DISSERTATION

INTEGRATED FLOOD MANAGEMENT MODEL: A SOCIO-TECHNICAL SYSTEMS APPROACH TO OVERCOME INSTITUTIONAL PROBLEMS IN JAKARTA

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Emma Akmalah

Department of Civil and Environmental Engineering

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY EMMA AKMALAH ENTITLED INTEGRATED FLOOD MANAGEMENT MODEL: A SOCIO-TECHNICAL SYSTEMS APPROACH TO OVERCOME INSTITUTIONAL PROBLEMS IN JAKARTA BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Darrell G. Fontane

Jose D. Salas

Evan C. Vlachos

Advisor Neil S. Grigg

Department Head Luis A. Garcia

ABSTRACT OF DISSERTATION

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Urban flooding is a systemic problem of urban areas in developing countries, which face other difficult problems of urbanization, social inequality, and environmental degradation. The threats may overwhelm the institutional capacity to respond and cities may be unable to cope with the consequences. Although floods are triggered by natural events, the hazards they present are also affected by the social, economic, and political environments where people live. Low-income people suffer most from flood disasters because they tend to live in flood-prone areas, often do not understand the hazards they face, and lack institutional support.

This urgent situation of flooding in developing countries led to this study, which uses systems analysis tools to address flood disaster problems from multiple perspectives. Since flooding in Jakarta is a complex socio-technical problem, an integrated approach is used to show how to reduce the risk and mitigate the effects of flooding. The flood management system should be regarded as an integral part of the urban system, which displays very dynamic behavior among its subsystems.

The urban system analysis showed the links among attractiveness of the city, migration, poverty, lack of community cohesion, overwhelmed infrastructure and management systems, and the resulting succession of flood disasters.

The study applies a model of institutional, socio-economic, technical, financial, and environmental aspects of flooding in developing countries and uses a case study of flooding in Jakarta, Indonesia to test hypotheses about managing flood hazards in an integrated manner. The management model is based on an Integrated Flood Management approach to: identify stakeholders' roles, responsibilities, and actions to solve the problems; identify gaps between the disaster responses needed and provided; and build collaborative actions among stakeholders to overcome institutional problems. It seeks to identify appropriate flood management strategies that are sensitive to local conditions.

An integrated approach emphasizes community participation and a combination of structural and non-structural measures for flood mitigation programs and is directed to both short-term and long-term impacts and consequences. It also presents a framework for institutional analysis to ensure the political commitment for a proper institutional coordination, resources mobilization and enhancement of preparedness.

As a key path to a solution to the flood problem in Jakarta, the integrated approach must involve all relevant sectors and communities. This will require a paradigm shift in how flood problems are identified, addressed, and solved. Such an approach must involve a mutual effort at the institutional and community levels by enhancing institutional capacity at the local government level as well as empowerment of the total community.

The suggested model can be used in order to help policy makers develop an effective and comprehensive flood management strategy, solve flood problems, and improve local conditions. Considering that many large cities in developing countries face similar problems, the analysis and the case study can provide an example to help other flood-prone cities with similar characteristics and pattern of urban development.

Emma Akmalah
Department of Civil &
Environmental Engineering
Colorado State University
Fort Collins, CO 80523
Spring 2010

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CHAPTER I

INTRODUCTION

Flood disasters, which involve complex interactions among natural events, geomorphologic conditions, and human interventions, add greatly to the hardships of low-income people in developing countries. Although floods are triggered by natural events, the hazards they present are also affected by the social, economic, and political environments where people live. Vulnerability to flooding is also affected by social change, patterns of development, and political decisions. Low-income people suffer most from flood disasters because they tend to live in flood-prone areas, often do not understand the hazards they face, and lack institutional support to cope with the problem. Since much of the death and destruction can be prevented, a proactive approach is needed to replace traditional reactive responses. Flooding is only one of the systemic problems of densely-populated urban areas in developing countries, which face other problems of urbanization, such as social inequality, and environmental degradation. The threats may overwhelm the institutional capacity to respond and governments may be unable to cope with the consequences. Even in the United States, this was demonstrated by the suffering that occurred after the flooding in New Orleans during Hurricane Katrina. When the effects of global environmental and socio-economic change are combined with inadequate institutional support, risks can be magnified and threaten the quality of life for many people.

Flood disaster impacts are increasing due to population growth, pressures for land, and economic development in urbanized areas. Urbanization increases the magnitude and frequency of flooding by altering local hydrology characteristics. Therefore the need for effective flood management strategies increases, especially in flood-prone areas.

Disaster preparedness by structural measures is costly and usually out-of-reach of developing countries where disaster mitigation funding must compete with other priorities. Solutions must be more cost-effective, as well as socially, environmentally, and politically acceptable.

The urgent situation described by these facts about flooding in developing countries led to this study, which uses systems analysis tools to address flood disaster problems from multiple perspectives. The study considers institutional, socio-economic, technical, financial, and environmental issues of flooding in developing countries and a case study of flooding in Jakarta, Indonesia is used to test hypotheses about managing flood hazards. Considering that many large cities in developing countries face similar problems, the analysis and the case study can provide examples to help other flood-prone cities with similar characteristics.

1.1 Purpose and Scope of the Study

The study will provide a management model based on an Integrated Flood Management approach to: identify stakeholders' roles, responsibilities, and actions to solve the problems; identify gaps between the disaster response needed and provided; and build collaborative actions among stakeholders to overcome institutional problems. It will seek to create a model that offers appropriate flood management strategies that are

sensitive to local conditions. The strategies will need to be based on the integrated approach with emphasis on community participation and combination of structural and non-structural measures for flood mitigation programs and directed to both short-term and long-term impacts and consequences. It will also develop a framework for institutional analysis to ensure the political commitment for a proper institutional coordination, resources mobilization as well as enhancement of preparedness.

The term "model" in this study refers to the management system and institutional mobilization, and is not a typical mathematical or computer-derived model. Rather, it refers to a socio-technical systems model with both engineering and social aspects.

The stakeholders in this study include the local government, the communities that are vulnerable to flooding, and other entities such as national agencies and environmental groups, with an interest in the way the decisions affecting flood management are made.

1.2 Significance of the Study

Public perception about flood risk and its consequences may vary due to education levels as well as economic and social conditions. Planning for flood management strategy requires a clear understanding and awareness of the risk. Community awareness is needed for resource mobilization to build resilience.

Public education can augment regulation to be an important means for affecting development patterns and encouraging flood mitigation and preparedness programs. The programs should emphasize solutions that change attitudes in society that could make people more vulnerable. Building capacity for people to protect themselves against flood

hazard is crucial. Activities that can be sustained after the occurrence of flood hazards, such as restoration and rehabilitation, should also be supported.

For implementation, a flood management strategy needs leadership and support from the government and other organizations. Institutional arrangements for flood management also involve multidisciplinary and interagency partnerships. The major administrative challenge appears to be coordination among agencies and also enforcement of laws and regulations.

The successful implementation of flood management strategies depends also on interaction and collaboration among stakeholders. The roles and responsibilities of all stakeholders should be identified to build a more meaningful participation. People should be treated as partners in flood management. Community participation builds confidence that they could make a difference and capabilities to pursue flood management programs and other responsibilities at the local level, which leads to empowerment.

As flood management needs integrated approaches that involve multi-disciplinary studies and interagency coordination, the challenge that emerges is to build good communication and coordination among stakeholders – engineers, policy makers, local organizations, and affected people – with different backgrounds, perceptions and status levels.

The consequences of disasters are hard to cope with, especially for developing countries. There has been a tendency in developing countries to rely on external funding such as loans for construction of flood control measures and reconstruction of flood-damaged infrastructure. This non-sustainable approach simply moves the problems to the next generation.

Although there is a growing realization that the structural approach to flood control is not sufficient, engineers and project planners do not easily abandon the structural measures. It has been realized that a strategy using only structural measures is not realistic since the cost for construction, operation, and maintenance is beyond the government funding capability. For example, the Asian Development Bank (ADB) adopted a water policy for the first time in 2001, reflecting the urgent need to formulate and implement integrated, cross-sectoral approaches to water management and development. The policy promotes the use of combined structural and non-structural measures of flood protection (Fox, 2003).

Despite the ADB's policy, Indonesia still emphasizes controlling floods by costly structural measures. Little attention has been paid to manage watersheds which have degraded over the years and there has been lack of institutional arrangement to carry out the programs and responsibilities for watershed management (Fox, 2003). In addition, community participation in planning and management for flood mitigation and preparedness in the city of Jakarta so far has been minimal (Soenarno et.al., 2001).

Based upon the circumstances, most of the previous studies are more concerned about the feasibility of the structural flood mitigation projects than about non-structural measures or the mix of structural and non-structural approaches to flood challenges.

Since the flood problems in Jakarta are interrelated with many other issues such as urban development and environmental degradation, there is a need for effective integrated flood management. The model can be used as a reference to help policy makers develop an effective and more comprehensive flood management strategy to solve the flood problems and to improve local conditions.

1.3 Research Questions and Hypotheses

The overall question that drives the study is: "How can flood problems in Jakarta be confronted and mitigated in a comprehensive, integrated and implementable manner?" This overall question must be decomposed into elements to facilitate the study. Research questions that follow from this general question are:

- What are the factors that contribute to the flood problems and how do they relate to each other?
- How can community resilience and robustness be enhanced?
- How can community involvement in disaster prevention and preparedness are promoted?
- How appropriate and relevant are the existing flood management strategy and institutional arrangements for preventing, solving, and mitigating flood problems in Jakarta?
- What are some key options for improving the flood management strategy?
- How do these options contribute to improving the economic, social, and environmental conditions in Jakarta?
- What are the major constraints to the implementation such a strategy?

These research questions can be converted to hypotheses for the study. The research strategy is to apply the flood management model to the Jakarta case to test the hypotheses as far as possible within the context of the complex urban flooding issue that confronts us.

The following are general statements about the hypotheses that frame the study.

- ***Need for an integrated approach***

  An integrated approach with a mixture of structural and non-structural flood response measures is the most realistic solution for Jakarta. As the path to a solution to the flood problem in Jakarta must take an integrated approach and involve all relevant sectors and communities, it will require a paradigm shift in how flood problems are identified, addressed, and solved. The approach must involve a mutual effort at the institutional and community levels by enhancing capacity in the local government and empowerment of the community. It must go beyond traditional flood prevention to use a framework such as the one based on a holistic approach to hazard, exposure, vulnerability analysis, and mitigation.

- ***Comprehensive urban planning***

  City development and urbanization have created problems that directly contribute to flood events and expose the city's inadequate planning and inadequate drainage systems. The comprehensive urban plan and the drainage sector plan must be improved.

- ***Improved institutional arrangements for flood management***

  While there has been a master plan and programs to overcome the flood problems, they were not implemented properly because of institutional and financial problems. Therefore there is a need to create appropriate institutional arrangements to improve the programs.

- ***Clear and consistent regulations and law enforcement***

  Appropriate regulations are needed, along with clear administrative guidelines. Unless the law is enforced the program will not succeed.

- ***Address questions of poverty and development***

  Vulnerability to flood disasters is a function of poverty and lack of information about the hazard; therefore resilience may be enhanced by promoting access to knowledge and resources.

- ***Encourage public participation***

  Participatory planning to involve people at the neighborhood and zone levels is needed to facilitate cooperation in conserving and maintaining their immediate environments. Technical information must be understandable to the people with various educational backgrounds.

- ***Outline a context of Emergency Management***

  Inadequate emergency preparedness increases vulnerability to flooding. Institutions need to be developed to maintain good communication with people regarding the flood management strategy and help them to prepare themselves to deal with flood event.

- ***Increase financial support and supportive mechanism***

  Appropriate levels of financial support must be made available to take care of the most urgent infrastructure needs and to sustain public participation programs.

1.4 Case Study

The Jakarta case study is presented in Chapter 4, but a preview of it is provided here.

Like other large cities in developing countries, Jakarta is attractive to migrants. Increased urban investment, compared to investments in rural areas, suggests that employment opportunities are increasing. Most urban areas which have experienced such growth have not seen a proportional expansion in the capacity of public services, including hazards forecasting and warning systems as well as drainage structures.

As the main center of industry and commerce, Jakarta dominates Indonesia's administrative, economic, and cultural activities. Over the years, the city has grown rapidly, so much so its municipal governments have not been successful in coping with the impacts of urbanization. The rapid population growth has outgrown the government's ability to provide basic needs for its residents.

As a port city on alluvial lowland, Jakarta is naturally prone to flooding during periods of heavy rainfall. Thirteen rivers converge in the urban area, and every rainy season they swell quickly and massively (see Figure 1.1). Chronic flooding, mostly caused by clogged water ducts and poor drainage, hits Jakarta every year during the wet season. An extensive drainage system, including major canals, exists to prevent flooding but it is poorly maintained and often clogged. Lack of appropriate garbage collection and disposal decrease the water quality and the capacity of the urban drainage network due to filling. Flooding is also caused by poor watershed management, deforestation and exploitation of natural resources. As a result, the flood situation in Jakarta is getting worse because the city is growing without proper control and expansion in areas that are particularly susceptible to floods.

Figure 1.1 Rivers in the City of Jakarta

The problem of flooding in Jakarta has long been recognized. However, the approach to flood management has always been reactive and flood control measures are usually built after flooding causes severe damage to constructed facilities. The government has invested considerable funds in infrastructure development on floodplains, including funds to build canals and reforest areas to offset the problem. Disaster prevention and mitigation measures have been largely concerned with costly technical solutions.

Recent studies have shown that traditional engineering measures are insufficient to protect the population from flooding. A sustainable long-term approach for floodplain development, which considers socio-economic constraints as well as environmental objectives, is necessary in order to mitigate flood impact and to manage the causes of flooding. In developing country, such as Indonesia, emphasis should be on low-cost high-return approaches rather than on application of high-tech solutions. Costly structural flood control measures are beyond of financial capacity of the city. A mixed approach of flood mitigation measures is probably the realistic solution.

In 2007, Indonesia passed the Disaster Management Law (No. 24/2007). However, the implementation of this new law will take time and efforts. The local government also needs to enforce all of the current laws and implement a participatory paradigm that involves people conserving and maintaining their immediate environment. Lack of effective empowerment of the community and inadequate local institutions capacity building coupled with lack of coordination and financial capability have been major problems. The policy calls for a paradigm shift in flood management from conventional top-down approach to stakeholders' collaboration approach by allowing stakeholders to take active roles in flood management.

1.5 The Study Organization

The study is organized as follows:

- This chapter introduces the study objective and scope, the significance of the study, the research questions and hypotheses, the preview of the case study, and the organization of the study.
- Chapter II contains a literature review from relevant books, journal articles, dissertations, and other materials.
- Chapter III presents the study methodology which includes study design and procedure for data collection.
- Chapter IV describes the case study.
- Chapter V provides the research findings and analysis.
- Chapter VI summaries and concludes the findings throughout the study, and also recommend several suggestions for future study.

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CHAPTER II

LITERATURE REVIEW

2.1 General Problems with Flooding

The central issue of the study is flooding, which is one of the greatest natural hazards that affect humans. During the 20th century, floods were the number-one natural disaster in the United States in terms of number of lives lost and property damage (USGS, 2000). In 1998, floods in the Yangtze and Songhua rivers in China caused about $7.3 billion direct damage and more than 3500 deaths (Fox, 2003). Again in China, 1,123 people were reported killed, 1.3 million left homeless and 140 million people have been affected in 2002. Similarly, in India more than 600 people have been killed and at least 1.5 million homes destroyed. In Nepal, at least 50 people are feared dead after landslides triggered by monsoon rains swept through two villages. In 2002, the Philippines was severely hit by floods, which caused 142 casualties, and affected nearly 500,000 families and over 2.2 million people (UNESCAP, 2002). Bangladesh is flooded annually over much of its area, and severe floods inundate as much as two thirds of the country. Floods which occur annually in the Lower Mekong Delta have affected up to eight million people through evacuation, loss of crops and livestock, and loss of work opportunities. Heavy rains in 2002 also brought flash flood, mudslides, and numerous deaths to inhabitants of the Indonesian islands of Java and Sulawesi. More than 360,000 residents have been displaced from their homes.

2.2 Flood Studies in Developing Countries

Nearly 200 million people in more than 90 countries are exposed to catastrophic flooding every year. Populous Asian countries are at the top of the list of countries with the highest number of people exposed. Apparently, death rates are far higher in poor or developing countries than in wealthy nations, even if the incidence and intensity of disasters are the same.

The flood problems in developing countries are becoming more serious. So far the world community has witnessed ravaging flood events occurring mostly in the developing countries. Less than half of all flood disasters occurred in Asia; however, over 80% of the people killed, affected or homeless were located in this continent. In developing countries, due to water scarcity, large populations live along the major rivers and as a result the floods are more devastating, killing millions of people and damaging property every few years (UNEP, 2002).

2.2.1 Flood Problems and Responses in Bangladesh

As an example of severe flooding in a developing country, Bangladesh is located in South Asia and built over the floodplains of three major rivers, the Ganges, Brahmaputra, and Meghna. The three rivers converge in Bangladesh and empty into the Bay of Bengal through the largest river delta in the world. The geomorphologic condition, deforestation and human activity on floodplains have increased the flood risk. Bangladesh is flooded annually over much of its area. Such flooding provides fertile floodplains. However, since the country is densely populated and the floodplains are intensely utilized, floods on any of the rivers can affect a vast number of people.

Flood control measures in Bangladesh have been limited to building of earthen embankments, polders, and drainage. Embankments and polders have reduced floodplain storage capacity during floods, leading to an increase in water levels and discharges in many rivers. Earthen embankments can be damaged by riverbank erosion and fail easily. Moreover, embankments have created a false sense of security among residents living within embanked areas and breaching embankments caused substantial damage to the environment and property (Khalequzzaman, 2000).

In 2002, the Local Government Engineering Department stated that "total flood control in Bangladesh is neither feasible nor desirable". This lesson was harshly learned from the loss of life and severe devastation caused by the floods of 1988 and 1998 that tore through flood control embankments and swept over vast tracts of the countryside. From 2000 to 2002, the Japan International Cooperation Agency assisted the government in preparing a master plan for rural development focusing on flood proofing. Poverty alleviation is an integral part of the project that builds on the participatory approach to introduce self-managed savings and credit programs, cost sharing, and institutional building (Fox, 2003).

Hossain (2003) explained that flood management strategies adopted in Bangladesh have continuously evolved over the last 50 years. Initially, the emphasis was on structural measures through the implementation of some large-scale flood control, drainage and irrigation projects. However, it was soon recognized that their implementation involved large investments, as well a long duration for their completion. Later, environmental protection was also raised as a concern.

Non-structural measures such as flood forecasting and warning were later incorporated, as it was felt that structural measures alone could not mitigate flood problems. More emphasis is now put on other non-structural means for flood mitigation, in particular by adopting a policy of involving communities in flood management, the stopping of encroachment on floodplains through legislation controlling the developments in the floodplains and wetland. In addition, the government has made flood management as a participatory activity. Updated Guidelines for Participatory Water Management have been prepared to involve all kind of stakeholders, both at national and local levels. Some pilot studies have recently been completed to ensure effective people participation in dissemination, as well as in flood preparedness activities at the community level.

Hossain (2003) added that Bangladesh has learnt many lessons from its experiences in flood management, namely:

- Flood management activities should be an integrated approach in line with Integrated Water Resources Management (IWRM)
- Flood management should combine structural and non-structural measures
- The process of flood management should be based on a participatory approach, and communities should be proactive
- Flood management should be sustainable
- Technical considerations should not preclude socio-economic considerations
- Flood management should directly contribute to poverty alleviation in the developing countries.

2.2.2 Flooding in Jakarta, Indonesia

Jakarta, Indonesia, which will serve as our case study, has also experienced severe flooding for many years. Indonesia is located in Southeast Asia, with an area of 1,919,440 square kilometers (741,050, sq mi) and a current population of over 234 million people. The country is richly endowed with natural resources, yet poverty is a defining feature of contemporary Indonesia.

Indonesia's high population and rapid industrialization present serious environmental issues, which are often given a lower priority due to high poverty level and weak, under-resourced governance. Issues include large-scale deforestation, over-exploitation of marine resources, and environmental problems associated with rapid urbanization and economic development.

Jakarta is the capital and largest city of Indonesia. Currently, Jakarta is the eleventh largest city and ninth most densely populated city in the world with 44,283 people per square mile. Urbanization has been a major problem which leads to infrastructure inadequacy and environmental degradation. Coupled with geomorphologic condition, these factors contribute to the frequent flooding.

During the wet season, Jakarta suffers from flooding mostly due to heavy rain, clogged sewage pipes and waterways, deforestation, and lack of adequate drainage system and flood control. The flood in 2007 is considered the worst in three centuries. The flood affected 80 separated regions in and around Jakarta, and over 70,000 homes were flooded, resulting in the displacement of some 200,000 people. The death toll reached 68 people, and approximately 190,000 people have fallen ill due to flood-related illnesses. The flood has caused about $879 million in losses (BPS, 2007).

As pointed out by Siswoko (2005), flood mitigation in Jakarta has relied heavily on structural measures. Despite millions of Rupiah invested in flood control, flooding still remains a problem and is getting worse. Moreover, most of flood mitigation activities have been carried out by the government with lack of public participation, especially over land acquisition and in maintaining their environment. Rapid population growth, lack of law enforcement and top-down approach by the government has also contributed to the problem.

Caljouw et. al. (2004) explained that flood solutions in Jakarta can be done from all sorts of short term measures such as cleaning, better solid waste management, removal of obstacles, dredging, enhancement of operation and maintenance and improvement of infrastructure to institutional strengthening by technical training, awareness programs, law enforcement and early warning and emergency assistance systems, as well as long term improvements by means of upper watershed planning and management, and the improvement of discharge capacity and retention capacity. The latest developments focus on extensive dredging works, evictions of illegal settlers from riverbanks and the setting up of an early warning system. Since existing infrastructure and facilities are not performing at their planned capacity, the focus in Jakarta should initially be on the rehabilitation of the existing infrastructure.

Soenarno et. al. (2001) also pointed out that the impact of political reform on administration and legal systems is believed to improve overall conditions which will in time make real achievement possible.

2.3 Flood and Flood Hazards

The flooding problem in Jakarta involves both urban drainage and stream flooding. A flood is defined as overflowing of water onto land that is normally dry. Floods often happen when bodies of water overflow or tides rise due to heavy rainfall. Wohl (2000) defined a flood as simply the flow of a larger-than-average volume of water along a river channel. Flood area is most commonly described in terms of discharge relative to channel morphology or of estimated recurrence interval. Marsalek (2000) defined floods as hydrological events characterized by high discharges and/or water levels leading to inundation of land adjacent to streams, rivers, lakes, and other water bodies.

The U.S. National Flood Insurance Program defined flooding as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from one of the following:

- Overflow of inland or tidal waters
- Unusual and rapid accumulation or runoff of surface waters from any source
- Mudflow
- Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

2.3.1 The Cause of Flood

Flooding is caused by excess rainfall or snowmelt – that is, runoff that is in excess of that needed to replenish aquifers or surface water features. All aspects of the hydrologic cycle are involved in flooding, such as precipitation, runoff, infiltration, and channel flow (Grigg, 1996).

Miller (2000) classified floods as to origin – floods caused by excessive rain over a vast area, floods caused by dam breakage, flash floods cause by thunderstorms, floods caused by excessive rain from hurricanes, tsunami floods caused by undersea earthquakes, and floods caused by wind-driven tidal waves.

Parker (2000) explained that flood hazards and disasters are the products of an interaction between environmental and social, economic, and political processes. Although they are caused by natural events, they are also caused by the social, economic, and political environment which structure and configure the lives of individuals and groups of people.

Many causes of floods are attributed to human activities, such as deforestation in the upstream region, damming of rivers, and soil erosion due to tilling. Flood hazards are created by countless individual decisions that encourage the settlement and economic development of floodplains and flood-prone areas. Because flood hazards are essentially created by human decisions and actions, it follows that the social and political context for such actions is an important element in the selection of any subsequent flood mitigation schemes. Future management of the risk from flooding will aim to reduce the risk of flooding by reducing community vulnerability.

A preoccupation with natural events and hydrological processes may lead to a narrow, cosmetic, and incomplete understanding of the causes of flood hazards and disasters, and to narrowly defined and unsuccessful approaches for addressing them. On the other hand, too much focus on social causes can lead to effective measures for reducing flood risks being overlooked. Social, economic, and political conditions, and the variable quality of material life, are overwhelmingly important to the incidence and distribution of damage in disasters, including flood disasters.

2.3.2 Flood Risk and Vulnerability

Historical experience is the basic tool to assess the flood risk. Grigg (1996) wrote that the first consideration in flood risk is the chance of extreme rainfall depths or the intensities which cause flooding which are described by the historical records of rainfall at a particular location. The next consideration is that flood risk depends on runoff which in turn depends on a number of hydrologic factors.

Flood severity is described by the average frequency of occurrence. In most locations, flood risks and impacts are modified by anthropogenic activities, largely by changing the catchment response by land development and possibly by changing the precipitation and runoff/snowmelt regimes by climate change (Marsalek, 2000).

Paton (2006) pointed out that even if the probability and intensity of hazard activity remain constant, continuing population growth and economic and infrastructure development results in increased potential magnitude and significance loss and disruption associated with hazard activity, and consequently, risk.

Parker (2000) listed a number of factors that are responsible for increased exposure to flood hazards as follows:

- Growth of population in floodplain settlements;
- Agricultural extension and intensification;
- Urbanization and urban development in floodplains and coastal flood zones;
- The attraction of riverside and ocean-front locations for property development;
- The water orientation of many societies (marine flood sources; amenity, leisure and retirement attractions; waterfront lifestyles; growth in popularity of water sports);

- The growth of megacities, many of which have flood-prone coastal locations, partly as a result of migration from rural areas;
- Urbanization of catchments, leading to increased flood volumes, higher flood peaks and expanding floodplains;
- Subsidence along coastlines, causing land levels to fall relative to sea levels;
- Sea-level rise induced by global warming processes;
- Rising standards of living, exposing more damageable goods to flooding in existing flood-prone properties;
- Dam building and the construction of flood defenses (in certain cases).

Vulnerability is viewed as central to the origins and causes of flood disasters. The incidence of flood hazards is related to people's differential capacity to cope, which in turn is related to material wealth or poverty, ability to access information, and access to decision-makers. High vulnerability frequently promotes and exacerbates floods disasters and is often closely associated with underdevelopment. The causes of vulnerability lie in social, economic, and political processes and differential access to resources. Although vulnerability and poverty are not synonymous, vulnerability to hazards is often promoted by poverty and through related low response and recovery capacity.

Certain characteristics of large cities exacerbate human vulnerability. The larger the city and the greater its rate of growth, the more intractable are the problems of managing and controlling development. A large proportion of a city's population may live in unplanned informal settlements, which are often particularly prone to natural hazards. Those who live in the informal sector are often in generally poor health, with very low incomes and no personal food stocks. The high rate of unplanned development and the pressure on

resources means that the provision of water, shelter, health services, and transport is often inadequate. When a natural hazards strikes, the larger and more unplanned the city, the more difficult it is to organize rescue and response to disaster.

Resilience, which may be taken as the opposite of vulnerability, may be enhanced by promoting access to knowledge and resources, through poverty-reduction programs and through the general process of development as reflected, for example, in better healthcare, housing, and infrastructure.

2.3.3 Flood Impacts

Floods disrupt the social systems of the countries and the cities, and cause enormous economic losses. Andjelkovic (2001) listed the impacts produced by increased runoff especially in urban setting as follows:

- Loss of human life
- Flooding of housing, commercial and industrial properties
- Flooding of streets, intersections and transportation systems, causing traffic delays
- Spilling the surcharged sewer content into streets
- Damage to public and personal property
- Health hazards
- Disruption of services such as water supply, sewerage and power supply
- Cleanup demands
- Adverse effects upon the aesthetics
- Economic losses
- Pollution of local waterways and receiving water bodies

2.3.3.1 Flood Impacts on Society and Economy

Parker (2000) indicated that the impacts of floods on society are complex. Impacts include positive and negative ones, effects that may be difficult to attribute solely to a flood and impacts that are difficult to trace because of their multiple-order effects on society and economy. Flood disasters invariably have a range of adverse impacts directly or indirectly associated with a disaster event. However, some of these impacts may endure for years and may become combined with effects of other disasters.

The social disruption caused by floods is one of the most significant effects to be considered. Other consequences are of a medical nature and are generated by the trauma of flooding and the destruction of essential services. Social problems include (Andjelkovic, 2001):

- Dislocation and disruption of transport, public and commercial services, food supply and medical services
- Public health and housing of evacuees in unsanitary conditions
- Emergency preparedness in activating food and power supplies, medical services and transportation
- Care of disadvantaged social groups
- Loss of employment
- Temporary accommodation
- Effect of involuntary relocation of flood affected residents
- Safety aspects

2.3.3.2 Flood Impacts on the Environment

From the environmental point of view, floods are natural events, which bring both adverse and beneficial environmental effects. Seasonal flooding of the environment is a natural feedback mechanism serving to replenish floodplains and sustain their ecosystems. However, in most major river basins, this natural feedback has been modified by humans, through catchment development, implementation of flood management projects, and most recently, climate change. The best recognized environmental impact of floods is the alteration of morphological processes. Other environmental impacts may result from mitigation of flood problems by structural measures. These impacts were particularly well described for large reservoirs, which serve many other purposes besides flood protection. The adverse aspects of these projects include increases in the severity of floods, ecological destruction of inundated land, uprooting of the population that lived in the area flooded by the reservoir, interference with sediment transport, and some additional impacts on human health (Marsalek, 2001).

2.4 Floodplain Management and Urban Development

2.4.1 The Value of Floodplains

Wohl (2000) explained that humans have settled along the river corridors for access to food, water, and transportation since the beginning of human history. Increasing human population density and rising land costs as well as a sense security from floods as a result of flood control works have encouraged denser human settlement within flood zones. Since level floodplains also provide the best agricultural land on earth as well as easy transportation routes, they have some of the highest population densities.

Although floodplains provide an excellent environment for development, they are all subject to flooding. These provide important water resources and fertile agricultural lands, which are essential for supporting livelihoods. This makes floodplains desirable areas for human settlements and related economic activities. However, flooding may also have negative impacts on the lives and livelihoods of those who settle on floodplains

The potential interaction between human use of the floodplain and the natural event could create a natural hazard. Despite the hazards associated with floods, floodplains also serve essential ecological, societal, and geomorphologic functions. Floodplains not only function to support habitat for rich species diversity but also retard flood waves and store sediment (Mertes, 2000).

2.4.2 Urban Development Impacts on Floods

Montz (2000) explained that floodplains have long been sought as sites for urban development because of the amenities they offer, including level, usually well-drained land for building, access to a source of water for a variety of uses, proximity to transportation routes, and availability of a sink to which wastes can be dumped and either degraded or transported downstream. They also have scenic value.

Flood exposure is a measure of the human population, land uses, and investment located in flood zones and at risk from flooding, and increasing exposure is a prime, contributory cause of flood hazards and disasters. Exposure to floods is growing rapidly as human occupation of floodplains and flood-prone coastal zones intensifies. Coastal flood zones are particularly attractive locations for urban development, and many of the world's rapidly expanding megacities are located in coastal zones.

Andjelkovic (2001) indicated that the primary cause of urban flooding is a severe thunderstorm or a rainstorm preceded by a long-lasting moderate rainfall that saturates the soil. Floods in urban conditions are flashy in nature. They may occur on both urbanized surfaces (streets, parking lots, yards, parks) and in small urban creeks that deliver water to large water bodies. Other causes of urban floods include inadequate land use and channelization of natural waterways, failure of the city protections dikes, and surcharge due to blockage of drains and streets inlets.

Development in floodplains, along and across rivers, can intrude on the river and restrict flow as a result. Thus, the capacity of the river can be reduced in and near cities built along rivers and streams. City government areas are often unable to expand infrastructure as developed land expands. As a result, the flood problem is worsened even more as rubbish clogs streams and blocks drains and as stormwater systems back up. However, many factors force people to remain in the vulnerable locations.

As urban areas grow, both geographically and demographically, the flood hazard increases. It is not merely the existence of development at risk in floodplains that creates a hazardous situation. The process of urbanization itself increases flood magnitude and frequency by altering local hydrologic characteristics. First, urbanization inhibits infiltration by creating impermeable surfaces. As a direct result, a higher proportion of precipitation enters streams and rivers as overland flow. Second, this increased runoff reaches rivers and streams faster because of smoother surfaces, and because of surface and subsurface drainage networks designed to move overland flow into channels as quickly as possible. Thus, lag time is decreased and discharge is increased, with resulting impacts on magnitudes of floods when they occur.

2.4.3 The Need of Floodplain Management

One of the most important goals of water management is the protection of the society and material property against the harmful effects of water, including flooding and disruption economic activities by flood waters. Such a goal is particularly important in densely developed urban areas with high concentrations of population, material properties, and economic activities, and potentially high flood damages.

Montz (2000) pointed out that disaster impacts are growing worldwide for a number of reasons. In order to reduce urban vulnerability to flooding, it is necessary to deal with the hydrologic system as well as to address the social, economic, and political pressures at work in defining and reinforcing vulnerability. As the urban area grows, there is a need to recognize the impact of all factors involved and keep up with the development that is occurring.

Similarly, Marsalek (2000) explained that the final reason for increasing flood damages are societal choices leading to a growing population in and near flood-prone areas, and continuing development in floodplains. Lack of land available for development, combined with growing population pressures and sometimes a misplaced reliance on flood defense structures lead to a continuing encroachment on floodplains. In fact, many flood management projects induce new development and thereby increase future risks. Successful floodplain management requires an accurate delineation of areas at risk in the form of flood maps, and a strict enforcement of floodplain land-use regulations. Where land-use regulations are not strictly enforced, increased future risk can be expected.

Changes in flood exposure are very large, and this is likely to be the major force behind increased flood hazards and disasters. Economic growth, the accumulation of property and wealth, and urbanization – which are interrelated – are the principal forcing agents. Because of the considerable economic and other benefits of floodplain and coastal locations, such as locations are often too likely to be cost-effective and we cannot necessarily avoid them. The key issue is how to achieve wise use of flood-prone land.

Parker (2000) stated that floodplain management aims to constrain flood losses, and to protect and enhance floodplain environmental values. However, Gruntfest (2000) pointed out that goals for floodplain management can be conflicting. The flood loss reduction goal may contradict goals to real estate and industrial development or increased agricultural production.

2.5 Flood Mitigation and Preparedness Planning

Natural hazards are generally inevitable. Actions to lower the risk of these hazards become disasters are therefore needed. These actions are expected to reduce the impacts of the hazards so the damage is less extensive and consequently will reduce losses and their associated cost.

Like any other natural events, floods cannot be prevented from happening, but planning the emergency measures through flood management can often reduce their disastrous consequences. However, as pointed out by Andjelkovic (2001), total flood protection is unrealistic and unwise. The ultimate goal of flood loss prevention is the improvement of the quality of life by reducing the impact of flooding and flood liability on individuals, as well as by reducing private and public losses resulting from the flooding.

2.5.1 Mitigation and Preparedness Concept

Mitigation is defined as "any sustained action to reduce or eliminate long-term risk to people and property from hazard and their effects". This definition highlights the long-term benefits that effective mitigation can have. This definition also emphasizes that is an ongoing effort that communities must make on a continuous basis (Schwab et.al., 2007).

Mitigation encourages long-term reduction of hazard vulnerability. The goal of mitigation is to save lives and reduce property damage. Mitigation can accomplish this through cost-effective and environmentally sound actions. This, in turn can reduce the enormous cost of disasters to property owners, businesses, and all levels of government. In addition, mitigation can protect critical community facilities, reduce exposure to liability, and minimize community disruption. Mitigation is an ongoing process, prior to the occurrence of a disaster that is directed at reducing future flood damages of the community and the nation. This process teaches people how to live rationally with floods. Mitigation measures, active and passive, rely on the experience and capacity of people where disaster occurs.

In case of floods, Andjelkovic (2001) explained that flood mitigation comprises a variety of measures that alter the exposure of life and property to flooding. It reflects the holistic nature of those flood management measures that do not have structural nature. Mitigating means planning, programming, setting policies, coordinating, facilitating, raising awareness, assisting, and strengthening. It also encompasses educating, training, regulating, reporting, forecasting, warning, and informing. Other mitigating actions include reducing physical vulnerability, reducing vulnerability of the economy, and strengthening the social structure of the community.

Schwab (2007) characterized preparedness as a state of readiness to respond to any emergency of disaster. It involves anticipating what might happen during different sorts of hazard events and developing plans to deal with those possibilities. Preparedness also involves carrying out exercises, evaluating plans for shortfalls, as well as training and education.

ESCAP (1990) described disaster preparedness as the action designed to minimize loss of life and property damage and to organize and facilitate timely and effective rescue and relief in the case of disaster. It is supported by necessary legislation which can achieve readiness to cope with disaster situations or similar emergencies which cannot be avoided.

Disaster preparedness planning is the major factor in cutting the chain of phenomena which lead to a disaster. The role of local government is important at the time of a disaster because the local conditions of the disaster are best known to the local organizations. The disaster plan at the local level must be prepared in detail. The characteristics and responsibilities of various organizations, including the central government, local government, the private sector, and non government organizations, as well as the general public, must be clearly identified and understood.

Flood disaster preparedness plans should include arrangements for public education, warning, forwarding information to flood-affected communities, road control, sandbagging, evacuation, re-supply, rescue, the registration and welfare of evacuees, initial recovery and post-flood debriefing. The plan should also be subject to periodic review in consultation with the local floodplain community and they should be placed on public display and made widely available within the community.

Solway (2004) suggested that before any plans can be developed, the socio-economic environment of the city needs to be understood. This should incorporate a perception of:

- The social structure of the city classified by social groups according to their socio-economic, cultural, ethnic, and religious conditions, as well as their age and gender;
- The vulnerability of the various social groups to disastrous events;
- The nature of all existing strategies for coping classified according to social group;
- The nature and roles of existing social support networks;
- The city's institutional framework (community, private, and public);
- The city's formal approach to disaster management and development including the division of existing responsibilities for disaster preparedness and mitigation.

2.5.2 Flood Control Measures

There are several reasons why people continue to live in flood-prone areas. Socio-economic motivation as the area may offer economic opportunities is usually the primary reason. The other reasons may include the possibility that people living in hazardous area simply fail to perceive the true degree of risk or may simply have no choice. Since people live with natural hazards, they must find means to adapt the hazardous conditions.

General strategies for coping with floods comprise learning to live with floods; reducing flood peaks and volumes; and protecting life, land and property. Specific measures employed in these strategies include: the "do nothing" option, structural measures and non-structural measures.

2.5.2.1 Do Nothing Option

The "do nothing" option is based on the acceptance of floods as inevitable natural events which the society needs to learn to live with. This generally means to avoid occupancy of floodplains and more or less restrict their use to wildlife habitat, land conservancy, some agriculture activities, and cattle grazing. The "do nothing" approach does not create any new stresses on the environment, but where floodplains are already occupied, it produces tangible as well as intangible flood impacts and damages.

2.5.2.2 Structural Measures

Parker (2000) described structural or engineering means usually involves large scale, capital-intensive construction of levees and floodwalls, or modifying the river channel. Structural methods are usually designed to reduce flood risk by changing the probability of flooding and by reducing the exposure of properties and people to floods. They may involve upstream catchment controls to abate floods which influence a catchment's hydrological response and downstream flood problem.

