FINAL REPORT

VULNERABILITY AND ADAPTATION ASSESSMENT TO CLIMATE CHANGE IN SEMARANG CITY

2010

EXECUTIVE SUMMARY

In the future, a changing climate brought about by global warming is estimated to create new patterns of risk, and higher risks generally. Sea level rise due to melting glaciers and polar ice and thermal expansion will contribute to the increase of coastal flooding. Semarang as a coastal city will be impacted seriously by climate change and sea level rise. At present, some of coastal areas at Semarang are already inundated due to sea level rise. Floods and drought also occur quite often. Government of Semarang City has implemented various program and also developed medium and long-term strategies to manage hazards. Plan for improving infrastructure for climate hazard control such as drainage system and dike has been prepared (Bappeda, 2007). However, under changing climate with the increasing frequency and intensity of extreme climate events the current design may not be very effective for managing future climate hazards. Therefore it is also very important to consider climate change in designing climate hazard control system.

ISET under the Asian Cities Climate Change Resilience Network (ACCCRN) with the support from the Rockefeller Foundation, coordinate a study on vulnerability and adaptation assessment to climate change conducted by MercyCorps, URDI and CCROM SEAP-IPB at Semarang City. The study aims (i) to assess current and future climate variability in Semarang city, (ii) to assess vulnerability and adaptive capacity as well as current and future climate risk at *Kelurahan* level, (iii) to identify direct and indirect impact of climate hazards now and in the future at *Kelurahan* level, (iv) to identify the most vulnerable areas and social groups, and dimensions of vulnerability, including adaptive capacity of community to climate change impact, (v) to identify institutional and governance issues that may affect the resilience of the city to current and future climate risk, and (vi) to develop initial recommendations for Semarang City for increasing resilience of the city to current and future climate risk

SEMARANG CITY PROFILE AND CLIMATE

The City of Semarang is the capital of Central Java Province with total administrative area of about 374 km^2. Administrative boundaries of this area are Demak Regency (*kabupaten*) in the east, Java Sea in the north, Kendal Regency in the west and Semarang Regency in the south. City of Semarang is divided into 16 sub-districts (*kecamatan*) and 177 villlages (*kelurahan*). It is located in Central Java's north coast at 6.93^o – 7.13^o latitude and 110.27^o – 110.50^o longitude. The topography of the coastal area is flat with elevation of less than 3.5 meters above m.s.l. while in the south has topography with slope of between 2 and 40% and elevation of between 90 and 200 meters above *msl*. The rivers that flow in the City of Semarang include Garang, Kreo and Kripik rivers. Fresh water some are taken from shallow ground water at the depth of 3-18 m (lowland) and 20-40 m (highland), and from ground water stored in depressed aquifer layer at the depth of 50-90 m from the surface.

Based on the location and shape of coastal physiographic, Semarang Harbour city is located in an open coastal plain. In open coastal plains, high waves resulted from strong winds may hit coastal plains easier. In some coastal plains, *rob* (flooding associated with high tides) phenomenon has been observed that can disrupt resident's economic activities. Centre of economic activities in the coastal areas of Semarang City, are among others focused in the area of Tanjung Mas Port. In

this coastal area there are also several fishing activities, such as cultivation pond. Semarang City also faced with problem of land subsidence.

In 2008, the population of Semarang City is about 1.5 million people with growth rate of about 1.85% per annum. The densest is South Semarang sub-District with 14,458 people per km^2, while the least dense is Mijen and Tugu Districts, i.e. about 850 people per km^2. The number of population with productive age (15-64) in the City of Semarang is quite large, reaching 74% of the total population. On the other hand, formal education level of residents in the village observed is still relatively low. The percentage of residents who did not attend schools reaches as much as 8.2%. While the number of people who did not complete elementary school and those who complete elementary school is as much as 50.82%. Thus, approximately 59 % percent of residents are in low level formal education structures. The number of residents who are junior high school graduates is as much as 20.49%, high school graduates is as much as 18.03% and university graduates is as much as 2.46%.

The main livelihoods of Semarang City are industrial workers (25.13%), construction workers (13.05%), government employees/Armed Forces (16.04%), and other services (10.38%) and farmers (4.8%). These livelihoods are the main contributor to the Gross Regional Domestic Product (GRDP) in the City of Semarang. Gross Regional Domestic Product of the City of Semarang (Table 2.8) is largely contributed by trade, hotel and restaurant (30.27%), followed by industry (27.60%), buildings (14.76%), services (12.08%) and transportation and communication (9.58%). Agriculture only contributes 1.25% to GDP.

Based on analysis to long historical climate data, it was found that there was a change in trend and variability of climate variables such as temperature and rainfall. The most tangible evidence can be seen from the increasing trend of mean surface temperature over the last 100 years in the city. The change in seasonal rainfall was also found, i.e. a shift in the monsoon onset and a change in the frequency of extreme rainfall. Based on 14 global climate models (GCMs), it was indicated that wet season rainfall of Semarang City (DJF) in the future may be slightly lower than current climate particularly in the center of the city. In contrast, the dry season (JJA) rainfall might increase. However, the analysis of future climate may need to be refined using climate models with high resolution such as RCM. The use of global model such as GCM will not be able to capture the local effect. Further analysis on extreme weather under changing climate should also be done. Many studies have shown that global warming will bring more extreme events.

IMPACT OF EXTREME CLIMATE EVENTS

Flood and drought are two common extreme events that hit the Semarang City. Based on literature study, field survey and interview in four villages (Mangunharjo, Tanjungmas, Rowosari, and Tandang), we found that flooding commonly occurs in locations with lower elevations in coastal areas or basins, or with poor drainage system. While erosion and landslides occurred in the hills/mountains that has a high slope. Floods provide the greatest impact on the residential sector, transportation, and health, agriculture, fisheries, drainage and infrastructure. Meanwhile drought impacts the drinking water sector, health, agriculture and fisheries.

Floods and drought has change working relationship and transaction patterns of criminality. A social relationship between people at the time of the disaster is still running well. The people help each other during the disaster. However, in terms of working relationships the disasters caused a change in pattern of working relationship. Many people have to find side-jobs to get additional income, particularly when the disaster destroys their farming activities. Time is becoming more precious for them. This condition gradually changes the working relationship, initially was to help each other (for example replanting activities) and now this is transformed into a pattern of wage payment system. In terms of the transaction patterns of production, the disaster could encourage the development of the barter system (exchange of goods) as an implication of the difficulty or lack of money held by the victims of the disaster. But on the other hand, disasters also lead to increasing incidence of crimes such as theft.

Economic losses due to extreme climate events such as flood and drought can be evaluated from their impact on main job, and prices of some commodities. The disasters reduce work productivity especially if the main jobs of the society are vulnerable to disasters, such as the agricultural, fisheries etc. The impact of flooding in coastal areas is reducing working people in the fisheries sector, while in coastal areas; flood tides resulted in a decline in farmer incomes. Based on the sectors of the economy, the impact of floods caused loss to the infrastructure sector, housing and fisheries sectors. Meanwhile, drought caused losses in agriculture, fisheries and drinking water. The disaster also caused an increase in prices of some agricultural products like rice, crops and livestock, but this occurs only in the area surrounding the disaster.

Impact of disasters on health is the increase in number of people infected by diseases. Types of diseases which often infect people during disaster are cough/cold /runny nose, fever, dengue, diarrhea, itching, typhus, respiratory infection and asthma. Number of infected people by these diseases was higher during floods season than during the drought.

The impact of the disaster resulted in a change in behaviour as a form of adaptation. There is a difference between adaptation measures undertaken by communities in coastal and non-coastal during floods. To adapt to impact of robs (flood due to high tide), most communities in coastal areas raise the floor level and build a dike. While communities in non-coastal areas also build a dike, and some temporarily moved to other locations not affected by floods. During drought season, to manage water scarcity problem, communities in coastal areas buy clean water, whereas in non coastal region is by reducing water consumption.

Forms of adaptation can also be seen on a living strategy. The livelihood strategy that has been conducted by residents up until now is intensification of agriculture and double income pattern. Intensification of agriculture is conducted by the community through the development of agricultural techniques. Residents began to recognize a type of paddy whose harvest time is shorter and that will give more results. This enhances the intensity of rice cultivation from what is originally once in a year to twice in a year. Residents also know the pattern of sloping the land. The purpose is to make the rice crop they cultivate can get enough water. Livelihood strategy is not only related to changes in agricultural techniques but is also a pattern of double livelihoods. Residents do not rely their income solely on agriculture, either rice or crops. Dry season is the period of working in city, while rainy season is the period of working on farms at home. Residents also carry out livelihood strategy by empowering their family members, such as wives

and children who have grown up. This strategy is done in almost every village observed, both in coastal areas and in non-coastal areas.

Communities expect that early warning system on disasters is in place. However, about 83% of respondents stated that they did not get any information associated with the disaster from the government. However, most of residents are aware of climate change. In general, they now about climate change from television. Global warming will rise sea level, shift the seasons, increase temperature, etc.

CLIMATE RISK LEVEL OF '*KELURAHAN*'

Level of risk of a system to a disaster or extreme climate event (ECE) will depend on capacity of the system to cope with the events (called coping capacity index) and likelihood of the ECE to occur. This study evaluated the level of climate risk at Kelurahan (village) level. The coping capacity index is developed based on vulnerability and adaptive capacity index of the Kelurahan. The vulnerability and capacity index of Kelurahan is measured using a number of socio-economic and biophysical indicators. Kelurahan in which many of its household/ building located in river bank, source of drinking water mostly not from PDAM (piping system), high density population, many poor people and big portion of Kelurahan area near the river and coastal with less green open area will be more vulnerable (*high vulnerability index*) than Kelurahan with less household/building in the river bank, low population density, get better services from PDAM, less poor people, and small portion of Kelurahan area near the river and coastal with more green open area (*low vulnerability index*). The consequences (damage, economic loss etc) caused by events will be severe in Kelurahan having high vulnerability index. However, the consequence cased by the events in the high vulnerable Kelurahan would be less if it has high adaptive capacity. Kelurahan with high adaptive capacity index is Kelurahan where many of its households are well educated, main income source of communities not sensitive to climate hazards (e.g. trading is much less sensitive than agriculture) and has better health facility and road infrastructure. In this study, we normalized all the scores of the indicators in order to have index of vulnerability and capacity range from 0 to 1.

To classify the Kelurahan based on their coping capacity index, the vulnerability (VI) and capacity index (CI) of each Kelurahan were subtracted by 0.5. As the normalized VI and CI values range from 0 to 1, by subtracting the index values with 0.5, the VI and CI will range from -0.5 to +0.5. The relative position of Kelurahan according to their VI and CI is determined based on their position in the five Quadrants (Figure 1). Kelurahans situated in Quadrant 5 will have high VI and Low CI. Whereas Kelurahans situated in Quadrant 1 will have low VI and high CI. Using this classification system, if *Kelurahan*s situated in Quadrant 5 are exposed to certain hazards, the impact would be more severe compare to *Kelurahan*s Situated in Quadrant 1. To assess the change of V and C in the future, we only consider the change of population density (based on government projection), health facility (based on Semarang City Facilities Plan in 2020 and 2030), and non-green opened area as defined in the revised spatial plan of Semarang 2010-2020 (Bappeda, 2007). Factors used for normalizing the score of these corresponding indicators in 2025 and 2050 were the same as those of the baseline year 2005.

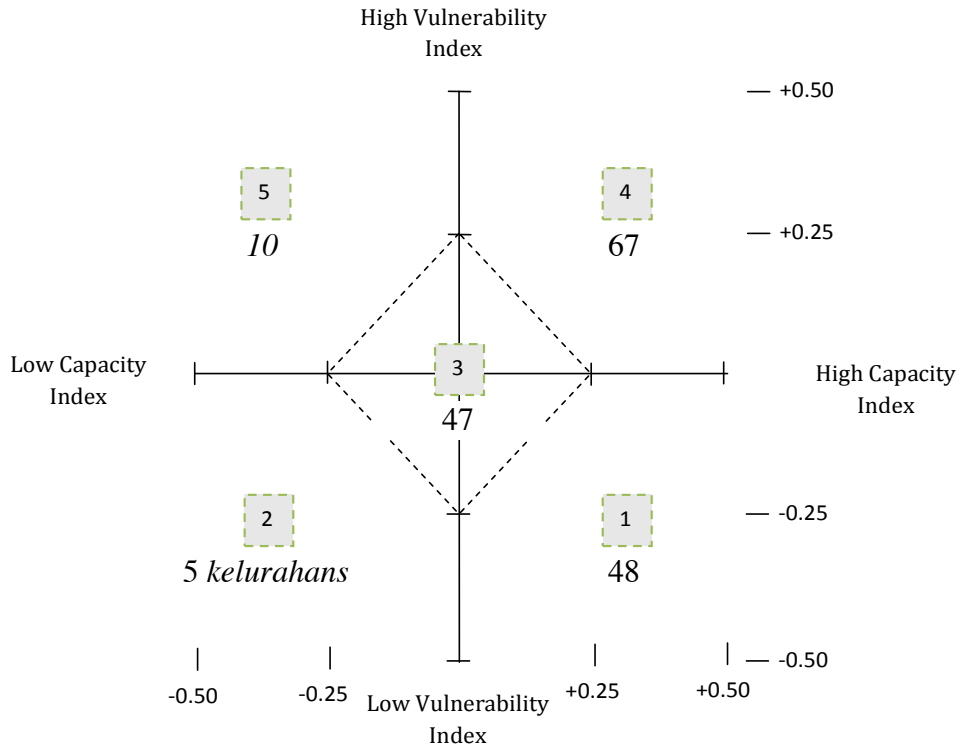

Figure1. Classification of the villages based on their coping capacity index (quadrants 1 to 5) and number of Kelurahan that are situated in each Quadrant at Current Condition (2005)

The analysis suggested that at present about 6% of Kelurahans have high coping capacity index (Kelurahans with high vulnerability and low capacity index or at Quadrant 5), 38% in Quadrant 4, 27% in Quadrant 3, 3% in Quadrant 2 and 27% in Quadrant 1 (Kelurahan with low vulnerability and high capacity index). Kelurahan at Quadrant 5 include Bandarhardjo, Bengetayu Kulon, Bubakan, Gunung Pati, Kudu, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo and Wonoplumbon. In 2025 and 2050, one Kelurahan in Quadrant 5 will move to Quadrant 4 indicating that there is an improvement of its coping capacity index. However, coping capacity index of some Kelurahans in Quadrant 3 may change to Quadrant 4 in the future (Figure 2). This suggests that coping capacity of these Kelurahans would decrease in the future (Figure 3).

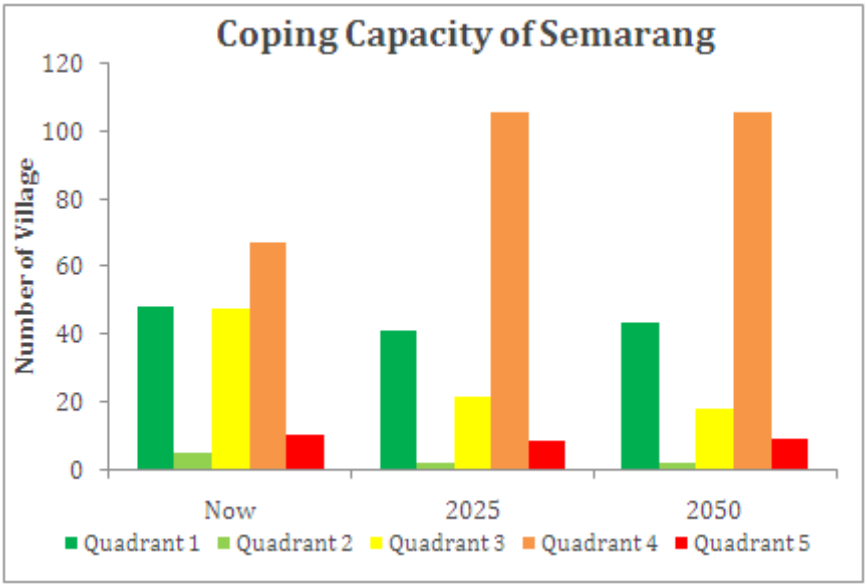

Figure 2. Number of Kelurahans according to the coping capacity index (quadrant 1-5) at present and in the future (2025 and 2050)

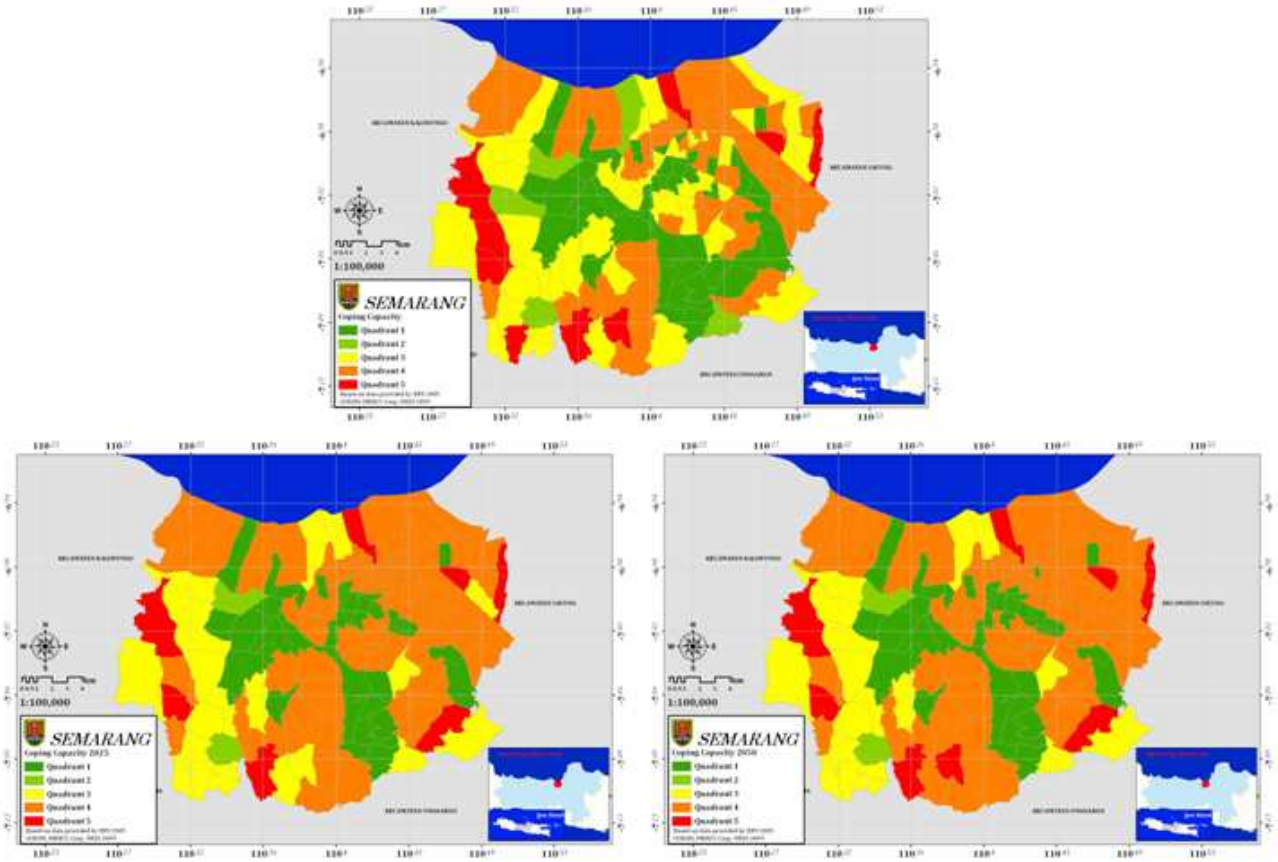

Figure 3. Coping Capacity of Kelurahan at Semarang city

To define level of risk of the Kelurahan to the impact of climate change was defined as a function of the probability of unexpected (extreme) climate event to occur and the consequence of the events if it occurs. As describe previously, we can expect that Kelurahans with high vulnerability but low capacity indices (at quadrant 5) will be impacted more severe by the extreme events than those with low vulnerability and high capacity indices (quadrant 1). Thus we can define that the climate risk will be very high in Kelurahan at Quadrant 5 if probability of the extreme climate events to occur in these Kelurahan is high. Climate risk will be very low in Kelurahan at Quadrant 1 and the probability of the extreme climate events to occur in these Kelurahan is also low.

To allow multiple climate hazards being accommodated in the climate risk assessment, we developed composite climate hazard index (CCHI). The types of climate hazards include flood, drought, landslides, and sea level rise. We classified the climate hazard index (index values ranges from 0 to 4.5) into three categories, i.e. less than 2.0, between 2.0 and 3.5 and more than 3.5. Kelurahan with CCHI of 4.5 means that all area of this Kelurahan is exposed to flood and drought, and land slide every year and it is completely inundated when robs occur. Kelurahan with CCHI of zero means that none of the hazards occur in the Kelurahan. We used the rainfall outputs from 14 general circulation models (GCM)[1] run under high emission scenarios (SRESA2) and low emission scenarios (SRESB1)[2].

The study suggested that in 2005, the CCHI in most areas of Semarang City was mostly less than 2.0, and only a small portion of more than 2.0 which is situated in a small part of the northern part of Semarang. In the future, A2 scenario, areas of index> 2 has decreased in 2025, but increased slightly in 2050. Kelurahan with high CCHI both at present and in the future is *Kelurahan* Tanjung Mas, Semarang Utara Sub-district.

Furthermore, we classified the level of climate risk of the Kelurahans based on their coping capacity index and CCHI (Table 1). The climate risk maps of the Semarang City by Kelurahan were produced by overlaying the coping capacity index map and CCHI under current and future climate as shown in Figure 2.

Table 1. Matrix of Climate Risk according the coping capacity index and composite climate hazard index

Coping Capacity Index-Quadrant	Composite Climate Hazard Index (CCHI)		
	More than 3.5	Between 2.0 and 3.5	Less than 2.0
5	*Very High (VH)*	*High (H)*	*Medium to High (M-H)*
4	*High (H)*	*Medium to High (M-H)*	*Medium (M)*
3	*Medium to High (M-H)*	*Medium (M)*	*Medium to Low (M-L)*
2	*Medium (M)*	*Medium to Low (M-L)*	*Low (L)*
1	*Medium to Low (M-L)*	*Low (L)*	*Very Low (VL)*

[1] General Circulation Model is a numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties.
[2] Concentration of GHG in the atmosphere in 2025, 2050 and 2100 under the SRESA2 would be about 440, 535, 825 ppm respectively and under the SRESB2 about 425, 480, and 600 ppm respectively.

The result of analysis suggested that there are no Kelurahan with Very High (VH) Climate Risk Category at present (baseline conditions). The highest category is only Medium to High (M-H). There are about 15 Kelurahans (8%) with M-H risk category. These include Bandaharjo, Bangetayu Kulon, Bubakan, Gunungpati, Kudu, Mangkang Kulon, Mangkang Wetan, Mangunharjo, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo, Tanjungmas, Tanjungmas, Tugurejo, amd Wonoplumbon. The remaining are 63 Kelurahans (36%) as M (Medium) risk, 47 Kelurahan (27%) as L-M (Low to Medium) risk, 6 Kelurahans (3%) as L (Low) risk and 46 Kelurahans as VL (Very Low) risk. In the future (2025 and 2050), more Kelurahans will be exposed to higher climate risk, particularly under scenario SRESA2 (Figure 5). There would be two Kelurahans would move from M-H to High climate risk category, namely Mangunharjo Village at Tugu Sub-District and Mangunharjo Village at Tembalang Sub-District. While many of Kelurahans with L-M risk category would move to Medium risk category (Figure 6).

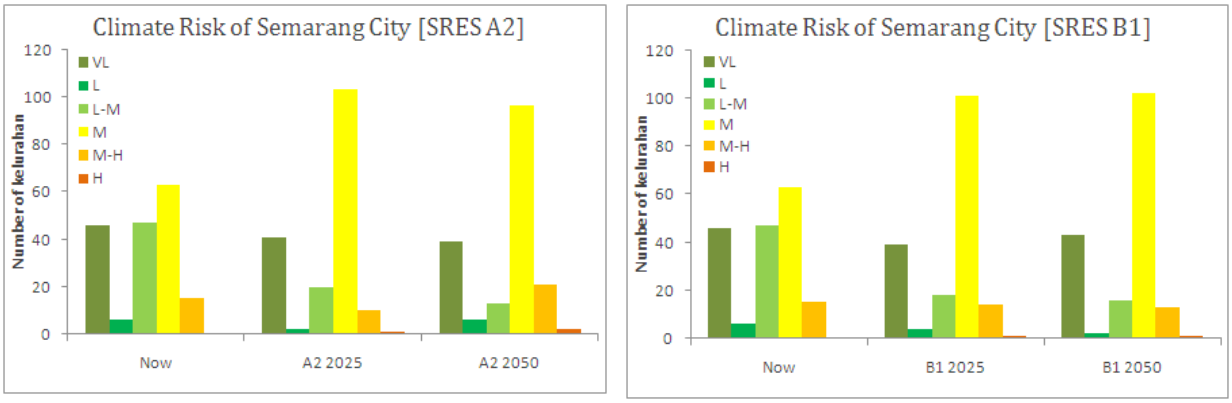

Figure 4. Number of Kelurahan by climate risk index category

The above analysis demonstrated that how change in socio-economic and biophysical conditions will change coping capacity of the Kelurahans. Adaptation programs should be prioritized in Kelurahan with high vulnerability index and low capacity index and being exposed or potentially exposed to high climate hazard index. To reduce the level of risk of Kelurahan to the impact of climate change, the infrastructure and community development programs should be directed to improve socio-economic and biophysical indicators shaping the vulnerability and adaptive capacity of the Kelurahans.

