

# STRENGTHENING COMMUNITY TO PREVENT FLOOD USING PARTICIPATORY APPROACH (A CASE OF THE SEMARANG CITY)

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## Abstract

The geography of the Semarang City makes this city is frequently suffered from flooding. Land subsidence and sea level rise are also the main causes of flood in the Semarang City. To cope with this condition, several programs have been made by the government to mitigate and to adapt floods in the Semarang City. By using comparative analysis, it concludes some programs are not successful yet. The effort made by the government to develop a program for coastal zone management and protection against flooding can be efficiently implemented through coordination and participation among stakeholders and the community. Making guidelines for participatory approach is very important step to make programs more understandable for multi-stakeholders. There are two types of guidelines which is the guideline of compensation and share information (Type I) and the guideline of share information only (Type II). From these guidelines, they will know their own roles and the benefits

of the programs.

Keywords; Participatory approach, mitigation and adaptation of floods

## 1. Introduction

The Semarang City is the capital city of Central Java Province of Indonesia and it is located at the northern Java Island with the total population of approximately 1.5 million (Figure 1). From the geographical view, it lies in the 0.5 m to 348 m above sea level. Based on Public Relation Division of the Semarang City (1993), the Semarang City with the area of 373.7 km<sup>2</sup> consists of the coastal zone and lowland area in the northern part (Kota Bawah) in the slope of 0 - 20 and upland areas in the southern part (Kota Atas) with the slope up to 450 (see Figure 2). In addition, the Kreo River and the Garang River divide the city of the Semarang City into eastern and western regions. The land use of the northern part is utilized to serve the activities of harbor, warehouses, and industrial matters, and its facilities such as residential, office, retail, public use, and open space. Southern part, in the past was used to serve the activities of agriculture using the large un-built areas as catchment region, but now gradually the southern part is developed to be built areas which serve the activities of education and housing matters, including its facilities, such as offices, retail, etc. The remains of the un-built area are still used for agricultural activities.