Although some communities have benefited from structural measures, others have experienced some of the serious disadvantages. Structural change involves modification to the built environment to minimize flood damage, and sometimes could be achieved at large environmental and ecological cost. According to Schwab (2007), the major drawback of many structural mitigation projects is that in the process of reducing short-term risk they can actually make future disaster worse, particularly by encouraging development in hazard-prone areas when residents feel a false sense of security.

Flood-control structures may create a misleading sense of security when people assume that floods will no longer occur. Structural measures may give the illusion of security but the security can be temporary. A flood can occur that is bigger than the design of the channel or levee. The failure of structural flood control works poses a significant threat to the lives of the people who live downstream of a massive structural project such as dams (Grunfest, 2000).

In addition, structural engineered projects can also reduce nature's ability to mitigate the impacts of storms and floods. Levees may worsen upstream or downstream flooding by changing the natural flow and volume of river. Channel diversions that are built for flood control purposes can rob surrounding wetlands and marshes of silt deposits and starve them of nutrients, reducing the floodplain's natural capacity to absorb floodwaters. Dams can eliminate the natural and beneficial function of the floodplain, including its ability to absorb floodwater. Dams can also change the hydrology of an entire watershed.

Marsalek (2000) added that flood defense structures, such as dams and embankments, may weaken with age and lose their effectiveness in flood protection. The resulting floods may result in high losses of human life and property damage. Proper inspection and maintenance need to be applied to all structures serving for storage of water.

Many structural projects are technically difficult, land consumptive and costly to build. Their benefits are often short-lived and they only prevent damage from floods for the capacity that they are designed to handle. When budgets are tight, routine maintenance and repairs to levees, dams, and other large projects may be postponed, increasing the likelihood of failure (Schwab, 2007).

2.5.2.3 Non-Structural Measures

Non-structural measures strive to reduce flood impacts without altering flood characteristics and focus on policies and emergency measures with low capital investments. Non-structural approaches also involve adjustment to human activity to accommodate the flood hazard, whereas structural methods are based on flood abatement or protection of human settlement and activities against the ravages of inundation.

White (1945) wrote that adjustment to floods means an ordering of occupancy to floods and to flood hazard. The ordering may be systematic or unsystematic, rational or irrational, conscious or unconscious, but it comprises an observable arrangement of occupancy in relation to floods. Adjustment to floods may be divided into eight major classes, i.e. land elevation, flood abatement, flood protection, emergency measures, structural, land use, relief, and insurance. Some adjustments seem naturally to employ technology, and others might be considered to be legal or social measures. However, according to White, solutions which emphasize technology are increasing rather than decreasing the degree of risk. Some of the increase in vulnerability is due to population shifts into hazardous areas, in the belief that technological solutions have made the hazard negligible and therefore create false sense of security.

Parker (2000) explained that non-structural flood adjustments are those which are based upon (a) controlling and limiting the use of floodplains, through a variety of planning or regulatory mechanisms; (b) reducing the extent to which people and property are in the path of floods through flood forecasting and warning; and (c) reducing the effects of floods through flood insurance, flood relief and other social security measures.

Similarly, Grunfest (2000) explained that non-structural measures include floodproofing, land-use planning, soil-bioengineering, warning systems, pre-flood mitigation efforts, and insurance. The simplest non-structural measure is to accept the loss. Another non-structural measure is to provide post-flood relief. One of the most promising strategies for reducing flood losses is public acquisition of land susceptible to flooding.

ESCAP (2003) recognized that non-structural measures are generally required as complementary measures to structural measures and in certain circumstances may be considered as alternatives to the construction of engineering works for flood mitigation, as these non-structural measures may prove to be more cost-effective or politically and socially acceptable.

According to ESCAP (2003), non-structural measures may include:

1. Floodplain zoning (land use regulation), especially for the use of floodplains or flood-prone areas. This land-use regulation with strict enforcement could be one of the most important non-structural measures not only to ensure effective prevention of disasters, but also for efficient management of flood control and mitigation;
2. Provision of effective flood warning systems to give advanced notification of flood events, along with well-organized and equipped evacuation schemes to remove occupants, livestock, etc., from flood-prone lands in advance of these events;
3. Provision of adequate flood emergency services, including medical support, alternative transport, the maintenance of communications and supply of food, water, and other essentials to flood-bound persons or communities;
4. Flood Insurance

2.5.2.4 Selection of Flood Mitigation Measures

Fordham (2000) criticized that floodplain management is a multidimensional problem which has been ill-served in the past by a one-dimensional, technical-engineering approach resulting in a bias towards structural 'solutions' to flood hazards and that non-structural approaches have fulfilled a secondary role, complementing physical structures. However, the increasing costs of structural solutions and the growing environmental concern at their impact meant that the structural bias slowly began to erode. Increasingly it is considered necessary to involve the public in the decision-making process in order to attempt to achieve consensus on what can be controversial issues.

Similarly, Montz (2000) pointed out that the traditional responses to urban flooding have been to control floods and to keep out of flood hazard areas. Flood control by structural measures is an effective tool under some circumstances, but it is a static response to an ever-changing problem. It is also necessary to control development. Such control has not been easy, especially in developing countries where it is increasingly difficult to keep up with the rate of growth in urban areas. Moreover, the provision of flood protection initiates a cycle wherein protection encourages development which increases the flood problem, thereby creating a need for additional protection, and so on.

Since most flooding problems involve complex socio-technical systems, there is no single solution to solve the problem. Another nature of complex socio-technical systems is that they are too large to be centrally coordinated in any specific manner. An integrated and participatory approach to flood management also indicates that there is a growing need to develop conditions under which a group entity can become a right. It also allows different groups with different visions to engage for the reasons they see fit without forcing them

to strictly stick on to predefined roles that they may not be suitable for. As a socio-technical system slowly evolves, different groups develop different expectations of its various components and institutions. These differences may lead to conflicts which must be negotiated between the groups.

To be effective, community or stakeholder participation in a collective approach to developing a management strategy needs reliable commitment and cooperation. In addition, flood policy development needs greater input and locally-relevant information from the community in order to implement strategic management options that would be effective, acceptable and achievable. Therefore it is imperative that the local community and wider stakeholders are more involved and proactive in the preparation of local planning policy on development and flood risk.

The selection of flood management measures is based either on the traditional benefit/cost analysis, or on multi-criterion ranking. In the benefit-cost analysis, benefits include reduction in costs of floodplain occupancy, reduced flood emergency measure costs, and improvements in floodplain land use. These benefits are compared with the costs of flood management measures. However, economic valuation is not a complete tool because its limits, uncertainties and poor consideration or neglect of environmental and social aspects. These shortcomings are somewhat mitigated by the multi-criterion ranking, which is based on criteria such as low costs, large benefits, limited environmental impacts, limited adverse social effects, and desired social effects. The implementation of flood management measures should serve the overall objective of supporting sustainable development of the river catchment and maximizing the economic efficiency of the catchment use.

2.5.3 Mitigation and Preparedness for Resilient Communities

One approach to reducing community losses from natural hazards involves the development of sustainable communities that can avoid or reduce exposure to natural hazard events to acceptable and manageable levels. Sustainability envisions a wise use of resources and fair chance for all community members to live meaningful, productive lives both now and in the future. But sustainable policies are meaningless if a community is exposed to natural and man-made hazards and does nothing to reduce its vulnerability.

Schwab (2007) explained that sustainable communities are those that take proactive measures to combat the economic, environmental, and social problem that come their way. A truly sustainable community must also be a hazard-resilient community, and considers disaster prevention along with issues of environmental stewardship, quality of life, economic vitality, and a fair legacy for future generations. In conclusion, a disaster resilient community is a community developed or redeveloped to minimize the human, environmental, and property losses, and the social and economic disruption caused by disaster.

Mitigation helps build community resilience, which in turn contributes to community sustainability. Through mitigation and preparedness, resilient communities take actions prior to a hazard event so that a disaster does not result. In addition, if disaster occurs, individuals and communities can recover more rapidly from disaster, lessening the financial burden of disaster on individuals, families, community, and government (Schwab et.al., 2007).

2.6 Public Involvement

2.6.1 Public Awareness

The development and dissemination of awareness programs is an essential prerequisite of successful flood risk reduction measures. It is a fundamental principle of emergency management that communities that understand the hazards they face and know to prepare for and react to them will have a better chance of mitigating the effects of flood disasters than those that do not.

The level of public awareness in flood mitigation and preparedness can be gauged by the willingness to live with floods. While the acceptability of the concept "to live with floods" is a function of the learning and participatory process, a successful framework for flood mitigation and preparedness is usually launched immediately after a catastrophic flood event. Such a framework is built on the sudden increase of public concern for the damage or potential loss of extreme floods. It is therefore important to develop a detailed action program immediately after a catastrophic flood event to transform public concern into a long-term commitment (ESCAP, 2003).

In areas where flood or property modification measures are undertaken, individuals should be made aware that these measures do not entirely eliminate flood risk, and that problems can arise when floods greater than the flood used to derive the design flood level and used to design the measures occur. This aspect is of particular importance where flood and property modification measures do not exclude very large floods and where floodways can develop, levees can be overtopped, water levels can rise quickly, and evacuation routes can be cut.

2.6.2 Public Information and Education

In order to promote community involvement in disaster prevention and preparedness, community awareness programs and educational programs on warning systems and other aspects of disaster preparedness should be developed and implemented. Flood education provides information on the likely effects of flooding and knowledge of the relevant flood warning, response, and evacuation procedures. It raises awareness of the flood problem and enables individuals to understand how to manage themselves and their property in response to flood warnings and in a flood event. It also invokes a state of flood readiness and allows the community to react in a timely fashion.

Efforts should also be made to enhance public understanding of the interaction between flood hazards and the environment and of the choices society may make to affect the flood risks, and the community's ability to predict, control, and limit the impact of floods. General public should also be knowledgeable on how taxes and other local revenues are allocated and used to provide solutions to problems associated with urban flooding.

Dissemination of public information on a regular basis is very important. This can be done through a variety of measures, including distribution of print material, community meetings, websites, displays at community fairs, and supporting programs which involve environmental activities undertaken by schoolchildren.

The provision of adequate and reliable information is the key to effective participation. In order to ensure effective participation, the provision of adequate and reliable information should be made in timely manner. Reasonable time frames should be provided so as to allow adequate participation.

2.6.3 Public Participation in the Flood Management Process

The degree and extent of effective participation of people at various stages of flood management will determine not only the effectiveness of flood management measures but also the sustainability of these measures, including structural and non-structural measures. The role of individuals in minimizing the damage caused by floods is central to successful flood management. If flood management is to be sustainable, it must accommodate the economic, environmental, and social needs of the basin, and stakeholders reflecting these elements must have a role in the way flood management is planned and implemented (GWP/WMO, 2006).

Stakeholder participation and flood risk assessment should be inherently linked processes. This relates both to identifying who would be the most affected by floods of a certain magnitude through flood hazard mapping as well as stakeholder involvement in verifying the results of such assessments by local knowledge on past floods.

An effective participation process would need to be properly planned, implemented, and integrated into the socio-economic development process. Effective stakeholder participation in pre-flood preparedness and planning processes can be implemented at different levels through formal or informal means. In designing participatory mechanism for flood management it is essential to enable the most flood-affected sectors of society to make their voices heard. Such involvement is indispensable in building the resilience of communities. Resilience-building measures at the household or community levels are effective means of minimizing flood losses.

Andjelkovic (2001) stated that public and community participation are two important elements of an effective social 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.

ESCAP (2003) wrote that participatory tools and techniques are expected to generate active collaboration among stakeholders to work together, despite the fact that they may have different interests, values, or goals and come from different political, cultural or socio-economic backgrounds. Partnerships are likely to lead to more viable solutions than would be developed by any one group independently. Mitigation partnership bring together the leadership and expertise of business, governments, utilities, research and academia, nonprofit groups, and other community organizations to develop integrated strategies to reduce exposure to hazards and make post-disaster recovery easier (Schwab et.al., 2007).

2.7 Legal and Institutional Issues

Grigg (2005) wrote that the definition of institution also includes elements such as customs, relationships, or behavioral pattern in society. A framework for institutional analysis must comprise a systematic and repeatable way to break the element apart for study and answer these questions: who has control?; what are the laws and controls?; what are the incentives?; who has what role?; and what is the management culture? This provides the input to answer the three main questions of for institutional analysis: what goes on here?; what processes need adjustment?; and what ought to go on here?

Then, Grigg (2005) suggested that the framework for institutional analysis will include:

1. A conceptual model on how management and control system work;
2. Identification of key issues in each category of institutional element;
3. Identification of institutional practices that should lead to improvement.

Floods cannot be managed effectively without understanding the laws that apply. Laws and policies form the foundation of the institutional and legal framework of water resource management, including flood mitigation and preparedness. Strengthening the legal and institutional framework is therefore expected to facilitate public participation. It would also be more effective if the institutional and legal framework could provide freedom and incentives for people to participate in the planning and management of water resources, including flood mitigation and preparedness (ESCAP, 2003).

Andjelkovic (2001) stated that the institutional aspect of flooding deals with the role of governments in the process of decision making. In local conditions all major decisions are made by local governmental institutions and water-related companies. The local government is the focal point for flood management programs since they are better informed than others regarding the local conditions and must be understand and responsive to the needs, desires, and requests of the local public.

A major constraint to successfully being able to mitigate the effect of flooding is the fragmented institutional structures and lack of coordination and cooperation that can exist among national institutions. This can result in a general lack of planning and commitment to implement disaster mitigation activities (UN/ISDR, 2002).

Most of the flood management strategies are top-down in nature. To be effective, community structures need to be formalized and their role in disaster management need to be strengthened. Community involvement is also needed in planning for disaster management because in many cases there is a missing link between the disaster response actually needed and what is provided. Local community organizations can serve as an important bridge to link the ground-level response to a higher level of decision-making (UN/ISDR, 2002).

Participatory planning and management requires a fundamental change in the ways government bureaucracies are accustomed to function, particularly in the operational aspect by putting people first and being customer-focused. To do so, institutions must redefine responsibilities and priority scope of the work, reallocate resources, and provide incentives to meet the priority objectives, to build mechanisms for monitoring and adjustment, and to enhance outreach capacity for better interaction with stakeholders.

To be effective, the function of local government should be emphasized more. Disaster response volunteer organizations should be formed, trained and equipped to work with professional agencies, as required. Governments should provide incentives for the formation of such organizations of volunteers at the community level. Governments should exercise their sovereign responsibility to prepare and issue hazard warnings for their area in a timely and effective manner, and to ensure that warnings and relative protective guidance are directed to those populations determined to be most vulnerable to the hazard risk. The provision of support to local communities to use information and develop operational capabilities is an essential function to translate early-warning knowledge into risk reduction practices.

During its initial decade of implementation, a mitigation strategy needs recognition and leadership from a high governmental and city management level. Periodic renewals of policy statements, materials for mitigation works and public education programs will also be needed. A major objective of this first decade of implementation is to involve all sectors of society to some degree in contributing to the formulation of appropriate mitigation measures and in the execution of work where possible (ESCAP, 2003).

The difficulties experienced in the implementation of flood management strategies are usually linked to the issues of institutional arrangement and capacity. Effective, integrated and coordinated disaster management is based on participatory planning and the implementation of disaster mitigation measures. Therefore the establishment of effective institutional arrangements is fundamental to integrated and coordinated flood disaster management.

For the participative and integrated approach to become a reality, the institutions and individuals involved must have not only the necessary rights to be able to enforce such system, but also the powers to do so. However, the appropriate obligations must also be imposed upon them so that they are accountable for their actions or inactions. The responsibilities and duties of institutions and individuals should be set out, and the details of the relevant functions performed by each, so that the individual roles are well defined. The establishment of clear procedures and standards adds both transparency and predictability. (GWP/WMO, 2006)

2.8 Financing Flood Management Programs

The economic aspect of flooding also deals with the issues of financing the capital improvement, operations and maintenance of flood protection schemes. Local stormwater drainage and flood protection are usually financed by local revenues, such as local taxation, service fee, or user charge fee. There are many other methods available for local financing: various means of borrowing, current revenues, grant of fund from the national government, contribution of land owners, and special user charges. The stormwater drainage and flood control financing should represent a stable, adequate, and publicly acceptable funding mechanism for drainage capital investment, operations, and routine and remedial maintenance (Andjelkovic, 2001).

Schwab (2007) explained that community can incur significant costs in implementing many of the mitigation programs. Local government officials must balance many competing interests when deciding how to distribute limited resources. Many local government budgets are stretched thin in meeting urgent needs of citizens, and mitigation may receive low priority. To fund mitigation activities, local governments can use a variety of sources, including capital budgets, taxation and special assessments, municipal bonds, utility and permitting fees, and partnership with nonprofit organizations.

Local governments can also study their annual operating budgets carefully to see where mitigation can fit into ongoing community programs. Often a change in spending priorities is all that is needed to finance some mitigation ideas. And sometimes, the most effective mitigation activities require no new money at all, just a shift in thinking so that the community includes mitigation principles in day-to-day operations and decision making.

2.9 Obstacles to Flood Management Programs Implementation

Solway (2004) criticized that while knowledge of effects of natural hazards is extensive, and the planning and engineering solutions to mitigate the effects of these hazards are well established, instituting mitigation measures still remain a problem. To some extent this is because of the low priority according to mitigation compared to other needs of the city. It is also because mitigation plans often assume that people form one homogenous group with the same needs, abilities and aspirations.

Marsalek (2000) observed that in spite of significant expenditures on flood control, flood damage are on the rise. Several explanations for this trend include increasing trends in flood magnitude, deterioration of structural flood management measures, and growing populations and continuing development in and near flood-prone areas. Increases in flood magnitudes may also result from climate change and changes in land use and cover.

Parker (2000) observed that public policies for flood hazards and disasters are constrained in numerous ways. The major constraints on public flood policy may be considered to be physical and technical; financial and economic; legal and administrative; environmental; and political.

Physical and technical constraints apply mainly to engineering approaches to reducing flood hazards. Public flood policy is often constrained by availability of financial resources. Following floods, repair of damaged infrastructure and houses is often a high priority. However, the severe shortage of finance and high levels of foreign debt seriously affected the pace of restoration of flood-damage infrastructure. Developing countries are often caught in such circumstances.

Engineering options are increasingly expensive, particularly when improvement works have to be constructed in highly built-up areas. In addition, there are practical difficulties in relocating squatters, services, and public utilities, and working space is limited. In many urban centers, the cost of acquiring land or reserves for the construction of drains has become a major concern. There have been situations where the cost of land acquisition was higher than the engineering construction cost. The government, local authorities, and the private sector should assume a larger role and responsibility in addressing stormwater management and flood control problems.

Parker (2000) indicated that the environmental constraints on public flood policy became increasingly significant during the later quarter of the twentieth century, especially in developed nations. Designing flood management policy with regard to the beneficial values of the floodplain and to be consistent with sustainable development objectives has become an important goal. Political factors further constrain the formulation and implementation of public flood policies.

Parker (2000) also explained that issues of legality and administration present constraints on what may be achieved through public flood policy. The firm belief in individual property rights is a serious barrier to effective land-use planning in some countries. Lack of legal rights can have serious adverse effects on those who are most vulnerable to floods. The major administrative challenge appears to be enforcement of hazard reduction regulations. In poor nations, enforcement problems are likely to be widespread because of the existence of a large informal sector in which individual decisions are taken with no regard to the constraints imposed by public regulations, and monitoring for compliance is weak.

Institutional arrangements may present severe constraints in effective implementation of public flood policy. Institutional arrangements frequently constrain and narrow policy choice because agencies commonly seek to operate only within their boundaries of responsibility and find it more difficult to form alliances for broader inter-institutional policy promotion. It is often easier to approach a flood hazard problem by implementing a narrow, engineering-based project than by developing a broader and diverse program of projects promoting social change to reduce flood hazards. Unfortunately, institutional arrangements and related public policies can have negative effects on flood hazard and disaster reduction, especially where government policies relating to different sectors conflict.

2.10 Integrated Approach in Flood Management

The conventional approach to flood management was based on river-basin oriented programs and plans that were needed during floods to minimize their impact on the individuals and the community. Those traditional programs dealt mostly with measures of a structural nature, which included also some flood recovery activities, but did not fully address the specifics of an urban environment that might have remained confined within the boundaries of a structural flood protection scheme. Conventional approach focused mostly on measures that modified flooding or provided protection against flooding, such as dams, storage reservoirs, dikes, floodwalls, flood diversion, channels, and land treatment practice.

The contemporary concept addresses the problem of flooding by considering the best mix of flood management options available, selected among both the structural works and non-structural measures. It is based on an integrated and environmentally sustainable

approach, addressing fully all aspects of flood occurrence in an urban setting, where other kinds of urban waters and the land itself are exposed to the action of excessive stormwater. In addition, integrated flood management also emphasized the importance of participatory approach to create a resilient community with the active involvement of all stakeholders and the community at large.

In recognition of the benefits of regular floods, the importance of floodplains and the increasing demands of development they are facing, and at the same time being aware of the fact that the disruptive nature of floods need to be minimized, the Integrated Flood Management (IFM) was developed by the Global Water Partnership (GWP) and World Meteorological Organization (WMO) under the auspices of the Associated Programme on Flood Management (APFM).

In their publication, GWP/WMO (2006) explained that Integrated Flood Management (IFM) has evolved as a concept, embedded within the broader context of Integrated Water Resources Management (IWRM). IFM aims to maximize the efficient use of floodplains while minimizing the loss of life from flooding. It represents a fundamental reorientation of how flood are perceived by society. This range from the "need to control" approach, where floods are considered to be threats as part of uncontrollable natural cycle, to the "need to manage" approach, where floods are seen as part of broader natural occurrence, with some beneficial elements. Therefore, considering the evolution and trends, the approach to natural hazards requires a paradigm shift from defensive action against hazards to proactive action towards culture prevention by managing the risk and living with floods.

The emphasis on flood management within the context of IWRM will be on the adoption of flexible structural and non-structural solutions suited to each flood-prone region, recognizing the importance of evaluating differing options and their relative advantages and disadvantages. Integrated Flood Management should be based on a participatory approach involving stakeholders, and should be open, transparent, inclusive and communicative (WMO/GWP, 2006).

The IFM Approach expects various roles to be played by a complex set of actors to ensure coordination and cooperation across institutional and disciplinary boundaries. To be successful, the approach should be based on a firm legal framework. Relevant bodies must be aware of their functions and role in flood management, and individuals must also be made aware of their responsibilities, rights, and powers with respect to flood management. The establishment of institutions with clearly defined structure, roles, and responsibilities before, during, and after a flood can be an effective platform for the stakeholder participation.

WMO/GWP (2006) stated that in designing participatory mechanisms for flood management, it is essential to enable the most flood-affected sectors of society to make their voices heard. Such involvement is indispensable in building the resilience of the communities. For better flood response and management, it is necessary to develop and strengthen community-based institutions. The overall objective is to increase the flood awareness, preparedness and response capacity of the local authorities and population in order to reduce the vulnerability of the affected population. It is important for various stakeholders to develop a common strategic vision in flood management policy development.

The United Nations and Economic Commission for Europe (UN/ECE) Guidelines on Sustainable Flood Prevention (2000) stated:

- To reduce the potential for damage, both the public concerned and the authorities should closely interact.
- The public should be informed by the competent authority that floods are a natural component of the hydrological regime of watercourses. Thus, the public should become aware that there is a need to restrict uses in areas at risk of flooding to reduce potential damages.
- The public should be encouraged to take their own flood prevention measures and be informed about how to act during flood events.
- Public participation in decision-making concerning flood prevention and protection is therefore needed, both to improve the quality and the implementation of the decisions, and to give the public the opportunity to express its concern and to enable authorities to take due account of such concern.

The Best Practices document which is an update of the UN/ECE Guidelines stated that flood management strategy should be based on an integrated approach covering all relevant aspects of water management, physical planning, land use, agriculture, transport and urban development, nature conservation, at all levels. In development of a flood management plan, decision makers at all levels as well as stakeholders and civil society should be involved. Comprehensive national and local emergency plans that cover the crisis management before, during, and after the flood event should be properly prepared.

2.11 Systems Approach and Socio-Technical Analysis

Systems thinking provides a method to see the whole picture of flooding and identify the most productive interventions. It is a framework that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation. The only way to fully understand why a problem or element occurs and persists is to understand the part in relation to the whole.

The systems approach considers two basic components: elements and processes. Elements are measurable things that can be linked together. They are also called objects, events, patterns, or structures. Processes change elements from one form to another. They may also be called activities, relations, or functions. In a system the elements or processes are grouped in order to reduce the complexity of the system for conceptual or applied purposes.

According to the Technology Strategies International (2009) the systems approach is characterized by:

- Identifying the core elements of the system, as well as the system boundary
- Understanding the role or function of each element in the system
- Understanding the dynamic interaction between elements of the system
- Understanding the environment within the system operates.

The benefits of adopting the systems approach are that it: (TSI, 2009)

- Ensures that holistic strategies and policies are developed, as opposed to those which act in isolation to the whole.

- Provides a sound analytical basis for developing strategies and policies that are to be implemented in highly complex systems, such as companies, industries or national economies.
- Establishes a framework for assessing the impact and effectiveness of strategies and policies prior to implementation.

A socio-technical systems is an approach to complex organization that recognizes the interaction between people and technology. The term also refers to the interaction between society's complex infrastructures and human behavior. The technical subsystem comprises the devices, tools, and techniques needed to transform inputs into outputs in a way which enhances performance of the organization. The social subsystem comprises of the people, and the knowledge, skills, attitudes, values and needs, as well as the reward system and authority structures that exist in the organization.

Systems diagrams are powerful tools that can help to understand how complex systems work. They are particularly helpful in showing how a change in one factor may impact elsewhere.

2.11.1 The DPSIR Framework

The methodological framework proposed to evaluate the flood issue in Jakarta is based on the DPSIR (Driving Forces, Pressures, States, Impacts, and Responses) Model developed by the European Environmental Agency. As a tool for systems thinking, it provides a causal framework to describe the interactions between society and the environment. The DPSIR framework is probably the most widely used approach for sustainability assessment and analysis, largely due to its simplicity and adaptability at any

scale. Within the DPSIR framework, human activities and external forces (the driving forces) are seen as producing pressures that can induce changes (impacts) in the state of biophysical and socio-economic environments. Society then responds to changes in pressure or state with policies and programs intended to prevent, reduce, or mitigate pressures and their impacts (CSIR, 2004).

The DPSIR framework will be further discussed in Chapter III and Chapter V.

2.11.2 The Causal-Loop Diagram

Causal-loop diagrams provide a systems thinking tool and can be very helpful in conceptualizing and communicating structures. The diagram consists of a set of nodes representing the variables connected together and arrows connecting these variables in a way that shows how one variable affect another. The arrow shows the direction of the relationship between these variables and can be labeled as positive or negative. A positive sign is used to signify that a change in one variable cause the second variable to change in the same direction. A negative sign denotes that the first variable causes a change in the opposite direction in the second variable. Causal-loop diagram brings out the systematic feedback by showing how variable X affects variable Y, and how variable TY affects variable Z through a chain of causes and effects. With a causal-loop diagram there is no longer need to focus only on one interaction between two variables. By looking at the interactions of the variables, the behavior of the entire system can be discovered.

The Causal-Loop Diagram will be further discussed in Chapter III and Chapter V.

CHAPTER III

RESEARCH APPROACH

3.1 Introduction

Several systems tools are used to identify the elements of flood management and their inter-relationships. The DPSIR (Drivers, Pressures, States, Impacts, and Responses) model provides the overall view of the system's functionality. The problem architecture is explained by a process flow diagram, and a general feedback model is used to explain how the components of the system and their interaction are identified and how the feedback could alter the initial condition. Finally, a causal-loop diagram is used to show the influences among the elements. The set of these working together will comprise a conceptual systems model that describes its functionality, explains its important components and processes, and identifies how the components and processes are connected. To add detail to the model, components are added for its institutional, technical, socio-economic and financial subsystems.

3.2 The Overall Approach

3.2.1 The DPSIR Framework

Chapter 2 explained the origins of the DPSIR model and how it can be applied to socio-technical problems. In this chapter, it is applied to the flood problem where, in the case of flooding (see Figure 3.1):

- The **driving forces** represent human activities, processes, patterns, and external influences that impact on sustainable development. These are the forces of change such as urbanization, demographic change, socio-economic activities, policy development, and climate.
- The **pressures** are the consequent pressures of human activities on the environment and socio-economic development that often lead to flooding, such as urban expansion and deforestation.
- The **states** describe the current condition as a consequence of the pressures caused by human activities and external factors, including the level of flood risk, the level of access to services, the environmental quality, and the ability to support human development.
- The **impacts** describe the human well-being and environmental consequences of the state, such as loss of livelihoods and degraded living condition due to flooding.
- The **responses** describe policy options and other responses which are aimed at improving the state and reducing the impacts by managing the driving forces and the pressures. Societal responses refer to individual and collective actions to mitigate or prevent negative impacts.

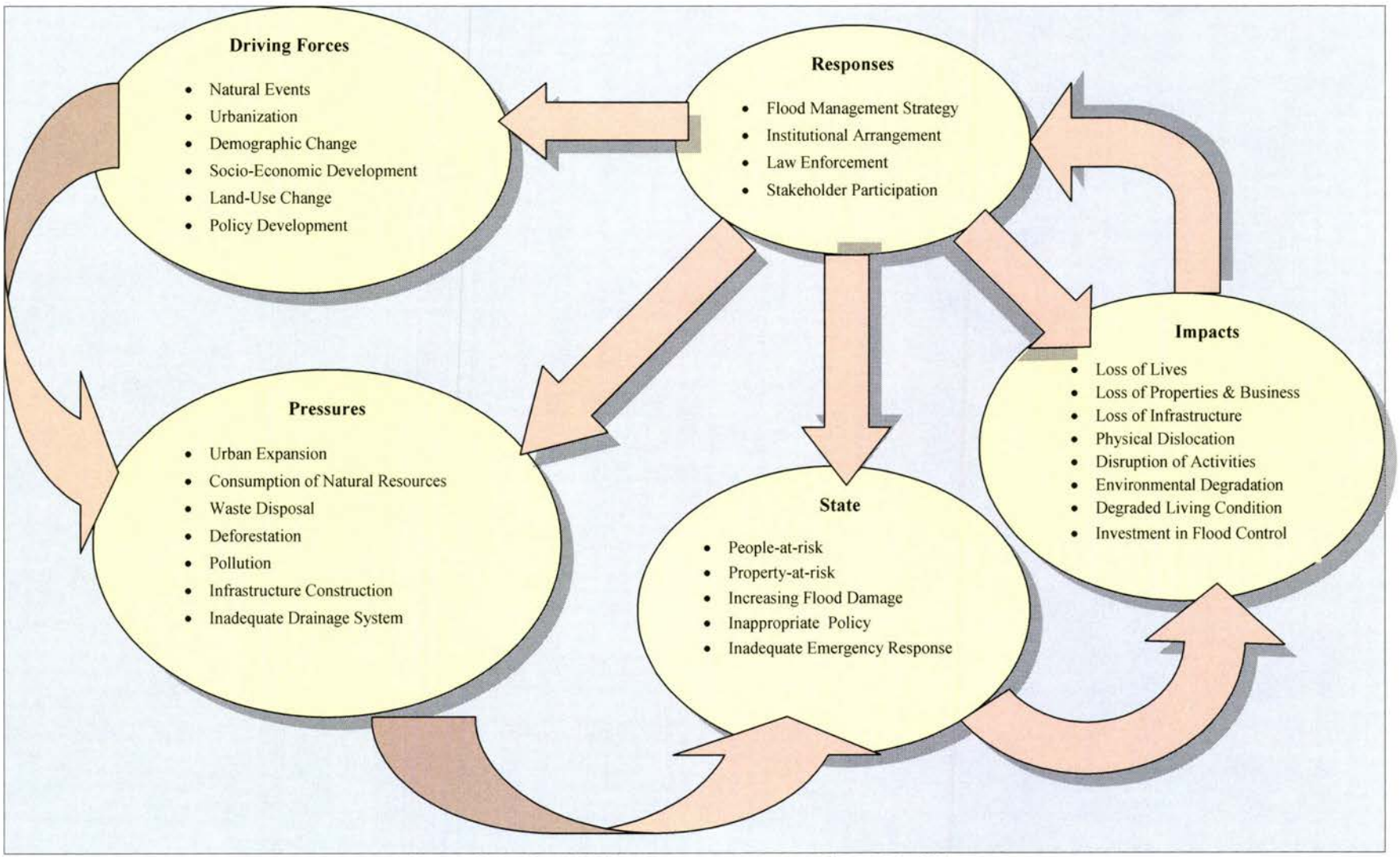

Figure 3.1 The DPSIR Framework for Flood Problem

3.2.2 Problem Architecture and Feedback Analysis

The DPSIR model must be applied to a system that has been identified with boundaries, inputs and outputs, and other elements of systems analysis. The architecture of the problem and a causal loop analysis are presented in this section

Overview

As mentioned earlier, flood hazards in Jakarta result from a combination of physical exposure and human vulnerability to flooding. External factor such as climate change also exacerbate the problem, particularly for a densely-populated coastal city like Jakarta. As global temperature rise, oceans get warmer; and when water heats up, it expands and sea levels rise. Rising sea levels also make coastal areas more vulnerable to storm surges and, in turn, to flooding.

Global climate change increases the vulnerability of many areas in Indonesia to natural disasters. Compared to other areas in the country, Jakarta is predicted to be more vulnerable. Up to now, disasters frequently occurred in Jakarta are caused by a pattern change of rainfall (Susandi, 2009).

Figure 3.2 shows the factors comprising the problem architecture of flooding in Jakarta.

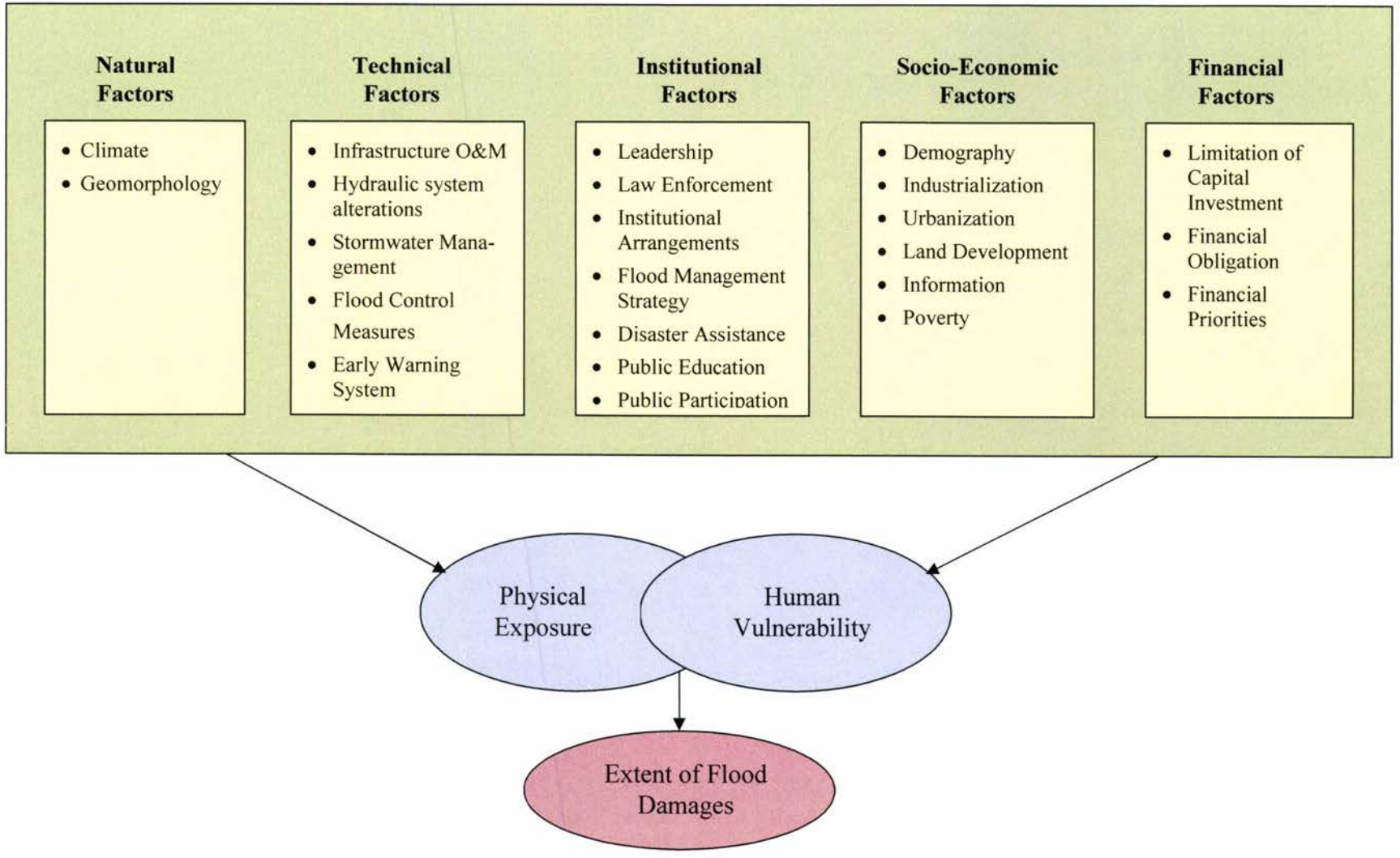

Figure 3.2 Factors Contributing to Flood Problem in Jakarta

Feedback Model

A simple general feedback model is shown in Figure 3.3. The model is useful for identifying and evaluating the components of the system and the feedback. Depending on the system, there can be interactions among the conditions, some may interact with others, and some may be static.

Many systems have an initial condition which provides the initial inputs to process operating within the system. The outputs from the processes have impacts on parts of the system which give a feedback and alter the initial condition of the system. The initial condition of the system may also altered by external forces.

In the case of flooding, the conditions interact naturally. The initial condition could be related to the natural conditions such as weather, topography, soils and land cover; or other conditions that are engineered, regulated, or socio-economically driven. Among the many inputs provided by the initial condition are alterations to hydrologic and hydraulic system, as well as geomorphologic and demographic conditions. The processes described the system behaviors related to flooding. The outputs are the consequences of the processes which can have impacts on various part of the system such as the socio-economic and environmental conditions, and could give feedbacks that alter the initial conditions.