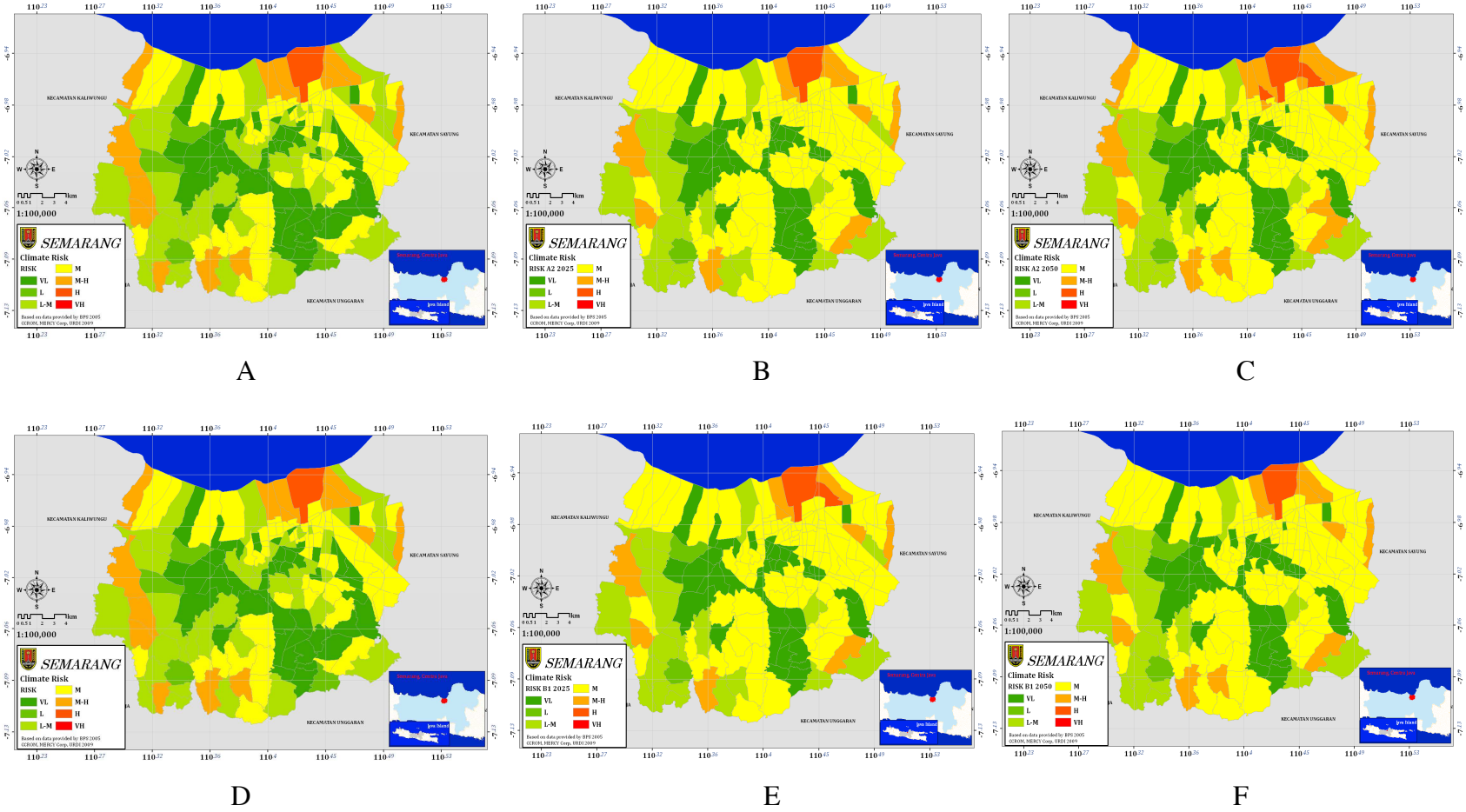

Figure 5. Classification of Kelurahan based on their level of their exposure to climate risk (A)& (D) Climate risk baseline, (B) Climate risk A2 2025, (C) Climate risk A2 2050, (E) Climate risk B1 2025, (F) Climate risk B1 2050

GOVERNANCE AND INSTITUTIONS

Governance and institutions are two determinant factors affecting the resilience of the city to climate change. Good governance and strong institutions will lead to climate change resilience city. There are three important aspects needs to be assessed to assess the resilience of the city to climate change. The first is how the stakeholders play their role in managing climate risk. The second is what are current initiatives and programs (short and long term) to cope with climate risks and how effective they are. Third is what is the capacity of local government and institutions to integrate climate change into short and long term development planing.

From the analysis it was revealed that the management of climate change in City of Semarang involve stakeholder both from internal and external of the city. Each stakeholder has their own roles and contribution to adapt and strengthen community to climate change. This partnership is a pre-condition to create community that has capacity to adapt to climate change. Overall, local government of Semarang plays the major roles in climate change both for financial support and implementing program. While the role of provincial government claims not too significant, but it has more roles in coordinating programs and policy from some cities. However, coordination among stakeholders and sectors should be strengthened in order to gain maximum benefits of the program to environment and community.

There are a number of programs and plans prepared by the government to address natural hazards in the city. The programs and plans were described in documents on development planning, spatial planning and disaster management. However there are some related problems with planning and programming facing by local government in Semarang in the light of addressing climate change. These problems include (i) lack of integration, coordination and vision-mission in climate change management, (ii) lack of budget allocation to support climate change, (iii) ineffective spatial planning to mitigate and adapt the impact of climate change, and (iv) no formal board or institution that formed to address local disaster.

Climate change management (adaptation and mitigation) is considered as new concept and not fully understood by all stakeholders at the local level. No special policies or programs related to climate change for both middle term (5 year plan) and long term (20 year plan) are issued. At present, even there are a number of local NGO's and private sectors actively contribute to climate change related programs, however, the program are implemented partially with limited coordination among stakeholders.

Funding allocated to address climate change is also limited. Local government agency in charge with environmental issue received very low budget allocation. This agency will play significant role in improving environmental quality and contribute toward resilience city. Overall, each year budget for programs related to climate change has increased but far from enough to solve city problems. In last three years, local government only allocate 5-6 percent of its budget for program that related to climate change.

On the other hand, in the revision of city spatial planning of Semarang, climate change issues have not been well taken into account. Improper spatial plan will

expose the city to higher climate risk in the future. Some problems that potentially cause the difficulty to implement climate proof spatial planning include inconsistency in the implementation of spatial planning, land use change such as areas along the river and others. Initial assessment conducted by this study to evaluate the level of climate risk at Kelurahan level at present and in the future should be considered in prioritizing programs and revising spatial plan.

Establishment of local disaster board as mandated by law no. 24/2007 is still underway. The presence of this board may be important to ensure the effective implementation of hazards and climate change programs by various stakeholders. It is planned that this board will be established in early year 2010. The role and function of this board in addressing climate change issues should be considered. The City Team[3] should involve in the process of establishing the board.

Current capacity of local government in integrating climate change into long-term development planning is still limited. This can be understood as climate change is a complex issue. Strong scientific works on climate change scenarios and climate change impacts in Semarang City will be required to assist local government in developing horizon plan of adaptation[4] to climate change. Technical assistance and capacity building program for local government officers is required to enable them in developing horizon plan of adaptation.

There are a number of good conditions that positively can contribute the process of developing resilience city to climate change. In the existing laws and policies, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. The Semarang City Government will also formulate a new medium term development plan for 2011-2014 as resulted from the direct election which will be taken in April 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. It needs political commitment and comprehensive understanding from the City Team to introduce the issues.

ADAPTATION ACTION PLANNING

To have resilience city to climate change, it is important to understand how people, community, and sectors response to current climate risk and how the current capacity should be developed to strengthen the capacity in managing future climate risk. Particular pilot projects may also be needed to get lesson learnt how we can effectively manage climate risk and use the lesson learnt to improve the climate change adaptation plan.

[3] City Team is a team represented by various stakeholders from government bodies, academia and NGOs, community leaders being formed for formulating climate change programs for Semarang City as part of for Asian City Climate Change Resilience Network (ACCCRN) program funded by Rockefeller Foundation

[4] Horizon plan of adaptation relates to the lifetime of decision-making associated with a particular activity – how far into the future is it planned. Thus it is the period of time over which a particular adaptation program is planned to be implemented (Jones et al., 2004).

Based on study on the Community Based Vulnerability Assessment (CBA) in *Kelurahan* Tandang, Sukorejo, Mangunharjo and Kemijen, and also considering findings from surveys and literatures, we extract a number of lessons that may contribute in developing adaptation strategies. We learned some of the common qualities that seem to be present in the adaptation strategies at community levels:

- *Quite simply 'they work':* this is a very practical sense of adaptations that have real bearing and effect on their everyday lives.
- *They are inexpensive and work with what materials are available:* for the urban poor, resources are scarce. They, for example, scavenged housing materials from a nearby scrap heap, or even community savings groups that collect very minimal amounts. These are what people can afford and that make sense to them.
- *Accessible in times of need:* In order to raise capital to recover from a flood a family may sell their television, motorbike or other fungible assets, rather than go through a bureaucratic process of applications that might imply lengthy paperwork. Generally in the city people want access to resources quickly and this is a very important characteristic of adaptation strategies that work, they are easily managed and accessed.
- *They don't rely upon big government projects or interventions: People* have developed reliance upon community organization and initiatives that better respond to their needs within their own means. While government intervention is appreciated and instrumental local self-reliance seems to be a key characteristic of adaptation strategies.
- *Adaptation to severe climate events must work together with other adaptation strategies:* Those most affected people by climate change may not know or care to plan for it if it doesn't benefit other aspects of their lives. Safety for its own sake is not a motivating factor, but when other benefits can be derived then the solution becomes workable.
- *The whole is greater than the sum of the parts:* Many of the adaptation strategies are successful because they harness the collective efforts and strengths of people. People are concerned about each other and when this concern translates in collective action the results can be significant.
- *Leveraging government support leads to better results:* When communities are able to work together with local and city government (and vice versa) adaptation strategies seem to have been successful.
- *More access to information can lead to better outcomes:* Urban poor communities are usually isolated and so successful adaptation strategies seem to increase access to information.

From the above lesson learnt, we can summarize that successful adaptation at community level depends of several factors namely: (i) availability of funding, (ii) capacity levels, (iii) access to information, (iv) collaboration and engagement of local government, (v) migration and growth rates, (vi) public service delivery, and (vii) mobility. Semarang City is in a good position to move into resilience city as there are already (i) existing cases that exist and workable, (ii) possible social networks of people in similar situations with know how, (iii) local level neighbourhood government, (iv) city and national government programs (*e.g.* PNPM), (v) materials and know-how from industries and economic activities, (vi) local leadership, (vii) community cohesion, and (viii) local civil society organizations, (ix) utilising existing resources (such as subsidies, sharing community narratives and networks, low cost financing of incremental housing improvements, Neighbourhood

Vulnerability Index, detailed maps for local neighbourhood government use, alternative social safety nets, and broad based coalition to deal with climate change issues).

Pilot projects are necessary to help local government to better understand how climate change will impact communities and sectors, how current capacity has to be strengthened and spatial plan to be improved to form climate change-resilience city and how to use the good lesson learnt from pilots in designing long term policies and strategies to address climate change. The City Team has facilitated a number of stakeholders to develop a number of pilot projects. The objectives of pilot implementation are (i) to prepare for climate change impact at the city level, (ii) to engage city level stakeholders (city government, NGOs, universities, CBOs, private sectors, community groups), (iii) to implement the pilot projects that test climate change resilience strategy, and (iv) to test the adaptive capacity of the community. For these pilot projects, the subject is vulnerable people who affected by climate change impact. The beneficiaries are women, children, elderly and men, both in terms of increased awareness, increase local capacity, influence local policy etc.

The activities of pilot project are also designed to meet the following criteria: (i) replicability, (ii) addressing current and future risks, (iii) benefit to local community, (iv) innovation, (v) collaboration, (vi) scalability, and (vii) sustainability strategy. There are some additional criteria that should be conducted by the implementer of pilot project: (i) implementation of pilot project has to be related to the local problems at local administrative or cross border administrative communities on issues of environment, health, education, social, economy in which related to the impact of climate change, and (ii) implementation of pilot project directed for adaptation and response effort activities to the impact of climate change, such as: erosion, flooding, drought, landslide, and etc.

There are four pilot projects being selected under the Asian Cities Climate Change Resilience Network (ACCCRN) for Semarang City. The projects include:

1. Land Arrangement Models In Sub District of Sukorejo, City of Semarang by State University of Semarang
2. Micro Finance Program: Community Based Revolving Fund for Improving Sanitation in Sub District of Kemijen, City of Semarang by Perkumpulan Perdikan (Local NGO)
3. Coastal Community Adaptation in Tapak Tugurejo as Resilience Community Coping Climate Change by BINTARI (Local NGO)
4. Adaptation to Cope Climate Change Impacts (Landslide and Cyclone) in Sub District of Tandang, City of Semarang by Centre of Planning and Public Participation

The City team will work closely with the project implementers to gain lesson learnt from the projects and use it as inputs in developing strategies for managing current and future climate risks.

PREFACE

Indonesia has more than 17,000 islands, a coastline of more than 80,000 km, and the majority of population living in coastal zones where most of the country's economic activity takes place. Indonesia is a country prone to natural disasters such as floods, droughts, storms, landslides, volcanic eruptions, and wild fires. In the future, a changing climate brought about by global warming is expected to create new patterns of risk, and higher risks generally.

Semarang is a coastal city which will be impacted by climate change and sea level rise. In the recent years, some locations in Semarang have been experiencing land subsidence. Some of coastal areas in Semarang City are already inundated due to high tides (*rob*). In these locations, there are many households that have low income and live in poverty; and they are highly vulnerable to the effects of environmental problems. City Government must take this into account seriously in developing its city development plan, while taking immediate actions response to immediate needs of the people in addressing their current problem. Therefore, **Vulnerability and Adaptation Assessment to Climate Change in Semarang City** was implemented and results of this assessment are presented in this report.

This report describe in detail: (i) characteristics of current and future climate of Semarang City, (ii) Impact of climate hazards and vulnerability of community to extreme climate events, and existing adaptive capacities, (iii) Maps of current and future vulnerabilities and capacity as well as climate risk at *Kelurahan* Level, (iv) Governance and institutional issues that may affect the effectiveness of the implementation of climate change programs, (v) Initial recommendations for increasing resilience of the City to current and future climate risk, and (vi) Recommendation on types of pilot projects for increasing communities' resilience to the impact of climate change.

The study was supported by many institutions. Institute for Social and Environmental Transition (ISET) is managing the Asian Cities Climate Change Resilience Network (ACCRN) as part of the overall Rockefeller Foundation Climate Change Initiative. MercyCorp assists ISET in implementing the ACCRN program in Semarang City in collaboration with Local Government (City Team), Urban and Regional Development Institute (URDI), Centre for Climate Risk and Opportunity Management in South East Asia and Pacific (CCROM SEAP) Bogor Agriculture University, local institutions, local communities, and local NGOs. Their supports during the implementation of the study are paramount and highly appreciated.

We hope Semarang City Government would use some of the results presented in this report in addressing current problems, in its city development plan, and in implementation of climate change programs.

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Chapter 1 INTRODUCTION

1.1 Background

In the future, a changing climate brought about by global warming is estimated to create new patterns of risk, and higher risks generally. Sea level rise due to melting glaciers and polar ice and thermal expansion will contribute to the increase of coastal flooding. Increasing intensity of tropical cyclones observed in recent decades may be tied to increasing sea surface temperatures. By impacting the hydrologic cycle, global warming is expected to alter climatic ranges, shift regional climatic averages, resulting in shifting of climate zones, and lead to a higher frequency and amplitude of weather events. Climate variability and change occurring against a backdrop of increasing global population and globalization of economic processes may be expected to lead to increased competition over resources and new vulnerabilities. With the increase of climate risk, many countries, particularly least developed and developing countries may have difficulties to achieve the Millennium Development Goals related to poverty, hunger and human health.

Indonesia is a country already prone to natural disasters such as floods, droughts, storms, landslides, volcanic eruptions, and wild fires. Indonesia has experienced more frequent and severe climate-related hazards in recent years. Floods and windstorms accounted for 70% of total disasters and the remaining 30% of the total disasters are accounted for by droughts, landslides, forest fires, heat waves, storm, *robs* (flood due to high tides) and others. Within the period of 2003-2005 alone, there were about 1,429 disaster incidences in Indonesia. About 53.3 percent were hydro-meteorological disasters (Bappenas and Bakornas PB, 2006)

Rising sea levels pose a further risk. Approximately 24 small islands in Indonesian are already submerged (Ministry of Marine Affairs and Fisheries, 2007). This vast archipelago is extremely vulnerable to sea level rise with over 17,000 islands, a coastline of more than 80,000 km, and the population majority living in coastal zones where most of the country's economic activity takes place. Currently, around 42 million people in Indonesia live in areas less than 10 meters above the average sea level (Government of Indonesia, 2007). Most of households living in the coastal area has an income of between the US$2 and US$1-a-day poverty lines (Indonesia Poverty Analysis Program, 2006), far too many Indonesians live in poverty and remain highly vulnerable to the effects of climate change. The high population densities of Indonesia will further increase its sensitivity to climate hazards.

Semarang is coastal city which will be impacted seriously by climate change and sea level rise. At present, some of coastal areas at Semarang are already inundated due to the increase of sea level rise. Floods and drought also occur quite often. Government of Semarang City has implemented various program and also developed medium and long-term strategies to manage hazards. Plan for improving infrastructure for climate hazard control such as drainage system and dike has been prepared (Bappeda, 2007). However, under changing climate with the increasing frequency and intensity of extreme climate events the current design may not be very

effective for managing future climate hazards. Therefore it is also very important to consider climate change in designing climate hazard control system.

1.2 Objectives

This study was aimed

- To asses current and future climate variability in Semarang city
- To assess vulnerability and adaptive capacity as well as current and future climate risk at *Kelurahan* (villages) Level
- To identify direct and indirect impact of climate hazards now and in the future at *Kelurahan* level.
- To identify the most vulnerable areas and social groups, and dimensions of vulnerability, including adaptive capacity of community to climate change impact
- To identify institutional and governance issues that may affect the resilience of the city to current and future climate risk.
- To develop initial recommendations for Semarang City for increasing resilience of the city to current and future climate risk

1.3 Outputs

The final outputs of this work will be a report describing

- Characteristics of current and future climate of Semarang City
- Impact of climate hazards and vulnerability of community to extreme climate events, and existing adaptive capacities
- Maps of current and future vulnerabilities and capacity as well as climate risk at *Kelurahan* Level
- Governance and institutional issues that may affect the effectiveness of the implementation of climate change programs
- Initial recommendations for increasing resilience of the City to current and future climate risk.
- Recommendation on types of pilot projects for increasing communities' resilience to the impact of climate change

Chapter 2 BRIEF DESCRIPTION OF SEMARANG CITY PROFILE AND CONDITION OF RESPONDENCE

2.1 Geographical Location and Context

The City of Semarang is the capital of Central Java Province. Semarang's geographical condition (Figure 2.1) is located in Central Java's north coast at 6.93^{o} – 7.13^{o} latitude and 110.27^{o} – 110.50^{o} longitude. And its size reaches 37,366,838 ha or 373,7 km^2. Administrative boundaries of this area are Demak Regency (*kabupaten*) in the east, Java Sea in the north, Kendal Regency in the west and Semarang Regency in the south. The City of Semarang has a flat to hilly topography (Figure 2.2); flat topography is in coastal areas with 0-2% slope and elevation less than 3.5 meters above mean sea level (*msl*), while hilly topography is in the south of the flat topography with 2-40% slope and 90-200 meters above *msl* elevation. (http://www.semarangkota.go.id).

The geographical position of Semarang City in Central Java development corridor is a node of four gateways, which are north corridor of Coastal/Sea, south corridor towards dynamic cities such as Regencies of Magelang and Surakarta which is known as Merapi-Merbabu corridor, east corridor towards Demak/Grobogan Regencies, and west corridor towards Kendal Regency. In the development and growth of Central Java, Semarang City plays an important role, especially with its ports, land transportation networks (rails and roads) as well as air transportation, which is a potential for transport node and transit City of Central Java Region. Another position that is not less important is the strength of the relationship with areas outside Java, directly as central part of national territory in the middle. (http://www.semarangkota.go.id).

Topographic elevation is at altitude between 0.75 m to 350 m above sea level. The topography creates the potential for a beautiful panorama and a more diverse ecosystem. Altitude of 0.75-90.5 includes the area of Semarang City Center (North Semarang Lowland) represented by elevation points in the Costal Region of Port Tanjung Mas, Simpang Lima, Candibaru. While altitude of 90.5-348 is located in the suburb of Semarang, the largest is along the cardinal direction represented by elevation points located in Jatingaleh and Gombel, South Semarang, Tugu, Mijen and Gunungpati (Source: Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030). While the slope condition of Semarang can be seen in the following map (Figure 2.2).

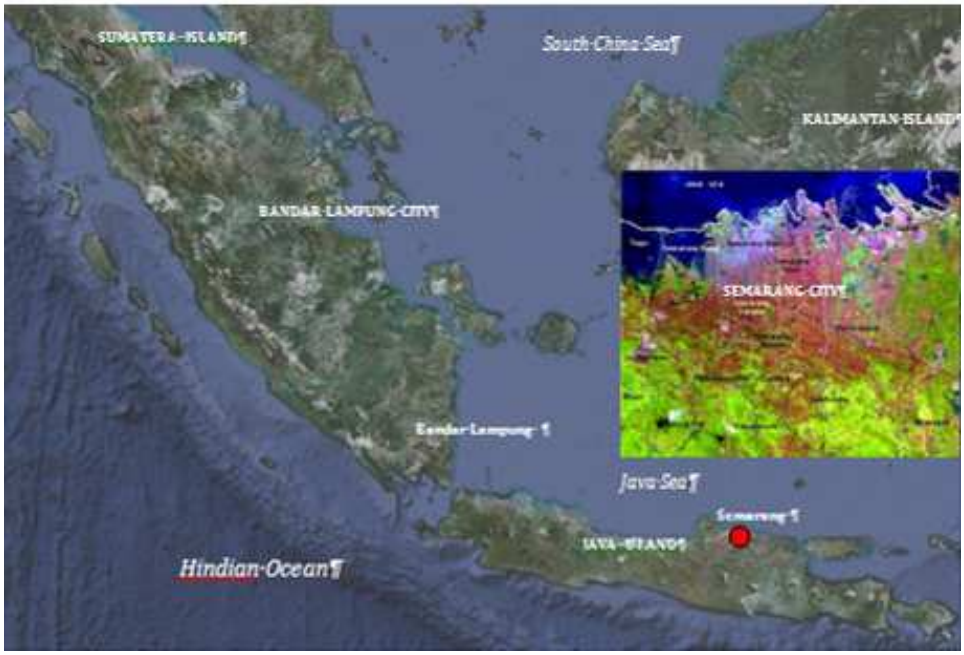


Figure 2.1: The Position of Semarang City and Its Surrounding Areas (Source: Google Earth, 2009 and Image of Landsat ETM+, 2001).

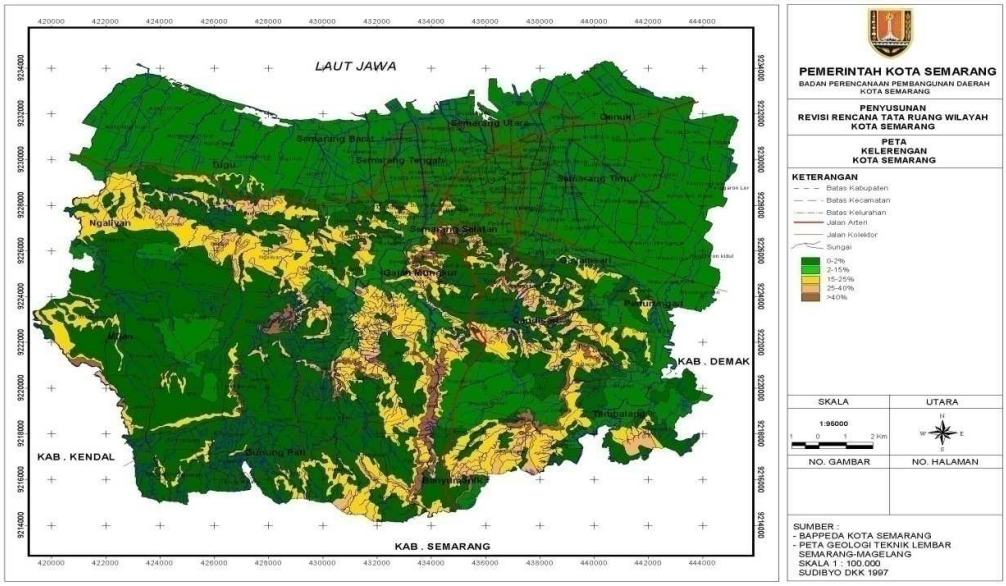


Figure 2.2: Semarang City Slope Map.

2.2 Municipal Administration

Administratively City of Semarang is divided into 16 districts (*kecamatan*) and 177 villlages (*kelurahan*). Those districts are: 1. West Semarang District, 2. East Semarang District, 3. Central Semarang District, 4. North Semarang District, 5. South Semarang District, 6. Candisari District, 7. Gajahmungkur District, 8. Gayamsari District, 9. Pedurungan District, 10. Genuk District, 11. Tembalang District, 12. Banyumanik District, 13. Gunungpati District, 14. Mijen District, 15. Ngaliyan District, 16. Tugu District. (Figure 2.3).

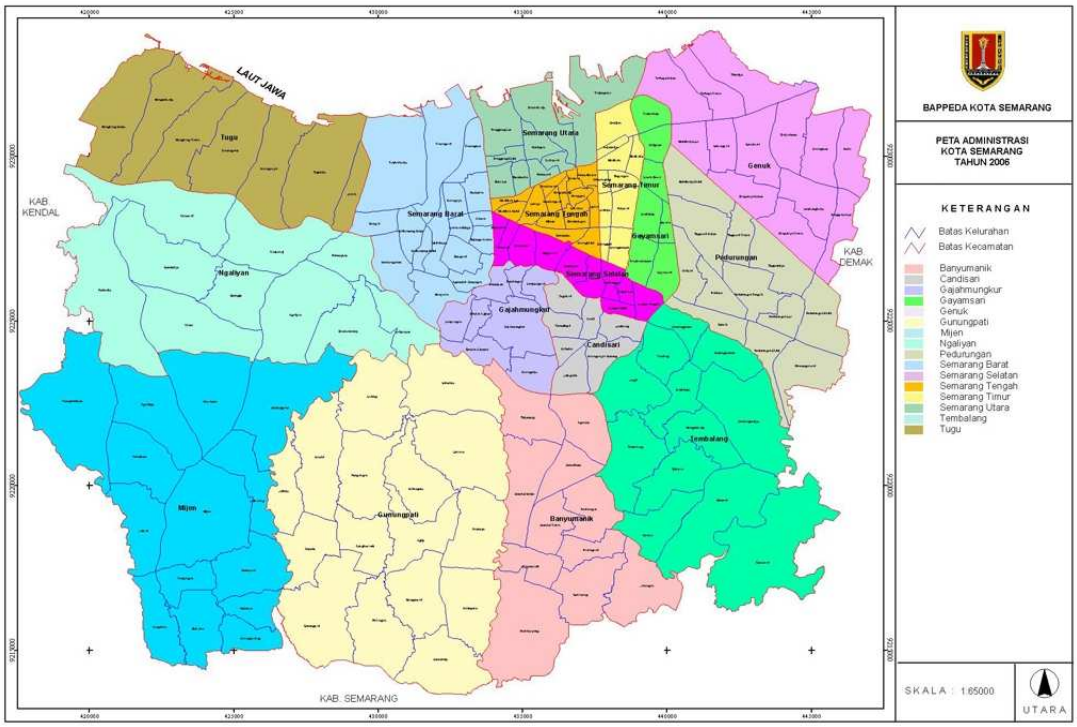


Figure 2.3: City of Semarang Administrative Map (Source: http://www.semarangkota.go.id).

2.3 Resource Base

2.3.1 Water resources

The rivers that flow in the City of Semarang include Garang, Kreo and Kripik river; Their flow velocity percentages are respectively 53%, 34.7% and 12.3% (Government of Semarang City, 2009). From the three rivers, Garang River has the most dominant function for Semarang City, and one of the functions is as water source for Tirta Moedal Water Company. Distribution of the water company is still concentrated in the centre of the city, which are East, North, West, South and Central Semarang. Residents who have not received water supply from the water company usually use shallow/deep ground water to meet their needs.

