysticism associated with the Java view of the world in the neighbourhood
PAUD	*Pendidikan Anak Usia Dini* Education for early-age children
Pengajian	Religious meeting in community, mostly held by Muslims
PKK	*Pembinaan Kesejahteraan Keluarga* Family Welfare Assistance (A program at village level to educate women on various aspects of family welfare)
PNPM	*Program Nasional Pemberdayaan Masyarakat* National Program of Community Empowerment
Pokja	*Kelompok Kerja* Task Force
Ronda	Community patrol to guard the neighborhood area
RT	*Rukun Tetangga* (sub area of *RW*)
RW	*Rukun Warga* (sub area of village)
SPSS	Statistical Product and Service Solution (software)
UN-ISDR	United Nations International Strategy for Disaster Reduction
UNDRO	United Nations Disaster Relief Organization
UN-OCHA	United Nation Office for the Coordination of Humanitarian Affairs

1. Introduction

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

Floods cause tremendous damages every year in some areas in the world. In Indonesia, flooding becomes a routine event particularly during the rainy season. For example, in 2007, there were 338 flood events in which 102 people died and over 1 million people were displaced (BNPB, 2009).

People living near the river embankments or in the flood plains are usually more vulnerable to flood than people living in other areas. There are possibilities that people can be threaten. First, there is a possibility that soon after the water exceeds the top of dikes, the water can affect the area. Second, there is a possibility that dike failure could happen. When those happen, people living along the river embankment will be exposed to floods earlier than others will.

Surakarta City, well known as Solo City, is one of municipalities in Central Java Province. It is a part of downstream areas of Bengawan Solo River Basin, which has frequently been struck by flood events in recent years. For the past three years, floods have happened several times affecting thousands of houses and infrastructures. The floods that occurred in the period late December of 2007 until early January 2008 were killing nine people and damaging houses and infrastructures. The floods that happened in March 2008 were inundating more than 1000 houses located in six sub districts in Surakarta City. The last flood event in late January until February 2009 inundated more than 11,000 houses in Surakarta City, caused more than 800 people displaced and two people killed (OCHA, 2009; Surya Online, 27 February 2009). The floods also caused economic losses for about more than 36 billion rupiah based on released data from The Central Java Government (Kompas, 19 March 2009).

The local authority has implemented several mitigation measurements to minimize flood risk, e.g. building riverbank protection, so-called Upper Solo River Improvement, and relocation of people living in flood plain to safer locations. However, flooding remains difficult to handle and the application of flood risk management are far from adequate to reduce flood risks. Integrated flood risk management is necessary to be implemented to support the efforts of local government in reducing the impact of flooding.

Risk perception plays an important role in how people anticipate floods and deal with it once they occur. People's knowledge of risk will give contribution in managing the flood risk. There are some points of risk perception of community that should be considered by local government in making a grand plan of flood risk management. First, what people usually do before, during and after floods. Second, how people critically understanding floods as a part of their environment phenomena. People participation is also an important part of gathering information from local level for determining steps to lessen the flood impacts. Collaboration between local people and local government should be conducted in order to formulate the better action plan for risk reduction in the implementation of flood risk management.

Participatory approach is an attempt to generate information from the local level and considered an effective tool for extracting local knowledge among affected community. People living in floodplain usually have valuable local knowledge to deal with floods. They can reveal historical data about floods events from the past. It can provide information of how bad the floods and what kinds of coping strategies of community to overcome the floods impacts.

Dewi (2007) has conducted a research using participatory approach in Semarang City, Indonesia. She captured people perception and response to floods. Besides, the research described the types of coping strategies against flooding. However, the result cannot automatically represent all the communities in all parts of Indonesia. Different type of floods and characteristics of a community will cause different coping strategies when people deal with flooding.

This study focuses on identifying the community risk perceptions and coping mechanism of people living in flood-prone area in Surakarta City by using participatory approach. This research will provide information for improvement of flood risk management in Surakarta City. It is also necessary to compare the current research with the result from the previous one, which was done by Dewi (2007) in Semarang City.

1.2. Problem Statement

It is known that floods mostly affect community living in prone areas. They learn how to cope with it and survive from the impacts. There are many kinds of coping strategies done by local community before, during and after the floods happened. Those strategies are influenced by their perceptions of floods and experiences from the past.

The previous research (Dewi, 2007) has mentioned that the local government started to pay attention on the integrated flood management. They realize that it is the best way to solve the complex flooding problems. It can be achieved by actively cooperating with all the stakeholders, including the affected community. Unfortunately, in the research area, flooding is still the major problem that still cannot be solved by the local government. There is still no comprehensive solution made up until now.

Behavior or local knowledge and community capacity toward the flood hazard should be taken into account in an integrated flood risk management. This is necessary since the risk management conducted by local government so far is not working very well. Unfortunately, information and data related to local community, community capacity and coping mechanism is rare. The local government is also facing the lack of knowledge about coping capacity and stakeholders participation in flood risk management.

1.3. Objectives

The research intends to identify the local community perception on flood risk. It is also aimed to identify coping mechanism that people have living in the flood prone areas. This is usually done by using a participatory approach. The more specific objectives are:

1. To identify and to map the local community perceptions of flood risk.
2. To identify the community's coping strategies related to flooding
3. To compare the coping strategies between local community in Solo City and Semarang City.
4. To identify the proposed mitigation action plan based on the community participation.

1.4. Research Questions

There are four research questions that need to be addressed to achieve the research objectives, which are described in Table 1.1.

Table 1.1. Research Objectives and Research Questions

No	Research objectives	Research questions
1.	To identify and to map the local community perceptions related to flood risk.	a. What are the people perceptions of flood risk? b. What are the differences flood risk perceptions among community?
2.	To identify the coping strategies related to flooding	What kinds of community coping strategies used by local community?
3.	To compare between the coping strategies of local community in Solo City and Semarang City	What are the differences between the coping strategies of local community in Solo City and Semarang City?
4.	To identify a proposed mitigation action plan based on the community participation.	a. What kind of mitigation action plan that community proposed? b. Is the mitigation plan related with the government policies in mitigation action?

1.5. Benefit of the Research

This study provides an important information for local government in making an integrated plan for mitigation action strategies.

2. Review of Related Literatures

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. General Understanding of Hazard and Disaster

2.1.1. Hazard

There are several definitions of hazard. One of those is proposed by UNISDR (2009), stated that *"A 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"*.

Another definition formulated by Twigg (2004) describes that a hazard is a potential threat to humans and their welfare. The hazard can be natural or induced by human processes. While ADPC (2004) mentioned that, a hazard is any phenomenon, substance or situation, which has the potential to cause disruption or damage to infrastructure and services, people, their property and their environment. Wisner et al. (2003) refers hazard to a natural events that can affect different places singly or in combination in a different times and different degrees of intensity and severity.

From those definitions above, it can be seen that hazard consists of some elements; possibility of threat, causes (can be natural or human induced) and disruption, and damage to human and environment.

2.1.2. Disaster

Wisner et al. (2003) mentioned that disaster occurrences are the result of interaction between hazard and vulnerability. Disaster is normally defined as a damage disruption that exceeds the capacity of community to cope with it (Twigg, 2004). In other words, disaster is what occurs when the impact of a hazard on a part of society e.g. causing death, injury etc, ove*RW*helms that society's ability to cope.

From the same point of view, UNISDR (2009) defined disaster as a serious disruption of the functioning of a community or a society. It involves widespread human, material, economic or environmental losses and impacts. However, those exceed the ability of the community or society to cope using its own resources. Disaster can deeply affect the social structure in the area and cause many damages to the environment, agriculture, rangelands, etc. and of course give the severe consequences to men as well (Nunez, 2005).

Aysan (1993) mentioned, "*Most disasters are manifested in some physical losses*". In addition, the worst condition happens when the physical vulnerability occurs where people have lack of resources, awareness, knowledge, power and lack of choices to defense from the hazards.

2.2. Flooding

Flooding is among the most damaging natural hazards. It causes tremendous damages and loss of lives in the world. According to Birkmann (2006) generally, about 196 million people in more than 90 countries are affected by disastrous flooding each year. Aysan (1993) stated more than 20,000 people were killed and more than 73,000,000 people were affected by floods per-year worldwide in 1982-1991. While, Birkmann (2006) mentioned that between 1990 – 2000 flooding had caused death tolls approximately 170,000 people around the world. South Asian countries with China and India are the top of the list of absolute exposure of flooding indicating around 150 million victims each.

When flooding exceeds their normal limits or when people fail to adapt their land use, it can bring about a significant loss and damage to livelihoods by damaging crops, industry, commerce; disrupting education and other services; taking lives and displacing people (ADPC, 2006).

According to Ramsbottom, (2003) cited from Azad, (2008), there are many factors that influence hazard and disruption caused by flooding, which can be classified into four groups:

- Flood behavior including the severity of flooding, response, rate of rise, depth, flow velocity and duration,
- Evacuation issues including route and time of evacuation,
- Population at risk including number of people, vulnerability, awareness,
- Emergency management includes flood forecasting, flood warning, flood response, evacuation, and recovery.

Sources of water that could cause floods are present in many types. However, according to Alkema et al. (2009), the location, terrain characteristics and climate play important role in determining the level of vulnerability of an area.

There are two types of flooding based on ADPC report 2006:

1. Riverine Floods, referred as monsoon floods in Asia, which occur when major rivers and their side channel overflow, causing extensive inundation. The rivers rise slowly and with slow recession may remain high for many weeks. Floods peaks may occur simultaneously on many interconnected rivers, which can cause particularly extensive flooding. Alkema et al. (2009) described that this type of flooding, so-called alluvial flooding, is often associated with low flow-velocities in the overbank area, especially when they occur in the areas with low gradients, like alluvial and coastal plains.

   On the ADPC report 2006, it is also mentioned that the riverine flooding is divided into two types. First is slow-onset flooding, which occur slowly and can last weeks or even months. It can be caused by snow melt or steady ongoing rainfall. In this case, there is opportunity for people to be evacuated from the area at risk. Often this floods cause extensive damages and losses. Second is rapid-onset/flash flooding, which occurs mainly in steep rivers with small and steep mountainous catchments after periods of intense rainfall. The flash floods are accompanied by a rapid rise and fall in water levels. The sudden onrush of water from mountains and high-flow velocity causes intense damages to crops and property and greater direct loss of life than slow-onset flooding.

2. Localized and urban floods, which are caused by the intense local rainfall in the areas with inadequate drainage, storm water management and flood evacuation systems tend to result in localized flooding. Floodwater inundates particular areas and may remain for a long duration of time.

However, there is another type of floods so-called tidal floods or coastal floods, that should be taken into account as a form of flooding endangering and causing damages and death tolls, especially for coastal areas. Marfai et al (2008) stated that there are many natural processes which play important role in coastal flooding. Those factors can be identified as high tides, wave action, sea level rise due to the global warming and high sea level together with river flows which can affect the magnitude of coastal flooding. In other words, tidal floods can be defined as flood in low-lying coastal areas caused by those factors mentioned above. Flooding occurs as the sea level getting higher until the critical height above the coastal lands due to tidal sea and sea surges (Marfai et al, 2007).

In Semarang City, one of the coastal cities in Indonesia, tidal floods become a major threat for the city development besides the riverine flooding, since the tidal floods become worse due to enhanced land subsidence (Marfai et al, 2007).

2.3. Flood Hazard Management

Flooding caused damages that increased over the past 50 years. Fortunately, nowadays there is a shift of paradigm appreciated that the previous paradigm of flood protection was inappropriate (UNDRO 1991, Plate 1999 cited from Schanze, 2006). It is also mentioned that absolute protection is both unachievable and unsustainable, because of high costs and inherent uncertainties. Instead, risk management has been recommended as being more suitable and this paradigm is now receiving growing attention within flood research. It is realized that many flooding problems involves many aspects including social and physical aspects.

Twigg (2004) stated that flood hazard management mainly consists of three aspects, which are mitigation, preparedness and prevention. However, the action of flood-risk reduction will be more effective if there is a strong partnership between every stakeholder such as local government, private sector, society organization, etc.

There was a research done by Tran et al. (2008) on flood risk management in Central Vietnam, which tried to explore the impacts of flood and to clarify the rural community's coping mechanism to flood disasters there. In this research, Risk Management Framework (Standards Australia 1999) was applied aimed to help decision makers more effectively to achieved flood risk reduction (see Figure 2.1). Since the flooding is considered a product of hazard and vulnerability, this risk management framework includes structural measures to reduce the hazard factors and non-structural measures to mitigate the social vulnerability.

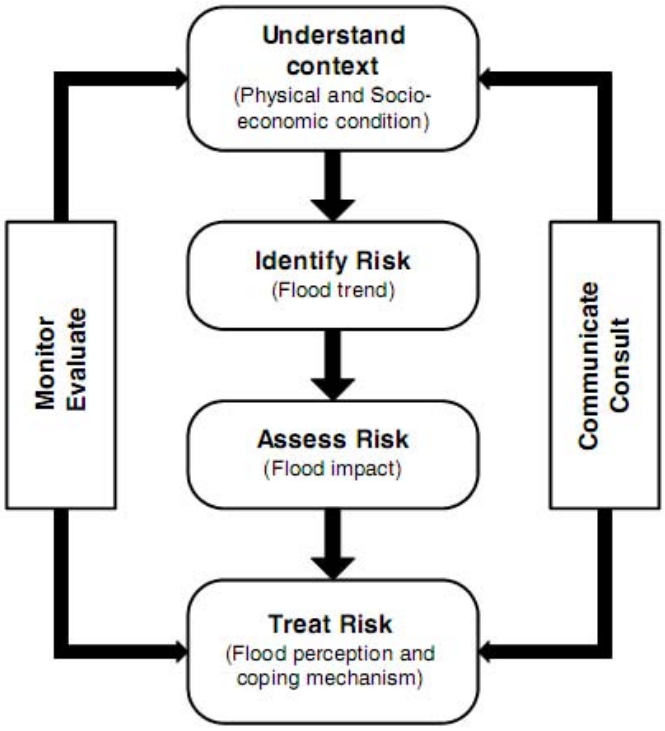

Figure 2.1. Flood Risk Management framework adapted from the Risk Management Standard AS/NZS 4360:1999 (Tran et. al., 2008).

2.4. Risk Perception

Risk perception is a subjective opinion of people about the risk, its characteristics, and its severity, include multiple factors: the individual's knowledge of the objective risks, the individual's expectations about his or her own experience to risks, and his or her ability to mitigate or cope with the adverse events if they occur. Risk perception is related to the estimated probability of people that hazard will affect them. Individual capacity to manage risk can feed back into risk perceptions (Rianto, 2009).

One of the substantial factors in determining people's behavior toward a risk is their perception of risk itself. According to Plapp and Werner (2006) "*risk perception defined 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*". In addition, experience from the past disaster event will influence how people learn and think about disaster's occurrences.

External factors were also described as the characteristics of the disaster's occurrence e.g., magnitude, duration, frequency, and temporal spacing, the public education programs of natural hazard and source of information (Paton et al., 2008 cited from Rianto, 2009).

Risk perception, then, become important to support the effective strategies on protection measurement. Risk perception plays an important role to shape the flood coping mechanism and flood management (Tran et al., 2008). It can influence the design and the operational aspects in flood risk management. If the flooding perceived as a hazard-led events, then the coping will be focused on physical aspects, structural measures and external relief. On the other hand, if the flooding perceived as a hazard product of hazard and vulnerability, then the human behavior becomes the important aspect of mitigation measure and the management should be focus on non-structural measures. Marincioni (2001) cited in Tran et al. (2008), also emphasized that understanding how people perceive the flood risk is important to formulate a flood mitigation policy and plan.

2.5. Coping Mechanism

Coping defined as the manner in which people act within the limits of existing resources and range of expectations to achieve various ends (Twigg, 2004). It can be expressed as defense strategies, active ways of solving problems and methods for handling stress (Murphy and Moriarty, 1976 cited from Twigg, 2004).

Heijmans (2004) mentioned that coping strategies are the result of a process of experiments and innovation through which people build up the skills, knowledge and self-confidence necessary to shape and respond to their environment. This provides people with a sense of 'safety'.

Coping strategies are often transmitted from generation to generation within the communities and households (Marschiavelli, 2008). Besides, Twigg (2004) stated that coping strategies by setting up ways of coping with disaster depends on the assumption that the event itself will follow a familiar pattern, and that people's earlier action will be a reasonable guide for similar events.

There are some categories of coping mechanism applied by community (Twigg, 2004) described below.

1. Economical strategies including diversification of income sources, diversification of production, saving and credit,

2. Technological strategies including building constructions and building material that have to be adapted with frequent flooding,

3. Social strategies including development of network exchange, social contact and mutual assistance within the family or wider.

4. Cultural strategies including risk perception and religious views.

Social and institution plays important role in determining coping range within community. The effectiveness of the social network or the institution, economic resources and infrastructure are the factors that can influence for coping with the hazards (Dewi, 2007; Marfai et al, 2008).

The same idea also found by Marschiavelli (2007) in her research result stated that there were three types of coping mechanism employed by the community in Kampung Melayu, which are technological/structural, economic and social coping mechanism. Technological/structural coping mechanism is described as the action generated to protect or cope with flood damages involving material or existing action. Economic coping mechanism means all strategies linked to materials, resources and capability of producing profits or benefits. Further, she explains that social mechanisms are those activities that relate to the society in which they occur.

2.6. Participation of Community in Flood Risk Management

Communities are at the frontline of disasters. Over the last two decades, it has become apparent that top-down approaches to disaster risk management alone fail to address the specific local needs of vulnerable communities, often ignoring the local capacities and resources. At times, this approach further increases the vulnerability of the community. In response to the limitations of this top-down methodology, the community-based disaster management emerged as an alternative approach, during the decades of 1980s and 1990s (ADPC, 2006).

Related to disaster occurrences, according to Twigg (2004), community participation concept can be understood as "*the active involvement of people making decisions about the implementation of process, programs and projects which affect them*".

Heijmans (2004) mentioned that participation of people at risk is essential for building effective disaster risk reduction. She argues that local people have knowledge about their locality and the history of local disasters. People's participation is not just the process of consultation and providing information to outsiders during assessments, intervention selection and implementation. People's participation should be made part of an empowerment process, joint assessment of capacities and vulnerabilities building awareness.

Battista and Baas (2004) cited in Dekens (2007) stated that local people's participation is one of many aspects in disaster risk prevention and management. Participatory approaches to disaster management and preparedness often pre-suppose a basis in local knowledge and practices because communities in disaster-prone areas have accumulated a lot of experience over time.

Regarding the flood disaster mitigation, public and community participation become two essential elements of an effective social mobilization and public awareness program (Dewi, 2007). Furthermore, she suggested that co-ordination and collaboration between community agencies, representing its citizens and the municipal authorities is important.

2.7. Mitigation Measures

Twigg (2004), states that a flood hazard management includes mitigation, preparedness, and prevention. He defined mitigation as any action to minimize the extent of a hazard. Mitigation

measures can take place before, during and after a disaster. However, mostly the term is usually identified as action against potential disaster. Mitigation is the effort to reduce loss of life and property by lessening the impact of disaster.

In Indonesia, definition of mitigation has also described in Disaster Tackling Act No. 24 2007. Mitigation explained as a set of endeavors to reduce disaster's risk through physical development or resuscitation and capacity improvement to face any kind of hazard.

Mitigation measures can be classified into two types, structural and non-structural. Structural measures are usually related with physical measures such as building embankment/dike or modified building to make it strong. While non-structural measures can be done through training, socialization and regulation.

Andjelkovic (2001) mentioned that in relation to flood mitigation, public and community are two important elements of an effective mobilization and public awareness program. This program should be community-specific, based on assessment of information needed, integrated with existing disaster warning and response systems, focused towards information on prevention, mitigation and long-term recovery, established as ongoing-process and addressed towards the most vulnerable people.

3. Study Area and Research Methods

This chapter introduces the general overview of the study area. It also describes the methods used in the research. The discussion comprises the general information of Surakarta City, Bengawan Solo River and Gajah Mungkur Dam as the flood mitigation infrastructures, and general overview of the surveyed kelurahan as well as the characteristics of flood in 2007.

3.1. Study Area

3.1.1. General Information of Surakarta City

Surakarta is one of big cities in Central Java Province. It plays an important role in the cultural, political and economic development in Central Java Province. It is located approximately 65 km Northeast of Yogyakarta, and 100 km Southeast of Semarang (see Figure 3.1). The eastern part of the city is bordered by Bengawan Solo River, the longest river in Java Island. Surakarta City has an area of about 44 km^2 wide.

Figure 3.1. Location of Surakarta City

In Surakarta City, tourism and trading are important sectors that give significant contributions to the economic growth. It is also one of the old cities in Indonesia that has many important cultural relics and inheritances from historical and pre historical era (Qomarun and Prayitno, 2007).

Administratively, there are five sub-districts (*kecamatan*) in Surakarta City, which are Banjarsari, Jebres, Laweyan, Pasar Kliwon, and Serengan. Figure 3.2 describes those sub districts in Surakarta City.

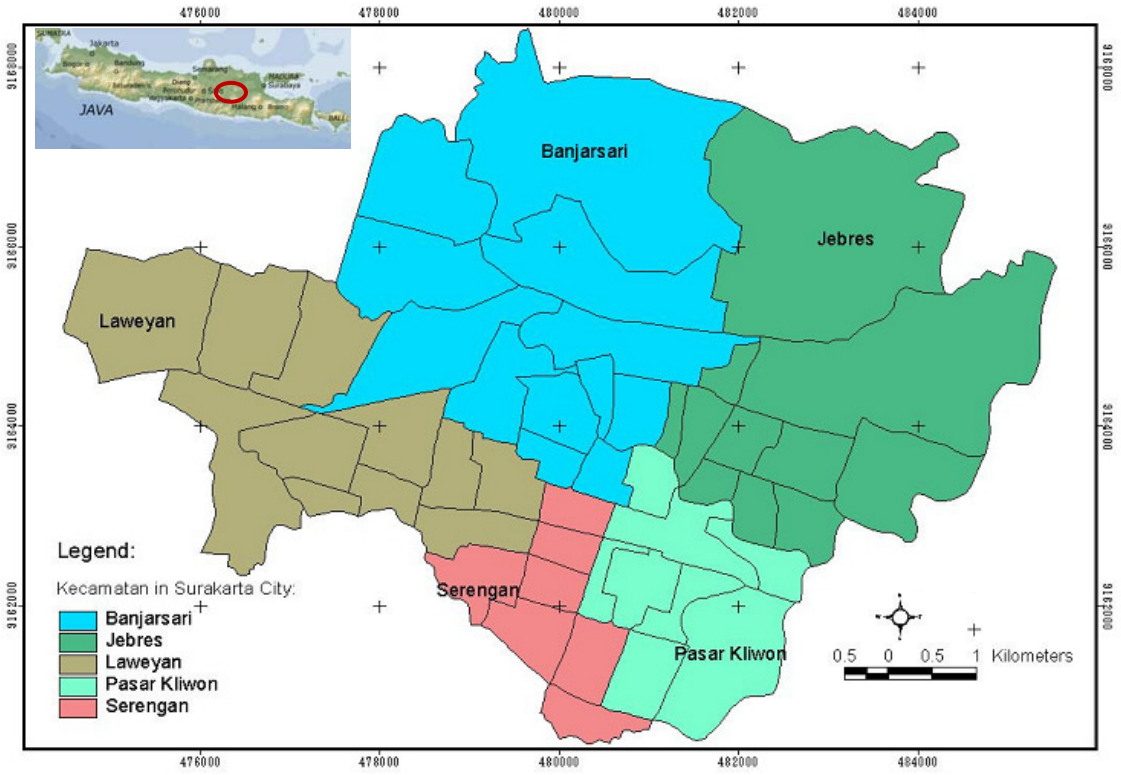

Figure 3.2. Administrative map of Surakarta City

Since 1900's, Surakarta has developed to become a city as the facility of transportations and utilities of the city have been built. According to the BPS (2008), more than 515.000 people live in Surakarta City recently and population density in 2007 is 12.827/km^2. Table 3.1 describes the population density in Surakarta City in 2008.

Table 3.1. Population Density in Surakarta City in 2008 (BPS, 2009)

No.	Sub-district	Wide Area (km^2)	Sex		Total	Population Density (/km^2)
			Male	Female		
1.	Laweyan	8.64	54,164	55,766	109,930	143,762
2.	Serengan	319.40	24,984	25,863	50,847	1,170.79
3.	Pasar Kliwon	4.815	43,172	44,808	87,890	18,272
4.	Jebres	1.260	70,466	71,826	142,292	177,036
5.	Banjarsari	14.81	80,259	81,834	162,093	10,944

3.1.2. Topography and Climate

Surakarta City is located on 110^o 46' 10" E – 110^o 51' 25" E and 7^o 32' 13" S – 7^o 35' 12" S approximately 92 meter above sea level with relatively flat topography (0-3% slope). The lowest area is in eastern part of the city with has altitude approximately 85 meter above sea level with 0.3% slope. The northern part is approximately 135 m above sea level and the topography is hilly. While the southern part is relatively flat with the slopes below 3 %. *Kali* Anyar separates these two parts of the city.

The temperature ranges from 24.8° C to 28.1° C. Setiyarso (2009) stating that Surakarta City has a Tropical Rain Climate with daily average temperature around 26.5^o C. The average annual rainfall in Surakarta City is 2,070 mm/year with the highest average rainfall amount is in

December (358.2 mm) and the lowest average rainfall is in August (25.1 mm). The humidity in Surakarta is recorded between 66% to 84%. In general, December is the month with the most rainy days, the amount of rainy days is 24 days. The largest volume of rainfall is measured in February as high as 595 mm (BPS, 2008).

3.1.3. Land Use

The areas of Surakarta City mostly have been built as residential areas. More than 60% of the total areas in Surakarta City are covered by settlements. Table 3.2. below describes the land use of Surakarta City in 2007.

Table 3.2. Land use of Surakarta City in 2007 (BPS, 2008)

No	Land Use	Wide Area	
		Km^2	%
1.	Residential areas	27.31	62.01
2.	Manufactures	1.01	2.29
3.	Buildings for offices, services and commerce	7.15	16.24
4.	Sawah (paddy field)	1.50	3.41
5.	Dry land	0.85	1.93
6.	Cemetery	0.73	1.66
7.	Sport field	0.65	1.48
8.	Fallow land	0.53	1.20
9.	City park	0.32	0.73
10.	Others	3.99	9.06
	Total	**44.04**	**100.0**

3.1.4. General Description of Bengawan Solo River and Gajah Mungkur Dam

As mentioned in the previous section, Bengawan Solo River so-called Solo River is the longest river in Java Island. Solo River has more than 548 km length (Tjahjono, 2007). It has a wide catchment area that is over 16,000 km^2 wide or about 12.31% of the extent of Java Island. Solo River originates from a confluence of two small rivers so-called *Kali* Tenggar and *Kali* Muning in Mount Sewu in Wonogiri Regency, Central Java Province and flows along the eastside of Surakarta City to the coast of East Java. Figure 3.3 shows the Solo River Basin extending over two provinces in Java Island.

Solo River plays important role in the development of the city. It was the main important transportation for the citizen, before other facilities such as train and tram have been provided. However, the trend has change as the city grows. Pressure from population growth has caused a change in land use system in the Solo River catchments area.

Based on the report of the Bengawan Solo Expedition Team (2007), people living along the river use the floodplain as an agriculture area for growing peanuts, maize, and cassava. When rainy season comes, the soil along the river slides and it falls into the river. The erosion causing sedimentation and it can be found along the river from Wonogiri, Sukoharjo, and Solo until Gresik. In addition, water contamination also becomes a big problem for Bengawan Solo. Especially in Surakarta City, people throw domestic and industrial waste into the river causing poor water quality, clock the drainage system, and enhanced flood problems.