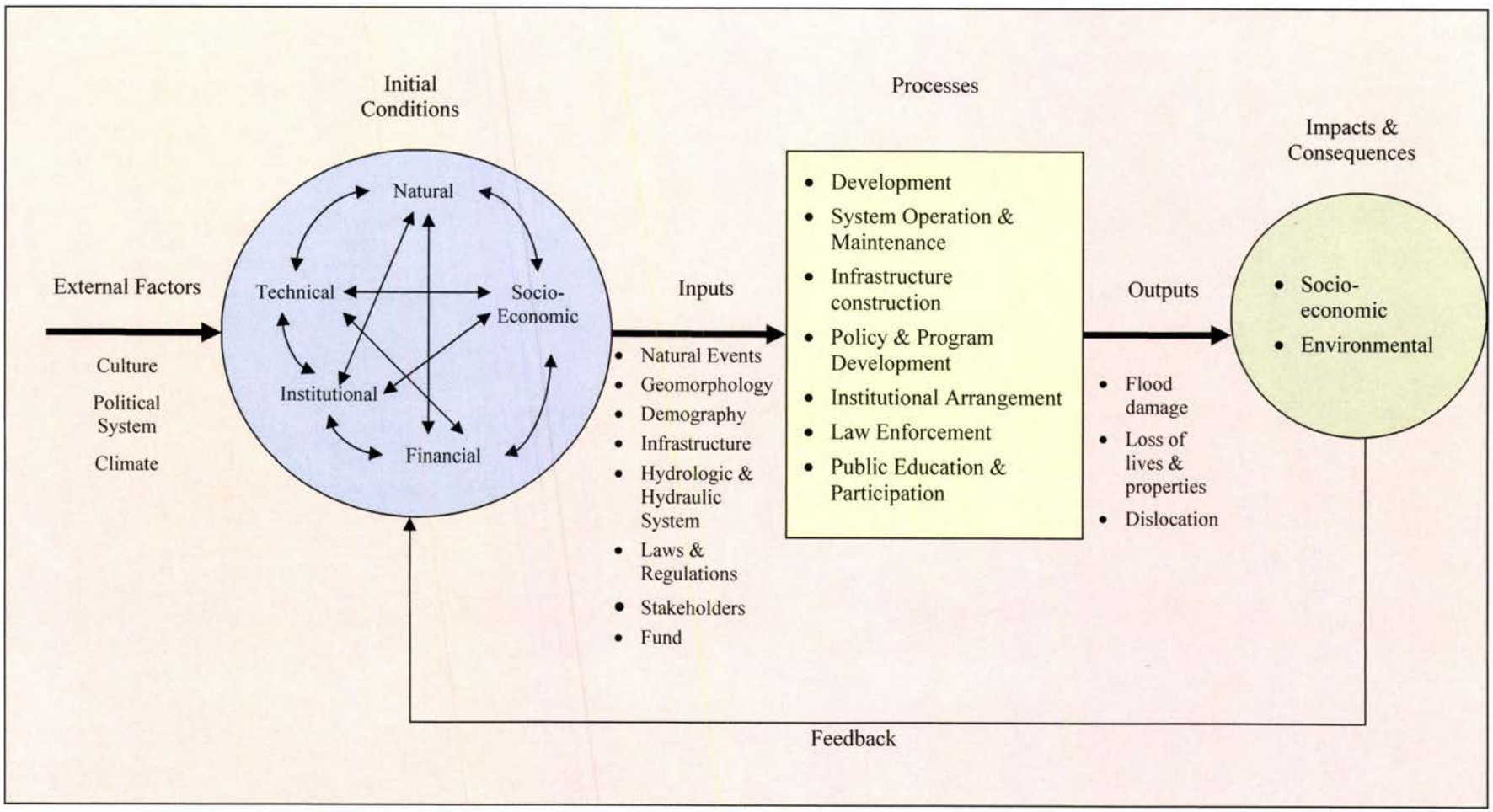

Figure 3.3 General Feedback Model

Causal-loop Diagram

Causal-loop diagrams can be used to show inter-relationships among key variables, and Chapter II explains how they work. For flooding in Jakarta, a causal-loop diagram is used to describe the interactions through cause and effects (causalities) between variable systems (Figure 3.4). A plus (+) sign implies that a change in the variable at the end of the arrow will cause a change in the variable at the top of the arrow in the same direction. Similarly, a minus (–) sign implies that a change in the variable at the end of the arrow will cause a change in the variable at the top of the arrow in the opposite direction. The next paragraphs will describe the causal-loop diagram related to flood problem in Jakarta.

Economic Subsystem

Since Jakarta is a large port and capital city, its business communities are predominantly formal and informal industrialist, especially in manufacturing, trade, and service businesses. Industrialization has created job vacancies in Jakarta which results in urbanization, land pressures and often leads to flooding. The flood current situation is thus a threat to the economic development. With acute recurrent flooding in the area, businesses are becoming unsustainable. The investors are usually reluctant to invest their capital in the disaster-prone areas.

The economic development is often contradicts the flood loss reduction programs. On one hand, economic development needs a lot of activities in floodplain areas and on the other hand there is a need to limit floodplain occupation because those activities could increase community vulnerability to flooding. Therefore goals for floodplain

management can be conflicting. Prerequisites for sustainable development will need an effective flood control measures along with an appropriate watershed management.

Due to the high population growth rate, existing infrastructure systems are not performing at their planned capacity, and thus need additional facilities. This results in changes in land-use patterns which lead to environmental degradation due to decreasing of green spaces and natural areas and cause higher risk of flooding and losses. Lack of regulatory control has made the problem worse.

Laws and policies form the foundation of the institutional and legal framework of flood mitigation and preparedness. In order to develop the appropriate flood mitigation programs for the city, the role of the institutions and their coordination need to be strengthened. The best overall flood mitigation strategy may involve structural and non-structural measures, designed to work in an integrated way and to provide the best compromise solution for the city and community at risk.

The public should be knowledgeable about flood risk and should be given opportunities to express opinions and become involved in flood mitigation programs. Public participation could increase flood awareness and create better disaster preparation and could minimize the effect of flood disasters. In addition, public participation in maintaining their environment, especially drainage systems, could reduce the risk of flooding.

However, an increasing sense of security from floods as a result of flood mitigation programs would make Jakarta even more attractive and encourage more people to come. This will result in increasing urbanization, and the flood problems will remain.

Requirements for strengthening the existing institutions in flood control and watershed management have to be analyzed. The local government needs to enforce all of the current laws and regulations, particularly those which deal with urbanization, land-use, drainage, and flood control.

The impact of the improved institutions quality as well as their coordination and arrangements, especially on law enforcement and on public participation, is expected to improve overall conditions. These could also give the most effective and least costly solution.

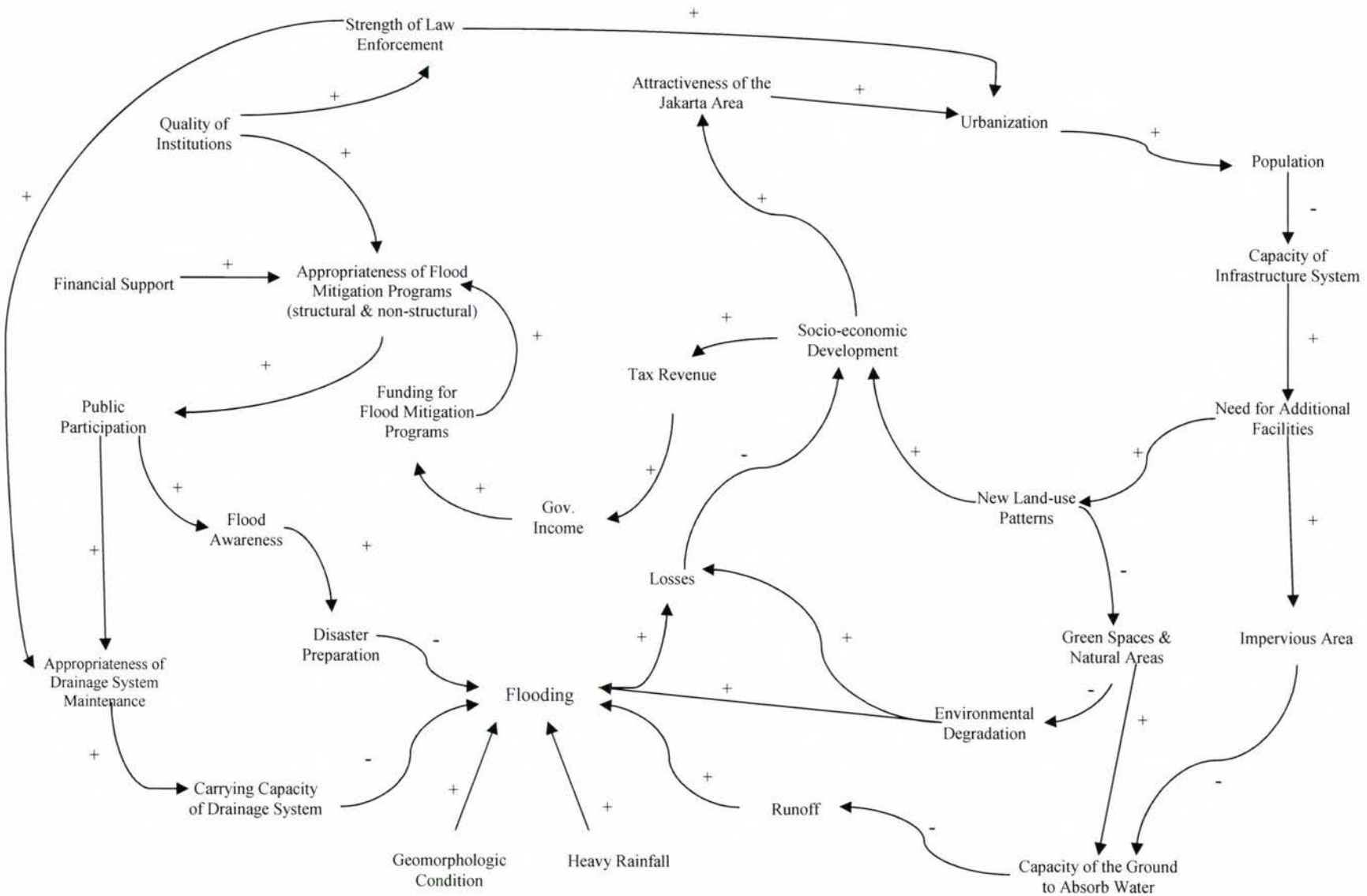

Figure 3.4 Causal-Loop Diagram

3.2.3 Framework of the Management Model

Figure 3.5 shows the interrelated elements of the model which include institutional, technical, socio-economic, and financial factors. A more detailed presentation of the elements of the model is given in Table 3.1.

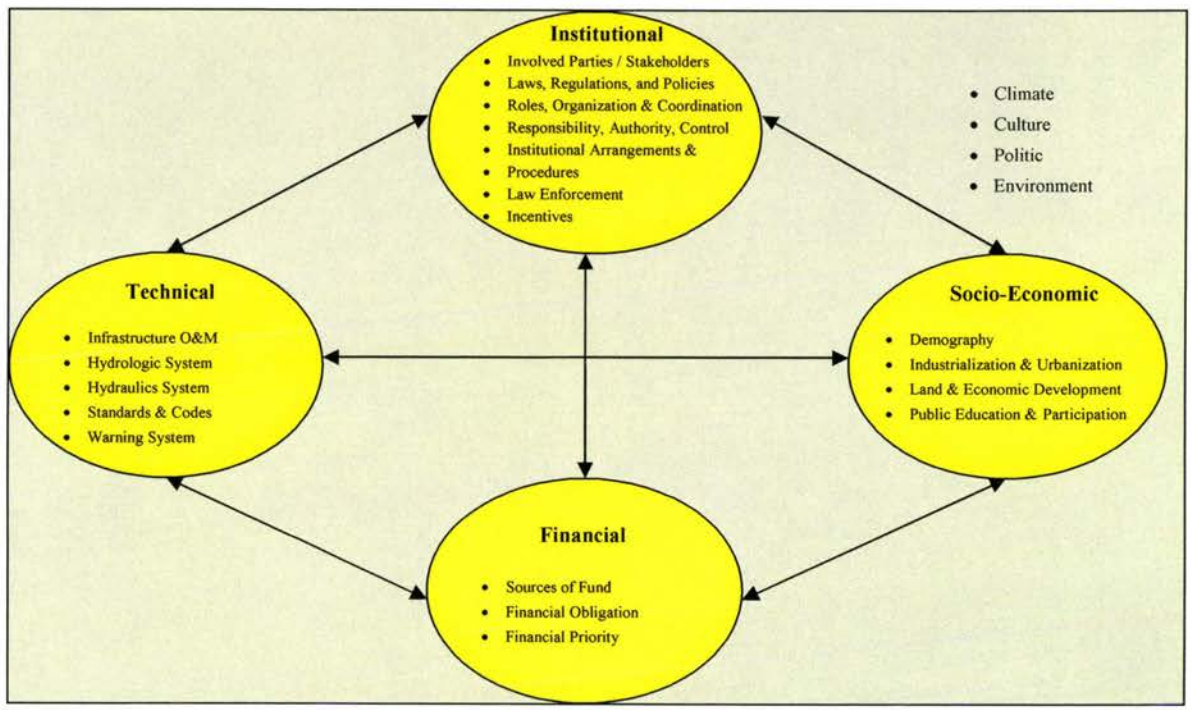

Figure 3.5 Elements of the Model

The conceptual model is used as a way to:

- Summarize existing knowledge about the system
- Identify and select important components
- Identify relationships between the possible causes and impacts
- Identify what types of data needed
- Communicate understanding of the system to stakeholders
- Facilitate review of the outcome by outside experts by summarizing system complexities in a digestible form.

Table 3.1 Preliminary Framework of the Management Model

Overall Goal	To protect and prepare the community from flooding and to reduce the impacts of flooding			
Management System Category	**Institutional**	**Technical**	**Socio-Economic**	**Financial**
Components	• Involved Parties / Stakeholders • Laws, regulations, policies • Roles • Organization • Coordination • Responsibility • Authority • Control • Arrangement • Procedures • Enforcement • Incentives	• O & M • Hydrologic System • Hydraulic & urban drainage System • Standards, Codes • Warning System	• Demography • Industrialization • Urbanization • Land Development • Economic Development • Public Education • Public Participation	• Sources of Fund • Financial Obligation • Financial Priority
Objective	• To strengthen institutions that deal with flood management • Develop improved flood management strategy through enhanced institutional support, collaboration, and law enforcement	Reduce flooding through improved facilities O&M and effective flood control measures	• Reduce social, economic, and environmental impacts from floods, especially on the urban poor • Develop community-based flood disaster awareness and preparedness • Improve public participation	Provide funds necessary to implement the programs

Activities	• Identify Stakeholders • Analyze circumstances of flood • management in Jakarta • Review existing laws, regulations, policies and programs • Review existing institutions / stakeholders roles and involvement in flood management • Gap analysis • Identify opportunities, limitations & constraints • Develop coordination mechanism among stakeholders • Develop institution arrangement to implement flood management strategy	• Review of the existing codes and standards • Improve flood management • technologies and information • Improve flood emergency & recovery measures	• Review the current situation regarding public education and participation • Gap analysis • Identify community-based program opportunities • Develop public education program • Develop participatory programs for communities	• Review of the current financial problems faced by the local government • Develop funding mechanism for flood management programs implementation
Targets/Indicators	• Improved flood management strategy and implementation • Improved coordination among parties / stakeholders	• Reduced loss of lives • Reduced flood damages • Reduced areas and people affected by floods	• Increased public awareness on flood hazard • Increased public participation on flood mitigation programs	• Improved financial capability of the local government to support flood mitigation programs • Improved cost-effectiveness of flood mitigation programs

3.3 Surveys and Data Collection

Following the literature review and conceptual model development, a survey was conducted to gather information regarding the current conditions in Jakarta. The stakeholders would provide critical input and would help to identify issues of concern, develop goal and objectives, and propose management strategies for implementation.

Interviews, observations, and questionnaire as primary data; and secondary data such as hydrological and past flood data records are the major sources of data for this study. The list of questions and the questionnaire are presented in the appendix.

The primary data include:

- Observational study

  The purpose of observational study is to be able to describe the setting, activities, and people observed and follow through with information on the meanings of what was observed from the participants' perspective.

- Interviews

  Interviews were performed with relevant parties such as the local government of Jakarta, Department of Public Works, and other participants that fit the background requirements. The structured interview materials include:

  - the existing role and responsibility of the institution
  - the existing policy and regulations
  - major problem or issue that has been solved and how they solved it
  - the existing and future flood management programs and how they publicize or communicate the programs to the public

❖ Questionnaire

The questionnaire provides extensive, descriptive data and further elaborated information gathered at the sites. A purposeful sampling method was used to select the participants (stratified sample). The questionnaire was designed mostly to address the research questions. Areas of major concern include:

- Community awareness of flood risk, especially in their community
- Community preparedness to cope with flood occurrence
- Public information and education regarding flood risk and flood mitigation and preparedness program
- Flood impacts on the community well-being
- How people carry on with their lives forward after the floods
- How long people are able to recover from flood event
- How people improve their flood management capacity and preparedness for future floods
- The willingness of the community to participate in flood mitigation and preparedness program

Secondary data, such as geographic, demographic, and hydrological data; past flood data; land-use pattern and regulations; and Jakarta's Drainage and Flood Control Master Plan were obtained from literatures, publications, and internet search from Indonesian and Jakarta Central Bureau of Statistics, Local Government of Jakarta, Department of Public Works, Indonesian Geophysics and Meteorological Department, and other relevant sources.

The aim of the first data collection is to gather information and opinions from people in Jakarta regarding their concern about Jakarta flooding, as well as their awareness, willingness and preparedness to overcome the problem. Collecting this background information would help focus on the efforts to identify the issues of concerns and solutions. The results would give representation of the current and desired conditions, the similarities and differences among communities, and subsequently would support the flood management policy development in Jakarta.

3.4 Data Analysis and Interpretation

Data analysis begins following each observation and interview to identify recurring themes and patterns. Subsequent interviews and observations might be required to focus on emerging themes. The analysis of the questionnaires involves summarizing the data and exploring similarities and differences occurring among respondent with different backgrounds and characteristics. The interview and observation information as well as questionnaire data are examined for their consistency. Statistical tables, graphs, and charts are prepared to visualize the data and appropriate statistical analyses are carried out to analyze the data.

3.5 Expected Outcome

The overall expected outcome for this study is to develop an effective and improved flood management strategy to cope with the ongoing flood problems in the Jakarta area. This overall outcome is supported by the following outcomes:

- Reliable flood-related information is widely available; therefore the nature and risk of flooding are understood by communities, local government and other stakeholders.

- The development and strengthening of institutions and capacities at local government and community level that can contribute to building resilience to flood hazard.
- Stakeholders involved in flood risk management have clear responsibilities and are working together within a common framework to achieve the goal.
- Flood risk management decisions lead to sustainable development.

With the combination of the conceptual model developed in detail, the survey instrument, and the analysis of data, the problem of flooding in Jakarta can be understood from a systems viewpoint. This would enable the research to develop specific recommendations to improve flood protection in Jakarta and similar areas in ways that have not been practiced before. The improvement would come by new ways of engagement of stakeholders in helping to solve problems.

The proposed model is intended to be applied to all of Jakarta area. However, if there are significant differences, additional recommendations would be suggested to those specific areas.

CHAPTER IV

CASE STUDY: FLOOD MITIGATION IN JAKARTA

4.1 General Information

The case study of Jakarta (also known as DKI Jakarta) was introduced in Chapter I. It explained how, like many other large cities, Jakarta has rapid population growth because it attracts migrants and urban investment. Public services, including flood protection and drainage systems, have not kept pace. Jakarta has especially severe problems because it is prone to flooding with thirteen rivers converging in the low urban area, and some flooding occurs every year during the wet season. The extensive drainage system is poorly maintained and flooding is exacerbated by poor watershed management. This problem has been recognized for a long time, but the approach to flood management has been reactive and reliant on structural measures. It is clear that traditional engineering measures alone will not protect the population from flooding and a broader approach is needed. This approach should include better law enforcement, public participation, and active stakeholder roles in flood management. This chapter presents the details of the case study of Jakarta.

Jakarta, the largest city in Indonesia, is a strategic area due to its status as the capital city and the center of the governmental administration. It covers an area of 661.52 square kilometers (255.41 square miles) and is currently the eleventh largest city in the world (BPS, 2007). The maps of Indonesia and Jakarta are shown in Appendix A.

Officially, Jakarta is not just a city, but is a province and is administered much like any other Indonesian Province. Jakarta has a governor (instead of a mayor), and is divided into several sub-regions with their own administrative systems. Administratively, it consists of five municipalities, i.e. North Jakarta, South Jakarta, Central Jakarta, West Jakarta, and East Jakarta, and one autonomous second level region, Kepulauan Seribu (Thousand Islands), which was formerly a sub-district of North Jakarta. The Thousand Islands is located in the Jakarta Bay, about 28 miles on the northern part of the city.

The area of Jakarta is mostly occupied for housing (43,788.57 ha) and industrial activities (4,417.87 ha) (BPS, 2007). Table B.1 and Figure B.1 in Appendix B show the land area and its usage by municipality.

4.1.1 Geography

As shown by the map on Figure 1-1, Jakarta is located on the northwestern coast of Java Island at the mouth of the Ciliwung River. Its northern is on plains and the southern parts of the city are hilly. The some thirteen rivers flowing through Jakarta mostly flow northwards toward the Java Sea. The Ciliwung River is the dominant river through Jakarta which divides the city into the western and eastern principalities.

4.1.2 Climate and Hydrology

Jakarta's climate is hot and humid year-round with a daily temperature range of about 25° to 38°C (77°-100°F) and average humidity of 78.4%. Rainfall occurs throughout the year, although it is heaviest from November to May. Jakarta's wet season rainfall peak is usually in January with average monthly rainfall of 350 mm (14 in). The annual precipitation in Jakarta is 1,790 mm (71 in) (BPS, 2007).

4.1.3 Demographic Dimensions

The population in Jakarta has increased rapidly from 1.2 million in 1960 to 8.8 million in 2004 and these numbers do not include illegal residents. According to 2008 data, Jakarta is inhabited by 8,489,910 people and has population density of 11,315 persons per square kilometers. The proportion of male and female residents is about the same. According to population statistics based on education in 2005, 34% of Jakarta populations are high school graduates, 27% are junior high school graduates, and 12% are college graduates. Jakarta also has several ethnic groups, such as Javanese (35%), Betawi (28%), Sundanese (15%), Chinese (6%), Batak (4%) and Minangkabau (3%) (BPS, 2007).

4.1.4 Infrastructure

Like other large cities in developing nations, Jakarta's rapid growth overwhelms public services, roads and infrastructure and has outgrown the local government's ability to provide basic needs for its residents. Compared to similar capital cities in Asia, Jakarta's water, sewerage, waste disposal, and housing are seriously deficient. Severe infrastructure deterioration such as aging pipes, limited road networks that cannot cope with the rising traffic volume and power outages due to heavy demands impede economic activities.

With some 13 rivers through the city, there is no shortage of water but less than a quarter of Jakarta's population has water piped into their homes and there are concerns about the quality of the piped water due to network conditions. Jakarta's water supply system is fragmented and cannot reach even half of the population, especially lower income areas. As a result, about 80% of inhabitants use the underground water which has become

steadily depleted. In low-lying North Jakarta, ground water depletion has caused serious land subsidence, making the area more vulnerable to flooding and allowing sea water from the Java Sea to seep into the coastal aquifers. As groundwater is shallow throughout the city, much of it has become polluted.

Despite its size, Jakarta has a very limited sewer system and surface water sources are contaminated by sewage and industrial effluents. Wastewater receives little treatment and is discharged either into canals and rivers or into septic tanks.

The lack of an effective solid waste collection system in Jakarta has exacerbated the flood situation, with household waste collecting in canals which provide water supply and flood drainage for the city.

Until now, the investments needed to provide public services to all its residents are far beyond the government's capacity and the best services are provided to those who can afford them. Drinking water is absolutely essential for humans, but its availibility is limited by a ability to pay. It has been a challenge for the government to provide a good but affordable services to the underprivileged residents.

Although infrastructure in Jakarta depends on financial aid from the government, the tight monetary policy implemented at the request of the International Monetary Fund (IMF) has severely restricted Jakarta's ability to fund infrastructure programs that would create jobs and get the economy moving. The Indonesian government has announced that it considers infrastructure development to be one of the primary targets for foreign investment and financing.

4.1.5 Socio-Economic Conditions

Indonesia enjoyed an improving economy during the 1970s due to high oil prices, which assisted both public and private construction. During the 1980s, Indonesia's economy began to diversify and local entrepreneurs invested more in property and construction. This increase in development led to a rise in land prices and also speculative practices by private investors. During the 1990s, there were large numbers of high-rise building and luxury houses constructed, leading to over-building at the expense of agricultural land on the fringes of the greater Jakarta area.

The tremendous economic growths in the 1980s and 1990s were also supported by Indonesia's abundant natural resources and increases in the manufacturing and services sectors. As a result, Indonesia's middle class grew considerably, but poverty remained widespread. Table B.3 in the Appendix shows the socio-economic condition in Jakarta.

Indonesia's economic crisis that began in 1997 hit Jakarta the hardest and the city's urban poor increased significantly. The crisis also hurt property developers where large-scale development slowed down and many infrastructure projects were suspended.

As Jakarta grew, retail and commercial buildings surrounded the unplanned settlements. Soon after, the slums were usually demolished in favor of new business and commercial facilities. Since Jakarta's importance as an economic center increased, large private developers sought to build office buildings and shopping malls in the city center. These developers as well as local government usually cleared tracts of land to make way for public works projects or commercial building for minimal compensation.

Jakarta had economic growth in 2005 of 6.01%, and the Gross Regional Domestic Product (PDRB) of Jakarta reached 295.3 trillion Rupiahs (about 31.2 billion dollars). The sectors which contributed the biggest amount to this were finance, leasing, and business service, reaching Rp. 90.9 trillion ($9.6 billion) or 30.8% out of the total of PDRB. This was followed by trade, hotels and restaurants amounting Rp. 63.5 trillion (21.5%) and manufacturing industry as much as Rp. 51.2 trillion (17.3%) (BPS, 2007).

Similar to many large cities throughout the world, Jakarta continues to struggle with urbanization, which leads to urban poverty, inadequate housing, high rates of unemployment, inadequate infrastructure, inadequate provision of health care, lack of services, and decreasing environmental quality. It is also a segregated city, where the rich live in exclusive residential communities while the poor reside in unplanned urban villages or slums. As Jakarta continues to attract migrants, housing has become one of the most serious problems. Scarcity of available or affordable residential land forced many people to build on land they did not own by reclaiming coastal areas and swamp land; subdividing unused lots; or staking plots in the public spaces along railway tracks, canal, rivers, roads, and under bridges. Over the years, many people were evicted from their homes due to urban redevelopment and infrastructure projects. Today, the majority of underprivileged residents continue to live in unplanned and unregulated settlements. The revival of economic growth in Indonesia and its likely impacts on urbanization and economic development can be expected to place further demands on land, infrastructure and services in Jakarta.

4.2 Outlining Flood Management

During the wet season, Jakarta suffers from flooding mainly due to clogged sewage pipes and waterways. Deforestation due to rapid urbanization on the highland areas south of Jakarta near Bogor and Depok has also contributed to the floods. The combination of the increased loss of vegetation in the upper catchments of rivers that flow into Jakarta region and the lack of adequate flood control has created a situation where floods created by heavy rainfall cannot be adequately diverted away from the Jakarta area. Eventually, water flowing into Jakarta overflows some of the city's flood control systems and causes devastation in these areas.

4.2.1 Flooded Area

Forty percent of the metropolitan area is technically below the sea level. As a consequence, even without residential and industrial activities, Jakarta is prone to flooding (Figure 4.1). In addition, over the years, legal and illegal building activities have decreased Jakarta's water catchment area, making the flood problem worse.

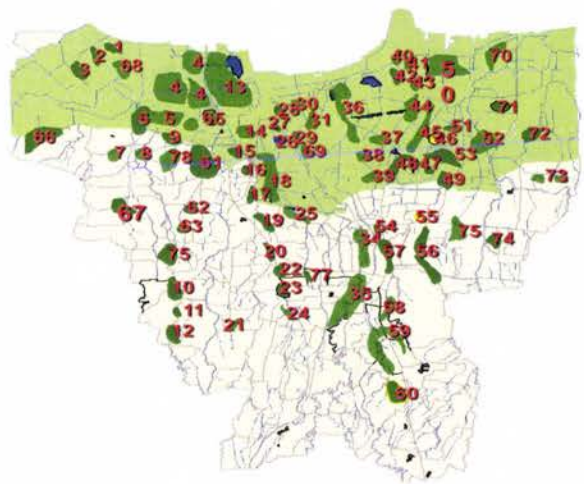

Figure 4.1 Flooded Areas in Jakarta

4.2.2 The Causes and Impacts of Flooding

The most significant cause of flooding in Jakarta is the high rate of rain. But the flood situation in Jakarta had become more drastic because the city was growing without proper control. Environmentalists have blamed the floods on years of bad city planning and on the uncontrolled development of green spaces and natural water catchment areas, along with broken or blocked drains. In addition, lack of appropriate garbage collection and disposal decrease the water quality and the capacity of the urban drainage network due to filling.

Over the years, there has been a rampant urbanization with no consideration of long-term consequences, such as increased run-off and a higher risk of flooding. Jakarta's need for renewal and modern facilities fueled an ongoing construction boom since early 1970s. The number of private automobiles has increased faster than any other form of transportation in Jakarta and this has created a demand for the expansion of roads and parking. New toll roads were built; factories sprang up in new industrial suburbs.

Flooding is also caused by the treatment of the environment, in terms of practicing deforestation and exploitation of natural resources. Land and greenbelt areas which continue to decrease each year, lack the capacity to absorb water and have contributed to severity of flooding. Agricultural lands were turned into housing estates and industrial uses, with some estates being built on water catchment areas. Residential housing and commercial developments exacerbate urban drainage problems by increasing the impermeable area that produces urban runoff which increase the overland flow and decrease the groundwater flow.

Natural disasters are a potentially serious shock to an economy. Floods have a direct impact on infrastructure and productive facilities and resources, as well as on social resources and infrastructure, especially housing. The flood damaged productive assets and distorted the Jakarta economy also. The floods in Jakarta since late January 2002 had caused 700 billion Rupiah of damage. The estimates were based on the funds needed to repair or rebuild the ruined infrastructure and did not include the value of damage and losses of individual properties. At least 200 billion Rupiah (19.4 million dollars) is needed to repair roads damaged by the devastating floods.

The worst affected by the flood are the poor living in the low-lying area of the city. Their homes have either been destroyed or badly damaged. The urban poor have been finding it hard to deal with the disaster, with food and water becoming scarcer each day. There were also outbreaks of diarrhea and skin problem, as temporary shelters are far from hygienic. Much of the disease is caused by the lack of clean water. As the water receded it left behind piles of rotting garbage and thick mud, increasing the danger of epidemics.

4.2.3 Flooding Experiences and Lessons Learned

Nowadays, flooding has become an annual event in Jakarta. Some of the worst flooding in history occurred in 1996, 2002, 2007, and 2008.

4.2.3.1 The 1996 Flood

In 1996, the rainfall in Jakarta reached a cumulative total of 400 mm. The city was severely affected where about 30 people were killed, thousands were homeless and 5000 hectares flooded. The government and experts claimed that the cause of flooding was lack of awareness towards the need to preserve the environment.

It had been long predicted that major flooding would hit Jakarta and then there was a warning that such a disaster could happen once every five years. Unfortunately the local government took it lightly. Flood control projects were not carried out properly and the city planning was very poor.

4.2.3.2 The 2002 Flood

Massive flooding has been predicted by the Meteorology and Geophysics Agency to hit Jakarta following a five-year cycle, which is caused by heavy rainfall. Although many people clearly remember the 1996 flooding, only few people were prepared for the coming torrential rain, saying they were unaware of any potential disaster. Some of the residents in flood-prone areas felt that due to repeated experience of flooding, they found it unnecessary to take any special precautions.

In late January 2002 a severe flood hit Indonesia and inundated much of Jakarta, leaving hundreds of thousands homeless. About 15-20 percent of the city was under water, and thousands of homes were flooded. At least 60 areas in the city's five municipalities were swamped with 150 cm of flood water. In the worst hit areas, the water level reached three to five meters.

The rising water level forced hundreds of power generators to shut down across the country causing power outages. Commuters had been caught in traffic jams while others found difficulty accessing public transport. Reportedly it was the worst flooding in the city since 1996. The damages caused by the flood were far exceeding those in 1996, mostly because clearer rivers and canals allowed the floodwaters to drain away into the

sea faster. Again, the government and experts claimed that the main cause of the flood was lack of awareness to preserve the environment.

As of February 7, the media were reporting that 57 people had died as a result of the flood. The floods left many people homeless and forced residents to take shelter in mosques, schools, local government offices and cemeteries and under elevated highways after their homes were inundated by up to three meters of dirty brown water. The government and private organizations set up temporary posts to provide basic supplies such as water and blanket and to feed people at public kitchens.

After the initial concern of rescuing, sheltering, and feeding the displaced, disease became a matter of concern. The flooding was responsible for thousand cases of malaria and diarrhea. After the floods had subsided, in mid-March, about thirteen people died from leptospirosis, which can be passed from rats to humans during times of flooding.

4.2.3.3 The 2007 Flood

The 2007 flood is considered the worst in the last centuries, including the 1996 and 2002 Jakarta floods. The flood also affected several other areas around the city, such as West Java and Banten. The flood, beginning on February 2, 2007 was a result of heavy rain, deforestation in southern areas of the city, and clogged waterways. The local government was also blamed of sacrificing water catchment areas for economic reasons.

The water reached 4 meters of depth, and about 70 to 75 percent of the city, where 80 separate regions were affected and over 70,000 homes were flooded. The flood also caused a high level of illness due to diarrhea and dengue fever.

The local government placed all emergency services on the highest level of alert in an effort to protect the residents of Jakarta. Medical teams, rescue teams, soldiers, and volunteers worked together to cope with the effect of the disaster, especially in evacuation process and supplies delivery.

The flood had always caused lower-class communities who lived in riverbanks to take the strongest impact. However, this time the flood had inundated not only the slums, but also many middle-class residential areas. The flood also reached close to the presidential area and business center in downtown Jakarta. The worst hit areas were in East Jakarta where the water levels were recorded at 3 to 6 meters.

In this flooding event, at least 85 people were killed and about 350,000 were forced from their homes. The losses from infrastructure damage and state revenue were close to 7.8 trillion rupiah (879 million dollars).

4.2.3.4 The 2008 Flood

The most recent flood occurred in late January 2008, when hours of heavy rain caused most of the main roads to be submerged in knee-depth water, and more than 40 locations were inundated by water more than one meter high. A numbers of cars were stranded and people had to walk through murky water in many parts of Jakarta. Fortunately, the extent of this flood is less than that of 2007. There were no reports of deaths in Jakarta caused by this flood.

Floodwater caused public transportation across Jakarta to stop their operations. One of the major impacts of this flood is the inundation of the toll road leading to the Soekarno-

Hatta International airport which resulted in the cutting of the highway for a few days. Nearly a thousand flights were delayed or diverted and hundreds were cancelled.

Unlike the 2007 flood where the former governor blamed deforestation and overbuilding in neighbor areas which were supposed to be water catchment areas, in this year flood, poor drainage system was blamed as the primary cause of the flood. Parts of the city's micro drainage system were blocked and some canals were not functioning properly.

After the 2007 flood, the former governor said that the city administration needs more help from the central government to deal with annual natural hazards. The Vice President instructed the governor to install more pumps for drying out the flooded toll road, and requested an investigation on an upscale neighborhood near the flooded toll road which was not flooded.

4.2.4 Current Institutional Arrangements

The concept of Integrated Water Resources Management (IWRM) has been recognized to be the key to achieving water security and water resources sustainability. Flood disasters adversely affect sustainability and should be addressed in the context of IWRM by integrating flood risks in the development of strategies.

4.2.4.1 The Legal Framework

Law is considered to play a vital role in the effective implementation of Integrated Flood Management practices at the local, regional and international levels. Based on Law No. 10 of 2004 (article 7) on the formulation of laws and regulations, the Indonesian legal hierarchy as follows:

- Indonesian Constitution of 1945
- Law
- Government Regulation
- Presidential Regulation
- Regional/Local Regulation

Some of the key laws and regulations regarding water and water related resources management are described in Appendix D. The laws and regulations developed specifically for disaster/flood management are as follows:

❑ **The Disaster Management Law (No. 24/2007)**

After various disasters occurred in a short period in Indonesia, including the 2004 tsunami, a joint team of government, non-governmental organization and experts drafted a law in disaster mitigation that allows for more coordinated action and greater public involvement. The draft aimed to prevent manmade disaster, or to warn people of imminent disaster. The law would also discourage people from actions or behavior that increase the risk of disaster.

The Disaster Management law which has been passed in March 2007 regulates roles and responsibilities of both national and regional government, roles and responsibilities of stakeholders, establishment of a new agency for disaster management, the inclusion of community participation, and funding framework for disaster management. The scope of the law is far-reaching, affording Indonesian citizens individual rights to protection from and during disasters. The law reaffirms that the government has an obligation to protect citizens, and provides a legal structure for victims of disaster to obtain assistance. One of the most significant aspects of the new law consists of provisions for preventing as well

as responding to emergencies. This law also establishes a National Disaster Management Agency to coordinate effort to reduce disaster risks in advance and to provide leadership during an emergency.

The Law No. 24/2007 has changed some paradigms such as from emergency response to risk management and gives new perception for disaster management activities in Indonesia, including a series of integral and continuous activities. These activities start before a disaster occurs, during disaster, and after a disaster has happened. The law also provides strategic values for implementation of disaster management in the future.

❑ Government Regulations

- No. 21/2008 on Disaster Management Implementation

The implementation of disaster management is undertaken by the National Disaster Management Agency (NDMA) for the national level and the Regional Disaster Management Agency (RDMA) for the regional/city level. The duties of the NDMA include composing the guidance for formation of the regional disaster management agency. In executing its functions, the NDMA also has an integrative duty that includes pre-disaster, during disaster response, and post disaster.

- No. 22/2008 on Finance and Disaster Assistance Management

The disaster management funding is a joint responsibility of the national and regional government. The funds come from the general public should be encouraged and should be allocated properly for the implementation of the program. The regulation also states that the government has an obligation to provide assistance to the disaster victims, and public participation should be encouraged. The management of disaster assistance

comprises planning, operation and maintenance, monitoring and evaluating of national and international goods, services, and/or assistance monies.

- No. 23/2008 on International and NGOs Participation in Disaster Management

The regulation provides the opportunity to the business institutions and international institutions to participate. The role of international institutions in giving assistance can be done by respecting social, culture, and religion of the society around. The implementation of disaster management activity by international institution and international non-governmental institution should be regulated by the establishment of Government Regulation.

❑ **President Regulation No. 8/2008 on The National Disaster Management Agency**

This regulation describes a more detailed of the organization, role, responsibility, and standard operating procedure for the National Disaster Management Agency.

❑ **Regional Regulations**

- No. 96/2002 on the Development of the Organization and Standard Operating Procedure for the Coordinating Unit for Disaster Response in Jakarta.
- No. 1230/2002 on the Standard Operating Procedure for Disaster Management in Jakarta.

4.2.4.2 The Organizational Framework

The National and Regional Government are responsible for the organization of disaster management. The Disaster Management Law (Section III article 6) describes the government responsibilities and authorities in disaster management as indicated in Appendix E.

❑ The National and Regional Disaster Management Agency

The implementation of the Disaster Management Law requires a considerable institutional reform that is currently ongoing. Following the enactment of the law, the Indonesian Government prepared detailed arrangements for the reorganization of the disaster management institutional structure, including the introduction of a new agency coordinating and implementing unit.

At the national level, the National Coordinating Board (BAKORNAS) for disaster management that was established based upon the President Regulation in 2005 became an agency called the National Disaster Management Agency (NDMA) or *Badan Nasional Penanggulangan Bencana* (BNPB); while the Regional Disaster Management Agency or *Badan Penanggulangan Bencana Daerah* (BPBD) takes over the task and mandate of the Coordinating Unit for Disaster Response or *SATKORLAK* at the provincial level and Disaster Implementing Unit or *SATLAK* at the city/district level.