Shallow ground water in the area of Semarang City is at the depth of 3-18 m (lowland) and 20-40 m (highland). Shallow ground water quantity is strongly influenced by the seasons and the surrounding environment. In addition to the shallow ground water the residents also use deep ground water, which is ground water stored in depressed aquifer layer. The depth of this layer is at 50-90 m from the surface and the location of the aquifer is in the northeast of Semarang City and at the mouth of old Garang River located in the confluence of Garang river valley and coastal plains (Government of Semarang City, 2009).

2.3.2 Coastal areas

City of Semarang is a port city that is important for Java. Based on the location and shape of coastal physiographic, Semarang Harbour city is located in an open coastal plain. In open coastal plains, high waves resulted from strong winds may hit coastal plains easier. In some coastal plains, *rob* (flooding associated with high tides) phenomenon has been observed that can disrupt resident's economic activities.

The northern part of Semarang City is bordered by Java Sea. Centre of economic activities in the coastal areas of Semarang City, are among others focused in the area of Tanjung Mas Port. In this coastal area there are also several fishing activities, such as cultivation pond.

In Semarang City also faced with problem of land subsidence. One of the triggering factors of the problem is the high population growth. The growing population will result in increased consumption of ground water. As a result there is decrease in hydraulic pressure in the soil layer that will be followed by decrease in soil surface. This condition will get worse if there is additional load on the surface such as settlements or other building areas. Georisk Project (cooperation between Indonesia and German Geological Agency) has conducted a research to determine the rate of land subsidence in the area of Semarang City. The data of PSI (Persistent Scattered Inferometry) in 2002 to 2006 has been used by the Project to build Georisk maps or spatial distribution of the rate of land subsidence in Semarang City. The rate of land subsidence in this region is between 0-1 cm/year and 8-9 cm/year (see Figure 2.4.)

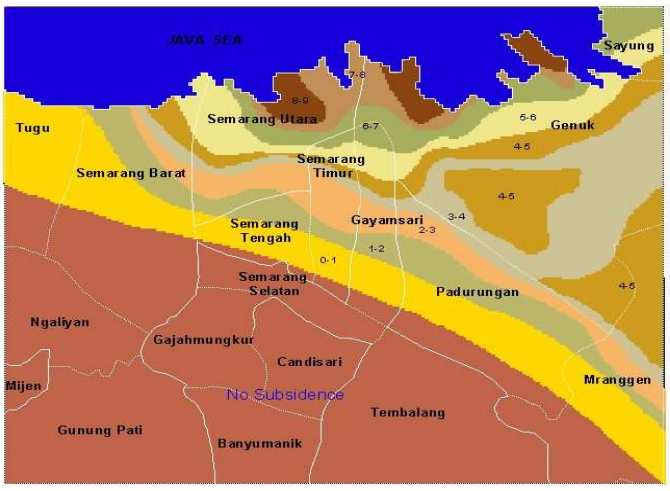


Figure 2.4: The Rate Of Land Subsidence In Semarang City:

The highest rate of land subsidence (8-9 cm/year) covers most of North Semarang district and Genuk District, while the lowest (0-1 cm/year) are in some parts of Tugu District, central part of West Semarang District, and southern parts of the following four districts, namely Central and East Semarang, Gayamsari and Padurungan.

Some areas near the coast which has low elevation are susceptible to water inundation caused by rob; while the regions far enough from the coast are susceptible to water inundation due to water overflow as drainage system in the area is inadequate. The distribution of water inundation in Semarang City area can be seen in Figure 2.5.

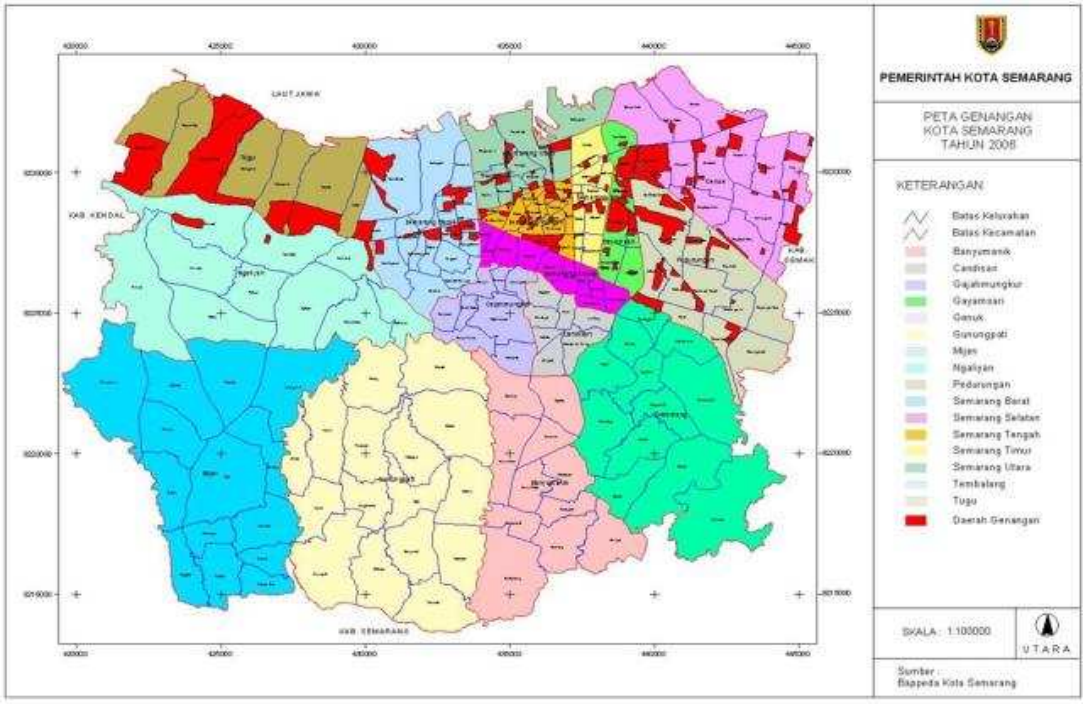


Figure 2.5: Distribution of Inundation Area in Semarang City (Source: http://www.semarangkota.go.id)The Rate of Land Subsidence in Semarang City

2.3.3 Water resources

Land area is the area for many sectors such as residential, industrial, trade and services, green open land, and agricultural land. The largest percentage of land use/land cover in the City of Semarang is settlement and the smallest is bare land. The distribution of the settlement is to the north, east and south (Figure 2.6). The western part is dominated by land use for dry land agriculture and forest plants. Because the north, east and south side of this city are highly occupied with settlements, then in the coming years it is predicted that settlement development will shift to the west. As a result, land use for forest plants and dry land agriculture may will be converted to settlements or other land use that supports the settlement

Out of 33,493 ha of dry land, mostly are used for buildings (41%), fields and other land use (25%). The extent of land use in the form of buildings shows that the development orientation of Semarang City is to non-agricultural sector. This will support the development of Semarang City to secondary and tertiary sectors, so

trends in the development of the future is increasing number of built land (Source: Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030)

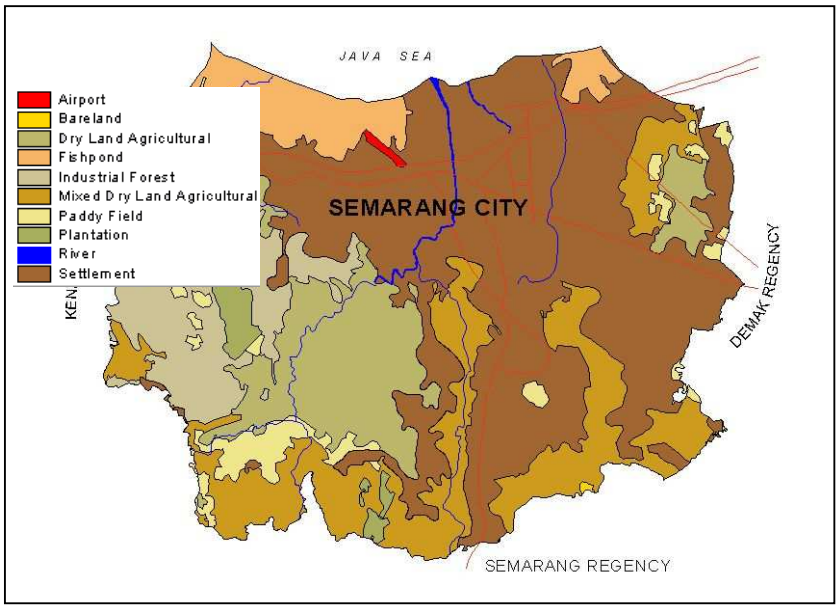


Figure 2.6: Distribution of Land Use/Land Cover in Semarang City In

Table 2.1 informs that the largest land use is dry land use. This is a reasonable; given the City of Semarang is the capital of Central Java Province that has urban hierarchy as a *prime city* in Central Java scope. Thus, the City of Semarang is an area with very high urban level. This is supported by the position of Semarang City that is in the regional route node of Jakarta-Surabaya and south route to Surakarta and Yogyakarta (Source: Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030).

Table 2.1: Use of Land in Semarang City in 2005

No	District	Paddy field	Dry lands							Total
			Building	Garden	Grassland	Swamp	Fish pond	Forest	Others	
1	Mijen	1.008,89	822,88	1.715,79	0,00	0,00	17,34	809,70	611,52	4.986,12
2	Gunungpati	1.382,00	1.313,00	2.180,37	0,00	0,00	0,00	0,00	125,08	5.000,45
3	Banyumanik	95,00	430,00	379,58	614,00	0,00	0,00	0,00	811,48	2.330,06
4	Gajahmungkur	0,00	691,63	2,97	0,00	0,00	0,00	0,00	54,27	748,87
5	S.Semarang	0,00	473,39	2,50	0,00	0,00	0,00	0,00	371,16	847,05
6	Candisari	0,00	494,39	19,98	13,87	0,00	0,00	0,00	1,02	529,26
7	Tembalang	432,00	2.085,40	800,80	0,00	0,00	0,00	0,00	623,84	3.942,04
8	Pedurungan	64,00	1.507,00	356,00	0,00	394,19	0,00	0,00	113,00	2.434,19
9	Genuk	94,00	1.118,71	890,14	0,00	0,00	208,40	0,00	0,00	2.311,25
10	Gayamsari	19,50	420,89	0,00	13,75	0,00	11,09	0,00	49,50	514,73
11	E. Semarang	0,00	696,80	0,00	0,00	0,00	0,00	0,00	73,45	770,25
12	N. Semarang	0,00	979,33	0,00	0,00	0,00	9,43	0,00	144,51	1.133,27
13	C. Semarang	0,00	527,55	5,48	0,00	0,00	0,00	0,00	66,53	599,56
14	W. Semarang	18,57	1.389,20	8,20	0,00	0,00	52,66	0,00	899,07	2.367,70
15	Tugu	460,00	507,73	30,20	0,00	0,00	1.579,00	0,00	53,52	2.630,45
16	Ngaliyan	324,00	418,00	469,00	10,00	0,00	0,00	706,00	817,84	2.744,84

(Source: Semarang in Figures, 2005; in Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030)

2.4 Position of Semarang City in Regional Context

The descriptions in Section 2.4 are quoted from Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030.

2.4.1 Pattern of regional development and function of the City

Based on RTRWN regarding regional development and function of the city, Semarang City area is in the development plan of regions of Semarang - Demak as shown in Table 2.2.

Table 2.2: Development Plan of Semarang-Demak Regions

Land Area	Related Sea Area	Areas In Land Area	National City Function
Area of Semarang-Demak Commodity Sectors: • Industry • Tourism • Food Crops • Trade	Area of Karimunjawa and its surroundings Commodity Sectors: • Fishery • Mining • Tourism City Orientation: Semarang	• Semarang • Kendal • Demak • Ungaran • Salatiga • Purwodadi	• PKN • PKL • PKL • PKW • PKW • PKL

Source: Government Regulation No 47 Year 1997.

Notes: Local Activity Center (PKL), Area Activity Center (PKW), National Activity Center (PKN)

2.4.2 Conservation areas

Conservation areas are areas whose main function are to protect the environmental sustainability that covers natural resources, man-made resources, historical value and culture for the interest of sustainable development.

Conservation areas in Semarang City include:

1. Conservation areas that protect sub areas

2. Local conservation areas that include coastal border, river bank, areas around lakes/reservoirs, and areas around springs;

– River border

– Coastal border

– Areas around lakes/reservoirs

– Areas around springs

3. Disaster prone areas

• Rob/flood prone areas

Flood prone areas are areas that will routinely every rainy season have puddle of water for more than six hours when rain falls in a normal rainy season. Flood prone areas are conservation areas that are temporary, until the flooding problem in those areas are handled thoroughly and permanently.

In the area of Semarang City, areas potential to be flood prone areas include part of Districts of Tugu, West Semarang, Central Semarang, North Semarang, and Genuk.

- Prone to landslides and land movement

Prone to landslides and land movement areas are areas that have a vulnerability to natural disasters of landslides and soil movement. Prone to landslides area are areas that have slopes of more than 40%, which can be found in some location in Districts of Gajahmungkur, Candisari, Tembalang, Banyumanik, Gunungpati, Mijen, and Ngaliyan

Areas that are prone to soil movement are in Gunungpati, and Banyumanik Districts. Based on its geological conditions this area is potential to land movements. Active fault areas, which are areas geologically have fault prone to land movements. The locations of these areas are:

- Along the Mijen and Gunungpati Districts, through Villages of Sumurejo, Mangunsari, Gunungpati, Purwosari, Limbangan, and Cangkiran.

- Along Banyumanik District, through Villages of Jabungan, Padangsari, Plalangan, Sumurboto, and Tinjomoyo.

- Gunungpati Districts, through Villages of Sukorejo, Kalipancur and Bambankerep

4. Culture conservation areas

2.4.3 Utilization of areas

The utilization of areas in the provincial level is in the form of space utilization for various activities. The utilization should consider (a) the conditions of existing city planning, natural resources and man-made resources, human resources, socio-economic and the environment; (b) development objectives and (c) regional spatial planning objectives. Types of utilization of areas in the City of Semarang can be seen in Table 2.3.

2.4.4 Strategic and priority regions

Areas in the administration of Central Java Province can be classified into strategic and priority areas. These area are:

1. Strategic regions

a. Mainstay region (*kawasan andalan*); One of the mainstay region in Central Java is Kedungsapur (Kendal, Demak, Ungaran, Salatiga, Semarang, Purwodadi)

b. Strategic development region which is potential for the development of national service.

Semarang City, due to its role as the provincial capital that has complete facilities in the form of complete infrastructure and facilities in Central Java, has potential in industrial and trade and has every outlet (airport, sea ports, terminals for vehicles, and railways). Besides that the function of Port of Tanjung Mas that is planned to be

upgraded to be secondary main port as the container of activity overflow from port of Tanjung Priok or Port of Tanjung Perak is one of the strong considerations for the development of this area.

2. Priority regions

a. Kedungsapur region is included in provincial strategic rgional cooperation. The development strategy for this region is intra regional as a distribution center for products from hinterland because it is around the route of north coast and inter regional and national as transit location of trade and services from west and east Java and from other islands especially Kalimantan.

b. Province border cooperation region. Kedungsapur region is included in Joglosemar (Jogjakarta, Solo dan Semarang) regional cooperation between Central Java and Jogjakarta.

c. Region of conservation and protection againts disasters. Included in this region is the Kaligarang watershed area (DAS). The management of Kaligarang watershed area is done mainly in order to address the problems of flooding and environmental hazards that occur in other areas around the watershed through improving the water resistance and accelerating the drainage process into the sea. As a watershed area, the handling is integrated by considering the administrative, ecological, economic, social and physical aspects in the areas located along the river path.

Table 2.3: Types of Utilization of Areas in Semarang City According To RT/RW in Central Java Province (Central Java Province Regulation No.23/2003)

NO	Type of activity	Remarks
1	Tourism area	Semarang City is part of development area B This area is more varied with several attraction themes, namely maritime, culture and mountain. This area covers the corridor of Semarang-Demak-Kudus-Jepara and corridor of Semarang-Ambarawa-Wonosobo. Objects in this development area are: Cultural tourism objects in Semarang, Karimunjawa Islands, Great Mosque of Demak, Kudus Mosque and Kretek Museum, Dieng Highland
2	Industrial area	Tugu industrial area, Genuk industrial area There is a need in the area of Central Java Province of integrated zone integrated to port area (outlet), which is Port of Tanjung Emas Semarang and Port of Tanjung Intan Cilacap, to improve industrial commodity export.
3	Settlement area	The growth of settlement in Semarang City is classified into settlement prone to problems (environmental conflict)

Source: RTRW in Central Java

2.4.5 Plan of Green Zone Determination

Based on Land Use Plan, Plan of Green Zone Distribution and Size, Plan of Land Support and Green Zone Density in Semarang City, it can be arranged the Plan of the Minimum Green Zone in Semarang, as follow:

1. In the Urban Area, because the Open Space area is getting smaller due to increase in built land and building density, the amount of green area is directed to reach the minimum of 15% -25% of the total area. This condition is directed to areas in Semarang City that cover the following districts: North Semarang, West Semarang, East Semarang, Central Semarang, South Semarang, Genuk, Pedurungan, Gayamsari, Gajah Mungkur, Candisari and Tugu.

2. In Rural Areas, as the potential for Open Space is still quite big and building density is still relatively small, the amount of green area is directed to reach the minimum of 25% -40% of the total area. This condition is directed to areas in Semarang city that cover the following districts: Ngaliyan, Mijen, Gunungpati, Banyumanik and Tembalang.

Therefore the percentage of Green Zone in each district in Semarang City is as follows:

1. Percentage of Green Zone in Mijen District : 60%-75%
2. Percentage of Green Zone in Gunungpati District : 60%-75%
3. Percentage of Green Zone in Banyumanik District : 40%-60%
4. Percentage of Green Zone in Gajahmungkur District: 10%-15%
5. Percentage of Green Zone in South Semarang District : 25%-40%
6. Percentage of Green Zone in Candisari District : 10%-15%
7. Percentage of Green Zone in Tembalang District : 40%-60%
8. Percentage of Green Zone in Pedurungan District : 15%-25%
9. Percentage of Green Zone in Genuk District : 25%-40%
10. Percentage of Green Zone in Gayamsarig District : 15%-25%
11. Percentage of Green Zone in East Semarang District: 10%-15%
12. Percentage of Green Zone in North Semarang District : 10%-15%
13. Percentage of Green Zone in Central Semarang District : 10%-15%
14. Percentage of Green Zone in West Semarang District : 25%-40%
15. Percentage of Green Zone in Tugu District : 25%-40%
16. Percentage of Green Zone in Ngaliyan District : 40%-60%ad

2.5 Demographic Conditions and Social Context

2.5.1 Population and population density

The population of Semarang City in 2008 according to the Regional Development Planning Agency and the Statistic Center Agency of Semarang City is 1,481,640, which comprises of 735,457 male residents and 746,183 female residents (Table 2.4). The rate of population growth in Semarang City in 2008 is 1,85%. The densest district is South Semarang District with 14,458 people per km^2, while the least dense is Mijen and Tugu Districts, with around 850 people per km^2. This can be seen in Table 2.5.

Table 2.4: Female and Male Population in Semarang City in 2008

District		Population		
		Male	Female	Total
Mijen		24.804	24.119	48.923
Gunungpati		32.720	32.745	65.465
Banyumanik		60.616	61.239	121.855
Gajah Mungkur		30.942	30.726	61.668
South Semarang		42.839	42.752	85.591
Candisari		38.380	39.557	77.937
Tembalang		64.127	62.881	127.008
Pedurungan		81.242	82.320	163.562
Genuk		40.219	40.381	80.600
Gayamsari		35.010	35.772	70.782
East Semarang		40.047	41.700	81.747
North Semarang		61.366	65.399	126.765
Central Semarang		36.086	38.142	74.228
West Semarang		79.076	80.349	159.245
Tugu		13.449	13.527	26.976
Ngaliyan		54.534	54.574	109.108
Total	2008	735.457	746.183	1.481.640
	2007	722.026	732.568	1.454.594
	2006	711.755	722.270	1.434.025
	2005	705.627	713.851	1.419.478
	2004	695.676	703.457	1.399.133

Source: Regional Development Planning Agency and the Statistic Centre Agency of Semarang City, 2009.

Table 2.5: Area, Number of Households, Total Population and Population Density in Semarang City in 2008

Village	Area (km^2)	Number of household	Population (people)	Population density (people/km^2)
Mijen	57,55	13.212	48.923	850
Gunungpati	54,11	22.449	65.465	1.210
Banyumanik	25,69	33.646	121.855	4.743
Gajah Mungkur	9,07	14.599	61.668	6.799
South Semarang	5,92	20.265	85.591	14.458
Candisari	6,54	16.498	77.937	11.917
Tembalang	44,20	35.920	127.008	2.873
Pedurungan	20.72	39.292	163.562	7.894
Genuk	27,39	20.338	80.600	2.943
Gayamsari	6,18	16.471	70.782	11.453
East Semarang	7,70	22.189	81.747	10.616
North Semarang	10,97	28.727	126.765	11.556
Central Semarang	6,14	19.458	74.228	12.089
West Semarang	21,74	36.654	159.425	7.333
Tugu	31,78	6.896	26.976	849
Ngaliyan	37,99	27.306	109.108	2.872
TOTAL	373,69	373.920	1.481.640	3.965

Source: Regional Development Planning Agency and the Statistic Center Agency of Semarang City, 2009

2.5.2 Population growth and Migration

Based of the population growth occurring in 2005-2006, the largest population growth comes from natural growth factor (number of birth minus number of death), which is 12,442 people; whereas population growth from migration factor (number of population coming minus number of population leaving) is 10,247 people. Population growth based on natural and non-natural factors can be seen in Table 2.6 (Regional Development Planning Agency and the Statistic Center Agency of Semarang, 2009).

Table 2.6: Population Growth Based on Natural and Non-natural Factors in 2008

No	District	Number of people			
		Birth	Death	Coming	Leaving
1	Mijen	883	301	2,052	865
2	Gunungpati	970	345	1,641	737
3	Banyumanik	1,688	708	3,776	2,864
4	Gajah Mungkur	998	395	1,644	1,724
5	South Semarang	1,202	674	1,880	2,372
6	Candisari	1,302	671	1,978	2,653
7	Tembalang	1,994	691	4,742	2,104
8	Pedurungan	2,332	864	5,536	4,095
9	Genuk	1,821	414	3,183	1,186
10	Gayamsari	1,368	472	2,448	2,120
11	East Semarang	1,370	754	1,729	2,882
12	North Semarang	2,637	1,101	2,761	3,356
13	Central Semarang	944	688	1,525	2,174
14	West Semarang	2,906	1,217	4,602	5,436
15	Tugu	404	193	753	473
16	Ngaliyan	1,653	530	3,937	2,087
Total	2008	24,472	10,018	44,187	37,128
	2007	22,838	10,018	43,151	35,180
	2006	21,445	9,023	42,714	32,557
	2005	19,504	8,172	38,940	29,107
	2004	17,562	7,320	35,105	25,657

Source: Kota Semarang in Figures, 2009

2.5.3 Number of poor families

The largest number of poor families in Semarang is in North Semarang District (12,117 families) and the smallest is in Tugu District (2,007 families) as shown in Table 2.7.

2.5.4 Education

Population above five years old reaches 1,429.889. From this number, their education level is as follows: not graduating elementary school (130.411), elementary graduate (326.847), junior high school graduate (289.915), high school graduate (301.658), Diploma III graduate (62.136), university graduate (64.484). The education structure such as this is considered reliable for supporting Semarang City development; especially improvement in population quality is always prioritized in

the effort to improve welfare (Regional Development Planning Agency and the Statistic Center Agency of Semarang City, 2009).

Table 2.7: The Number of Poor Families in Semarang, 2008

No	District	Number of Household	Number of Poor Family
1	Banyumanik	26,264	5,611
2	Candisari	16,454	3,897
3	Gajah Mungkur	13,022	2,139
4	Gayamsari	14,132	2,619
5	Genuk	16,102	7,475
6	Gunung Pati	17,031	7,547
7	Mijen	11,103	5,940
8	Ngaliyan	23,048	8,942
9	Pedurungan	34,786	10,252
10	West Semarang	32,399	12,117
11	South Semarang	17,408	4,672
12	Central Semarang	18,857	7,944
13	East Semarang	21,316	8,854
14	North Semarang	28,597	12,561
15	Tembalang	30,033	8,871
16	Tugu	5,563	2,007
Total		326,115	111,448

2.6 Economy and Livelihood

Information of economy and livelihoods can give a picture of the level of public welfare, and is one of the important factors that could support community resilience in the face the disasters mainly caused by climate change.

Livelihoods are basically closely related to level of income, welfare and management of natural resource around the people. Population with a high level of dependence on agriculture and fisheries sector needs to get greater attention, because the sector is strongly influenced by the climate or season.

The main livelihoods of Semarang City are industrial workers (25.13%), construction workers (13.05%), government employees/Armed Forces (16.04%), and other services (10.38%) and farmers (4..8%). These livelihoods are the main contributor to the Gross Regional Domestic Product (GRDP) in the City of Semarang.

Gross Regional Domestic Product of the City of Semarang (Table 2.8) is largely contributed by trade, hotel and restaurant (30.27%), followed by industry (27.60%), buildings (14.76%), services (12.08%) and transportation and communication (9.58%). Agriculture only contributes 1.25% to GDP.

Table 2.8: Gross Regional Domestic Product According Type of Business Based on Prevailing Price Rate in 2007 – 2008

No	Activities	2006	2007
1	Agriculture	321.780,06	365.094,82
	1.1. Food crop	144.430,90	160.886,40
	1.2. Estate	19.233,28	22.346,07
	1.3. Animal husbandry	132.746,60	152.295,66
	1.4. Forestry	1.258,18	1.336,44
	1.5. Fisheries	24.111,10	28.230,25
2	Mining	52.326,97	57.062,91
3	Industry	7.147.317,38	7.883.532,65
4	Electricity, Gas, and Water	487.538,02	532.279,91
5	Building	4.445.307,70	5.414.829,31
6	Trade, Hotel, Restaurants	7.480.617,87	8.635.562,26
7	Travel and Communication	2.762.149,15	3.073.387,13
8	Monetary, Rental, and Services	772.160,41	889.126,40
9	Other services	3.155.016,61	3.664.861,32
	Gross Regional Domestic Product	26.945.994,23	30.515.736,32

Source: Regional Development Planning Agency and the Statistic Center Agency of Semarang City, 2009

2.7 Respondent Profiles

To describe the socioeconomic conditions in the City of Semarang more broadly, there are limitations in the availability of secondary data. Therefore representations are made by using survey data on the eight observed villages in Semarang City. Based on the condition of area, the observed villages are grouped into non-coastal and coastal areas. Non-coastal villages are: 1). Gunung Pati , 2) Tandang , 3). Lempong Sari and 4). Rowosari. Whereas coastal villages are: 5). Tanjung Mas, 6). Kemijen, 7). Mangun Harjo, 8). Trimulyo. The survey involved 278 respondents, consisting of male (63.1%) and female (36.9%). Besides from survey, information is also obtained from focus group discussion (FGD) in 4 locations, namely, Villages of Mangunharjo, Tanjungmas, Rowosari, and Tandang.