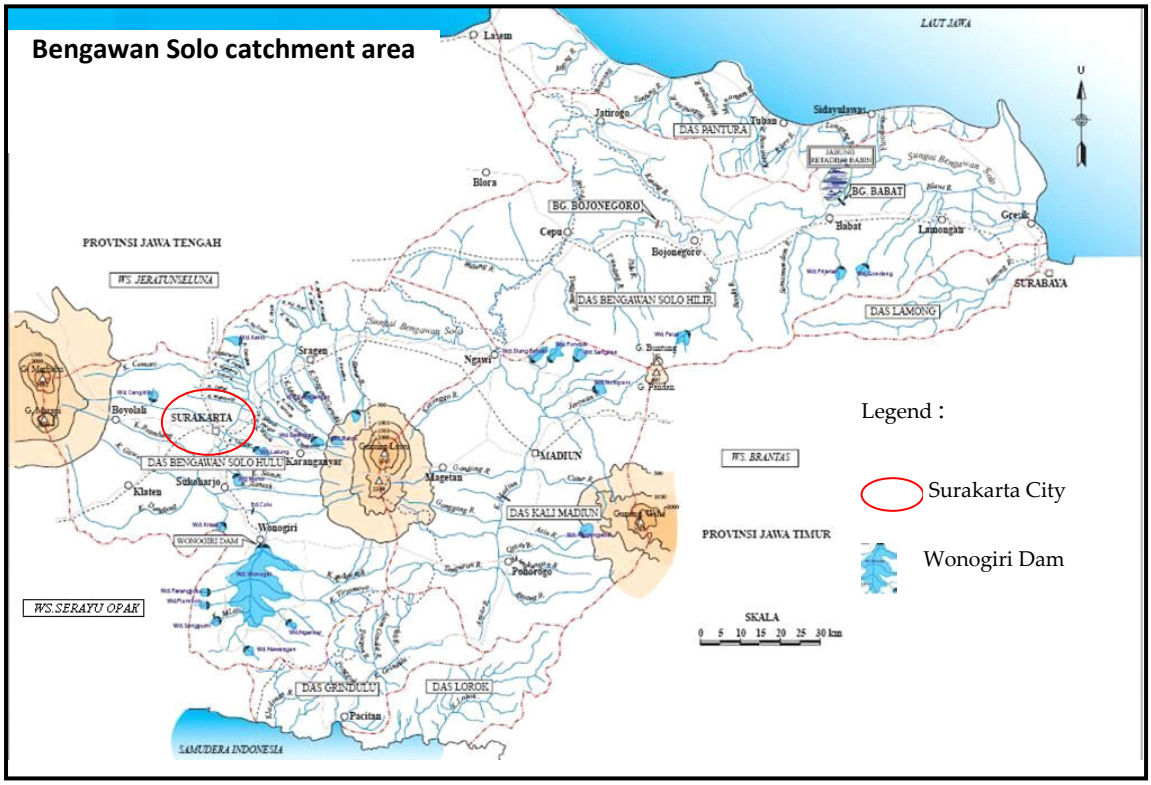

Figure 3.3. Bengawan Solo Watershed (Source: BBWS Bengawan Solo)

Furthermore, a multipurpose dam was also build in 1978 in Wonogiri, a part of Solo River catchment area, so-called Gajah Mungkur Reservoir. It has approximately 8,800 hectares wide and extends over seven sub districts in Central Java Province. The building of this dam was meant to protect and mitigate Surakarta City from frequent floods. It has capacity of 730 x 10^6 m^3 to store water. Besides, the dam functions to supply fresh water, paddy field drainage, fisheries and electricity for the area surround it. Gajah Mungkur Reservoir was designed with 100 years protection level and it was assumed that the sedimentation rate would be around 2 mm/year. Unfortunately, nowadays about 90% of the total land of reservoir catchments has been cultivated leaving only 10% forested area. It is recently found that in the sedimentation rate in the dam is now over 8 mm/year. The sediments are rapidly transported from the catchments area (Hidayat and Valiant, 2007). Nevertheless, according to The Regent of Wonogiri, the dam might not last than 10 – 15 years more (Tjahjono, 2007).

3.1.5. General Profile of Surveyed Kelurahan

From the previous research conducted by Prasetyo (2009), it is found that there are five levels of flood susceptibility in Surakarta City (see Figure 3.11. in the next sub-chapter). This research covers three levels of flood susceptibility; very susceptible to flood, susceptible and less susceptible to flood. Those levels are respectively represented by three *kelurahan* in Surakarta City, e.g. *Kelurahan* Sangkrah, *Kelurahan* Joyotakan and *Kelurahan* Serengan. Detailed explanation of sampling method of study area determination will be presented in the next sub-chapter.

3.1.5.1. *Kelurahan* Sangkrah

Kelurahan Sangkrah is one of nine *kelurahan* in *Kecamatan* Pasar Kliwon. Based on the map generated by Prasetyo (2009), *Kelurahan* Sangkrah can be classified as a highly susceptible to floods in Surakarta City considering the slope, the drainage system and the landuse in the area. It has 13 *RW*, 58 *RT*, 2998 households and almost 12,000 people live in the area. *RW* can be defined

as the smaller administrative area after village. Thus, a village consists of some *RW*s. While *RT* is the smallest form of administrative area, so that in one *RW*, there can be some *RT*s existing. The general overview of this village is shown in Figure 3.4.

Having 45,20 Ha wide area, Sangkrah is located near the Bengawan Solo River. In the middle of the area there are 2 canals, *Kali* Jenes and *Kali* Pepe. The overflow of the Bengawan Solo River and the two canals caused a huge flood in 2007 in *Kelurahan* Sangkrah. There are two river embankments built in two different periods. The first was built by The Netherlands Government so-called Tanggul Lama. The other was built in Paku Buwono (PB) X Kingdom period. At this moment, the area along the dikes is occupied and built up as settlements. Generally the area can be classified as slum area based on the type of buildings and the density of the population. As the 2007 floods happened, more than 900 households were influenced by the floods.

In fact, almost all *RW*s in the village were affected by the floods in 2007 but there were four *RW*s (*RW* X, *RW* XI, *RW*, XII, *RW* XIII) which were severely flooded. Figure 3.5. shows the damages due to flood event in 2007 in this area.

Figure 3.4. Flood impacts in *Kelurahan* Sangkrah
a. Embankment damaged due to flooding (source: fieldwork, 2009); b. Demangan Water Gate filled with garbages due to flood in 2007 (source: DPU, 2009); c. Flood depth in 2007 (www.detik.com)

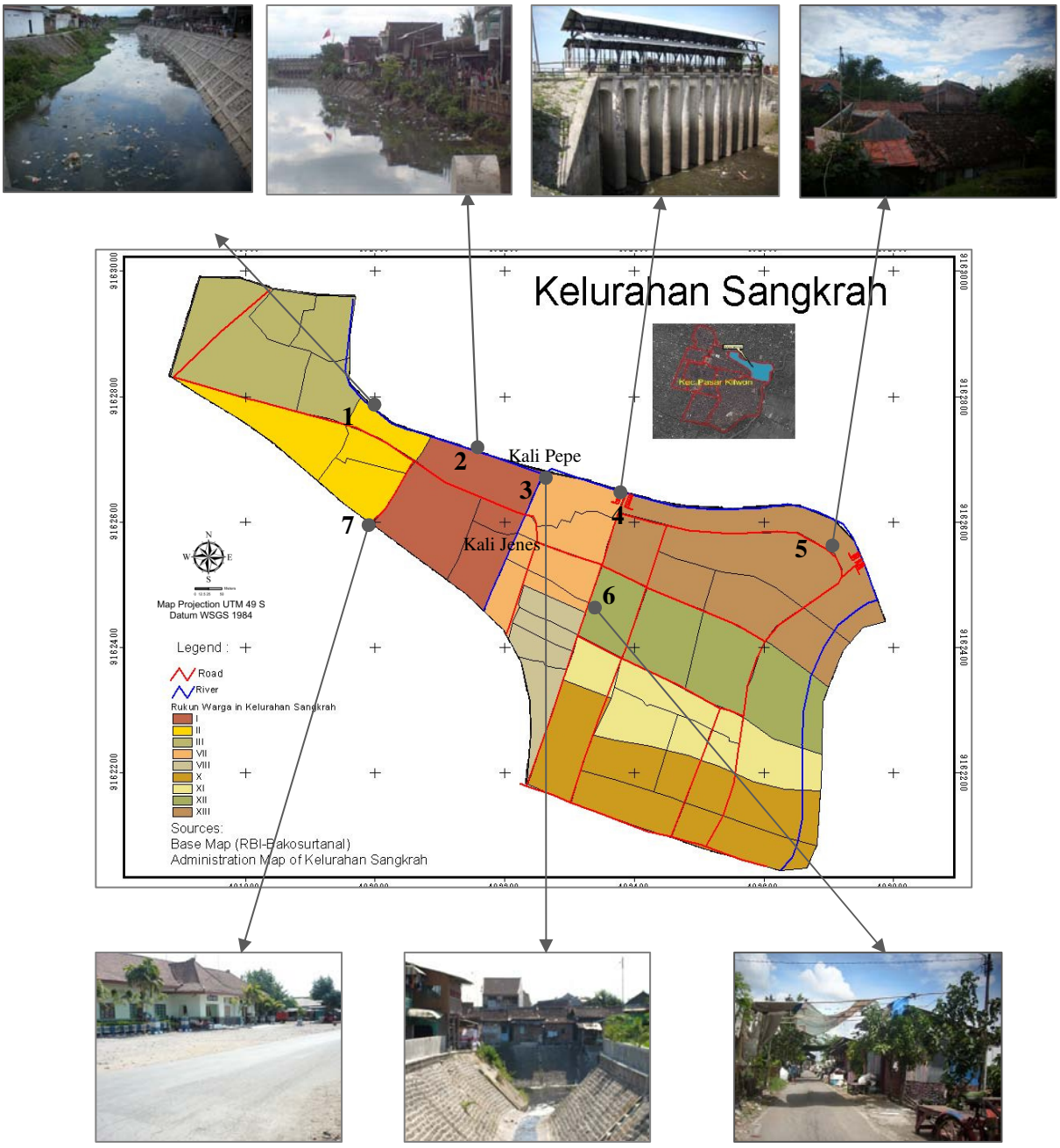

Figure 3.5. General overview of *Kelurahan* Sangkrah (Source: fieldwork, 2009)

Point 1: *Kali* Pepe. It can be seen from the recent condition of the river that the local people still throw waste and garbages into the river although they understand that it is not allowed.
Point 2: Settlements built ontop of the dike built during the PB X Kingdom in 1982. In this part of the village, it can be observed that many people having their work in the non-formal sectors and having relatively a lack of economical capacity.
Point 3: The intersection of *Kali* Jenes and *Kali* Pepe. The area surrounding is already occupied by densed settlement whichis situated almost only one metre away from the canal.
Point 4: Demangan Water Gate. This water gate is one of main flood mitigation infrastructures in Surakarta City. It was built during the ocupation of The Netherlands Government. It was built to protect the city from overflow (floods) of the Bengawan Solo. It is also provided with water pump to maximize its function. When the gate is closed the water from Bengawan Solo River cannot enter the city. The pumps can pump water from the canal out into the river to avoid inundations in the town.

Point 5: Settlement built along the embankment of Kali Pepe.
Point 6: Tanggul Lama. The embankment built by The Netherland Government during the colonization period in 1910 is already occupied by the people recently.
Point 7: The train station yard which was used by the people as a shelter place to evacuate their family and belongings to, bf ecause its higher location.

3.1.5.2. *Kelurahan* Joyotakan

Kelurahan Joyotakan is one of the seven *kelurahan* in *Kecamatan* Serengan. More than 90 % of the area was inundated and more than 8000 people were affected by the floods. The difference from *Kelurahan* Sangkrah is that the 2007 floods was not caused by the overflow of the Bengawan Solo river, but due to the acumulation of the rainwater from the canals (*Kali* Tanggul and *Kali* Wingko) of the city and the failures of the dike along *Kali* Wingko and *Kali* Tanggul in some points. Picture 3.6. shows the water mark of the 2007 and the 2008 flood. From this the local waterdepth inside the house can be defined.

Figure 3.6. Flood marks in RT 3/*RW* 3 *Kelurahan* Joyotakan
Left: Floodmarks of the 2008 flood; Right: Floodmarks of the 2007 flood. (source: fieldwork, 2009)

The area of *Kelurahan* Joyotakan iss 45.90 ha and than 8,500 people live in the area. It consists of 6 *RW*, 27 RT and more than 2,000 households, mostly are middle-low income. *Kelurahan* Joyotakan is not directly located besides the Bengawan Solo River. It has been wedged in among two canals; *Kali* Tanggul and *Kali* Wingko as the border of the region. Figure 3.7. shows the general overview of the village.

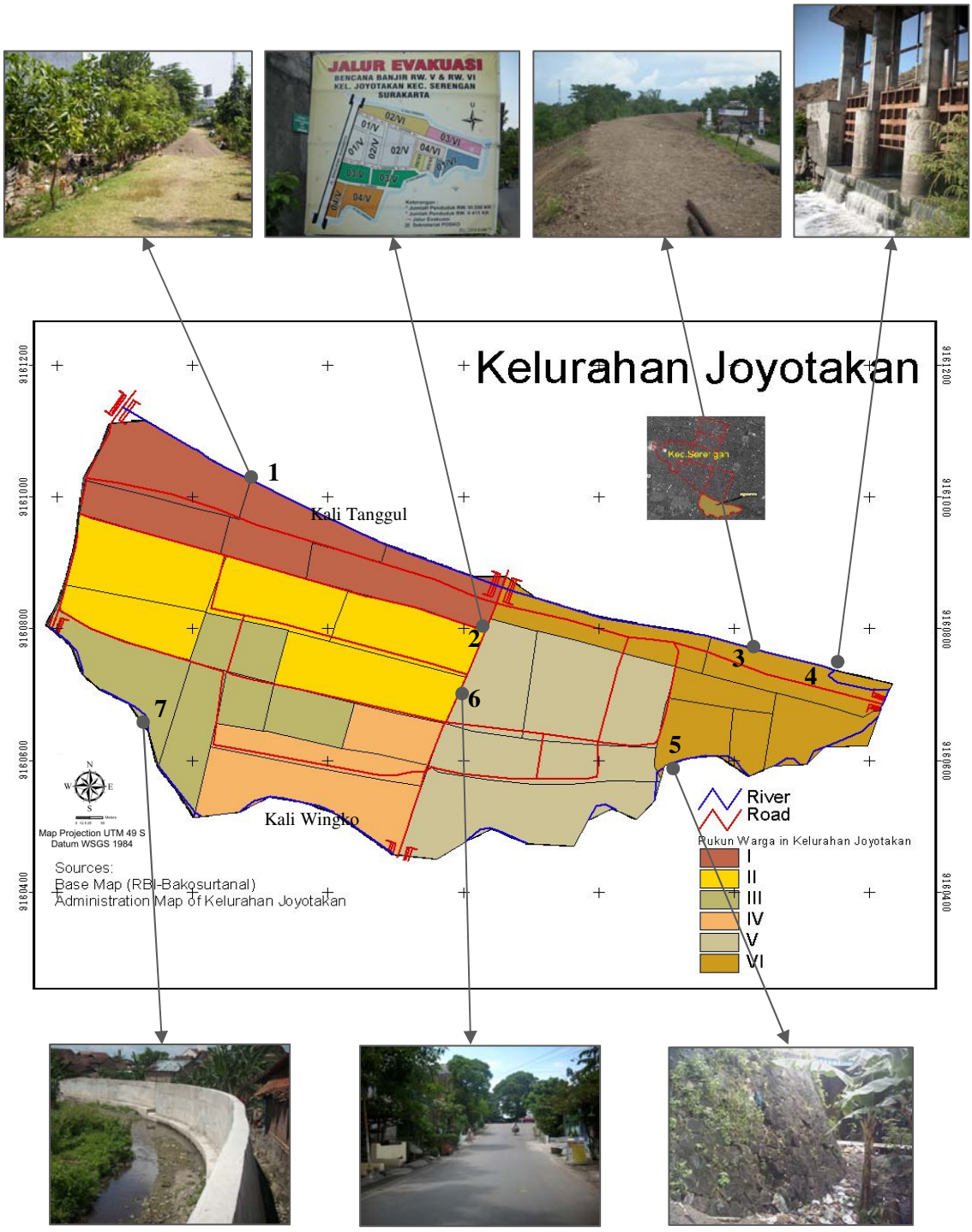

Figure 3.7. General overview of *Kelurahan* Joyotakan

Point 1: The embankment along *Kali* Tanggul. In 2007, when the floods struck this area, this dike was damaged. The surface of the dike cracked and the water seeped into the area next to it.
Point 2: One of the evacuation route maps in *RW* V and *RW* VI.
Point 3: Strengthened embankment along Kali Wingko.
Point 4: Plalan Water gate. This water gate was also built during The Netherland Goverments colonization. When the floods occurred in 2007, this water gate did not work very well and it worsen the floods. At this moment, the water gate is still not in a very good condition. Some foundation has damaged due to the floods inundation. Thus, the government decided to fix it and

provides a big pump to improve the function of the gate in protecting the area from frequent floods.

Point 5: Cracked parapet. This point is a part of the damaged embankment along the *Kali* Wingko. It failured in 2007causing the water entered the area very fast. In a very short time, the water level increased up to 2 meters high, especially in *RW* V.

Point 6: The topography of he study area. It can be seen from this point that the western and eastern parts are lower than the middle part of the village.

Point 7: Another damaged part of the parapet along *Kali* Wingko affecting *RW* III in 2007. At this moment, the new parapet has almost done to be built in order to protect this area from the frequent flooding.

3.1.5.3. *Kelurahan* Serengan

Kelurahan Serengan consists of 15 *RW*, 64 RT and more than 2,200 households. *Kelurahan* Serengan can be classified as less susceptible to floods considering the slope, the drainage system and the landuse in the area. Most part of it has not yet experienced any flood event. However, it is important to know whether the people living in this area realize the threat of the potential floods in their area since some parts of the area have a drainage problem caused by a bad condition of canal e.g. garbage accumulation and sometimes experience inundation due to the bad drainage (see Figure 3.8). Minor inundation were caused by the bad drainage problems.

Figure 3.8. Drainage System in *Kelurahan* Serengan
Left: Drainage congestion by the vegetation in part of *Kali* Jenes;
Right: Bad water quality indicated by the dark color and the smell of the water in *Kali* Tanggul

Besides, it is also important to know if they are prepared for this potential disaster and what do they think about the hazard according to their knowledge. The general overview of *Kelurahan* Serengan is shown in Figure 3.9.

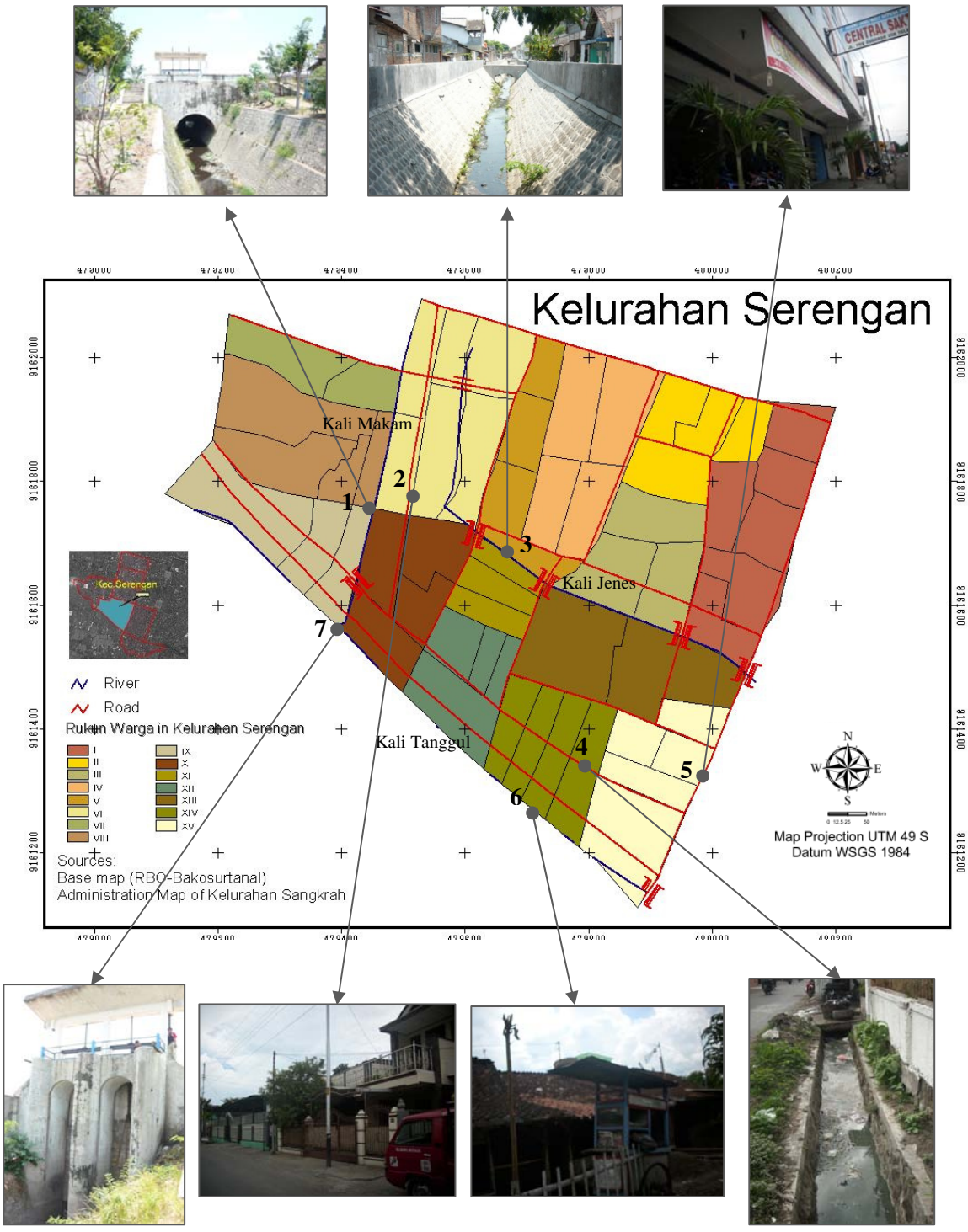

Figure 3.9. General overview of *Kelurahan* Serengan

Point 1: Kali Makam, one of the canals crossing over Kelurahan Serengan.
Point 2: A type of settelement in *Kelurahan* Serengan. In this village many settlement areas are well arranged. It can be observed from the structural type of the houses.
Point 3: *Kali* Jenes crossing over of the village.
Point 4: Bad drainage in one part of the village. The accumulation of garbage clogged the small canal. In the rainy season the road usually experiences minor inundation.

Point 5: Business and shopping complex on the main road. Many stores and offices are built on Kol. Yos Sudarso Street, one of the main streets in Surakarta City. In the rainy season some parts of this street experience minor inundation.
Point 6: Settelements built on top of the embankment along Kali Tanggul.
Point 7: Serengan Water Gate.

3.1.6. Characteristics of the Floods in 2007 in Surakarta City

Flooding in 2007 happened in Surakarta City and in surrounding sub-districts because of the high amount of rainfall in 25 December 2007 for almost 6 hours and in surrounding sub-districts (almost 200 mm/hour). The flood lasted 3-5 days in some areas, especially in Jebres and Pasar Kliwon sub-districts (see Figure 3.2 for the location). The rising of water level in the Bengawan Solo River and some dam failures in *Kali* Wingko and *Kali* Tanggul caused the flooding in *Kelurahan* Joyotakan. The overflow of the Bengawan Solo River and backwater also caused flooding in *Kelurahan* Sangkrah. The flooding occurred several times until the 2nd of January 2008. Some parts of the study area continue to experience floods every year during the rainy season. However, *Kelurahan* Serengan, as shown in figure 3.10., was not influenced by the floods in 2007.

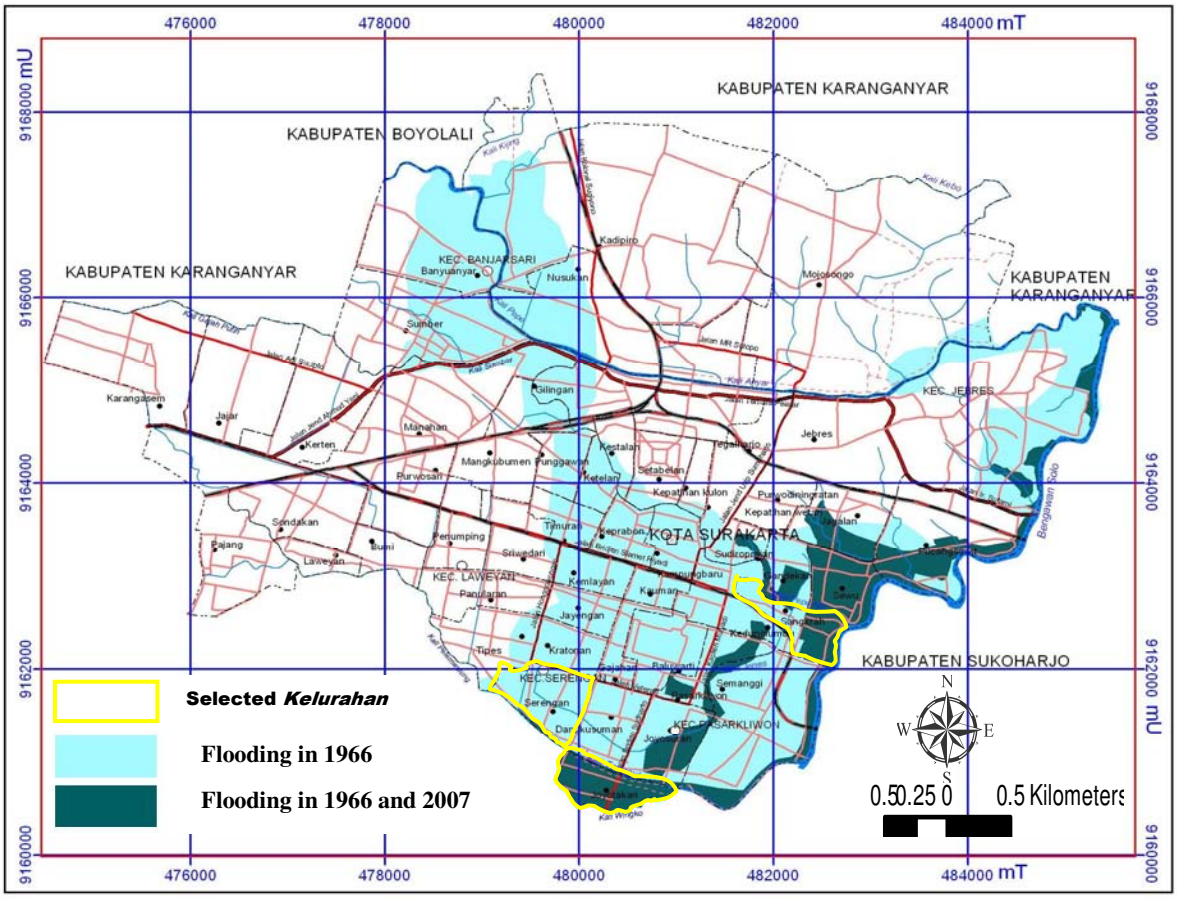

Figure 3.10. Flood extent in 2007 and 1966 (Source: Setiyarso, 2009)

Kecamatan Pasar Kliwon and *Kecamatan* Serengan suffered severe effect of floods in 2007. As many as 2,173 houses were damaged in *Kecamatan* Pasar Kliwon when the floods happened. *Kecamatan* Serengan was also one of severely flooded sub-districts in the floods event, especially in *Kelurahan* Joyotakan.

3.2. Methods

This research focused on analyzing the local community risk perception in some parts of Surakarta City which are often flooded. Study area were selected by using Purposive Sampling based on the level of their flood susceptibility from a susceptibility map generated by the previous research done by Prasetyo (2009) (see Figure 3.11).

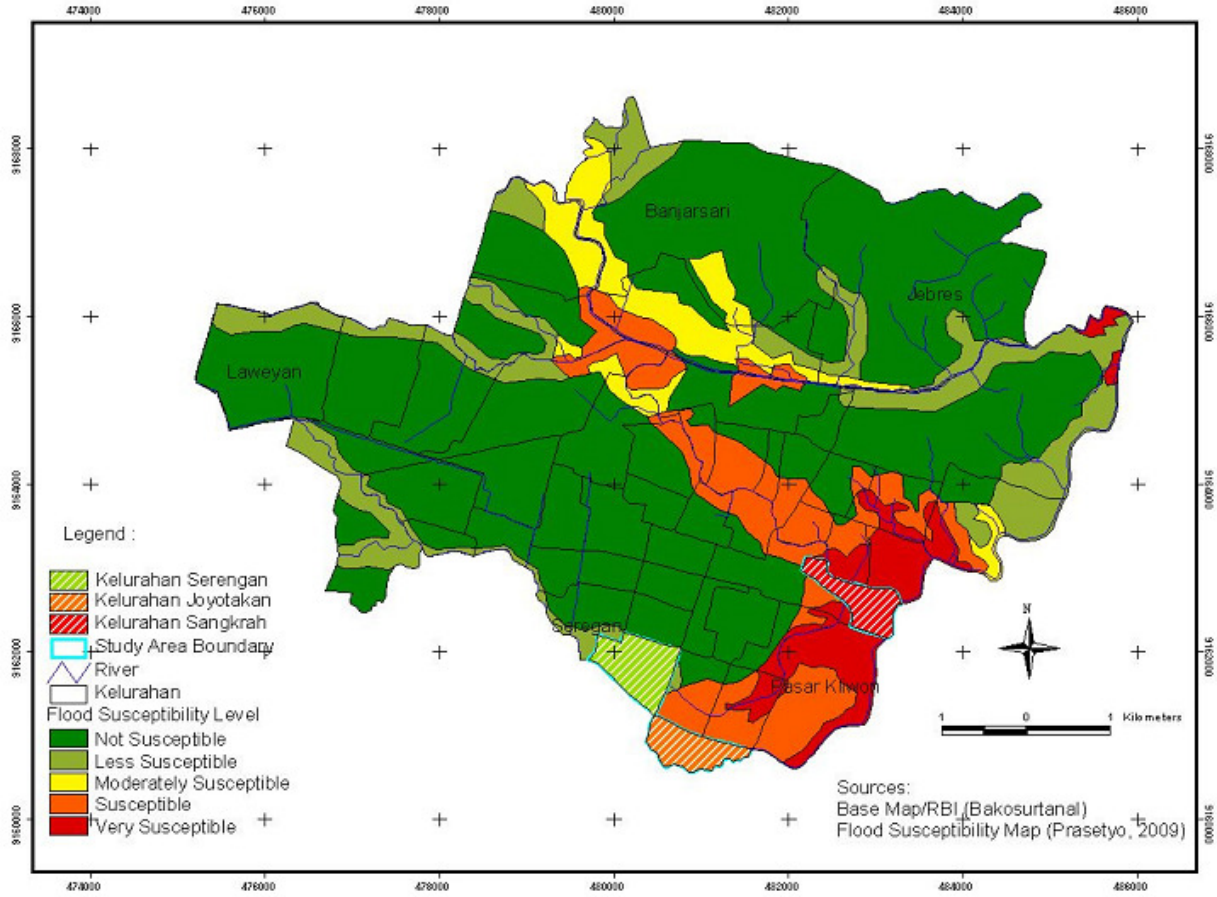

Figure 3.11. Flood Susceptibility Map of Surakarta City

Based on the map shown in Figure 3.11, two subdistricts (*kecamatan*) were chosen to represent three levels of flood susceptibility. These *kecamatan* are located near the riverbank of the Solo River and have been severely flooded in 2007. There are 16 villages (*kelurahan*) in the selected *kecamatan*. However, three *kelurahan* were chosen to be the study areas i.e. Sangkrah in *Kecamatan* Pasar Kliwon; Joyotakan and Serengan in *Kecamatan* Serengan. Those villages can be stratified as highly susceptible area, susceptible area and moderately susceptible area respectively. Then, sampled Rukun Warga (*RW*) were selected purposively in every *kelurahan*. This selection of *RW* process was based on the representation of the flood extention in 2007. Furthermore, in every selected *RW*, sampled RT were chosen purposively also based on floods event and their positions from the dike. Rukun Tetangga is the smallest administrative area in a *kelurahan* after *RW*. Finally, 150 households were selected to be interviewed from all selected RTs by using selected sampling based on the suggestion of the RT's heads. After determining samples to be interviewed, spatial distribution of respondents were made by transfering point stored in the GPS into ArcView software. The spatial distribution of the respondents can be seen in Figure 3.12, Figure 3.13 and Figure 3.14 for every *kelurahan*.