The President Regulation for establishing the National Disaster Management Agency (NDMA) has already signed on January 26, 2008. The NDMA is a non-departmental body equal to ministry and are composed of:

- A steering committee responsible for policy formulation and monitoring and evaluation.
- An operational implementing unit responsible for coordination, command, and implementation.

The Disaster Management Law Section IV article 12 describes the responsibilities and roles of the National Disaster Management Agency as indicated in Appendix E.

In response to this problem, the Indonesian Government seeks and promotes a more effective approach to flood management, realizing that floods cannot be prevented totally. The main focus would be on "living with the floods" and non-structural measures to limit the damages. The structural measures are still important, but it would only be applied to feasible locations.

Policy support and good governance are considered as important issues that must be included in flood mitigation plans. Recently, the Indonesian Government has developed policies that try to address flood mitigation in a comprehensive way with synergizing spatial planning, integrated water resources management, providing better drainage system management and garbage disposal, controlling new settlement development, and improving community preparedness.

Flood management will be more effective if it is supported by the local government and communities. The recent policy and institutional reforms in Indonesia are calling for decentralization, empowerment of local communities, capacity building of the government, and shared responsibility among stakeholders.

4.2.5.1 Jakarta Flood Control Master Plan

The Master Plan for Drainage and Flood Control in Jakarta was prepared by the Ministry of Public Works and was completed in 1973. Implementing the whole master plan had been difficult, although some significant works, mostly construction of canals, reservoirs and pumping stations were completed. However, many other plans have yet to be implemented. Many hydraulic structures have not been built and river maintenance could not catch up with fast development of the ever-increasing population.

By 1990, as a result of a rapid population growth, it was considered necessary to review the plan. The new drainage master plan study was designed to meet the requirement up to the year 2010. In 1991 a new drainage master plan for Jakarta was established to cover the areas of the city that were not included in the 1973 master plan. Most of the works that have been completed were those that were planned in the 1973 drainage master plan.

Since the urbanization had extended beyond the local government boundaries, a review study was conducted in 1995-1996. In this study, Jakarta was treated as a part of a larger ecosystem. The resulting flood control master plan was not only for the City of Jakarta, but also its surrounding areas.

The master plan of the flood control in Jakarta is shown in Figure 4.2. According to the plan, Jakarta's flood control would rest on the two canals (West and East Flood Canals) that circled most of the areas in the city. The canals would retain all water coming from the southern part of Jakarta and convey it to the sea through downstream areas. Other efforts were the construction of reservoirs and placement of water pumps in lower areas.

❑ The Ministries and Agencies Involved in Flood Management

At the national level, there are many departments dedicated to disaster management spread across various ministries. The ministries in Indonesia have already significant involvement in disaster management although they are mostly response-oriented. The ministries that are involved in disaster management include: the Ministry of Public Works, the Ministry of Home Affairs, the ministry of Communication and Information, the State Ministry of Research and Technology, the Ministry of Social Affairs, the Ministry of Health, the Ministry of Environment, the Ministry of Forestry, and the Ministry of Transportation.

Agencies and organizations involved in flood management in Jakarta include: the National Development Planning Agency, the Meteorology and Geophysics Agency, the Indonesian Institute of Science, the Indonesian Red Cross Society, the Indonesian Armed Force, the Indonesian Society of Disaster Management, the Indonesian Statistics Bureau, and the Indonesian Forum for Environment.

The roles of the ministries and agencies involved are described in Appendix F.

4.2.4.3 The Disaster Management Plan

The Indonesian Government is shifting the paradigm from disaster response to disaster risk reduction by the enactment of the Disaster Management Law and the issuance of the National Action Plan for Disaster Risk Reduction.

The National Action Plan for Disaster Risk Reduction 2006-2009 is a collaborative undertaking by the National Development Planning Agency and the National

Coordinating Board for disaster management. The purpose of the action plan is to provide guidelines and information that facilitates decision makers to pledge commitment to cross-area and jurisdictional priority programs based on a strong and systematic foundation. The objective is to support policymaking and monitoring of disaster risk reduction activities. It lends the document a regulatory authority in maintaining the activities within the right direction, integrated and sustainable.

The five priorities in the National Action Plan for Disaster Risk Reduction include:

- Incorporating disaster risk reduction into national and regional priority policies with a strong institutional foundation for implementation;
- Identifying, assessing and monitoring disaster risks and enhancing early warning system;
- By means of knowledge, innovation and education to build a safety culture and resilience at all administrative and community level;
- Reducing underlying risk factors;
- Strengthening disaster preparedness for effective response at all level.

4.2.5 Flood Mitigation Activities

Earlier flood mitigation plans mainly focused on infrastructure improvement to address flood prevention inadequacies. However, the result of these plans is usually ineffective because due to economic feasibility, insufficient analysis of the problem, and lack of institutional capacity to support the measures. Moreover, the structural measures usually address only part of the problem, since they have often addressed the systems but not treated the causes of flooding.

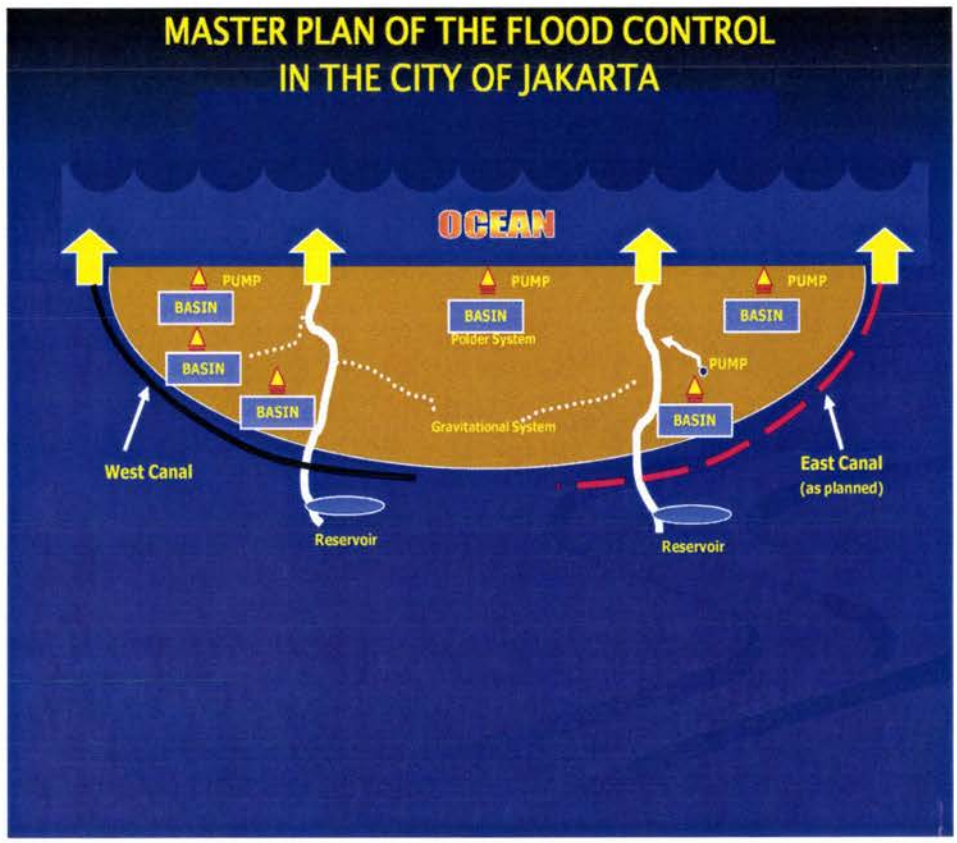

Figure 4.2 Jakarta Flood Control Master Plan

4.2.5.2 Structural Measures

The structural or physical activities that have been done to overcome flooding problem in Jakarta include: construction of flood control dams, dikes/polder system and levees; river/channel dredging, widening, and diversion; and drainage system and flood control maintenance. In addition, there are plans to build the East Flood Canal to alleviate flood problems in Jakarta. The East Flood Canal is a canal made in order to shift the stream flow of Ciliwung River and made it only crossing outside and not inside the city.

The flood canal was an idea presented in 1920, following a big flood occurred in Jakarta. The West Flood Canal was built by the Dutch Government in 1922; however the East Flood Canal which was planned to be constructed right after the West Flood Canal was completed, has not been implemented. The concept of the canal was formulated into the Master Plan for Drainage and Flood Control of Jakarta on December 1973.

The East Flood Canal refer to the Master Plan which later on been completed by "The Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta" on 1991, also "The Study on Comprehensive River Water Management Plan in Jabotabek" on March 1997. The construction planning of the East Flood Canal is formulated in Jakarta's Bylaw No. 6/1999 on Jakarta's City Planning of 2010. However, after being planned for years, the construction of the canal was delayed due to unforeseen problems, including budget cuts and the complicated process of land acquisition.

After the 2008 flood, the government announced that they would complete the East Canal project by 2010. However, some parties think that the canal is not sufficient to resolve the flood problem in Jakarta. Some experts suggest that instead of building new canals, the local government should focus on dredging the thirteen rivers regularly.

In addition, the local government should also build additional polders and pump the water into the sea. The polder and pump system require small investment but they have to be regularly maintained and dredged. Jakarta already had the polder system for about 30% of its areas, and would build more in the future. Figure A.6 in the Appendix shows the polder system in Jakarta.

4.2.5.3 Non-Structural Measures

Non-structural measures had received little attention in the past, although their contribution to flood mitigation can be significant. The non-structural measures that have been implemented include: flood hazard mapping and forecasting, improving community awareness and preparedness, and develop early warning system.

The indicators used for flood warning in Jakarta are water level, mean sea level, and rainfall depth. Water levels are observed only in seven stations located in upstream and in five water gates located in the downstream which are managed by the Ministry of Public Works and the local government of Jakarta. In addition, rainfall depth used to indicate flood warning is observed in a number of rainfall stations managed by the Meteorology and Geophysics Agency.

The flood warning is communicated to the community using various means such as radio, phone, facsimile, television, and website. Based on the standard operating procedure issued by the Coordinating Unit for Disaster Response, types of response that should be done by local authorities and communities depend on alert status. Table 4.1 shows the alert level definition, and Table 4.2 shows flood mitigation activities that have been implemented in Jakarta.

Table 4.1 Alert Level

Alert Level	Definition	Rainfall Observation
I	Imminent overflow	Heavy rainfall (> 100 mm)
II	Medium possibility of overflow	Rainfall Increases (50 – 100 mm)
III	Lower possibility of overflow	Medium (20 – 50 mm)
IV	Normal level	Light rainfall (5 – 20 mm)

Table 4.2 Flood Mitigation Activities in Jakarta

Type of Measures	Phase		
	Before	**During**	**After**
Structural Measures	• Planning flood control projects • River improvement (dredging, widening channel & diversion) • Building flood control project (dams, levees, dikes/polder system) • Drainage pump placements	• Emergency flood control works	• Rehabilitation and reconstruction of affected facilities • Evaluation of flood control performance • Revision of flood control plan
Non-Structural Measures	• Spatial planning • Rainfall monitoring • Flood forecasting • Flood hazard mapping • Early warning system • Logistical planning • Public education & training • SOP planning • Assign shelter & evacuation route • Network establishment among involved agencies • Assign rescue team • Soil conservation • Flood proofing	• Monitoring of flood water levels & flood control facilities • Dissemination of flood warning • Assign shelter & rescue team • Evacuation of people from inundated areas • Search & Rescue of missing people • Resources mobilization • Distribution of food, drinking water, medical supplies • Collecting flood information	• Providing medical care & counseling • Returning back displaced people • Cleaning up vital public facilities • Assessment of flood impacts • Inventory of number of victims & damages • Report & evaluation of the event • Maintenance of public infrastructure

4.3 Survey Results

To support this research a survey was developed for the purpose of providing a better understanding of the current conditions by collecting data and gathering information regarding flood-related problem in Jakarta.

4.3.1 Overall Observation

The survey was conducted on February 10, 2008 to March 11, 2008, about ten days after Jakarta was struck by another major flood. The water had receded; the traffic and other services along with everyday life in Jakarta were gradually backed to normal.

The communities were still recovering from the disaster. Some of the population also prepared for the possibility of future flooding by making their home more resistant to the hazard.

On the other hand, the government tried to find the best solution to overcome the problem. Days after the flooding occurred, the governor announced that his government would complete the East Flood Canal construction by 2010. In addition, he also vowed to expand the green areas surrounding river basins, as well as increase the capacity of dams.

4.3.2 Interviews

Interviews were conducted during the survey with relevant parties, such as the local government, the Ministry of Public Works, academician, researcher, consultant, non-governmental organization, and communities. The summary of the results is presented below:

- **The Local Government and the Ministry of Public Works**

  - The government is well-aware of the cause of flooding in Jakarta and prepares the city to cope with the disaster.

  - The government has tried its best to overcome the problem by developing flood mitigation programs, providing assistance during floods, and rehabilitating the facilities after floods events.

  - Although the plans and programs are deemed appropriate, the implementation has faced some problems. There have been obstacles to implement the programs such as: inadequate fund, illegal development, lack of public participation and inadequate law enforcement.

  - While the government understands that non-structural measures are important and can give significant contributions to solve the problems, it is still believed that the most feasible solution for preventing floods in Jakarta is structural measures, such as the completion of the East Flood Canal project. But apparently, due to the ongoing disputes regarding the land acquisition, the East Flood Canal is not easy to implement. In addition to the canal, the government will also construct additional reservoirs and pumping systems.

  - The government is still adjusting with the new law and regulations regarding disaster management and organization reform to implement the law.

- **Academician/Researcher/Consultant**

  - Flooding in Jakarta is very complicated and there is no easy way to solve the problem.
  - The solution to flooding problem should be done in the context of Integrated Water Resources Planning and Management, which covers the upstream and downstream areas.
  - Besides the natural factors such as climate change or heavy rainfall, the most significant cause of flooding in Jakarta is illegal settlement on riverbanks which reduces the capacity of the rivers to flow the water.
  - The government should focus on the polder and pumping system to prevent flooding along with the improvement of drainage system and the regular maintenance of the facilities.
  - The government should improve the policy and law enforcement regarding flood management, and focus not only on the emergency assistance but also on the "before" and "after" flood occurrence.
  - The government should assign qualified staffs to carry out flood management programs.
  - The government should improve its communication with the communities and develop materials that are understandable by the public.
  - Public participation need to be enhanced.
  - The government, communities, and other parties involved should work together to solve the problem.

- **Non-governmental Organization**

  - The government needs to adjust with the new law and regulations regarding flood management.
  - The Presidential Regulation to implement the Disaster Management Law needs to be improved.
  - The complicated bureaucratic mechanism to implement the disaster management programs should be avoided.
  - The staffs who conduct the disaster management task must be adequately qualified.

- **Communities**

  - After getting struck by flood every year, most of the communities are getting used to the hazard.
  - Some people are relatively prepared to face future flooding by making their homes and neighborhood more flood resistant, while some others have not taken any precaution because they feel they do not really need it or they are accustomed to flooding.
  - Most of the communities feel that the assistance from the government has been minimal.

4.3.3 Questionnaire Results

The main purpose of the questionnaire is to "capture" Jakarta resident views on flood-related problems in the city of Jakarta. Hopefully this information will be helpful for the government to enhance their understanding in people's perception and needs to cope with ongoing flood problem in Jakarta; and be more alert and responsive to help communities especially during flood events. Furthermore, the government could improve their communication with stakeholders and work together to alleviate the problem and improve the local condition.

The questionnaire was developed to reach out to communities in each municipality that would be helpful to gather information regarding current conditions in the areas, to understand people's concerns and needs, and to determine whether there is any significant difference among communities.

About 350 questionnaires were distributed between February 10th and March 11th 2008. The method of distribution included direct distribution to current residents in several communities, universities, offices, and public places. The questionnaire generated a 51.71% of responses. Most of the respondents are students (51.9%) and with the age under 25 years old. From the observation, respondents with those categories were more responsive and showed more enthusiasm and willingness to fill out the questionnaire.

Cross-tabulation (pivot table) and contingency table (chi-square independent test) is used to analyze relationship between several variables in the questionnaire data. For instance, this method could be used whether there is relationship between location and public participation. For this questionnaire, it is determined that if the probability is lower than

0.05, the two variables have relationship; otherwise it cannot be concluded any relationship between the two variables in the contingency table.

The questionnaire results indicate the current conditions in Jakarta as follows:

❖ People's perception on the causes of flooding

Most of the respondents thought that natural and technical factors are the primary causes of flooding in Jakarta, while urbanization and population density are not really contributed to the problem. In addition, from the chi-square test: there is a relationship between locations and flooding problem existence. However, there is no relationship between location and flood damage.

❖ Community awareness, willingness and participation

- The majority of the respondents did not know about flood mitigation program or flood regulations for Jakarta.
- Most of the respondents did not receive any flood warning.
- Almost half of the respondents have not taken any action to make their home or neighborhood flood-resistant, but they expressed great concern on reducing flood risk in their area.
- Most of the communities do not have any flood mitigation program and the majority of the respondents have not participated, however they expressed interest to join the program.
- From the chi-square test: there is a relationship between locations and flood mitigation program existence as well as between locations and flood regulation knowledge. However, it can be considered that there is no relationship between locations and public participation.

❖ Public views on government efforts to solve flood problem

- There is lack of trust in the government where only 15% of the respondents believed that the government has appropriately allocated funds to solve flood problem in Jakarta.
- The majority of the respondents felt that the government has not been responsive enough to solve flood problem and there has been minimum assistance during flood events.

The complete results of the questionnaire are given in Appendix H.

CHAPTER V

RESEARCH ANALYSIS AND FINDINGS

5.1 Introduction

The study showed many serious and unsolved problems, which are caused by inadequate technical systems and institutional arrangements. The consequences of these problems lead to a great deal of suffering. The first part of the analysis uses a causal-loop diagram to illustrate the big picture. The diagram shows subsystems to illustrate the technical, institutional, socio-economic, and financial aspects of the problem. Then the DPSIR framework will be used to describe the driving forces, pressures, states, impacts and responses for each aspect. The sequence up to this chapter is shown in Figure 5.1.

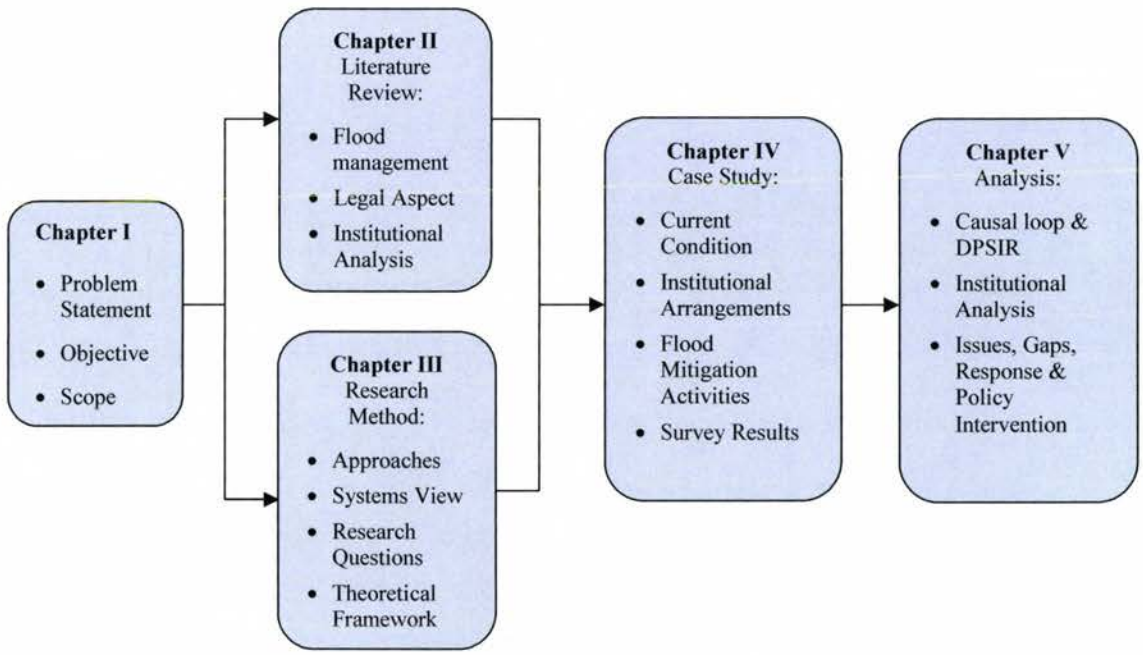

Figure 5.1 Research Sequence Diagram

5.2 Systems Approach: The Causal-loop Diagram

The flood management system should be regarded as an integrated part of the urban system, which is very dynamic. Understanding of the complex social, economic, technical, and cultural phenomena requires integration of the "hard" technical information with the "soft" information from the socio-economic approach and human behavior information.

Figure 3.4 introduced 'the big picture' of flood-related problem in Jakarta. It shows how systems work and interact with each other as well as relationships between components. The diagram is also helpful in showing how a change in one factor may impact elsewhere or may feedback to affect itself. In flood management systems these interactions are complex by nature, because many factors and actors are involved as well as many policy field are covered.

Figure 5.2 is a modification of the causal-loop diagram to show the subsystems that are derived from the management model (technical, institutional, socio-economic, and financial aspects).

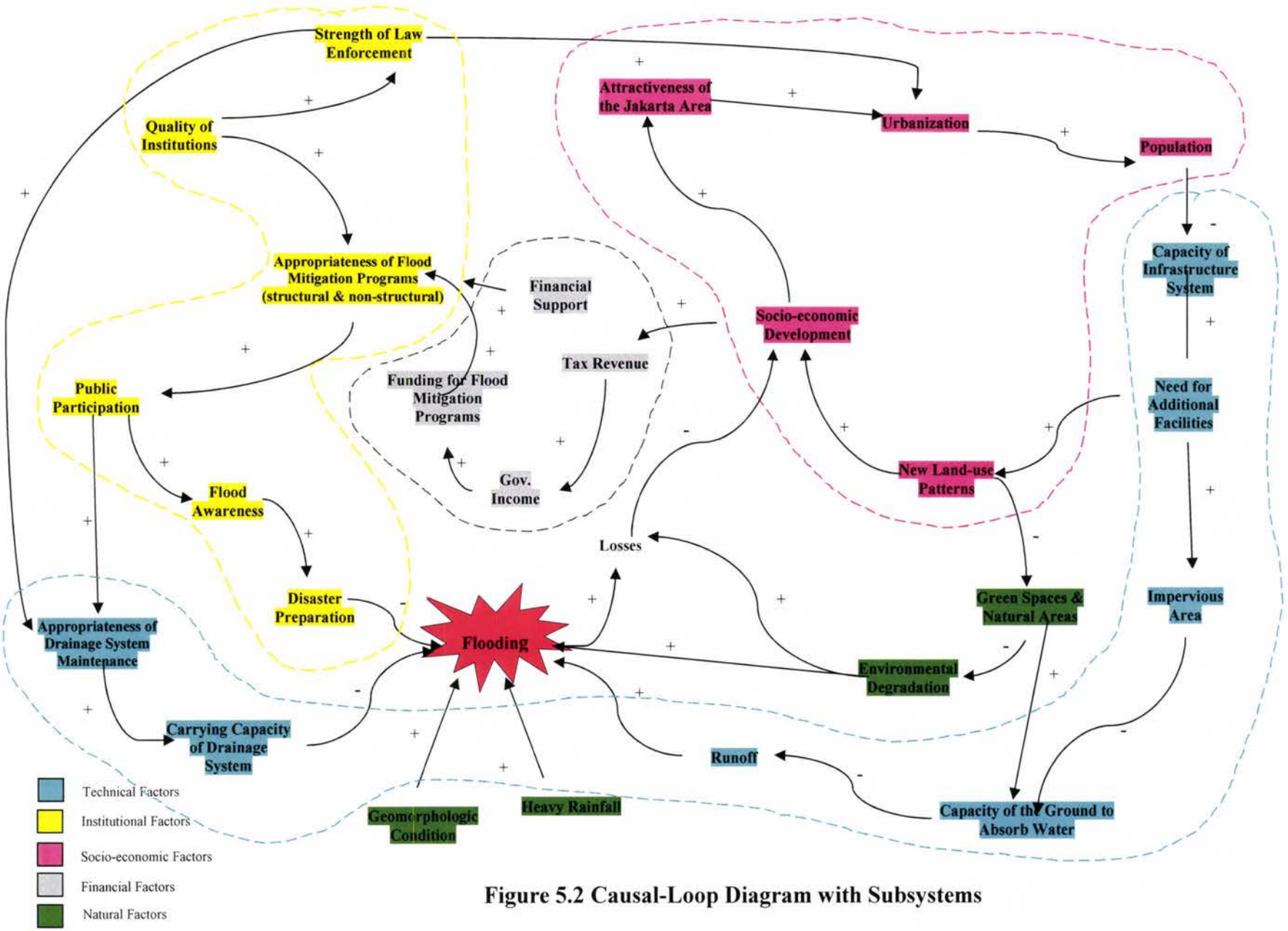

Figure 5.2 Causal-Loop Diagram with Subsystems

To concentrate on each aspect, Figures 5.3 through Figure 5.6 show subsystems that are derived from the causal-loop diagram and survey results.

5.2.1 Technical Subsystem:

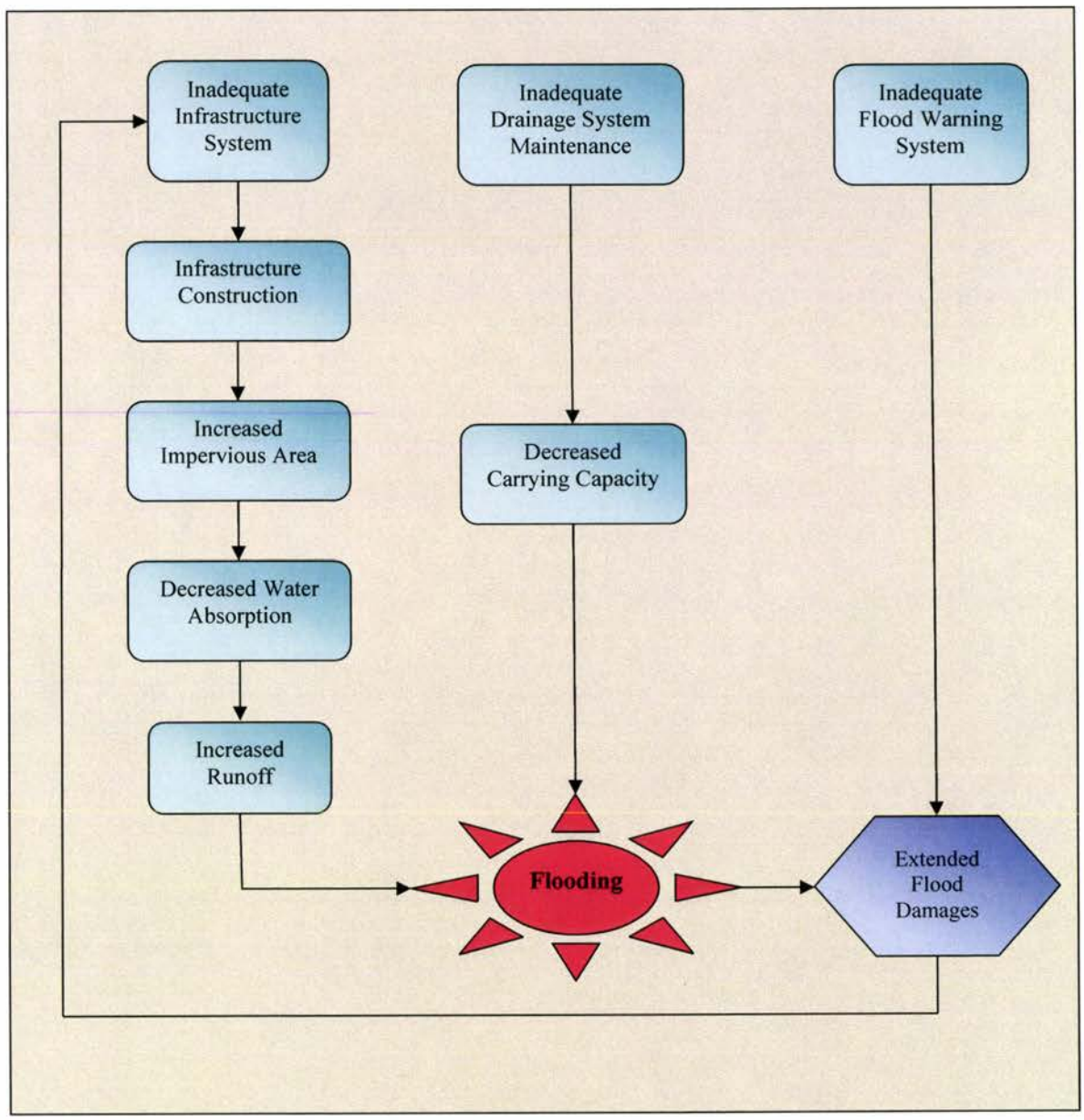

Figure 5.3 Technical Subsystem Diagram

The technical system explains how vulnerability to flood hazard is mostly the consequence of human actions and choices, resulting from cycles of development, flood damage, and protection. The cycle starts with investment and development in flood-prone areas, suffering from damages when flooding occurs, and triggering flood protection measures. In turn this is followed by more investment, resulting in more flood damage and triggering more protection, and the cycle goes on.

The three parts of the technical system, infrastructure, maintenance, and flood warning, show how the management issues of capital investment and operations and maintenance converge to cause increased runoff, decreased carrying capacity, and more flood damages.

From the survey results, there is an indication that flood mitigation in Jakarta still relies heavily on structural measures. Disaster management has been focusing on physical issues, such as the East Flood Canal, provision of water pumps, and normalization of the rivers. Early warning system, information dissemination, institution capacity building, and contingency planning have been somewhat overlooked. Flood management has been based on an emergency management system.

Urbanization in Jakarta has resulted in rapid population growth in the city. The city's need for additional space resulted in rampant housing and commercial development, reducing the water retention capacity of the area. A number of areas allocated for green spaces have been transformed into shopping, commercial and residential buildings. When such construction is done in greenbelts, their concrete floors stop the absorption of rainwater, which then overflows the drains and inundates roads and properties.

Only 13% of Jakarta remains a water absorption area and the decreasing infiltration capacity and water storage capacity of the soil increases the storm water runoff rate and the total runoff volume, shortens the runoff travel time, and reduces groundwater recharge and base flow. Therefore, rainfall which previously would not cause any problems may now become the cause of flooding.

To keep up with the needs, the local government should increase its capacity to construct and manage its urban infrastructure and services but its ability to do so has been limited.

Flood management plans mainly focus on improvement of infrastructure to address inadequacies for flood prevention. The East Flood Canal is an example of a physical attempt to prevent flooding. Along with this project, there are several ongoing projects such as eviction of illegal residents along the riverbanks, provision of pumps and infrastructure repairs. However, these efforts are still insufficient to overcome the problem. Moreover, overstatement about the capacity of the canal to mitigate flooding will only give rise to false hope. The people have already been let down by the tardy construction of the canal.

The operation and maintenance of the drainage system affect disasters. Also, structures may be outdated and were never sufficient to meet current requirements of discharge capacity.

As the city expanded rapidly the existing drainage system was neglected. Uncontrolled urbanization, poor spatial planning, lack of maintenance and inaction to implement improvements to the drainage system have led to the situation where drains and rivers do not have sufficient capacity to cope with the increasing peak flows.

The condition is getting worse due to poor maintenance. The drainage system has not been functioning properly mostly because it has been covered by trash. Most drains and rivers are clogged by garbage, which is dumped by many people.

In Jakarta, all 13 rivers and several dams are crowded with thousands of illegal settlements, mostly housing lower-income citizens, although some are also commercial buildings. Many of the canals and rivers are filthy, stinking, and open sewers clogged with rubbish.

As mentioned earlier, early warning is an important part of disaster mitigation. Efficient and accurate early warning can protect residents and safeguard them against disaster threats. It gives communities an opportunity to act in order to save lives and their property/assets.

In Jakarta, the early warning system is coordinated with the Department of Public Works, the information center of the meteorology and Geophysics Agency, information from meteorology scientists, water height monitoring officers in seven monitoring location and public participation.

Despite the local government claim that there is an adequate early warning system, the questionnaire result shows that most people in Jakarta did not receive any warning prior to flooding. The weakness of the current early flood warning system is at the level of the flood affected communities, especially at the village level. The responsible agency staff usually receives the information on time, but the communities are frequently alerted at the last moment. Moreover, warnings are not always trusted by the people because the information has not always been accurate.

5.2.2 Institutional Subsystem

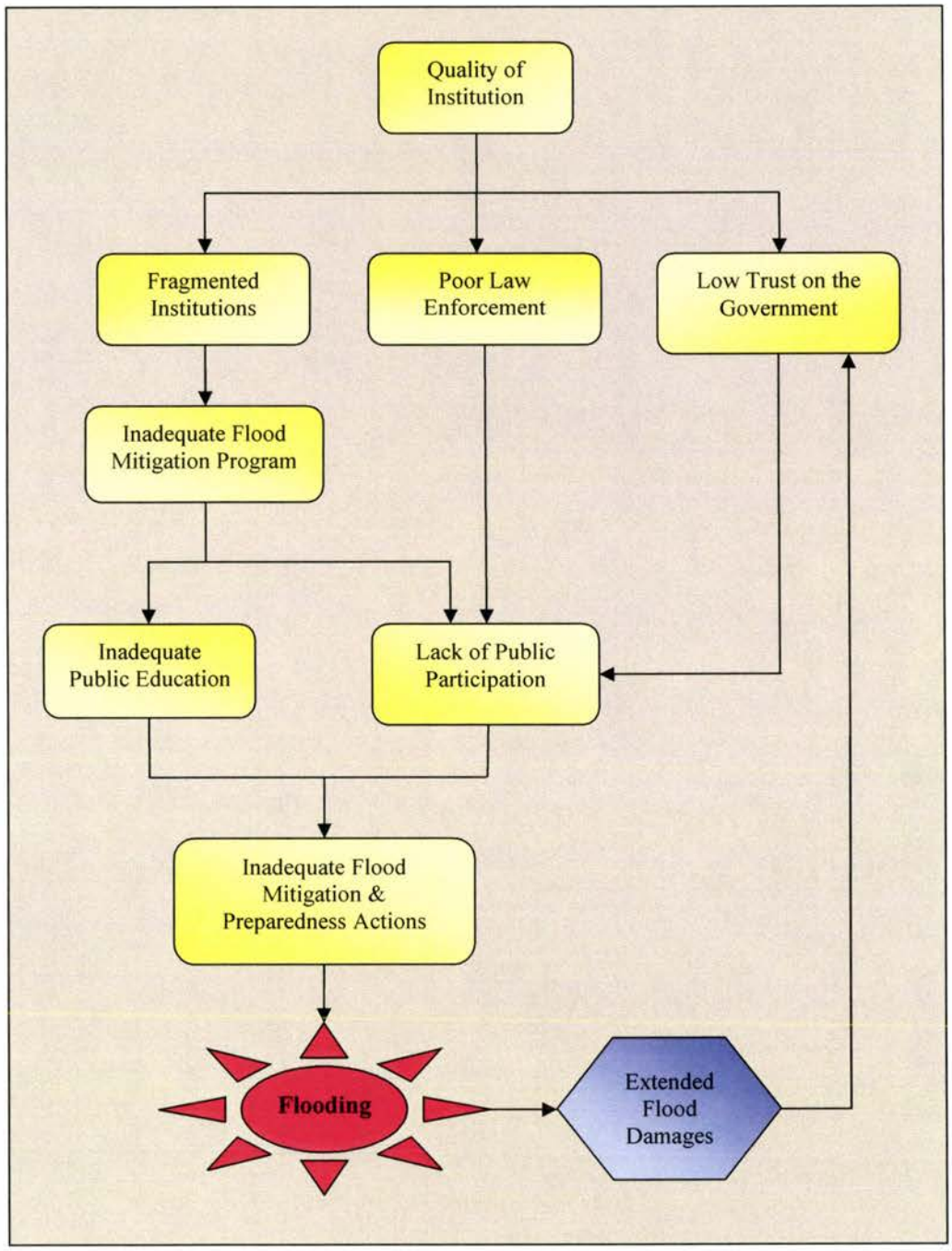

Figure 5.4 Institutional Subsystem Diagram

The institutional subsystem features the quality of the institutions, law enforcement, and trust in government.

The focus of the institutional subsystem is on good governance, which is a major requirement for a successful flood mitigation program. Weak governance, usually characterized by unclear policies, ambiguous roles and responsibilities among agencies, creates overlapping responsibilities and gaps in task distribution. The enforcement of rules and regulations relies to a great extent on the effectiveness of the government and its policies.

Quality

Establishment of effective institutional arrangements is fundamental to integrated and coordinated disaster management. Fragmentation and sharing of responsibilities in an organization are inevitable. The allocation of clearly defined roles and responsibilities is essential to the elimination of confusion and to ensuring good decision-making.

To cope with flooding problem, a number of plans for flood control and drainage management were prepared in the past. However, most of those planned projects have not been implemented to date. The local government has prepared a master plan to overcome the annual flood, which includes collaboration with neighboring administrations. The government had planned to build a canal, which was scheduled to be completed in 2007. However the completion of the project has been delayed mostly due to land acquisition and resettlement of the residents.

Spatial plans have been established for broad areas, including flood control. There are mechanisms to restrict land use and control development in flood retention basins and wetland, but the enforcement is usually weak. Violations are committed by both poor squatters and the developers of luxury homes, hotels, and commercial areas along the city's riverbanks.

Law enforcement

Regulations are also ignored at will by industrial companies who run factories without concern for the surrounding environment. The "laissez-faire" attitude to the environment has delivered disaster after disaster. The disaster highlights the lack of action and commitment of both the community and the government.

Trust

Trust in government agencies is an essential ingredient of successful integrated approaches to flood management with active community participation and support. While flood management should be a responsibility of both the government and the community, there has been wrong perception that the government is fully charge to protect Jakarta from flooding. It is time to realize that Jakarta residents are not only the victims, but also part of the problem that can help to mitigate the problem. However, there are still limited supports from communities to the local government efforts and there is still limited awareness in the community where they are still throwing trash into the river and developing house at river banks.

Facts show that information on flooding mitigation and preparedness are yet to reach targeted communities. Most information on evacuation post and equipment, evacuation facilities and routes, as well as the early warning system are still inaccessible to the public. The survey result also shows that the majority of the respondents think that the government has not been responsive enough to solve flooding problems in Jakarta. In addition, there is lack of trust in the government where only a small percentage of the respondents believe that the government has appropriately allocated funds to solve the problem. Low trust in the government and low understanding of flood risk as well as

flood regulations has turned into inadequate community participation. Fortunately, the survey result also shows that the majority of the respondents are concerned about the flooding problem in Jakarta and they are willing to make their home more resistant to flood hazard and to participate in flood mitigation program in the future.

5.2.3 Socio-economic Subsystem:

The socio-economic subsystem deals with growth and development. Floodplain occupation has occurred as a result of countless individual decisions rooted in the belief that the benefits of developing the location outweighed the risks. From the socio-economic standpoint, floodplain development is not necessarily uneconomic. A net economic benefit can occur if the additional benefits derived from developing the floodplain outweigh the average annual flood losses. However, once floodplains become urbanized, there would be a demand from the local community for flood protection that often leads to even greater future losses.