2.7.1 Social Context

A. Education level

The level of education is one of the indicators in assessing the ability of communities to accept new knowledge, and absorb new skills and technologies. The higher the education level of society, the easier to inspire their awareness to respond to disaster adaptation efforts, either through the process of training, counselling, and provision of skills or adopting examples. Therefore, the education level of the population can be used as one of the benchmark in assessing the vulnerability of the population to disasters.

The number of population with productive age (15-64) in the City of Semarang is quite large, reaching 74% of the total population. On the other hand, formal education level of residents in the village observed is still relatively low. The percentage of residents who did not attend schools reaches as much as 8.2%. While the number of people who did not complete elementary school and those who

complete elementary school is as much as 50.82%. Thus, approximately 59 % percent of residents is in low level formal education structures. The number of residents who are junior high school graduates is as much as 20.49%, high school graduates is as much as 18.03% and university graduates is as much as 2.46%.

By looking at the variation of educational profile data of the residents in observed villages linked with the type of livelihood, it appears that the educational level of people who work *off-farm* (non-agricultural) is higher compared to residents who work *on-farm* (this can be seen in Table 2.9). Thus the implications for the variation in region is, most of the population in the areas dependent on agriculture have low level education which is elementary graduates and below. Whereas most of the population in the areas that are not dependant on the agricultural sector, have relatively high-level education such as junior high school, high school and university graduates, and the percentage is relatively higher. Low level education in an area can indicate that the respective area is more vulnerable to disasters.

B. Family decision making

A family member who is dominant in family decision-making is the husband with a percentage of 48,67 percent. But there is a family group respondent who stated that family decision-making can not be made alone by their husbands, they involve their wives in family decisions and the number of this group is quite large, as much as 30,42%. If this number is compared to the percentage of wage earners in the family which is the husband and wife, it seems consistent that the participation of women in family decision-making is also influenced by their involvement in helping their husbands to obtain income.

By comparing the percentage of decision makers in every village, it can be seen that the percentage of husbands making decisions alone is higher than the percentage of husbands and wives making family decision, except in Trimulyo Village, where the percentage of husbands and wives making decisions is higher compared to husband making decision alone. It can be seen in Table 2.10.

Table 2.9: Distribution of Education Level and Types of Livelihoods in the Observed Villages (%)

Name of village and type of livelihoods	Education level (%)							Total (%)
	No school	SD, levels 1-3	SD, levels 4-6	SD Finished	SMP Finished	SMA Finished	Univ. graduated	
Gunung Pati	**0,82**	**0,82**	**1,64**	**6,56**	**0,00**	**4,10**	**0,00**	**13,93**
Farmer, food crop	0,82	0,00	0,82	3,28	0,00	3,28	0,00	8,20
Farmer, home garden	0,00	0,00	0,82	0,00	0,00	0,00	0,00	0,82
Trader	0,00	0,00	0,00	0,00	0,00	0,82	0,00	0,82
Farmer labour	0,00	0,00	0,00	3,28	0,00	0,00	0,00	3,28
Labour	0,00	0,82	0,00	0,00	0,00	0,00	0,00	0,82
Kemijen	**0,00**	**0,00**	**0,82**	**0,82**	**4,10**	**4,92**	**0,00**	**10,66**
Trader	0,00	0,00	0,82	0,00	2,46	1,64	0,00	4,92
Crafter	0,00	0,00	0,00	0,00	0,82	0,00	0,00	0,82

Services	0,00	0,00	0,00	0,82	0,00	1,64	0,00	2,46
Carpenter	0,00	0,00	0,00	0,00	0,82	1,64	0,00	2,46
Lempong Sari	**0,00**	**1,64**	**1,64**	**0,82**	**0,82**	**0,82**	**0,82**	**6,56**
Trader	0,00	0,00	0,82	0,00	0,82	0,00	0,00	1,64
Public servants (PNS/ABRI/POLRI)	0,00	0,00	0,00	0,00	0,00	0,82	**0,82**	1,64
Services	0,00	0,82	0,82	0,00	0,00	0,00	0,00	1,64
Labour	0,00	0,82	0,00	0,82	0,00	0,00	0,00	1,64
Mangun Harjo	**0,00**	**2,46**	**0,00**	**5,74**	**3,28**	**2,46**	**0,82**	**14,75**
Farmer, food crop	0,00	0,00	0,00	0,82	0,82	0,00	**0,82**	2,46
Farmer, home garden	0,00	0,82	0,00	0,00	0,00	0,00	0,00	0,82
Fishery	0,00	0,82	0,00	0,00	0,82	0,82	0,00	2,46
Trader	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Service	0,00	0,00	0,00	0,00	0,82	0,00	0,00	0,82
Farmer labour	0,00	0,82	0,00	3,28	0,00	0,00	0,00	4,10
Labour	0,00	0,00	0,00	0,82	0,82	1,64	0,00	3,28
Rowosari	**4,92**	**0,00**	**0,82**	**6,56**	**3,28**	**0,00**	**0,00**	**15,57**
Farmer, food crop	3,28	0,00	0,82	4,10	0,00	0,00	0,00	8,20
Farmer, home garden	0,00	0,00	0,00	0,00	0,82	0,00	0,00	0,82
Carpenter	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Farmer labour	0,82	0,00	0,00	1,64	1,64	0,00	0,00	4,10
Labour	0,82	0,00	0,00	0,00	0,82	0,00	0,00	1,64
Tandang	**0,00**	**0,82**	**3,28**	**1,64**	**3,28**	**0,82**	**0,00**	**9,84**
Farmer, home garden	0,00	0,00	0,00	0,00	0,82	0,00	0,00	0,82
Trader	0,00	0,00	0,82	0,00	1,64	0,82	0,00	3,28
Crafter	0,00	0,00	0,00	0,00	0,82	0,00	0,00	0,82
Public servants(PNS/ABRI/POLRI)	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Carpenter	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Labour	0,00	0,82	2,46	0,00	0,00	0,00	0,00	3,28
Tanjung Mas	**0,82**	**1,64**	**0,00**	**10,66**	**3,28**	**2,46**	**0,00**	**18,85**
Farmer, food crop	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Fishery	0,00	0,82	0,00	2,46	0,82	0,00	0,00	4,10
Trader	0,00	0,00	0,00	3,28	0,00	0,00	0,00	3,28
Crafter	0,00	0,00	0,00	0,82	0,00	0,00	0,00	0,82
Services	0,00	0,00	0,00	1,64	0,00	0,82	0,00	2,46
Labour	0,82	0,82	0,00	1,64	2,46	1,64	0,00	7,38
Trimulyo	**1,64**	**0,00**	**0,82**	**1,64**	**2,46**	**2,46**	**0,82**	**9,84**
Farmer, food crop	0,82	0,00	0,00	0,00	0,00	0,00	0,00	0,82
Fishery	0,00	0,00	0,82	0,00	0,00	0,00	0,00	0,82
Trader	0,82	0,00	0,00	0,00	0,82	0,82	**0,82**	3,28
Public servants (PNS/ABRI/POLRI)	0,00	0,00	0,00	0,00	0,00	0,82	0,00	0,82
Services	0,00	0,00	0,00	0,82	0,00	0,82	0,00	1,64
Labour	0,00	0,00	0,00	0,82	1,64	0,00	0,00	2,46
Grand Total	**8,20**	**7,38**	**9,02**	**34,43**	**20,49**	**18,03**	**2,46**	**100,00**

Table 2.10: Family Members Participating In Family Decision Making in the Observed Villages, 2009 (%)

Region/Village	Family member who make decision						
	All member	HW	H	W	HS	Other	Total
Non coastal							
Gunung Pati	0,38	0,76	4,56	0,00	1,52	1,14	8,37
Lempong Sari	0,38	3,04	5,32	1,14	0,38	1,90	12,17
Rowosari	0,00	3,80	7,22	0,76	0,38	0,76	12,93
Tandang	0,00	4,18	6,84	0,76	0,00	0,00	11,79
Sub Total	0,76	11,79	23,95	2,66	2,28	3,80	45,25
Coastal							
Kemijen	0,38	2,28	5,70	1,52	0,00	2,28	12,17
Mangun Harjo	0,38	4,56	6,84	0,00	0,00	1,52	13,31
Tanjung Mas	0,76	5,32	8,37	0,76	0,38	1,14	16,73
Trimulyo	0,38	6,46	3,80	1,52	0,38	0,00	12,55
Sub Total	1,90	18,63	24,71	3,80	0,76	4,94	54,75
Grand Total	2,66	30,42	48,67	6,46	3,04	8,75	100,00

Notes: H (Husband), W (Wife), S (Son), D (Daughter)

C. Family participation in joining trainings

In general the participation of residents in joining trainings to improve their abilities is quite low. From Table 2.11, it can be seen that the husbands' participation in training is as much as 22,30%, therefore 77,7% of residents do not participate in training activities. Compared to the participation of the husbands, the wives' participation in training is relatively lower at around 17.27%. From the data it can be seen that boys are more active joining the training than girls. Specifically in Lempong Sari, Rowosari, Tandang, and Kemijen Villages wives' participation in trainings is more than that of husband's.

The relatively low level of public participation in joining various trainings to improve their life skills will have an impact on the limited skills possessed by the public, especially when dealing with a variety of conditions that threaten the survival of their families. In these circumstances, if a family is affected, which in turn can no longer depend on its main job (both short and long term), then the alternative to do side job is relatively difficult to do because of their limited skills. It is different if the public is quite active in participating in various trainings, in which it will lead to the opportunity to perform various kinds of alternative jobs, thus reducing disaster vulnerability.

In the context of an urban society with lower level economic strata, improvement of skill is not always obtained through formal trainings, but can also be obtained through informal ways, such as learning from others in the neighbourhood.

Table 2.11: Family Member Participation in Training in the Observed Villages, 2009 (%)

Region/Village	Husband	Wife	Son	Daughter
Non coastal				
Gunung Pati	40,91	13,64	13,64	4,55
Lempong Sari	6,25	15,63	3,13	6,25
Rowosari	10,26	25,64	0,00	0,00
Tandang	22,22	25,00	2,78	5,56
Sub Total	17,83	20,93	3,88	3,88
Coastal				
Kemijen	12,50	18,75	3,13	3,13
Mangun Harjo	48,57	20,00	5,71	2,86
Tanjung Mas	25,53	4,26	8,51	0,00
Trimulyo	17,14	17,14	0,00	0,00
Sub Total	26,17	14,09	4,70	1,34
Grand Total	22,30	17,27	4,32	2,52

The results of the survey is reinforced by the results of FGD, for example most residents of Mangunharjo Village admitted that in carrying out their work they do not have the expertise or special skills. They acquired the skills largely from experience and learning from other people who have previously worked in the field. But there are some jobs that require them to have greater knowledge such as builders. The same goes for kinds of jobs done by women. There are jobs that require special skills such as sewing and food processing. These skills are obtained from courses and trainings.

In Tandang Village, male residents who work as construction workers, factory or industry workers claimed that their jobs require special skills. However, these skills are not derived from the courses and trainings. Meanwhile, the women participants who work on crafts and waste recycling industries, such as plastic rope bag making industry, said their skills can be obtained through various ways, such as experiences, courses and learning from friends, neighbours or assistance from NGOs in Semarang City.

D. Family participation in joining community organizations

Participation of family members in the organization in each region can be seen in Table 2.12. Based on these tables it can be seen that the husbands' active participation in organizations is 45,68 %, while 54,32 % is inactive. The husbands' and wives' active participation in organizations is relatively the same. The wives' active participation is 44,24 %. This data also reflects that boys are more active than girls in organizations. In Rowosari, Tandang, Trimulyo, and Kamijen Villages, the wives' active participation in organizations is relatively higher than the husbands'. The connection of this to disaster is that when more and more residents participate in organizations, the more is the chance of the residents to obtain access to information and disaster relief.

Table 2.12: Distribution of Residents Based on Family Member Participation in Community Organizations (%)

Region/Village	Husband	Wife	Son	Daughter
Non coastal				
Gunung Pati	50,00	18,18	13,64	9,09
Lempong Sari	28,13	21,88	12,50	6,25
Rowosari	41,03	48,72	15,38	2,56
Tandang	44,44	50,00	2,78	5,56
Sub Total	40,31	37,21	10,85	5,43
Coastal				
Kemijen	37,50	75,00	6,25	9,38
Mangun Harjo	62,86	31,43	8,57	8,57
Tanjung Mas	53,19	42,55	10,64	6,38
Trimulyo	45,71	57,14	2,86	2,86
Sub Total	50,34	50,34	7,38	6,71
Grand Total	45,68	44,24	8,99	6,12

E. Community participation in institutions

One of the residents' strengths in facing disaster is their high social cohesiveness. The more cohesive the residents in civic activities are, the more powerful their social cohesiveness. This high social cohesiveness leads to the attitude of helping each other when disaster strikes. The level of social cohesiveness can be seen from the various social activities. Residents' active participation in various social activities such as mutual cooperation, *3 M* activities, religious recitation/Koran study can be seen in Table 2.13. To see the residents' active participation, it is measured by the index value, the closer it is to 1, the more residents joining the activity. In general, residents in non-coastal areas are more active than those in coastal areas. For example: the value of mutual cooperation activities in non-coastal areas is 0.9, meaning 90% of the residents are actively involved in this activity. While in the coastal areas, the value is 0.7, meaning only 70% of the residents are actively involved. In a very active non-coastal area such as Gunung Pati Village, every resident is actively involved in mutual cooperation activities. Another actively followed activity is Koran study.

The number of residents participating in mutual cooperation and Koran study also influences the disaster response efforts. Often, disaster warning and information on disaster relief is passed to the residents by using intuitions such as mutual cooperation, Koran studies, or house of worships.

The findings of this survey are in line with the results of the FGD. In Mangunharjo Village there are different types of organizations or associations both formal and non-formal. The form of those organizations is divided into organization or association for male and female groups. This is because the type of information discussed and the work undertaken for each group. Organizations for women's groups include: the PKK, Independent Women Farmers Group, as well as women's Koran study groups. While the organization for men's groups include: Subur Makmur Farmer Group, Mina Karya Utama Farmer Group (NGO Free), Youth Organizations, and Koran study groups. Meetings for formal groups like PKK,

Farmer Groups, and Youth Organizations are conducted once every single month. As for Tahlilan, hospitality, Koran studies, and RT-RW meetings, aimed at solving the residents' problems and complaints are conducted once a week. The level of public participation in meetings or programs conducted by each organization is considered quite high. At each meeting almost all of the members are present and participate in the meeting, unless there are obstacles that force the members to be unable to attend. Men and women have equal opportunities to participate in these meetings. There are no limitations due to gender differences. But the residents still consider the type of information discussed and the type of group they join. The same pattern occurs in Tanjung Mas Village.

Table 2.13: Residents Participation in Social Community Activities Villages, 2009 (%)

Region/Village	Mutual cooperation	3 M	Arisan Bapak	Arisan Ibu	Religious recitation
Non coastal					
Gunung Pati	1,00	0,55	0,50	0,50	0,91
Lempong Sari	0,91	0,44	0,81	0,88	0,72
Rowosari	0,79	0,13	0,18	0,41	0,87
Tandang	0,94	0,61	0,94	0,94	0,89
SubTotal	0,90	0,41	0,60	0,69	0,84
Coastal					
Kemijen	0,94	0,44	0,56	0,94	0,81
Mangun Harjo	0,86	0,37	0,66	0,77	0,80
Tanjung Mas	0,62	0,30	0,38	0,36	0,85
Trimulyo	0,60	0,20	0,60	0,63	0,79
Sub Total	0,74	0,32	0,53	0,65	0,82

The same goes for Tandang village. The level of residents participation in the activities of organizations or meetings is considered very good. At each meeting almost all residents attend and participate, unless there are obstacles that force people to be unable to attend. Women and men have equal opportunities to attend these meetings. But they still consider the type of information discussed and the type of group they join. The meeting time between men and women residents is different. Women hold their meetings in the afternoon, while men hold their meetings at night on the grounds during the day men are busy outside the house to make a living. The advantage of organizations in Tandang village is the information coming to the village is flowing like water from upstream to downstream. Information obtained by the village will be presented to the heads of RT and RW then delivered to the residents' representative and by word of mouth. This can avoid social jealousy between residents and is intended to make the available information to be delivered equally to all residents.

Some of the mutual cooperation activities undertaken by the residents are to improve various public facilities such as village road maintenance, drainage maintenance, parks maintenance, garbage disposal maintenance and places of worship maintenance. Based on the data in Table 2.14, participation of residents to engage in a variety of efforts to maintain environmental infrastructure, is relatively small, especially for the maintenance of parks, garbage disposal and places of worship. In

general, people consider that there are already institutions to take care such matters, namely, the village officials.

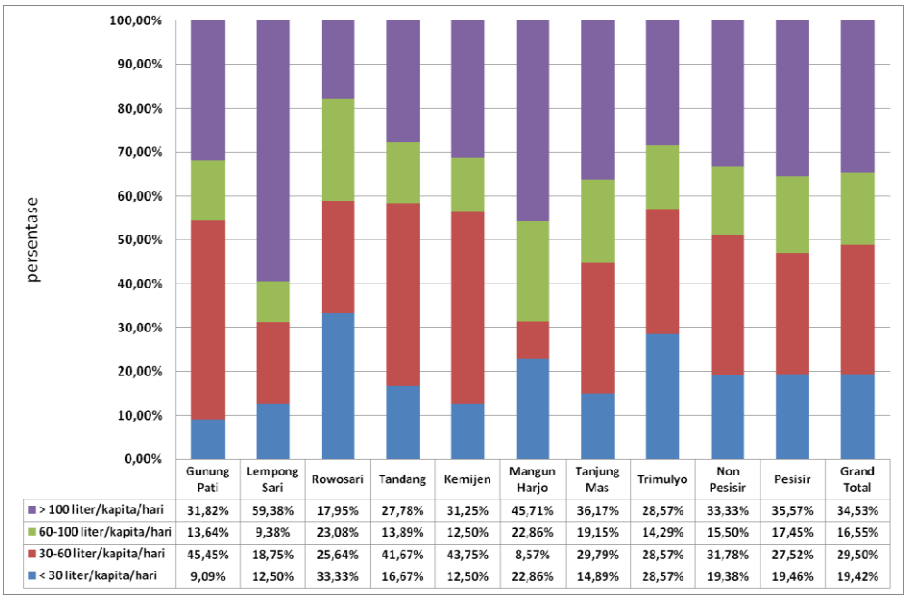
For the activities of village road maintenance and drainage maintenance, residents' participation is relatively higher than residents' participation in other maintenance activities. In non-coastal areas, the participation of residents in Rowosari Village is relatively low compared to other residents in other areas. In general, residents in Gunung Pati and Kemijen Villages are more active than those of other areas

Table 2.14: Residents' Participation in Various Public Facility Maintenance in the Observed Villages, 2009 (%)

Region/Village	Maintenance				
	Road	Sewages	Gardens	Waste disposal	Religious building
Non coastal					
Gunung Pati	0,82	0,68	0,36	0,32	0,55
Lempong Sari	0,44	0,53	0,06	0,13	0,13
Rowosari	0,38	0,31	0,03	0,00	0,26
Tandang	0,57	0,50	0,14	0,22	0,28
Sub Total	0,52	0,48	0,12	0,15	0,28
Coastal					
Kemijen	0,63	0,78	0,06	0,13	0,09
Mangun Harjo	0,44	0,57	0,00	0,17	0,26
Tanjung Mas	0,38	0,45	0,00	0,06	0,13
Trimulyo	0,31	0,23	0,03	0,03	0,11
Sub Total	0,43	0,50	0,02	0,09	0,15

F. Clean water consumption

The amounts of water used for various purposes such as bathing, washing, cooking, are classified into four groups, namely 1). Water consumption less than 30 liters/capita/day, 2). 30-60 liters/capita/day, 3). 60-100 liters/capita/day, and 4). More than 100 liters/capita/day. Based on the illustration it can be seen that the number of residents consuming more than 100 liters/ capita/day is the biggest with 34,53 %, whereas groups that consume 30 liters/capita/days is as much as 19,42 %. Both coastal and non-coastal areas have the same pattern in the use of water, in this case the number of residents consuming water between 30-60 liters/capita/day and more than 100 liters/capita/day is more than those of any other categories.



	Gunung Pati	Lempong Sari	Rowosari	Tandang	Kemijen	Mangun Harjo	Tanjung Mas	Trimulyo	Non Pesisir	Pesisir	Grand Total
> 100 liter/kapita/hari	31,82%	59,38%	17,95%	27,78%	31,25%	45,71%	36,17%	28,57%	33,33%	35,57%	34,53%
60-100 liter/kapita/hari	13,64%	9,38%	23,08%	13,89%	12,50%	22,86%	19,15%	14,29%	15,50%	17,45%	16,55%
30-60 liter/kapita/hari	45,45%	18,75%	25,64%	41,67%	43,75%	8,57%	29,79%	28,57%	31,78%	27,52%	29,50%
< 30 liter/kapita/hari	9,09%	12,50%	33,33%	16,67%	12,50%	22,86%	14,89%	28,57%	19,38%	19,46%	19,42%

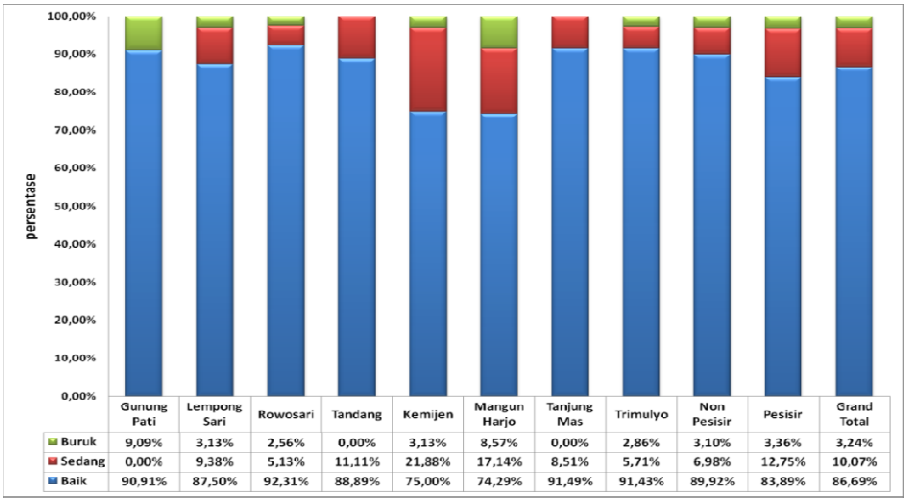
Figure 2.7: The Amount of Water Consumption by Residents in the Observed Villages, 2009 (%)
Note: liters/capita/day (liter/kapita/hari)

From Figure 2.7, it can be seen areas that consume relatively plenty of water are Lempong Sari, Mangun Harjo, and Tanjung Mas Villages. In these areas the number of residents consuming water for more than 60 liters/capita/day is more than residents consuming water less than 60 liters/capita/day. In Tanjung Mas Village, source of water is from artesian wells and water is abundantly available, so even when there is flood, the water remains available. Only the color is relatively turbid, but this should not become a problem for the local community. As long as the water can still be used for everyday purposes, people are not bothered.

In Tandang Village, residents admitted that they have difficulty in getting water sources. So far, the residents rely on clean water from the Regional Water Company (PDAM) of Semarang City, however not all areas are can be supplied by the Company. Therefore, some people also try making artesian wells. Given that this area in the high region, then the excavation must be done deep enough. According to residents, because the wells are so deep, they need a water pump with 3 Horse Power (equivalent to twice the power of a motor boat used by fishermen) so that the water comes to the top. The cost of making this artesian well is quite high ranging from Rp. 200.000,00 to Rp. 300.000,00 per meter. The price does not include the cost of procurement of pipes and pumps, thus not all residents can afford to make artesian wells. In fact, in a village discussion it is known that from the whole of Tandang Village, there are only 10 artesian wells.

Difficulty in obtaining water is also experienced by the residents of Rowosari Village. They always look for water from springs, which are located very far away and the nearest river distance is about 8 km and sometimes the river is often dry. The solution that can be done for example is by bringing water tank trucks, but the residents are constrained by cost that reaches Rp. 300.000,00 per tank. Sometimes the residents have to find water to other villages with the risk of far distance and limited water supply. Therefore many residents take the water at night.

The quality of water used by the residents can be categorized into good (*baik*), moderate (*sedang*), and poor (*buruk*). Water is said to have good quality if it is clean, clear, and odorless. Meanwhile, water is said to have moderate quality if it is somewhat dirty, murky and has the smell of chlorine. Water is of poor quality if it is said to have the characteristics of dirty, smelly, dark, salty, and has high iron level. Based on these categories, then the perception of residents about water quality in various areas is shown in Figure 2.8. Based on these images, it can be seen that in general water used nowadays by the residents is considered clean. As much as 86,69 % of residents said the water that they've been using for bathing purposes, drinking, cooking, and washing is clean water. Nevertheless there are 10,07 % of residents who said the quality of water they've been using is moderate and as much as 3,24 %t, claimed it to be of poor quality. When viewed in greater detail, it can be seen that the quality of water in Kamijen and Mangun Harjo (both located on the coast) is relatively worse than other areas. In both areas, residents who said the water is of good quality are about 75% t, at the least compared to other areas.



	Gunung Pati	Lempong Sari	Rowosari	Tandang	Kemijen	Mangun Harjo	Tanjung Mas	Trimulyo	Non Pesisir	Pesisir	Grand Total
Buruk	9,09%	3,13%	2,56%	0,00%	3,13%	8,57%	0,00%	2,86%	3,10%	3,36%	3,24%
Sedang	0,00%	9,38%	5,13%	11,11%	21,88%	17,14%	8,51%	5,71%	6,98%	12,75%	10,07%
Baik	90,91%	87,50%	92,31%	88,89%	75,00%	74,29%	91,49%	91,43%	89,92%	83,89%	86,69%

Figure 2.8: Water Quality According Residents in Various Areas of Semarang City, 2009.
Notes: good (baik), moderate (sedang), and poor (buruk)The Amount of Water Consumption by Residents in the Observed Villages, 2009

2.7.2 Economic and Livelihoods

A. Livelihoods

In this study, residents livelihoods are divided into two, namely *on-farm* (agriculture), such as food farmers, plantation farmers, farm labors, fishing and fishpond fishing labors; and *off-farm* (non-agriculture), such as labors, traders, builders, service workers, etc.. Based on the distribution data in Table 2.13, out of eight observed villages, residents having high dependency on agriculture sector are in Gunung Pati, Rowosari, and Mangunharjo Villages. And residents having high dependency on the fishery sector are in Tanjung Mas and Mangun Harjo Villages. Meanwhile, the livelihoods of residents in Kemijen, Lempong Sari, Trimulyo, and Tandang Villages are dependent on non-agriculture sector, such as traders, labors and service areas. Thus when viewed from the livelihoods of residents, the areas prone to disasters are Gunung Pati, Rowosari, MangunHarjo and Tanjung Mas Villages. But

if these people have other livelihood alternatives, then these vulnerabilities can be relatively reduced.