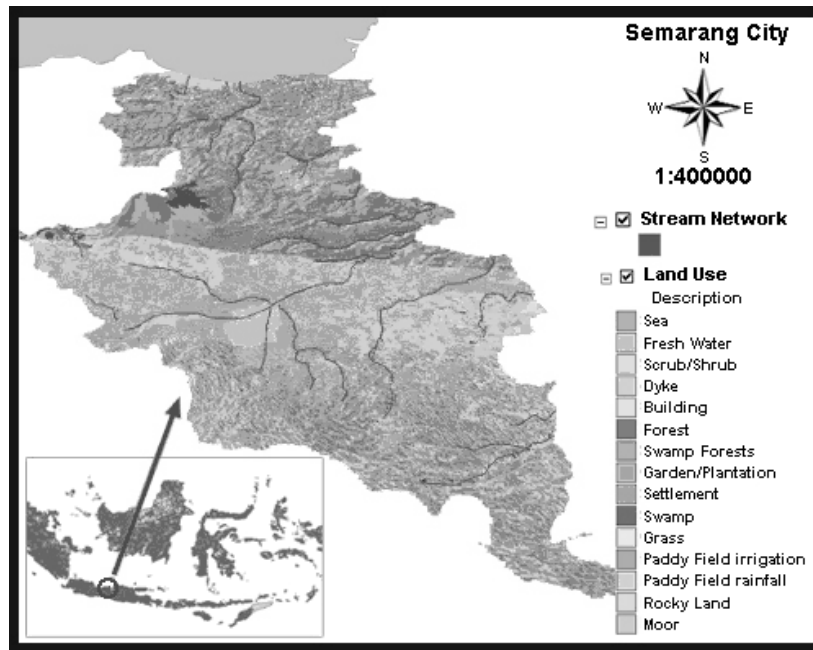


Figure 1: Position of the Semarang City in Indonesia

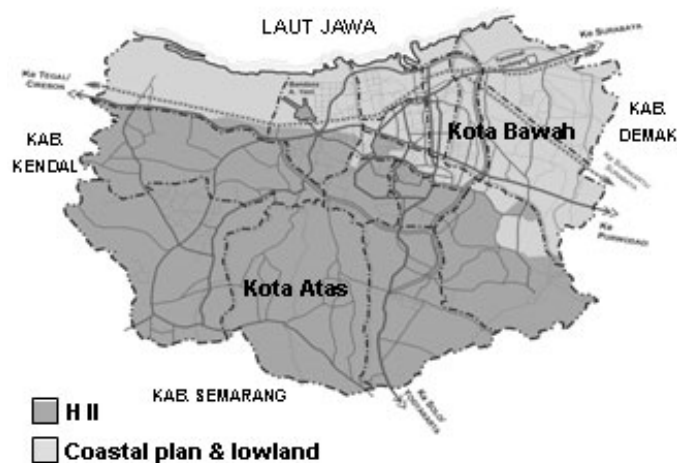


Figure 2: Existing Condition of the Semarang City Territory

In the 1990s, the development was more centralized in the northern coastal and low-lying areas, which led to rapid urbanization and environmental problems such as coastal erosion and sedimentation, over-exploitation of ground water resources, land subsidence, and tidal inundation. Due to this condition the Semarang City is frequently suffered from flooding. There are two types of flood in the Semarang city; first is caused by river flooding (from the hinterland); and second is caused by sea level rise or high tide.

To reduce negative impact of biophysical degradation against coastal areas, mitigation effort must be made. Mitigation, which is a process of various preventive measurement effort for minimizing negative impact of disaster that is anticipated from its occurrence in the future at certain areas, is a long term investment for the welfare of layers of community. To deal with disaster issue, it will require comprehensive mitigation effort which is a combination of physical/ structural effort (creation of infrastructure and control facility) and non-physical/ non-structural effort. There is tendency that a demand is directed more towards mitigation effort as compare to post-disaster response.

In order that coastal areas problems can be dealt with a more long lasting manner, without posing any damage to the ecosystem, a more comprehensive approach with a more holistic view are needed. For that purpose, a more comprehensive approach of development of coastal areas and balance of interest between the need of inland areas development and coastal areas development, and strengthening cooperation and partnership ties between stakeholder, are needed. To integrate various sector planning and to provide direction of sustainable coastal areas utilization have therefore summoned for an integrated coastal management concept.

Current flood risk management schemes are based on the accumulated knowledge of past weather events and scientific assessment based on the hydrological approach, without taking into account the long term impacts of climate change scenarios and the way that it would impact the frequency and intensity of floods. A promising approach to reducing the risk of urban floods is to adopt a strategy combining the present approaches that addresses multiple components of risk, with long term climate change scenarios in different spatial and temporal scales. A comprehensive risk reduction approach has to consider the aspects of reduction of impact considering the issues related to hazard, vulnerability and exposure in a manner that it considers not only the risk as at present but also future risks. A major challenge for the effective disaster risk reduction in the region is to ensure that risk reduction strategies are integrated with broad development strategies, as well as climate change adaptation efforts in an effective and efficient manner and the objectives are to:

1. Examine and share experiences on innovative strategies towards flood resilient cities;
2. Recommend policy options for effective urban flood management considering climate change.

Moreover, flood management should take account of: (1) reduction of deaths, (2) reduction of economic damage, and (3) enhancement of disaster preparedness.

The objective of this paper is to make a guideline how to mitigate and to adapt the floods in the Semarang City by using a participatory approach which involves multi-stakeholders in order to implement some projects successfully.

## **2. The Current Status of the Semarang City**

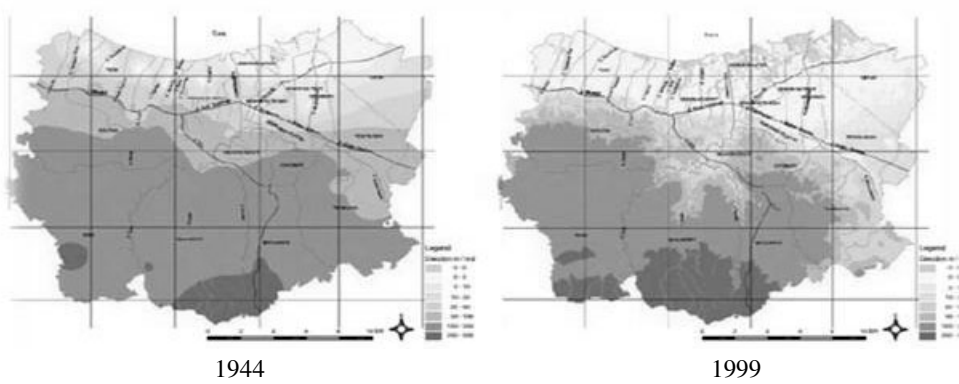
### **2.1. The Causes of Flood in the Semarang City**