The attractiveness of a major city which has caused increasing urbanization is inevitable. Besides the push factors of the rural areas, there are also the pull factors such as the higher pay of urban jobs as compared to the rural income possibilities. However, many of urban population cannot find adequate and stable livelihood. Urbanization has resulted in rapid population growth and most housing in the city is done outside official plans and usually in illegal settlements occupied by the urban poor. Furthermore, with few jobs available in established businesses or government services, people have to find or create their own source of income that suits their qualifications.

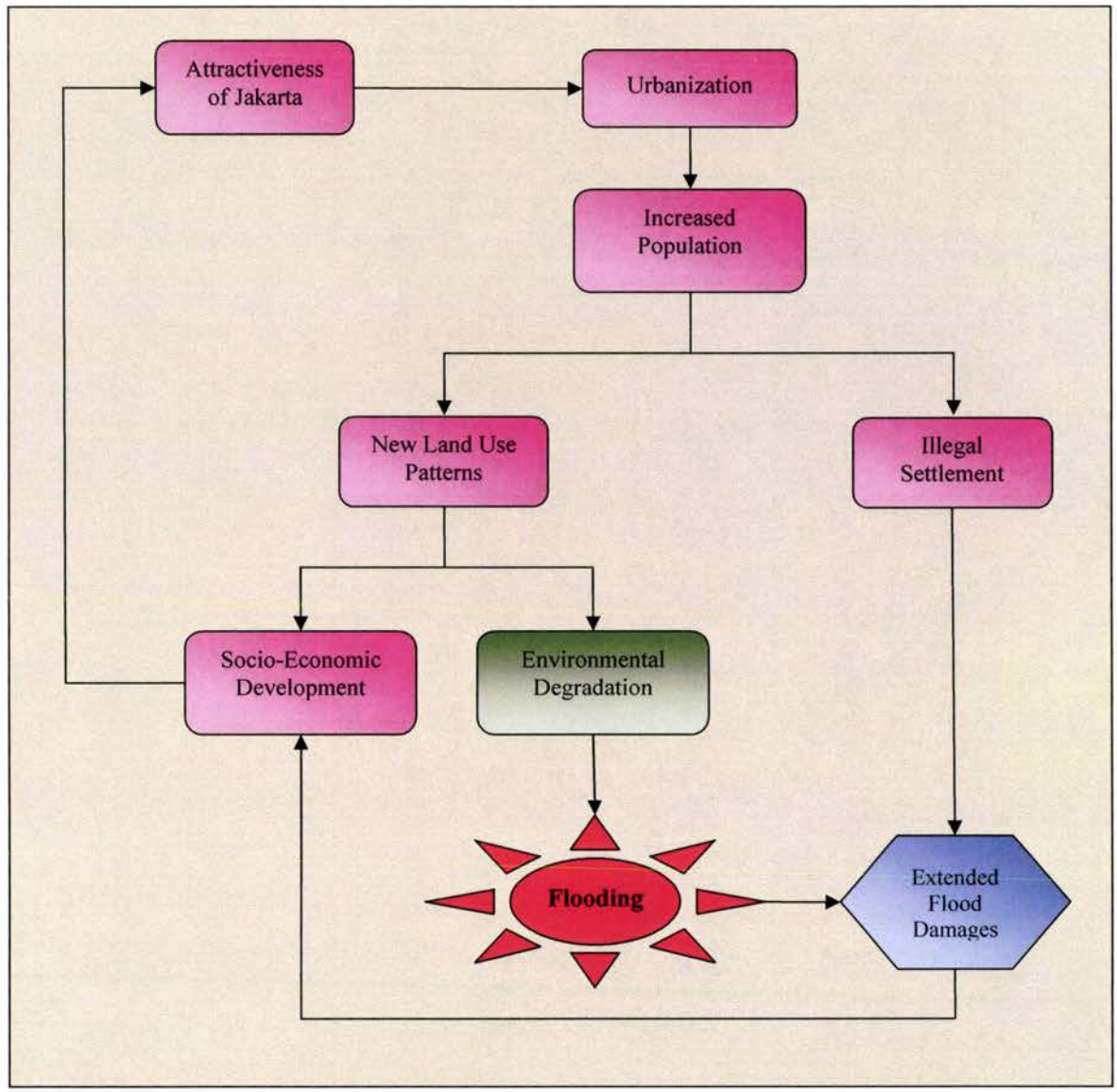

Figure 5.5 Socio-Economic Subsystem Diagram

Jakarta is an urban area with complex socio-economical problems contributing to a flood event. Urbanization has altered the pattern of land use and caused serious problems. Jakarta's buffer regions and the altered function of water catchments are significant factors in the occurrence of these floods. Deforestation on the hillsides south of Jakarta and the massive real-estate development surrounding Jakarta have replaces thousands of hectares of irrigated rice paddies, small lakes, and other natural habitats. Some of these

estates are even built on water catchment area which paid no attention the environmental impacts. Meanwhile, in the city, greenbelt areas have long been gone, swallowed up by office blocks.

Flooding in Jakarta has disrupted the social system and caused material and non-material losses. A proportion of the communities suffered loss of their incomes as a result of the flooding. At the same time the prices of basic necessities increased. Flooding will inevitably cause damage to various facilities, assets, and people's livelihoods. This will clearly affect the sustainability of life.

The need to address both the negative and positive characteristics of floods has been recognized, such as the Integrated Flood Management concept, a process promoting an integrated approach to flood management aimed at maximizing the net benefits of floodplains and minimizing the loss of life from flooding.

Although urbanization and development in the city are major contributors to flooding in Jakarta, the survey results show that the majority of the respondents still believe that natural factor and technical factors are the main causes of the problems.

5.2.4 Financial Subsystem

The financial subsystem copes with flood mitigation program funding and how urban development and economic growth is needed to support flood mitigation funding.

As previously described, floodplains have been a favored place for human settlement and socio-economic development because of their amenities. However, at the same time flood hazards generate severe impacts on the economy and people safety. This is partly a reflection of rapid population growth and development, increased investment in

infrastructure and inadequate understanding of flood risks. However, reducing flood risks by totally restricting the occupation of floodplain limits the potential of these areas for socio-economic development, which in turn will also contribute to funding flood mitigation activities in the area.

The main source of funding for flood mitigation activities in Jakarta still relies on the national and local budget, as well as external funding such as loans and grants from international organizations.

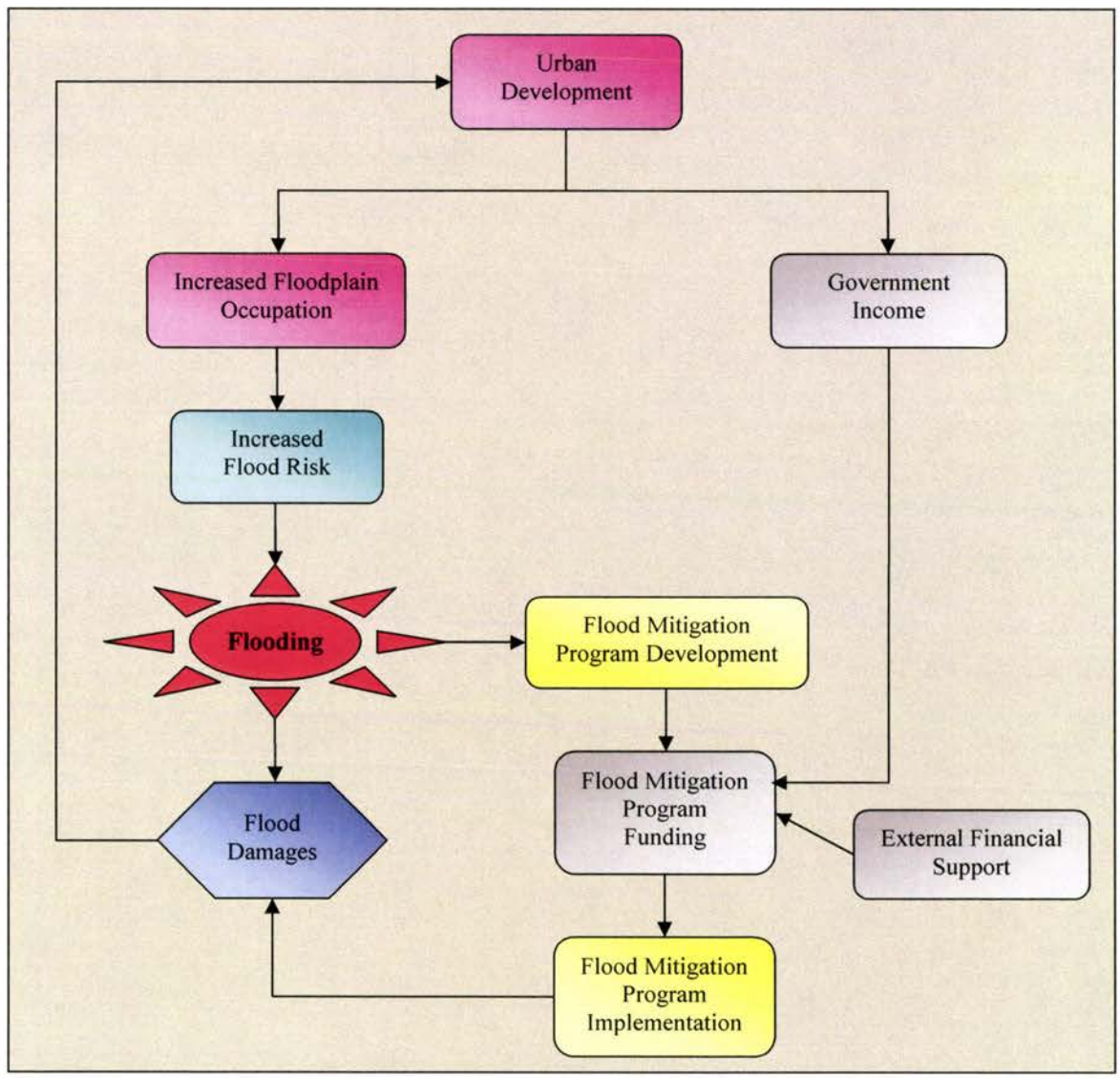

Figure 5.6 Financial Subsystem Diagram

5.2.5 Summary of Challenges and Emerging Problems

Table 5.1 shows the summary of the major problems as well as causes and impacts of flooding in Jakarta for each aspect previously discussed.

Table 5.1 Summary of the Major Problem, Causes and Impacts of Flooding in Jakarta

Element	Major Problems	Causes	Impacts
Technical	• Inadequate infrastructure system • Inadequate drainage system • Inadequate flood warning system	• Urbanization • Population growth • Poor city planning • Lack of maintenance • Outdated infrastructure • Low understanding on the Early Warning System (EWS) • Weak link to the flood affected community • Poor Emergency Management	• Additional infrastructure construction • Decreased infiltration capacity • Increased runoff • Decreased water retention • Decreased carrying capacity • Low trust in the EWS • Warnings are not received by the communities in timely manner
Institutional	• Fragmented institution • Poor law enforcement • Low trust in the government	• Inadequate/weak governance • Lack of coordination among agencies • Low understanding of flood risk • Lack of transparency	• Unclear policies • Ambiguous & overlapping roles, responsibilities • Lack of disaster awareness • Lack of public participation • Lack of actions & commitment of both the community & the government

Element	Major Problems	Causes	Impacts
Socio-Economic	• Urbanization	• Attractiveness of Jakarta • Socio-economic motivation • Poverty	• Rapid population growth • Land use change • Illegal settlement • Socio-economic development • Environmental degradation
Financial	• Limited budget for flood mitigation activities	• Global economy • Developing country • Financial priority	• The local government inability to solve flooding problem in Jakarta

5.3 The DPSIR Framework and Inferences

The next step is to place the information derived from the causal loop diagram and the subsystem analysis into the DPSIR framework, which is a causal framework for describing the interactions between society and the environment. As previously described in Chapters II and III, the DPSIR framework is a causal framework for describing the interactions between society and the environment. The components of this model are: Driving Forces (D), Pressures (P), States (S), Impacts (I), and Responses (R).

The DPSIR framework works as follows: first, data and information on all the different elements in the DPSIR chain is collected, then the possible connections between these different aspects are suggested. Through the use of the DPSIR framework, it is possible to determine the effectiveness of responses put into place. This framework has the ability to illustrate the cause-effect relationship between interacting components of complex technical, social, economic, institutional and environmental systems that makes it an

effective tool to analyze flood risk. It describes the causes and relationships leading to flood generation, and at the same time provide the possible response to deal with the risk.

Feedback loops operate at different level within the DPSIR framework. For instance, flood mitigation measures might be considered among responses which would feed back to alter the states and reduce the impacts. Meanwhile, change in flood management policy might include decision which would alter the driving forces and pressures.

From the information gathered and organized in previous sections, possible connections between different aspects can be proposed. Through the use of the DPSIR Framework, it is possible to develop effective responses to the problem.

Driving Forces

A driving force or a driver is any natural or human-induced factor that directly or indirectly causes a change in the system. Sometimes, some drivers might be influenced by other drivers.

As mentioned, there are a large number of drivers that have direct or indirect impacts on flooding in Jakarta. Heavy rainfall and geomorphologic condition are two of the major natural and uncontrollable driving forces that affect flooding. Other factors include but not limited to global and local economy, urbanization, community behavior, inadequacy of infrastructure, quality of institution, and law enforcement.

Pressures

The driving forces cause pressures on the system. Human activities such as floodplain occupation, illegal settlement and land-use change as the result of urbanization and urban development contribute greatly to the problem.

Urbanization which leads to rapid population growth has put pressures on the local government to provide more adequate services and facilities. This frequently must be accomplished under conditions of economic hardship and uncertainty, with resources diminishing relative to needs and rising expectations. Moreover, with limited fund available, the government has to make budgetary or financial priority for the city as well as to fulfill its financial obligation since the government often receives financial assistance from international organizations.

Another aspect of urbanization is the need for land. People cut down trees for settlement or business, leading to deforestation. Deforestation for massive construction also increases the flood risk. Coupled with lack of drainage system maintenance which leads to clogged sewage pipes and waterways, the risk of flooding is increasing.

To understand the urban life in Jakarta, it is crucial to recognize the socio-economic dualism which lives in the society. The expression of this dualism is the existence of the modern city and the villages or slums in the urban area. Urbanization causes demographic change that often leads to socio-economic disparities. Coupled with lack of public awareness and coordination, it has been a challenge to manage various stakeholders with different background to work together and deal with the ongoing flooding problems.

State

Natural factor such as global climate change might cause imbalance and irregular precipitation in the region. The pressures on the system by natural and human activities have lead to environmental degradation, increased runoff and consequently flood generation. As the result, Jakarta's vulnerability to flooding is significantly increasing and this condition put people and property all across Jakarta at risk. The ability of people

to cope with flooding problem is also associated with their capacities which are influenced by their socio-economic characteristics. The local government inability to cope with the effect of the rapid population growth and urban development, especially in floodplains, exacerbate the problem.

Impacts

The impacts of flooding may include disruption of activities, damages to properties, people suffering, and loss of lives. Flooding could also decrease public confidence and trust in the government. It is understandable that the government of rapidly growing city has not been able to allocate significant resources to disaster risk reduction because they are already pressured by the task of providing basic services for its expanding population. However, transparency in the allocation of funds is necessary to ensure they are used appropriately.

In addition, the impact of flooding could have long-term consequences on the environment and socio-economic condition. Another impact of flooding is the increased need of additional flood protection which in turn could give false sense of security and attract more people to come and flooding problem will remain.

Responses

Responses to flooding could be improving institutional arrangement and regulatory intervention, economic incentives, and promoting stakeholder participation which could increase the capacity building of the government and community resilience. The main purpose is to reduce the loss of lives and other negative impacts of flooding on the environment and society.

The DPSIR Framework for the case study is shown in Figure 5.7 below.

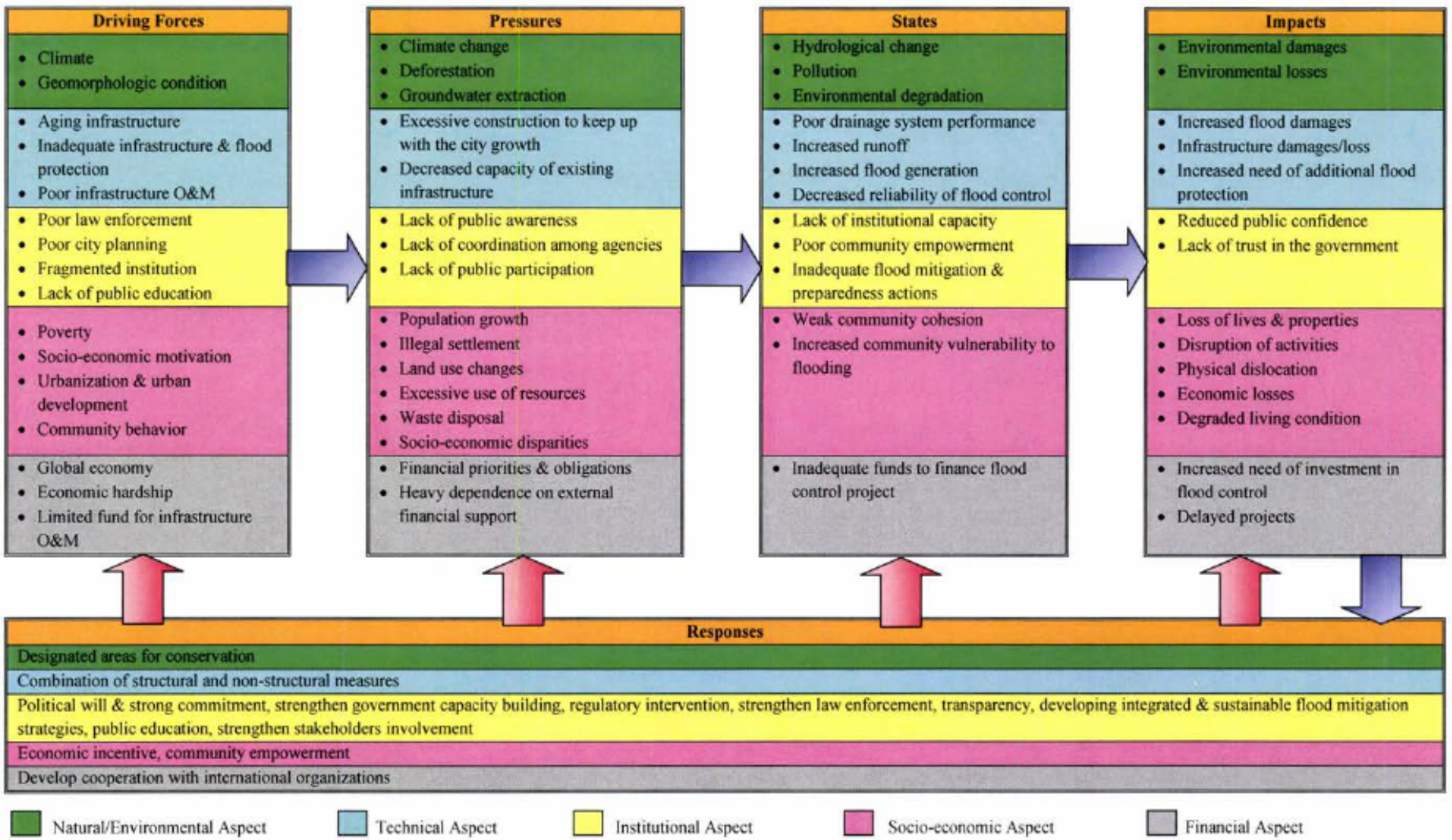

Figure 5.7 The DPSIR Framework for Flooding Problem in Jakarta

5.4 Analyzing the Emerging Institutional and Administrative Context

The institutional analysis provides a mechanism to draw from the case study conclusions to test the hypotheses that were introduced in Chapter I. Briefly, these were: need for an integrated approach, urban planning and implementation, institutional arrangement for flood management, regulations and law enforcement, poverty, public participation, emergency management and financial support.

Need for an integrated approach

Flood mitigation measures have always been considered the sole responsibility of the government and flood-prone community are viewed as victims that need help. Most of the communities like the authorities to take physical measures to give them a sense of security. High preference for structural measures needs to be changed by implementing more educational programs to inform the public of the benefits of non-structural measures as well as actions that could be taken by the community or individuals to mitigate the effect of flooding. It is important to understand that both structural and non-structural response measures are required. These must involve all relevant sectors and communities and will require new paradigm for identification of flood management measures. It must be a mutual effort at the national and community levels and enhance capacity of the local government and empower the community.

Comprehensive urban planning

Urban areas provide valuable services, opportunities for employment, social interactions and other activities for their residents, although owing to their dense populations and infrastructure, are also typically high resources users and waste producers. Planning,

management and policy making for sustainable cities require a clear understanding of urban systems, their subsystems and interactions.

As people continue to live in urban areas, it is important that there be sufficient services to meet their demands. However, the ability of local government and ecosystems to provide services needed tends to decline. The increase size of the city without adequate infrastructure has put pressures on the basic services necessary for healthy life.

To live, work and invest in a safe and attractive living environment requires efforts to facilitate and cope with changes to the urban systems and its environment such as rapid urbanization, urban development and climate change. These changes increase both flood probability and potential flood impact. As urbanization creates problems that contribute to flood events and expose inadequate drainage systems, the comprehensive urban plan and the drainage sector plan must be improved. Efficient urban management and sustainable development also requires a critical evaluation of different policies and their impacts.

In case of Jakarta, urban development process has not only increased the economic growth, but also the city's vulnerability to flooding, among other problems. Flood mitigation measures that have been taken could give false sense of security and could also attract more people to come. Therefore there is an urgent need to control development and urbanization as well as to mitigate the effect of flooding without increasing the attractiveness of the city. Developing public policies and regulations are crucial, and the effective implementation of these policies needs stronger law enforcement.

Improved institutional arrangement for flood management

The nature of the Integrated Flood Management approach requires extensive coordination between various stakeholder groups. This requires an enabling institutional framework which facilitates effective coordination, cooperation and collaboration across jurisdictional boundaries, departments, institutions, disciplines, users and uses. An institutional framework defines the recognized roles of all IFM stakeholders and offers a coordinating mechanism for organizations and institutions. Such a framework should facilitate the development of a multi-disciplinary perspective to flood management, define accountability and show flexibility by accommodating learning by experimenting.

Stakeholder involvement programs should include clear objectives and show an understanding of the benefits and pitfalls, as it perceived differently by different people. An analysis of the stakeholders, their respective roles and the mechanism of their engagement should aim to ensure the sustainability of the process.

The variety of stakeholders, their respective interests, needs and gaps with regard to skills, knowledge and ability to adequately take part in participatory planning processes should be carefully analyzed. The facilitating organization should first develop skill sets in identifying stakeholders and their interest and develop engagement methodologies and negotiating strategies to build confidence in the process.

Clear and consistent regulations and law enforcement

In order to understand the institutional context we need to review the legislative processes involved in flood management in Jakarta, identifying relevant institutions and organizations i.e. institution responsible for developing national policy; local authority to carry out measures for the prevention or mitigation of flooding; drainage; and land use.

The law relating to IFM must clearly establish a framework that defines the rights and obligations of institutions and individuals at both the planning and operational phases of all stages of a flood event – before, during, and after. Without an appropriate legal regime, accountability and transparency cannot be put in place, and the rights, powers and obligations of all actors involved, along with relevant standards performance, cannot be clearly and unambiguously set out. A successful legal framework is also one that is adaptive and responds to changing conditions by providing a clear sense of direction.

The Indonesia Government has taken important steps to institutionalize disaster preparedness and risk reduction. A major step is the enactment of the Disaster Management Law which in 2007. As discussed in Chapter IV, the law has carried out the new perspective on disaster management. The previous perspective emphasized only on emergency response/relief on disaster. The new one inserted disaster management not only on emergency response, but also pre-disaster and post-disaster. The law also covers natural as well as non-natural or human factors that result in human casualties, environmental damage, loss of property, and psychological impact. However, the implementation of the law is not easy. Unless the law is enforced the flood mitigation program will not succeed.

Address questions of poverty and development

Socio-economic motivation is a major cause of urbanization which leads to rapid population growth in a city. Poverty increases the community vulnerability to flooding, as they tend to live in flood-prone areas. These communities usually do not have appropriate job due to low education level and job competitiveness in the city. This situation has a negative impact on the economic development in the city. In addition, poor city planning,

weak law enforcement and lack of public participation to maintain their environment also increase vulnerability to flooding. However, people-at-risk seem to adjust with regular floods as they feel that living in urban area is better than living in rural area, or simply because they do not have any choice. Resilience may be enhanced by promoting access to knowledge and resources.

Encourage public participation

Integrated Flood Management (IFM) is based on the principle of reducing vulnerability through building resilience and developing a culture of prevention through preparedness rather than reactive responses alone. Since stakeholder participation is integral to the IFM concept, it is imperative that all stakeholders are involved in the decision-making processes that affect flood management. Multi-stakeholders engagement is key to the success of IFM as it ensures strong stakeholder support and is a catalyst for proactive engagement in flood issues.

Promoting participation and constructive engagement between stakeholders involved in flood management, especially in a big city like Jakarta, is difficult. Social discourse and the need of integration of diverse stakeholders' interests into collective decisions are important. The institutional context can affect the level of participation thereby affecting trust and the ability to develop networks of constructive engagement.

An important element of the institutional analysis is the identification of actors and organizations involved. It is crucial to identify all the relevant stakeholders involved in flood management in Jakarta as well as their roles and responsibilities within flood risk management in order to be able to develop a truly integrated approach.

However, too many stakeholders can render the process unwieldy and unproductive. For effective integrated flood management and river basin development, it is important to carefully identify all relevant stakeholders. Stakeholders involved in IFM can be divided into seven groups: (WMO/GWP, 2006)

- Government ministries, department and agencies;
- Flood-prone communities;
- Other basin communities;
- Scientific institutions;
- Registered NGOs;
- Voluntary organizations;
- The private sector.

Participatory planning at the neighborhood and zone levels will facilitate cooperation and requires technical information that is understandable to all. To achieve effective, meaningful participation, it is important to implement a well-defined, transparent, strategic approach. The political, economic, cultural, institutional and legal situations within a given region determine the mechanism chosen to achieve the desired participation level. Different groups of stakeholders have different needs and requirements depending on their areas of interest and respective roles and responsibilities, and therefore must be engaged through different methods.

Community, as individual and as a whole, can play an important role in flood management such as (but not limited to):

- To control urbanization and population growth;
- Not to live in river banks;

- Not to dump trash to rivers and drainage systems;
- Not to build bridge or other structures that could obstruct river flow;
- To stop deforestation;
- To participate in education of flood disaster prevention/mitigation;
- To involve in flood mitigation drill;
- To participate in a flood-proofing houses program;

Outline a context of Emergency Management

In general, floods and flood hazard management are culturally constructed phenomena, where people's understanding of them derived from their environmental and cultural conditions. Therefore, in order to develop appropriate flood management strategies, it is important to really understand the local conditions that may vary amongst communities, groups or individuals. Existing, traditional community structures should be use to find solutions to flood mitigation. The establishment of a local volunteer-based system is also needed to ensure an immediate coordinated response in case of emergency.

Institutions engaged in disaster management are important stakeholders, as their interaction with flood-prone communities, NGOs and voluntary organizations is crucial during flood-emergency operations. Institutions are needed to maintain communication regarding the flood management strategy and help people prepare.

Emergency response is widely regarded as the initial responsibility of the local authority. When the local capacity to deal with the emergency at hands is exceeded, it will be necessary to request assistance from the national government. The primary role of the national government is the function of "preparedness and recovery". Financial support

from the national government is usually required to assist to local government in the recovery process following and emergency.

Increase financial support and supportive mechanism

Limited financial capability of the local government has been a major constraint for effectively implementing flood mitigation programs. Therefore, adequate financial support is required for urgent infrastructure needs and public participation programs.

Promoting incentives is one of various activities mandated through the National Action Plan for Disaster Reduction 2006-2009. However, the government of Indonesia has not established a formal incentive structure for flood mitigation activities. The recent presidential decree regarding maintaining green zones around Jakarta and its neighboring areas could allow the local government to discuss possible incentives for the areas to better manage their environment as current legal enforcement is too weak to motivate actions. The incentives could also encourage the solution to flood problem move away from traditional engineering solutions and work with natural processes, such as wetland conservation which can absorb some excess flood water. To enhance community participation, the government could also rewards communities for what they are doing to prevent flood damage or to undertake new flood protection activities.

The hypotheses suggest that flood mitigation measures can be successful with appropriate legal and institutional framework and suitable economic incentives and disincentives. Since proper law enforcement requires political will, good governance is an essential ingredient.

The purpose of the Integrated Flood Management is to create resilient communities through a best mix of short-term and long-term strategies consisting structural and non-structural flood management measures implemented through the active involvement of all stakeholders. To implement the concept effectively, a coordination of various institutions and agencies is definitely required. Therefore, IFM can only be built upon a strong but flexible legal framework and supporting institutional arrangements.

Figure 5.8 illustrates how flood disaster problem in Jakarta is caused not only by the natural factors, but also by its overloaded systems which is greatly influenced by poverty.

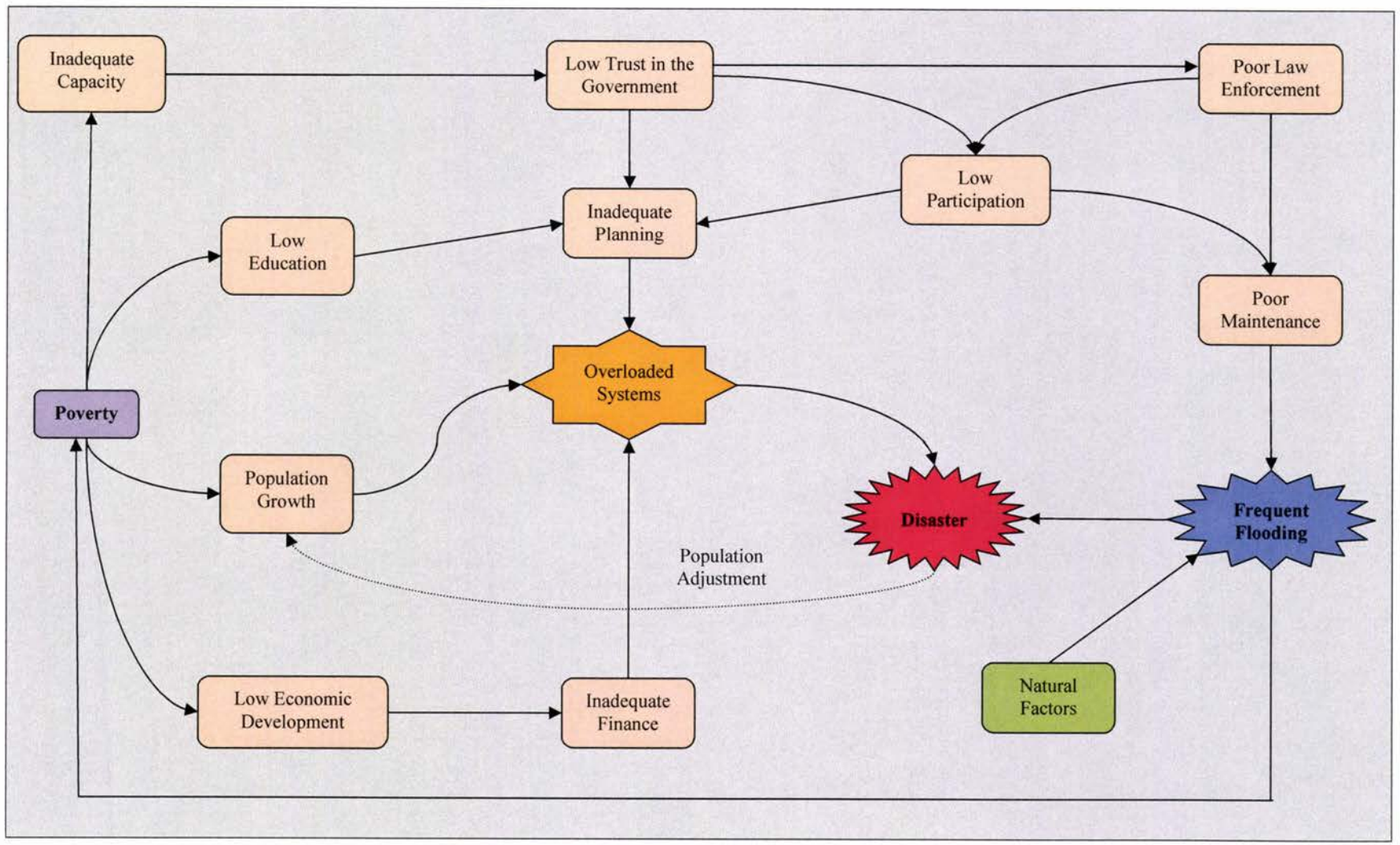

Figure 5.8 Poverty and Flooding Problems in Jakarta

5.5 Major Issues, Gaps and Response

The major issues as well as the gaps and responses are discussed below as they fall into the technical, institutional, socio-economic, and financial categories.

5.5.1 Technical Aspects

The major technical gaps are that population and land use have outstripped the overloaded flood control infrastructure elements and the system relies too heavily on structural measures. Operation and maintenance of the system are inadequate, and the main non-structural measure of a flood warning system does not work well.

The government preoccupation with infrastructural development to keep up with rapid population growth has resulted in higher risk of flooding in the city. Rehabilitation and improvement of the infrastructures are important, and flood risk management should be integrated into infrastructure development planning and implementation. The government should also control urbanization and urban development as the pressures from population growth are overwhelming.

The effectiveness of current drainage and flood control was questioned, considering the ever-increasing flood damage, despite many engineering measures having been implemented. Previous large investments in drainage and flood control infrastructures and various structural measures have not solved the flood problems in Jakarta.

Historically, flood risk management in Jakarta aimed to reduce flood risk by reducing flood hazard. As a result, many of the river systems have been modified. Modifying the hazard will probably reduce the risk from flooding, but does not eliminate the risk.

Structural flood control measures can still be effective at mitigating flood damages to floodplain development. However, structural measures usually involve capital-intensive construction that could create social disruption and environmental degradation. Structural measures could also give false sense of security and encourage more people to live in floodplains. The establishment of structural measures usually requires huge areas of land. The area requiring flood control works may or may not be in the government's possession and has been a major factor delaying the project. The importance of non-structural and combination of structural and non-structural measures to mitigate flood hazards should be emphasized and introduced to the public and other stakeholders through educational programs and training.

Poor drainage as well as a small local infiltration area creates wider flooding. This condition is worse because of high volumes of solid waste thrown into the river system by the residents. It is important to educate the communities to maintain their environment. There is so much, individuals and communities can and should do to reduce flood risks and damages. On the other hand, the government should apply tougher law enforcement against those who increase the flood risks.

The flood early warning system in Jakarta is quite well developed. However, the dissemination of warning to wider community is still not effective due to limited communication facilities and limited capacity of human resources to disseminate the warning due to their limited knowledge. Therefore, it is important to develop early warning system that are timely and understandable to those at risk.

5.5.2 Institutional Aspects

The main institutional problems are fragmented authorities and programs, poor law enforcement, low public trust in the government, and low public understanding of the issue. Understandably, the level of public participation in shared programs is low.

The current local government administrative and regulatory framework remains inadequate to cope with flood-related problems. The institutions are highly fragmented; roles, responsibilities and coordination mechanisms are poorly defined; and human and technical resources are limited. These pose significant constraints on the effective flood management in the city. Therefore a more effective coordination among stakeholders is needed.

It is important to create a system that is clear and flexible and at the same time robust for its effective implementation, compliance and enforcement. For various reasons, in practice it may not immediately possible to implement the reforms identified as required in order to promote Integrated Flood Management. Legislative reform may be hindered due to poor institutional arrangements, including law enforcement.

To effectively implement integrated approaches to flood management with active community participation, it is necessary to identify the needs of the communities and to work closely with them. The local government's ability to be prepared and mobilize resources when needed greatly increases its credibility. At the same time, the government commitment and accountability, transparency of action, application of equality principles and tolerance towards dissent are factors that determine, encourage and promote public

participation. The participatory process should not be perceived as a threat to the power and authority of existing institution taking decisions regarding flood management.

Public awareness and participation are key components of disaster preparedness. However, like in many other developing countries, community involvement and participation is still in its early stage. The government needs to improve its institutional arrangement and communication with communities, and allow the public to have access to adequate information. Building community cohesion and recognizing the special needs of individuals or social groups is also needed.

The level of community awareness and knowledge on flood disaster risk management in Jakarta is still low. Currently, the community and institutional capacity to develop and implement flood disaster risk reduction programs is inadequate due to limited knowledge and resources. Therefore public education and motivation are very important to reduce their vulnerability.

Community participation has come to be recognized as an important aspect of disaster management, as it is the local community which can provide immediate help when a flood disaster strikes suddenly. However, community participation level in Jakarta is still low. Existing institutions need to be modified to facilitate community involvement. A common platform for stakeholders needs to be developed. It is also important to develop rules dealing with flood management to see how they provide for the mobilization and involvement of the local community in the decision-making process at various levels.

5.5.3 Socio-Economic Aspects

The socio-economic gaps focus on a failure to implement effective urban planning and development to consider the flood hazard.

Safety is one of the basic goals for any society; this implies avoiding any loss of life, health risks and serious damage to property. However, existing risk can be blamed only partly on natural hazards, being mainly a result of economics and social development. To minimize the risk in the future, any flood protection should not restrict itself to protecting what already exists but must steer development in a direction that minimizes new risks. It means that flood protection must be embedded in the planning of economic development. Disconnecting hazard and risk mitigation issues from development could lead to creation of additional vulnerabilities.

The burden of the flooding is often laid on the shoulder of the local government. The government has been deemed incapable of dealing satisfactorily with urban development issues, such as spatial planning, upper watershed management, urban infrastructure operation and maintenance, solid waste management, housing, and water resources. The government should regulate urbanization and avoid policy interventions that increase the attractiveness of the city. The policy should also ensure the livelihood security and poverty alleviation to reduce community vulnerability to flooding.

5.5.4 Financial Aspects

The main financial gap is inadequate funding for flood programs.

The routine flood cost people in Jakarta billions of rupiah in lost and damaged property and produce additional burdens for the city due to the destruction and damaging of

infrastructure. Solution for flooding problem in Jakarta will require huge amount of funding. Hundreds of billions Rupiah of taxpayers' money is spent every year on flood mitigation efforts such as dredging rivers, constructing floodgates, expanding reservoirs; and also purchasing essential equipment such as pumps. However, flooding still occurs every year.

The local government has not been able to mitigate the annual disaster. It has a limited budget for flood control which covers the limited dredging of rivers and some improvements to the drainage system and infrastructure. Limited financial, material and human resources available to governmental agencies give an opportunity to greater collaboration between the government and non-governmental agencies in sharing and managing resources. The involvement of private sectors in disaster risk reduction for use of financial instruments should be enhanced, and the development of financial risk-sharing mechanism should be promoted.

Accountability cannot be disregarded in flood disaster management. Management of the fund and logistics that are provided and distributed must be held to public account. The distribution of logistical aid must be equitable and reach those in need. The size of the budget prepared by the government and how it allocated and used must be known to the public.

Table 5.2 shows the summary of the major issues, gaps, responses and responsible organizations for implementing flood mitigation strategies and Figure 5.9 shows the interdependent factors for integrated flood management in Jakarta.