Based on the FGD results, it is shown that the location where residents live affects their livelihoods, for example in Mangunharjo Village, which is located in a coastal area, most residents who live in the north work as fishermen. Meanwhile, residents who live in the south work as rice farmers. But many residents in Mangunharjo also claim that their work is not permanent. Residents having rice field during bad season or dry season, will turn profession to brick makers, labors or mangrove labors. Residents stated that the most important thing is to have money to survive, while the type of job is not significant as long as the job is permitted. These conditions explain the data in Table 2.13, where most residents classify their jobs under "others".

Table 2.15: Distribution of Livelihoods in the Observed Villages, 2009 (%)

livelihood	Village							
	Gunung Pati	Tandang	Lempong Sari	Rowo-sari	Trimulyo	Tanjung Mas	Kemijen	Mangun Harjo
Farmer, food crop	54,55			25,64	2,86	2,13		8,57
Farmer, garden	4,55	2.78		2,56				2,86
Fishery					2,86	10,64		8,57
Farmer labour	18,18			12,82				14,29
Labour	4,55	11,11	6,25	5,13	8,57	19,15		11,43
Trader	4,55	11,11	6,25		11,43	8,61	18,75	2.86
Carpenter		2,78		2,56			9,38	
Crafter		2,78				2,13	3,13	
Services			6,25		5,71	6,38	9,38	2.86
Public servants (PNS/ABRI/POLRI)		2,78	6,25		2,86			
Others	13,64	66,67	75,00	51,28	65,71	51,06	59,38	48,57
Total (%)	100,00							

Group of wives and teenage girls also have a role in making a living. This is done to help the family economy. Types of jobs undertaken by women in Mangunharjo Village include mangrove farmers, rice field labors, tailors, producers of fishery products (crackers or shrimp paste), and basic commodity sellers. While most of the teenage girls work as factory workers and some as migrant workers.

The same is shown by the people in Tanjung Mas and Rowosari Villages. In Tanjung Mas Village, the main livelihoods of its residents are in the field of fisheries as fishermen, fishpond farmers or labors. But during bad season or "Timuran" (FGD participant's term), where the number of fish is usually low because of the small waves causing the fish to swim farther and harder to catch. In such condition usually residents will try to find alternative employment in the land as factory workers, fishing equipment artisans, or pedicab drivers. Based on information from one of the fishermen, Mr. Arifin, in 1985 and 1990 a prolonged shortage occurred (where the number of fish is very low). This forced the fishermen to find a new job location and

leave his family. Some fishermen migrated to other islands such as Riau, Lampung and Jakarta. In this village, there are also lots of women who work to help ease the burden of her husband. Types of jobs undertaken by women in this village are generally as fishpond labors and traders of fishing equipment, basic necessities, and seafood.

In Rowosari Village, the majority of its residents are farmers; both rice field and non-staple food crop farmers. Other livelihoods are construction workers or truck/public transportation drivers. Residents claimed that the condition of agriculture in their region was not reliable, for example during bad season they would have to go to another city to make a living. The economic conditions of most residents are worrisome so this what makes the women in that area to participate in making a living to help meet the needs of the family. But other than being driven by economic demands, work habits of women in that village are admitted as hereditary habits. Female occupations in Rowosari Village revealed during the FGD are as domestic labors or as freelance garment labors.

B. Family member partisipation in making a living

In sustaining their lives and in improving the welfare of their families, each member of the household will seek to utilize all their potential in accordance with their own understanding. In general, every head of the household must earn a living for his family, but often due to limitations, each family if there is a chance, will ask their family members to seek additional income. Thus the task of the head of household in earning a living is relatively lessened. Based on Table 2.16. there can be seen 13 models of livelihoods earning, 1). husband alone; 2). husband and wife; 3). husband and son; 4). husband, son, and daughter; 5) husband, wife, and son; 6). husbands, wife, son, and daughter; 7). wife alone; 8). wife and son; 9). son alone, 10). husband and daughter; 11) husband, wife, and daughter; 12). son and daughter, and 13). daughter alone.

Based on the data, it shows that the role of husband as the sole breadwinner is only about 30.71%. This illustrates that in order to meet the family's needs a family no longer relies solely on income from husband. There are about 35.21% of families where husband and wife work together to support his family. The role of the wife is very imminent in helping to ease her husband burden. Even for husbands who are not able to work again for reasons of unemployment and illness. To sustain his life he relies on his wife. And based on the data, there are about 6.37% of family members whose lives depend on wife’s income. Although this amount is relatively small, but its presence is relatively evenly distributed in every region except in Gunung Pati and Mangun Harjo Villages. In addition, there are residents where all of their family members work. The percentage of this group is 5.24%. This pattern is found in every village with a relatively small amount, and is relatively prominent in Gunung Pati Village.

Table 2.16: Distribution of Family Members Making a Living in the Observed Villages, 2009 (%)

Region/ Village	Family members Making a Living (%)															TOTAL
	All	HWS	HWD	WS	WSD	HW	SD	HS	HD	WS	WD	H	W	S	D	
Non coastal																
1. Gunung Pati	0,75	1,87	0,37	0,37	-	1,87	-	1,12	-	0,37	-	0,75	-	0,37	-	7,87
2. Lemp Sari	0,75	0,75	-	0,75	0,37	1,50	0,75	0,37	-	-	0,37	3,75	1,50	0,75	-	11,61
3. Rowosari	-	0,75	-	-	-	7,12	-	-	-	0,75	-	3,75	1,12	0,37	-	13,86
4. Tandang	-	0,37	0,75	-	-	5,62	0,37	0,75	0,37	-	-	4,12	0,75	-	-	13,11
Sub Total	1,50	3,75	1,12	1,12	0,37	16,10	1,12	2,25	0,37	1,12	0,37	12,36	3,37	1,50	-	46,44
Coastal																
5. Kemijen	-	0,37	0,75	-	0,37	3,37	0,37	0,37	-	-	0,37	4,12	1,12	0,37	0,37	11,99
6. Mang.Harjo	0,75	0,37	-	0,37	0,37	3,75	-	-	-	0,37	-	5,99	-	-	-	11,99
7. Tjg. Mas	1,87	0,37	-	0,37	0,37	5,99	0,37	0,75	0,75	-	-	5,24	0,75	0,37	-	17,23
8. Trimulyo	0,37	0,37	-	-	-	5,99	0,37	-	-	0,75	-	3,00	1,12	0,37	-	12,36
Sub total	3,00	1,50	0,75	0,75	1,12	19,10	1,12	1,12	0,75	1,12	0,37	18,35	3,00	1,12	0,37	53,56
Total	**4,49**	**5,24**	1,87	1,87	1,50	**35,21**	2,25	3,37	1,12	2,25	0,75	**30,71**	**6,37**	2,62	0,37	100

From the data there is also information, that there are around 4.49% of residents where every member of their families has a job to support their family. In this group all members of the family consisting of husband, wife, son and daughter who are grown up and have jobs, and all of the income is intended for family survival. In such a family group, the task of the husband to earn a living becomes lighter because of the help from his wife and children. This way, in general, the role of the wife (woman) in establishing a family life is relatively large. This is indicated by the relatively small proportions of families that depend on the husband as the only breadwinner.

C. Income

Information on income can describe the welfare level of the community, and is one of the important factors that can support community resilience in facing the climate change.

In general, the average income of residents in the observed villages is Rp 1,113,579,00/month. Compared to the minimum wage in Semarang City in 2009, which is Rp. 830.000,00, then the average income of the residents in the observed villages is higher. However, when compared to the number of family members per household, the amount of such income becomes relatively small. The income is from fixed monthly income as much as Rp 850,611,00/month and from other additional income of Rp 263,060,00/month. From this data, it can be seen that side jobs have a relatively large proportion of 24 percent. The average distribution of income of residents in the eight observed villages can be seen in Figure 2.9.

From the distribution of the data, it shows that the average income of residents of Kemijen and Lempong Sari Villages is relatively higher compared to other villages. Thus both villages are relatively prosperous compared to other villages. This is supported by information that in both of these villages, the residents have household

assets more than any other villages. When compared to villages whose residents have high dependency in the agricultural sector, then Mangun Harjo is a Village whose total income average is higher than Gunung Pati and Rowosari Villages.

Based on the FGD results, it is revealed that the period of 1996-1997 can be said as a very good economic conditions in Mangunharjo Village. In that period the majority of Mangunharjo residents made a living as pond farmers, either as shrimp farmers or milkfish (*bandeng*) farmers. The high export demand of shrimp caused the shrimp price at that time was quite high. The shrimp price followed the high price of gold. The selling price of shrimp by size of shrimp was around Rp.100,000-Rp.125.000 per kg. One resident said *that* "A*t that time, not only to pay school fees, to go to hajj and even to buy a car is easy to do, but right now let alone going on hajj pilgrimage and buying a car, for daily meals and the school fees is already difficult* ".

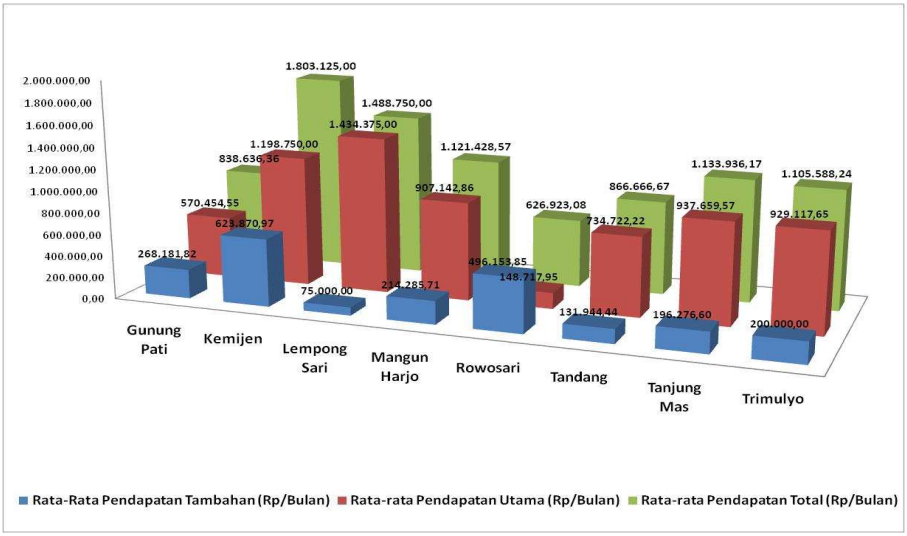


Figure 2.9: Distribution of Resident's Income in the Observed Villages in Semarang, 2009,

Mangunharjo Village residents whose livelihoods are as farmers experience similar conditions. The male residents' average daily income in Mangunharjo is approximately Rp. 25.000,00 with working hours from 08.00-12.00; Rp. 30.000,00 with working hours from 08.00-16.00. As for the female, the average daily income is approximately Rp. 20.000,00 with working hours from 08.00-12.00; Rp. 25.000,00 with working hours from 08.00-16.00. Wage difference is related to the amount of work done by men that is more than women. The income is adjusted to the prevailing wage in Mangunharjo Village. The amount of income of both owners and farmers is treated the same as wages earned is in the form of daily wages in accordance with the working hours endured.

In Rowosari Village, residents acknowledged that the rice and non-rice crops fields are economically unprofitable, even more likely to be detrimental. In a rice-planting season with an area of one hectare, it is needed at least an expense of Rp. 1.400.000,00. Expense such as this is allocated for the purchase of seeds, fertilizer and tractor rentals as well as for labor wages during land preparation and harvesting. That expense has not yet calculated the landowner's work fee during land preparation, weeding until the harvest period. Often the crops cannot fulfil daily

needs, but also unable to return the capital used. However, residents are generally unable to break away from rice farming, although agriculture is often harmful, people assume that the planting of rice is a habit that cannot be eliminated. Thus, farmers do not behave rationally in farming. Loss due to farming in this season does not make them stop farming in the next season. This is partly because they feel safe in terms of food needs when they have a piece of land planted with rice. Therefore, to satisfy the economic needs of the family, the community has side jobs.

The existence of alternative livelihoods other than the main livelihoods causes most of the residents to have two sources of income, namely main income and additional income. This can be seen in Table 2.17. Almost in the entire villages, the role of main job has a relatively larger proportion compared to the proportion of additional income. This is different from the Rowosari Village. The women admitted that the income from working in a factory is larger than what is obtained from agricultural products. These conditions are also recognized by the men. The income from laboring in various development activities is bigger than the income obtained from rice fields and crops. However, residents explained that the two sources of income compliment each other. Rice crops are used for their daily rice needs. While income from laboring or working in factories is used to buy the side dishes and other needs and is used to buy rice when their crops are not sufficient for one year.

Table 2.17: The Average Percentage of Alternative and Main Income towards the Residents' Total Income in the Observed Villages, 2009.

Village	The Average Percentage of Alternative Income towards the Residents' Total Income	The Average Percentage of Main Income towards the Residents' Total Income
Gunung Pati	31,98	68,02
Kemijen	34,60	65,40
Lempong Sari	5,04	94,96
Mangun Harjo	19,11	80,89
Rowosari	79,14	20,86
Tandang	15,22	84,78
Tanjung Mas	17,31	82,69
Trimulyo	18,09	81,91
Average	24,40	75,60

D. Ownership of housing ad assets

Information about housing and assets ownership can depict the level of the residents' welfare in one area. As much as 87.77 % of the residents have already owned a house with property rights. Their house is around 68.17 m^2 – 103 m^2. The area whose residents have the smallest house size is Tanjung Mas Village (68.17 m^2), while the area whose residents have the largest house size is Kemijen Village (103 m^2).

Building and land ownership

There is a positive connection between the building and land size. This shows the residents have orientation towards housing that need the existence of a garden in each house. Therefore, not every area of land is consumed for building. The vastness of land and building also indicates the residents' welfare. Data can be seen in Table 2.18

Table 2.18: The Average Building and Land Sizes in the Observed Villages, 2009

Village	Average size of building (m^2)	Average size of land (m^2)
Gunung Pati	81,02	169,73
Kemijen	103,91	108,23
Lempong Sari	95,19	117,06
Mangun Harjo	73,54	132,11
Rowosari	70,38	142,72
Tandang	85,56	123,72
Tanjung Mas	68,17	77,21
Trimulyo	94,20	134,54
Grand Total	82,93	122,03

In general, most of the residents housing (87.4%) are made of masonry walls, while as many as 12.6% are made of wood or bamboo. The village with the largerst number of residents owning houses made of wooden walls in Rowosari. Viewed from the aspect of the welfare of residents, houses with brick walls reflect the relatively higher level of welfare than houses with wooden/bamboo walls. This data can be seen in Table 2.19.

Table 2.19: Type of Walls Owned by Residents in the Observed Villages, 2009 (%)

Village	Type of wall		
	Concrete bricks	Wood	Total (%)
Gunung Pati	90,48	9,52	100,00
Kemijen	96,77	3,23	100,00
Lempong Sari	96,77	3,23	100,00
Mangun Harjo	90,00	10,00	100,00
Rowosari	43,75	56,25	100,00
Tandang	100,00	0,00	100,00
Tanjung Mas	91,30	8,70	100,00
Trimulyo	88,57	11,43	100,00
Grand Total	**87,40**	**12,60**	**100,00**

Asset ownership

Another indicator that can be used to view the welfare of residents is based on the ownership of electronic equipment and family facilities such as bicycles, motorcycles, cars, washing machines, and telephones and others. Indicator used is the average indicator, the closer it gets to zero, the more residents who do not have

these assets, while the closer to 1, the more residents who have these assets. If it is more than 1 it means there are more than one asset in a family. Based on these categories, residents of Kemijen and Lempong Sari Villages are relatively more prosperous than any other villages. It can be said that almost all residents in this area has a motor vehicle, TV/Radio, Fan, and mobile phone. Assets rarely owned by residents are cars, air conditioners, house phones, water pumps, and washing machines. This data can be seen in Table 2.20.

Table 2.20: Type of Walls Owned

Village	Average of ownnership (Unit)											
	Bicycle	Motor	Car	TV/ Radio	Washing machine	AC	Fan	Refrige-rator	Water pump	Tele-phone	Hand phone	Gas stove
Gunung Pati	0,23	0,73	0,05	1,00	0,09	0,00	0,41	0,23	0,36	0,05	0,68	0,73
Kemijen	1,00	0,97	0,03	1,03	0,34	0,09	1,19	0,44	0,31	0,31	1,50	1,00
Lempong Sari	0,34	1,19	0,09	1,38	0,22	0,06	1,16	0,77	0,31	0,38	1,59	1,16
Mang. Harjo	1,26	0,91	0,00	1,00	0,09	0,00	0,66	0,40	0,37	0,11	0,86	1,09
Rowosari	0,62	0,79	0,00	0,85	0,00	0,00	0,46	0,13	0,21	0,00	0,46	0,69
Tandang	0,42	0,75	0,03	0,83	0,19	0,00	0,81	0,39	0,22	0,08	1,31	0,89
Tanjung Mas	0,74	0,81	0,06	1,04	0,21	0,00	0,83	0,47	0,04	0,17	1,15	1,00
Trimulyo	0,77	1,14	0,06	1,14	0,06	0,03	0,97	0,37	0,20	0,23	1,31	0,89
Grand Total	0,69	0,91	0,04	1,03	0,15	0,02	0,82	0,40	0,24	0,17	1,11	0,94

E. Access to Financial Institutions

Poor people or those who are economically weak need more financial and asset protection, both for short and long term, from any calamity that may happen. However, due to limited economic condition; they have difficulty obtaining access to financial institutions such as banks or insurance. Thus, in the event of misfortune befall them, such as accident at sea, their economic conditions will become worse. Residents' access to banking institutions is relatively big, as can be seen in Figure 2.6. The figure shows that male residents have bigger access to bank than female residents. As for access to insurance agencies, both male and female residents have very low access, which is 14.03 % of the total residents.

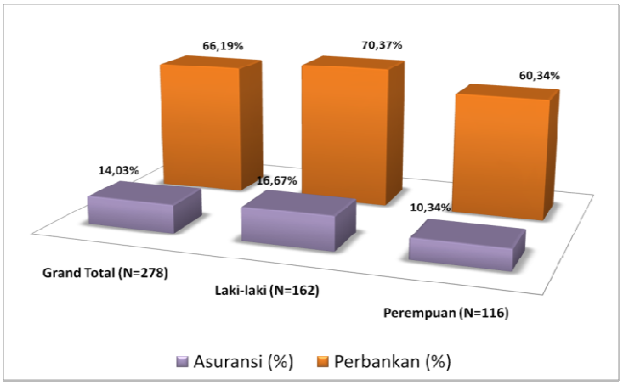


Figure 2.10: Residents' Access to Banking and Insurance in the Observed Villages, 2009

When compared to FGD results, it seems as though there is difference with the results of the survey. Based on the survey, it can be seen that residents' access to banking institutions is quite high. In fact, based on discussions with residents, opposite conditions were shown. This corresponds to the term "access" which means that under normal conditions, there is no obstacle for residents who want to save in banking institutions, if they want and have the money.

In Mangunharjo Village, some residents claim to have savings although the numbers are very small. Form of savings that are stored is in the form of money but usually the money is saved at home, not in banking institutions. Savings in the form of money is aimed for easier and faster use when there are sudden needs. These savings are savings that can be used in urgent situations, especially during bad season. Residents admitted that they are reluctant to save and borrow money from the bank because they have to go through many stages and they fear the amount of collateral they must provide.

It is another case with residents of Tandang Village. The residents claimed that with the amount of earned income and the amount of current expenditures, most Tandang residents have difficulty to save part of their income for savings. Nevertheless Tandang residents still try to set aside some income to save for time of need. Usually the savings are kept at home in the form of money, but there are also people who have savings in the form of investments, like buying a goat farm. This can be a side job as well as future savings. The same pattern occurs in Rowosari Village. In addition to savings in the form of livestock investments, there are also residents who use their extra money to buy seeds or fruit tree crops such as teak. Residents see that teak has high economic value.

Regarding insurance, almost all FGD participants claimed that they do not have insurance. This is because the premium to be paid is considered very expensive, besides that the participants

Chapter 3 CLIMATE HISTORY AND FUTURES IN SEMARANG CITY

3.1 Extreme Climate and Weather Events

3.1.1 The influences of ENSO and IOD on rainfall variability over the Semarang City

Extreme climate events in Indonesia are related to large-scale climate phenomena involving coupled ocean-atmospheric interactions in the Indian and Pacific Oceans (Boer & Faqih 2004; Faqih 2004; Haylock & McBride 2001; Hendon 2003; Kirono et al. 1999; Saji et al. 1999). El Nino-Southern Oscillation (ENSO) is one of the most well-know climate events in the Tropical Pacific region that plays important role in characterizing climate variability in Indonesia, especially rainfall. ENSO warm (ENSO cold) episode known as El Nino (La Nina) is associated with an increase (decrease) of SST anomalies in the eastern or central tropical Pacific region that manifests to a decrease (increase) of rainfall amount in most parts of Indonesia. Decreasing rainfall driven by El Nino is associated with intensifying drought occurrences that could cause significant impacts for the people living in the affected regions. Another problem will also occur when flood frequency increases due to La Nina event.

Despite ENSO, the rainfall variability in Indonesia is also associated with Indian Ocean Dipole (IOD) that is measured by the gradient of SSTa in the western (40°E-70°E, 10°S-10°N) and east-/south-eastern (90°E-110°E, 10°S-0°) Indian Ocean known as Dipole Mode Index (DMI, Saji et al. 1999; Webster 1999). Although in general, the IOD influence on rainfall variability in Indonesia is not as strong as ENSO, its impact is found to be significant in driving rainfall variability over western Indonesia, particularly over Sumatra and Java. A strongly positive (negative) DMI points to an increase (decrease) of SSTa over the western Indian Ocean and a decrease (increase) of SSTa over the east-/southeast of the region that is associated with rainfall decrease (increase) over parts of Indonesia.

In this part, we investigate the influences of both phenomena (ENSO and IOD) on rainfall variability over Semarang. The relationship between ENSO dan DMI with seasonal rainfall over the city is shown in Table 3.1.

Table 3.1: Correlations between seasonal rainfall over Semarang city with DMI and with Nino3.4 SST anomaly

	DJF	MAM	JJA	SON
DMI	-0.23	-0.02	-0.12	-0.60
Nino 3.4	0.12	0.03	-0.36	-0.62

Table 3.1 shows that ENSO influences on rainfall variability in Semarang is found to be strong during dry season (JJA) and during transition period (SON). This suggests some possibilities of prolonged dry seasons and delays on monsoon onsets impacting the region during warm ENSO episodes (El Nino). This condition is getting worse when concurrent with positive IOD event, especially during SON season where we

find the correlations of both ENSO and IOD indices with rainfall are strong. Table 3.1 also demonstrates significant correlation between Semarang rainfall and DMI during the peak of wet season (DJF). The delay of the IOD impact on rainfall in Semarang could be related to the influence of monsoon activities in controlling the difference of wet season onsets. Based on the significant correlation of DMI with rainfall found during DJF, another possibility is the chance of having more rainfall when the IOD condition is negative, leading to more flood occurrence in the region.

The sequences of seasonal rainfall time series correspond to floods and droughts occurrences due to both phenomena, i.e. ENSO and IOD, can be explored in Figure 3.1. The figure shows some fluctuations of rainfall as a result of extreme climate events during the years when ENSO and/or IOD occurred. In El Nino years during late 20th century (1972, 1983, 1987, 1994, 1995 and 1997), the records showed significant decreases of rainfall over Semarang city. Since the sensitivity of rainfall variability in this city is quite large to the extreme climatic conditions such as ENSO and the IOD, this is showing the need for more systematic adaptation planning and strategy for the regions to anticipate the impact of extreme events causing floods and droughts

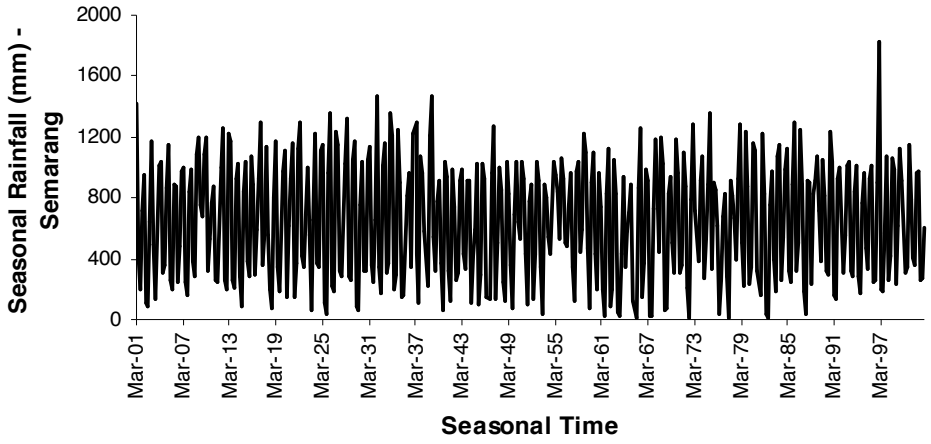


Figure 3.1: Series of seasonal rainfall over Semarang

3.1.2 Extreme wind

Despite the influence of extreme climate events caused by large-scale climate variability on interannual time-scales, the Semarang City is also influenced by short-time extreme weather condition, such as extreme wind speed. Based on the record of historical daily data collected from weather stations in Semarang and Ahmad Yani, we found that the extreme wind speeds tend to occur locally (Figure 3.2). In the Semarang station, we found extreme wind speed above 60 km/hour (17.2 m/s or 62 km/hour) occurred on 15 June 1994, while the highest wind speed in Ahmad Yani station occurred in 5 March 1995 (12.5 m/s or 45 km/hour). Due to data constrain, it is difficult to analyze this extreme event, especially in defining its recurrence period.