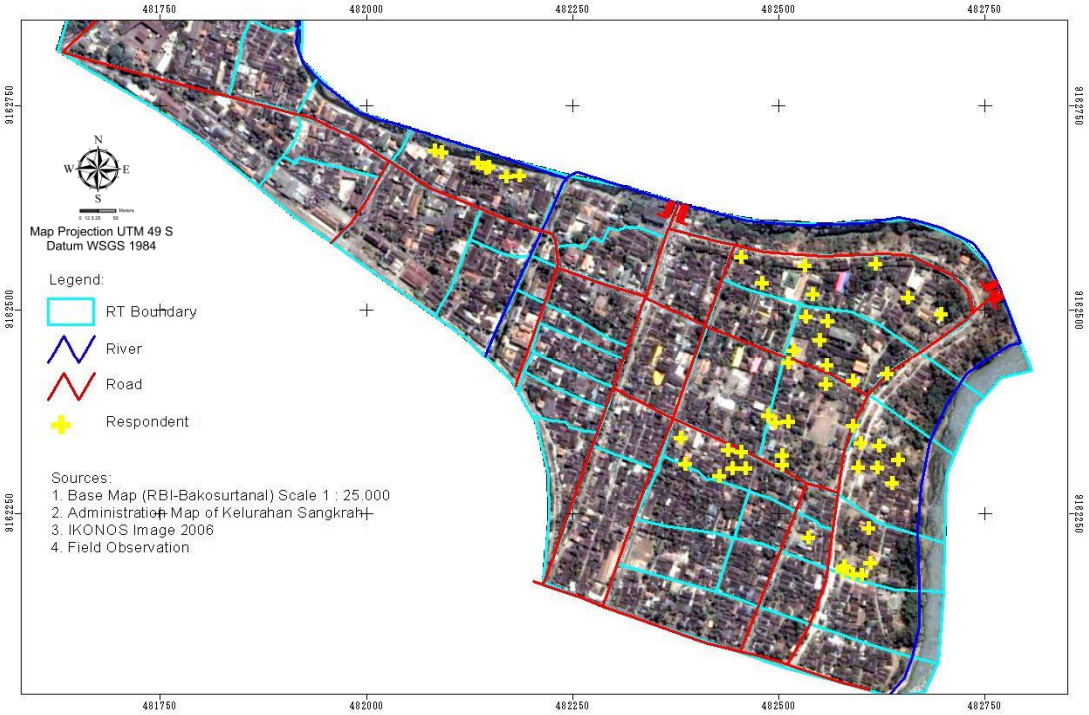

Figure 3.12. Spatial Distribution of Respondent in *Kelurahan* Sangkrah

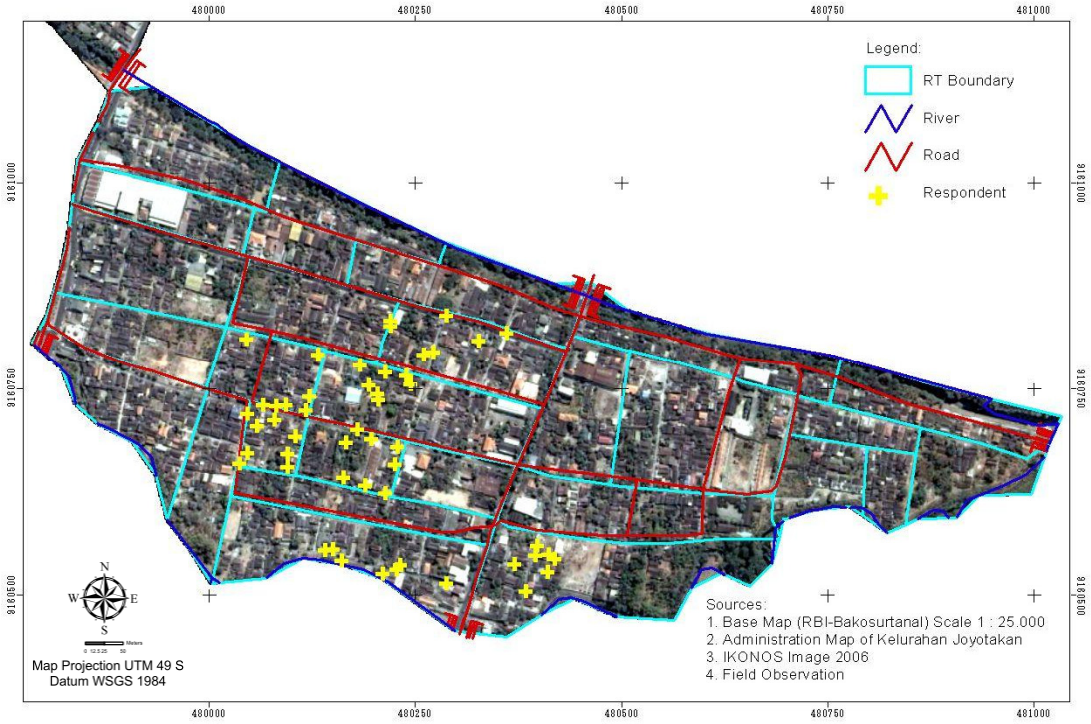

Figure 3.13. Spatial Distribution of Respondent in *Kelurahan* Joyotakan

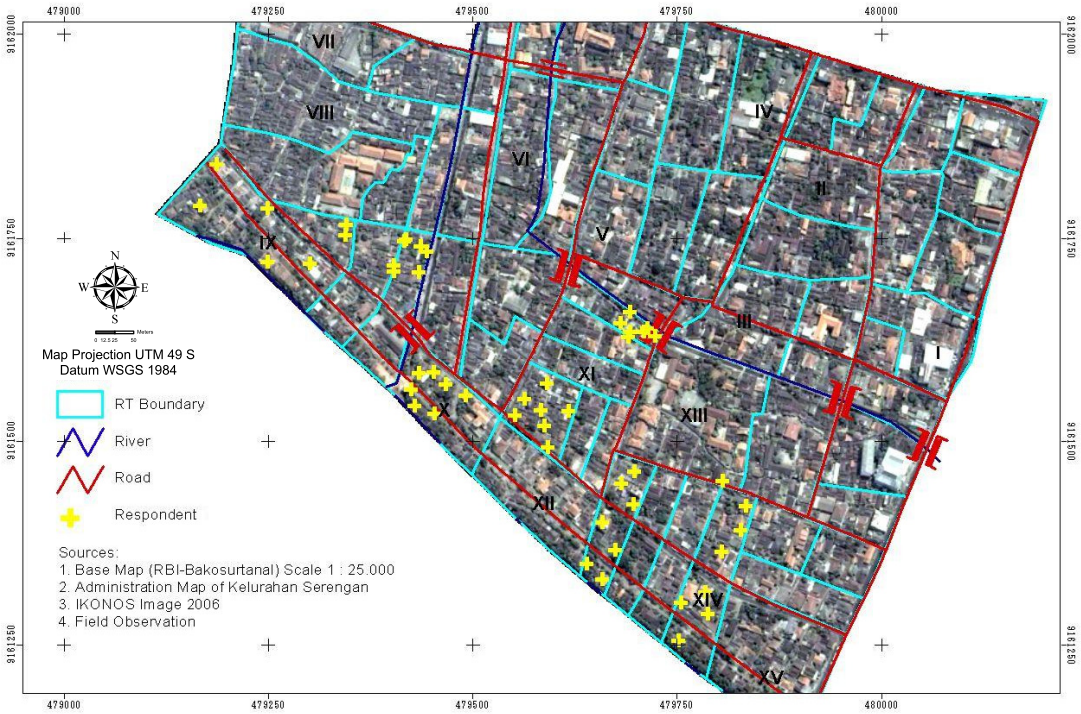

Figure 3.14. Spatial Distribution of Respondent in *Kelurahan* Serengan

The identification consists of several aspects including identification of flood risk perception of local communities, identification of the factor influencing the risk perception, and mapping of flood risk perception of local community. Besides, the research includes the coping mechanism done by people before, during and after the floods. The overall steps of this research are shown in Table 3.3.

Table 3.3. Research Methodology

Research Aims	Data Sources	Method	Data Analysis
Identify the flood risk and flood coping mechanism of the local community	Households	Questinaire survey of households	Qualitative analysis and descriptive analysis Quantitative analysis using SPSS software
Map the local community perception related to floods risk.	Community Leaders, Households	Focus Group discussion with community leaders and key informants Questinaire survey of households	Participatory mapping
Compare the coping strategies between Surakarta City and Semarang City	Previous research	Indentification of the previous researches on flooding	Comparative analysis and descriptive analysis
Identify mitigation plan based on community participation	Community leaders, Key informants	Focus group discussion with community leaders, and governmental officers Questionaire survey of households	Qualitative analysis and descriptive analysis

This research activities comprise actitivities divided into three stages; pre-fieldwork activities, fieldwork activities and post-fieldwork activities. Overall, the description research activities is depicted in Figure 3.15.

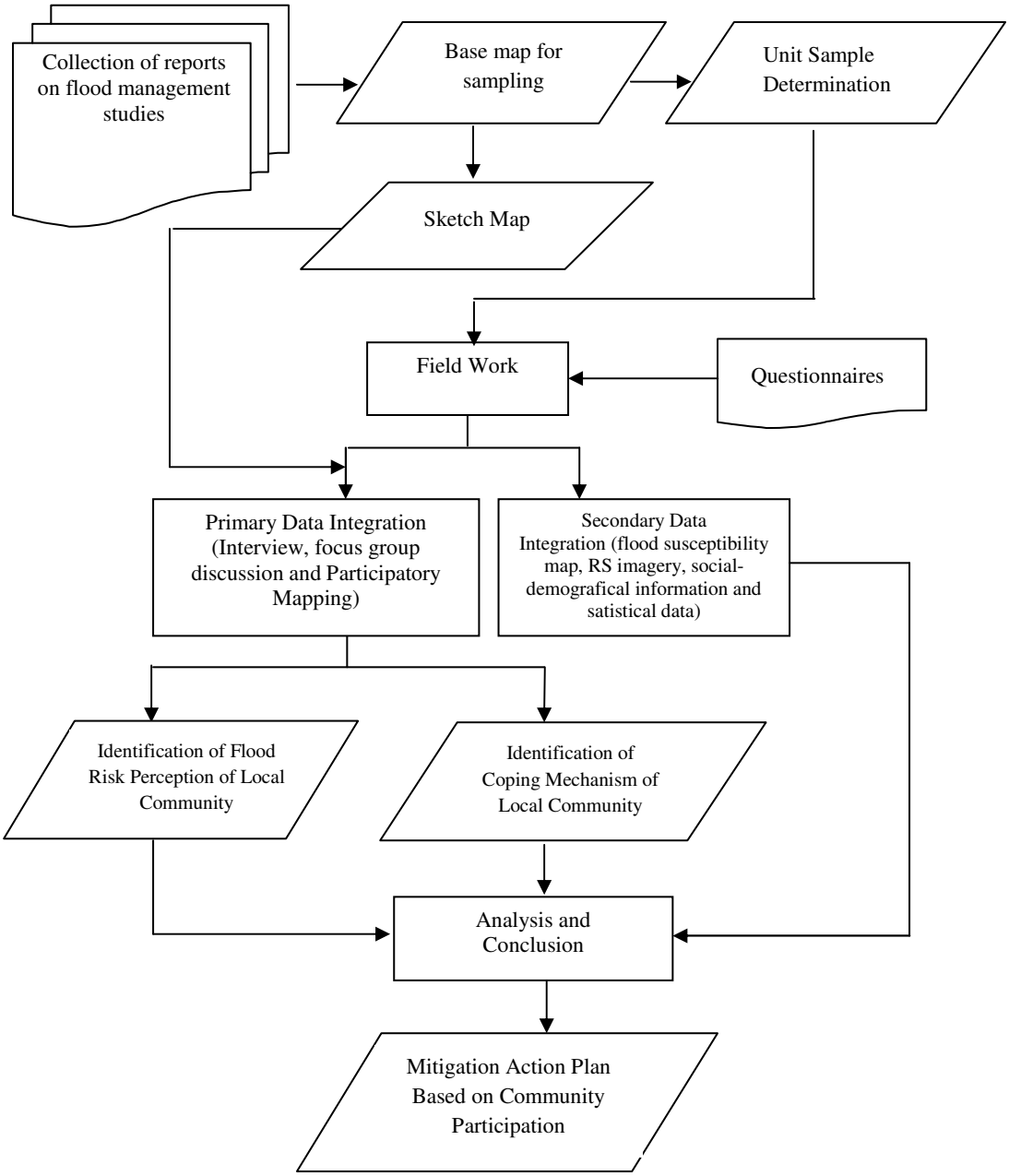

Figure 3.15. Research Activities

3.2.1. Pre-Field Work

The pre-field work activities were:

a. Intensive related literature review; The aim of this step is to strengthen the concept of the research. This phase consists of designing problem statement, objectives, formulating research questions, study of area and identification of available data.

b. Material and work preparation; The goals of this phase are to prepare and arrange all tools, materials and administrations that will be used for fieldwork.

c. Site observation; the aimed of this step is to obtained the real condition of the study area.

From literature review and site observation, the sampling method can be designed as well as the questionaire. The questionaire consists of six sections (see appendix 1). The first section tries to obtain personal information of the respondent (age, sex, education and occupation); second section is concerned with the household's profile (member of family and expense per-day). The

next section is focussed on flood occurrence (characteristics of late flooding based on the respondents' perception). The fourth section tries to get information about the element at risk (structure and age of the house and building content). The fifth section is focussed on coping mechanism employed against the floods' impacts. The last section tries to reveal the behavour and the feeling of respondent upon the floods impact and the flood occurrence in their village.

However, from the pre-fieldwork it was found that *Kelurahan* Serengan, which can be classified as less susceptible to flood area, was not influenced by the late floods in 2007 and 2008. Thus, the questionaire needs to be revised and adjusted by omitting and replacing some questions emphasizing on information of their perception and feelings upon the floods event and the victims of the floods (see Appendix 2).

3.2.2. Fieldwork

This phase was conducted in July-October 2009. There are two main activities in fieldwork phase; colecting the secondary data and primary data.

3.2.2.1. Secondary Data

Secondary data consists of the flood-susceptibility map and remote sensing imagery. Those were collected from related organizations and a number of sources. Besides, secondary data includes the social-demografical information and statistical data of the study areas. This can be usefull to do verification of the primary data.

3.2.2.2. Primary Data

Primary data collection was conducted by interviewing sampled households, governmental agencies such as The Surakarta Government, Public Work Service of Surakarta City, and other related organizations. Data was also collected from discussion with community leaders and key informants.

Primary data covers some variables such as: floods' depth, duration of inundation, flood extent, flood history, coping mechanism and social economic information of the respondents.

For participatory mapping, sketch map was used to draw the perception of community related to flooding. The respondents were asked to sketch their knowledge about the recent big flood event in 2007.

3.2.2.3. Households Interview

During fieldwork, the primary data was collected by interviewing respondents about the flood perception and coping mechanisms. In this research, a sample size in every *kelurahan* is 50 households. According to De Gier (2004) cited from Mandara (2007), sample size should be at least 25 or even 50; this will ensure how representative the sample among a homogenous population in the study area. In addition, digital camera was used to capture the overview of the study area, coping strategies and interview activities. MP4 recorder was employed to record information during the interview. The location of respondents were stored in GPS and the points were transferred into Arcview software to make the spatial distribution of the respondents.

3.2.2.4. Offices Interviews

In order to get integrated information about flood risk management in Surakarta City, there were discussions and consultation with the local authorities and related organization such as Nation Unity and Society Protection Agency (Kesbanglinmas) of Surakarta City, Public Work Agency (DPU) of Surakarta City and village institutions during the fieldwork.

Figure 3.16. Primary data collections in the study area;
(a, b, c) Household interviews (source: fieldwork, 2009); (d) Office interview (source: fieldwork, 2009)

3.2.2.5. Focuss Group Discussion and Participatory Mapping

In this research, participatory mapping was conducted through focus group discussions as shown in Figure 3.17. Participants were asked to draw on a sketch map based on high-resolution imagery (IKONOS), about their perception of previous flood event and draw the extent of the floods, the floods depth and duration of flooding. This is aimed to help the community to identify their own area, identify floods occurrences and to build their recognition about the potential threat of flooding. According to Tran et al. (2008) mapping is one of the effective tools to raise flood disaster awareness among communities. This participatory process can help local authorities and local people increase their sense of ownership over the process of planning and implementing the flood prevention projects.

Figure 3.17. Focus group discussions sessions and participatory mapping in *Kelurahan* Joyotakan (source: fieldwork, 2009)

3.2.3. Post Field Work

For the finalization of the fieldwork result, data was analyzed according to the objective of the research. Qualitative analysis was conducted by using literature review. Quantitative analysis was supported by SPSS.16 software to analyse the main variables. Spatial analysis was achieved by linking the database with tabular data to the spatial data into Arcview GIS Geodatabase.

In the post-fieldwork phase conclusions are drawn on the overall discussion of the analyses. To give input to the local government in designing a flood risk mitigation plan, the research comes up with an indentification of a mitigation plan based on local community perception of flooding and local community capacity.

4. Social Economic Profile and Flood Risk Perception of Respondents

This chapter describes the social economic profile of the respondents and the general information of the household based on the household interviews with 150 respondents from three selected villages so-called Kelurahan. It also illustrates the perception of the respondents on flood risk in 2007 based on some characteristics of floods and how they perceived the floods. The result from this chapter will be then used in the discussion in chapter 5.

4.1. Introduction

Identifying the coping mechanism employed by the local community, this research firstly tries to describe the social economic characteristics of respondents among the three villages, which have different magnitude of floods. It is assumed that in different magnitude of flooding, there will be different perception of how do people perceive the flooding and different type of coping strategies employed by the community.

In addition, it is believed that social and economic characteristics of respondent such as gender, age, education, and income per-month can, directly or indirectly, influence the perception of respondents related to flooding. Those variables are also considered as indicators of people's capacity in dealing with flooding.

4.2. Social Economic Profile of Respondent

4.2.1. Gender

From the interviews, it is appeared that the percentage of male respondents is higher than female respondent (see table 4.1.). Of total, more than 50 % respondents are male and approximately 40% are female. This is reasonable since most of the household's heads are working in the non-formal sectors such as trader, laborer, and tailor that will be presented further later. The large number of female respondent can also be explained since the interviews were conducted during the day and most of the women are housewives who can be easily met in the house.

Table 4.1. Distribution of respondents based on gender

Gender	Frequency	Percent (%)
Male	87	58.0
Female	63	42.0
Total	**150**	**100.0**

4.2.2. Age

The ranges of respondents' age varied from 20 until more than 70 years old. Overall, respondents interviewed mostly are from productive ages ranged from 20 - 60 years old. Only 18.6 % of total respondent are from the elder ages (61 – more than 70 years old). The distribution of respondent based on their age can be seen in Table 4.2.

Table 4.2. Distribution of respondents based on age

Age (year)	Frequency	Percent (%)
20 - 30	14	9.3
31-40	25	16.7
41-50	39	26.0
51-60	***44***	***29.3***
61-70	20	13.3
>70	8	5.3
Total	**150**	**100.0**

4.2.3. Education

The interview results show that 42 % of the respondents are graduated from elementary school, 23 % from junior high school and 21% from senior high school. Only 8 % of the total respondents graduated from a college. However, there are also 7 respondents who did no schoolling at all. Distribution of respondent based on education level is shown in Table 4.3.

Table 4.3. Distribution of respondents based on level of education

Level of education	Frequency	Percent (%)
Un-educated	7	4.7
Elementary School	***64***	***42.7***
Junior High School	35	23.3
Senior High School	32	21.3
College	12	8.0
Total	**150**	**100.0**

4.2.4. Occupation

There are nine types of respondents' occupation found during the interview. Respondents in the study areas mostly work in the non-formal sectors. More than 30 % of total respondents are trader and more than 23 % are laborer, while the rest are teachers/lectures (6%), retired officers (8.7%) and housewives (12 %). These conditions apparently made it easier to meet the head of the households since the men work at the house. Even if the head of households are not in the house, housewives and working-housewives who also have side jobs as trader and laborer. It was possible to meet them during the fieldwork. Table 4.4. shows the distribution of respondents' based on their occupation.

Table 4.4. Distribution of respondents' based on their occupation

Occupation	Frequency	Percent (%)
Teacher/lecturer	9	6.0
Government Officer	5	3.3
Trader	***50***	***33.3***
Farmer	8	5.3
Laborer	*35*	*23.3*
Housewife	19	12.7
Tailor	4	2.7
Retired	13	8.7
others	7	4.7
Total	**150**	**100.0**

4.3. Information of Households

4.3.1. Income per-month

From the interviews, respondents in three *kelurahan* have seven ranges of income per-month. The lowest range of income is around Rp. 50,000 – 750,000 per-month, represented by 21 respondent. About 28% of the total respondents have an income around Rp. 750,000 – 1,000,000 per-month. Fifty respondents (33.3% of the total respondent) have a higher income around Rp. 1,000,000 – 1,500,000 per-month and 12% of total respondent represents the income ranging Rp. 1,500,000 - Rp.2000,000. The three highest income-ranges are between Rp. 2,000,000 until more than 3,000,000 and represent approximately 12 % of the total respondents. Table 4.5. ilustrates the distribution of respondents based on the income per-month.

Table 4.5. Distribution of respondent based on income per-month (Rupiah)

Income per-month (Rp.)	Frequency	Percent (%)
500,000-750,000	21	14.0
750,000-1,000,000	43	28.7
1,000,000-1,500,000	***50***	***33.3***
1,500,000-2,000,000	18	12.0
2,000,000-2,500,000	11	7.3
2,500,000-3,000,000	6	4.0
>3,000,000	2	1.3
Total	**150**	**100.0**

4.3.2. Expense per-day

The households interviews indicated that the expenses for meals and transportation every day for a family was quite varied. There are six ranges of expense per-day among the households, which are from the lowest (below Rp. 10,000 per day) until the highest (above Rp. 50,000 per day). Only three households spend less money than Rp.10,000 per day for meals and transportation. Most households interviewed, which is more than 40 % of the total respondent, have expense around Rp. 20,000 – Rp. 30,000 every day. Besides, almost 30 % of total respondent spend Rp. 10,000 – 20,000 per day for the family. Only 7 % of the all of respondent spend money more than Rp. 40,000 every day for their family needs. Table 4.6. shows the distribution of respondents expense every day for the family needs.

Table 4.6. Distribution of respondents based on expense per-day (Rupiah)

Expense per-day (Rp.)	Frequency	Percent (%)
<10000	3	2.0
10000-20000	43	28.7
20000-30000	***65***	***43.3***
30000-40000	28	18.7
40000-50000	9	6.0
>50000	2	1.3
Total	**150**	**100.0**

4.3.3. Household's size

The size of households interviewed is quite varied (see Table 4.7). The two largest sizes of households are six members and more than six family members, represent both 4.7% of total respondent have the amount. The rest numbers of family are distributed evenly. Twelve percent of all of respondent has only one member in their families. More than 19 % have two members and 26.7% has three members of families.

Table 4.7. Distribution of respondent based on number of family member

No of family member (person)	Frequency	Percent (%)
1	18	12.0
2	29	19.3
3	***40***	***26.7***
4	29	19.3
5	20	13.3
6	7	4.7
>6	7	4.7
Total	**150**	**100.0**

4.3.4. Structure of the house

The house's structure can be grouped, based on the roof, wall and floor material. There are two types of roof materials e.g. zinc and clay. While five types of wall material are concrete, wood, plywood, bamboo and mixed materials. Floor material can be classified into three types, which

are ceramic, cement and tile. Cross tabulation of the roof, wall and floor materials can be seen in table 4.8.

Table 4.8. Cross tabulation of wall material, floor material and roof material of the respondents' houses

Roof material	Wall Material	Floor material			Total
		Ceramic	Cement	floor tile	
Zinc	Concrete	3	4	0	7
	Bamboo	0	1	0	1
	Mix	0	1	0	1
Total		**3**	**6**	**0**	**9**
Clay	Concrete	***59***	***39***	1	99
	Wood	1	***25***	0	26
	Plywood	0	1	0	1
	Bamboo	0	2	0	2
	Mix	1	***10***	2	13
Total		**61**	**77**	**3**	**141**

From the cross tabulation result, it can be found that the most common type of the house structure in the study area is the combination of clay, concrete and ceramic as the roof, wall and floor material respectively, which is represented by 59 respondents. Then, combination of clay for roof material, concrete wall material and cement floor material also has a bigger number of respondent (39 respondents) compare to other types of house structure. In addition, a large number of respondents (25 respondents) also represent combination of clay roof material, wood for wall material and cement for floor material.

Overall, there are four main structural types, namely houses with clay roof, concrete wall and ceramic floor; clay roof, concrete wall and cement floor; clay roof, wood wall and ceramic and clay roof, mixed wall and cement floor which are shown in Figure 4.1.

a. Clay-Concrete-Ceramic

b. Clay-Concrete-Cement

c. Clay-Wood-Cement

d. Clay-Mixed-Cement

Figure 4.1. Four main combinations of structural types of respondents' house in study area

Based on the description of the social economic characteristics of the respondents, it is found that most of the people who live in the study area work as trader and laborer. In addition, most of respondents only have education until elementary school and junior high school only. Thus, these facts could indicate that in this urban poor area, the people have relatively low income and low level of education as well.

4.4. Respondent's Perception of Flooding

People that have been interviewed in the study areas have almost the same perceptions of the 2007 multi-event flood event. According to their perceptions, the floods in 2007 happened three times during one week. The first floods occurred on 26 December 2007 in the middle of the day and reached maximum breast height. In the next day, when the water recedes, the people went back to their houses and cleaned up all the mess. Unfortunately, in the middle of the night of 27 December 2007, a bigger flood arrived and they did not have time and energy to evacuate their belongings that they have already moved to lower places again. The water even reached the head height and the stream was very strong. This flooding caused many damages and losses for the people. Then the last flooding peak happened in 28 December 2007 which reached also head height. However, the people have varied perception of flood duration, flood depth inside the house, days of maximum flood depth, flood frequency, the cause of floods, and the severity of floods perceived by the community.

4.4.1. People's Perception of Flood Depth inside the House

In 2007 respondents experienced quite varied of flood height. In areas experienced the flooding, floods depth ranged between 0.5 – 4 meters. *Kelurahan* Sangkrah mostly experienced inundation ranging from less than 1 meter until 2 meters high. While in *Kelurahan* Joyotakan, most of respondents (more than 50% of the respondents in the village) experienced flooding of about 1.5 until 2 meters high. While in the area which is less susceptible to flood, there is no flood occurred. Table 4.9 illustrates the distribution of maximum flood depth inside the house perceived by the respondents in study area.

Table 4.9. Maximum floods depth in 2007 inside the house based on respondents' perception

Floods depth (m)	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
No flood	0.0	0.0	***100.0***
<1	***26.0***	2.0	0.0
1	***30.0***	12.0	0.0
1.5	16.0	***28.0***	0.0
2	18.0	***42.0***	0.0
2.5	2.0	14.0	0.0
3	6.0	2.0	0.0
4	2.0	2.0	0.0
Total	**100.0**	**100.0**	**100.0**

Different maximum flood height perceived within the house varies according to the height of the building above sea level (elevation) and flood proofing measures like raised entrances, raised foundation of the house, etc. The distribution of maximum flood depth perceived by the community can be presented spatially. Spatial distribution map of every *kelurahan* can be seen in Figure 4.2., Figure 4.3., and Figure 4.4 below.