#### **(1) Land Subsidence**

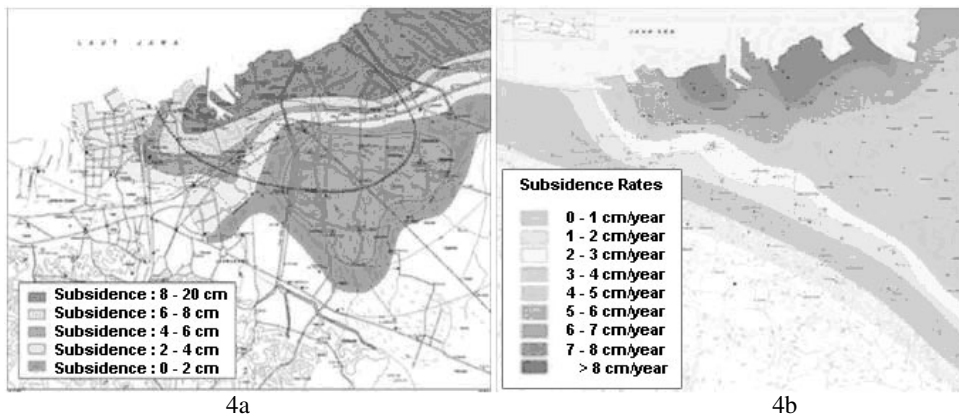
Due to the rapid growth of population and industrialization in the Semarang City, one of the impacts is groundwater over extraction. According to data provided by Ministry of Public Works the demand of water supply was 57.28 million m<sup>3</sup>/yr and 75.89 million m<sup>3</sup>/yr in 1995 and 2000 respectively. To meet the demand of water, the people are using the groundwater. So, it causes the land subsidence in the Semarang City and the sinking area is gradually increasing year by year (Marfai and King, 2007). They estimated the increase of sinking area is from 362 ha in 2010 to 1,377.5 ha in 2015 and 2,227 ha in 2020.

According to the Semarang City Drainage Masterplan Document (2007), there are several factors that lead to land subsidence in the Semarang City, such as an excessive groundwater extraction, a soft soil layer consolidation or mounded soil and another factor. Land subsidence in period of 1944 and 1999 presents in Figure 3 with the grey area represented 0 m or even below 0 m below the sea level and the green area represented 100 m above sea level, while the level subsidence in recently is about 8 - 20 cm with subsidence rate of > 8 cm/year (Figure 4a and 4b).

Land subsidence in the Semarang City is supposed to be caused by compaction in marine and alluvial sediments containing clay. Compaction is a natural process but can also be caused by uncontrolled usage and over-exploitation of ground water, especially in the Semarang City. This over-exploitation of ground water is leading to a rapid decline of water levels, drying out clay layers that finally results in land subsidence of 15 cm/year and above (Kuehn et al., 2009). Land subsidence in the Semarang City has been leading to severe and costly damages to urban infrastructure such as buildings, roads, and railway