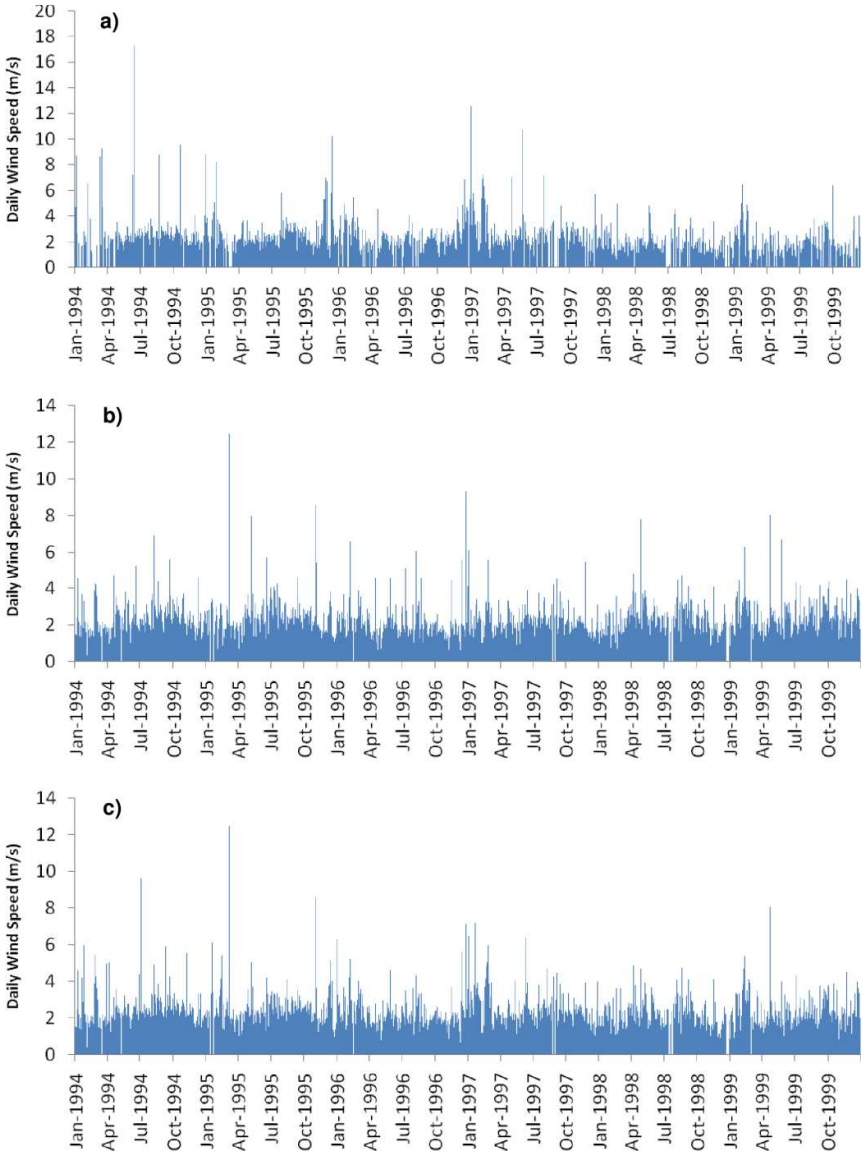


Figure 3.2: Daily wind speed in two stations over Semarang city, a) Semarang station, b) Ahmad Yani station, and c) average of both stations (1 January 1994 – 31 December 1999).

3.2 Trends of Historical Climate in Semarang

3.2.1 Rainfall

In general, it was shown in previous study that the observed rainfall in Indonesia experienced decreasing trends after 1970s (IPCC 2007). If we investigate the rainfall over different regions in Indonesia, it is possible that the trend will vary. Here we investigate the trends of rainfall in Semarang city as respectively shown in Figure 3.3.

Based on the average of observed rainfall from five rain gauge stations over Semarang city during 1970-2000 periods, it is found that there is no considerable trend of rainfall in all seasons (Figure 3.3). This is supported by the result of Mann-

Kendal statistical test as performed in Table 3.2. However, this result will slightly different with spatial distribution of rainfall trends in the city as performed in Figure 3.4. The absence of trend in the averaged rainfall is likely caused by uneven spatial distribution of rainfall trends within Semarang city (Figure 3.4). This contributes to the average value of rainfall that seems to show no significant trend in all seasons.

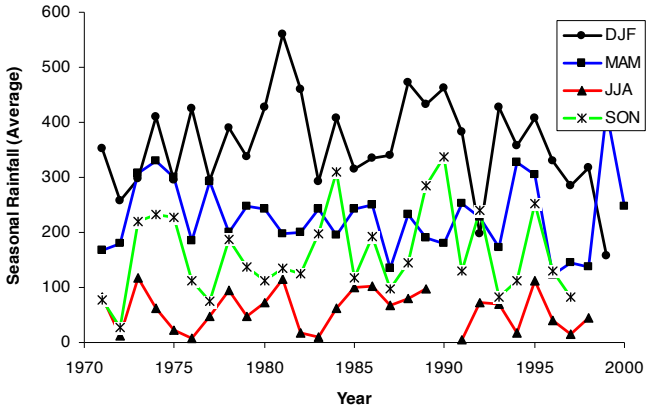


Figure 3.3: Observed seasonal rainfall over Semarang averaged from five rain gauge

Table 3.2: Mann-Kandal Test for Detecting Trend

Season	Slope	Lower	Upper	Z
DJF	-0.58574	-4.73124	2.799827	-0.31889
MAM	-1.2	-3.72318	1.572046	-0.74932
JJA	-0.20784	-1.71996	1.347403	-0.20847
SON	0.859804	-2.92664	4.105129	0.625407

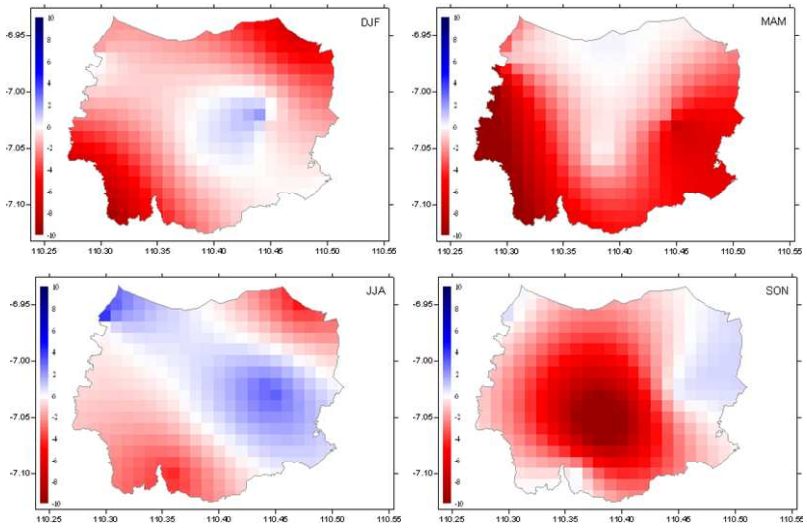


Figure 3.4: Spatial patterns of seasonal rainfall trends over Semarang.

It should be noted that the selection of different ranges of data will affect the trend and the result of statistical test conducted in this study. Therefore, despite the use of ~30 year observed data, a longer period of rainfall is also needed in order to confirm

the consistency of rainfall trend over Semarang. Therefore, we use observed rainfall grid data from Climate Research Unit (CRU), namely CRU TS2.0 (Mitchell and Jones 2005). The data set has 0.5x0.5 degrees grid resolution covering global land area for a period of 1901-2002. In order to analysis the rainfall data over Semarang, a spatially averaged data within Semarang city (110.25E-110.51E, 7.12S-6.95S) is extracted from the datasets.

By using the CRU data that has a longer period, Figure 3.5 shows an increasing trend of rainfall, especially in SON and DJF. The upward rainfall trends in both seasons indicate that the wet seasons tend to come earlier and end slower than usual. This is supported by the declining trend of rainfall in dry season (MAM and JJA). Here we found inconsistency between the trends resulted from using ~30 year observations and from ~100 year gridded observations of CRU TS2.0 in Semarang city. The trend differences are more likely caused by the dissimilar length of time periods used in the analysis. A longer data will give better description of the actual trend that can be linked to climate change impact, while a shorter data will tend to represent the trend that is more affected by climate variability, especially by the oscillations of low-frequency climate events.

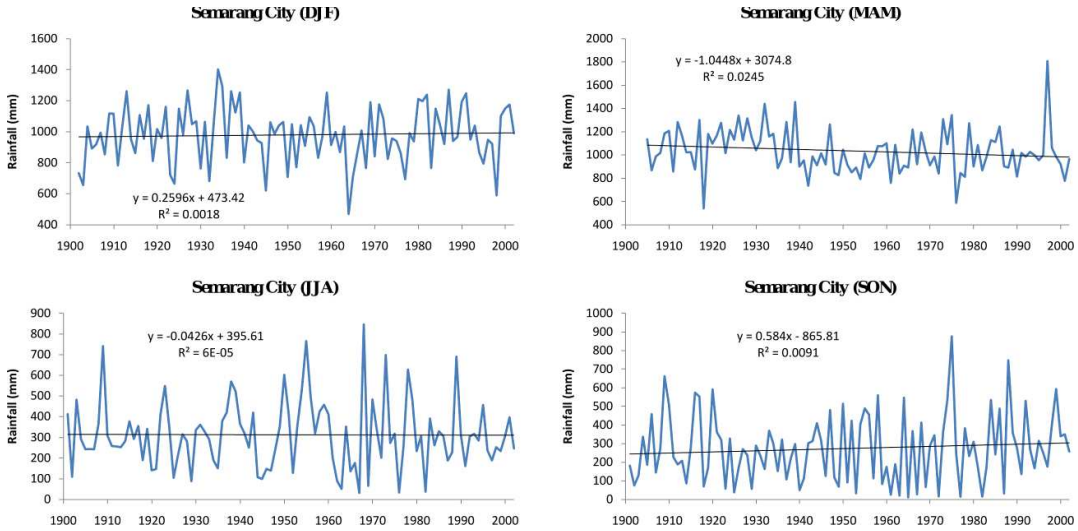


Figure 3.5: Trends of seasonal rainfall in Semarang city (110.25E-110.51E, 7.12S-6.95S) extracted from CRU TS2.0 dataset

In addition to the above analysis, we also investigate the trends in seasonal wet days frequency (Figure 3.6). The data is also collected from the CRU TS2.0 dataset. Figure 3.6 demonstrates similar trends of wet days frequency with the rainfall trends performed in Figure 3.5 for all seasons except in JJA. The upward trends of rainfall during wet seasons (SON and DJF) are associated with increasing trends of wet days frequency at the same seasons. This indicates that the increasing rainfall during 20th century over Semarang city is caused by the rains that came more often, raising the probability of floods in the region. In contrast, a downward trend appears in MAM season, indicating a decrease of wet days frequency that is associated with greater chance of dry season that comes earlier. Especially for the wet days frequency during JJA, the trend seems to be relatively flat with a very slow increase.

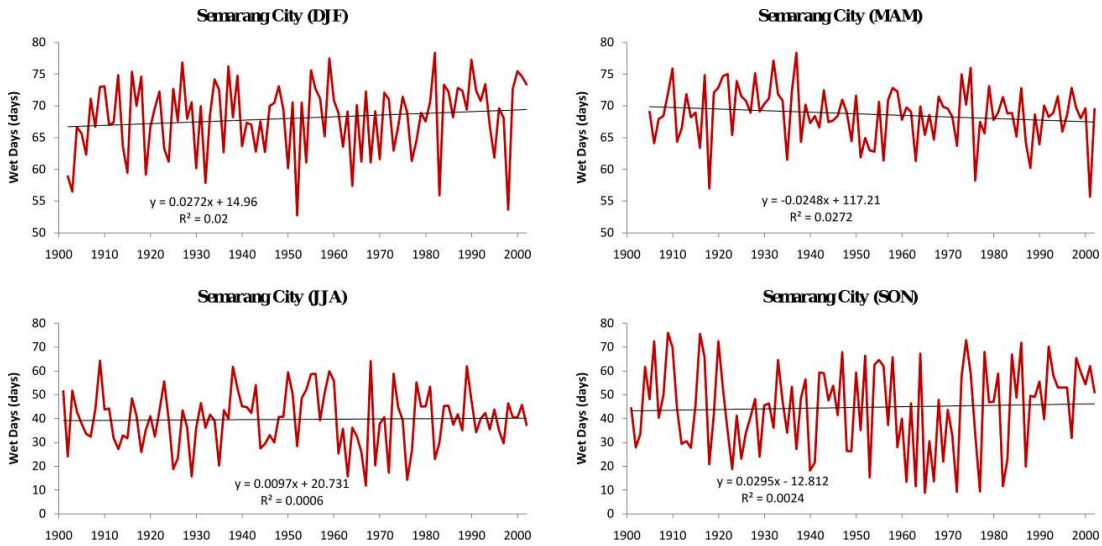


Figure 3.6: Trends of seasonal wet days frequency in Semarang city (110.25E-110.51E, 7.12S-6.95S) extracted from CRU TS2.0 dataset

Given the result shown in Figure 3.10 and the fact of significant upward trend found in rainfall data, it is evident that global warming has important role to these changes. In addition, the low frequency oscillations found in rainfall data could be related to the low-frequency of Indo-Pacific climate drivers such as Interdecadal Pacific Oscillation (IPO) (Folland et al. 1999) or Pacific inter-Decadal Oscillation (PDO) (Mantua & Hare 2002 ; Mantua et al. 1997). Several studies have shown strong relationships between these interdecadal climate phenomena with the changes of ENSO intensity and frequency (Saji & Yamagata 2003; Salinger et al. 2001; Wang et al. 2008; Barnett et al., 1999, White & Cayan, 2000). During the negative phase of the PDO / IPO, an increase in the number of La Nina events are quite significant compared to El Nino, as happened in the period between 1948-1976. Conversely, during the positive phase, e.g. in the period of 1972-1990s, the number of El Nino events considerably increased than in the negative phase. This study shows that the long-term rainfall variability in Semarang is not only affected by climate change, but also by the low-frequency climate drivers. If both of these components continue to show changes from current conditions, this may result in uncertainty of changes in the conditions of future rainfall over the city. Figure 3.7 shows the low-frequency component of rainfall defined by a simple moving average.

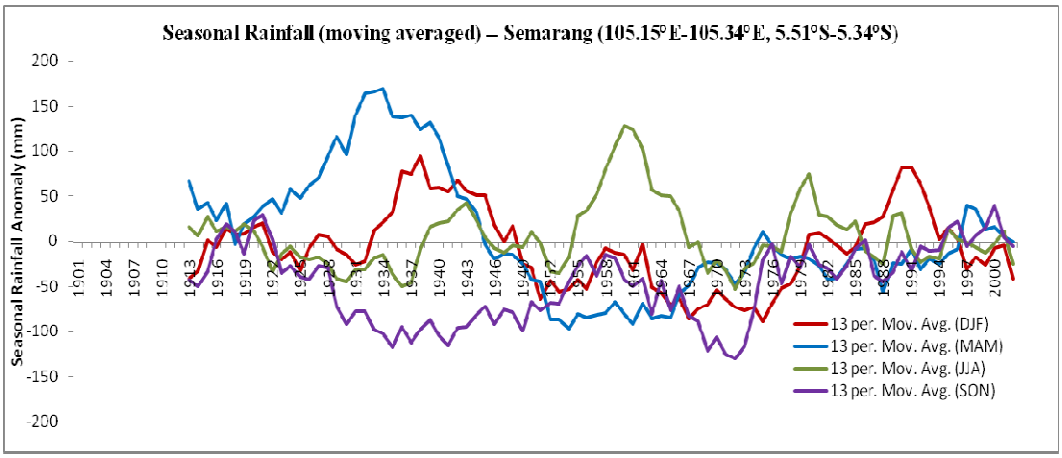


Figure 3.7: Low-frequency component of seasonal rainfall in Semarang defined by a simple 13-year moving average

3.2.2 Temperature

Based on the CRU TS2.0 temperature data extracted for Semarang, we found considerable upward trends in each season (Figure 3.8). The increasing trends are also associated with the upward trends in daily maximum (Figure 3.9) temperatures. Here the daily temperature range (DTR) found to experience downward trend (Figure 3.10), indicating that the increase of daily minimum temperature is more rapidly occurred than the maximum temperature

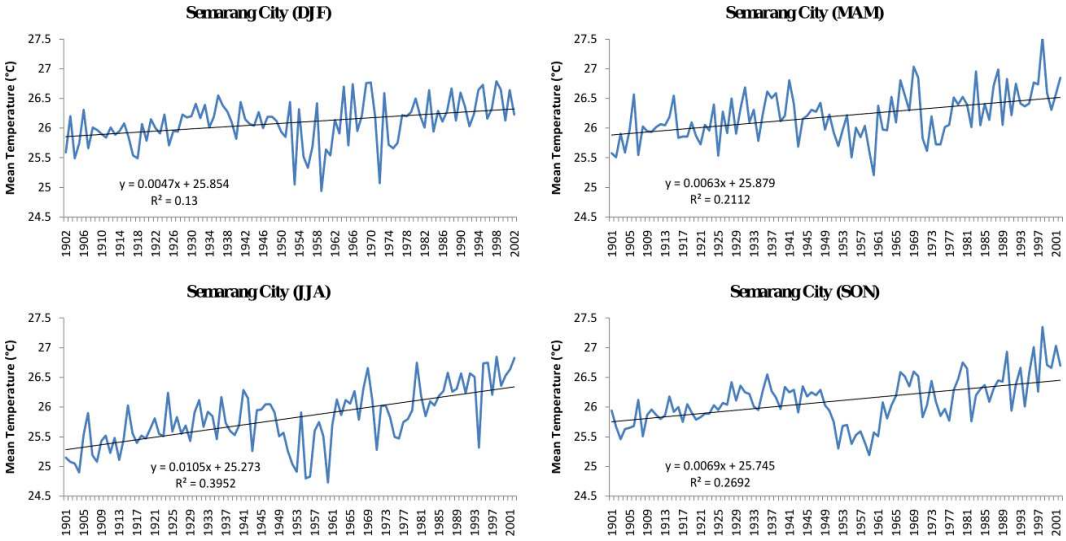


Figure 3.8: Trends of seasonal mean temperature in Semarang city (110.25E-110.51E, 7.12S-6.95S) extracted from CRU TS2.0 dataset

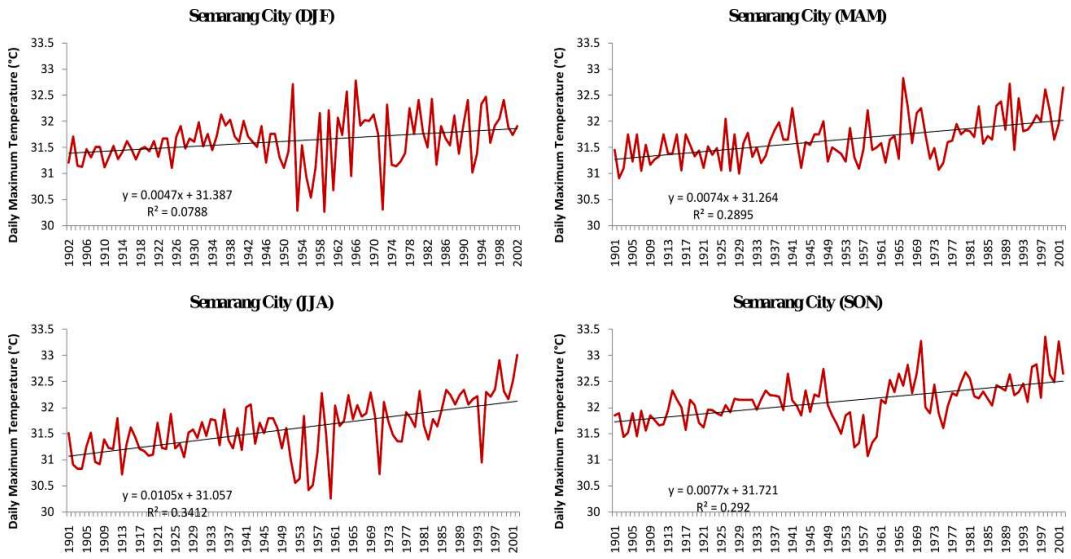


Figure 3.9: Trends of seasonal daily maximum temperature in Semarang city (110.25E-110.51E, 7.12S-6.95S) extracted from CRU TS2.0 dataset.

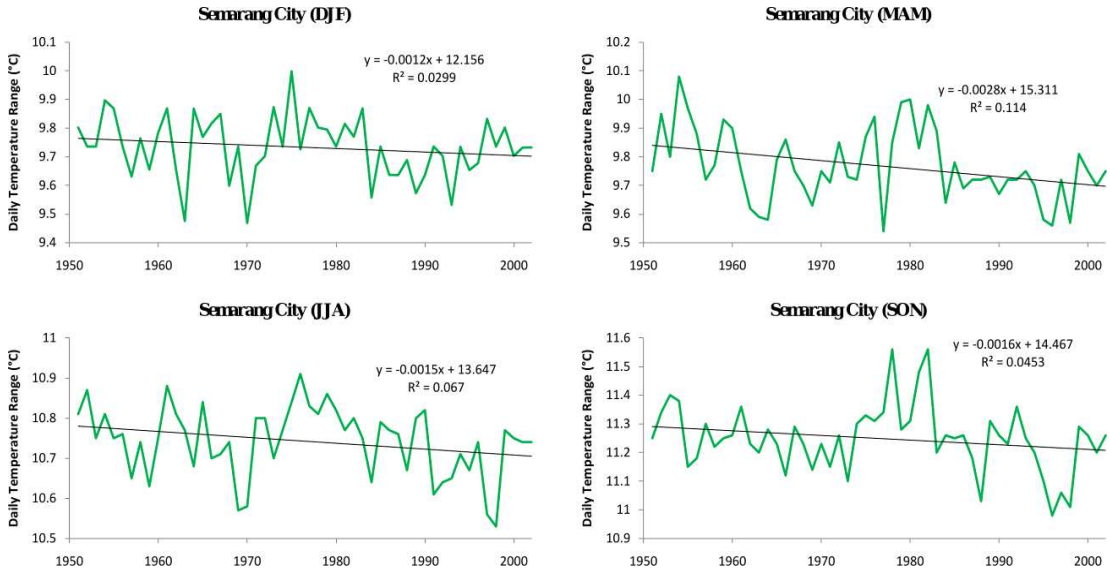


Figure 3.10: Trends of seasonal daily temperature range in Semarang city (110.25E-110.51E, 7.12S-6.95S) extracted from CRU TS2.0 dataset.

3.3 Climate Change Projections

Projection of climate to future was developed using REGional Climate Model version 3 (RegCM3) model and 14 GCMs. The 14 GCMs include (i) bccr_bcm2_0, (ii) cccma_cgcm3_1, (iii) cnrm_cm3, (iv) gfdl_cm2_0, (v) gfdl_cm2_1, (vi) giss_model_e_r, (vii) inmcm3_0, (viii) ipsl_cm4, (ix) miroc3_2_medres, (x) miub_echo_g, (xi) mpi_echam5, (xii) mri_cgcm2_3_2a, (xiii) ukmo_hadcm3, and (xiv) ukmo_hadgem1. These GCM outputs were provided by NIES (National Institute for Environmental Studies Japan; Masutomi, 2009) . The resolution is 1 degree and the climate variables are precipitation and temperature with 2021 -2030, 2051-2060, and 2081-2085.

The RegCM3 was used to generate high resolution of historical rainfall data from 1958-2001. Since the RegCM3 model output shows systematic error compared to observations, we corrected the historical data from RegCM3 using rescaling factor developed using 752 rainfall stations in Java. The rescaled RegCM3 for grid-i, year-t and month-b (*rRegCM3(i,t,b)*) is defined as

$$r\,\mathrm{Re}\,gCM3(i,t,b) = \mathrm{Re}\,gCM3(i,t,b) * R(i,t,b)$$

Where the scaling factor was determined using the following formula

$$R(i,t,b) = \frac{O(i,t,b)}{m\,\mathrm{Re}\,gCM3(i,t,b)}$$

Where O(i,t,b) is observation data of station-i near the four Grid of RegCM3 at year-t and month-b, while *mRegCM3(i,t,b)* is the mean of rainfall of the four grids of RegCM3 near the station. The current (baseline) climate in grid-i for month-n is represented (rRegCM3(i,b)) by calculating the mean of the rRegCM3 from 1958-2001:

$$r\,\mathrm{Re}\,gCM3(i,b) = mean\left\{r\,\mathrm{Re}\,gCM3(t,i,b)\right\}_{t=1958}^{2001}$$

The future climate under different GCM is predicted using the following formula:

$$pF(s,m,i,t,b) = r\,\mathrm{Re}\,gCM3(i,b) * \left(1 + \frac{F(s,m,i,t,b) - B(s,m,i,b)}{B(s,m,i,b)}\right)$$

Where $pF(s,m,i,t,b)$ is the projected rainfall under emission scenario-s, model-m, grid-i, year-t and month-b, $F(s,m,i,t,b)$ is future climate from the GCM under scenario-s, model-m, grid i, year-t and month-b, and $B(s,m,i,b)$ is baseline climate from GCM under scenario-s, model-m, grid-i, and month-b. Since we have 14 GCMs and each GCM has two set of future climate (t1=2021-2030 and t2=2051-2060), overall we will have 140 rainfall data for each period of time. Using data we develop distribution of future climate for the two periods.

The emission scenarios selected for this study are SRESA2 and SRESB1. These two scenarios were selected as they reflect current understanding and knowledge about underlying uncertainties in the emissions. SRESA2 describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slow. SRESB1 describes a convergent world with the same global population that peaks in mid-century and declines thereafter, rapid change in economic structures toward a service and information economy, with reduction in material intensity, and the introduction of clean and resource-efficient technology (IPCC, 2000). With these characteristics, the SRESA2 will lead to higher future GHG emissions while SRESB1 leads to lower future GHG emissions. Thus SRESB1 was defined as a policy scenario, while SRESA2 as a reference scenario.

Based on the two scenarios described above, in the next 100 years, concentrations of CO_2 in the atmosphere under the reference emission scenario would be more than double, while under the policy emission scenario only 1.5 times the current condition. Similarly for other gases (CH_4 and N_2O; Table 3.2). Concentration of SO_2, which counters the effect of greenhouse gases, would not change significantly (Table 3.3).

Table 3.3:. Gas Concentrations (ppmv)

	2000	**2025**	**2050**	**2100**
CO_2: SRESA2: Best guess	370	440	535	825
: Range	370	430-450	515-555	760-890
SRESB1: Best guess	370	420	460	550
: Range	370	410-430	450-470	510-590
CH_4: SRESA2: Best guess	1600	2250	2850	4300
: Range	1600	2200-2300	2700-3000	3800-4800
SRESB1: Best guess	1600	2050	2250	2200
: Range	1600	2000-2100	2150-2350	2100-2300
N_2O: SRESA2: Best guess	316	344	375	452
SRESB1: Best guess	316	340	360	395

Under increased GHG conditions, it was estimated that global temperature will consistently increase by about 0.027 ^{0}C per year, while sea level increased by about 0.6 cm per year (Table 3.4). Historical records show that over the last 100 years the global sea level has increased between 0.10-0.25 cm per year (Warrick *et al*., 1996).