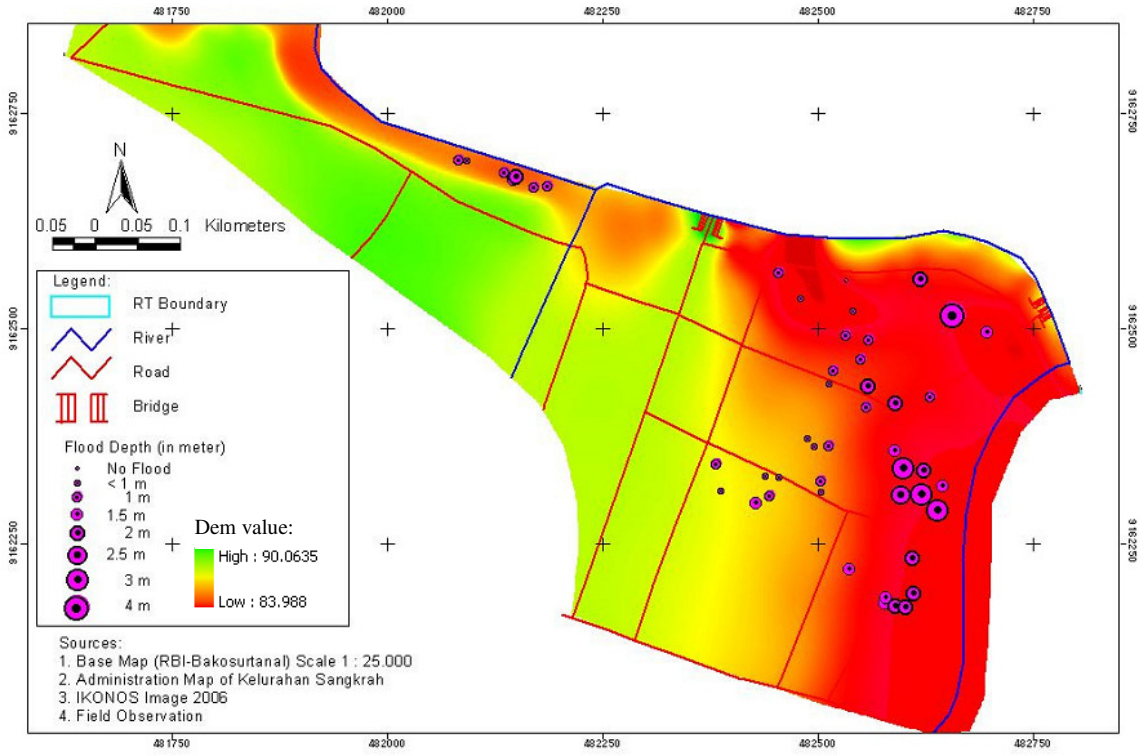

Figure 4.2. Spatial distribution of maximum flood depth inside the house perceived by the people in *Kelurahan* Sangkrah

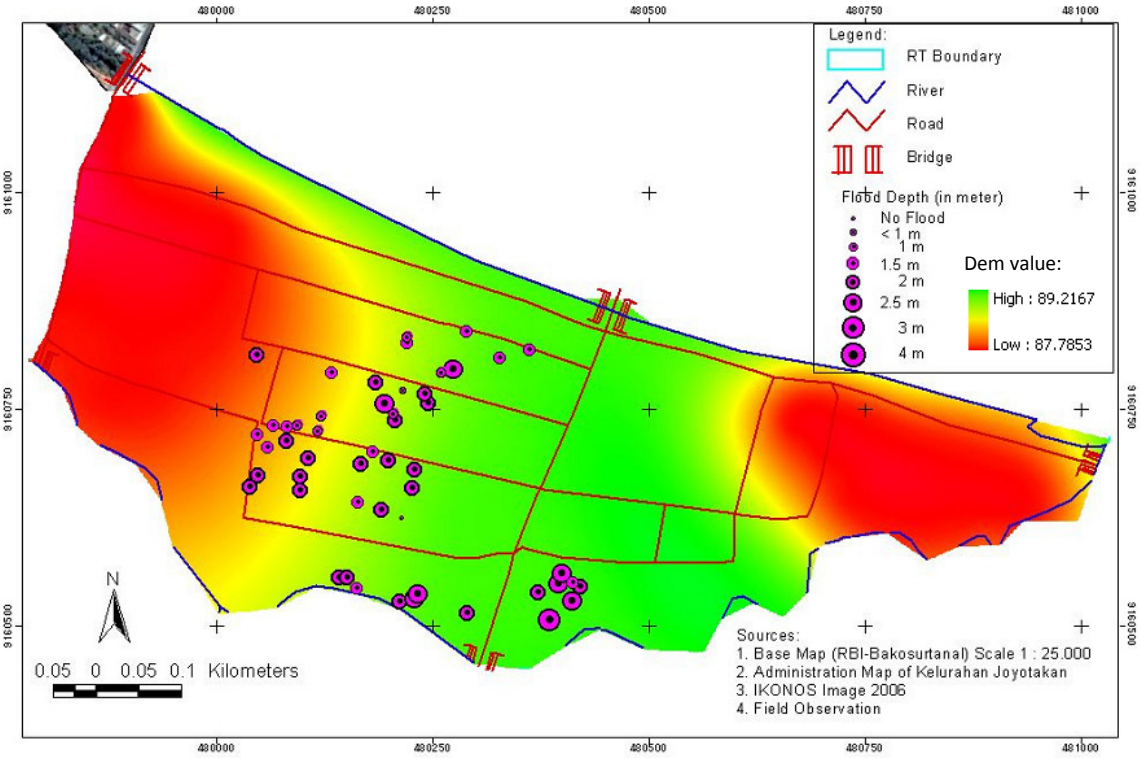

Figure 4.3. Spatial distribution of maximum flood depth inside the house perceived by the people in *Kelurahan* Joyotakan

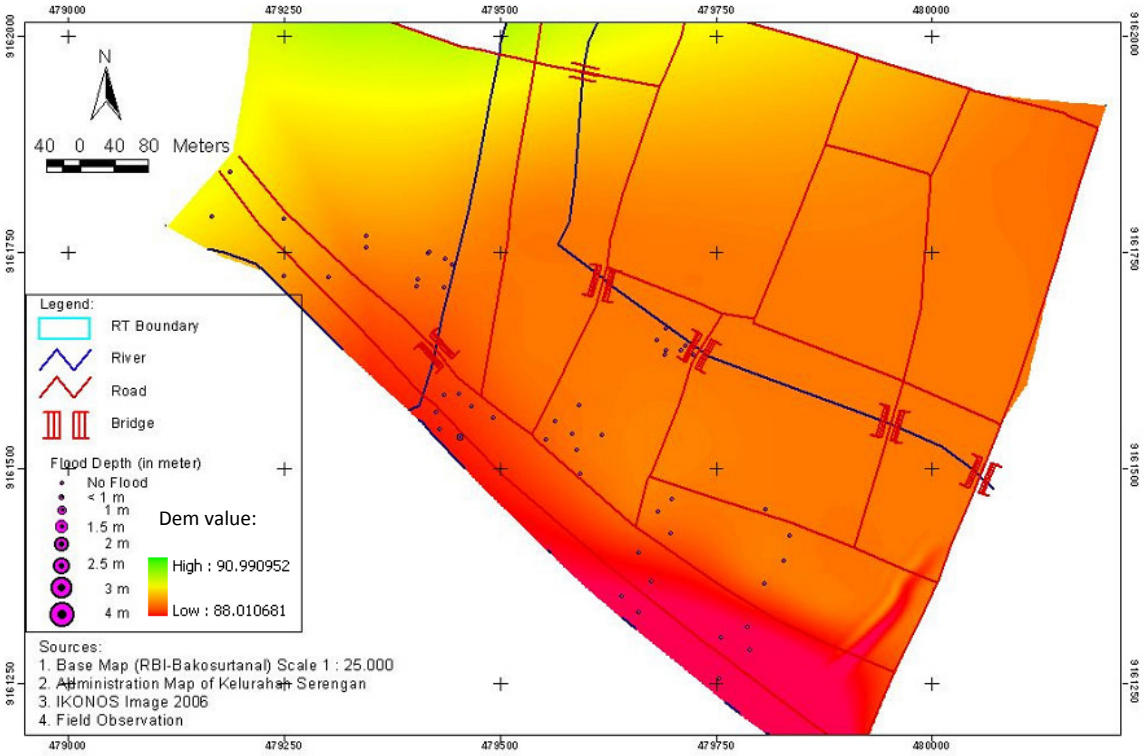

Figure 4.4. Spatial distribution of maximum flood depth flood depth inside the house perceived by the people in *Kelurahan* Serengan

4.4.2. People's Perception of Flood Duration

Based on the interviews, flood duration in the areas which influenced by the flooding is varied from 1 – 7 days (see Table 4.10). Almost 50% of the respondents in *Kelurahan* Sangkrah experienced flooding as long as 7 days and 28% of the respondents in the village suffered flooding for 3 days. While most of the respondents in *Kelurahan* Joyotakan (34% of total respondents in the village) experienced 7 days flooding followed by some respondents suffering 3 days flooding in 2007. In *Kelurahan* Serengan there was no flooding occurrence. That is why there was no data of flood duration can be found in this area.

Table 4.10. Flood duration based on people's perception

Duration (day)	**Kelurahan**		
	Sangkrah (%)	**Joyotakan (%)**	**Serengan (%)**
No Flood	0.0	0.0	***100.0***
1	0.0	0.0	0.0
2	4.0	2.0	0.0
3	28.0	28.0	0.0
4	14.0	16.0	0.0
5	6.0	14.0	0.0
6	0.0	6.0	0.0
7	***48.0***	***34.0***	0.0
Total	**100.0**	**100.0**	**100.0**

The distribution of flood duration perceived by the community can be presented spatially. Spatial distribution map of every *kelurahan* can be seen in Figure 4.5., Figure 4.6., and Figure 4.7.

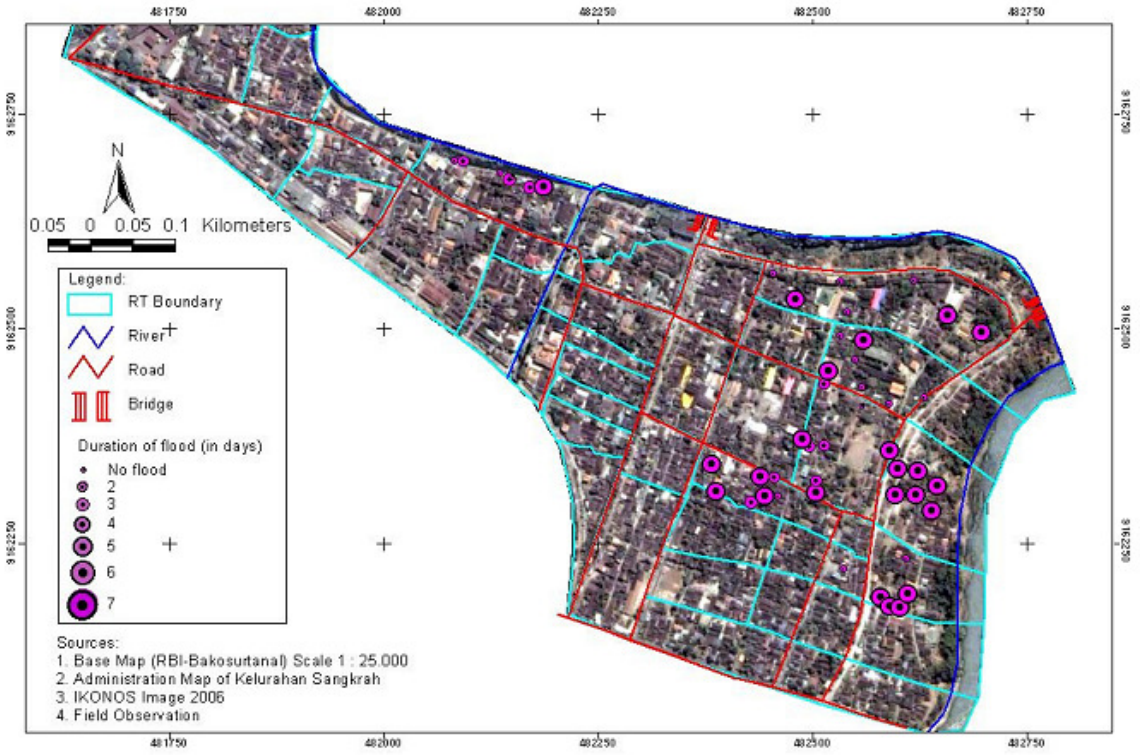

Figure 4.5. Spatial distribution of flood duration based on people perception in *Kelurahan* Sangkrah

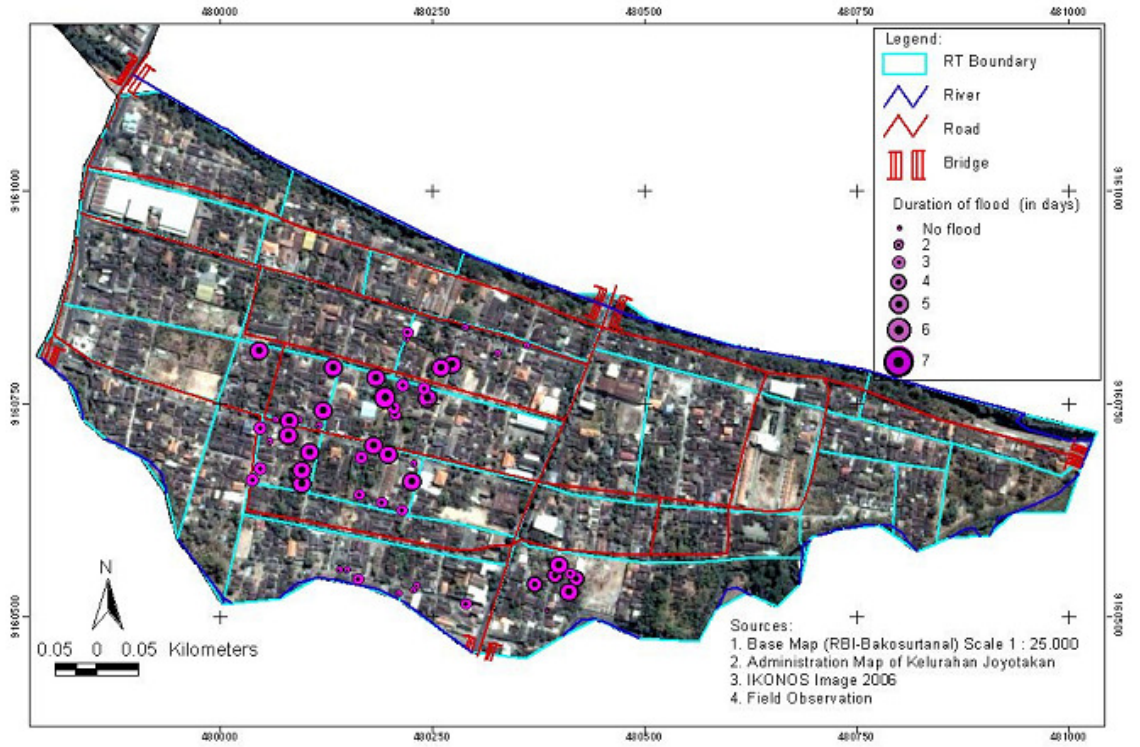

Figure 4.6. Spatial distribution of flood duration based on people perception in *Kelurahan* Joyotakan

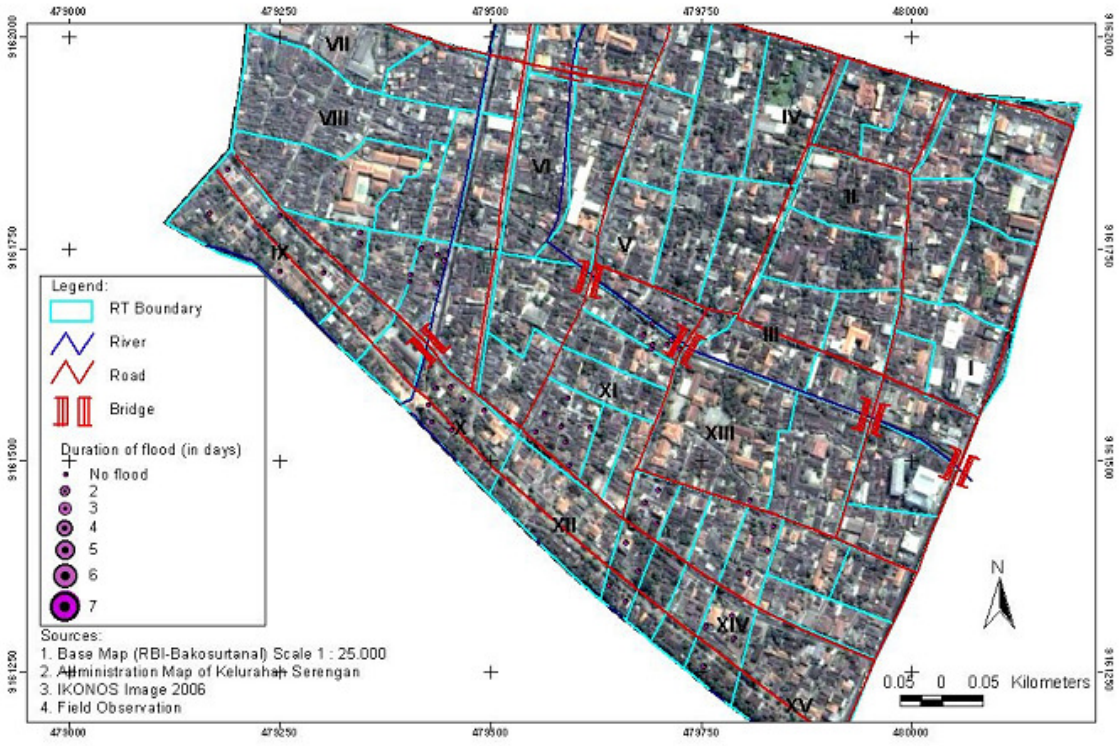

Figure 4.7. Spatial distribution of flood duration based on people perception in *Kelurahan* Serengan

4.4.3. People's Perception of Day of Maximum Flood Depth

Since there were differences in flood 2007 characteristics between in *Kelurahan* Joyotakan and *Kelurahan* Sangkrah, there is a difference as well in day of maximum inundation in those areas. This made the answers of respondents various (see Table 4.11). According to 62% of total respondent in Kelurahan Sangkrah, maximum flood depth occurred on the second day of the flooding. A bit different answer came from most of the respondents in *Kelurahan* Joyotakan. More than 70% of respondents in the village informed that the highest flood depth happened in the second and the third day of flooding. However, since there was no flooding occurrence in *Kelurahan* Serengan, there was no data of the time maximum floods occurrence found in this area.

Table 4.11. Day of maximum floods based on perception of respondents

Day	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
No Flood	0.0	0.0	***100.0***
day 1	26.0	22.0	0.0
day 2	***62.0***	***38.0***	0.0
day 3	10.0	***40.0***	0.0
day 4	0.0	0.0	0.0
day 5	2.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**

4.4.4. People's Perception of Flood Frequency

The frequency of flood occurrence in the study area within 5 years time also has variation. More than 60 % of total respondent in *Kelurahan* Sangkrah experienced flooding less than 3 times in a year and 22% underwent 3 times floods annually. While, according to 46% and 30 % of total respondents in *Kelurahan Joyotakan* experienced less than 3 times flooding and 3 times flooding respectively. In addition, due to no flooding occurrence in *Kelurahan* Serengan, there was also no

data of the frequency of floods' occurrence found in this area. Table 4.12. shows the distribution of flood frequency per year in the study area.

Table 4.12. Floods' frequency per year within 5 years time

Floods' Frequency (time/year)	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
Never	0.0	2.0	***100.0***
<3	***64.0***	***46.0***	0.0
3	22.0	***30.0***	0.0
4	12.0	18.0	0.0
5	2.0	0.0	0.0
7	0.0	4.0	0.0
Total	**100.0**	**100.0**	**100.0**

The distribution of flood frequency perceived by the community can be presented spatially. Spatial distribution map of every *kelurahan* can be seen in Figure 4.8., Figure 4.9., and Figure 4.10.

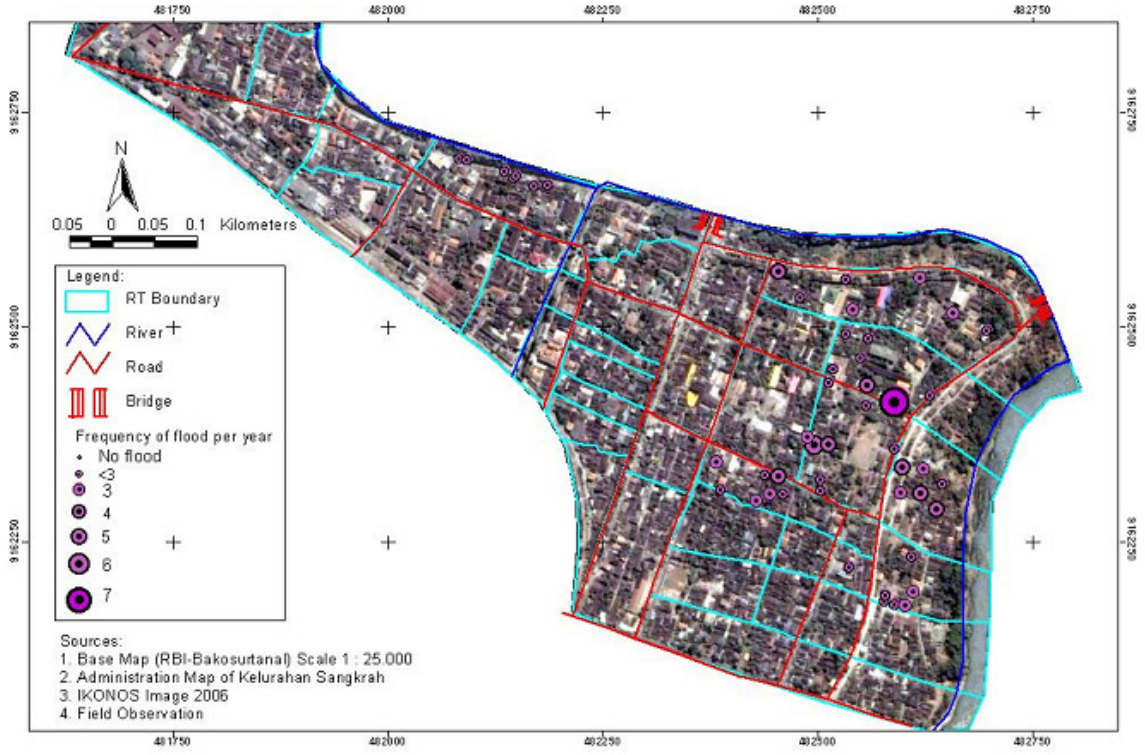

Figure 4.8. Spatial distribution of flood frequency based on people perception in *Kelurahan* Sangkrah

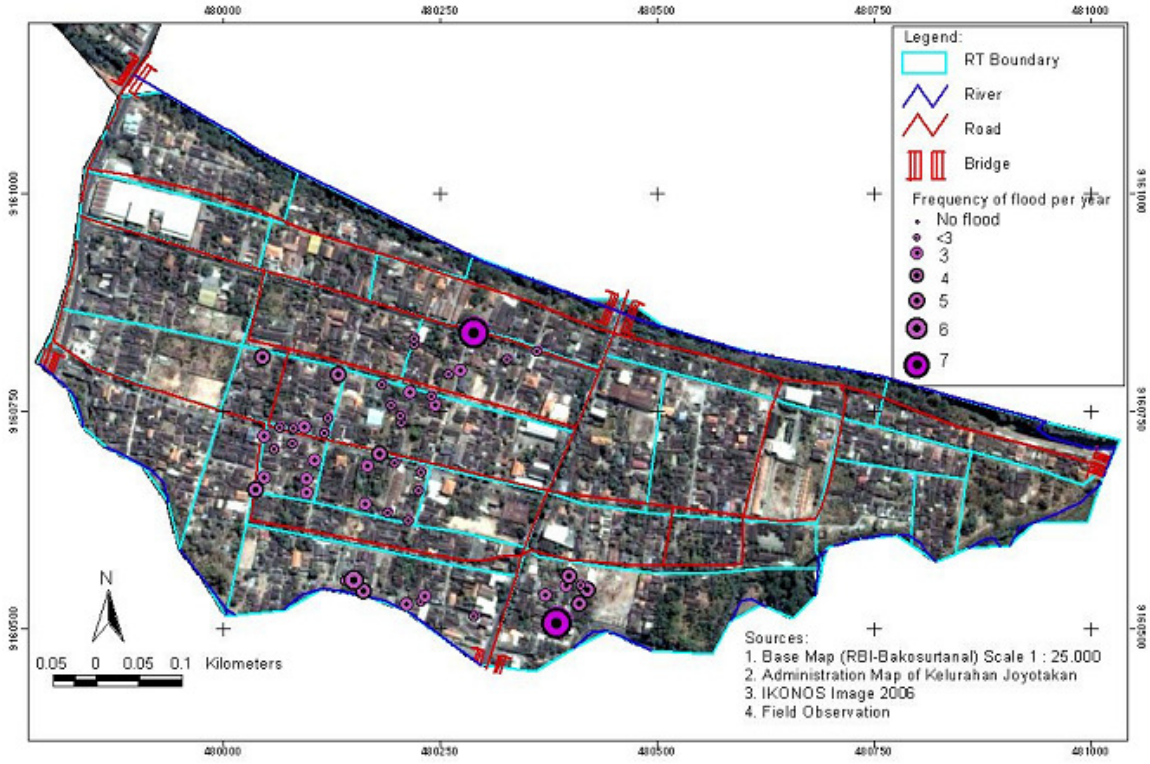

Figure 4.9. Spatial distribution of flood frequency based on people perception in *Kelurahan* Joyotakan

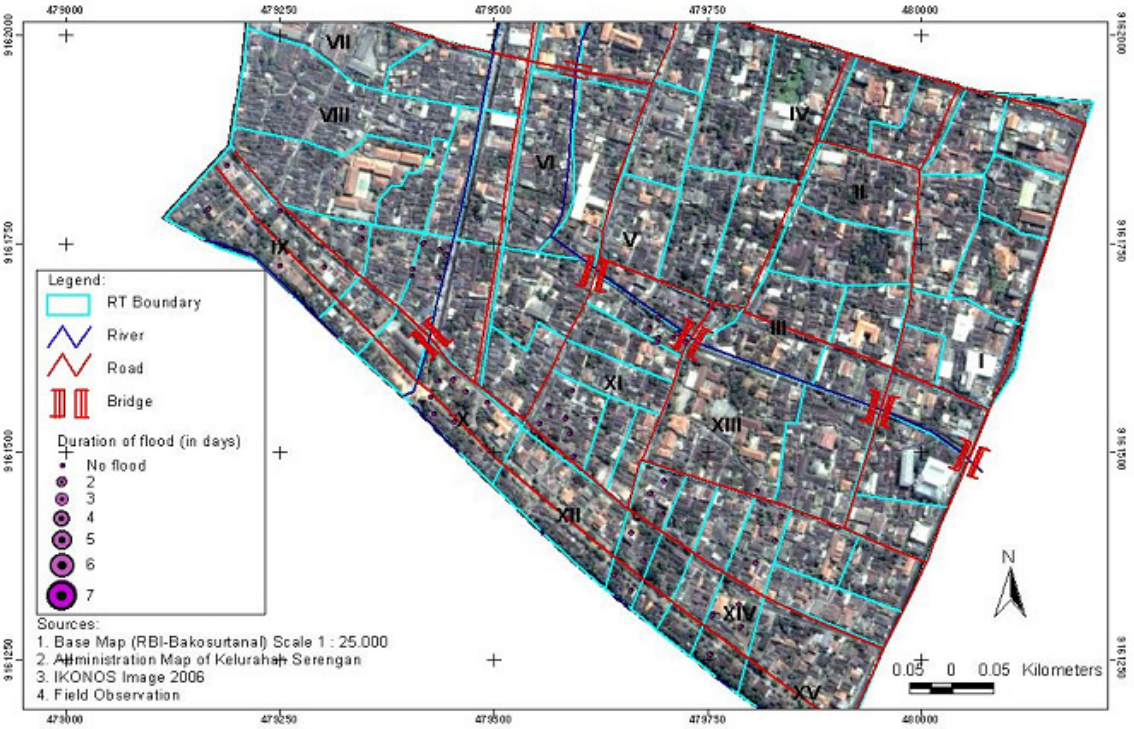

Figure 4.10. Spatial distribution of flood frequency based on people perception in *Kelurahan* Serengan

Furthermore, Most of the respondents in the study area have no experience with big flooding such as severe flood in 1966. This is reasonable since in those areas there are a lot of migrate inhabitants which do not originally came from Surakarta City. The distribution of respondent based on the big flood's experience can be seen in Table 4.13.

Table 4.13. Information of people's experience of big floods

Experienced big floods	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
Yes	30.0	32.0	36.0
No	***70.0***	***68.0***	***64.0***
Total	**100.0**	**100.0**	**100.0**

There is only a small number of respondent experienced the big flood in 1966. Among the respondents there are elderly people interviewed. Most of the respondents in the study area experiencing the flooding are ranging from 51-60 years old, 61-70 years old and older than 70 years old. Table 4.14 shows the cross tabulation between age of respondent and their experience of big flood in 1966.