Table 5.2 Summary of Major Issues, Gaps, Responses and Responsible Organizations

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
Technical	Solution to flooding has relied heavily on costly structural measures. There is a need to combine the structural and non-structural measures for effective flood risk reduction.	• Improve knowledge on flood disaster mitigation measures. • Use knowledge, innovation, and education to build a culture of safety and resilience. • Apply mix structural and non-structural measures. • Promote collective flood alleviation over individual flood mitigation.	• National Government • Local Government • Department of Public Works • Private Sectors • Scientific Organizations
	Inadequate infrastructure system due to rapid population growth and outdated infrastructures. There is a need to build additional structures to increase discharge capacity without damaging the environment and exacerbate flood problem.	• Rehabilitation of existing infrastructure. • Improvement of infrastructure. • Integrate flood risk management consideration into infrastructure development planning and implementation. • Develop policy for mandatory risk assessment for infrastructure development projects. • Control urbanization & population growth. • Develop and implement system for assessing and strengthening critical public infrastructures in order to make them adequately resilient to flood hazard.	• National Government • Local Government • Department of Public Works • The Ministry of Environment • Private Sectors • Scientific Organizations

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
Technical	Inadequate drainage system operation and maintenance is one of the major factors causing flood in the city. There is a need to improve the system as well as educate people to maintain their environment.	• Technical training • Develop maintenance schedule • Improve solid waste management • Enhance law enforcement • Establish awareness program • Control urbanization & population growth	• National Government • Local Government • Department of Public Works • The Ministry of Environment • Community at large
	Current Early Warning System has not yet reach community-at-risk in timely manner and there is lack understanding of the system due to inadequate information. Therefore there is a need to develop reliable EWS to reach targeted communities and interpret flood risk information for the city. The system should be developed by combining the knowledge on the technology needed as well as the vulnerability and capacity of the community and agencies. The system should also be regularly updated.	• Establish flood disaster management information system • Establish system for monitoring related flood hazards. • Prepare disaster map and vulnerability profile for the city. • Risk and vulnerability assessment at different levels and scales. • Improve communication among stakeholders. • Establish reliable EWS so that the information is disseminated widely, especially to the community-at-risk in timely manner. • Develop system for continuously monitor and update the EWS.	• National Government • Local Government • Department of Public Works • The Ministry of Communication and Information • The State Ministry of Research and Technology • The Meteorology and Geophysics Agency • The National Institute of Science • The Central Bureau of Statistics • National Disaster Management

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
			Agency • Scientific Organizations • NGOs
Institutional	The current authority for managing flood mitigation program is fragmented result in unclear roles and responsibilities. There is a need to improve coordination among parties involved.	• Enhance institutional system for flood disaster risk management. • Improve institutional arrangement.	• National Government • Local Government • National Disaster Management Agency
	Poor law enforcement exacerbate flood problem.	• Improve disaster risk management policies. • Publish and implement relevant policies, regulations, standards and guidelines for flood disaster mitigation. • Improve law enforcement with applying incentive and disincentive/penalty.	• National Government • Local Government • People's Representative Council • Ministry of Justice and Human Rights
	The incapability to overcome flood problem in Jakarta result in low trust in the government. To be effective, flood disaster management need good governance and strong leadership.	• Enhance political will from the government. • Improve enforcement of rules and regulations. • Improve accountability and transparency. • Improve communication with communities and relevant agencies/ organizations.	• National Government • Local Government
	The level of flood disaster awareness and knowledge on disaster risk	• Develop flood disaster risk management information in understandable language	• Local Government • The Ministry of

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
Institutional	management is low at all levels, result in inadequate preparedness and capacity to cope with flooding problem. Therefore a policy and mechanism to address this issue is needed.	and make it publicly available. • Record, analyze and disseminate statistical information on flood disaster occurrence, causes and impacts on regular bases. • Develop a system to periodically update the disaster information. • Develop/improve public education and implement it, e.g. recognizes schools as important center for propagating flood disaster awareness. • Develop programs on flood disaster mitigation and preparedness training for different target groups and implement training programs for all stakeholders. • Encourage and support all stakeholders for developing and implementing awareness-raising on flood disaster mitigation and preparedness • Develop an integrated emergency response during disaster occurrence. • Enhance capacity of communities during disaster occurrence.	Communication and Information • The Ministry of Education • National Disaster Management Agency • NGOs • Scientific Organizations • Private Sectors • Community

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
	Level of public participation is still low. There is a need to build institutional and community capacity.	• Develop system for stakeholders' analysis. • Develop legal and institutional framework and continuous efforts to build capacity of different stakeholders. • Develop participatory mechanism to engage active participation. • Systematically involving community in flood disaster risk reduction.	• Local Government • National Disaster Management Agency • NGOs • Community
Socio-Economic	Urbanization and poor spatial planning are the major factors causing flood hazard. There is a need to alleviate poverty, control urbanization and avoid creating policies that will increase attractiveness of the city.	• Prepare land use maps focusing on urban and urbanizing areas • Improve land use planning • Develop system for periodically update the land use planning • Control urbanization and population growth • Develop strategies for poverty alleviation	• National Government • Local Government • The National Development Planning Agency • The Ministry of Home Affairs • The Ministry of Social Affairs
	Lack of proper mechanism for integrating flood disaster mitigation issues with development planning.	• Incorporate flood disaster risk management into existing development strategies and policies • Create supportive policies and provide incentives	• National Government • Local Government • The National Development Planning Agency • The Ministry of Home Affairs • The Ministry of Environment

Element	Major Issues and Gaps	Responses/Policy Intervention	Responsible Organizations
Financial	Limited budget for implementing flood mitigation programs	• Improve resources allocation for the development and implementation of flood mitigation policies and programs based on identified priorities. • Develop sustainable funding mechanism. • Develop and promote alternative financial instruments for funding flood mitigation programs. • Develop a system to distributing the fund to affected communities as well as develop its monitoring mechanism.	• National Government • Local Government • The Ministry of Finance • Private Sectors

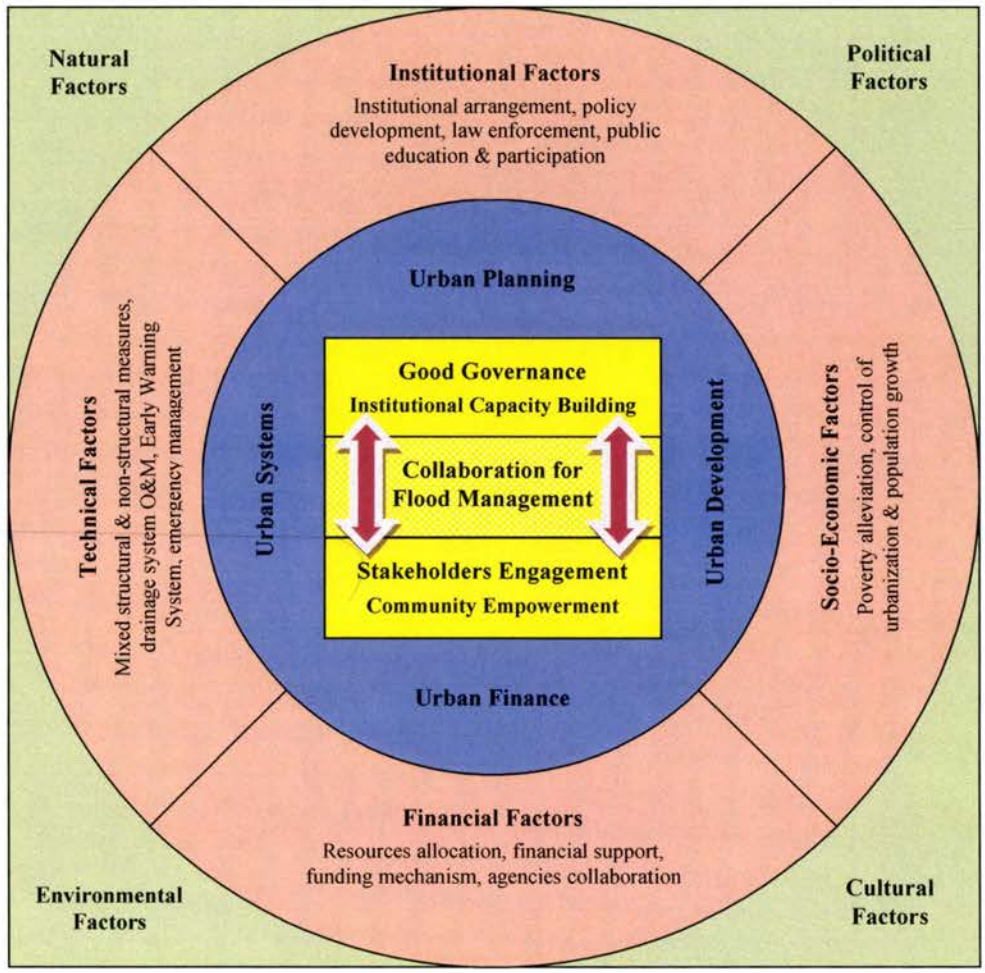

Figure 5.9 Interdependent Factors for Integrated Flood Management in Jakarta

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

The study focused on the problem of annual flooding in Jakarta which is becoming more devastating and widespread. In addition to the annual floods, Indonesia has experienced very damaging floods about once every five years.

The study recognized that flooding in Jakarta is a complex socio-technical problem and that an integrated approach is required to reduce the risk and mitigate the effects of flooding. The flood management system should be integrated with other urban subsystems in the city, which displays dynamic behavior among its sectors.

This chapter summarizes the findings of the study of flood-related problem in Jakarta and recommendations for future research.

6.1 Conclusions

1. The flood problem in Jakarta is caused not only by natural events but also by human activities which increase the risk of flooding. Urbanization and development also contribute to the problem as Jakarta continues to sacrifice its green spaces for the construction of buildings and infrastructures. Lack of drainage capacity and poor system operation and maintenance have made the problem even worse. Socio-cultural factors related to policy implementation and solidwaste management are also implicated, since much of the flooding is caused by blocked pipes and waterways.

2. The prevailing approach to flood problems, which uses a precautionary approach to apply flood reduction measures without considering full flood risk, is not adequate for situations like this. In any case, the financial capacity of the government to mitigate flood hazard by structural measures is far from sufficient. There is a growing realization that besides engineering considerations, economic, social, and environmental aspects play important roles in the decision-making process. It is believed that integrated long-term flood risk management can be more efficient and effective if these other measures are also considered. The measures should reduce potential flood impact by reducing the vulnerability and increasing the resilience of the city's zones. The measures should also adjusted over time as the city changes. Additionally, these measures could also enhance safety and create a more attractive living environment at the same time. Hence, flood risk requires a more integrated approach and considers a broader range of solutions. A mix of structural and non-structural measures should be promoted.

3. A successful legal framework is required to adapt and respond to changing conditions by providing a clear sense of direction. For various reasons, in practice it may not immediately possible to implement the reforms identified as required in order to promote Integrated Flood Management. Legislative reform may be hindered due to poor institutional arrangements, including law enforcement.

4. The major challenge in flood management strategies lies in the socio-technical domain. The social component is usually more challenging as it includes varied perceptions from various stakeholders. The interaction between technological and social components is also critical and it seems that the local government has not yet

sufficiently engaged in the problem. Strengthening coordination and cooperation among all stakeholders is a crucial point to support the preparedness of institutions and communities in preventing and mitigating the risk of future flooding. Community participation has been recognized as an essential element of flood risk management that builds a culture of safety and ensures sustainable development. It addresses specific local needs and actively engages them in flood disaster management activities.

5. Economic growth and development are important in developing countries, but they are usually accompanied by increased urbanization, which in turn is followed by excess demand for housing, water, sewerage, and other urban services and by increasing levels of urban unemployment. These problems may be compounded by poor spatial planning, poor public policy and law enforcement. As a result, the city's inability to solve flooding problem in Jakarta is due to a mixture of public financial, institutional, managerial, cooperative, participative, and human resources problems. The problem is so difficult that the question must be raised of whether it is possible to master all the flooding and urbanization problems with reasonable investment levels.

6. Efforts on previous and current mitigation management to reduce flood disaster impacts seem to have failed to reach their potential targets. Reasons include: lack awareness on disaster of communities living in river floodway and flood prone areas; lack of direct participation from communities, communities' habits currently are not conducive for an effective integrated flood management, lack of massive dissemination for communities, and lack of budget allocation for operation and maintenance for flood control structures and emergency measures.

7. While it is not possible or feasible to totally eliminate the flood risk, it should be recognized that floods also have some positive impacts. The challenge is how to manage floods as part of natural occurrences and take advantage of the beneficial aspects. This is in line with current thinking and the concept of Integrated Flood Management, which shifts away from directly fighting against floods towards managing the risk of flooding and integrating flood control with other urban systems. In case of Jakarta where most of the communities are getting accustomed to flooding, the approach should be focused on the communities' adjustment to the flood hazards rather than costly total flood control. By increasing people's resilience to flood hazards, such an approach will enable people to live and cope with floods.

6.2 Recommendations

Sustainable approaches to urban flood risk is becoming an increasingly challenging task for urban communities and local governments to address, and a great deal of further research is required. This study has outlined principles for solutions, but each urban area must take its own approach.

Following the principles outlined by the study, the following categories of research needs are indicated:

1. **Integrated approach**

   Many urban areas are not up to this challenge because they take a mono-sectoral approach to urban management plans and this hinders effective responses to flood risk. Too often urban flood management is carried out by concentrating on the hydraulic and engineering aspects of flood management while ignoring institutional, socio-economic, environmental and political aspects and risks. Research is needed to build

on the model of this dissertation to create a transferable paradigm for integrated flood management planning.

2. **Modeling**

   An integrated approach to urban flood management should consider the aspects that will lead to a more sustainable and effective flood management approach and the causes and impacts of floods can be distinguished between their several components. Agent-based modeling could be used for simulating the actions and interactions of individual components as they affect the system as a whole.

3. **Institutional analysis**

   The study showed how the technical, institutional, socio-economic, and financial subsystems interact in determining the effectiveness of flood management. Each of these subsystems requires additional research to improve its contribution to flood damage reduction. For example, in the technical area, research is needed to show how to "do more with less" in best management practices. The institutional arena holds many challenges to improve law, governance, and community interactions. Many other such examples can be cited.

In the final analysis, flooding in Jakarta and similar cities must be seen as one of many problems that sap the vitality and opportunities within the urban areas. By using workable systems approaches to tackle these problems, public administrators can improve the lives of hundreds of millions of city dwellers around the world.

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APPENDIX A

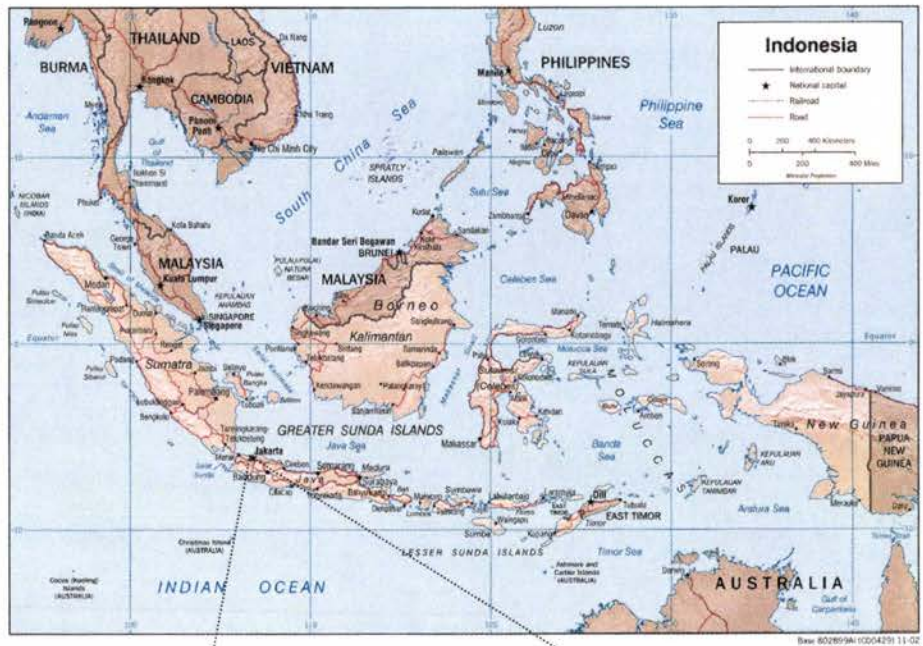


Figure A.1 Indonesia Archipelago

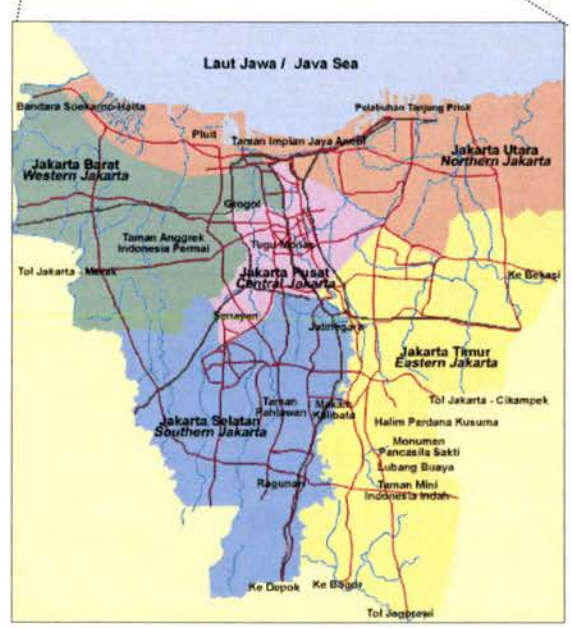


Figure A.2 Jakarta Area

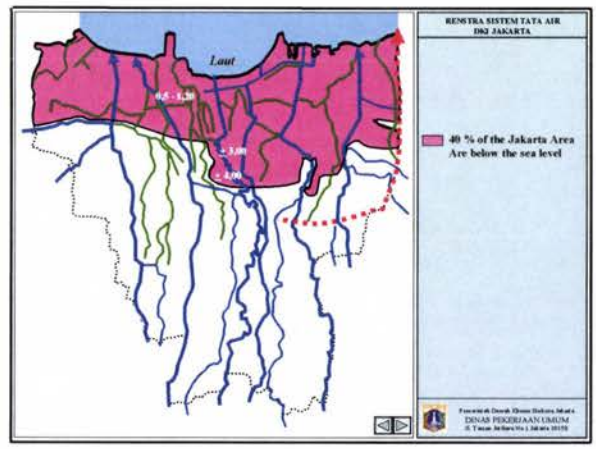


Figure A.3 Lowland Areas in Jakarta

(Source: Department of Public Works of Jakarta)

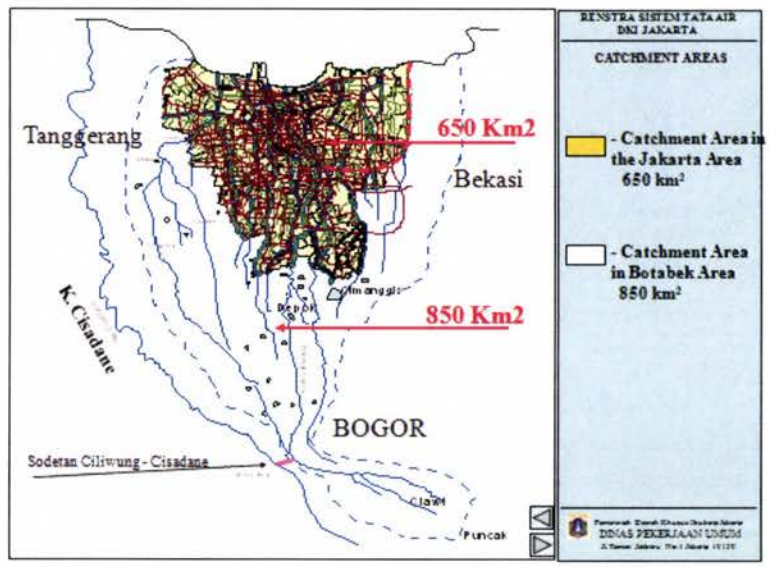


Figure A.4 Catchment Areas in Jakarta and Surrounding Area

(Source: Department of Public Works of Jakarta)

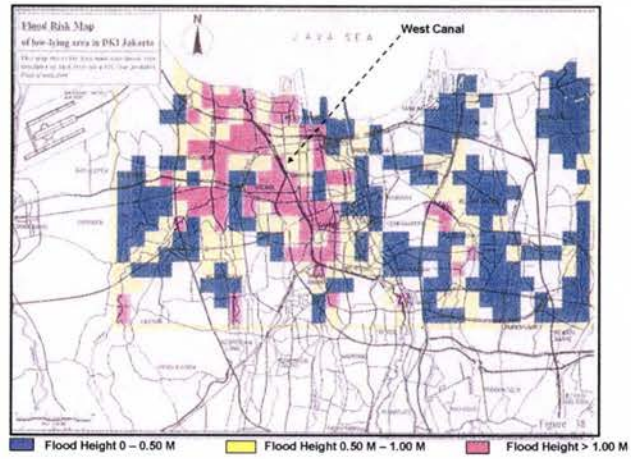


Figure A.5 Flood Risk Map for a 100-year Flood in Jakarta

(Source: Department of Public Works of Jakarta)

Figure A.6 Polder Systems in Jakarta

(Source: Department of Public Works of Jakarta)

APPENDIX B

Table B.1 Land Area and Its Usage by Municipality in 2004

Municipality	Usage (ha)					Area (ha)
	Housing	Industry	Office and Warehouse	Park	Others	
North Jakarta	7,495.36	2,171.39	1,474.61	126.56	2,952.07	14,220
South Jakarta	10,428.43	236.08	1,757.50	190.91	1,960.07	14,573
Central Jakarta	2,968.84	92.93	1,068.65	170.04	489.54	4,790
West Jakarta	9,032.34	512.77	1,253.93	209.41	1,607.15	12,615
East Jakarta	13,542.84	1,130.13	1,798.45	217.77	2,083.80	18,773

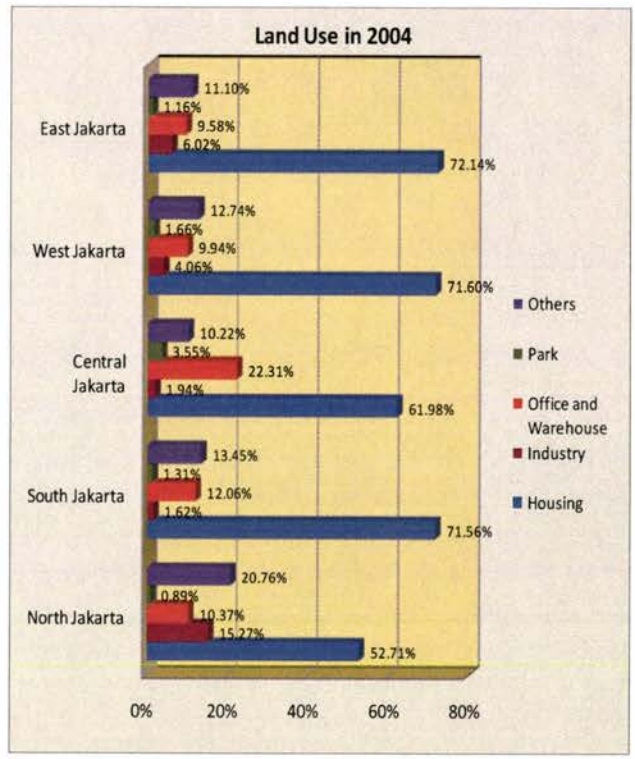


Figure B.1 Land Use by Municipality in 2004

Table B.2 Average Precipitation in Jakarta

Month	Average Precipitation (mm)	Wet Days (+0.25 mm)
Jan	300	18
Feb	300	17
March	211	15
April	147	11
May	114	9
June	97	7
July	64	5
Aug	43	4
Sept	66	5
Oct	112	8
Nov	142	12
Dec	203	14

The following bar chart for **Jakarta, Indonesia** shows the years average weather condition readings covering rain, average maximum daily temperature and average minimum temperature.

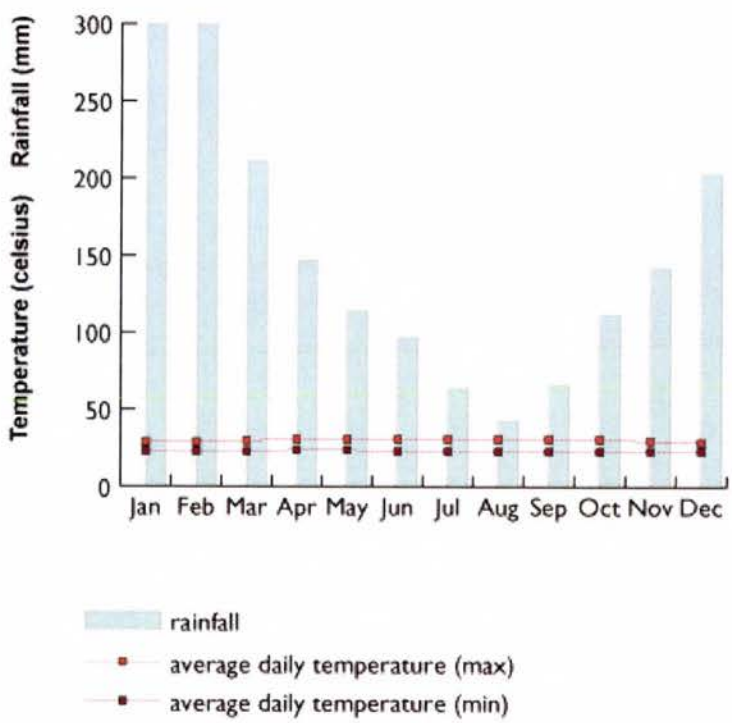
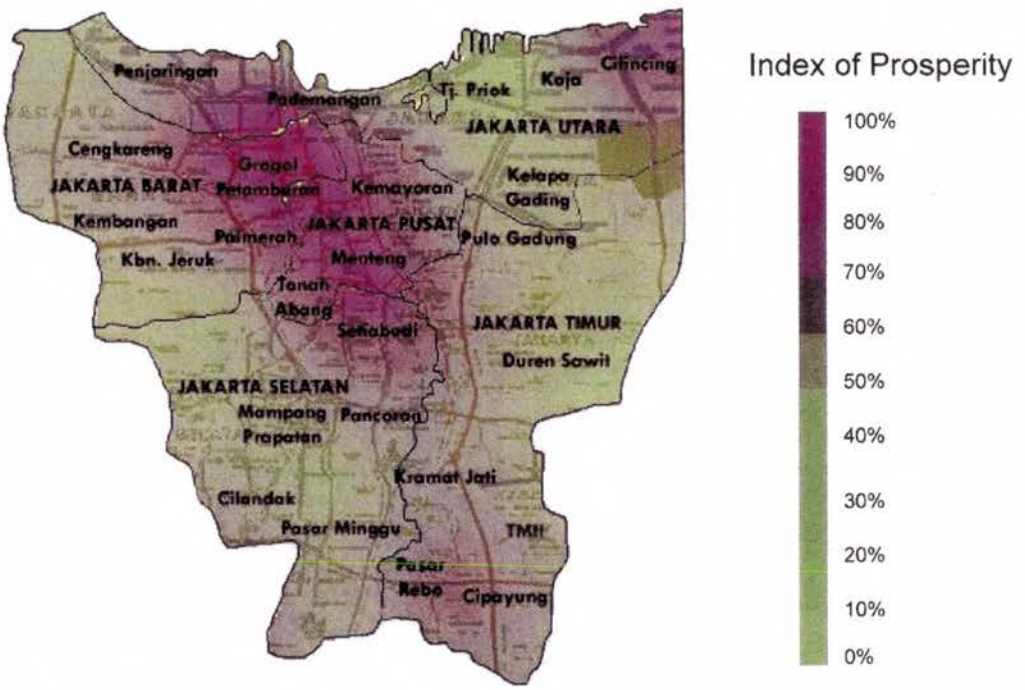


Figure B.2 Rainfall and Temperature Data



(Susandi et. al, 2009)

Figure B.3 Map of Prosperity in Jakarta

APPENDIX C

Table C1. Summary of Flooding Experiences in Jakarta

Year	Major Causes	Impacts	Remarks
1996	• Heavy rainfall • Lack of awareness to preserve the environment • Flood control projects were not carried out properly	• 30 people killed • Thousands homeless • 5000 ha flooded	• Rainfall reached a cumulative of 400 mm
2002	• Heavy rainfall • Lack of awareness to preserve the environment	• 57 people died • 15%-20% of the city was under water • Hundreds of thousands homeless • Thousand cases of malaria & diarrhea	• The water level reached 3-5 m • The flood was worse than the 1996 flood
2007	• Heavy rainfall • Deforestation • Clogged waterways • Economic development	• At least 85 people were killed • 70%-75% of the city were affected • Over 70,000 homes were flooded • High level of illness due to diarrhea & dengue fever	• The water reached 3-6 m • The worst flood in the last centuries
2008	• Heavy rainfall • Poor drainage	• There were no report of deaths • Toll roads were inundated • Public transportation & airports stopped their operations	• The extent of the flood is less than the 2007 flood

APPENDIX D

❑ Indonesian Constitution (1945)

The Indonesian Constitution perceives water both as a part of human rights and as a natural resources that shall be controlled by the State. Water as a natural resource is regulated in the Economic chapter of the Constitution, i.e. Chapter XIV, article 33, that states: "Land and water, and the natural resources found therein, shall be controlled by the state and shall be exploited for the maximum benefit of the people. The statement "control by the State" should be interpreted to mean that although the State does not own the natural resources, it is responsible for arranging and managing them in a sustainable way for the benefit of present and the future generations.

❑ Laws

- *The Basic Agrarian Law (No. 5/1960)*

The Basic Agrarian Law No. 5/1960 is based on Article 33 of the Indonesian Constitution, on Principle 5 of the state philosophy of Pancasila, and a reflection of efforts to re-manage the imbalance of agrarian structure as a result of colonialism and feudalism production style to be fairer. This law covers the legal aspects of land, such as land rights and land registration, and hence the security and certainty of rights to land.

- *The Basic Law on the Management of the Living Environment (No. 4/1982)*

This law approaches resource management through a basic concept of ecological management, thus endeavoring to provide the basis for a legal obligation to manage the environment in a sustainable fashion which according to this law must "be included in every license issued by an authorized agency". Implied in this law is the clear obligation of all licensees given rights to resources by a government agency to participate fully in efforts such fire prevention.

- *The Conservation of the Living Environment and Its Ecosystems Law (No. 5/1990)*

The Law defines efforts on conservation of the natural environment and establishes a comprehensive obligation on all parties who hold rights to land or water to exercise a function of 'protection' within their areas. This law also sets forth a range of substantial financial and penalties for the violation of the obligations promulgated by this law.

- *The Law on the Management of the Living Environment (No. 23/1997)*

This law explicitly develops, extends and enhances the earlier Basic Law of the Living Environment issued in 1982 taking into account the more complex nature of environmental management and its international implications. It confirms the government's fundamental role in managing the environment but it also allows this role to be decentralized. It defines better what constitutes environmental damage and creates the legal underpinnings for environmental audits. It sets out penalties for environmental damage but at the same time encourages settlement resolutions on environmental matters outside the courts.

- *The Law on Spatial Management (No. 24/1992)*

This law follows closely the sense of the Management of the Living Environment Law particularly in reference to 'management rights over natural resources'. The law sets out the principles for the determination of land use throughout the country, devolving to the provinces the authority to classify land and to organize its functional use. This law also governs the allocation of land for human activities, including conservation and preservation. To avoid conflicts, the spatial allocation of land is regulated at national, provincial and regional levels by the general spatial plan.

- *The Spatial Planning Law (No. 26/2007)*

The new spatial planning law 26/2007 has stipulated the importance of the informal sector in urban areas, but the implementation of this new law is not fully enforced yet. The full enforcement of the new spatial planning law and the understanding of the urban informality concept are needed to ensure the availability of urban spaces for the street vendors.

- *The Environmental Management Law (No. 23/1997)*

The Environmental Management Law states that: every person has the same right to an environment which is good and healthy; has the right to environmental information which is related to environmental management roles; and has the right to play a role in the scheme of environmental management in accordance with applicable laws and regulations. The law also states that natural resources are controlled by the state and are utilized for the greatest possible public welfare, and the arrangements thereof are determined by the government. In addition, environmental management must be performed in an integrated manner with spatial management, protection of non-biological natural resources, protection of artificial resources, conservation of biological natural resources and their ecosystems, cultural preservation, bio-diversity and climate change.

- *The Water Resources Law (No. 7/2004)*

The Water Resources Law was enacted to respond to the imbalance between the availability of water that continues to decrease and the need for water that continues to increase, and to replace Law Number 11 of 1974 concerning Irrigation. The Water Resources Law is designed with a water management and conservation paradigm.

Before the Water Resources Law was enacted, Law No. 11 of 1974 on Irrigation served as the main instrument for water management. This law was very broad and simple, and it is understandable because in 1974, the water condition in Indonesia was relatively good with abundant water sources. Consequently, Law No. 11 does not really focus on water management and conservation, but focuses mainly on construction and protection of water installations and buildings. The new Water Resources Law focuses on water conservation, infrastructure and its management. It targets surface and groundwater and has opened the door for public participation.

- *The Basic Forestry Law of 1967 and later the Basic Forestry Law of 1999*

These laws provide basic legislation and regulations regarding the management and control of forest, protected forest, conservation forest, production forest, reforestation and environmentally sensitive areas, as well as regarding the role of the general public in the control and conservation of the nature.

The Basic Forestry Law (Act no. 5/1967) stated that 'All forests within the Indonesian Republic including the natural wealth in the forests are under the control of the State'. In Law No. 41/1999 which replaced the earlier law, the same wording occurs with an additional phrase namely "... for the greater of peoples' welfare". Both Laws stated sanctions in the form of punishment by imprisonment and/or fines for every activity against them and therefore special police authorities were given to the Forestry officers. However, even with so many laws and regulations, regulations, illegal logging has remained common throughout the country.

- *The Regional Administration/Local Autonomy Law (No. 22/1999) and later Law no. 32/2004*

The Law No. 22/1999 has transformed the government system from being highly centralized to a more decentralized, allowing for more autonomy at local government level. This law also provides flexibility for the regional government to manage their own affairs, including getting more revenue from the utilization of natural resources in their areas. The law has also provided the local communities greater opportunities to develop and strengthen their institutions. The main purposes of the revised law (no. 32/2004) are to rearrange conflicting institutions authorities and to avoid the decentralization goes too far. The new law guarantees that the power and authority shall be used accordingly with appropriate measures and control, and states a clear distinction on the issues which can be handle by the local government and which that cannot.

❑ **Government Regulations**

- No. 47/1997 on National Spatial Management
- No. 27/1999 on Environmental Impact Analysis
- No. 82/2001 on Water Quality Control

❑ **Presidential Regulations**

- No. 32/1990 on Conservation Area Management
- No. 41/1996 on Industrial Zone
- No. 114/1999 on Spatial Management in Bogor, Puncak, and Cianjur Areas.

APPENDIX E

The government responsibilities in disaster management are as follows:

- Reducing disaster risk and including disaster risk into development planning;
- Protecting the public from disaster impact;
- Ensuring fairly fulfillment of rights of impacted communities and Internally Displaced Persons (IDPs) in accordance with minimum service standards;
- Recovering the condition from disaster impact;
- Allocating sufficient disaster management budget in state budget;
- Allocating on-call funding for disaster management; and
- Maintaining authentic and credible archives/documentation from hazard and disaster impact.

The authorities of the government in organizing the disaster management are as follows:

- Stipulating disaster management policies that are aligned with national development policies;
- Preparing development plans that incorporate disaster management policy elements;
- Proclaiming status and level of national and regional disaster;
- Developing disaster management cooperation policies with other countries, agencies, or other international parties;
- Formulating policies on use of technology posing potential threat or hazard;
- Formulating policies preventing the controlling and exploitation of natural resources;
- Curbing the amassing of national wealth.

Disaster management responsibilities of the regional government are:

- Ensuring fulfillment of rights of impacted communities and Internally Displaced Persons (IDPs) in accordance with minimum service standards;
- Protecting the public from disaster impact;
- Reducing disaster risk and including disaster risk reduction into development programming; and
- Allocating sufficient disaster management budget in regional budget.

The authorities of the regional government are:

- Stipulating disaster management policies in its territory that are aligned with regional development policies;
- Formulating development planning that includes disaster management policy elements;
- Developing disaster management cooperation policies with other provinces and/or other districts/cities;
- Regulating the use of technology posing potential source of threat or hazard in its territory;

- Formulating policies preventing the controlling and exploitation of natural resources;
- Curbing the amassing of wealth in its territory.

The Disaster Management Law Section IV article 12 describes the responsibilities and roles of the National Disaster Management Agency as follows:

- Providing guidelines and instructions on disaster management effort addressing fair and impartial disaster prevention, emergency response, rehabilitation, and reconstruction;
- Stipulating disaster management organization standardization and needs based on the regulation of the law;
- Informing the public on activities;
- Reporting progress achieved in disaster management organization to the President on monthly basis during normal times and at all times during state of disaster emergency.
- Using and accounting the national and international donations/assistance;
- Accounting the use of funds sourced from the state budget;
- Implementing other obligations in accordance with the regulation of the law; and
- Preparing guidelines on the establishment of the Regional Disaster Management Agency

The roles of the National Disaster Management Agency are:

- Formulating and stipulating disaster and management policies by acting promptly, effectively, and efficiently;
- Coordinating the implementation of planned, coordinated, and comprehensive disaster management activities.

Further provisions on establishment, roles, responsibilities, organizational structure, and operating procedures of the National Disaster Management Agency are regulated by the President Regulation No. 8/2008.

At regional level, the Regional Disaster Management Agency comprises of:

- An agency at provincial level led by an official who is one level below the governor;
- An agency at district/city level led by an official who is one level below the district head/mayor.

The Regional Disaster Management Agency also comprises of the steering committee and executive body.

According to the Disaster Management Law, the roles of the Regional Disaster Management Agency are:

- Formulating and stipulating disaster and management policies by acting promptly, effectively, and efficiently; and

- Coordinating the implementation of planned, coordinated, and comprehensive disaster management activities.

The responsibilities of the Regional Disaster Management are:

- Stipulating guidelines and instructions in accordance with the local government policy and the National Management Agency on disaster management effort addressing fair and impartial disaster prevention, emergency response, rehabilitation, and reconstruction;
- Stipulating disaster management organization standardization and needs based on the regulation of the law.
- Preparing, stipulating, and informing disaster prone map area;
- Preparing and stipulating standard operating procedure for disaster management;
- Implementing organization of disaster management in its territory;
- Reporting progress achieved in disaster management to the regional leader on monthly basis during normal times and at all times during state of disaster emergency;
- Curbing the amassing and distribution of wealth;
- Accounting for use of funds sourced from regional budget; and
- Implementing other obligations in accordance with the regulation of law.

Further provisions on establishment, roles, responsibilities, organizational structure, and operating procedures of the Regional Disaster Management Agency are regulated by law.

APPENDIX F

❑ The Ministry Involved in Flood Management

At the national level, there are many departments dedicated to disaster management spread across various ministries. The ministries in Indonesia have already significant involvement in disaster management although they are mostly response-oriented. The ministries that are involved in disaster management are:

- *The Ministry of Public Works*

The Ministry of Public Works coordinates development and management assets in the build up area through its Directorate Generals. It also coordinates research, development and training. The ministry has responsibility for all activities related to flood control and mitigation, including building dikes, ponds, and reservoirs, and shares its responsibility with the local government. In case of a disaster event, the ministry provides support and services through shelters, clean water, sanitation, and repair of infrastructure and other facilities.