**Figure 3:** Comparison of the Semarang City land subsidence condition in 1944 and 1999



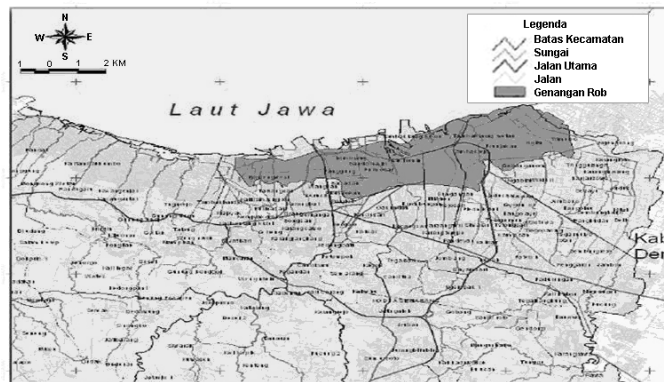
**Figure 4a:** Land subsidence in the Semarang City in the period of 2000 to 2001 (Murdahardono *et al.*, 2007) and **4b:** Land subsidence rates in the Semarang City (Murdahardono *et al.*, 2009; Kuehn *et al.*, 2009).

tracks. As a consequence, flooding hits the city frequently and if it continues at these annual rates, wide areas of the Semarang City will be flooded, leading to severe human and economic losses.

(2) Sea Level Rise

Other factor of floods in the Semarang City is the increasing of sea water level as the impact of global warming. In the Semarang City, some areas are found to increase to be lower, below the sea level. Factually this is occurred as the result of land subsidence process that brings high water flooding those areas directly, whether it is rainy or in dry season. Figure 5 shows inundation area due to tide flood in a blue color.

With estimated sea water level rise of 0.8 m for 100 years ahead, tidal flood puddle at the Semarang City will reach distance approximately 1.70 - 3.20 km inland, where total areas of water puddle will reach 8,537.9 hectares. Sea water level rise will hit the fishery sector (fish pond) and residential areas that reach 176.7 hectares or 10,425 units of houses (Ministry of Marine Affairs and Fisheries in cooperated with JICA).



**Figure 5:** Inundation area due to tide flood

## 2.2. The Impacts of Flood in the Semarang City

Floods have many impacts not only on physical, social, economic but also on environment. Physical impact is the damage to public facilities. Social impacts include death, health risks, mental trauma, declining economy, and the disruption of educational activities (children cannot go to school), disruption of office activities of public services, lack of food, energy, water and other basic needs. The economic impact includes the loss of materials, disruption of economic activities (one cannot go to work, late for work, or obstructed the transportation of commodities, etc.). Environmental impacts include water pollution (by pollutants carried by the flood) or vegetation around the river carried away damaged by the floods.

In term of economic value, during January to October 2009, loss of infrastructure damaged by natural disasters in the Semarang City reached USD 7 billion (Disaster Information Center, Central Java Province). In addition, there are some researches to calculate the loss of flood in the Semarang City. Table 1 below shows the estimation of loss in terms of economic value due to the coastal inundation. There are two scenarios to estimate the loss of economic value. First scenario is 120 cm of inundation and second scenario is 180 cm of inundation.

**Table 1:** Estimation of economic value of land use vulnerable to coastal inundation

Land use	Affected area (ha)		Total Value (Million EUR)	
	120 cm of inundation	180 cm of inundation	120 cm of inundation	180 cm of inundation
Agriculture and plantation area	527.8	712.5	42.2	57.0
Bare land, beach and yard	775.7	930.8	1.3	1.6
Build up area	1,320.5	1,716.6	1,584.6	2,059.9
Fishpond area	1,943.5	2,335.0	184.6	212.3
Total	4,567.5	5,594.9	1,812.8	2,330.8

Source: Analysis of Muh Aris Marfai & A Lorenz King, 2007

## 3. Countermeasures Against the Semarang City Flood

### 3.1. Methodology

To answer the objective of this paper is by using comparative analysis. From comparative analysis, it can categorize common important matters. Due to the main causes of flooding in the Semarang City are land subsidence and sea level rise, there are some programs that can solve these problems. The programs are creating dam areas, river improvement, migrating from hazardous areas, seawall construction, mangrove reforestation and giving early warning system. Those programs will be separated into types which are Type I and II. There are differences between Type I and II. Type I consists of compensation to the affected communities and sharing information about the on-going programs by the local government. Meanwhile Type II only consists of sharing information between the stakeholders. The next step is to get a common participatory approach for all programs or cases. In order to make it in detail, it will choose one case from Type I and one case from Type II. So, based on this framework, it can get the guideline for a participatory approach. Figure 6 describes the methodology in diagram.