Table 4.14. Cross tabulation of respondents' age and big flood experience

Age (year)	Big flood experience (frequency)					
	Sangkrah		Joyotakan		Serengan	
	Yes	No	Yes	No	Yes	No
20-30	0	9	0	3	0	2
31-40	0	5	5	8	0	7
41-50	2	11	5	6	0	15
51-60	5	8	4	11	9	7
61-70	5	0	1	5	9	0
>70	3	2	1	1	0	1
Total	**15**	**35**	**16**	**34**	**18**	**32**

4.4.5. People's Perception of Flood Severity

Flood 2007 in Surakarta City extended over the city including in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan. Nevertheless, the impacts of the flood event, of course, influence almost all the people living in the city both directly or indirectly. In the interview, respondents were asked about their perception on the level of how severe the flooding perceived in 2007. There are three level of flood severity perceived by the local community; no problem, nuisance and disastrous.

According to Dewi (2007), the flood is perceived as normal or no problem when the impacts of the flooding do not affect daily activities of the community whatsoever. On the other hand, the flooding is in the nuisance level of severity when it starts to give any negative impact, which disturbs, injures, and endangers the comfort, health and properties of the people. Further, disastrous, then, refers to a disaster, when the negative influences of flooding is not only threaten their properties but also directly threaten their lives.

In Table 4.15, it can be seen that most of respondents in *Kelurahan* Sangkrah (80%) and *Kelurahan* Joyotakan (56%) perceived the flooding as nuisance event. While 40% of total respondent in Kelurahan Serengan perceived the flooding as no problem.

Table 4.15. Flood severity perceived by the local people in the study area

Flood Severity	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
No Problem	2.0	4.0	***40.0***
Nuisance	***80.0***	***56.0***	32.0
Disastrous	18.0	40.0	28.0
Total	**100.0**	**100.0**	**100.0**

Over all, from the interview, it can be found out that most of people who have not experienced floods consider the flood event as normal event. They do not feel the impact of flood influenced their daily lives. On the other hand, more than 50 % of total respondent think that the flood event is a nuisance occurrence that can damage their properties but it did not threaten their lives and 28.7% of total respondent perceived the flood as disastrous event. Table 4.16 described the cross tabulation between flood duration and the severity of flood in 2007 perceived by the community,

while table 4.17 shows the cross tabulation between the flood's depth and the severity of floods in 2007 perceived by the people.

Table 4.16. Cross tabulation of floods duration and flood's 2007 severity perceived by the local community

Flood duration (day)	Flood's 2007 Severity (frequency)								
	Sangkrah			Joyotakan			Serengan		
	No Problem	Nuisance	Disastrous	No Problem	Nuisance	Disastrous	No Problem	Nuisance	Disastrous
No flood	0	0	0	0	0	0	***20***	***16***	14
2 days	0	2	0	0	0	1	0	0	0
3 days	0	***11***	3	0	***12***	2	0	0	0
4 days	0	7	0	0	3	5	0	0	0
5 days	0	2	1	2	4	1	0	0	0
6 days	0	0	0	0	2	1	0	0	0
7 days	1	***18***	5	0	7	***10***	0	0	0
Total	**1**	***40***	**9**	**2**	***28***	***20***	***20***	***16***	**14**

Table 4.17. Cross tabulation of floods depth and flood's 2007 severity perceived by the local community

Flood depth(m)	Flood's 2007 Severity (frequency)								
	Sangkrah			Joyotakan			Serengan		
	No Problem	Nuisance	Disastrous	No Problem	Nuisance	Disastrous	No Problem	Nuisance	Disastrous
No flood	0	0	0	0	0	0	20	16	14
<1	1	***12***	0	0	1	0	0	0	0
1	0	***14***	1	0	5	1	0	0	0
1.5	0	6	2	1	8	5	0	0	0
2	0	4	5	1	***12***	8	0	0	0
2.5	0	1	0	0	2	5	0	0	0
3	0	3	0	0	0	1	0	0	0
3.5	0	0	0	0	0	0	0	0	0
4	0	0	1	0	0	0	0	0	0
Total	**1**	***40***	**9**	**2**	***28***	***20***	***20***	***16***	**14**

In table 4.17, it can be seen that most respondents who experienced no flood until 3-meters water depth perceived the flood as nuisance event. On the other hand, a number of respondents who experienced flood with 2 meter up of water depth perceived the flood as a disastrous occurrence. While people who lived in save area, have various opinions about the severity of the flood but most of them perceived the flood as a normal event which did not disturb their daily activities and nuisance event which did not threaten their lives. The distribution of severity of flood perceived by the community can be presented spatially. Spatial distribution map of every *kelurahan* can be seen in Figure 4.11 and Figure 4.12.

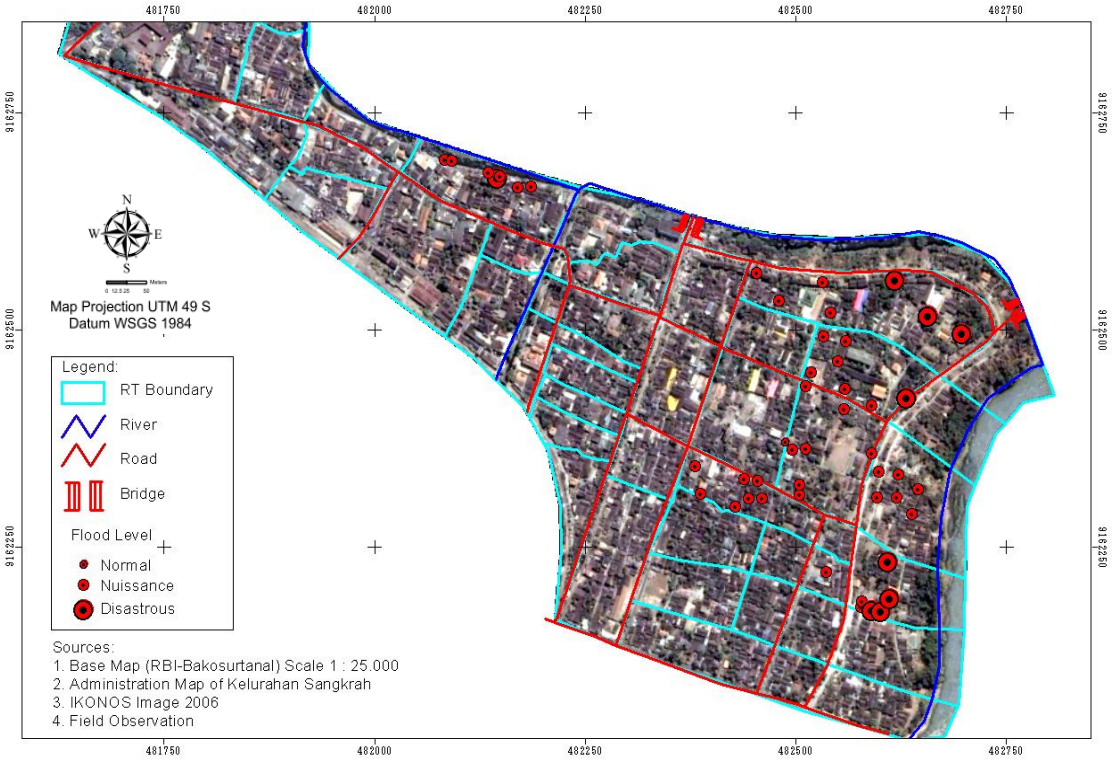

Figure 4.11. Spatial distribution of flood severity based on people perception in *Kelurahan* Sangkrah

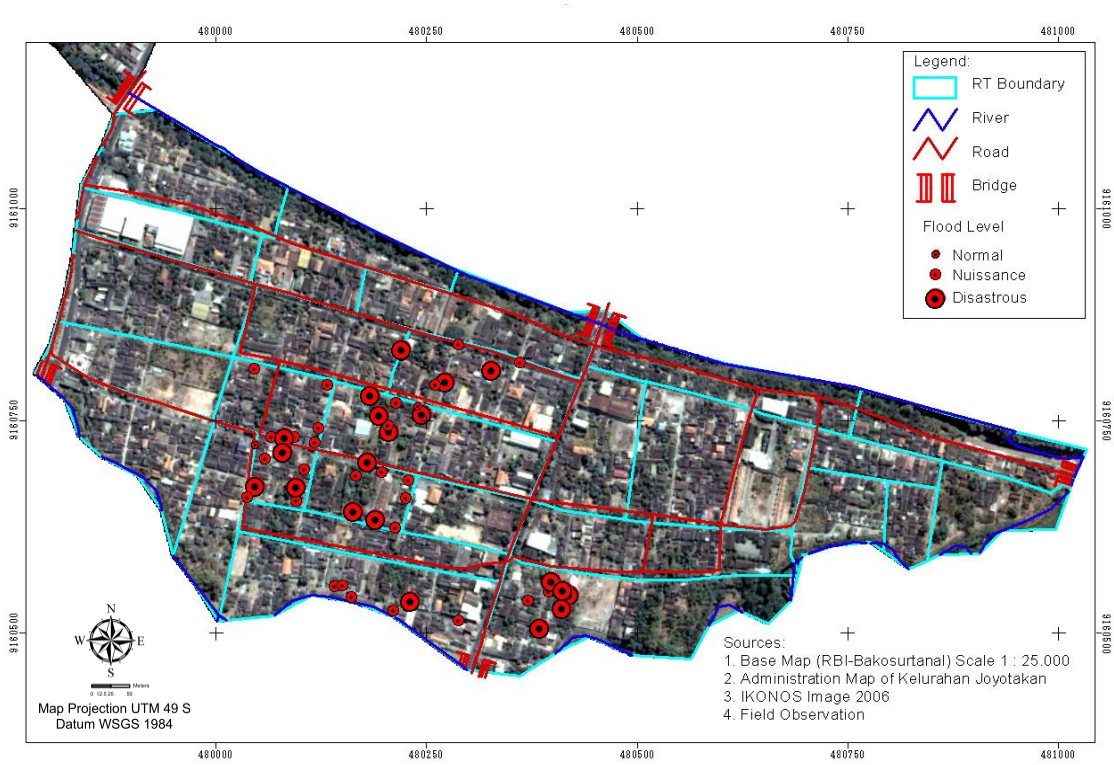

Figure 4.12. Spatial distribution of flood severity based on people perception in *Kelurahan* Joyotakan

4.4.6. People's Perception of Cause of Flooding

Most of respondents believe that the cause of the floods is the accumulation of the water coming from Boyolali and Klaten due to the prolonged high rainfall in those areas as well as in Surakarta City, which lasted for several days. Of the total, more than 33% of total respondents stated that there was backwater that occurs when Bengawan Solo River is overflowing through the canals to the city so that the water from the city flows back to the contrary direction. According to 30.7% of total respondents, floods happened because there were dike failures at some points in their area and the high rainfall exacerbated the condition.

Hence, 20.7% of the total respondents think that the floods occurred because the river cannot accommodate the water anymore and then the overflow of the water influenced the areas. Another cause is the sedimentation of Gajah Mungkur/Wonogiri Dam and Bengawan Solo River stated by 2 % of the total respondent as well as deforestation. However, there were two different combination of floods happened in the study area: Riverine floods and urban floods. The riverine floods occurred because of the overflow of the Bengawan Solo River and dike failures. While the urban floods occurred due to the high-prolonged rainfall and trapped water in the polder as well as bad drainage system in the area. Table 4.18 shows the causes of flooding in the study area based on local community's perception.

Table 4.18. Cause of the floods based on perception of respondents

Cause	Kelurahan		
	Sangkrah (%)	**Joyotakan (%)**	**Serengan (%)**
Backwater	***44.0***	32.0	24.0
The opening of Wonogiri Dam Water Gate	2.0	2.0	36.0
Dike failure	14.0	***42.0***	16.0
Overflow of the river	28.0	18.0	24.0
Dam Sedimentation	8.0	4.0	0.0
No catchments area (deforestation)	2.0	2.0	0.0
Trapped water in the polder	2.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**

As shown in Figure 4.13., different perception on the main cause of flood appeared among the local community in study area. Most of the respondents in Kelurahan Sangkrah believe that the main cause of the flooding was the backwater of canals in the city followed by the overflow of the Bengawan Solo River. Meanwhile, most of respondents in Kelurahan Joyotakan stated that the main cause of the flooding happening in their village was the dike failures followed by backwater. The local people in Kelurahan Serengan observed that there are several causes of the flooding which happened in Surakarta City. Those main causes are backwater in the canals, dike failures, the overflow of the river and deforestation in upper catchment area.

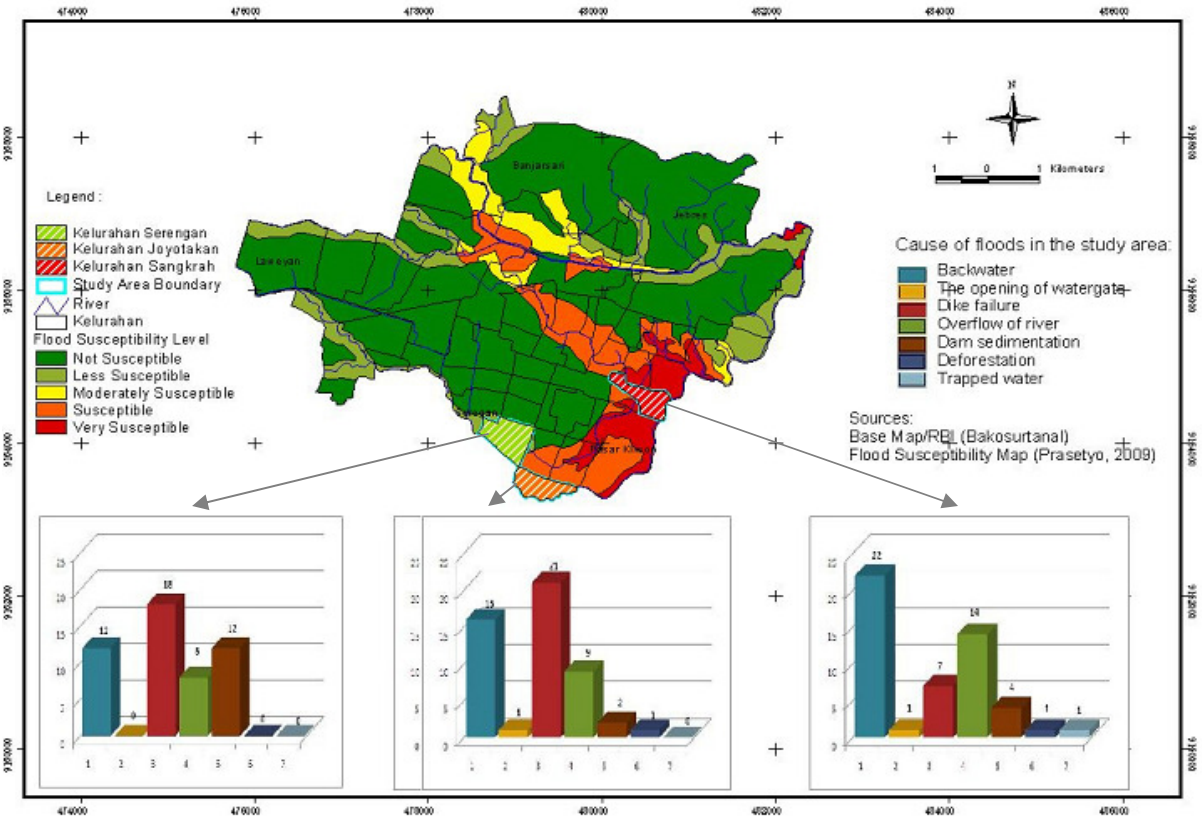

Figure 4.13. Spatial distribution of floods cause based on the local people perception

4.4.7. People's Reason of Staying

There are various primary reasons of why people keep staying in the flood-prone area which often influenced by the floods (see Table 4.19). Most of respondent in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan (44% and 56% of total respondent respectively) choose the area as their living places despite the floods threat because their houses are inheritances from the parents or ancestors. Others decided to live in the area because they are the owner of the house. The rest keep staying in the area because they can buy the house with the cheap prize or they feel it is easy to access the work places from there. However, 36% of the total respondent in *Kelurahan* Serengan decided to live in the village because of the comfortable environment.

Table 4.19. Reason of Stay

Reason	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
Inheritance from the parents	***44.0***	***56.0***	18.0
Private property	36.0	22.0	20.0
Comfortable environment	8.0	4.0	***36.0***
Cheap price	6.0	8.0	22.0
Easy to access the work place	6.0	10.0	0.0
Easy to access school	0.0	0.0	4.0
Total	**100.0**	**100.0**	**100.0**

4.4.8. People's Perception on Floods Mitigation Infrastructure

In study area, there are some flood mitigation infrastructures built by the government. There are two dikes in *Kelurahan* Sangkrah and Joyotakan built by the Paku Buwono X kingdom and the recent government. In addition, there are many canals constructed by both the local government and The Netherland Government. Besides, Gajah Mungkur Dam (GMD) was built as well in 1978 to mitigate Surakarta City from frequent flooding.

However, to know whether those infrastructures are effective or not so far based on nthe perception of the local community, some questions have been asked to the respondents. Table 4.20 shows the distribution of the people's perception of flood infrastructures in Surakarta City. Most of the respondents in the three villages think that those dikes are still effective to protect the area from floods. Furthermore, the local people also think that the GMD is still sufficient to mitigate the city from frequent flooding.

However, most of the respondents in Kelurahan Sangkrah and Kelurahan Serengan think that there was no flood early warning system in their area. On the other hand, 66% of total respondents in Kelurahan Joyotakan feel that there was enough early warning before the flooding occurs. This fact might relate with their social coping strategy to find the information of flood possibility together with the neighbor which will be discussed later in the next chapter.

Table 4.20. People's Perception on floods mitigation infrastructures

Perception on flood-mitigation infrastructures	Kelurahan								
	Sangkrah (%)			Joyotakan (%)			Serengan (%)		
	Yes	No	Do not Answer	Yes	No	Do not Answer	Yes	No	Do not Answer
Dikes are still effective for preventing the area from flooding	***92.0***	8.0	0.0	***76.0***	22.0	2.0	***96.0***	4.0	0.0
Dam is still effective for protecting Surakarta from flooding	***90.0***	10.0	0.0	***82.0***	12.0	6.0	***98.0***	2.0	0.0
There was Early Warning System applied in the area before the flooding	14.0	***86.0***	0.0	***66.0***	34.0	0.0	14.0	***86.0***	0.0

4.4.9. People's Perception on Mitigation Measures should be done by the Government

Based on the cause of the floods mentioned by the respondents, there are some mitigation measures that they think should be done by the government (see Table 4.21). More than 30% of total respondents in every Kelurahan agreed that the urgent mitigation action should be taken by the government is the maintenance of the GMD. They believe that the GMD still plays a very important role to mitigate the Surakarta City from flooding. In addition, a routine dredging of Bengawan Sola River and Gajah Mungkur Dam also can be a solution to reduce the flood risk in their area. Strengthening the dike also becomes one of the urgent mitigation measures according to the local people.

Table 4.21. Mitigation measures should be done by the Government based on people's perception

Mitigation Measure	Kelurahan		
	Sangkrah (%)	Joyotakan (%)	Serengan (%)
Maintenance of the GMD	***32.0***	***32.0***	***38.0***
Routine dredging in BS river/GMD	26.0	30.0	26.0
Strengthen the dike	24.0	28.0	12.0
Maintenance of water gate	6.0	10.0	2.0
Reforestation on the catchment area	4.0	0.0	12.0
Re-arrange the flood vulnerable areas	4.0	0.0	2.0
Do not answer	0.0	0.0	8.0
Widening the river body	2.0	0.0	0.0
Increasing the irrigation channel to sawah areas	2.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**

4.4.10. People's Behaviors Related to Flooding

Other information that needs to be gained from the interview is the behavior of the respondent related to flooding. Respondents were asked about their feeling related to flooding. Table 4.22 shows the response of the respondent upon the flood event. More than 70% of total respondent in *Kelurahan* Joyotakan and 70% of total respondent in *Kelurahan* Sangkrah feel that the flood occurrence started to disturb their daily lives and livelihoods. While the local people in *Kelurahan* Serengan do not perceive the flooding to be a threat to their daily lives and families.

However, the interesting findings from this part are: (1). More than 50% of total respondent in *Kelurahan* Sangkrah and 98% of total respondent in *Kelurahan* Serengan think that their villages are still save to become their living places. On the other hand, 76% of total respondent in Kelurahan Joyotakan realized that their living place is not save anymore, (2). Even though most of local people in *Kelurahan* Sangkrah feel that their livelihoods were threatened by the flooding, they do not want to move to other places. More than 76% of total respondent in this village want to keep staying in the study area. (3). The most bizarre finding is that even though most of respondent in *Kelurahan* Joyotakan feel that their daily lives and livelihoods were threatened by flooding and they agreed that their village is not save from the flooding, 90% of total respondents in this village still do not want to move to other safer areas. This can be explained since the respondent need more money to buy a new house in the safer area that is more expensive because it is already in the middle of the city, far from the floodplain. The other cause is that they think that the flood only occurs during the rainy season, not every time in a year. They prefer to deal with the floods once a year despite of spending more money to buy a new house in the other place. The last is that they already get used with flood occurrences because it always happens annually since the first time they live in the area.

Table 4.22. People behavior related to flooding

No	People's Behavior	Kelurahan					
		Sangkrah (%)		Joyotakan (%)		Serengan (%)	
		Yes	No	Yes	No	Yes	No
1.	Livelihoods threatened due to the flooding	***70.0***	30.0	***74.0***	26.0	22.0	***78.0***
2.	Your place is save from flooding	***52.0***	48.0	24.0	***76.0***	***98.0***	2.0
3.	Wants to move from the area	24.0	***76.0***	10.0	***90.0***	14.0	***86.0***
4.	Keep working during the flooding	0.0	***100.0***	6.0	***94.0***	***92.0***	8.0
5.	Needs to move things to anticipate flooding	***100.0***	0.0	***100.0***	0.0	10.0	***90.0***

The other behavior of community related to flooding is their activities during the floods. Almost all of respondents living in the area influenced by the flooding cannot work since the water inundated the accesses to the working places and disturbed their daily activities. On the other hand, local people living in *Kelurahan* Serengan keep doing their works as usual during the flooding because the impact of flooding was not too much influencing their daily activities.

Hence, all of respondents in Kelurahan Sangkrah and Kelurahan Joyotakan think that they need to move things to anticipate the damage when the water level tends to increase. This decision was not applied by the respondents in *Kelurahan* Serengan since they believed that the flooding will not influence their homes.

Furthermore, there are some questions related to their feeling and behavior of the flooding event happened in other places especially for the local people living in the save area (*Kelurahan* Serengan). Those questions were aimed to obtain the information how far is their awareness of flood threat which possibly can happen in the area. The responses of the respondents to those questions can be seen in Table 4.23.

Table 4.23. The behavior of the local people living in save area

No	People's Behavior	Frequency		Percent (%)	
		Yes	No	Yes	No
1.	Was your village used as the evacuation place?	25	25	50.0	50.0
2.	Mind if your living place is used for evacuation place for the flooded neighbor?	7	***43***	14.0	***86.0***
3.	Did you send aid for the people who affected by the flooding?	***45***	5	***90.0***	10.0
4.	Is there any dangerous area in your village related to flood occurrence?	17	***33***	43.0	***66.0***
5.	Needs to move things to anticipate flooding	5	***45***	10.0	***90.0***

From Table 4.23, it can be seen that people living in the safer area generally still have a good response to the people suffering the flooding. As the village is located near the affected area, some parts of the village were used as the evacuation points such as dike, village hall, mosque and schools. Mostly the local people do not mind if some buildings in their village or even their houses are used to accommodate their neighbor affected by the flooding. Of the total, 90% of the respondents sent aid, mostly food, for the victims. They also sent clothes, blankets and money to help them.

Most of the people (66% of total respondent) do not recognize whether there is any dangerous area related to flood occurrence in their village or not. However, 43% of total respondent mentioned that the southern part of the village is prone to flood since it is located beside the river embankment (*Kali* Tanggul), and many villagers live there. There is a possibility that there will be an overflow if the water comes in a very large amount and the condition of the canals is getting worse since there are many people still functioning the river and canal to throw the domestic wastes and garbage. During the rainy season, usually the water level is getting higher but do not influence the houses yet.

4.5. Concluding Remarks

This chapter elaborates the socio economical profile of respondents and reveals how they perceived the flooding occurred in 2007. This part also identified and appraised the overall perception of local people related to floods, such as flood depth, flood frequency, flood severity and flood duration.

The social economic profile of respondent can be represented by level of education, level of income, expenses for the family obligation and household size. From the descriptions of the social economic characteristics of the respondents in the study area, it can be concluded that most of the respondents have low incomes and low level of education as well. These facts are assumed can influence the choice of coping strategy employed by the respondents.

The flood risk perception of the local community consists of some characteristics of floods perceived by the local respondents. The flood risk perception of the local people that can be identified based on the interview are flood frequency, flood depth inside the house, flood duration, day of maximun flood depth, 2007 flood severity, and cause of flooding. In addition, the local respondents have been questioned of their perception on flood mitigation infrastructures existing in Surakarta City and what kind of mitigation measures should be done by the government. Based on the result of the interview, it can be concluded that the flood risk perception among the local communities are varied.

The result shows that the height of the flood inside the house perceived by the local people ranging between 0 – 4 meters high. Mostly, in *Kelurahan* Sangkrah maximum height of floods ranging less than 1 meter until 1 meter high. While in *Kelurahan* Joyotakan maximum water height reached 1.5 meters until 2 meters high. It is also revealed that the duration of the flood in

2007 is also varied. *Kelurahan* Serengan as the area which is less susceptible to flood, did not experience the inundation. On the other hand, *Kelurahan* Sangkrah as the flood prone area were mostly inundated between 3 – 7 days as well as *Kelurahan* Joyotakan. In fact, some parts of the prone area experienced frequent flooding almost every year. Nevertheless, the annual flooding did not influence large area and only last for a half day. That is why people seem unprepared for a sudden flood with a very high magnitude like what happened in 2007.

Moreover, maximum water height was varied within those villages influenced by the flooding. In *Kelurahan* Sangkrah, maximum water height was in the 1st and 2nd day of flood occurrences. While in *Kelurahan* Joyotakan, the water level reached the maximum height in the 2nd and 3rd day of flooding. The frequency of the floods annually in those prone villages is mostly ranging between less than 3 times per year until 3 times in a year. Overall, the severity of flooding in 2007 perceived as a nuisance event by most of the respondents in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan as the prone to flood area. The main cause of flooding mentioned by most of respondents in *Kelurahan* Sangkrah was the backwater following the prolonged high rainfall and overflow of the Bengawan Solo River. Most of respondents in *Kelurahan* Joyotakan stated that the main cause of the flooding in their area was the failure of some points of the dike along *Kali* Wingko as well as backwater into the canals.

The main reasons why people keep staying in the area are varied. In *Kelurahan* Sangkrah and *Kelurahan* Joyotakan most of respondents decided to keep stay in the village because of their houses are inheritance from the ancestors or parents. Other main reason is that the house is already become the private property. While in *Kelurahan* Serengan, respondents choose the area as the living place because of the comfortable environment. Most of respondents in the study area think that the flood mitigation infrastructures in Surakarta City are still sufficient to mitigate the area from flooding. Dikes and Gajah Mungkur Dam as the main infrastructures are considered helpful to prevent the city from flooding. However, most of respondents in the study area think that there are some mitigation measurements that should be done by the government in their area e.g. maintenance of GDM, routine dredging of Bengawan Solo River, and the strengthening of embankments. There are different opinions of the respondent on the availability of early warning system for their area. Most respondents in *Kelurahan* Sangkrah and *Kelurahan* Serengan mentioned that there was no enough early warning system in their village before the flooding. On the other hand, most respondents in *Kelurahan* Joyotakan stated that they got the warning before the floods occurred. This fact relates with their coping strategy before the flooding which will be discussed later.

This research also figures out the behavior of the local people upon flooding occurred in their villages. Most respondents in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan feel that the flooding threatened their lives as well as the family, while in *Kelurahan* Serengan most of respondents did not threaten by the flooding. Thus, all of respondents in flood prone areas think that they should move things to safer places, while in *Kelurahan* Serengan most of respondents think that they do not have to do it. Respondents in *Kelurahan* Sangkrah and *Kelurahan* Serengan mostly feel that their living place is still save from floods. On the other hand, generally respondents in *Kelurahan* Joyotakan realize that their village is not safe from flooding. In contrary, when respondents in *Kelurahan J*oyotakan and *Kelurahan* Sangkrah were asked if they want to move to a safer place, most respondents stated that they do not want to move. The respondents in prone flood areas (*Kelurahan* Sangkrah and *Kelurahan* Joyotakan) did not go to work during the flooding, while people live in the save area keep working since the flooding did not influence their daily lives.

5. Coping Mechanism Employed by the Local Community in Surakarta City

This chapter explores the coping mechanisms against flooding employed by the local community in the study area based on the result of the interviews. The coping strategies is classified into three flooding stages; before, during and after the flooding and each stages will be differentiated into three type of coping mechanism; economical, physical and social coping mechanisms. The discussion also comprises the comparison of the coping mechanism employed by the local people in Surakarta City with the coping strategies employed by the local people in Semarang City, another city in Central Java Province.