- *The Ministry of Home Affairs*

The Ministry of Home Affairs is responsible to support all activities of development. During a disaster event, the ministry is involved in emergency response coordination, with branches in all provinces and district-level governments.

- *The Ministry of Communication and Information*

To increase disaster preparedness, the ministry of Communication and Information is mandated to disseminate warning information through all channels using mass media and to promote public awareness on disasters through public dialog and interaction.

- *The State Ministry of Research and Technology*

The State Ministry of Research and Technology is a coordinating agency responsible to helping identify and introduce appropriate science and technology, and also to implement new technologies.

- *The Ministry of Social Affairs*

The Ministry of Social Affairs provides emergency relief support as such food, clothing, and other social needs during the disaster event.

- *The Ministry of Health*

In case of a disaster, the Ministry of Health provides medical workers, medical supplies and other healthcare services, and sanitation.

- *The Ministry of Environment*

The Ministry of Environment is a government agency dealing with environmental matters. Its areas of responsibility include, among others: formulating the national environmental policies; planning national implementation programs; coordinating all environmental

activities carried out by government institutions/ and enhancing people's participation in environmental programs and activities.

- *The Ministry of Forestry*

The main responsibility of the Ministry of Forestry in flood management is to carry out the task of soil conservation activities, such as reforestation and rehabilitation of degraded lands.

- *The Ministry of Transportation*

The Ministry of Transportation is responsible for transporting facilities and to support rescue and evacuation.

❑ Other Agency/Organization Involved in Flood Management

- *The National Development Planning Agency*

The National Development Planning Agency is the central planning agency which has primary responsibility for national economic planning. Through this agency, development planning proposal from all departments are centralized to ensure their coordination and incorporation into the national five-year development plan.

- *The Meteorology and Geophysics Agency*

The Meteorology and Geophysics Agency is responsible to monitor rainfall throughout the country and provides climate forecast information on the onset of seasons and its rainfall characteristics whether the seasonal rainfall will be normal, below or above normal. The agency is also responsible for seismic/geophysical information processing data and data management and dissemination of the information.

- *The National Institute of Science*

The Indonesian Institute of Science is involved in community preparedness and some aspects of building a warning system. The institute focuses on activities such as hazard mapping and socio-economic research, among others.

- *The Indonesian Red Cross Society*

The Indonesian Red Cross Society sees its role as a bridge in the end-to-end warning system through radio networks and in reinforcing warnings from the Meteorology and Geophysics Agency. It also provides first aid and related assistance to disaster victims.

- *The Indonesian Armed Force*

The military in Indonesia has an important role in handling disaster and emergency situations. The armed forces mobilize personnel and equipment for search and rescue and other response activities.

- *The Indonesian Society for Disaster Management*

The Indonesian Society of Disaster Management is a Non-governmental Organization associating of individual disaster management practitioners, scientists and observers from the government sector, UN agencies, international agencies, private sector, national and

local NGOs, academicians, and others. It envisions a society that live side-by-side with disaster risks without suffering from their adverse impacts. Prior to the enactment of the Disaster Management Law, the organization also facilitated civil society participation and involvement in an effort to fill in the void due to absence of a legislation to guide disaster management and came up with a draft of Disaster Management Bill.

- *The Central Bureau of Statistics*

The Indonesian Statistics Bureau has supported the process of data collection at both national and regional levels.

- *The Indonesian Forum for Environment*

The Indonesian Forum for Environment is involved in policy advocacy, critiquing government policies on spatial planning, mining, forestry, and other environment-related issues. It also supports activities that encourage accountability and responsibility.

APPENDIX G: QUESTIONNAIRE

Name *(optional)* : _____
Gender : _____
Age : _____
Occupation : _____

Please check ☑ one of the answers for each question below:

1) Current address: (*Please indicate the region*)

☐ North Jakarta, _____
☐ South Jakarta, _____
☐ Central Jakarta, _____
☐ West Jakarta, _____
☐ East Jakarta, _____

2) How long have you lived at this address?

☐ Less than 1 year
☐ 1 – 5 years
☐ 6 – 10 years
☐ 10 – 15 years
☐ 15 – 20 years
☐ more than 20 years

3) Is your home or property located in a floodplain?

☐ Yes ☐ No ☐ Do not know

4) How concerned are you about the possibility of your community being impacted by flood disaster?

☐ Extremely concerned ☐ Somewhat concerned ☐ Not concerned

5) Do you have any flooding problem in your neighborhood?

☐ Yes ☐ No

If "yes", please complete the entire questionnaire
If "no", please complete questions 22 to 37

6) How often does your neighborhood experience of flooding?

☐ Less than once a year
☐ Once a year
☐ 2 – 3 times a year
☐ more than 3 times a year

7) What do you feel was the cause of flooding in your neighborhood?
(*Please check all that apply*)

☐ Heavy, intense rainfall
☐ Inadequate storm drainage
☐ Poorly-maintained drainage system
☐ Dense population
☐ Lots of developments
☐ Lack of green spaces
☐ Other, _____

8) When was the biggest flood you have experienced in your neighborhood?
(month, year) _____

9) How severe was the damage?

☐ No damage
☐ Little damage, mostly cosmetics
☐ Moderate, some repairs needed
☐ Severe, temporary loss of use
☐ Extreme, permanent loss of use
☐ Personal injury or loss of life

10) In this biggest flood, where did you hear the flood warning?

☐ No warning
☐ Witnessed with own eyes
☐ Police
☐ Local Radio or TV
☐ Neighbors, relatives, friends
☐ Other, _____

11) What was the maximum depth of water over your grounds?

☐ Less than 30 cm
☐ 30 cm to 60 cm
☐ 60 cm to 1 m
☐ 1 m – 2 m
☐ 2 m – 3 m
☐ more than 3 m

12) In the biggest flood, were you evacuated from the property?

☐ Yes ☐ No

If "yes", where did you stay?

☐ With friends or relatives
☐ In community facility or shelter
☐ Motel or hotel
☐ Other, _____

13) How long did you need to recover from the disaster and live normally?

☐ Less than 1 week
☐ 1 – 3 weeks
☐ 4 – 6 weeks
☐ more than 6 weeks

14) Does your community have a well-defined program for flood mitigation?

☐ Yes, well-defined ☐ Informal Program ☐ No ☐ Do not know

Please describe your community program if you have one

15) Have you taken any action to make your home or neighborhood more resistant to flood hazard?

☐ Yes, by _____ ☐ No

16) Are you interested in making your home or neighborhood more resistant to flood hazards?

☐ Yes ☐ No ☐ Not sure

---

17) Please indicate your highest level of education completed:

☐ Elementary School
☐ Junior High School
☐ High School
☐ Undergraduate Higher Education
☐ Graduate Higher Education
Other, _____

18) How many times have you observed flooding in the city of Jakarta?

☐ Never
☐ Once
☐ 2 – 3 times
☐ 4 – 5 times
☐ 6 – 7 times
☐ 8 – 10 times
☐ more than 10 times

19) To what extent has flooding in Jakarta area affected you?

☐ Not at all
☐ To a little extent
☐ to a great extent

20) In your opinion, what is (are) the cause(s) of flooding in Jakarta area?

(*Please check all that apply*)

☐ Heavy, intense rainfall
☐ Geomorphologic condition
☐ Inadequate urban storm drainage
☐ Run-off or lack of green spaces
☐ Drainage system, due to solid waste disposal
☐ Urbanization
☐ Poorly-maintained drainage system
☐ Lots of developments
☐ Do not know
☐ Other, _____

21) In your opinion, has the local government been responsive to solve flood-related problems?

☐ Yes ☐ No ☐ Do not know

22) To what extent has the local government helped communities during flood events?

☐ Not at all
☐ to some extent
☐ To a little extent ☐ to a great extent

23) Do you believe that the government is appropriately allocating funds to solve flood problem?

☐ Yes ☐ No ☐ Not sure

24) Do you know any flood regulation or flood mitigation program for Jakarta area?

☐ Yes ☐ No

25) Have you participated in any flood mitigation program?

☐ Yes ☐ No

If yes, what kind of activity have you been involved?

_____

If no, would you be interested in participating in a flood mitigation program?

☐ Yes ☐ No ☐ Not sure

26) How important is it for the local government to undertake the following activities?

	Very Important	Somewhat Important	Not Important	Not Sure
a) Restrict new development in the floodplain	☐	☐	☐	☐
b) Planning and zoning	☐	☐	☐	☐
c) Open space preservation	☐	☐	☐	☐
d) Relocation from hazard areas	☐	☐	☐	☐
e) Construction of dams, levees or canals	☐	☐	☐	☐
f) Maintenance of facilities program development	☐	☐	☐	☐
g) Flood warning system improvement	☐	☐	☐	☐
h) Public education and community participation	☐	☐	☐	☐
i) Emergency preparedness program	☐	☐	☐	☐
j) Review existing flood mitigation program	☐	☐	☐	☐

27) In what ways could the government improve their performance: (*Please check all that apply*)

☐ No improvement needed

☐ Concentrate on land use planning

☐ Concentrate on law enforcement and alert

☐ Concentrate on the city development maintenance

☐ Improve their communication with community

☐ Concentrate on public health

☐ Concentrate on public education

☐ Be more prompt, responsive,

☐ Improve public facilities

☐ Other, _____

Additional comments:

APPENDIX H: QUESTIONNAIRE RESULTS

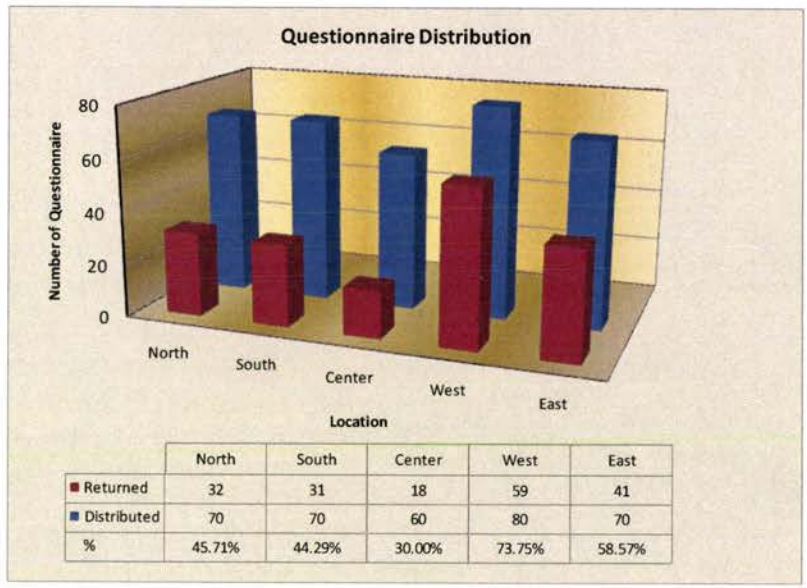
❑ Questionnaire Purpose

The main purpose of the questionnaire is to "capture" Jakarta resident views on flood-related problems in the city of Jakarta. Hopefully this information will be helpful for the government to enhance their understanding in people's perception and needs to cope with ongoing flood problem in Jakarta; and be more alert and responsive to help communities especially during flood events. Furthermore, the government could improve their communication with stakeholders and work together to alleviate the problem and improve the local condition.

❑ Questionnaire Distribution and Return Rate

The questionnaire was developed to reach out to communities in each municipality, i.e. North, South, Center, West and East Jakarta., that would be helpful to gather information regarding current conditions in the areas, to understand people's concerns and needs, and to determine whether there is any significant difference among communities.

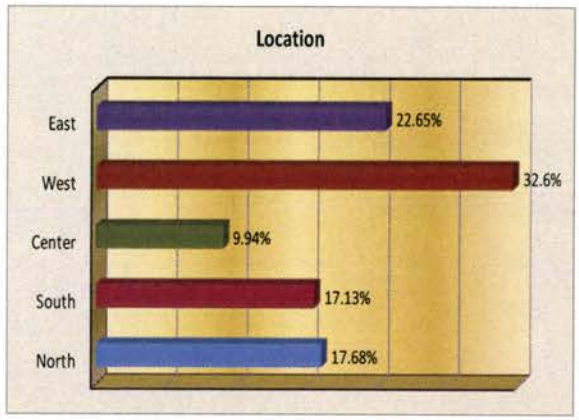
About 350 questionnaires were distributed between February 10th and March 11th 2008. The method of distribution included direct distribution to current residents in several communities, universities, offices, and public places. The questionnaire generated a 51.71% of responses. The questionnaire distribution and return as well as their proportion are shown in the following charts.

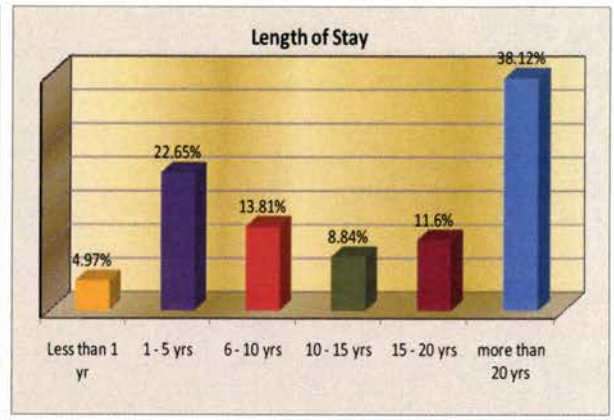


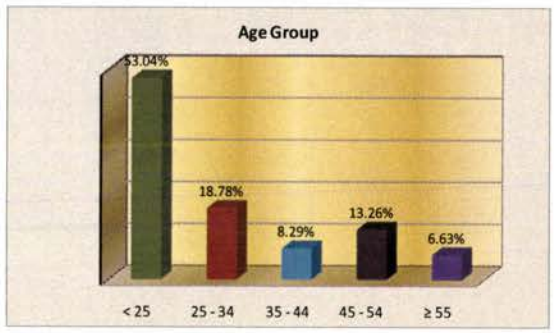
	North	South	Center	West	East
Returned	32	31	18	59	41
Distributed	70	70	60	80	70
%	45.71%	44.29%	30.00%	73.75%	58.57%

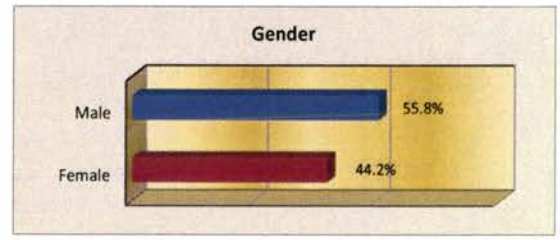
❑ Respondents' Profile

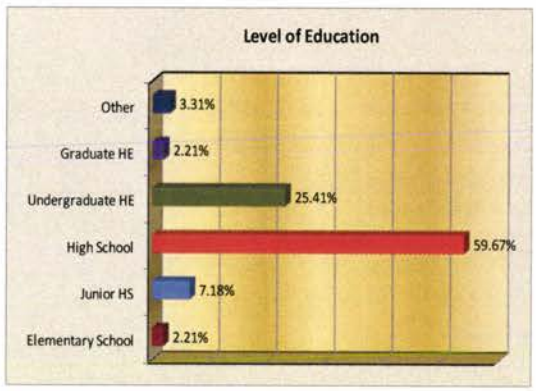
Most of the respondents are students (51.9%) and with the age under 25 years old. From the observation, respondents with those categories were more responsive and showed more enthusiasm and willingness to fill out the questionnaire. The following charts show respondents' profile categorized by location (municipality), length of stay in the area, age group, gender, level of education, and occupation.

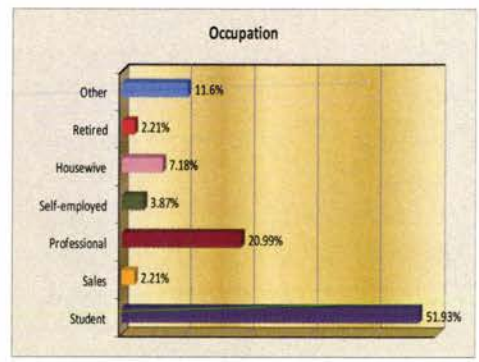












❑ Questionnaire Responses

The overall survey responses for each question are shown in the summary below. Differences in related responses are noted.

Question 3: <u>Is your home or property located in a floodplain</u>?

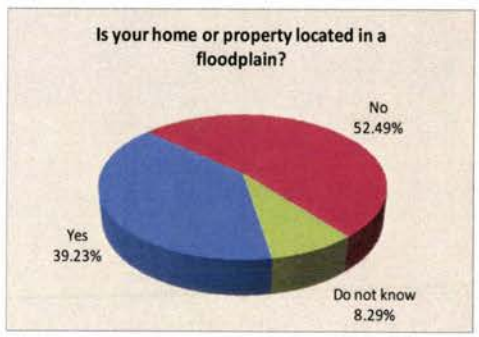
More than half (52.49%) of the respondents believed that they do not live in floodplain areas, while 39.23% indicated the opposite. Almost 70% (12.15% overall) of North Jakarta respondents indicated that they live in floodplain area. On the contrary, almost 80% (17.68% overall) of East Jakarta respondents indicated that they do not live in floodplain areas. This could be further verified by evaluating the responses and the floodplain map.

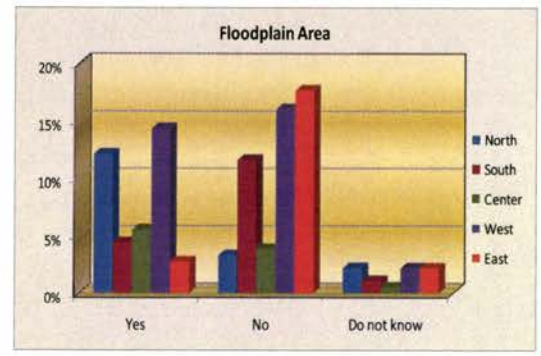
Response Counts

Description	Value	Count	%
Yes	1	71	39.23%
No	0	95	52.49%
Do not know	-1	15	8.29%

Descriptive Statistics

Count	181
Sum	56
Minimum	-1
Maximum	1
Mean	0.3094
Median	0
Mode	0
Standard Deviation	0.6177
Sample Variance	0.3815
Kurtosis	-0.6391
Skewness	-0.3123





Question 4: How concerned are you about the possibility of your community being impacted by flood disaster?

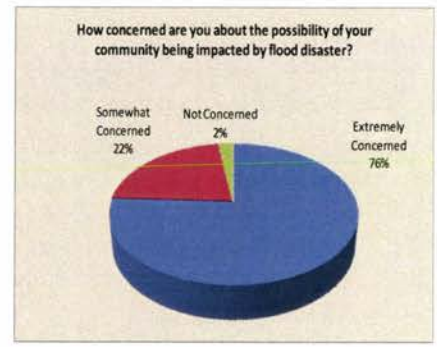
The majority (75.69%) of the respondents expressed their great concern regarding flood risk in their community. However, there are still 2.21 percent of the respondents who are not concerned about this matter.

Response Counts

Description	Value	Count	%
Extremely Concerned	2	137	75.69%
Somewhat Concerned	1	40	22.10%
Not Concerned	0	4	2.21%

Descriptive Statistics

Count	181
Sum	314
Minimum	0
Maximum	2
Mean	1.7348
Median	2
Mode	2
Standard Deviation	0.4903
Sample Variance	0.2404
Kurtosis	1.7768
Skewness	-1.6300



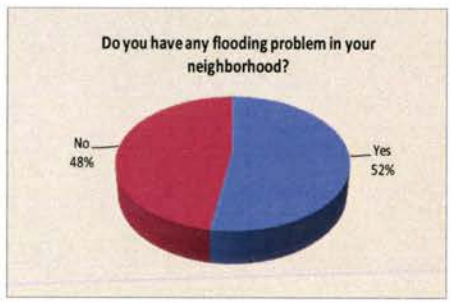
Question 5: Do you have any flooding problem in your neighborhood?

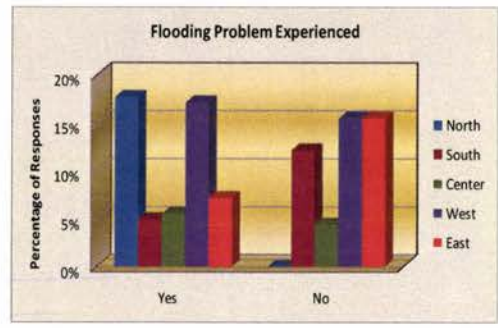
The proportion of respondents who have flooding problem in their neighborhood are slightly higher, i.e. 52.49%, than those who do not have that problem. All of respondents located in the North have flooding problem, and so do most of the West and Center Jakarta respondents.

Response Counts

Description	Value	Count	%
Yes	1	95	52.49%
No	0	86	47.51%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	95	32	9	10	31	13
Minimum	0	1	0	0	0	0
Maximum	1	1	1	1	1	1
Mean	0.5249	1	0.2903	0.5556	0.5254	0.3171
Median	1	1	0	1	1	0
Mode	1	1	0	1	1	0
Standard Deviation	0.0372	0	0.0829	0.1205	0.0656	0.0736
Sample Variance	0.2508	0	0.2129	0.2614	0.2537	0.2220
Kurtosis	-2.0123	-	-1.1338	-2.1994	-2.0601	-1.4045
Skewness	-0.1004	-	0.9715	-0.2445	-0.1045	0.8164





Questions 6 to 16 were only answered by respondents who have flooding problem in their neighborhood (95 respondents).

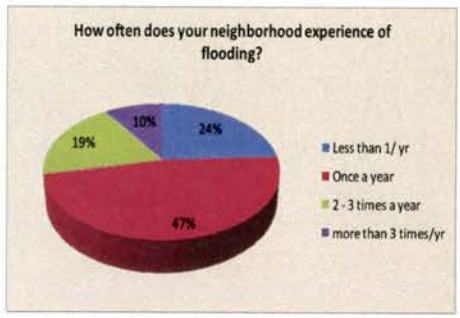
Question 6: How often does your neighborhood experience of flooding?

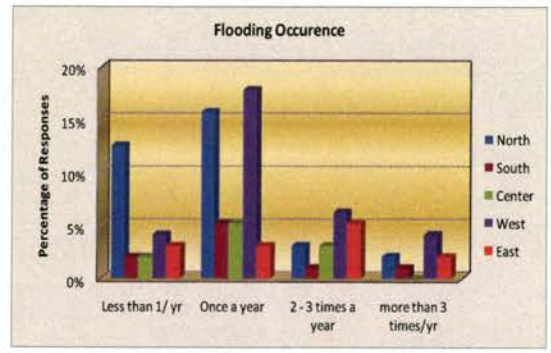
Overall, 47.37% of the respondents experience flooding once a year, and about 24% do not experience flooding every year.

Response Counts

Description	Value	Count	%
Less than 1/ yr	1	23	24.21%
Once a year	2	45	47.37%
2 - 3 times a year	3	18	18.95%
more than 3 times/yr	4	9	9.47%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	203	59	19	21	72	32
Minimum	1	1	1	1	1	1
Maximum	4	4	4	3	4	4
Mean	2.1368	1.8438	2.1111	2.1000	2.3226	2.4615
Median	2	2	2	2	2	3
Mode	2	2	2	2	2	3
Standard Deviation	0.8946	0.8466	0.9280	0.7379	0.8713	1.0500
Sample Variance	0.8002	0.7167	0.8611	0.5444	0.7591	1.1026
Kurtosis	-0.3202	0.8544	1.3539	-0.7336	-0.1202	-1.0408
Skewness	0.5446	0.9945	0.9435	-0.1660	0.5883	-0.1359





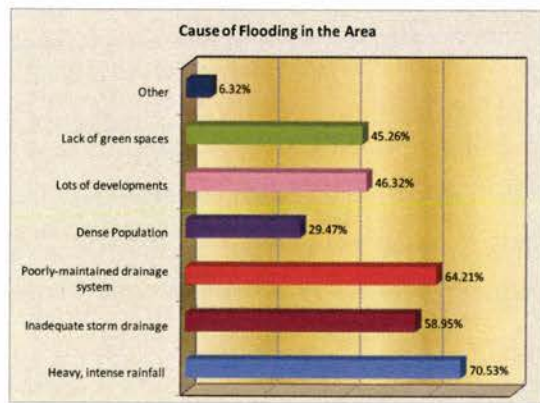
Question 7: <u>What do you feel was (were) the cause (s) of flooding in your neighborhood</u>?

The majority of the respondents felt that natural and technical factors are the main causes of flooding in their neighborhood. Only 29.47% of the respondents believed that dense population has also contributed to the problem.

<u>Response Counts</u>

Description	Count	%
Heavy, intense rainfall (a)	67	70.53%
Inadequate storm drainage (b)	56	58.95%
Poorly-maintained drainage system (c)	61	64.21%
Dense Population (d)	28	29.47%
Lots of developments (e)	44	46.32%
Lack of green spaces (f)	43	45.26%
Other (g)	6	6.32%

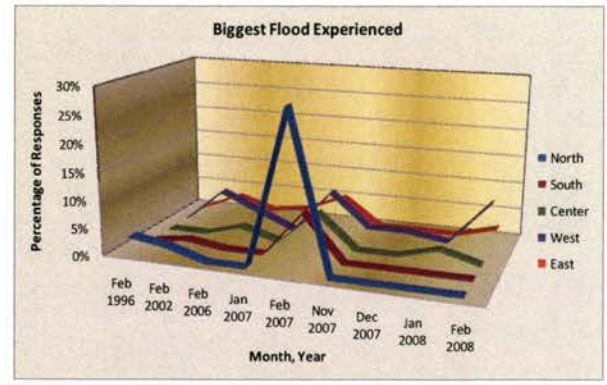
Descriptive Statistics	Overall						
	a	b	c	d	e	f	g
Count	95	95	95	95	95	95	95
Sum	67	56	61	28	44	49	6
Minimum	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	6	1
Mean	0.7053	0.5895	0.6421	0.2947	0.4632	0.5158	0.0632
Median	1	1	1	0	0	0	0
Mode	1	1	1	0	0	0	0
Standard Deviation	0.4583	0.4945	0.4819	0.4583	0.5013	0.7560	0.2445
Sample Variance	0.2101	0.2446	0.2323	0.2101	0.2513	0.5716	0.0598
Kurtosis	-1.1884	-1.9039	-1.6728	-1.1884	-2.0204	28.5095	11.5629
Skewness	-0.9149	-0.3696	-0.6024	0.9149	0.1502	4.0950	3.6496



Question 8: <u>When was the biggest flood you have experienced in your neighborhood</u>?

Overall, Jakarta had major floods in February 1996, February 2002, February 2007, and the most recently in February 2008. More than half (55.79%) of the respondents indicated that they had the biggest flood in February 2007. However, almost 30% (9.47% overall) of the West Jakarta respondents felt that they just had the biggest flood in February 2008.

Month, Year	Overall	Location				
		1	2	3	4	5
February 2008	11	0	0	0	9	2
January 2008	3	0	0	2	1	0
December 2007	2	0	0	0	2	0
November 2007	2	0	0	0	2	0
February 2007	53	27	8	6	8	5
January 2007	2	0	0	0	0	2
February 2006	7	0	0	2	3	1
February 2002	12	2	1	0	6	3
February 1996	3	3	0	0	0	0
Total	95	32	9	10	31	13



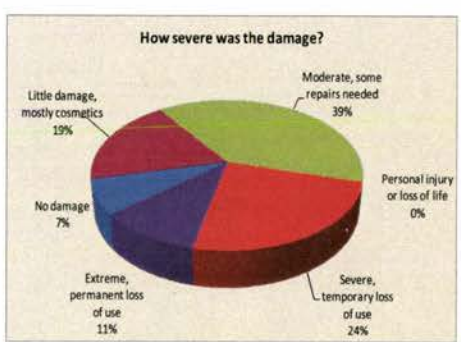
Question 9: How severe was the damage?

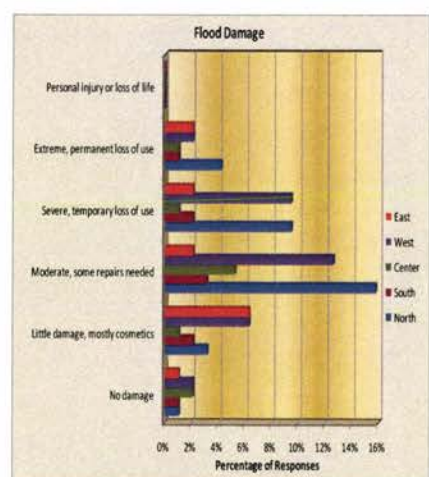
About 38% of the respondents had moderate damage, and about 24% had severe damage. Fortunately, there was no respondent who had personal injury or lost their family.

Response Counts

Description	Value	Count	%
No damage	0	7	7.37%
Little damage, mostly cosmetics	1	18	18.95%
Moderate, some repairs needed	2	37	38.95%
Severe, temporary loss of use	3	23	24.21%
Extreme, permanent loss of use	4	10	10.53%
Personal injury or loss of life	5	0	0.00%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	201	76	18	18	65	24
Minimum	0	0	0	0	0	0
Maximum	4	4	4	4	4	4
Mean	2.1158	2.3750	2.0000	1.8000	2.0968	1.8462
Median	2	2	2	2	2	1
Mode	2	2	2	2	2	1
Standard Deviation	1.0705	0.9419	1.2247	1.2293	1.0118	1.2810
Sample Variance	1.1460	0.8871	1.5000	1.5111	1.0237	1.6410
Kurtosis	-0.4365	0.2737	-0.2857	0.1446	-0.2328	-0.7898
Skewness	-0.0759	-0.1081	0.0000	0.0179	-0.2045	0.6154





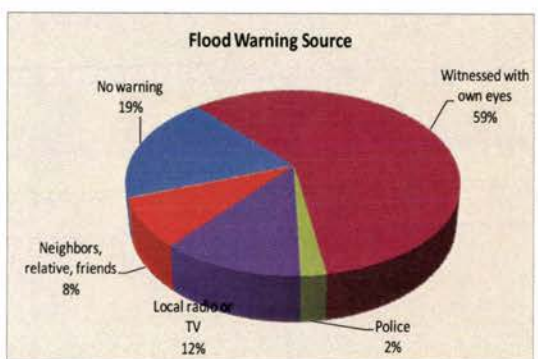
Question 10: In this biggest flood, where did you hear the flood warning?

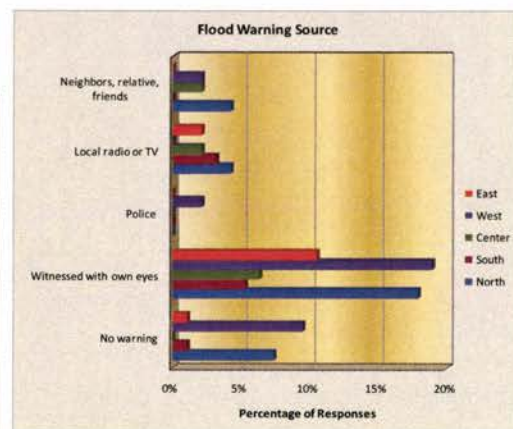
Most of the respondents did not receive any warning (58.95%) or witnessed with their own eyes (18.95%). Only about 12 percent of the respondents heard flood warning from local radio or television.

Response Counts

Description	Value	Count	%
No warning	0	18	18.95%
Witnessed with own eyes	1	56	58.95%
Police	2	2	2.11%
Local radio or TV	3	11	11.58%
Neighbors, relative, friends	4	8	8.42%
Other	5	0	0.00%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	125	45	14	20	30	16
Minimum	0	0	0	1	0	0
Maximum	4	4	3	4	4	3
Mean	1.3158	1.4063	1.5556	2.0000	0.9677	1.2308
Median	1	1	1	1	1	1
Mode	1	1	1	1	1	1
Standard Deviation	1.1602	1.3164	1.1304	1.3333	0.9826	0.8321
Sample Variance	1.3460	1.7329	1.2778	1.7778	0.9656	0.6923
Kurtosis	0.3989	-0.2537	-1.3902	-1.5770	4.5037	2.3782
Skewness	1.1492	0.9863	0.4918	0.7031	1.8703	1.5539



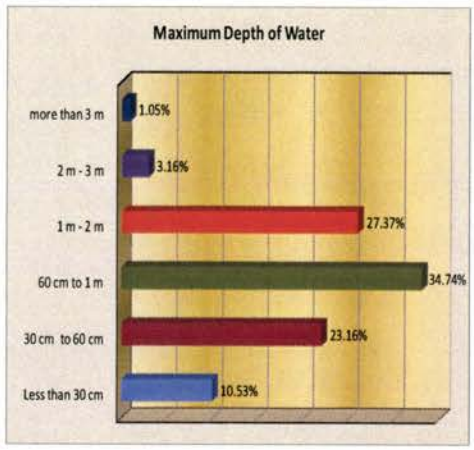


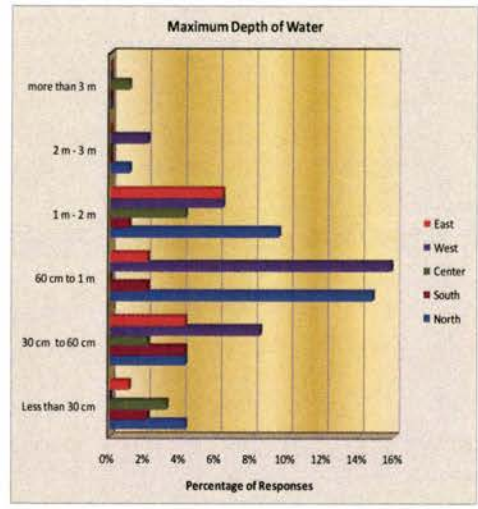
Question 11: What was the maximum depth of water over your grounds?

Response Counts

Description	Value	Count	%
Less than 30 cm	1	10	10.53%
30 cm to 60 cm	2	22	23.16%
60 cm to 1 m	3	33	34.74%
1 m - 2 m	4	26	27.37%
2 m - 3 m	5	3	3.16%
more than 3 m	6	1	1.05%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	278	95	20	29	95	39
Minimum	1	1	1	1	2	1
Maximum	6	5	4	6	5	4
Mean	2.9263	2.9688	2.2222	2.9000	3.0645	3.0000
Median	3	3	2	3	3	3
Mode	3	3	2	4	3	4
Standard Deviation	1.0743	1.0313	0.9718	1.7288	0.8538	1.0801
Sample Variance	1.1541	1.0635	0.9444	2.9889	0.7290	1.1667
Kurtosis	-0.2616	-0.1699	-0.0089	-0.9527	-0.0355	-1.2935
Skewness	-0.0086	-0.4991	0.5015	0.3516	0.5586	-0.4689





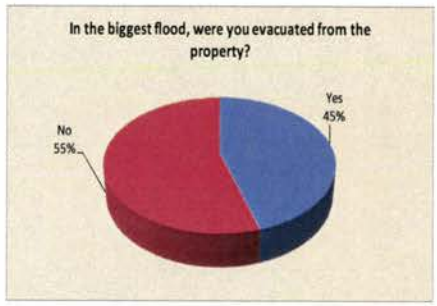
Question 12: <u>In the biggest flood, were you evacuated from the property</u>?

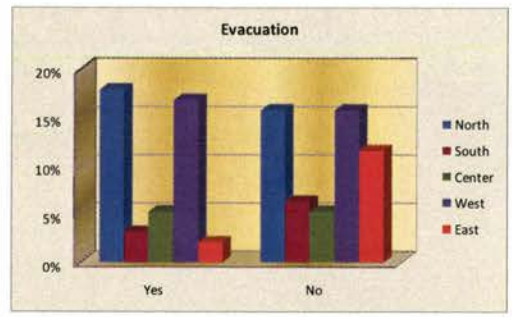
About 45% of the respondents were evacuated from their property and most of them stayed with their families and friends (62.79%), in community facilities or shelter (25.58%), and 11.63% stayed at a local hotel.

<u>Response Counts</u>

Description	Value	Count	%
Yes	1	43	45.26%
No	0	52	54.74%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	43	17	3	5	16	2
Minimum	0	0	0	0	0	0
Maximum	1	1	1	1	1	1
Mean	0.4526	0.5313	0.3333	0.5000	0.5161	0.1538
Median	0	1	0	0.5	1	0
Mode	0	1	0	1	1	0
Standard Deviation	0.5004	0.5070	0.5000	0.5270	0.5080	0.3755
Sample Variance	0.2504	0.2571	0.2500	0.2778	0.2581	0.1410
Kurtosis	-2.0053	-2.1195	-1.7143	-2.5714	-2.1379	3.2231
Skewness	0.1934	-0.1315	0.8571	0.0000	-0.0679	2.1787





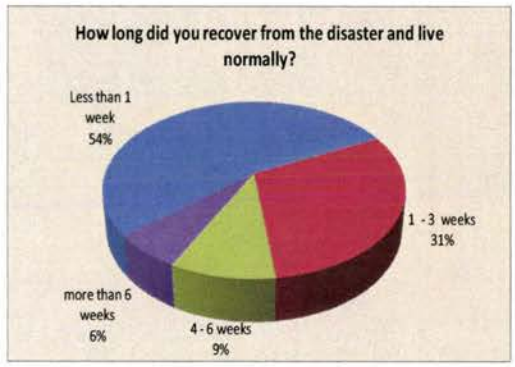
Question 13: <u>How long did you need to recover from the disaster and live normally</u>?

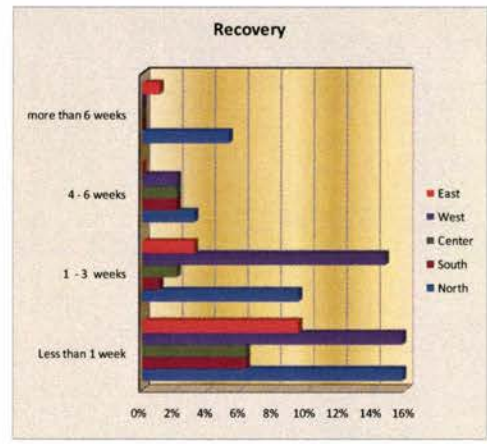
More than half of the respondents (53.68%) needed less than one week to recover from disaster. About 30% of the respondents needed one to three weeks to recover, and about 6% of them needed more than 6 weeks.

Response Counts

Description	Value	Count	%
Less than 1 week	1	51	53.68%
1 - 3 weeks	2	29	30.53%
4 - 6 weeks	3	9	9.47%
more than 6 weeks	4	6	6.32%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	160	62	14	16	49	19
Minimum	1	1	1	1	1	1
Maximum	4	4	3	3	3	4
Mean	1.6842	1.9375	1.5556	1.6000	1.5806	1.4615
Median	1	2	1	1	2	1
Mode	1	1	1	1	1	1
Standard Deviation	0.8904	1.1053	0.8819	0.8433	0.6204	0.8771
Sample Variance	0.7928	1.2218	0.7778	0.7111	0.3849	0.7692
Kurtosis	0.7083	-0.5363	-0.4461	-0.6655	-0.5069	5.9020
Skewness	1.2253	0.8945	1.1917	1.0006	0.5691	2.3270





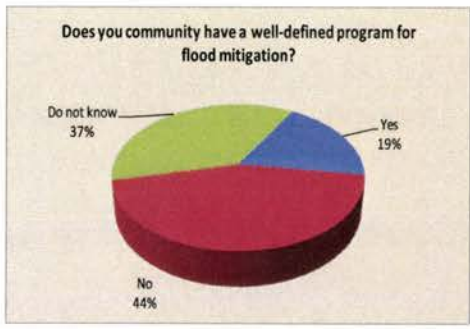
Question 14: Does your community have a well-defined program for flood mitigation?