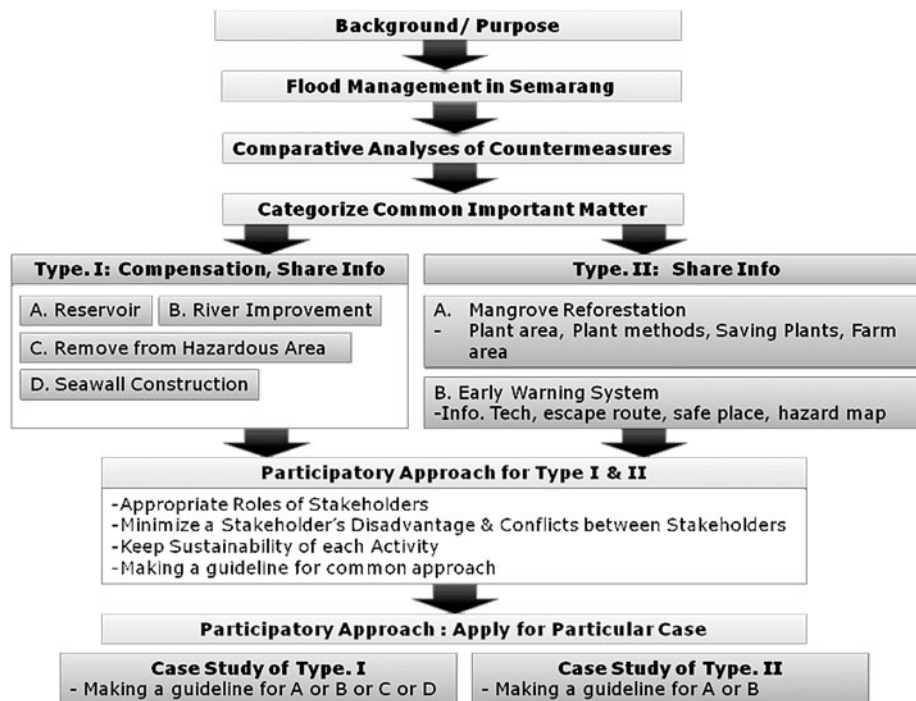
#### (1) Comparative Analysis of Countermeasure

##### 1) Dam

One of the ways to mitigate flooding in the Semarang City is by creating dam in Jatibarang. The uses of dams are to be direct water supply, hydroelectricity, controlling water courses, flow balancing and recreation. According to FoE Japan's report on December 2008, dam in Jatibarang is needed a lot of effort to make it successful. It is because the government faces in relocating numbers of households and land acquisition. Numbers of households that have some effects by submerging are 283 (land owner). Some farmers become non land owner and the total land acquisition is 150 ha. From this area, it is expected to have dam height about 77 m and the total dam storage is about 20.4 million m<sup>3</sup>. There are some compensation for households and farmers due to this project such as compensation in money, job training and prepare farm land. The local government decided the compensation rate. However, based on information of LARAP (Land Acquisition and Resettlement Action Plan), it has not been opened for stakeholders (residents, farmers) yet.

##### 2) River Improvement

In order to control flood in the Semarang City, the main rivers which are the Garang River, West Floodway, and



**Figure 6:** The Guideline for Participatory Approach

Simongan Weir should get some improvement. The objectives of river improvement works are to reclaim or to protect against flooding adjacent lands, to prevent flooding, to aid navigation or to provide water supply for irrigation, hydropower development or domestic and industrial use. The principal methods used to improve river channels are river regulation and dredging; on navigable rivers canalization, construction of lateral canals and flow improvement by dam construction and operation also to be taken into account.

However, to improve these rivers, the government has to relocate numbers of houses and small shops that are already built along side of the rivers. Based on the FoE Japan's report on December 2008, there are 264 houses and 498 small shops have to relocate to another places. In terms of total area of land acquisition is about 2.6 ha. To make this project successful, local government has some programs, LARAP. This program gave compensation to the people who should move from the side of river areas. The compensations are: (1) Compensation in terms of money where people have to find their house by themselves and (2) Build the house (Rusuwana), people have to live in the apartment. In case of (2), people can get additional compensations such as oil subsidy for poverty group, subsidy of education expense for poverty group, and obtaining low-interest financing from a government-linked company.