5.1. Introduction

Since the study area was classified into three levels of flood susceptibility, comparing the coping mechanism employed by the people who live in those different areas was considered more valuable. This is aimed to reveal how far the flooding influences the way of thinking and the way of how they perceived the flooding in their daily life. It is assumed that in different level of susceptibility in the study area, there will be different coping strategies employed by the local community.

Dewi (2007) did also research into coping mechanisms in Semarang City. There are several strategies employed by the local people in Semarang City for the frequent floods. It is also important to identify the difference and the similarity between coping strategies employed by the people living in the flood prone area in Semarang and in Surakarta. The result of the comparison can be very valuable information for the local government in formulating the mitigation action plan, especially since Surakarta City and Semarang City are located in the same province, Central Java Province. Hence, comparison between the results of the same research in those cities is described in this chapter as well.

5.2. Coping Mechanism Employed by Every Community Living in Three Surveyed *Kelurahan*

There were findings of coping strategies employed by the respondents in the study area. Those coping strategies can be grouped into three categories based on economical aspects, physical aspects and social and cultural aspects.

5.2.1. Economical Coping Strategies

Economical coping strategies include diversification of income sources, diversification of production, saving and credit (Twigg, 2004). In this case, it means all the actions which related to producing profits or benefits from all the resources, capability and materials that the people have before, during and after the flooding. According to Twigg (2004) "*vulnerable households usually try to store up and stock some kinds of foods and cash to be used in difficult times. When the crisis becomes worse, people will begin to sell their assets".*

There are three stages of economical coping mechanism employed by the respondents in those three-surveyed *kelurahan*. Table 5.1. illustrates the comparison of economical coping mechanism employed before, during and after the flooding in the study area.

Before the flooding, more than 50 % of the total respondents put their belongings like television, radio, and clothes to the safer places such as dike, highway and relatives/neighbor's house that have two-floor house, to anticipate if the floods happen.

From Table 5.1., it is also known that another 14.7% respondents employed other coping strategy before the flooding by preparing some more basic foods like sugar, rice and instant foods. Of total, 10 respondents also save money as the strategies to cope with the flooding and to anticipate if the flooding last longer than usual. However, 37 respondents (mostly living in safer area) do nothing related to economical coping strategy due to less influence of flooding and lack of financial capacity.

Table 5.1. Comparison of economic coping strategies employed by the local community in study area

Coping Strategy		Kelurahan (%)		
		Sangkrah	**Joyotakan**	**Serengan**
Before Flooding	Putting the belongings in saver/higher place	***72.0***	***74.0***	6.0
	Do nothing	12.0	14.0	***48.0***
	Save money	8.0	4.0	8.0
	Preparing basic food and cooking tools	6.0	2.0	*36.0*
	Preparing baby stuff	2.0	6.0	2.0
	Total	**100.0**	**100.0**	**100.0**
During Flooding	Do nothing	42.0	48.0	***82.0***
	Brings valuable documents to evacuation place	34.0	38.0	0.0
	Extra budget to buy food	16.0	8.0	18.0
	Find alternative job	6.0	2.0	0.0
	Asking help from relatives	2.0	4.0	0.0
	Total	**100.0**	**100.0**	**100.0**
After Flooding	Do nothing	88.0	72.0	***100.0***
	Selling things to get money for fixing house	6.0	22.0	0.0
	Borrowing money from relatives	6.0	6.0	0.0
	Total	**100.0**	**100.0**	**100.0**

During the floods, people living in the study areas do not have many choices in economical coping strategy. Of total, only 38 respondents living in the prone area still have time to bring some valuable documents like school's books of their children, land certificate, official documents of birth's certificate, diploma's certificate etc. with them to the evacuation places but the rest did not have time to think of it. Spending money or extra budget to buy foods also becomes one of economical coping strategies during the floods, especially when the water starts to recede and they were going back to the house.

After the flooding, almost none of the respondents in the three *kelurahan* apply any of coping strategies in term of economical action. Only 14 respondents try to sell things in order to get money for repairing the house and six respondents asking for financial support to their relatives.

In addition, it was found out also that most of respondents in the study area already raised their appliances such as television, radio, washing machine, and computer in the house and some respondents only raising some of the appliances as shown in Table 5.2. This was aimed to mitigate their properties from water whenever floods occur. On the other hand, most of the respondents in three villages do not raise the furniture since it considered can be fixed and cleaned up after the flooding.

Table 5.2. Economical coping mechanism related to raising the appliances and furniture

Measure		Kelurahan (%)		
		Sangkrah	**Joyotakan**	**Serengan**
Appliance raised	Yes	***92.0***	***78.0***	***92.0***
	No	0.0	14.0	0.0
	Some are raised	8.0	8.0	8.0
	Total	**100.0**	**100.0**	**100.0**
Furniture raised	Yes	0.0	8.0	0.0
	No	***92.0***	***82.0***	***100.0***
	Some are raised	8.0	10.0	0.0
	Total	**100.0**	**100.0**	**100.0**

5.2.2. Physical Coping Strategies

Physical coping mechanism identified in the study area refers to the structural action comprising some physical measurements like how people anticipate the frequent floods by raising the house for a certain high from the ground, using reinforced material to construct the house etc.

From the interviews with respondents, it can be found that people were not properly prepared in terms of structural measurements for such a sudden big flood like what has happened in 2007. So far, it seems that the community members did not prepare anything before the flooding.

Nevertheless, from the flood event, they have learnt to employ various physical coping mechanisms. According to Marschiavelli (2007), Technological/structural coping mechanism, or in this case physical strategies, is described as the action generated to protect or cope with flood damages involving material or existing action, including building constructions and building material that have to be adapted with frequent flooding. Table 5.3. illustrates the comparison of physical coping mechanism employed in the three *kelurahan* before, during and after the flooding.

Table 5.3. Comparison of physical coping strategies of floods employed by the local communities in study area

Coping Strategy		Kelurahan (%)		
		Sangkrah	**Joyotakan**	**Serengan**
Before Flooding	Building emergency rooftop	50.0	58.0	2.0
	Do nothing	24.0	22.0	76.0
	Raising the foundation of the house	10.0	4.0	2.0
	Building house with more than 1 floor	6.0	4.0	4.0
	Putting sandbag in front of the house	6.0	6.0	0.0
	Building house using concrete material	4.0	6.0	16.0
	Total	**100.0**	**100.0**	**100.0**
During Flooding	Evacuating things to the higher place	72.0	60.0	16.0
	Binding things(e.g. wood chairs, wood tables, wood cupboards)	24.0	22.0	0.0
	Lock all the windows and doors properly	4.0	10.0	0.0
	Do nothing	0.0	8.0	84.0
	Total	**100.0**	**100.0**	**100.0**
After Flooding	Cleaning up the house and furniture from mud	72.0	54.0	0.0
	Drying wet clothes and furniture	14.0	26.0	0.0
	fixing the damaged part of the house	10.0	14.0	0.0
	Do nothing	4.0	6.0	100.0
	Total	**100.0**	**100.0**	**100.0**

Before the flooding, they learnt to rebuild or renovate their house by rising the floor approximately 0.3 – 1.0 meter above the ground. Of the total, about 40% respondents in three selected villages raised the foundation of their house approximately 0.1 – 0.5 meter above the ground. While some respondents raised their foundation of their house more than half meter ranging between 0.6-1 meter high. Only a small number of respondents who did not raise their house or even build their house below the ground level. Distribution of respondent based on the height of the foundation shown in Table 5.4.

Table 5.4. Distribution of respondent based on the height of flood-proofing of the house

Height of foundation (m)	Kelurahan (Frequency)		
	Sangkrah	**Joyotakan**	**Serengan**
-2-0	2	4	5
0.1-0.5	***43***	***40***	***42***
0.6-1	5	6	3
Total	**50**	**50**	**50**

Before the floods occurred, the local people also build an emergency rooftop so-called *Anjang-anjang* inside the house to immediately evacuate their belongings when the floods is getting

higher (see Figure 5.2). In two *kelurahan* in the study area, 54 respondents applied the emergency rooftop. In *Kelurahan* Serengan only one respondent has the emergency rooftop in the house.

Figure 5.1. Physical coping mechanism employed by local community;
Left: Emergency rooftop (*anjang-anjang*); Right: Raised entrance of respondent's house (Source: fieldwork, 2009)

Another physical coping strategy before the flooding is constructing the house with more than one floor. However, this kind of strategy is rarely applied in the study area due to lack of financial capacity of the people. They usually cannot afford to build two-floor house. Overall, only 12 respondents have two-floor house and 138 respondents constructed their house with one floor. The last are built by respondents who have income ranging from Rp. 500,000 – Rp. 750,000 income per month until Rp. 2,500,000-3,000,000 income per month.

The table shows the trend that 10 respondents out of 12 respondents who have two-floor houses are from the higher range of income (Rp.1,500,000 – more than Rp. 3,000,000). In contrary, the respondents with the lower income generally built their houses with one floor. In other word, it can be assumed that the amount of the income is related to the number of the house floor. Table 5.5. illustrates cross tabulation of income of the respondents and number of house floor.

Table 5.5. Cross tabulation of income of the respondents and number of floor of the house

Income (Rp./month)	Number of floor (frequency)		Total
	1	2	
500000-750000	20	0	20
750000-1000000	***42***	1	43
1000000-1500000	***49***	1	50
1500000-2000000	12	6	18
2000000-2500000	11	0	11
2500000-3000000	4	2	6
>3000000	0	2	2
Total	**138**	**12**	**150**

Furthermore, there are 8.7% of total respondent choose to construct their house with concrete material as the main strategy before flooding and only 4% of total respondents put sand bag in front of the house before the floods. Nevertheless, there are also some respondents which do not applied any of physical strategy before the flooding. They mostly are the respondents living in *Kelurahan* Serengan.

During the floods, local people usually evacuating their properties like bed, chair and other things to the higher places inside the house. This strategy is mostly used strategy during the floods according to 49.3% of total respondents (see Table 5.3.). More than 15% of total respondent choose to bind the properties like chairs, table and cupboard, especially made from wood, in order to protect them from taken along by the water. Hence, according to seven respondents, locking the

windows and doors properly will make the house save from loosing properties since they have to leave the house and move to the safer place until the water recedes. However, the respondents living in *Kelurahan* Serengan mostly do not employ any of physical strategies to cope with the flooding.

As the water recedes, local people must cope with the impact of the water inundation. Of total, 40% respondents in the two affected *kelurahan* cleaned up the house and furniture from the mud. From further interview, it is concluded that local people wisely know when is the perfect time to clean up the house and furniture from the mud. Regarding the availability of water, they learnt that the best time to clean up mud and wastes after the flooding is when the water is still inundating the house approximately as high as the ankle (10 cm high). Besides, 13.3% of total respondents choose to save the clothes and furniture from damage by drying them up in the sun and nine respondents fix the damaged part of the house to cope with the impact of the floods. However, 36.7% of total respondents do not apply any of coping strategies in term of physical action, especially respondents who live in the save area.

5.2.3. Social and Cultural Coping Strategies

Social and cultural coping mechanism comprises the network in the community, kinship, mutual aid and self-help in the group of community (Twigg, 2004). There are some strategies employed by respondents before, during and after the flooding in term of social and cultural aspect in the study area as shown in Table 5.6.

Table 5.6. Comparison of social and cultural coping ctrategies of floods applied by the local communities in study area

Coping Strategy		Kelurahan (%)		
		Sangkrah	**Joyotakan**	**Serengan**
Before Flooding	Working together to clean houses and surrounding	78.0	52.0	36.0
	Cleaning up the canal	16.0	12.0	40.0
	Do nothing	6.0	12.0	20.0
	Monitoring the water level by using wooden stick	0.0	14.0	0.0
	Contact relatives or water gate officer to get information about the water level in the dam	0.0	10.0	4.0
	Total	**100.0**	**100.0**	**100.0**
During Flooding	Night Patrol/*ronda*	50.0	40.0	16.0
	Helping each other to evacuate people	48.0	30.0	12.0
	Sharing foods and water	2.0	10.0	8.0
	Distributing information about flood	0.0	2.0	8.0
	Do nothing	0.0	18.0	56.0
	Total	**100.0**	**100.0**	**100.0**
After Flooding	Working together with neighbors to clean up the wastes and mud	98.0	80.0	12.0
	Do nothing	2.0	20.0	88.0
	Total	**100.0**	**100.0**	**100.0**

Related to social and cultural aspect of coping, it can be described that in the three stages of flooding, most respondents in *Kelurahan* Sangkrah and Joyotakan usually work t**o**gether for either cleaning up the canal and surround the houses, helping each other in the evacuation process or for cleaning up mud after the water recedes.

Before the flooding, most people in both the flood prone area and the save area work together to clean up the house and surrounding to anticipate the rainy season (see Figure 5.2. a). As many as 55% of total respondents applied the strategies among them. In addition, 22.7% of total respondents clean up the canal in order to avoid the obstruction of the canal due to the accumulation of wastes and garbage.

Of the total respondent in *Kelurahan* Joyotakan, 14% respondents employ a simple technique to indicate how fast the water arises by using only a wooden stick. They put it upright in the street, and then they observe it every hour. As the stick sinks very fast, they believe that the water level be getting higher and they decided to move to other safer places.

The interesting finding in this social aspect is that 4.7% of total respondents in the study area initiated to find the further information about the water level in Wonogiri Dam and rainfall in upper area (Wonogiri and Boyolali) when they think the rainfall is getting higher and prolonged. Instead of merely waiting for the early warning from the government before the flooding, they also try to contact some family or relatives who live there to predict how long the water will arrive to their village. Of the total, seven respondents applied this strategy. However, 12.7% of total respondents in the study area do not have any strategy related to the social and cultural aspect.

During the floods, they apply so-called *ronda* (night patrol to guard the environment together with some neighbors). Of total, 33.3% respondents usually guard the neighborhood together with the other villagers during the floods. Another 30 % of total respondents helped each other to evacuate children, elderly people and women moving to safer areas. Furthermore, ten respondents share foods and drinks with others to cope with the lack of nutrition due to prolonged floods.

However, there are 24.7% of total respondents do not conduct any of coping strategy during the flooding, mostly originated from *Kelurahan* Serengan. In addition, based on the interviews, most of respondents in *Kelurahan* Sangkrah who have been influenced by the water decided to move to their relative's house, on top of the dikes, and to the city hall. While most of respondents in Kelurahan Joyotakan choose to evacuate their family to the highway which located on the higher area or to their relative's house. Almost all of the respondents living in the save area (*Kelurahan* Serengan) keep staying at their house (see Table 5.7).

Table 5.7. Evacuation places used by the respondents

Evacuation Place	**Kelurahan (%)**		
	Sangkrah	**Joyotakan**	**Serengan**
Stayed at the house	14.0	0.0	***100.0***
Relative's house	***26.0***	***30.0***	0.0
Highway	6.0	***48.0***	0.0
Dikes	16.0	10.0	0.0
City hall	16.0	0.0	0.0
School building	12.0	0.0	0.0
Mosque	2.0	6.0	0.0
Hotel	0.0	4.0	0.0
Two floors-neighbor's house	4.0	0.0	0.0
Church	0.0	2.0	0.0
Stadium	2.0	0.0	0.0
Station	2.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**

In the next stage of flooding, as the water recede, there are not many social coping strategies that can be applied. Mostly the local people work together (*gotong-royong*) with their neighbor to clean up the mud and waste surround their houses, after they personally finished with their own houses. Almost all the respondents in *Kelurahan* Sangkrah and Joyotakan employed this strategy. However, most of respondents living in *Kelurahan* Serengan do not employ any of the social coping strategies in their area since so far there is no flooding occurrence in the village. Figure 5.2. illustrates the social activities of the community doing *gotong-royong* and one of the post where the villagers usually come together to guard the neighborhood (*ronda*).

Figure 5.2. Social coping strategies employed by the local people
Left: People are doing *gotong royong* near the dike to anticipate flooding,
Right: One of *ronda* post in *Kelurahan* Sangkrah

5.3. Coping Mechanism Employed by the Local People Related to Social and Economic Characteristics

The coping mechanism employed were assumed to be influenced by the social and economic characteristics of the local people themselves. The level of education and the income of the respondents are some indicators of the social economic characters of the community that can affect the choice and decision of employing coping strategies.

Respondents' Education

As described in the previous Table 4.3, the level of education of most respondents is varied. However, most respondents (about 40 % of total respondent) are graduated from elementary school followed by the number of respondent graduated from junior high school and senior high school as many as 23% and 20% of total respondent respectively. Table 5.8. shows that most respondents choose to employ three kinds of coping strategies before the flooding, especially economic and social coping strategies.

Table 5.8. Cross tabulation of education level and type of coping strategies before flooding

Level of education	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	No	Yes	No
Un-educated	4.0	0.7	3.3	1.3	3.3	1.3
Elementary School	***36.0***	6.7	***26.0***	16.7	***37.3***	5.3
Junior High School	22.0	1.3	13.3	10.0	20.0	3.3
Senior High School	21.3	0.0	12.0	9.3	19.3	2.0
College	8.0	0.0	4.7	3.3	7.3	0.7
Total	***91.3***	**8.7**	***59.3***	**40.7**	***87.3***	**12.7**

As described in Table 5.8, respondents mainly employed economic and social coping strategies as many as 91.3% of the respondent applying economic strategies and 87.3% of them applying social strategies. Most of the respondents who employed those strategies are the respondents with elementary education. This is reasonable because the number of respondent of this class is higher than the other class.

Based on the result presented in Table 5.9, it can be seen that during the flooding, most respondents tend to do the physical and social strategies rather than economical strategy. In this case, there is no significant difference of coping strategies conducted by different respondent from different level of education. However, respondent graduated from elementary school, junior high school and senior high school tend to employ physical and social strategies.

Table 5.9. Cross tabulation of education level and types of coping strategy during flooding

Level of education	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
Un-educated	2.0	2.7	3.3	1.3	2.0	2.7
Elementary School	21.3	21.3	***30.7***	12.0	***32.0***	10.7
Junior High School	9.3	14.0	15.3	8.0	17.3	6.0
Senior High School	7.3	14.0	14.7	6.7	17.3	4.0
College	8.0	5.3	5.3	2.7	6.7	1.3
Total	**48.0**	***57.3***	***69.3***	**30.7**	***75.3***	**24.7**

Similar to the two previous flooding stages, most respondents do not applied economic strategies after the flooding (see Table 5.10). Significant result comes from the elementary school class where most respondent in this class (36 % out of the total respondent) do not apply any of economical coping strategies as well as the other classes.

Table 5.10. Cross tabulation of education level and types of coping strategy after flooding

Level of education	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
Un-educated	0.0	4.7	2.0	2.7	0.7	4.0
Elementary School	6.7	***36.0***	***30.0***	12.7	***30.7***	12.0
Junior High School	4.0	19.3	13.3	10.0	15.3	8.0
Senior High School	2.7	18.7	14.0	7.3	12.7	8.7
College	0.0	8.0	4.7	3.3	4.7	3.3
Total	**13.3**	***86.7***	***64.0***	**36.0**	***64.0***	**36.0**

Income per-month

As described in Table 4.5 presented in the previous chapter, it can be seen that of respondents income per-month varies between Rp. 500,000 until Rp. up to 3,000,000 per month. However, most respondent have a higher income ranging between Rp. 750,000 – Rp. 1,500,000 which is more than 50 % of total respondent followed by respondent who have income ranging between Rp. 1.500.000 – Rp. 2.000.000 which is 24 % of total respondent.

From the cross tabulation presented in Table 5.11, it can be assumed that, overall, most respondents do all types of coping strategies before the flooding, especially respondents in two classes income e.g. Rp.750,000 – Rp. 1,000,000 and Rp. 1,000,000 – Rp. 1,500,000 as well as the respondents with the higher income. In other word, the type of economic coping strategy employed by the respondents is relatively higher than the other strategies.

Table 5.11. Cross tabulation of income per-month and types of coping strategy before flooding

Income per-month (Rp)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
500000-750000	8.0	5.3	8.7	4.7	10.0	3.3
750000-1000000	20.0	8.7	15.3	13.3	21.3	7.3
1000000-1500000	***28.0***	5.3	19.3	14.0	***30.0***	3.3
1500000-2000000	9.3	2.7	8.0	4.0	10.7	1.3
2000000-2500000	6.7	0.7	5.3	2.0	6.7	0.5
2500000-3000000	4.0	0.0	2.7	1.3	3.3	0.5
>3000000	0.0	1.3	0.7	0.7	0.7	0.5
Total	***76.0***	**24.0**	***60.0***	**40.0**	***82.7***	**16.7**

In contrary, the result in Table 5.12. and Table 5.13 show that generally only physical and social coping strategies were applied during and after the flooding. The economic coping strategies during and after the flooding is significantly low compared to other coping strategies.

Table 5.12. Cross tabulation of income per-month and types of coping strategy during flooding

Income per-month (Rp)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
500000-750000	6.0	7.3	10.0	3.3	8.0	5.3
750000-1000000	10.7	18.0	16.7	12.0	18.7	10.0
1000000-1500000	14.7	18.7	***25.3***	8.0	***30.0***	3.3
1500000-2000000	5.3	6.7	8.7	3.3	8.7	3.3
2000000-2500000	3.3	4.0	7.3	0.0	7.3	0.0
2500000-3000000	2.7	1.3	2.0	2.0	3.3	0.7
>3000000	0.0	1.3	0.7	0.7	0.7	0.7
Total	**42.7**	***57.3***	***70.7***	**29.3**	***76.7***	**23.3**

Table 5.13. Cross tabulation of income per-month and types of coping strategy after flooding

Income per-month (Rp)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	No (%)
500000-750000	0.7	12.7	8.7	4.7	6.0	7.3
750000-1000000	5.3	23.3	16.0	12.7	16.7	12.0
1000000-1500000	5.3	***28.0***	***23.3***	10.0	***24.7***	8.7
1500000-2000000	1.3	10.7	6.7	5.3	7.3	4.7
2000000-2500000	0.7	6.7	7.3	0.0	7.3	0.0
2500000-3000000	0.0	4.0	2.0	2.0	2.0	2.0
>3000000	0.0	1.3	0.0	1.3	0.0	1.3
Total	**13.3**	***86.7***	***64.0***	**36.0**	***64.0***	**36.0**

Generally, it can be assumed that the income of the respondents influenced the choice of strategy and decision of how they try to cope against the flooding, especially in physical and social cultural strategies. The local people with the higher income tend to raise the foundation of the house and build their house with two-floor construction.

Furthermore, the interesting fact is that rarely do the respondents in all range of income level, save money before flooding to anticipate if the flooding will be prolonged. This might be happened since the priority choice in most of the household interviewed is to focus on fulfilling the daily obligations first rather than anticipating for the impact of prolonged flooding.

5.4. Coping Mechanism Employed by the Local Community Related to Flood Characteristics

It is importance also to explore how the flood characteristics determine the choice and decision of respondent against the flooding. In this research, flood depth and floods' frequency represent the flood characteristics.

Flood Depth

Based on the result of cross tabulation of flood depth and type of coping strategies illustrated in Table 5.14, it can be seen that economical and social strategies tend to be employed more before the flooding. From the result presented in previous Table 4.9, it is observed that most respondents experienced the flooding more than one meter deep (more than 48% of total respondent).

Table 5.14. Cross tabulation of flood depth and type of coping strategies before flooding

Flood depth (m)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
No flood	17.3	16	8.0	***25.3***	***26.7***	6.7
<1	7.3	2	4.7	4.7	8.7	0.7
1	14	0	11.3	2.7	13.3	0.7
1.5	12	2.7	11.3	3.3	12.0	2.7
2	19.3	0.7	18.7	1.3	18.7	1.3
2.5	4.7	0.7	2.0	3.3	4.7	0.7
3	0	2.7	2.7	0.0	2.7	0.0
4	0.7	0	0.7	0.0	0.7	0.0
Total	***75.3***	**24.7**	***59.3***	**40.7**	***87.5***	**12.8**

Table 5.14 shows that respondents struck by 2 meters inundation tend to employ all type of coping strategies before the flooding as well as the respondents with 1 meter and 1.5 meter high of inundation. An interesting finding is that respondents living in the save area tend to apply the economical and social strategy although they did not experience flooding in 2007-2008. However, physical coping strategy is relatively not applied in the area before the flooding.

Meanwhile, as described in Table 5.15. during the flooding generally people do not apply any of economic coping strategies, but tend to do the physical and social strategies, especially people struck by the flood depth with 1 meter – 2 meter high. On the other hand, people who did not suffer flooding in their area tend to not doing all type of coping strategies.

Table 5.15. Cross tabulation of flood depth and type of coping strategies during flooding

Flood depth (m)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
No flood	6.0	27.3	5.3	28.0	14.7	18.7
<1	3.3	6.0	9.3	0.0	9.3	0.0
1	8.7	5.3	14.0	0.0	14.0	0.0
1.5	8.7	6.0	13.3	1.3	12.0	2.7
2	6.0	7.3	19.3	0.7	19.3	0.7
2.5	2.0	3.3	4.7	0.7	2.7	2.7
3	0.7	2.0	2.7	0.0	2.7	0.0
4	0.7	0.0	0.7	0.0	0.7	0.0
Total	**36.0**	***57.3***	***69.3***	**30.7**	***75.3***	**24.7**

Furthermore, based on the result in Table 5.16, similar things happen after the flood occurred. People do the physical and social strategies rather than economic strategies. In contrast, most people with no flooding occurrence tend to not doing any of coping strategy types.

Table 5.16. Cross tabulation of flood depth and type of coping strategies after flooding

Flood depth (m)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
No flood	0.0	33.3	0.7	32.7	4.7	28.7
<1	0.0	9.3	8.0	1.3	9.3	0.0
1	4.0	10.0	14.0	0.0	13.3	0.7
1.5	0.7	14.0	13.3	1.3	11.3	3.3
2	8.0	12.0	19.3	0.7	19.3	0.7
2.5	0.7	4.7	5.3	0.0	2.7	2.7
3	0.0	2.7	2.7	0.0	2.7	0.0
4	0.0	0.7	0.7	0.0	0.7	0.0
Total	**13.3**	***86.7***	***64.0***	**36.0**	***64.0***	**36.0**

Frequency of Floods

Based on the previous Table 4.12, it can be assumed that mostly respondents experience frequent floods less than three times per-year followed by three times/year and four times/year flood occurrence. While, respondents living in save area are never struck by the flooding for the whole year.

According to the cross tabulation result of flood frequency and type of coping strategies in Table 5.17, it can be observed that before the flooding most of respondents experiencing flooding apply all type of coping mechanism, especially social cultural strategies.

Similar thing occurred with the respondents living in save area which was not struck by the floods. Most of them employ the economic and social strategies rather than physical strategies. This can be explained since usually people tend to aware if they have already experienced the event and the impact of it.

Table 5.17. Cross tabulation of frequency of flooding and type of coping strategies before flooding

Frequency (time)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
Never	17.3	16.0	8.0	25.3	26.7	6.7
<3	***32.7***	4.0	***30.0***	6.7	***33.3***	3.3
3	17.3	0.7	12.7	5.3	17.3	0.7
4	6.7	3.3	7.3	2.7	8.0	2.0
5	0.7	0.0	0.0	0.7	0.7	0.0
7	0.7	0.7	1.3	0.0	1.3	0.0
Total	***75.3***	**24.7**	***59.3***	**40.7**	***87.3***	**12.7**

As shown in Table 5.18., respondents suffering the frequent flooding apply mainly physical and social coping strategy during the flooding. Overall, most of respondent do not apply economic coping strategy, but respondents with frequency of flood <3 times and three times of flood per year still keep doing the economic strategy, but not for physical and social strategies. In contrary with it, people have never been struck by flood do not employ any type of coping strategies.

Table 5.18. Cross tabulation of frequency of flooding and type of coping strategies during flooding

Frequency (time)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
Never	6.0	27.3	5.3	28.0	14.7	18.7
<3	***21.3***	15.3	***35.3***	1.3	***34.0***	2.7
3	10.7	7.3	17.3	0.7	16.7	1.3
4	3.3	6.7	9.3	0.7	8.0	2.0
5	0.0	0.7	0.7	0.0	0.7	0.0
7	1.3	0.0	1.3	0.0	1.3	0.0
Total	**42.7**	***57.3***	***69.3***	**30.7**	***75.3***	**24.7**

Slightly different with the result in the previous Table 5.18, in Table 5.19, it can be observed that respondents who experience frequent flooding mostly apply only physical and social coping strategies and generally do not employ economic strategy. While respondents with no flood occurrence over the year, do not employ any of all types of coping strategy.