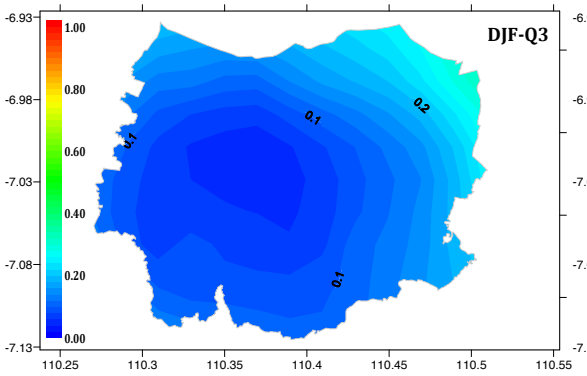
Table 3.4 Temperature (^{o}C) and Sea Level Rise (cm), with reference to 1990

	2000	**2025**	**2050**	**2100**
Temperature: SRESA2: Best guess	0.2	0.5	1.2	2.9
: Range	0.15-0.25	0.3-0.7	0.8-1.6	2.0-4.1
SRESB1: Best guess	0.2	0.7	1.1	1.9
: Range	0.15-0.25	0.5-0.9	0.7-1.6	1.2-2.7
Sea Level: SRESA2: Best guess	2	10	21	60
: Range	0-4.0	4.0-20	9.0-41	25-112
SRESB1: Best guess	2	10	21	48
: Range	0-4.0	4.0-22	9.0-42	18-85

In this study we assess the potential risk of the Semarang city to be exposed to extreme rainfall under current and future climate. The extreme rainfall was defined using climate hazards data (flood and drought). The extreme rainfall is defined as rainfall where its intensity is more than the critical threshold. For wet season (DJF), if the intensity is more than critical threshold, Semarang city is very likely to be exposed to flood hazard. While for dry season (JJA), if the intensity is less than the

critical threshold, Semarang city is very likely to be exposed to drought hazard. This analysis suggest that the critical threshold of rainfall for wet season is 302 mm (equivalent to quartile 3, Q3), and for dry season is 84 mm (also equivalent to quartile 3, Q3). Methodology for defining the critical threshold is described in Chapter 6.

It was found that probability of having rainfall more than Q3 in wet season (DJF) generally decreased in the future particularly in the centre of the city, irrespective of the emission scenarios (Figure 3.11). For the dry season, probability to have rainfall less than Q3 in coastal area is higher under current climate than that under changing climate. This suggests that wet season rainfall in the future tended to be lower than current climate while dry season rainfall tended to be higher than the current climate. This finding is not in conformity with other study of Naylor et al. (2007). Further analysis using improved methodology may be required to assess future climate trend in the Semarang city. The use dynamic and statistical downscaling technique is strongly recommended to study climate change scenario in small area such as Semarang City. Current approach may be appropriate to be applied for regional study.



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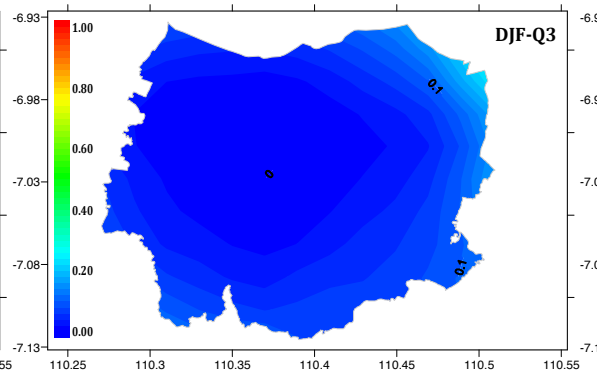

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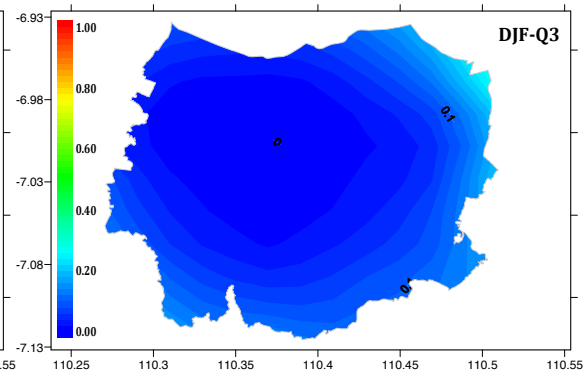

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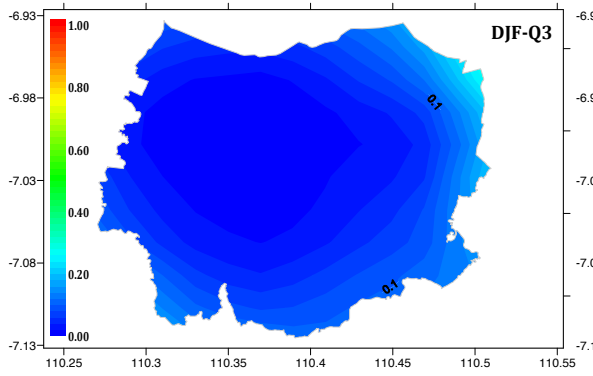

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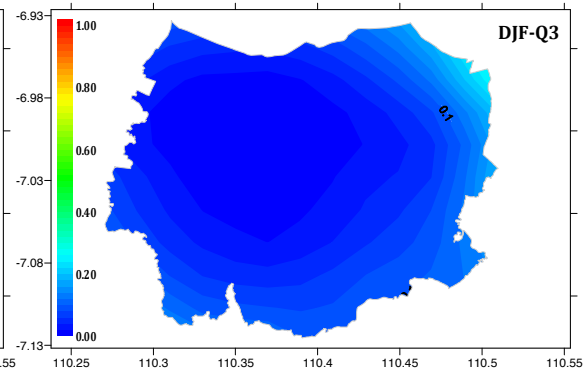

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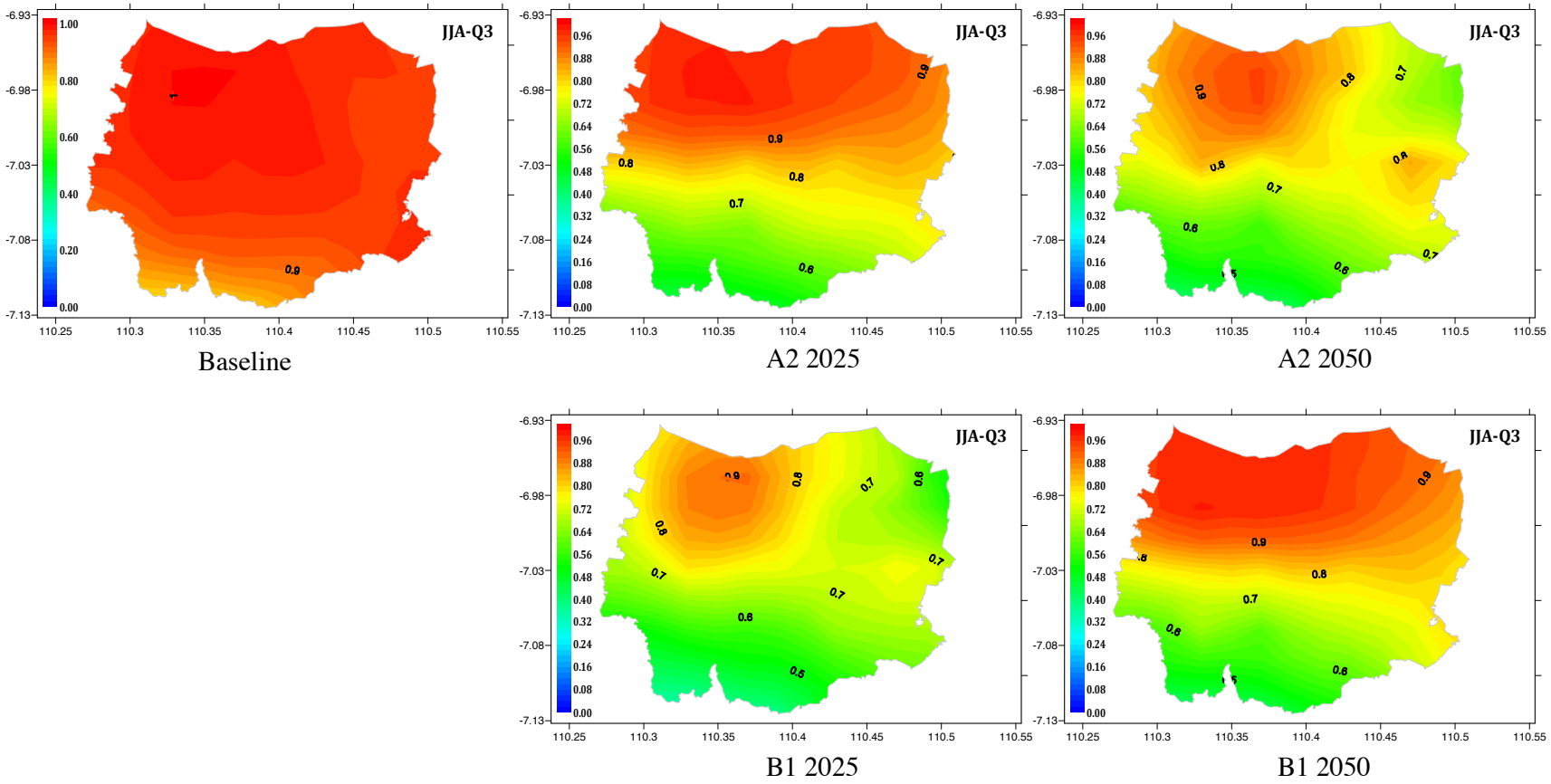


Figure 3.11: Probability to have rainfall more than Q3 in wet season (DJF) and less than Q3 in dry season (JJA) under two emission scenarios

Chapter 4 IMPACT OF EXTREME CLIMATE EVENTS

4.1 Biophysical Impact of Extreme Climate Events

Tropical climate conditions of Semarang City, in general are characterized dry and rainy seasons. In general, rainy season in the City of Semarang is in December to May, while dry season is in June to November. The City of Semarang has rainfall of 1500 mm to 3000 mm per year (Source: Regional Development Planning Agency of Semarang City, 2009/Semarang City RT/RW draft document, 2010-2030). Climate variability can occur in association with the phenomenon of ENSO/El Nino/La Nina, which can be categorized as extreme climate events, with a periodicity of 3-6 years. Every season, high rainfall during the rainy season can cause flood, erosion and landslides; and long dry periods during the dry season can cause drought.

Floods generally occur in low elevation sites in coastal areas or basins, or in places with poor drainage system. Some villages in coastal areas have experienced *rob* flood disaster. Some parts of the city have also experienced subsidence exacerbating flood conditions and rob. While erosion and landslides are especially in hilly/mountainous areas that have step slope. Based on information, in recent years, places such as Tandang and Sukorejo also experienced some storm events. Tabulation of incident/disaster-prone locations that have been reported is shown in Table 4.1.

Table 4.1: Incident/disaster prone locations in Semarang City (from various sources)

Disaster	District	Village
Flood	Gunungpati	Sukorejo
	Tembalang	Bulusan, Rowosari, Sendangmulyo, Mangunharjo, Sambiroto, Kedungmundu
	Candisari	Jomblang
	Semarang Utara	Bandarharjo, Bulu Lor, Plombokan, Purwosari, Panggung Kidul, Kuningan, Tanjungmas, Dadapsari
	Semarang Barat	Ngemplak Simongan, Kembangarum, Tawangmas, Cabean
	Semarang Timur	Kemijen, Rejomulyo
	Tugu	Mangkang Kulon, Karanganyar, Mangkang Wetan, Mangunharjo
	Pedurungan	Tlogosari Kulon, Muktiharjo Kidul, Pedurungan Kidul, Gemah, Kalicari
	Gayamsari	Tambakrejo, Kaligawe, Sawah Besar
	Genuk	Penggaron Lor, Terboyo Wetan, Sembungharjo, Kudu, Terboyo Kulon, Trimulyo, Gebangsari, Muktiharjo Lor
Landslides	Mijen	Karangmalang, Kedungpane, Purwosari, Tambangan, Cangkiran
	Gunungpati	Sukorejo
	Banyumanik	Srondol Kulon
	Tembalang	Bulusan, Sendangmulyo, Mangunharjo, Sambiroto, Kedungmundu, Tandang, Sendangguwo, Jangli
	Candisari	Candi, Tegalsari, Wonotingal, Jatingaleh, Jomblang

	Ngaliyan	Bamban Kerep, Wonosari, Purwoyoso, Tambakaji, Ngaliyan, Kalipancur, Bringin
	Pedurungan	Gemah
	Gajahmungkur	Petompon, Bendungan, Lempongsari, Bendan Ngisor, Gajahmungkur, Bendan Duwur
	Tugu	Tugurejo, Karanganyar, Mangkang Wetan, Mangunharjo, Mangkang Kulon
	Semarang Barat	Kembangarum, Ngemplak Simongan, Krapyak, Salaman Mloyo, Manyaran, Bojong Salaman, Bongsari
Drought	Mijen	Karangmalang ,Polaman, Wonolopo, Ngadirgo, Bubakan
	Banyumanik	Pudakpayung, Gedawang, Jabungan
	Candisari	Jomblang, Candi, Wonotingal
	Tugu	Jerakah, Tugurejo, Karanganyar, Randugarut, Mangkang Wetan, Mangunharjo
	Gunungpati	Sukorejo, Nongko Sawit, Kali Segoro, Kandri, Gunungpati
	Tembalang	Meteseh, Mangunharjo, Rowosari
High wind	Tembalang	Sendangguwo, Bulusan
	Tugu	Tugurejo
Abrasion	Tugu	Jerakah, Tugurejo, Karanganyar, Randu Garut, Mangkang Wetan, Mangunharjo, Mangkang Kulon
	Semarang Utara	Bulu Lor, Plombokan, Panggung Kidul, Panggung Lor, Kuningan, Purwosari, Dadapsari, Bandarharjo, Tanjungmas
	Semarang Barat	Kembangarum, Manyaran, Ngemplaksimongan, Bongsari, Bojongsalaman, Cabean, Salamanmloyo, Gisikdrono, Kalibanteng Kidul, Kalibanteng Kulon, Krapyak, Tambak Harjo, Tawangsari, Karang Ayu, Krobokan, Tawangmas
	Genuk	Muktiharjo Lor, Gebangsari, Genuksari, Bangetayu Kulon, Bangetayu Wetan, Sembungharjo, Penggaron Lor, Kudu,, Karangroto, Banjardowo, Trimulyo, Terboyo Wetan, Terboyo Kulon

4.2 Socio-Economic Impact of Extreme Climate Events

4.2.1 Social impact

A disaster in an area indirectly has the potential to change the order of social values of society. To get an idea of the magnitude of social impacts due to the disaster in the City of Semarang, one can see from the behavior of mutual cooperation or companionship among residents in handling problems that occur in communities, in work relationships, in patterns of production transactions and in other social values.

In coastal areas, generally disasters give positive impact in strengthening of social relationships and kinship among members of society, which is an important component in handling disaster problems. For example during floods, major efforts generally carried out by residents are discussing the way to solve the problems together with family members, neighbors, and friends in the village. And if the residents cannot find a solution in the first effort, the next step is to conduct village gathering to find the solution. These problems will be handed over to local governments either in village or district, if the problems have not been resolved.

Prevention and handling efforts that people generally do when there are big disasters that hit their area are working together to clean and tidy the environment. In addition, residents try to better protect, care, and preserve the existing environment to avoid disaster.

While for non-coastal areas, where most people depend on agriculture, the social impact that happens is a change in working patterns by doing shift. In the past, agricultural land management activities are carried out in turn and by helping each other. But today such patterns are no longer valid and have been replaced with payment or reward system patterns to people who work the land. Although there are values that change, there are also values that have been kept up to this day, which is the pattern of production transactions. When having short of money, the barter system between residents is still valid, although in limited amounts. Residents who do not have cash but have items such as rice but do not have vegetables can barter their rice to neighbors who have vegetable. This barter occurs on the basis of mutual needs.

Table 4.2: Disaster Impact on Residents' Social Values in the Observed Villages in Semarang City,

No	Description	Current condition
1	Social relations / kinship	There is still mutual cooperation between large numbers of village residents to complete a particular activity which is considered useful for general interest
2	Work relationship	Working in shifts has been replaced with payment/wage
3	Transaction patterns of production	There is still barter system, although limited to certain conditions
4	Crime	Possibility of theft increases

The nature of kinship among residents is also reflected when the dry season arrives, where it is difficult to work on farms, many people go to cities to work as labors. Information on jobs as labors is usually delivered by residents who are already working in that place. Generally they help other residents who struggle to get a job.

Disaster has the potential for negative impact towards public behavior. Based on the residents' experience, they revealed that when disaster occurred there was an increase in crime in their area. The act of crime that often happens is theft of valuables owned by residents. This may occur for several reasons. For example during floods, residents evacuate to a safe place and leave the house unlocked, thus providing an opportunity for theft. This indicates that there is need for attention and good cooperation between the village, RT and residents to remind each other and to be cautious when disaster strikes. Crimes such as theft also indicate that when disaster strikes, the economic level of residents that is already low becomes worse. Surviving residents generally are residents who have other livelihood alternatives. Meanwhile, residents who do not have livelihood alternatives, have great opportunities to conduct crimes

4.2.2 Economic impact

Every disaster has a potential for material or immaterial loss. Generally, the disaster impact towards economy is greater perceived by residents who work in agricultural sector. Change of seasons causes the cropping patterns in agricultural sector. Extended dry season reduce the opportunity to increase planting intensity. Similarly *rob* or floods causes damage to the business location and facility. Many fishponds are destroyed by the rob phenomena. For example, based on FGD results in Mangunharjo Village, big flood that occurred in 1998 has washed away most of the fishpond lands. Many residents changed their livelihood to become rice field and mangrove farmers which required much less investment than fish/shrimp culture, or work as laborers. The change in the livelihood resulted in deterioration of residents' economic condition and rapid decrease in residents' income from the range of (Rp. 100,000 - Rp. 300,000) to (Rp. 25,000 - Rp. 30,000 per day). This statement is supported by the results of investigation conducted by Bintari NGO regarding climate change impacts on agriculture and fisheries sectors in the City of Semarang. The study found that production of freshwater/fishpond fisheries since 1997 until 2006 had a significant decline.

Table 4.3: Amount of Freshwater/Fishpond Fisheries Production in 1997 and 2006 (Ton)

No	Type	Production (ton) 2006	1997	difference	(million Rp) 2006	1997	difference
1	Milkfish	251.8	839.5	-587.7	2.079.850	2.938.351	-858.501
2	***Belanak***	9.3	52.6	-43.3	73.800	268.908	-195.108
3	Shrimp	166.7	1210.5	-1043.8	5.440.725	12.102.267	-666.1542
4	Other	29	262.9	-233.9	149.550	629.711	-480.161
	Total	456.8	4.362.5	-3905.7	7.743.925	15.939.237	-8.195.312

Source: Bintari NGO, 2007

Residents who worked as farmers also experienced a similar effect. To get an idea about the disaster and the loss suffered, an interview was conducted with a farmer who was fixing a damaged dike due to the overflowing water from the river. At the time, his paddy was more than two months old. It was estimated that the plant could be harvested within approximately a month. According to him, the water came suddenly and in abundance. With the help of three people, at the time he could not repair the dike. It happened quickly, in less then half an hour, his rice field was already filled with water. The overflowing of the river was caused by rain for about two hours, which made the river filled with strong currents. The big picture of financial losses experienced is as follows

" *... for seed only it costs two hundred thousand, initial fertilizer is three hundred thousand, tractor rental is three hundred, hoeing and harrowing, then smoothing the ground, spraying, giving pesticides ... the point is the expense is big' '(Azis,* 53 years old, resident of Mangunharjo Village).

To get a bigger picture of disaster impact on economy, the data provided is: 1). Amount of loss based on main job, 2). Amount of loss based on sector, and 3) the impact on prices of some commodities.

Amount of loss based on main job

Table 4.4 shows the magnitude of loss in residents' main jobs due to disasters. Based on this data, the average loss suffered by residents of both coastal and non-coastal is Rp 1,041,531. Based on area, the loss in non-coastal areas is larger, Rp. 1,699,583, than in coastal areas, Rp. 1,285,333, -.

Table 4.4: Amount of Loss in Main Jobs Due To Disaster in Semarang City

Region	Losses (Rp)	Number of sample	Average (Rp)
Non coastal			
Lempong Sari	650.000	2	325.000
Rowosari	19.230.000	8	2.403.750
Tandang	515.000	2	257.500
Sub Total	**20.395.000**	**12**	**1.699.583**
Coastal			
Kemijen	3.670.000	8	458.750
Mangun Harjo	19.280.000	15	1.285.333
Tanjung Mas	1.700.000	4	425.000
Trimulyo	5.990.000	10	599.000
Sub Total	**30.640.000**	**37**	**828.108**
Grand Total	**51.035.000**	**49**	**1.041.531**

Fishpond owners also feel the impact of disaster. In non-coastal areas, loss in fishpond business is the loss suffered by farmers who own fishponds. Based on Table 4.5, it can be seen that the average loss of each fishpond farmer in non-coastal areas is Rp 2,942,000, whereas the average loss of each fishpond farmer in coastal areas is Rp. 2,252,600. Therefore loss suffered by fishpond farmers in non-coastal areas is larger than loss suffered by fishpond farmers in coastal areas. This is caused by (a) in general the scale of business of residents who seek additional income as fish farmers is larger than the scale of business of residents who seek additional income as fishpond farmers, (b) the number of residents who work as fish farmers is smaller than the number of residents who work as fishpond farmers.

Table 4.5: Amount of Loss in Fishpond Business Due To Disaster in Semarang City

Region	Losses (Rp)	Number of sample	Average (Rp)
Non coastal			
Lempong Sari	6.100.000	8	762.500
Rowosari	35.000.000	2	17.500.000
Tandang	3.030.000	5	606.000
Sub Total	**44.130.000**	15	2.942.000
Coastal			
Kemijen	21.045.000	5	4.209.000
Mangun Harjo	1.250.000	6	208.333
Tanjung Mas	1.153.000	4	288.250
Trimulyo	**23.448.000**	15	1.563.200
Sub Total	**67.578.000**	30	2.252.600

The amount of loss suffered by residents due to the floods, as well as the number of fishpond land which can no longer be used because of damage caused by abrasion, made the residents in coastal areas whose initial job was in agricultural sector turn to other sectors. Investigations done by Bintari NGO on the impact of climate change in agricultural and fisheries sectors in the City of Semarang, in 2007 showed that from 1997 until 2006 there was a decline in employment in fisheries sector, such as fishermen, fishpond farmers, fish farmers, and so on.

Table 4.6: The number of fishermen, fishpond farmers, and fish sellers in Semarang City, 1997 and 2006

No.	Work types	2006	1997	difference
1	Fishermen	917	1.520	-603
2	Fish pond farmer	425	688	-263
3	Fresh water pond farmer	64	329	-265
4	Fresh fish trader	251	361	-110
5	Processed Fish Trader	186	164	22
6	Ornamental fish trader	24	34	-10
7	Fish processor	227	345	-118

Source: Bintari NGO, 2007

2. Amount of loss based on sector

From Table 4.7, it can be seen that the impact of floods can cause losses in some sectors. Greatest losses occurs in infrastructure sector, namely Rp. 86,000,000,- in settlement sector, as much as Rp. 81.600.005,- and in fisheries, as much as Rp. 34,270,000, -.

Table 4.7: Amount of Loss (Rp) Due to Flood in Semarang City Based on Sectors

	Sectors							
Villages	Agriculture	Fishery	Transpor-tation	Industry	Settlement	Health	Drainage	Infrastruc-ture
Gunung Pati	1.000.000	0	0	0	0	0	0	0
Lempong Sari	0	0	5.000	0	60.000.000	0	0	5.000.000
Rowosari	0	0	0	0	4	3	0	0
Tandang	0	0	0	0	500.000	0	0	0
Kemijen	0	0	1.500	1.000.000	5.000.000	0	0	51.000.000
Mangun Harjo	3.400.000	34.200.000	1.050.000	0	0	0	0	10.000.000
Tanjung Mas	0	70.000	350.000	1	16.000.001	440.001	2.000.001	20.000.000
Trimulyo	0	0	25.000	0	100.000	20.000	0	0
Grand Total	4.400.000	34.270.000	1.431.500	1.000.001	81.600.005	460.004	2.000.001	86.000.000

Unlike flood, drought also has impact on some sectors, but the number of sector suffering loss due to drought is smaller. Those sectors are agriculture, fisheries and drinking water.

Table 4.8: Amount of Loss Due to Drought in Semarang City Based on Sector

Village	Agriculture loss (Rp)	Fishery loss (Rp)	Drinking water loss (Rp)
Gunung Pati	3.000.000	0	0
Lempong Sari	0	0	0
Rowosari	13.500.000	0	0
Tandang	0	0	0
Kemijen	0	0	200.000
Mangun Harjo	2.000.000	1.000.000	0
Tanjung Mas	0	0	0
Trimulyo	0	0	0
Grand Total	18.500.000	1.000.000	200.000

3. Impact on prices of some commodities

In addition to affecting income and sector, floods and droughts also affect prices in general. Here is a data about the price increase occurring in some agricultural commodities such as rice, crop and fish. In general, the price of all commodities, rice, crops, and fish, increases during drought and floods. Crops have the largest price increase percentage during floods or droughts compared to rice and fish. The average price increase during flood is as much as 38.80 %, while during drought it is around 36.75 %. The percentage of increase in fish prices is higher during flood than during drought. It is the other way around for rice. This is possible because of the nature of the commodity. Crops are plants whose production is difficult to be stocked, and thus more vulnerable to price shocks when there is production constraint. Fish and crops have higher price increase during flood because when there is flood production has big chance to fail or to be hindered. While during drought, water can be stocked from outside, because they need less water than rice commodities. For paddy, its price is higher during drought because during drought production process is stopped even before it could grow.

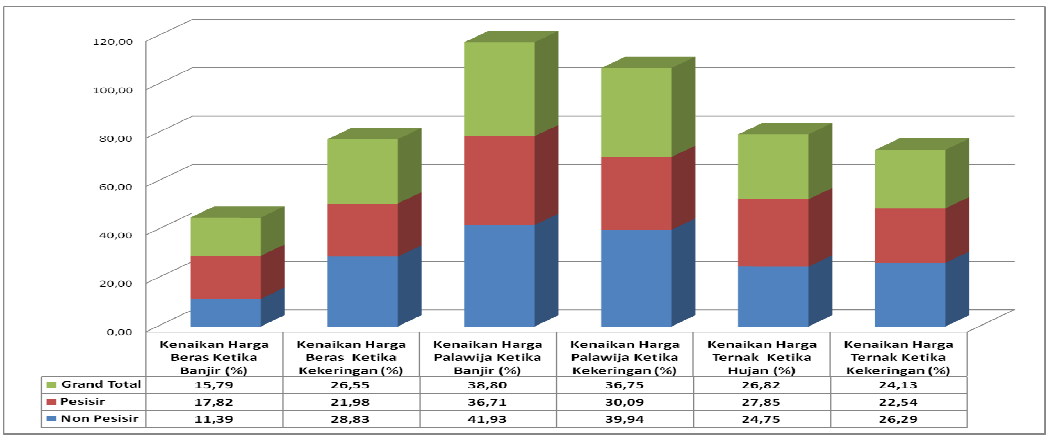


Figure 4.1.Price Increase in Some Agricultural Commodities in Semarang City During Flood and Drought

4.2.3 Health

Disaster also has an impact on public health. The size of the impact varies by region. In the event of floods, the number of diseases that often arise in coastal areas is more than the number of diseases that often arise in no-coastal areas.

Those types of diseases are cough/cold, 23.30 % and DHF, 21.36 % and itching, 17.48 %percent. Data can be seen in Table 4.9.

Whereas in time of drought, residents in non-coastal areas are experiencing more health problems compared to residents in coastal areas. Diseases that often occur during drought in non-coastal areas are cough/cold, 25.45 %, dengue, 12.73 %, fever and respiratory infection, each is 10.91 %. Even so, residents have easy access to health center either touring public health center or other health centers.