However this project is not successful yet because the new places provided by this project are not suitable for them especially for social economic living. The new location is quite far from the people activities, so it will reduce their income. In addition, the type of building is not so comfort for them because the room is quite small. Then, this is one of works that local government should do. The local government should convince the people and also provide some alternative jobs that they can survive. Communication between local government and local community will be very important.

### 3) Remove from Hazardous Area

Remove from hazardous area program is one solution to reduce negative impact from coastal flooding, but it needs to improve from multi stakeholders and compensation to local community. Some project is already established for small scale area, but it is still not effective and creates another problems. The problems is not caused by collaboration multi-stakeholders, but it is mostly focused for local community such as change the cultural from fishing activity to farmer activity or others and change the habitat behavior from coastal area to apartment.

To solve the problems, this study proposes to create job training and socialization for local community. It looks for long term planning, sharing information, and more to build capacity building. Therefore, this program should be integrated with short time planning concerning with mitigation option such as mangrove rehabilitation, dam, river improvement, and sea wall construction combined adaptation option such as integrated flood early warning system.

#### 4) Sea Wall Construction

The protection of beachfront development and other coastal infrastructure with sea walls and revetments must be studied and organized carefully. This sort of protection may cause significant erosion of the land on either side of the sea defense structure, and may even result in the loss of the beach in front of the structure if it is poorly designed and managed. This is not only the concern of coastal developers, but also among all stakeholders. Basically, lots of conflicts are raised especially when one group of stakeholders does not accept the rights of another group. For example, fishermen have traditionally used the reefs for bait fishing or for another purpose related to the reefs. On the other hand, when other stakeholders come to the area, they think that fishing is destructive. One of the main problems for the Semarang City also is that there is a different perception among the stakeholders on how to resolve the flood in the city. A miscommunication and lack of sharing information cause lots of conflict. For example, the central government does not exactly know the core of the problem of what is really happening in the Semarang City in terms of flood. Then, there is no mutual program to resolve the problem and top to bottom system is used most of the time which will not resolve the real problem.

However, it is important to notice that the protection should be regarded as a community responsibility. For that, all community members might contribute to the construction and maintenance of beach protection structures such as sea walls and breakwaters. Sea level rise is the concern of all stakeholders. Some opportunities should be given to the local communities when facing the flood. It will be such a kind of adaptation and mitigation since the structure of the Semarang City itself is a very low land and floods are frequent in this city. Seawall construction might be a very important approach to mitigate the damage caused by the sea level rise in the Semarang City if the seawall is well designed. A poor designed seawall may result in more degradation of the coastal area and the reefs.

#### 5) Mangrove Reforestation

The greatest threat in the future mangrove ecosystem is climate change and increase occurrence of climatic happenings. Important factor in supporting presence of mangrove is salinity and sedimentation level. The change in rainfall pattern poses impact on distribution and type composition because rainfall controls salt concentration on ground and trees also producing fresh water for mangrove.

Some part of coastal areas in the Semarang City has already been replanted through promotion of public participation by JICA. Although previously, some parts of coastal areas are used for shrimp and fish farming, but it is already damage because of sea level rise and coastal erosion. With the program of mangrove reforestation, it will be very useful for them in order to protect their farms from coastal erosion.

On the other hand, people who support the program somehow don't know how to conserve mangrove forest properly. At this condition, the active role of local government is very important to give an understanding of this project to local community such as conducting workshop and socialization. According to FoE Japan's report in 2009, the local government conducted mangrove conservation workshop that aims to preserve the entire coastal of the Semarang City and attracts a variety agencies involved in environmental protection.

#### 6) Early Warning System

Based on problem statements, the mostly disaster from coastal area in the Semarang City is flooding. Therefore, integrated flood early warning system needs to implement to reduce negative impact from coastal flooding. The system gives early detection using better simulation and prediction combined satellite monitoring for high or very-high resolution. The early warning system is already established in Jakarta City, but it seems still difficult for implementation. Because the activity is less involve local community, especially for evacuation. To anticipate the problem, this study tries to proposed participatory approach using comparative analysis method with focusing for local community.