Table 5.19. Cross tabulation of frequency of flooding and type of coping strategies after flooding

Frequency (time)	Economic (%)		Physical (%)		Social (%)	
	Yes	No	Yes	Yes	No	Yes
Never	0.0	***33.3***	0.0	***33.3***	4.0	***29.3***
<3	8.0	***28.7***	***34.7***	2.0	***33.3***	3.3
3	4.7	13.3	18.0	0.0	16.7	1.3
4	0.7	9.3	8.7	1.3	7.3	2.7
5	0.0	0.7	0.7	0.0	0.7	0.0
7	0.0	1.3	1.3	0.0	1.3	0.0
Total	**13.4**	***86.6***	***63.4***	**36.6**	***63.3***	**36.6**

5.5. Coping Mechanism employed by the Local Community in Surakarta City and Semarang City; a Comparison

Coping mechanism comprises many measures employed by the community to cope with the impact of floods in terms of economical, physical/structural and social cultural aspects. One of the main goals of this research is identifying which coping mechanism employed by the local community in Surakarta City. Dewi (2007) has done a same kind of research in the local community of Semarang City. Dewi (2007) tried to identify the coping strategies applied by the local people in the area to cope with the impact of coastal floods, which frequently occurred in some parts in Semarang City. However, this result cannot represent all local communities suffering flooding in Indonesia.

Thus, it is also important to identify the similarity and the difference of coping mechanism employed by the people in different city with different characteristics of floods and social economic of the local people, like Surakarta City. It can be very valuable information to support the local government in formulating the mitigation action plan, especially since Surakarta City and Semarang City are located in the same province, Central Java Province (see Figure 5.3.).

Figure 5.3. Central Java Province (source: Marfai and King, 2007)

5.5.1. Similarities

Overall, there are similarities of coping mechanism employed by flood prone communities in those cities including economical, physical, social and cultural aspects. Table 5.20 presents the similarities of the coping mechanism conducted by the local people in Surakarta City and Semarang City.

Even though the flood types occurring in those cities are different, the way of how the local people deal with it and how they minimize the negative impact of it are still more or less the same. Based on Table 5.20, it can be seen that the local communities in those two cities employ the same economic coping strategy before and during the flooding. They prepare the basic foods that can be used when the water starts inundating their houses. This is reasonable since usually there are the same negative impacts of the flood which should be anticipated even with the different characteristics of flood. During the flooding, they try provide foods for the family for emergency condition if the aid has not come.

The comparison of results also shows that in physical coping, they employ some similar strategies before, during and after the flooding. Before the flooding, they try to avoid the water of entering the house by using sandbags as the dike in front of their house. Many of the respondents in Surakarta and Semarang City constructed their houses by using concrete or reinforced material to strengthen the building. During the flooding, the local people sometimes should leave their houses to evacuate their family if the water is getting higher. This condition made them have to secure their belonging in the houses, thus they lock the windows and doors properly to make sure that all belongings are save. Furthermore, after the flooding, they have similar strategy to fix the damaged part of the house and the properties.

Table 5.20. Similarities of coping strategies applied by the local people in Surakarta and Semarang City

Coping Mechanism	Stages	Similar coping strategy applied by local community	
		Surakarta City	**Semarang City**
Economical	Before the floods	• Preparing basic foods and cooking tools	• Storing basic food items such as rice and sugar
	During the floods	• Do nothing • Extra budget to buy food • Find alternative job	• Purchasing cheap food • Continue working • Do nothing
	After the floods	• -	• -
Physical	Before the floods	• Putting sandbags in front of the house • Building house using concrete material	• Construction of house with the reinforced material • Building dikes in front of house using sand bags
	During the floods	• Lock all the windows and doors properly • Do nothing	• Closing the door and windows properly to avoid water • Do nothing
	After the floods	• Fixing the damaged part of the house/appliance	• Repairing minor damage of the appliance • Repairing important damage to the house • Fixing things
Social	Before the floods	• Working together to clean houses and surrounding • Cleaning up the canal	• Cleaning the canal surroundings the house
	During the floods	• Night Patrol/*ronda* • Helping each other to evacuate people • Do nothing	• Evacuating family, especially children and elderly to the safer place • Do nothing • Guarding the house to ensure safety belongings
	After the floods	• Working together with neighbors to clean up the wastes and mud	• Cleaning house and surroundings • Helping other's community member in doing work (*gotong royong*)

Hence, for these two different local communities, the social coping strategy has an important role. Generally, the local people work together to cope with the flood before, during and after the flooding. For instance, they help each other in order to clean up the canal, houses and its surrounding. During the flooding, they also help each other to evacuate people, especially children, women and elderly people to the save places. After the flooding, the local people work together to clean up the houses from wastes and mud.

5.5.2. Differences

Due to the difference of the flood types and social economic characteristics of the community, there are also some different strategies applied by the local community in both Surakarta and Semarang City to cope with the flood impact. Table 5.21 describes the different strategies applied by prone community in those cities.

Table 5.21. Differences of coping strategies applied by the local people in Surakarta and Semarang City

Coping Mechanism	Stages	Different coping strategy applied by local community	
		Surakarta City	**Semarang City**
Economical	Before the floods	• Putting the belongings in safer /higher place • Do nothing • Saving money • Preparing baby stuff	• Preparing place for storage at the higher place
	During the floods	• Brings valuable documents to the evacuation place • Asking help from relatives	• Evacuating the important things to the safe place • Saving money • Cleaning the house by draining
	After the floods	• Do nothing • Selling things to get money for fixing house/properties • Borrowing money from relatives	• Repairing minor damage of the appliance • Repairing important damage to the house
Physical	Before the floods	• Building emergency rooftop (*anjang-anjang*) • Do nothing • Raising the foundation of the house • Building house with more than 1 floor	• Cleaning the canal surrounding the house
	During the floods	• Evacuating things to the higher place • Binding things(e.g. wood chairs, wood tables, wood cupboards)	• Securing house entrance to avoid debris • Cleaning the house by draining
	After the floods	• Cleaning up the house and furniture from mud • Drying wet clothes and furniture • Do nothing	• -
Social	Before the floods	• Do nothing • Monitoring the water level by using wooden stick • Contact relatives or water gate officer to get information about the water level in the dam	• Preparing temporary place at friend's or relative's place • Preparing place for storage at the higher place
	During the floods	• Sharing foods and water • Distributing information about flood	• Searching relief materials
	After the floods	• -	• Looking for alternative place to move • Continue patrolling the neighborhood (*ronda*)

Economically, there are different strategies employed by those different local communities before, during and after the flooding. Before the flooding, the local people in Surakarta City employed more various strategies than in Semarang City. While during the flooding, there are some different strategies applied in both local communities. For instance, flood prone people in Surakarta try to save their precious things by bringing their most valuable documents such as certificates, school books, etc. with them.

However, people in Semarang try to evacuate their belonging to the save place during the flood. This is practically cannot be conducted in Surakarta, since the flood in 2007 and 2008 occurred very suddenly and sometimes people living in study area do not have time to move things to other places. After the flooding, there are couple of different economical strategies. Local people living in Semarang City repair the minor and important damages of their houses and appliances. While,

local people in Surakarta City try to get money for fixing the house or properties by selling things or borrowing money from their relatives.

Physically, there are different strategies applied in all stages of flooding in those flood prone areas. In Surakarta City, generally, local people have more various strategies rather than in Semarang City. However, the most important difference is that many prone people in Surakarta City built emergency rooftop so-called *anjang-anjang* as the emergency place for evacuating their belongings like clothes, appliances and furniture. They also employed to raise the foundation of the house and constructed their house with more than one floor. While, people in Semarang City cleaned up the canal to minimize the possibility of the negative impact of flooding.

Socially, there are couple significant differences between those communities. First, people in Surakarta City, as mentioned before, have a unique strategy to predict how fast the water will arise in their neighborhood by using observing hourly a wooden stick which put upright near the river. They also try to get information of the water level as soon as possible in order to prepare themselves and their family for the flooding, so that they can start to evacuate their belonging to the save places. While in Semarang City, they do not apply those kinds of strategy because of the different characteristic of the floods.

During the flooding, there are also differences related to social network between the community members. In Surakarta City, prone people usually helping each other in the evacuation shelters by sharing foods and water, especially for the children and elderly as well as distributing the information about the flooding. Whereas in Semarang City, most of the local people search for the relief materials together with other community members.

Another different strategy is, after the flooding, the local people in the Semarang City try to look for alternative place to move, which do not appear in the local people living in Surakarta City since most of respondents interview refuse to move from their living places.

5.6. Concluding Remarks

This chapter comprises two objectives of this research; identifying the coping mechanism employed by the local people of Surakarta City and comparing the result with the similar previous research done by Dewi (2007) in Semarang City. From the descriptions above, it can be concluded that the local people in Surakarta City apply three kind of coping strategies; economical, physical and social cultural coping strategies.

Generally, there is no significant difference in coping strategies employed in the three *kelurahan* in study area. However, people in save area (*Kelurahan* Serengan) tend to be unaware of the threat of flooding occurrence in their area. Nevertheless, it appears that they give attention and care to the neighbor village which struck by the flooding by giving aid and help to them. It means that social network between these local communities is relatively strong and this becomes an asset for the social capacity to cope with the floods.

From the comparison with the previous research, it is found that there are similarity and difference of coping strategies employed in these different cities. The significant difference is observed from the physical and social coping strategies. From the economical coping strategies, it can be concluded that the local people in those two cities are tend to unprepared since most of them are lack of capacity in financial aspect. Most of the local people do not really have a special budget to prepare if the flooding occurs.

6. Proposed Mitigation Plan

This chapter explores the current mitigation measurement applied in Kelurahan Joyotakan as the result of focus group discussion conducted in the village. It also comprises the identification of social capacity in the area. At the last part of this chapter, the proposed mitigation plan will be presented.

6.1. Introduction

Mitigation action plan at the lowest level can come from the local people. Unfortunately, recently, mitigation action plan is made using top-down coordination. Rarely, people are involved in action plan arrangements. Thus, the measurement employed often did not addressed to solve the real problem that the people perceived. In addition, the flood mitigation plan applied merely emphasizes on the structural measurements, such as building dikes, providing pumps, etc.

The newest paradigm of constructing flood mitigation plan considers participation of the people, especially the local people who live in the flood-prone area, as an important aspect to be involved. Many parts of flood prone area in Surakarta City can be classified as densely populated areas. This means that whenever floods struck the area, many people will be affected. Thus, their opinions should be taken into account in planning every action related to their safety and their livelihood.

In this research, the information about a proposed mitigation plan was gained through focus group discussions (FGD). In this activity, participatory mapping was conducted to obtain perceptions of the people related to the characteristics of floods in the area. It is hoped that the information from the mapping can confirm the same information of flood perception and coping strategies which was personally obtained during the household interviews.

Firstly, it is important for the local people to recognize the flooding problems happen in their living place. By knowing the source of the problem, the local people will be encouraged to find the way to solve the flooding problem.

6.2. Identification of Problems

The identification of problems was one of the activities during the focus group discussion (FGD). Participants of the FGD came from the village community, village authorities and the leaders of the social organizations in the village. In order to obtain a clear understanding of the flooding problem in the study area, participants were firstly involved in determining the source of the flooding problem that occurred in their villages. This was done through participatory mapping which was held during the FGD in *Kelurahan* Joyotakan. The participants were asked to identify the characteristics of the flooding in their village (see Figure 6.1).

The result of the participatory mapping can also automatically confirm the result of the household interview. Participants were asked to discuss and to draw the flood extent, flood duration, emergency evacuation route, evacuation shelters and flood prone are in the village. All participants contributed to map the flood events that have happened in their village using sketch map. They can recall the areas that have been severely flooded, the evacuation routes, evacuation places, flood susceptible area in the village, flood depth and flood duration as well. Participant could also correct each other if there was a doubt in the answer. The result of participatory mapping is shown in Figure 6.1.

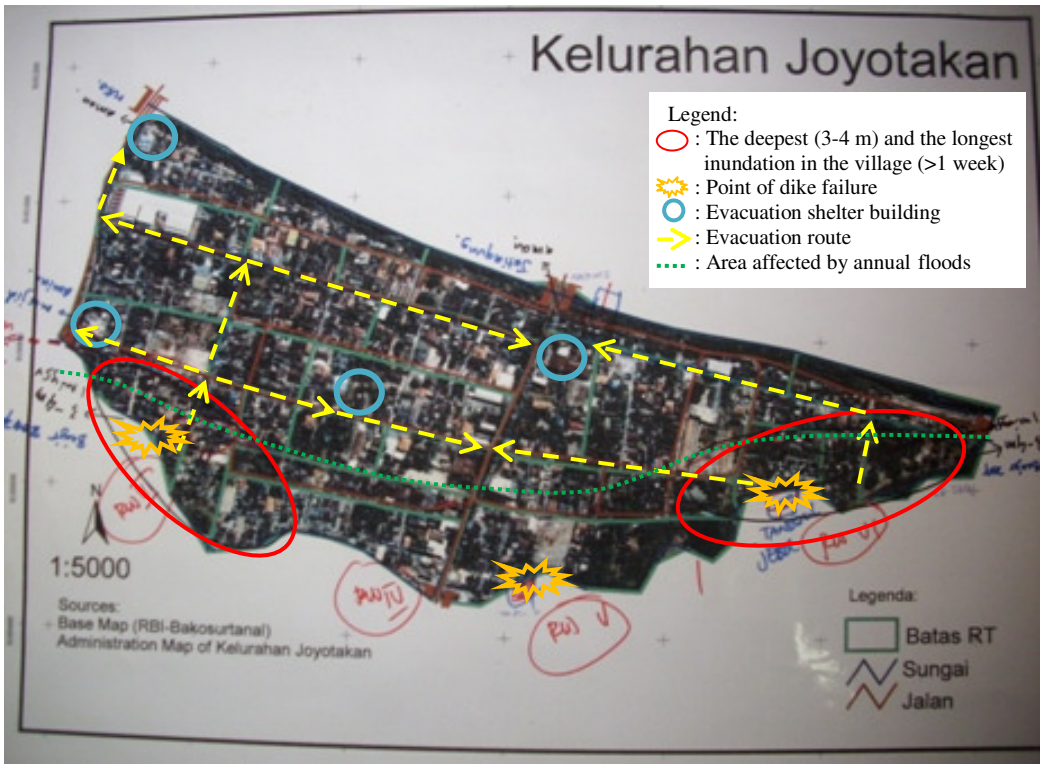

Figure 6.1. Sketch map used for participatory mapping (source: fieldwork, 2009)

From the participatory mapping, there is information that revealed in relation with the flooding occurrence in the village (see Table 6.1).

Table 6.1. Participatory mapping related to the flooding occurrences in *Kelurahan* Joyotakan

No	Subject discussed	Result
I.	Flood history Big Floods	• March 1966 • 1983 • December 2007 • January 2008
	Annual floods	Almost 1-3 times every year, but only in some certain areas such as RT 3 in RW III, and RT 6 and 5 in RW VI (see Figure 6.2).
II.	2007 Flood characteristics: Area most severely flooded	• RT 3 in RW III: flood depth reached 3-4 meters high • RT 4 in RW V: flood depth reached 2-3 meters high • RT 1, RT 5 and RT 6 in RW VI: flood depth reached 3-4 meters high
	Duration of inundation	• In RW III generally after 3 days the water has already receded, but in some parts (RT 2 and RT 3) the inundation retain until approximately 1 week. • Most of the areas in RW V were inundated, but the most severe area was RT 4 where floods prolonged until a week. • In RW VI especially in RT 1, RT 5 and RT 6 the inundation lasted until a week.

In order to illustrate the result in Table 6.1. above, the distribution of RW and RT in *Kelurahan* Joyotakan is described in Figure 6.2.

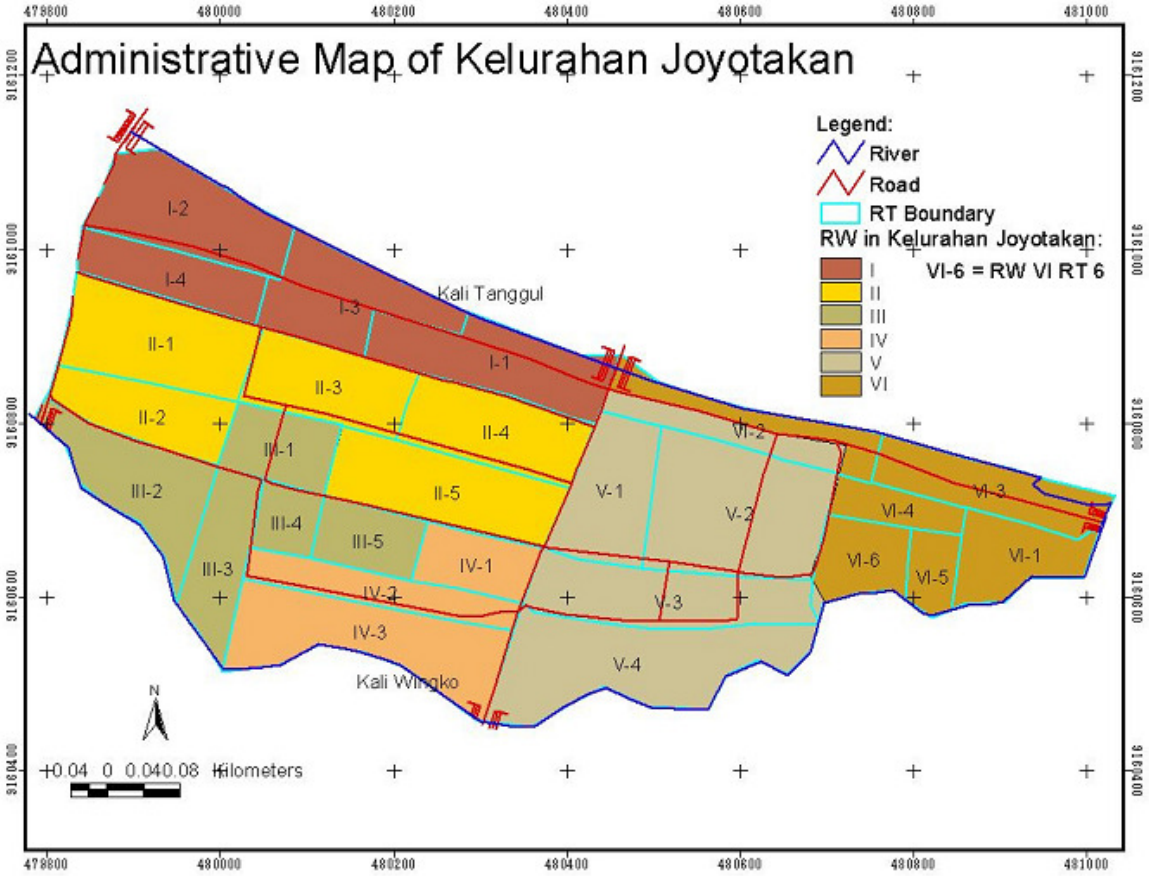

Figure 6.2. Distribution of RW and RT in *Kelurahan* Joyotakan

Furthermore, when the big flood in 2007 occurred, the local people can spontaneously determine where to go to evacuate their family and belongings. They used the best and the shortest routes to go to the mosque, village office, other 2-floors-buildings, dike and highway to be the shelter places (see Figure 6.3.).

a. Mosque

b. Joyotakan Village's office

c. Shopping complex

d. A private company's office

Figure 6.3. Shelter places used by the local people in *Kelurahan* Joyotakan

From the discussion, it can be summarized that the community could identify some following problems considered as the cause of the floods in their area:

1. Sedimentation in Bengawan Solo River narrowing the width of the river
2. Domestic and industrial wastes thrown to the river
3. Floodplain has been occupied and built up as settlements
4. Deforestation in upper areas

The community can also identify a number of solutions that are considered to solve the problems, such as:

1. Dredging of the Bengawan Solo River
2. Relocation of illegal settlements on floodplain
3. Management of waste disposal
4. Make regulations to restrict people building settlement on floodplain.
5. Law enforcement
6. Socialization and coordination of regulations
7. Training and education related to flood management.

6.3. Proposed Mitigation Plan

The identification of a mitigation action plan proposed by the local community has been gained through the FGD. Community leaders were involved to identify the assets of human resources, social organizations and what kind of roles that the organizations play in their area. Thus, the discussion brought out the identification of mitigation action plan that have been done by the community recently and what kind of mitigation plan that the local community, especially in *Kelurahan* Joyotakan wants to do.

To identify the social capacity of the community, social organizations in the area were listed in a calendar of season including the income and outcome flow of every organization. This is aimed to identify the social capacity of the community before the rainy season and flooding occurs. There are many social organizations in the community as shown in table 6.2.

Table 6.2 describes the social capacity in terms of economical aspects in *Kelurahan* Joyotakan. The "***"** (black asterisk) represents the income of the organizations and the "#" (red-number-sign) represents the outcome of the organizations. The more asterisk in a month, the more income that the organization had during the month. On the other hand, the more red-number-signs in a month, the more outcome that the organization should spend. By using this simulation, the participants could describe the economical capacity of every social organization existing in the village. Furthermore, through this simulation, participant could recognize how far the organization could contribute to support the flood mitigation action in the village.

Table 6.2. Calendar of season of social organizations existing in the community

No	Organization	Source of income (*)	Source of outcome (#)	Income and outcome flow in a year (month)											
				Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1.	*Karang Taruna* (neighborhood youth association)	• Routine contribution from member • Fund from RT, *RW* and Village head	• Independence Day Celebration(17th August)	** ##	** ##	** ##	** ##	** ##	** ##	** ##	** #####	** ##	** ##	** ##	** ##
2.	*PKK* (program at village level to educate women on various aspects of family welfare)	• Block Grant • Fund from RT, *RW* and Village head • Profit Activities	• Independence Day Celebration • New Year Celebration	**** * ##	**** * ##	***** ##	**** * ##	**** * ##	**** * ##	**** * ##	***** #####	***** ##	***** ##	***** ##	***** ###
3.	*Rukun Tetangga (RT)*	• Routine contribution every months to every households • *Jimpitan* (certain contribution for a certain purpose e.g. security, waste disposal management etc.)	• Independence day celebration • Handling if there were damaged roads or water canals • Helping if there was a member of *RT* who's sick	** ##	** ##	** ##	** ##	** ##	** ##	** ##	** #####	** ##	** ##	** ##	** ##
4.	*Rukun Warga (RW)*	• Block Grant	• Independence day celebration	*** ####	*** ####	*** ####	*** ####	*** ####	*** ####	*** ####	*** #####	***** ####	***** ####	*** ####	*** ####
5.	*Paguyuban Kejawen* (association of people who believe in mysticism associated with the Java view of the world)	• Block Grant • Routine contribution from members in every meeting	• Organizing routine meetings	* ##	* ##	* ##	* ##	* ##	* ##	* ##	* ##	***** ##	***** ##	* ##	* ##
6.	Paguyuban Becak (association of pedicab drivers in the neighborhood)	• Routine contribution from the members	• Organizing routine meetings	* #	* #	* #	* #	* #	* #	* #	* #	* #	* #	* #	* #
7.	*LPMK* (Institute of Community Empowerment)	• Kiosk rent fee • Building rent fee • Block Grant	• Independence Day Celebration • Carnivals • Development aid for community	*** #	** #	** #	** #	** #	** #	** #	** ###	** #	** #	** #	** #

Continue Table 6.2……

No	Organization	Source of income (*)	Source of outcome (#)	Income and outcome flow in a year (month)											
				Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
8.	*Desa Siaga* (a program for preparing the village to be ready for any hazard including health and disaster)	• National budget	-	*	*	*	*	*	*	*	*	*	*	*	*
9.	*Gerakan Sayang Ibu* (a program/movement to support the mothers' welfare through the improvement of health services)	• PKK budget • Routine contribution • Block Grant • Health Agency	-	*	*	**	*	*	**	*	*	**	*	*	**
10.	*Koperasi* (economic enterprise by community)	• Financial exertion	• End of year balance	*	*	*	*	*	*	*	*	*	*	*	* #####
11.	*PNPM* (National program to support community empowerment)	• Local Budget										*	*	*	*
												#	#	#	#
12.	*Pengajian* (religious meeting in community, mostly held by Muslims)	• Infaq (alms from the participants)	• Aid for sick participant	****	****	****	****	****	****	****	*****	*****	****	****	****
				#	#	#	#	#	#	#	#	#	#	#	#
13.	*PAUD* (Education for early age children)	• Block Grant • Tuition fee	• Teachers' Salary • School kits	*	*	*	*	*	*	*	*	*	*	*	*
				#	#	#	#	#	#	#	#	#	#	#	#
14.	*LP2A* (Institute of Islamic Education and Development)	• Block Grant • Infaq	• Short Training before fasting month • *Idul Fitri* Celebration • Grant for some mosques that have not been certified yet.	*	*	*	*	*	*	*	*	*****	*	*****	*
				#	#	#	#	#	#	#	###	#	#	#	#
15.	*Musrenbang kel* (a conference of village's planning and development)usually held in January or February														

Table 6.2 illustrates that many social organizations exist in the community and have the economic capacities. Unfortunately, none of those organizations have a special budget for mitigation action to anticipate floods in the area since in every end of year the income is completely used up for the other activities. In addition, regarding the flood risk management in the village, actually those organizations can contribute in reducing the risk of flooding and building the preparedness against floods among the community. For example, those organizations can initiate local level mitigation actions such as in managing mass evacuation, waste dumps management, emergency services like clean water supplies and sanitation, health services, common kitchen, etc. which can gradually reduce the dependency of the local authorities and external aid.

Table 6.3 shows that almost all of the mitigation measures were conducted by the government, especially related to the financial support. The contribution of those social organizations seems not very significant in order to build the capability of the community in dealing with the flooding. Based on the discussion, there are some measures had been applied in the area to mitigate floods since 1980 up until now as shown in table 6.3.

Table 6.3. Current mitigation measures in *Kelurahan* Joyotakan

No	Measure	Year	Source of Fund	Organizer
1.	Waste Disposal Management	1980-2008	• APBD • Self supporting by the community	*Karang Taruna*
2.	Building the embankment	1982	APBN	BUMN and *Gapensi,* involving the local community
		2009	APBN	BUMN and *Gapensi*, involving the local community
3.	Provision of water pumps in the area.	2004	APBN	Public Work Agency of Surakarta City
4.	Forming the *Pokja* (task forces) and *Desa Siaga*	2006	APBN	The Local Government of Surakarta City (Kesbanglinmas, Dinkes, and DKPP)
5.	Socializations:			
	• Regulation of illegal settlement on floodplain	2004	APBD	DKPP
	• Socialization and the training of Compost Production using domestic wastes	2005	APBD	The Local Government of Surakarta City
	• Simulation of Floods	2009	UN-OCHA	NGOs and the local government of Joyotakan village (involving local community)
6.	Law enforcement of illegal settlement regulation	2004	Self supporting by the local community	The local community
7.	Provision of more water pumps in the area.	2009 (still ongoing)	APBN	BUMN and BBWS Bengawan Solo
8.	Building of new parapet	2009 (still ongoing)	APBN	BUMN and BBWS Bengawan Solo
9.	Building the embankment	2009 (still ongoing)	APBN	BUMN and BBWS Bengawan Solo

Table 6.3. describes that mostly the mitigation measures in *Kelurahan* Joyotakan comprise the structural measures. The structural measures to mitigate flooding in the village are done through the building of flood mitigation infrastructures such as building new parapet, embankment, as well as provision of pumps. Most of the measures were supported financially by both local

budget and national budget. While non-structural measures were conducted through socialization and law enforcement but it still in a very limited number. Thus, the effort of building social capacity among the villagers should be improved to make people aware of the flooding impacts to their village.

Furthermore, the participants could determine the mitigation plan to reduce floods occurrence and to anticipate the floods. The mitigation plans formulated by the participants are shown in table 6.4.

Table 6.4. Mitigation Plan Formulated by the Participants

No	Mitigation Plan	Organizer	Time	Note
1.	Waste Disposal Management	*Karang Taruna*	Every day	Will be proposed in *musrenbangkel* (Conference of Village's Development Planning)
2.	*Padat Karya* (Intensive program to fix and to clean up water canals by involving community in the implementation)	The Head of the Village	October-November	Involving the community
3.	Building the Common Kitchen	PKK	During the flooding	
4.	Socializations of: • Waste handling • Floods handling and simulation	All of the social organizations in the village	All the times	

In the lowest level, the proposed mitigation plan that comes from the local people can be a good sign that people are starting to be aware and recognize the social capacity in their village. They proposed those activities as the basic things to be done considering the main problem in their village.

6.4. Concluding Remarks

Based on the facts revealed during the focus group discussion, it can be concluded that there are several social organizations existing among the local community in *Kelurahan* Joyotakan. Those organizations are the assets of social capacity in dealing with the frequent flooding. Unfortunately, the organizations still cannot play roles yet in flood risk management in the village. The organizations as the assets of social capacity in the community could have supported the flood risk management in the village since the organizations have financial capacity and strong social network between them. Actually, those organizations, with their can contribute in reducing the risk of flooding as well as building the preparedness against floods among the community. For example, those organizations can initiate local level mitigation actions such as in socializations to increase the awareness of flood risk, managing mass evacuation, waste dumps management, emergency services like clean water supplies and sanitation, common kitchen, etc. which can gradually reduce the dependency of the local authorities, either from financial aspects and option of mitigation measures.

Overall, most of the mitigation measures conducted in *Kelurahan* Joyotakan recently are still focused on structural measures rather than non-structural measures. In addition, the government through the local budget and national budget financially supported almost all of the structural measures. Socially, the capacity of the local people in coping with flooding still have to be strengthen through the empowerment of the social organizations.

7. Conclusion and Recommendation

This chapter concludes the discussions and summarizes the findings this research related with the objectives of the research. Some recommendations also will be described in the last part of this chapter.