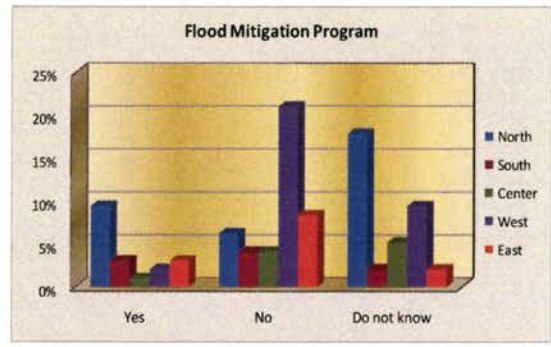
Only 18.95% of the respondents indicated that their communities have some kind of flood mitigation program. About 37% of the respondents did not know about that matter, and the rest of the respondents (44.21%) indicated that there is not any flood mitigation program in their neighborhood.

Response Counts

Description	Value	Count	%
Yes	1	18	18.95%
No	0	42	44.21%
Do not know	-1	35	36.84%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	-15	-8	1	-4	-5	1
Minimum	-1	-1	-1	-1	-1	-1
Maximum	2	1	1	1	2	1
Mean	-0.1579	-0.2500	0.1111	-0.4000	-0.1613	0.0769
Median	0	-1	0	-0.5	0	0
Mode	0	-1	0	-1	0	0
Standard Deviation	0.7624	0.8799	0.7817	0.6992	0.6878	0.6405
Sample Variance	0.5812	0.7742	0.6111	0.4889	0.4731	0.4103
Kurtosis	-0.6923	-1.5255	-1.0413	-0.1461	2.1187	0.0609
Skewness	0.4231	0.5304	-0.2160	0.7801	0.8757	-0.0532





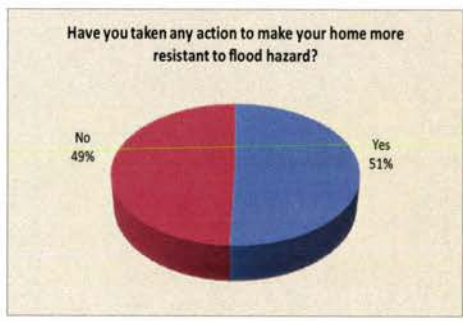
Question 15: <u>Have you taken any action to make your home or neighborhood more resistant to flood hazard</u>?

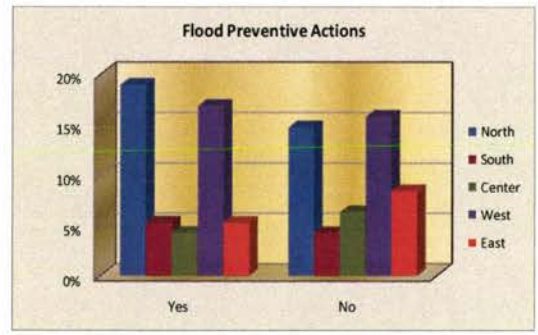
The proportion of respondents that have taken actions to make their home flood resistant is slightly higher than those who have not. Most of the Center and East Jakarta respondents have not taken any action to make their home resistant to flood hazard.

<u>Response Counts</u>

Description	Value	Count	%
Yes	1	48	50.53%
No	0	47	49.47%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	50	18	5	4	18	5
Minimum	0	0	0	0	0	0
Maximum	2	1	1	1	2	1
Mean	0.5263	0.5625	0.5556	0.4000	0.5806	0.3846
Median	1	1	1	0	1	0
Mode	1	1	1	0	1	0
Standard Deviation	0.5227	0.5040	0.5270	0.5164	0.5642	0.5064
Sample Variance	0.2732	0.2540	0.2778	0.2667	0.3183	0.2564
Kurtosis	-1.4786	-2.0633	-2.5714	-2.2768	-0.8550	-2.0564
Skewness	0.1214	-0.2645	-0.2711	0.4841	0.2577	0.5386





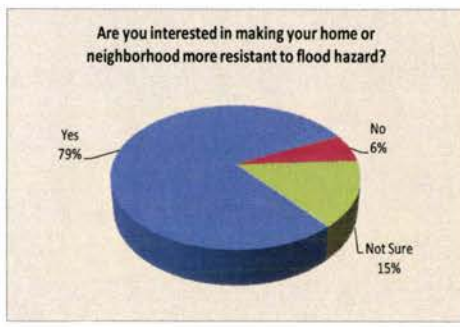
Question 16: <u>Are you interested in making your home or neighborhood more resistant to flood hazard</u>?

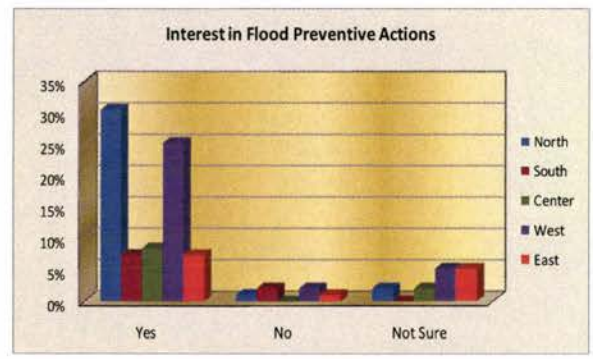
The majority (78.9%) of the respondents expressed interest to make their home more resistant to flood hazard, while about 15% of them were still not sure whether they were going to take any preventive action.

Response Counts

Description	Value	Count	%
Yes	1	75	78.9%
No	0	6	6.3%
Not Sure	-1	14	14.7%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	95	32	9	10	31	13
Sum	61	27	7	6	19	2
Minimum	-1	-1	0	-1	-1	-1
Maximum	1	1	1	1	1	1
Mean	0.6421	0.8438	0.7778	0.6000	0.6129	0.1538
Median	1	1	1	1	1	1
Mode	1	1	1	1	1	1
Standard Deviation	0.7281	0.5149	0.4410	0.8433	0.7606	0.9871
Sample Variance	0.5301	0.2651	0.1944	0.7111	0.5785	0.9744
Kurtosis	1.1001	9.8527	0.7347	1.4063	0.8923	-2.1189
Skewness	-1.6933	-3.2832	-1.6198	-1.7788	-1.6235	-0.3526





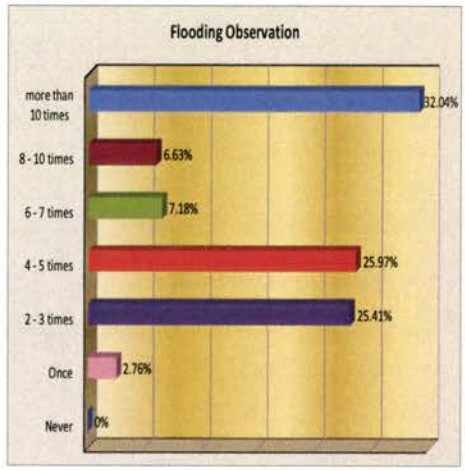
Question 18: How many times have you observed flooding in the city of Jakarta?

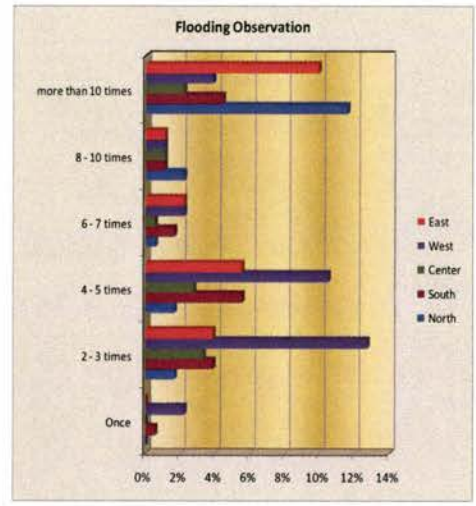
Overall, 32.04% of the respondents indicated that they have observed more than 10 times of flooding in Jakarta; most of them are North and East Jakarta residents. About 26% of the respondents have observed flooding 4 to 5 times, and about 25% of them had observed flooding 2 to 3 times during their stay in Jakarta.

Response Counts

Description	Value	Count	%
Never	0	0	0.00%
Once	1	5	2.76%
2 - 3 times	2	46	25.41%
4 - 5 times	3	47	25.97%
6 - 7 times	4	13	7.18%
8 - 10 times	5	12	6.63%
more than 10 times	6	58	32.04%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	698	165	115	65	175	178
Minimum	1	2	1	2	1	2
Maximum	6	6	6	6	6	6
Mean	3.8564	5.1563	3.7097	3.6111	2.9661	4.3415
Median	3	6	3	3	3	4
Mode	6	6	3	2	2	6
Standard Deviation	1.6936	1.3938	1.6164	1.6139	1.4016	1.6372
Sample Variance	2.8681	1.9425	2.6129	2.6046	1.9643	2.6805
Kurtosis	-1.5497	0.5774	-1.2855	-1.4025	0.3649	-1.7049
Skewness	0.1723	-1.4406	0.3546	0.5308	1.0734	-0.1884





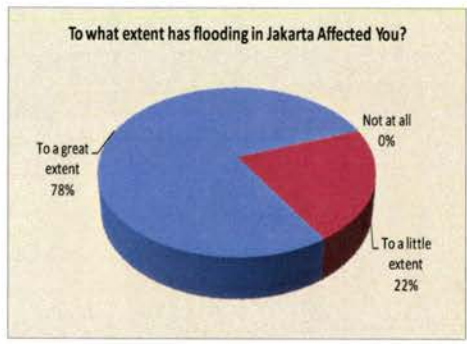
Question 19: To what extent has flooding in Jakarta affected you?

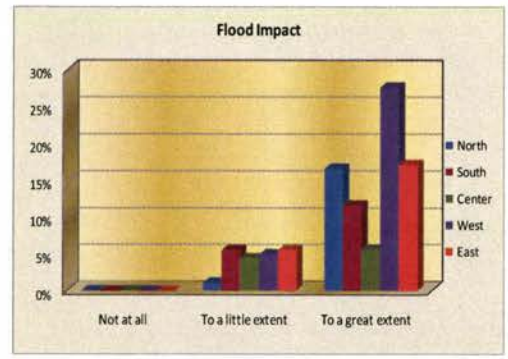
Most of the respondents (78.45%) expressed that flooding had a great effect on their lives, and the rest of the respondents stated that flooding had not affected their lives much.

Response Counts

Description	Value	Count	%
Not at all	0	0	0.00%
To a little extent	1	39	21.55%
To a great extent	2	142	78.45%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	323	62	52	28	109	72
Minimum	1	1	1	1	1	1
Maximum	2	2	2	2	2	2
Mean	1.7845	1.9375	1.6774	1.5556	1.8475	1.7561
Median	2	2	2	2	2	2
Mode	2	2	2	2	2	2
Standard Deviation	0.4123	0.2459	0.4752	0.5113	0.3626	0.4348
Sample Variance	0.1700	0.0605	0.2258	0.2614	0.1315	0.1890
Kurtosis	-0.0528	13.2267	-1.4616	-2.1994	2.0012	-0.4926
Skewness	-1.3957	-3.7950	-0.7982	-0.2445	-1.9835	-1.2385



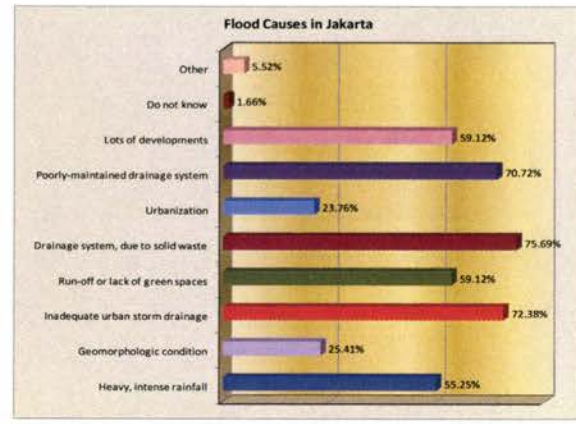


Question 20: <u>In your opinion, what is (are) the cause(s) of flooding in Jakarta</u>?

Most of the respondents believed that drainage system inadequacies as well as their conditions are the major factors contributed to flooding problem in Jakarta. Other factors included heavy rainfall, lack of greens spaces and lots of developments. Only about 24% of the respondent believed that urbanization have also caused flooding in Jakarta.

<u>Response Counts</u>

Description	Count	%
Heavy, intense rainfall	100	55.25%
Geomorphologic condition	46	25.41%
Inadequate urban storm drainage	131	72.38%
Run-off or lack of green spaces	107	59.12%
Drainage system, due to solid waste	137	75.69%
Urbanization	43	23.76%
Poorly-maintained drainage system	128	70.72%
Lots of developments	107	59.12%
Do not know	3	1.66%
Other	10	5.52%



Descriptive Statistics	Overall									
	a	b	c	d	e	f	g	h	i	j
Count	181	181	181	181	181	181	181	181	181	181
Sum	102	46	131	107	137	43	128	107	3	10
Minimum	0	0	0	0	0	0	0	0	0	0
Maximum	2	1	1	1	1	1	1	1	1	1
Mean	0.5635	0.2541	0.7238	0.5912	0.7569	0.2376	0.7072	0.5912	0.0166	0.0552
Median	1	0	1	1	1	0	1	1	0	0
Mode	1	0	1	1	1	0	1	1	0	0
Standard Deviation	0.5084	0.4366	0.4484	0.4930	0.4301	0.4268	0.4563	0.4930	0.1280	0.2291
Sample Variance	0.2584	0.1906	0.2010	0.2430	0.1850	0.1821	0.2082	0.2430	0.0164	0.0525
Kurtosis	-1.6786	-0.7110	-0.9926	-1.8811	-0.5472	-0.4587	-1.1699	-1.8811	56.9441	13.5632
Skewness	-0.1299	1.1389	-1.0092	-0.3740	-1.2079	1.2436	-0.9182	-0.3740	7.6364	3.9260

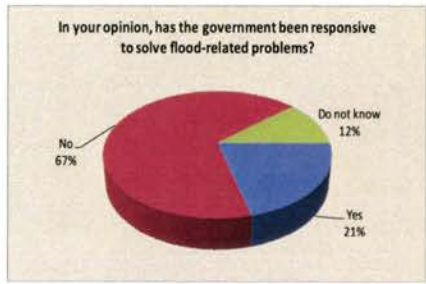
Question 21: <u>In your opinion, has the local government been responsive to solve flood-related problems</u>?

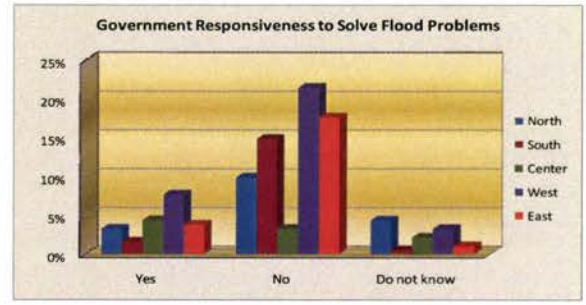
Only 20.99% of the respondents believed that the local government has been responsive to solve the problem, while 67.4% of the respondents thought otherwise.

<u>Response Counts</u>

Description	Value	Count	%
Yes	1	38	20.99%
No	0	122	67.40%
Do not know	-1	21	11.60%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	17	-2	2	4	8	5
Minimum	-1	-1	-1	-1	-1	-1
Maximum	1	1	1	1	1	1
Mean	0.0939	-0.0625	0.0645	0.2222	0.1356	0.1220
Median	0	0	0	0	0	0
Mode	0	0	0	1	0	0
Standard Deviation	0.5647	0.6690	0.3592	0.8085	0.5711	0.4580
Sample Variance	0.3189	0.4476	0.1290	0.6536	0.3261	0.2098
Kurtosis	0.0948	-0.6113	5.4365	-1.2837	0.0398	1.6052
Skewness	0.0211	0.0700	0.9552	-0.4515	0.0152	0.5078





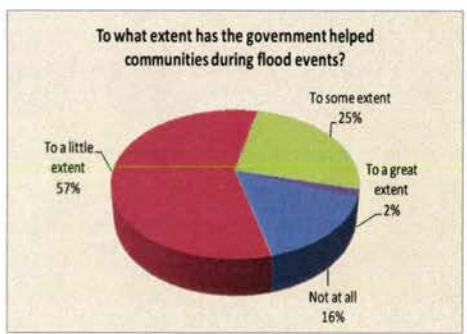
Question 22: <u>To what extent has the local government helped communities during flooding</u>?

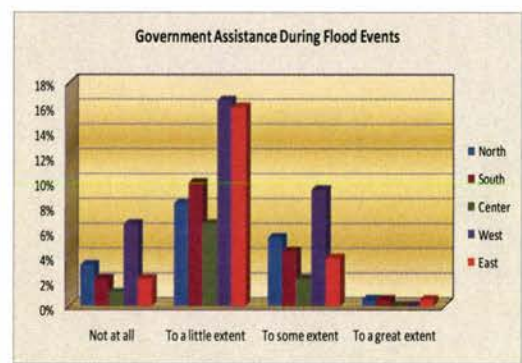
Only 1.66% of the respondents felt that the local government had helped their community to a great extent. More than half of the total respondents (57.46%) stated that the government did not much help them during flood events.

<u>Response Counts</u>

Description	Value	Count	%
Not at all	0	28	15.47%
To a little extent	1	104	57.46%
To some extent	2	46	25.41%
To a great extent	3	3	1.66%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	203	38	37	18	64	46
Minimum	-1	0	0	-1	0	0
Maximum	3	3	3	2	2	3
Mean	1.121547	1.1875	1.193548	1	1.084746	1.121951
Median	1	1	1	1	1	1
Mode	1	1	1	1	1	1
Standard Deviation	0.696523	0.780302	0.703295	0.766965	0.701922	0.599797
Sample Variance	0.485144	0.608871	0.494624	0.588235	0.492694	0.359756
Kurtosis	0.105498	-0.45157	0.365983	1.717	-0.91314	1.911105
Skewness	0.030462	0.084871	0.3236	-0.88009	-0.11874	0.689499





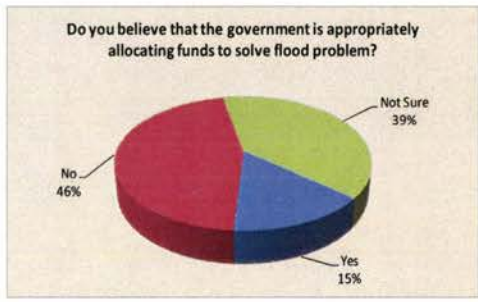
Question 23: <u>Do you believe that the government is appropriately allocating funds to solve flood problem</u>?

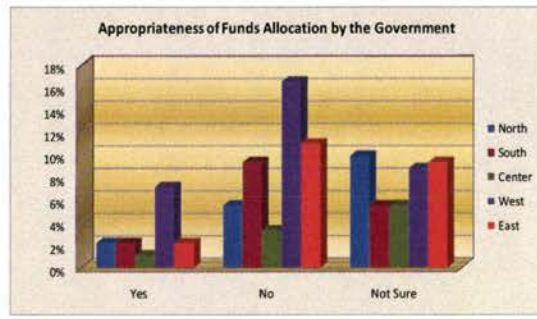
About 15% of the respondents believed that the government has appropriately allocated funds to solve the problem. On the contrary, 45.86% of the respondents did not believe that the government has allocated the funds appropriately, and the rest of them (39.23%) were not sure what to think about that matter.

Response Counts

Description	Value	Count	%
Yes	1	27	14.92%
No	0	83	45.86%
Not Sure	-1	71	39.23%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	-44	-14	-6	-8	-3	-13
Minimum	-1	-1	-1	-1	-1	-1
Maximum	1	1	1	1	1	1
Mean	-0.2431	-0.4375	-0.1935	-0.4444	-0.0508	-0.3171
Median	0	-1	0	-1	0	0
Mode	0	-1	0	-1	0	0
Standard Deviation	0.6964	0.7156	0.6542	0.7048	0.7052	0.6496
Sample Variance	0.4850	0.5121	0.4280	0.4967	0.4974	0.4220
Kurtosis	-0.9004	-0.4399	-0.5744	-0.2516	-0.9326	-0.6388
Skewness	0.3704	0.8935	0.2138	0.9148	0.0716	0.4182





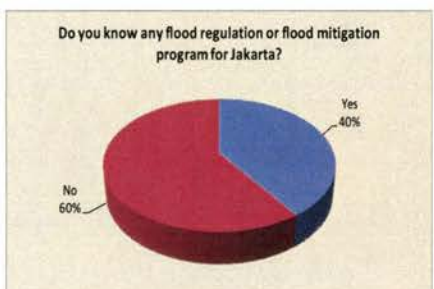
Question 24: Do you know any flood regulation or flood mitigation program for Jakarta?

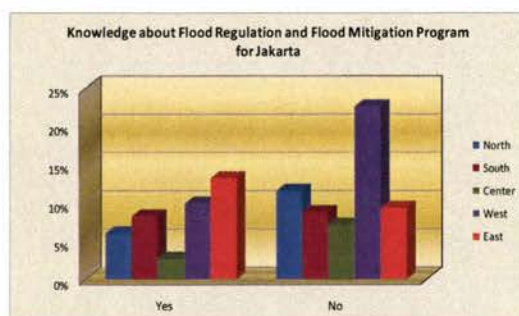
Only about 40% of the respondents have knowledge about flood regulation for Jakarta area, and most of them are East Jakarta respondents.

Response Counts

Description	Value	Count	%
Yes	1	73	40.33%
No	0	108	59.67%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	73	11	15	5	18	24
Minimum	0	0	0	0	0	0
Maximum	1	1	1	1	1	1
Mean	0.4033	0.3438	0.4839	0.2778	0.3051	0.5854
Median	0	0	0	0	0	1
Mode	0	0	0	0	0	1
Standard Deviation	0.4919	0.4826	0.5080	0.4609	0.4644	0.4988
Sample Variance	0.2420	0.2329	0.2581	0.2124	0.2157	0.2488
Kurtosis	-1.8627	-1.6289	-2.1379	-0.9415	-1.2900	-1.9691
Skewness	0.3975	0.6908	0.0679	1.0849	0.8689	-0.3599





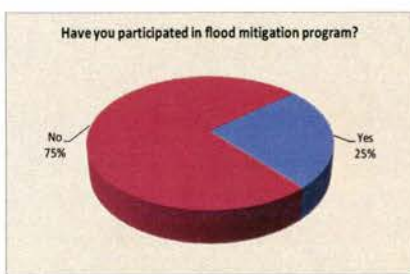
Question 25: Have you participated in any flood mitigation program?

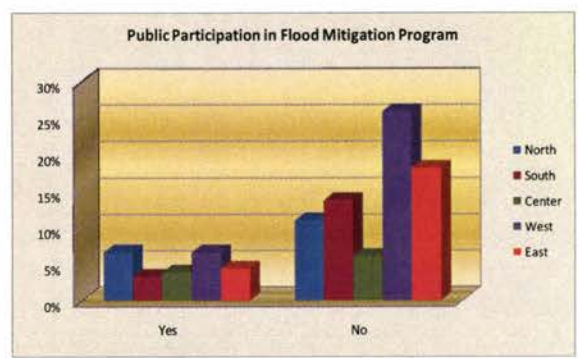
The majority (75.14%) of the respondent have not participated in any flood mitigation program. However, about 56% of them expressed interest in participating in the program. Only 15% of the respondents who have not participated do not have interest to join the program.

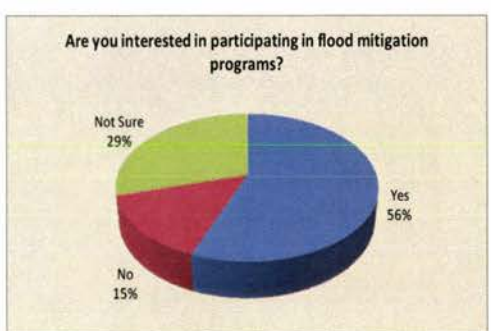
Response Counts

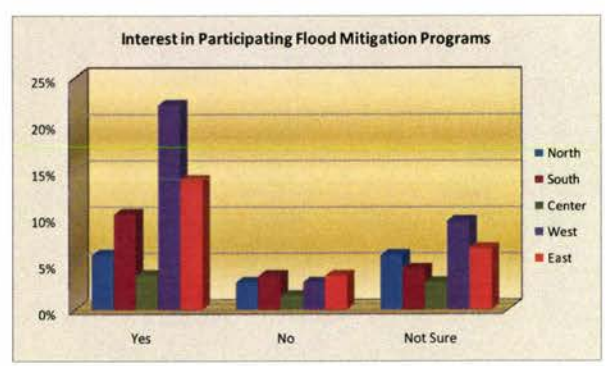
Description	Value	Count	%
Yes	1	45	24.86%
No	0	136	75.14%

Descriptive Statistics	Overall	Location				
		1	2	3	4	5
Count	181	32	31	18	59	41
Sum	45	12	6	7	12	8
Minimum	0	0	0	0	0	0
Maximum	1	1	1	1	1	1
Mean	0.2486	0.3750	0.1935	0.3889	0.2034	0.1951
Median	0	0	0	0	0	0
Mode	0	0	0	0	0	0
Standard Deviation	0.4334	0.4919	0.4016	0.5016	0.4060	0.4012
Sample Variance	0.1878	0.2419	0.1613	0.2516	0.1648	0.1610
Kurtosis	-0.6312	-1.8244	0.7025	-1.9870	0.2965	0.5785
Skewness	1.1730	0.5421	1.6314	0.4984	1.5125	1.5977





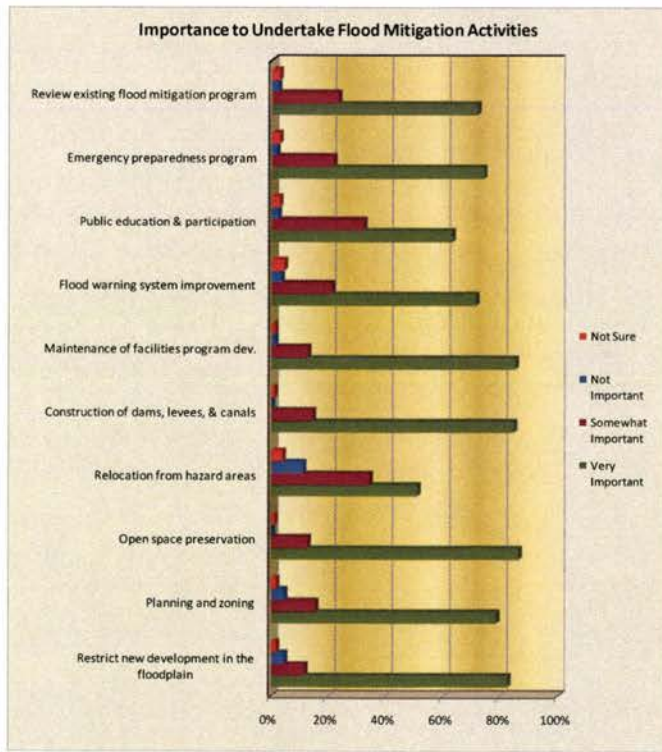




Question 26: How important is it for the local government to undertake the following activities?

Response	Very Important		Somewhat Important		Not Important		Not Sure	
Value	2		1		0		-1	
Restrict new development in the floodplain	149	82.32%	21	11.60%	8	4.42%	3	1.66%
Planning and zoning	142	78.45%	28	15.47%	8	4.42%	3	1.66%
Open space preservation	156	86.19%	23	12.71%	0	0.00%	2	1.10%
Relocation from hazard areas	92	50.83%	62	34.25%	20	11.05%	7	3.87%
Construction of dams, levees, & canals	153	84.53%	26	14.36%	0	0.00%	2	1.10%
Maintenance of facilities program dev.	154	85.08%	23	12.71%	2	1.10%	2	1.10%
Flood warning system improvement	129	71.27%	38	20.99%	6	3.31%	8	4.42%
Public education & participation	114	62.98%	58	32.04%	4	2.21%	5	2.76%
Emergency preparedness program	134	74.03%	39	21.55%	3	1.66%	5	2.76%
Review existing flood mitigation program	130	71.82%	42	23.20%	4	2.21%	5	2.76%

Descriptive Statistics	Activity									
	a	b	c	d	e	f	g	h	i	j
Count	181	181	181	181	181	181	181	181	181	181
Sum	316	309	333	239	330	329	288	281	302	297
Minimum	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Maximum	2	2	2	2	2	2	2	2	2	2
Mean	1.7459	1.7072	1.8398	1.3204	1.8232	1.8177	1.5912	1.5525	1.6685	1.6409
Median	2	2	2	2	2	2	2	2	2	2
Mode	2	2	2	2	2	2	2	2	2	2
Standard Deviation	0.6160	0.6302	0.4494	0.8213	0.4615	0.4887	0.7592	0.6780	0.6503	0.6652
Sample Variance	0.3795	0.3971	0.2020	0.6745	0.2130	0.2388	0.5764	0.4597	0.4228	0.4425
Kurtosis	6.9993	5.5865	16.8903	0.5349	14.5634	12.8995	3.9924	3.6199	6.1438	5.2039
Skewness	-2.6660	-2.3719	-3.6382	-1.0817	-3.3520	-3.2925	-2.0847	-1.7604	-2.3642	-2.1906

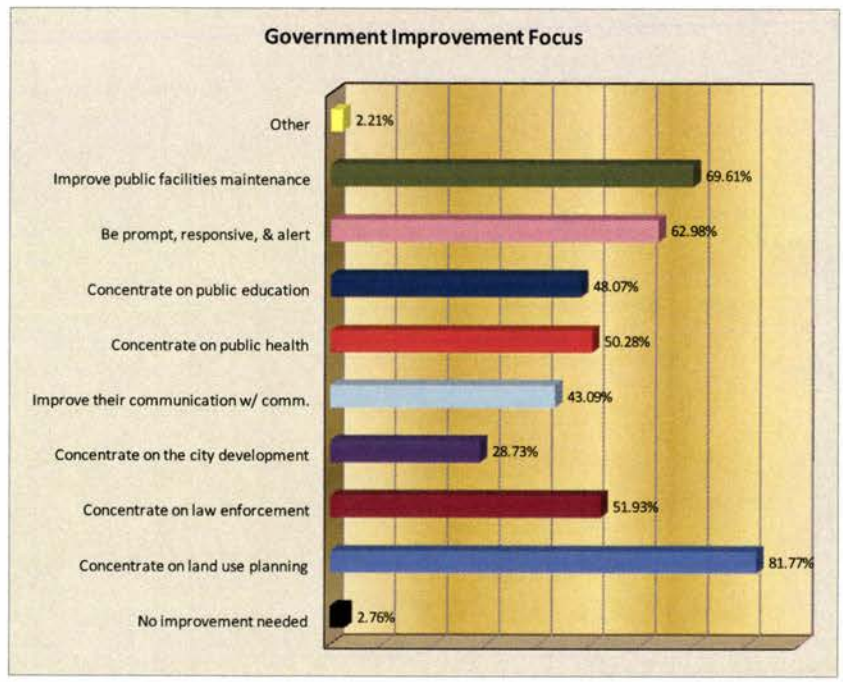


Question 27: In what ways could the government improve their performance?

Response Counts

Description	Count	%
No improvement needed	5	2.76%
Concentrate on land use planning	148	81.77%
Concentrate on law enforcement	94	51.93%
Concentrate on the city development	52	28.73%
Improve their communication w/ comm.	78	43.09%
Concentrate on public health	91	50.28%
Concentrate on public education	87	48.07%
Be prompt, responsive, & alert	114	62.98%
Improve public facilities maintenance	126	69.61%
Other	4	2.21%

Descriptive Statistics	Improvement									
	a	b	c	d	e	f	g	h	i	j
Count	181	181	181	181	181	181	181	181	181	181
Sum	5	148	94	52	78	91	87	114	126	4
Minimum	1	1	1	1	1	1	1	1	1	1
Maximum	0	0	0	0	0	0	0	0	0	0
Mean	0.0276	0.8177	0.5193	0.2873	0.4309	0.5028	0.4807	0.6298	0.6961	0.0223
Median	0	1	1	0	0	1	0	1	1	0
Mode	0	1	1	0	0	1	0	1	1	0
Standard Deviation	0.1643	0.3872	0.5010	0.4538	0.4966	0.5014	0.5010	0.4842	0.4612	0.1482
Sample Variance	0.0270	0.1499	0.2510	0.2059	0.2466	0.2514	0.2510	0.2344	0.2127	0.0220
Kurtosis	32.1424	0.7617	-2.0163	-1.1137	-1.9425	-2.0223	-2.0163	-1.7251	-1.2746	40.9409
Skewness	5.8127	-1.6593	-0.0781	0.9480	0.2813	-0.0111	0.0781	-0.5423	-0.8600	6.5179



❑ Test of Independence: Contingency Table

Cross-tabulation (pivot table) and contingency table (chi-square independent test) is used to analyze relationship between several variables in the questionnaire data. For instance, this method could be used whether there is relationship between location and public participation. For this questionnaire, it is determined that if the probability is lower than 0.05, the two variables have relationship; otherwise it cannot be concluded any relationship between the two variables in the contingency table. Some of the tests that have been completed are as follows:

- Location and floodplain area relationship

Chi-square Test

Actual Value	Location					Grand Total
Floodplain	1	2	3	4	5	
-1	4	2	1	4	4	15
0	6	21	7	29	32	95
1	22	8	10	26	5	71
Grand Total	32	31	18	59	41	181

Expected Value	Location					Grand Total
Floodplain	1	2	3	4	5	
-1	2.652	2.569	1.492	4.890	3.398	15
0	16.796	16.271	9.448	30.967	21.519	95
1	12.552	12.160	7.061	23.144	16.083	71
Grand Total	32	31	18	59	41	181

Probability **5.748E-05**

- Location and flooding problem relationship

Chi-square Test

Actual Value	Location					Grand Total
Flooding Problem	1	2	3	4	5	
0	0	22	8	28	28	86
1	32	9	10	31	13	95
Grand Total	32	31	18	59	41	181

Expected Value	Location					Grand Total
Flooding Problem	1	2	3	4	5	
0	15.204	14.729	8.552	28.033	19.481	86
1	16.796	16.271	9.448	30.967	21.519	95
Grand Total	32	31	18	59	41	181

Probability **1.048E-08**

- Location and flood damage relationship

Chi-square Test

Actual Value	Location					Grand Total
Flood Damage	1	2	3	4	5	
0	1	1	2	2	1	7
1	3	2	1	6	6	18
2	15	3	5	12	2	37
3	9	2	1	9	2	23
4	4	1	1	2	2	10
Grand Total	32	9	10	31	13	95

Expected Value	Location					Grand Total
Flood Damage	1	2	3	4	5	
0	2.358	0.663	0.737	2.284	0.958	7
1	6.063	1.705	1.895	5.874	2.463	18
2	12.463	3.505	3.895	12.074	5.063	37
3	7.747	2.179	2.421	7.505	3.147	23
4	3.368	0.947	1.053	3.263	1.368	10
Grand Total	32	9	10	31	13	95

Probability **0.475**

- Location and flood mitigation program existence relationship

Chi-square Test

Actual Value	Location					Grand Total
Flood Mitigation Program	1	2	3	4	5	
-1	17	2	5	9	2	35
0	6	4	4	20	8	42
1	9	3	1	2	3	18
Grand Total	32	9	10	31	13	95

Expected Value	Location					Grand Total
Flood Mitigation Program	1	2	3	4	5	
-1	11.789	3.316	3.684	11.421	4.789	35
0	14.147	3.979	4.421	13.705	5.747	42
1	6.063	1.705	1.895	5.874	2.463	18
Grand Total	32	9	10	31	13	95

Probability **0.0127**

- Location and flood preventive action relationship

Chi-square Test

Actual Value	Location					Grand Total
Flood Preventive Action	1	2	3	4	5	
0	14	4	6	15	8	47
1	18	5	4	16	5	48
Grand Total	32	9	10	31	13	95

Expected Value	Location					Grand Total
Flood Preventive Action	1	2	3	4	5	
0	15.832	4.453	4.947	15.337	6.432	47
1	16.168	4.547	5.053	15.663	6.568	48
Grand Total	32	9	10	31	13	95

Probability **0.786**

- Location and public knowledge on flood regulation relationship

Chi-square Test

Actual Value	Location					Grand Total
Flood Regulation Knowledge	1	2	3	4	5	
0	21	16	13	41	17	108
1	11	15	5	18	24	73
Grand Total	32	31	18	59	41	181

Expected Value	Location					Grand Total
Flood Regulation Knowledge	1	2	3	4	5	
0	19.094	18.497	10.740	35.204	24.464	108
1	12.906	12.503	7.260	23.796	16.536	73
Grand Total	32	31	18	59	41	181

Probability **0.0328**

- Location and public participation relationship

Chi-square Test

Actual Value	Location					Grand Total
Public Participation	1	2	3	4	5	
0	20	25	11	47	33	136
1	12	6	7	12	8	45
Grand Total	32	31	18	59	41	181

Expected Value	Location					Grand Total
Public Participation	1	2	3	4	5	
0	24.044	23.293	13.525	44.331	30.807	136
1	7.956	7.707	4.475	14.669	10.193	45
Grand Total	32	31	18	59	41	181

Probability **0.1706**

- Location and public view on government assistance relationship

Chi-square Test

Actual Value	Location					Grand Total
Government Assistance	1	2	3	4	5	
0	6	4	2	12	4	28
1	15	18	12	30	29	104
2	10	8	4	17	7	46
3	1	1	0	0	1	3
Grand Total	32	31	18	59	41	181

Expected Value	Location					Grand Total
Government Assistance	1	2	3	4	5	
0	4.950	4.796	2.785	9.127	6.343	28
1	18.387	17.812	10.343	33.901	23.558	104
2	8.133	7.878	4.575	14.994	10.420	46
3	0.530	0.514	0.298	0.978	0.680	3
Grand Total	33	31	18	59	41	181

Probability **0.691**

❑ Conclusion

The questionnaire results indicate the current conditions in Jakarta as follows:

❖ People's perception on the causes of flooding

Most of the respondents thought that natural and technical factors are the primary causes of flooding in Jakarta, while urbanization and population density are not really contributed to the problem.

In addition, from the chi-square test: there is relationship between locations and floodplain area as well as between locations and flooding problem existence. However, there is no relationship between location and flood damage.

❖ Community awareness, willingness and participation

- The majority of the respondents did not know about flood mitigation program or flood regulations for Jakarta.
- Most of the respondents did not receive any flood warning.
- Almost half of the respondents have not taken any action to make their home or neighborhood flood-resistant, but they expressed great concern on reducing flood risk in their area.
- Most of the communities do not have any flood mitigation program and the majority of the respondents have not participated, however they expressed interest to join the program.
- From the chi-square test: there is relationship between locations and flood mitigation program existence as well as between locations and flood regulation knowledge. However, it can be considered that there is no relationship between locations and public participation.

❖ Public views on government efforts to solve flood problem

- There is lack of trust in the government where only 15% of the respondents believed that the government has appropriately allocated funds to solve flood problem in Jakarta.
- The majority of the respondents felt that the government has not been responsive enough to solve flood problem and there has been minimum assistance during flood events.
- From the chi-square test: there is no relationship between locations and public view on government assistance or performance.