To establish the integrated flood early warning system, the application and sharing networks create several function and target among the multi stakeholders. They have several stakeholders such as Government, Private Sector, and International Bodies to contribute finance, decision making, and to set up facilities; while information and communication technology has 2 stakeholders (Government and Research Community) distributed to get the information. Before the integrated flood early warning system can be easily understood by the public community, the researcher should make interpretations based on observation data to try to simulate a prediction for alerting the flood. There are important activities to support accuracy and high performance for monitoring disaster risk reduction. If the prediction is not an accurate estimation, it can only create low-credible sources for any monitoring agency. The EWS cannot work well to support the network system based on these sources. Therefore, it is required to develop and upgrade the skills of simulation technology for researcher, not only with considerations for meteorology and hydrological component but also with ocean interactions.

Furthermore, the sharing networks should be supported by capacity building not only limited to the central government, but also extended to the local community level, quickly bringing brainstormed knowledge, information for easy understanding, and visualization before disasters.

#### **4. Recommendations for the Semarang City Flood**

##### **4.1. The Results of Analysis**

###### **(1) Type I: Compensation and Share Information**

There are a number of solutions that can be used in order to mitigate and to adapt to the flood in the Semarang City such as building dam which can be helpful to mitigate the flood and land subsidence and to have a new source of electricity, improving the river to mitigate the flood, migrating the local people from hazardous area can be used as flood adaptation, constructing sea wall to adapt for sea level rise and high tide, doing reforestation of mangrove to preserve the entire coastal of the Semarang City, and early warning system to prepare and evacuate local people to a safe area. Nevertheless, some problems occur when implementing these programs. Among them are the impact to the environment, lose of land and jobs, require high budget, and need long period of time to implement especially for dam.

However, in order to build the best plan and to implement such kind of solution, different stakeholders must be involved to achieve the goal before, during, and after implementing these approaches. These stakeholders include foreign government for loan and Environmental Impact Assessment (EIA), central and local government to make regulations of compensation, main contractor to do and realize the job, residents and fishers/ farmers to be removed to another safe area and get compensation from this migrating process, and NGO to check the EIA. One important task of the central and local government is urban planning especially in the case of migrating the local people from the hazardous area.

Since there are different stakeholders involved in the project, some conflicts raised among them. The share of information and insufficiency of compensation are the main core of these conflicts. Moreover, environmental problem can be faced between the government, residents, and NGO when building dam, and between government, fisher, and NGO when constructing sea wall.

###### **(2) Type II: Share Information**

Type II consists of sharing information between the stakeholders. There are often conflicts of interest between different stakeholders groups. The principal practical and moral task of mainstream management involving a variety of stakeholders' interests is to find a workable balance between them. So, in this case, there must be sufficient information about the on-going programs or projects involving those stakeholders.

For mangrove reforestation, the project scheme is expected to provide a number of benefits to the environment, society, and economy. The basic concept of mangrove reforestation is to measure the effect by fulfilling both "countermeasures against climate change and flood management" and also "adaptation" at the same time. In the other words, answering socioeconomic issues and conducting environmental conservation will mutually repeat the positive growth cycle, and the continuance of the program will contribute to the sustainable development.

Thus, local government should give information briefly to the local communities which are affected by this program. They should know about project planning such as concrete contents of the program; project boundary and baseline scenario; monitoring, and environmental impact, or maybe some general guidelines for mangrove reforestation.

Early warning system (EWS) has evolved considerably during the past two decades. Today, EWS exists for just about every hazard - technological, hydrological, meteorological, and anthropogenic. Its function has shifted toward societal risk and vulnerability reduction and toward sustainable development and also is an important tool in a government's toolbox for achieving sustainable development.

The stakeholders must know the success and limitations of EWS and identified lessons - do's and don'ts from the experiences of those who have worked with or helped to develop EWS for a wide range of societal concerns or in this case for flood management. This information will be used to remind about how to make early warning of flood hazards, effective.