7.1. Conclusion and Main Findings

Flood risk perception of the local community

One of the main objective of this research is to identify the flood risk perception of the local community in the study area based on different level of flood susceptibility in Surakarta City. The flood risk perception, as described in Chapter 4.4., consists of characteristics of floods perceived by the local respondents. It can be concluded that the flood risk perception among the local communities are varied. The result shows that the height of the flood inside the house perceived by the local people ranging between 0 – 4 meters high. Mostly, in Kelurahan Sangkrah maximum height of floods ranging less than 1 meter until 1 meter high. While in Kelurahan Joyotakan maximum water height reached 1.5 meters until 2 meters high. It is also revealed that the duration of the flood in 2007 is also varied. *Kelurahan* Serengan as the area which is less susceptible to flood, did not experience the inundation. On the other hand, *Kelurahan* Sangkrah as the flood prone area were mostly inundated between 3 – 7 days as well as *Kelurahan* Joyotakan..

Moreover, maximum water height was varied within those villages influenced by the flooding. In *Kelurahan* Sangkrah, maximum water height was in the 1st and 2nd day of flood occurrences. While in *Kelurahan* Joyotakan, the water level reached the maximum height in the 2nd and 3rd day of flooding. The difference could happen because of the different cause of the flooding. The frequency of the floods annually in those prone villages is mostly ranging between less than 3 times per year until 3 times in a year. Overall, the severity of flooding in 2007 perceived as a nuisance event by most of the respondents in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan as the prone to flood area. The main cause of flooding mentioned by most of respondents in *Kelurahan* Sangkrah was the backwater following the prolonged high rainfall and overflow of the Bengawan Solo River. Most of respondents in *Kelurahan* Joyotakan stated that the main cause of the flooding in their area was the failure of some points of the dike along *Kali* Wingko as well as backwater into the canals.

The main reasons why people keep staying in the area are varied. In *Kelurahan* Sangkrah and *Kelurahan* Joyotakan most of respondents decided to keep stay in the village because of their houses are inheritance from the ancestors or parents. While in *Kelurahan* Serengan, respondents choose the area as the living place mostly because of the comfortable environment. Flood mitigation infrastructures in the city assumed to be still sufficient to mitigate the city from frequent flooding. However, the local people hope that the government can enhance the condition of the Gadjah Mungkur Dam and do the routine dredging in the Bengawan Solo River and the dam. It also can be summarized that the local community still have a strong social network and high solidarity among them and later it has been prooved from the choice of coping strategy employed which is mostly social coping strategy.

There are different opinions among the respondents on the availability of early warning system for their area. Most respondents in *Kelurahan* Sangkrah and *Kelurahan* Serengan mentioned that there was no enough early warning system in their village before the flooding. On the other hand, most respondents in *Kelurahan* Joyotakan stated that they got the warning before the floods occurred. Then it revealed that this fact related with their coping strategy before the flooding.

This research also figures out the behavior of the local people upon flooding occurred in their villages. Most respondents in *Kelurahan* Sangkrah and *Kelurahan* Joyotakan feel that the flooding threatened their daily lives as well as their livelihoods, while in *Kelurahan* Serengan most of respondents did not feel their activities and livelihoods were threatened by the flooding. Thus, all of respondents in flood prone areas think that they should move things to safer places, while in *Kelurahan* Serengan most of respondents think that they do not have to do it. Respondents in *Kelurahan* Sangkrah and *Kelurahan* Serengan mostly feel that their living place is still safe from floods. On the other hand, generally respondents in *Kelurahan* Joyotakan realize that their village is not safe from flooding. In contrary, when respondents in *Kelurahan* Joyotakan and *Kelurahan* Sangkrah were asked if they want to move to a safer place, most respondents stated that they do not want to move. The respondents in prone flood areas (*Kelurahan* Sangkrah and *Kelurahan* Joyotakan) did not go to work during the flooding, while people live in the save area keep working since the flooding did not influence their daily lives.

Coping Mechanism employed by the local community in Surakarta City

Based on the discussion in Chapter 5.2, there are three main coping mechanism employed by the local community: economical, physical and social cultural coping mechanisms. Generally, there is no significant difference in coping strategies employed in the three villages in the study area. The local people living in flood-prone area usually cope with the flooding mostly by doing physical and social cultural coping strategies.

Before the flooding, not too many choices of economical coping strategies had been employed in the study area. Some of the local people try to save their belongings like television, radio, and clothes by putting them to the safer places such as dike, highway and relatives/neighbor's house that have two-floor house, to anticipate the flooding. In physical coping strategy, the local community learnt to rebuild or renovate their house by raising the floor from 0.3 until 1 meter above the ground. They also build emergency rooftop to evacuate their things immediately in a very emergency condition.

From social cultural coping strategy, the local people living in the flood-prone area and the save area work together to clean up the houses and the neighborhood. They also employ the *gotong-royong* to clean the canals in order to avoid the clogged drainage due to the accumulation of wastes and garbage. The local people applied a simple technique to indicate how fast the water arises by using only a wooden stick to observe hourly how fast the water level will arise. By forecasting the speed of water level rise, they can determine when they should start moving to safer places. They also initiated to find the further information about the water level in Wonogiri Dam and rainfall in upper area (Wonogiri and Boyolali) when the rainfall is getting higher and prolonged. Instead of merely waiting for the early warning from the government before the flooding, they also try to contact some family or relatives who live in the upper areas to predict how long the water will arrive to their village.

During the flooding, the local people do not have varied strategy economically. The local people try to save their valuable documents by bringing them to the evacuation shelter. Physically, the local community tries to minimize the damage and loss of their things and property by evacuating them to the higher place, binding the wood furniture and lock the doors and windows properly before leaving them to the evacuation place. Socially, during the flooding, the men guards the neighborhood together so-called *Ronda.*

After the flooding, no main economical coping strategy was employed. Mostly, the local people clean up the house and furniture from the mud and waste, both together (*gotong-royong)* and personally. They also dry the wet clothes and furniture as well as fixing the damaged part of the house.

However, people in save area tend to be unaware of the threat of flooding occurrence in their area. Nevertheless, it appears that they give attention and care to the next village which struck by the flooding by giving aid and help to them. It means that social network and solidarity among these local communities is relatively strong, and this becomes a good asset of the social capacity to cope with the floods.

Comparison of the coping mechanism employed by the local community in Surakarta City and Semarang City

Due to the different flood type, it was expected to have some differences in coping mechanism employed by the flood prone people in Surakarta City and Semarang City. From the comparison of the results of the researches, it is found that there are differences and similarities of coping strategies employed (see Table 5.20 and Table 5.21). The significant difference is observed in the physical and social coping strategies.

Physically, there are different strategies applied in all stages of flooding in those flood prone areas. The most important difference is that many prone people in Surakarta City built emergency rooftop so-called *anjang-anjang* as the emergency place for evacuating their belongings like clothes, appliances and furniture. They also employed to raise the foundation of the house and constructed their house with more than one floor. While, people in Semarang City cleaned up the canal to minimize the possibility of the negative impact of flooding.

Socially, people in Surakarta City have a unique strategy to predict how fast the water will arise. They also try to get information of the water level as soon as possible in order to prepare themselves and their family for the flooding. While in Semarang City, they do not apply those kinds of strategy because of the different characteristic of the floods.

During the flooding, there are also differences related to social network between the community members. In Surakarta City, prone people usually helping each other in the evacuation shelters by sharing foods and water, especially for the children and elderly as well as distributing the information about the flooding. While the local people in Semarang City tend to search the relief materials first to reuse them for rebuilding their damaged houses.

After the flooding, some of the local people in the Semarang City try to look for alternative place to move, which do not appear in the local people living in Surakarta City since most of respondents interview refuse to move from their living places.

From the economical strategies, it can be concluded that the local people in the two cities are tend to unprepared since most of them are lack of capacity in financial aspect. Most of local people do not really have a special budget to prepare if the flooding occurs.

Proposed mitigation plan

So far, most of the mitigation measures conducted in *Kelurahan* Joyotakan are still focused on structural measures rather than non-structural measures. Financial supports from the government still play important role in the implementation of mitigation measures in *Kelurahan* Joyotakan, especially for the structural mitigation measures. Socially, the capacity of the local people in coping with flooding still have to be strengthened through the empowerment of the social organizations. The dependency of the governmental support should be diminished through the society capacity building. Wisner and Luce (1995) in Dekens (2007) stated that building local knowledge and practices such as capitalizing on local strength could help the local community to reduce the dependency on external aid.

The local people as the root level of flood mitigation described the mitigation action plan through the FGD. The action plan consists of some measures that might be done in the village

scope. The proposed mitigation plan comprises two measures: structural measures and non-structural measures.

The structural measures are proposed to be conducted through the improvement of water canals in the village. The non-structural measures can be realized through the waste disposal management and continue socialization of flood handling and simulation, preparing the common kitchen during the flooding occurrence as well as domestic waste handling.

7.2. Recommendation

From the result and conclusion, there are some following recommendations can be proposed:

1. Further studies on relationship of social economic characteristics and coping strategies in different city with different community will be valuable to support the flood risk management in the area, since there are valuable local knowledges among the local community in coping with the negative impact of the flooding.

2. The co-operation between the local authorities and affected community will be needed in order to minimize the damages and losses and to maximize the flood risk management. Thus, the intensive coordination between the local authorities and the local community should be enhanced to make the cooperation between those groups can be benefit, especially for the community.

3. Since this research dealt with community participation, FGD has given benefit in rechecking the result of the interview. This research methods can be adopted by the government in a wider scope since it costs low budget and relatively effective in digging information of the flood perception and coping strategies of the local people to support the to support the flood hazard management in the city.

4. Regarding the comprehensiveness of the research result, the study area should be chosen based on both the flood vulnerability map and flood susceptibility map since those maps comprise wider aspects (physical, social and economical) of the element at risks.

References

Alkema, D., Damen, M., Kerle, N., Lubszynska, M., Kingma, N., PArodi, G., Rusmini, M., Van Westen, C., Woldai, T., (2009). Guide Book of Multi Hazard Risk Assessment Session 3; Hazard Assessment, ITC, International Institute of Geoscience and Earth Observation, Enschede, The Netherlands. (Unpublished).

Asian Disaster Preparedness Center (ADPC); UNDP, (2006), A Primer; Integrated Flood Risk Management in Asia, 332 p.

Aysan, Y.F., (1993). Vulnerability Assessment, Natural Disasters; Protecting Vulnerable Communities, Editor: Merriman, P.A. and Browitt, C.W.A., International Decade for Natural Disaster Reduction, Proceedings on the Conference Held in the London, 13-15 October 1993, Published by Thomas Telford Services Ltd, London.

Azad, A.K., (2008). Urban Flood Risk Assessment Using Community's Perception and Flood Propagation Model. ITC, International Institute of Geoscience and Earth Observation, MSc Thesis, Enschede, The Netherlands.

Birkmann, J., (2006). Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies, United Nation University Press, Tokyo, New york, Paris.

BNPB website, (2009). from http:/bpnb.go.id, last accessed on 14 May 2009.

BPS Kota Surakarta, (2008). Surakarta in Figure 2007.

BPS Kota Surakarta, (2009). Surakarta in Figure 2008.

Dekens, J., (2007). Local Knowledge for Disaster Preparedness; A Literature Review, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Dewi, A. (2007). Community-Based Analysis of Coping with Urban Flooding : a Case Study in Semarang, Indonesia, ITC, International Institute of Geoscience and Earth Observation, MSc Thesis, Enschede, The Netherlands

Heijmans, A., (2004). From Vulnerability to Empowerment, Mapping Vulnerability; Disasters, Development and People, In: Bankoff, G., Frerks, G., Hilhorst, D. (Eds), Earthscan, London, Sterling, VA.

Hidayat, F., Valiant, R., (2007). Sedimentation Problem and Water Allocation within the Bengawan Solo River Basin (Wonogiri Reservoir), Handout in the Third General Meeting of NARBO.

Kompas, (2009). Banjir Bengawan Solo: Kerugian Akibat Banjir Rp. 1 Trilliun, 19 March 2009, from http://cetak.kompas.com/read/xml/2009/03/19/03112028/kerugian.akibat.banjir.rp.1.triliun, last accessed on 16 May 2009.

Mandara, C.G., (2007). Participatory GIS in Mapping Local Context of Conflicts over Pastoral Resources. A case study of Duru Haitemba-Babati, Tanzania, ITC, International Institute of Geoscience and Earth Observation, MSc Thesis, Enschede, The Netherlands.

Marfai, M.A., King, L., (2007). Coastal flood management in Semarang, Indonesia, Environ Geol. 10.1007/s00254-007-1 101-3

Marfai, M.A., King, L., (2008). Tidal inundation mapping under enhaced land subsidence in Semarang, Central Java Indonesia, Nat Hazards, 44:93-109

Marfai, M.A., King, L., Sartohadi, J., Sudrajat, S., Budiani, S.R., Yulianto, F., (2008). The impact of tidal flooding on a coastal community in Semarang, Indonesia, The Environmentalist, 28(3): 237-248

Marschiavelli, M.I., (2008). Vulnerability assessment and Coping Mechanism Related to Floods in Urban Areas: A Community-Based Case study in Kampung Melayu, Indonesia, ITC, International Institute of Geoscience and Earth Observation, MSc Thesis, Enschede, The Netherlands.

Nunez, L., (2005). Tools for Forecasting on Warning as well as Hazard Assessment to Reduce Impact of Natural Disasters to Agriculture, Forestry and Fisheries, In: Siva Kumar MVK, Motha RP, Das HP (eds), Natural disasters and extreme events in agriculture, impacts and mitigation. Worl Meteorological Organization, Geneva.

OCHA-Partnership of Humanity, (2009). Indonesia Humanitarian Update – January 2009, from http://ochaonline.un.org , last accessed on 22 May 2009.

Plapp, T. and Werner, U., (2006). Understanding Risk Perception From Natural Hazard: Examples From Germany, RISK 21_Coping with Risk due to Natural Hazard in the 21st Century, In: Amman, Dannenmann and Vulliet (Eds), Published by Taylor and Francis Group, London.

Prasetyo, A.B., (2009). Pemetaan Lokasi Rawan dan Risiko Bencana Banjir di Kota Surakarta Tahun 2007, Skripsi, Education Science Faculty, Sebelas Maret University, Surakarta.

Qomarudin and Prayitno, B., (2007). Morfologi Kota Solo (tahun 1500-2000). Dimensi Teknik Arsitektur Vol.35, No.1, Juli 2007: 80-87

Rianto, T., (2009). Spatial Analysis of Volcanic Risk Perception Case Study in Local Community at Merapi Volcano Dangerous Zones, ITC, International Institute of Geoscience and Earth Observation, MSc Thesis, Enschede, The Netherlands.

Setiyarso, B., (2009). Studi Reaksi Manusia Terhadap Bahaya Banjir Kota Surakarta, Skripsi, Education Science Faculty, Sebelas Maret University, Surakarta.

Surya Online, (2009). Banjir Terbesar sejak 1982, 20.000 Rumah Terendam Lagi, 27 February 2009, from http://www.surya.co.id/2009/02/27/banjir-terbesar-sejak-1982-20000-rumah-terendam-lagi.html, last accessed on 16 May 2009.

Tran, P., Marioncioni, F., Shaw, R., Sarti, M., Van An, L., (2008). Flood Risk Management in Central Viet Nam; challenges and potentials, Natural Hazards (2008) 46;119-138, DOI 10.1007/s1 1069-007-9186-2.

Twigg, J., (2004). Good Practice Review, Disaster Risk Reduction: Mitigation and Preparedness in Development and Emergency Programming, Overseas Development Institute, 111 Westminster Bridge Road, London, UK.

Tjahjono, S., (2007). (Editor). Ekspedisi Bengawan Solo, Laporan Jurnalistik Kompas: Kehancuran Peradaban Sungai Besar, PT. Kompas Media Nusantara, Jakarta, January 2009.

UNISDR, (2009). Terminology on Disaster Risk Reduction.

Wisner, B., Blaikie, P., Cannon, T., and Davis, I., (2003). At Risk: Second Edition, Natural Hazards, People's Vulnerability and disasters; Published by Routledge, London.

Appendix

Appendix 1 : Questionnaire for Risk Perception and Coping Mechanism of Community related to Flooding in Kelurahan Sangkrah and Kelurahan Joyotakan

Purpose : This survey is intended only for scientific research purpose to study the risk perception and coping mechanism of local community in part of Surakarta City related to flooding.

Researcher : Fetty Febrianti

Contact : febrianti22617@itc.nl

Research title : Flood Risk Perception and Coping Mechanism of a Local Community: Study Case in Part of Surakarta City, Central Java Province, Indonesia.

(Part of this questioner is adopted from some questionnaires of previous researchs done by Dewi (2007) and Marschiavelli (2008))

Questionnaire no. : …… Interviewer :…… Date:…….. Time :……..

House number : …….. Name of respondent : ……..……

GPS No. : Lat……..……. Long…….……..

Sub-district : ……

Strata :……. Village :…….……

1. Information of Respondent Profile

(1). Age : …… years (2). Sex : Male ☐ Female ☐
(3). Position in Household : ……..
(4). Education : …… (5). Year of stay in this location: …….. years
(6). Job (Source of income): Teacher ☐ Merchant ☐
Government officer ☐ Police ☐
Farmer ☐ Labor ☐
Other ……

2. Information of Household/Family Profile

Name	Sex (F/M)	Age	Last Education and Current Job
……	……	……	……
……	……	……	……
……	……	……	……
……	……	……	……
……	……	……	……

Expense Per-Day :

(1). Food :
☐ < Rp. 10,000
☐ Rp. 10,000 – 20,000
☐ Rp. 20,000 – 30,000
☐ Rp. 30,000 – 40,000
☐ Rp. 40,000 – 50,000
☐ > Rp. 50,000

(2). Transport :
☐ Rp. 0 – 5,000
☐ Rp. 5,000 – 10,000
☐ Rp. 10,000 – 20,000
☐ > Rp. 20,000

(3). Others :	
……	**Rp…….**
	Rp. ……..
	Rp. ……..

3. Information of Element At Risk

3.1. Building

Wall Material	(1). Brick	(2). Wood	(3). Plywood	(4). Bamboo
	(5). Zinc	(6). Mix	(7). Other	
Floor Material	(1). Tile/ceramic	(2). Cement	(3). Wood	(4). Soil
	(5). Floor tile			
Roof Material	(1). Zinc	(2). Clay	(3). Cement	
	(5). Other			
Number of Floor	Pillar	(1). One	(2). Two	(3). Three
Height of Building				(m)
Height of 1st floor				(m)
Height from street				(m)
Age of the building				(Year)

3.2. Content of Building

a. Appliances

Item	Raised from ground floor (Yes/No)	No. of item	Value
Computer AC TV Radio Tape stereo Refrigerator Washing machine Stove …….. …….			

b. Furniture

Item	Raised from ground floor (Yes/No)	No. of item	Value
Sofa Chair Cupboard/Closet Table Carpet Dining Set Bed …….. …….. ……..			

c. Outdoor Properties

Item	No. of item	Value
Car Motor cycle Bicycle …….. …….. ……..		

4. Flooding

4.1. Flood history

Year	Single/Multi event	Flood Depth (head, breast, hip, knee, ankle)	Duration (day)	Casualties (death victims)	Cause of floods
2009 …….. …….. …… 2008 …… …… …… 2007 …… …… …… Before 2007 …… ……					

4.2. Late 2007 Floods' characteristics

How high was the maximum floods inundation level inside the house?
Where was the maximum floods' depth?
How long the water inundated the area?
When did the maximum flood height happen?
What do you think the cause of the flooding?
Do you think your place is safe from flooding?
How many times in a year the floods happen in your place?

5. Coping Mechanism

5.1. What is the reason you live here?

Ancestral properties ☐	Own properties ☐	Cheap Price ☐
Comfortable neighborhoods ☐	Easy access to business centre ☐	Others ☐
Easy access to work place ☐	Easy access to school/ Education inst. ☐	

5.2. Have you applied any floods coping mechanism for protection?

☐ **Yes;** ☐ **No;**

5.3. Coping Strategies in Economic/material Aspects

Before Flooding	During Flooding	After Flooding
Saving money ☐ Lend money from relative /friend ☐ Store basic foods and cooking equipment ☐ Placing things in safer place ☐ Preparing baby's stuffs ☐ Other ☐ ……. …….	Find alternative jobs ☐ Extra money for buying foods ☐ Other ☐ ……. …….	Sell goods to get extra money to repair house or appliance ☐ Lend money from relative /friend ☐ Other. ……. ……

5.4. Coping Strategies in Physical Aspects

Before flooding	During Flooding	After Flooding
Building house more than one floor ☐ Construct house using the concrete material ☐ Build a secure place under the roof ☐ Put sand bags in front of the house ☐ other ……	Evacuate personal goods to higher place ☐ Other …….. ……..	Repairing the damages ☐ Cleaning the mud from house and furniture ☐ Drying wet clothes and furniture ☐ Sorting house materials ☐ Other …… ……..

5.5. Coping Strategies in Social Aspects

Before flooding	During Flooding	After Flooding
Gotong royong to clean houses and its surrounding ☐ Cleaning the canal ☐ Discuss with other house Holds about the action plan to cope with flood ☐ other ……. …….	Guard houses with neighbors ☐ Help each other to evacuate neighborhood ☐ Share food and water ☐ Disseminate flood Information ☐ Other ……..	Clean up the mud and debris aft the flood together with neighbor ☐ Other …… ……

6. The Impact of Flooding

- Are you considering moving to another place for safety? Yes/No

  If Yes: Where is the place? ……..…….....

Why do you choose the place?.....

- Have you experienced with floods before you came to this area? Yes/No
- Do you think the floods in your area is threatening your daily lives and your livelihoods?

  Yes / No
- What do you think the level of floods in your area?

  (1). No problem (2). Nuisance (3). Disastrous
- What kinds of protection do you prefer for your building safety related to floods?

  ……
- Do you think the riverbank is still sufficient to reduce flood risk? Yes/No

  Please mention the reason: ……
- Do you think Wonogiri Reservoir is still helpful for protecting Surakarta City from floods? Yes / No

  If No, please mention why:……..

  What do you think government should do to improve it?.....……
- Did you notice any warning in case floods will occur? Yes/No

  If Yes, please mention from who: ……...…….
- How long do you need to move your things in case floods happen? (in hour)

  ……
- Where do you usually evacuate your family from floods?

  ……
- Can you continue working when flooding strikes? Yes / No

  If Yes, please mention how:……..

---------- Thank you for your cooperation ----------

Appendix 2 : Questionnaire for Risk Perception and Coping Mechanism of Community related to Flooding in Kelurahan Serengan

Purpose : This survey is intended only for scientific research purpose to study the risk perception and coping mechanism of local community in part of Surakarta City related to flooding.

Researcher : Fetty Febrianti

Contact : febrianti22617@itc.nl

Research title : Flood Risk Perception and Coping Mechanism of a Local Community: Study Case in Part of Surakarta City, Central Java Province, Indonesia.

(Part of this questioner is adopted from some questionnaires of previous researchs done by Dewi (2007) and Marschiavelli (2008))

Questionnaire no. : …… Interviewer :…… Date:…….. Time :……..

House number : …….. Name of respondent : ……..……

GPS No. : Lat……..……. Long…….……..

Sub-district : ……

Strata :……. Village :…….……

1. Information of Respondent Profile

(1). Age : …… years (2). Sex : Male ☐ Female ☐
(3). Position in Household : ……..
(4). Education : …… (5). Year of stay in this location: …….. years
(6). Job (Source of income): Teacher ☐ Merchant ☐
Government officer ☐ Police ☐
Farmer ☐ Labor ☐
Other ……

2. Information of Household/Family Profile

Name	Sex (F/M)	Age	Last Education and Current Job
……	……	……	……
……	……	……	……
……	……	……	……
……	……	……	……
……	……	……	……

Expense Per-Day :

(1). Food :
☐ < Rp. 10,000
☐ Rp. 10,000 – 20,000
☐ Rp. 20,000 – 30,000
☐ Rp. 30,000 – 40,000
☐ Rp. 40,000 – 50,000
☐ > Rp. 50,000

(2). Transport :
☐ Rp. 0 – 5,000
☐ Rp. 5,000 – 10,000
☐ Rp. 10,000 – 20,000
☐ > Rp. 20,000

(3). Others :

…… **Rp…….**
Rp. ……..
Rp. ……..

3. Information of Element At Risk

3.1. Building

Wall Material	(1). Brick	(2). Wood	(3). Plywood	(4). Bamboo
	(5). Zinc	(6). Mix	(7). Other	
Floor Material	(1). Tile/ceramic	(2). Cement	(3). Wood	(4). Soil
	(5). Floor tile			
Roof Material	(1). Zinc	(2). Clay	(3). Cement	
	(5). Other			
Number of Floor	Pillar	(1). One	(2). Two	(3). Three
Height of Building	(m)			
Height of 1st floor	(m)			
Height from street	(m)			
Age of the building	(Year)			

3.2. Content of Building

a. Appliances

Item	Raised from ground floor (Yes/No)	No. of item	Value
Computer AC TV Radio Tape stereo Refrigerator Washing machine Stove …….. …….			

b. Furniture

Item	Raised from ground floor (Yes/No)	No. of item	Value
Sofa Chair Cupboard/Closet Table Carpet Dining Set Bed …….. …….. ……..			

c. Outdoor Properties

Item	No. of item	Value
Car Motor cycle Bicycle …….. …….. ……..		

4. Flooding

4.1. Flood history

Year	Single/Multi event	Flood Depth (head, breast, hip, knee, ankle)	Duration (day)	Casualties (death victims)	Cause of floods
2009 …….. …….. …… 2008 …… …… …… 2007 …… …… …… Before 2007 …… ……					

4.2. Late 2007 Floods' characteristics

How high was the maximum floods inundation level inside the house?
Where was the maximum floods' depth?
How long the water inundated the area?
When did the maximum flood height happen?
What do you think the cause of the flooding?
How many times in a year the floods happen in your place?

5. Coping Mechanism

5.1. What is the reason you live here?

Ancestral properties ☐	Own properties ☐	Cheap Price ☐
Comfortable neighborhoods ☐	Easy access to business centre ☐	Others ☐
Easy access to work place ☐	Easy access to school/ Education inst. ☐	

5.2. Have you applied any floods coping mechanism for protection?

☐ **Yes;** ☐ **No;**

5.3. Coping Strategies in Economic/material Aspects

Before Flooding	During Flooding	After Flooding
Saving money ☐ Lend money from relative /friend ☐ Store basic foods and cooking equipment ☐ Placing things in safer place ☐ Preparing baby's stuffs ☐ Other ☐ …….. …….	Find alternative jobs ☐ Extra money for buying foods ☐ Other ☐ ……. …….	Sell goods to get extra money to repair house or appliance ☐ Lend money from relative /friend ☐ Other. ……. ……

5.4. Coping Strategies in Physical Aspects

Before flooding	During Flooding	After Flooding
Building house more than one floor ☐ Construct house using the concrete material ☐ Build a secure place under the roof ☐ Put sand bags in front of the house ☐ other ……	Evacuate personal goods to higher place ☐ Other …….. ……..	Repairing the damages ☐ Cleaning the mud from house and furniture ☐ Drying wet clothes and furniture ☐ Sorting house materials ☐ Other …… ……..

5.5. Coping Strategies in Social Aspects

Before flooding	During Flooding	After Flooding
Gotong royong to clean houses and its surrounding ☐ Cleaning the canal ☐ Discuss with other house Holds about the action plan to cope with flood ☐ other ……. …….	Guard houses with neighbors ☐ Help each other to evacuate neighborhood ☐ Share food and water ☐ Disseminate flood Information ☐ Other ……..	Clean up the mud and debris after the flood together with neighbor ☐ Other …… ……

3. The Flood Impact

- Did you come from other place? Yes/No
- If yes, please mention the place .....
- Have you ever experience flooding at your originate? Yes/No
- Is there any early warning system before the flooding in your original place?Yes /No
- If yes, From who? ……..…….....…….

- Do you think you need to start moving things in case of flooding in the neighboring areas? Yes/No
- If yes, how long does it take to move things? (in hour)……
- Did your family move when the flooding occured? Yes/No
- Did your village become the evacuation place for the victims of flooding from other village? Yes/No
- If yes, Where was the evacuation place?.....……
- Do you mind if your residence become a refuge for the flood victims? Yes/No
- Please mention the reason ……
- Did you send aid for flood victims in other areas? Yes/No
- If yes, in what form?.....
- Do you think the floods in your area is threatening your daily lives and your livelihoods? Yes / No
- Do you feel that your living place now is still safe from flooding? Yes/No
- Do you think in there are areas which include flood-prone area in your village? Yes/No
- If yes, where? ……
- Did you keep working during the flood in 2007 in Surakarta City? Yes/No
- Did the flooding occurred in the neighboring village become a threat to your living areas? Yes/No
- How do you think the level of flood events severity which occured in some regions of Surakarta City (e.g. Kelurahan Joyotakan and Kelurahan Sangkrah)?

  (1).No Problem (2). Nuisance (3). Disastrous
- According to you, the existence of Solo River levees are effective / useful to reduce the risk of flooding? Yes/No
- If no, please mention the reason: ……..……..
- Do you think that Gajah Mungkur Dam in Wonogiri is still effective/useful to protect the city of Surakarta from flooding? Yes/No
- If No, please mention the reason :…… ……..
- According to you, what government should do to improve the function of Gajah Mungkur Dam and these dikes?…….

---------- Thank you for your cooperation ----------