##### **4.2. Common Participatory Approach**

###### **(1) The Guideline of Participatory Approach of Type I**

The common importance of Type I is to the affected communities and sharing information about the on-going programs. For the Type I, we can divide the stakeholders into two groups which are government sectors and local people. Government sectors consist of Foreign Government, Central Government and Local Government. Then, for local people, there are two types



of local people. First group is the local people who get some effects from the project such as remove to other place, lose of land, jobs etc. Second group is people who get some benefits from the project such as flood mitigation, reducing flood risks, etc. Moreover, the local people consist of community leader and common people.

Each stakeholder takes some roles to make the program successful. The guideline of the participatory approach of Type I is:

1) Step I: Planning

- Share the philosophy of guideline
- Development of plan

2) Step II: Discussion for decision making

- Primary arrangement for each community
- Government explain about plan for each community
- Each community requests something to government
- Government reflects each community and has opinions to make a plan
- The community leader at each community explain their plan for people in common
- Hold the conference
- All the stakeholders will attend and then decision making can be made.

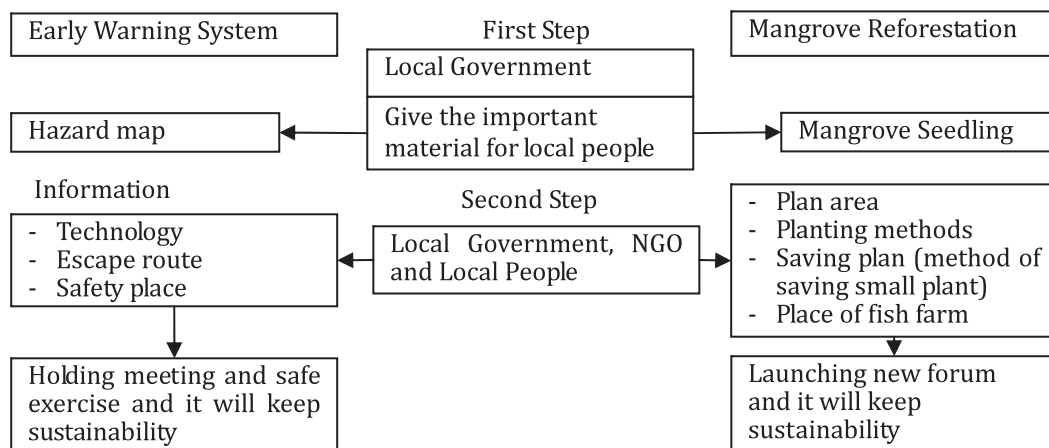
3) Step III: Implementation

- Government supports for local people through local government meeting
- Local government will improve the compensation and request more support to central and foreign government, so the local people can get benefits.

From these three steps, it will minimize complaint or conflicts among stakeholders and it will keep sustainability of the programs.

(2) The Guideline of Participatory Approach of Type II

The guideline of participatory approach of Type II can be described from figure 7.



**Figure 7:** The Guideline of Participatory Approach of Type II

## 5. Concluding Remarks

Several programs have been made by the government collaboration with other stakeholders to mitigate and to adapt floods in the Semarang City due to land subsidence, sedimentation, destructive mangrove, and sea level rise. The effort made by the government to develop a program for coastal zone management and protection against flooding can be efficiently implemented through coordination and participation among stakeholders and the community. Understanding the local community's own perceptions and assessments of their adaptive and pro-active capacities is a key issue in effective disaster reduction. The local government is leading to elaborate the cooperation and coordination between stakeholders and government to cope with flood problem. It would also be necessary to assess the stakeholder and community interests, and the ways in which those interests affect the program on disaster management.

In addition, several project collaboration are already done to implement which consist of Type I, for compensation and sharing information program and Type II, only for sharing information program. However the programs are insufficient due to

information gap, technology gap, less compensation, and lack cooperation with community leader. Therefore this study tries to make guideline participatory approach to strengthen community resistance to coastal flood hazard by means of public awareness action, field investigation and researches by Type I and Type II programs. There is a need to share social-community, technical and technological expertise to deal with flood problems.

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