Table 4.9: Residents' Ditribution based on types of diseases During Flood in observed Villages (%)

Village	N	Cough / cold	Dengue	Fever	Diare	Itching	Typhus	Total
Non coastal								
Gunung Pati								
Lempong Sari	7	2,91	1,94	0,00	1,94	0,00	0,00	6,80
Rowosari	14	6,80	1,94	0,00	1,94	2,91	0,00	13,59
Tandang	5	0,00	1,94	0,00	1,94	0,00	0,97	4,85
Sub Total	26	9,71	5,83	0,00	5,83	2,91	0,97	25,24
Coastal								
Kemijen	13	4,85	6,80	0,00	0,00	0,97	0,00	12,62
Mangun Harjo	19	5,83	4,85	0,97	2,91	3,88	0,00	18,45
Tanjung Mas	27	9,71	3,88	2,91	2,91	6,80	0,00	26,21
Trimulyo	18	2,91	5,83	0,97	1,94	5,83	0,00	17,48
Sub Total	77	23,30	21,36	4,85	7,77	17,48	0,00	74,76
Grand Total	103	33,01	27,18	4,85	13,59	20,39	0,97	100,00

Table 4.10: Residents' Distribution Based on Types of Diseases During Drought in Observed Villages (%)

Village	N	Cough / cold	Dengue	Fever	Diare	Respi-ratory Infec-tions	Eyes	Typhus	Grand Total
4.2.3.1 Non coatal									
Gunung Pati	9	5,45	3,64	0,00	1,82	0,00	5,45	0,00	16,36
Lempong Sari	6	1,82	7,27	1,82	0,00	0,00	0,00	0,00	10,91
Rowosari	19	10,91	1,82	9,09	1,82	9,09	0,00	1,82	34,55
Tandang	6	7,27	0,00	0,00	1,82	1,82	0,00	0,00	10,91
Sub Total	40	25,45	12,73	10,91	5,45	10,91	5,45	1,82	72,73

4.2.4 Coastal									
Kemijen	3	5,45	0,00	0,00	0,00	0,00	0,00	0,00	5,45
Mangun Harjo	6	10,91	0,00	0,00	0,00	0,00	0,00	0,00	10,91
Tanjung Mas	5	3,64	5,45	0,00	0,00	0,00	0,00	0,00	9,09
Trimulyo	1	0,00	0,00	0,00	1,82	0,00	0,00	0,00	1,82
Sub Total	15	20,00	5,45	0,00	1,82	0,00	0,00	0,00	27,27
Grand Total	55	45,45	18,18	10,91	7,27	10,91	5,45	1,82	100,00

4.3 Government Community Responses to Extreme Climate hazards

4.3.1 Residents' response towards the existence of disaster handling institutions

The existence of institutions is very important in improving the ability or the capacity of communities to cope with disasters. From the survey results in eight study areas residents felt unsatisfied with the presence of disaster handling agencies in the region. About 83% of the residents stated that there were no institutions handling the disaster in their territories. They also said that they never received any information about climate information or early warning from the Government. Only 17% of residents said that there was a disaster-handling institution in their areas. However, they said that the institutions do not function effectively in providing climate information or early warning. The institutions meant by residents are village, RT, RW in the local environment office.

4.3.2 Community's Response Towards Disaster Information

Currently in Indonesia there are various kinds of disasters ranging from floods, landslides, droughts, forest fires, and earthquakes whose frequency has become more often for the last couple of years. Every resident can monitor these events through various media either printed or electronic. With the support of the satellite network and residents' ability to purchase electronic equipment such as television and radio, most residents (79.5%) felt the benefit of watching the general news. Beside as a means of entertainment, general news also enriches residents' general knowledge.

Of various disaster-related information, the information deemed useful to the residents is information about climate change impacts. Information on the impact of climate change include increase in the volume of sea water, shift in seasons, increase in temperature, etc. Therefore the information is translated by the community as a source of disaster. Thus the information becomes more useful and attractive compared to other information. Data can be seen in Table 4.11.

If compared to men, in general female are more sensitive towards various types of news. Nevertheless, by seeing the percentage of resident response towards the use of various types of news, resident' sensitivity towards various disaster related news is relatively low.

Table 4.11: Residents' Response towards The Use of General Information and Information Relating to Disaster in Observed Villages in Semarang City, 2009 (%)

Village	News		Disaster warning		Disasters mitigation		Gov. program		Climate change		Climate change impact		Total
	UN	U	UN	U	UN	U	UN	U	UN	U	UN	U	
Gunung Pati	1,80	6,12	6,12	1,80	6,83	1,08	5,40	2,52	6,47	1,44	0,00	7,91	100,00
Kemijen	3,60	7,91	0,72	10,79	3,60	7,91	5,40	6,12	6,83	4,68	1,80	9,71	100,00
Lempong Sari	2,52	8,99	2,52	8,99	5,40	6,12	9,71	1,80	8,63	2,88	0,72	10,79	100,00
Mangun Harjo	2,52	10,07	4,68	7,91	6,83	5,76	8,63	3,96	5,76	6,83	0,72	11,87	100,00
Rowosari	2,88	11,15	5,40	8,63	6,47	7,55	7,55	6,47	11,15	2,88	0,00	14,03	100,00
Tandang	1,44	11,51	7,91	5,04	8,27	4,68	10,79	2,16	9,35	3,60	0,36	12,59	100,00
Tanjung Mas	3,96	12,95	7,91	8,99	12,59	4,32	11,51	5,40	15,11	1,80	2,16	14,75	100,00
Trimulyo	1,80	10,79	6,47	6,12	8,27	4,32	10,07	2,52	7,55	5,04	0,36	12,23	100,00
Grand Total	20,50	79,50	41,73	58,27	58,27	41,73	69,06	30,94	70,86	29,14	6,12	**93,88**	100,00

Notes : UN = Unuseful U= Useful

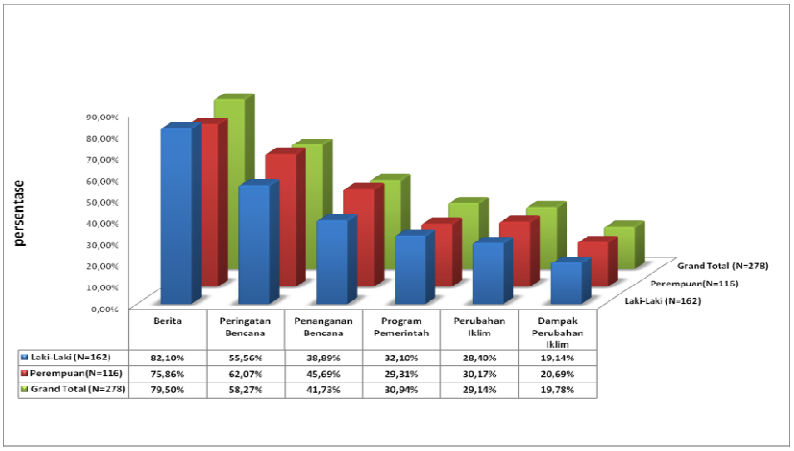


Figure 4.2.Residents' Response Towards The Use of News in Observed Villages in Semarang City based on Gender (%)

4.3.3 Availability of disaster information

Table 4.12 shows the average value of residents' response to the availability of disaster-related information resources. The closer to 1, then the information is available and can be accessed by the public. But the closer to 0, then the information becomes relatively unavailable. From these data, it can be seen that aside from

general news, then information that is relatively more available than other information is information about disaster warning. Although information about the impact of climate changes is very indispensable, but it turns out the availability of the information is minimal.

Table 4.12: Distribution of The Average Value of Information Availability in Semarang City, 2009

Village	News	Disaster warning	Disasters mitigation	Gov. program	Climate change	Climate change impact
Gunung Pati	0,77	0,23	0,14	0,32	0,18	0,18
Kemijen	0,69	**0,91**	**0,69**	**0,53**	0,38	0,22
Lempong Sari	**0,91**	0,78	0,47	0,16	0,22	0,19
Mangun Harjo	0,83	0,60	0,43	0,31	**0,54**	0,43
Rowosari	0,62	0,36	0,31	0,36	0,16	0,05
Tandang	0,89	0,39	0,36	0,17	0,33	0,14
Tanjung Mas	0,70	0,47	0,21	0,23	0,09	0,04
Trimulyo	0,94	0,54	0,40	0,20	0,44	0,29
Total	0,79	0,54	0,37	0,28	0,29	0,18

4.3.4 Disaster Information Sources

Areas that have relatively high access to information about disaster warning are Kemijen, Lempong Sari, Mangun Harjo, and Trimulyo village. The main source of information about disaster warning comes from printed and electronic media such as television, radio, and newspapers. However, there are other information sources that provide information about disaster warning, namely the government through its officials in each service to village; Neighbourhood watch system (SISKAMLING) managed by RT/RW; houses of worship such as mosque and its surrounding residents (Table 4.13). It turns out that the SISKAMLING is more effective in providing information about disaster warning than the government.

There are four villages that have role of SISKAMLING that is higher compared to other villages, namely Kemijen, Mangun Harjo, Tanjung Mas and Trimulyo village. The existence of SISKAMLING in these areas describes the behaviors of a community that has a high level of environmental awareness and values of togetherness. While government's role in providing information about disaster warning is relatively effective in Kemijen, Mangun Harjo, Tandang and Trimulyo village.

Other community institutions that is quite effective in providing information about disaster warning is house of worship such as by announcing disaster warning through loudspeakers in mosques. From the house of worship the information can cover a radius of 1 km. Villages that use house of worship's facilities to disseminate information on disaster warning are Lempong Sari, Rowosari, Tanjung Mas and Mangun Harjo

Table 4.13:. Sources of Disaster Warning Information in Semarang City (%)

Village	Govern ment	Police	TV	Nearby people	Neigh-bourhood watch	Worship house	News-paper	Total
Gunung Pati	-	-	3,13	-	0,78	-	-	3,91
Kemijen	3,91	-	7,03	-	7,81	0,78	-	19,53
Lempong Sari	0,78	-	7,81	3,13	-	3,13	0,78	15,63
Mangun Harjo	2,34	-	5,47	1,56	3,91	1,56	-	14,84
Rowosari	0,78	-	4,69	0,78	-	3,13	-	9,38
Tandang	2,34	-	3,91	0,78	1,56	-	-	8,59
Tanjung Mas	0,78	-	3,13	3,13	3,91	3,91	-	14,84
Trimulyo	3,91	0,78	4,69	0,78	3,13	0,00	-	13,28
Total	14,84	0,78	39,84	10,16	21,09	12,50	0,78	100,00

4.3.5 Forms of community adaptation

Flood

There is a difference between adaptation measures undertaken by communities in coastal and non-coastal during floods. During flood, most communities in coastal areas will raise the floor level. This is especially visible in Tanjung Mas Village where 79 percent of the residents raise the floor level of their house (Table 4.14).

Drought

Meanwhile, during drought, one adaptation measure often done by people in coastal areas is buying clean water, whereas in non-coastal areas is reducing the amount of water consumption (Table 4.15).

Clean Water

Figure 4.3. shows residents' perception towards the time of water shortages. Although not many people responded to it, but from the available answers one can estimate times of water shortages. Based on the figure it can be seen that the symptoms of water shortages occur in tandem with the dry season, especially in July and August.

Table 4.14:. Index Value of Forms of Adaptation During Flood in Semarang City

Village	Stay at home	Building dikes	Deepening water channel	Elevating house floor the house base	Strengthening house construction	Move to another place	Increasing food storage	Increasing fuel storage
Non coastal								
Gunung Pati	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Lempong Sari	0,13	0,16	0,03	0,00	0,00	0,13	0,03	0,00
Rowosari	0,23	0,05	0,08	0,03	0,05	0,05	0,00	0,00
Tandang	0,08	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Sub Total	0,12	0,05	0,03	0,01	0,02	0,05	0,01	0,00
Coastal								
Kemijen	0,88	0,16	0,22	0,75	0,25	0,03	0,22	0,00
Mangun Harjo	0,86	0,57	0,31	0,31	0,17	0,09	0,20	0,11
Tanjung Mas	0,79	0,38	0,21	0,79	0,40	0,09	0,02	0,02
Trimulyo	0,77	0,37	0,23	0,66	0,26	0,09	0,09	0,03
Sub Total	0,82	0,38	0,24	**0,64**	0,28	0,07	0,12	0,04
Grand Total	0,50	0,23	0,14	0,35	0,16	0,06	0,07	0,02

Table 4.15:. Index Value of Forms of Adaptation During Drought in Semarang City

Village	Deepening water wells	Buying water	Reducing water consumption	Pumping water from nearby sources	Move to another place not experiencing drought	Doing ritual to ask for rain
Non coastal						
Gunung Pati	0,59	0,55	0,50	0,14	0,14	0,09
Lempong Sari	0,06	0,10	0,31	0,19	0,03	0,00
Rowosari	0,08	0,21	0,33	0,18	0,03	0,03
Tandang	0,03	0,08	0,00	0,11	0,03	0,00
Sub Total	0,15	0,20	**0,26**	0,16	0,05	0,02
Coastal						
Kemijen	0,06	0,41	0,13	0,00	0,00	0,00
Mangun Harjo	0,14	0,46	0,26	0,03	0,03	0,03
Tanjung Mas	0,00	0,02	0,04	0,00	0,00	0,00
Trimulyo	0,09	0,11	0,03	0,00	0,00	0,00
Sub Total	0,07	**0,23**	0,11	0,01	0,01	0,01
Grand Total	0,10	0,22	0,18	0,08	0,03	0,01

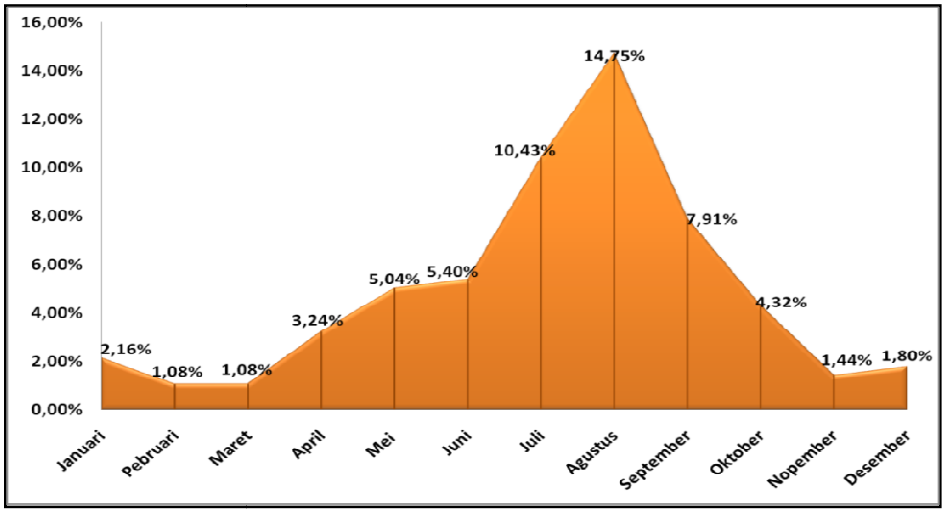


Figure 4.3:Residents' Perception About Times of Water Shortages

To meet the need of water for daily use, residents get it from various sources of regional water company, ground water, surface water and rainwater. Table 4.16. shows the sources of clean water during rainy season. Based on the table, it can be seen that in general the largest source of water comes from ground water and regional water company. Residents who obtain water from ground water are as many as 64.03 %, while from regional water company are as many as 43.53 %.

Table 4.16:. Sources of Water During Rainy Season in Semarang City

Village	Regional Water Company/PDAM	Ground water	Surface water	Rainwater
Non coastal				
Gunung Pati	13,64%	77,27%	4,55%	4,55%
Lempong Sari	56,25%	43,75%	0,00%	0,00%
Rowosari	15,38%	84,62%	0,00%	0,00%
Tandang	5,56%	88,89%	0,00%	5,56%
Kemijen	87,50%	12,50%	0,00%	0,00%
Sub Total	22,48%	74,42%	0,78%	2,33%
Coastal				
Mangun Harjo	40,00%	60,00%	0,00%	0,00%
Tanjung Mas	34,04%	65,96%	0,00%	0,00%
Trimulyo	25,71%	74,29%	0,00%	0,00%
Sub Total	44,97%	55,03%	0,00%	0,00%
Grand Total	34,53%	64,03%	0,36%	1,08%

Community's dependency on ground water in non-coastal areas is higher than community's in coastal areas. This is because the infrastructure of regional water company is relatively difficult to enter the non-coastal areas. Thus, if there is a long dry season that causes the decline of ground water, then community in non-coastal areas is relatively more vulnerable than the community in coastal areas. Table 4.17. shows water sources during dry season. Based on the data it turns out there is no significant difference. It means that residents do not make efforts to seek new water sources in case of drought. The implication is that many people during dry season provide water by purchasing it.

Table 4.17:. Sources of Water During Drought in Semarang City

Village	Regional Water Company/PDAM	Ground water	Surface water	Rainwater
Non coastal				
Gunung Pati	22,73%	72,73%	4,55%	0,00%
Lempong Sari	56,25%	43,75%	0,00%	0,00%
Rowosari	15,38%	84,62%	0,00%	0,00%
Tandang	5,56%	88,89%	0,00%	5,56%
Kemijen	87,50%	12,50%	0,00%	0,00%
Sub Total	24,03%	73,64%	0,78%	1,55%
Coastal				
Mangun Harjo	40,00%	60,00%	0,00%	0,00%
Tanjung Mas	34,04%	63,83%	2,13%	0,00%
Trimulyo	22,86%	77,14%	0,00%	0,00%
Sub Total	44,30%	55,03%	0,67%	0,00%
Grand Total	34,89%	63,67%	0,72%	0,72%

Livelihood Strategy

There are 3 livelihood strategies that are common in communities with livelihoods in *on-farm* sector, namely (1). Agriculture intensification and extensification; (2). Double income pattern (income diversity), and (3). Migration or permanent movement of population. Based on survey results and FGD in the observed villages, it can be drawn that the livelihood strategy that has been conducted by residents in the observed villages in Semarang City up until now is intensification of agriculture and double income pattern.

Intensification of agriculture is conducted by the community through the development of agricultural techniques. Residents began to recognize a type of paddy whose harvest time is shorter and that will give more results. This enhances the intensity of rice cultivation from what is originally once in a year to twice in a year. Based on the information, it is known that since ten years ago residents have known rice seedlings type IR 3 that can be harvested in just 3 months. From then on residents' planting calendar changed. Initially they planted rice in 1 period of 6 months starting from the beginning of the rainy season, and then followed by planting cassava. Now, rice is planted in 2 periods, after the second harvest then the farmland can be planted with crops.

Residents also know the pattern of sloping the land. The purpose is to make the rice crop they cultivate can get enough water. This technique is done in order that they have different height in land surface, some high, some low. The higher part of the land is commonly used to grow crops while the lower part of the land is used for planting rice so when water supply is low, the rice paddy field will still have enough water.

Various technical information on agricultural adaptation towards climate change is obtained from the interaction between fellow farmers, originating from the same or different regions. Dissemination officers and village government officials are considered not much of help in solving agricultural problems.

Livelihood strategy is not only related to changes in agricultural techniques, but is also a pattern of double livelihoods. Residents do not rely their income solely on agriculture, either rice or crops. In the dry season the men go to work to the center of Semarang City, or to other surrounding cities. Job that generally they look for is as construction workers. Meanwhile, the women find work as housemaids or freelance labors in some garment factories scattering around the City of Semarang. Residents claimed that they treated both jobs equally. The two or more jobs that they do are done in accordance with seasons. Dry season is the period of working in city, while rainy season is the period of working on farms at home.

Disaster causes work undertaken by residents in coastal areas to be impermanent, changeable in accordance with climatic conditions. It is possible for people who have rice fields to change profession into fishpond or mangrove labors during bad season. It also happens vice versa for fishpond and mangrove farmers. For example coastal abrasion washed away most land and turned it into a beach. In addition, the remaining land that is not washed away would suffer from decrease in nutrient levels due to the use of chemicals in food and medicines for the pond. As a result most people turned to work as rice field farmers, mangrove farmers or as labors. This strategy is done to support the family. The strategy of migrating to other islands is also done by fishermen. For example during a prolonged bad season where the number of fish is small, fishermen are forced to find a new work location and leave the family. Some fishermen migrate to Riau, Lampung and Jakarta. They will return when things are back to normal again. Besides that, there are also fishermen who sell or pawn the goods they have such as clothing, and household equipment. The majority of society never borrows from financial institutions, for fear of collateral that must be provided. Usually when they need to borrow money, they would rather borrow from loan sharks because the process is faster and easier.

Residents also carry out livelihood strategy by empowering their family members, such as wives and children who have grown up. This strategy is done in almost every village observed, both in coastal areas and in non-coastal areas. This strategy also applies to people with livelihoods in *on-farm* or in *off-farm*

Summary of adaptation and residents' efforts to handle the problems arising from the disaster can be seen in Table 4.18

Table 4.18:.Residents' Efforts in Handling Problems Caused by Disaster in Observed Villages in Semarang City, 2009

No	Problems	Distribution	Handling Efforts
1	Food Scarcity	▪ 18.3% of residents stated that there was scarcity of food at the time of flood ▪ 10.9% of residents stated that scarcity of food at the time of drought	Prepare food stock, look for food substitutes such as cassava, take potluck, find food in other areas, ask for help, and borrow money.
2	Scarcity of drinking water	▪ 9.4% of residents stated that there was no scarcity of drinking water at the time of flood ▪ 25.7% of residents stated that there was scarcity of drinking water at the time of drought.	Seek other sources, Buy water, conserve water usage, ask for help
3	Damage to houses	▪ 34.6% of residents stated their house were damaged after flood ▪ While only 1.4% of residents stated their house were damaged after drought.	Repair the house and raise the floor level
4	Damaged assets	▪ 25.4% of residents claimed to have damaged assets after flood ▪ While after drought only 1.1% of residents claimed to have were damaged assets.	Repair the assets and purchase them again
5	Debt/ borrowing money	▪ 13.7% of residents admitted to be in debt at the time of flood disaster ▪ 7.1% of residents admitted to be in debt at the time of drought.	Mortgage and sell goods
6	The emergence of various diseases	▪ 36.9 % of residents stated that various diseases came out at the time of flood ▪ 9,7% of residents stated that various diseases came out at the time of drought.	Go to doctors and maintain cleanliness
7	The decline in agricultural production/ livestock/fish.	▪ 13.4% of residents complained about it at the time of flood disaster ▪ 18,9% of residents complained about itu at the time of drought	Set the pattern for planting, improve fishpond, and look for another job.
8	Evacuation/ refuge	▪ 6.9% of residents stated that they evacuated during floods but not during drought	
9	Waste	▪ 8.9% of residents complained about it during flood disaster but not during drought.	Cleaned

4.3.6 Assistance expected by residents

Seeing the high potential for disaster in the future, based on discussions with residents, there was some information concerning the expectations of residents to the government's disaster handling programs. In the four villages that did FGD, three villages gave a positive answer. Those Villages were Mangunharjo, Tanjungmas, and Tandang. While residents in Rowosari implied a sense of distrust towards government programs.

Mangunharjo Village

Mangunharjo residents both male and female groups are willing to be resettled if the disaster is severe, and there is no other alternative where the existing conditions require them to move and switch jobs for their own safety. But beforehand, residents will still try to stay unless the condition is as described previously. In addition, residents still make various considerations, especially related to housing (housing not refugee camps), as well as decent jobs in accordance with the residents' capabilities. However, if they could choose, male residents as breadwinners are more interested in switching professions than being resettled to plateaus due to their different customs and their inability to adapt to conditions in the plateau.

Mangunharjo residents, both female and male groups are willing to attend a training program and community empowerment implemented by the government. The form of training to be taught is training in developing residents' skills used for making livelihoods. Examples of trainings for women groups are sewing, processing fishpond and sea products (making crackers, shrimp paste, nuggets, and others). While the desired trainings for male groups in Mangunharjo are crop cultivation and fishpond culture trainings. The Mangunharjo women's groups will follow the training programs if they get permission from their husbands.

There is slight difference in forms of assistance expected by each group in Mangunharjo. The main assistance expected by the men is infrastructure improvements such as repairing roads damaged by floods, because the main road is the main access to all daily activities such as work, education and other activities. Also repairing Beringin River dike that was damaged during the flood and the height of the dike as an effort to anticipate another flood. While the main forms of assistance expected by women's groups are daily necessities such as groceries (the nine basic needs), clothing, shelter, and medicine. Also assistance in the form of infrastructure improvements both roads and bridges. These differences occur because women are identical to daily needs.

Tanjungmas Village

Suppose there is a huge disaster and the government suggested that the residents should be relocated, the male residents are willing to move considering that they are given proper housing. Meanwhile, to change jobs, fishermen are not willing to do so as it is related to their skills. Despite the training given by government to increase their skills, the fishermen are still unwilling to change the type of job considering the length of time to learn. In addition, if they recall past experience, by changing jobs they obtain smaller income, and the work system should be according to the rules that is unlike the usual work system done by the fishermen. As for the women, they are willing to be relocated, change type of livelihoods, as well as follow training programs and community empowerment. However, this is sill based on their husbands' approval. Form of assistance expected by Tanjungmas residents is in the form of infrastructure improvements to support returning their daily life activities, and basic needs such as groceries and medicine.

Tandang Village

The residents' desire in Tandang village is relatively similar to those of Mangunharjo residents'. Tandang residents, both men and women, are willing to be resettled if the disaster is severe and highly required for their safety. Should the government conduct training and empowerment programs, residents in general are willing to follow the program. Form of training desired to be taught is residents' skills development training that can be used as a source of livelihood.

Forms of assistance that are expected by male and female residents of Tandang village if there is disaster are in the form of basic commodities, medicines, clothing, and shelter. Residents believe that those are the forms of assistance majorly needed by residents during disasters. After that infrastructure improvement consisting of roads, bridges, improvement. Besides that, residents also expect assistance in the form of jobs. Residents admitted that their current job is uncertain, because in general their current jobs are unfixed.

Rowosari Village

Compared to the three previous villages, related to residents' expectations of government's aid if there is severe disaster in the future, Rowosari residents gave different answers. From the discussion, residents said should there be any government programs regarding relocation or job change, they chose to stay and were reluctant to join the program. One resident said that:

"……the program conducted by the government are only promisies, sometimes in reality it is not implemented".

Therefore, residents never rely on government officials or the agriculture services to find solution for problems that they face during disaster. Most people thought that the government is not quick enough to respond to their problems. In some cases, during the emergence of pests attacking residents' crops, the agriculture services came after the pests have been bothering the crops for sometime. And they did not provide a satisfactory solution. According to residents, all the officials did were just observing it.

"……they took pictures of the crops and never returned...."

This is the expression that came from a resident responding to the role of agricultural services. Residents also tend to show a sense of apathy if they have to expect that the government will be able to bring changes in their agricultural activities. In addition to their past experience, residents also consider that the natural conditions that happen is a destiny from Allah SWT, so it is impossible for the government to handle it.

4.3.7 Identification of adaptation activities from the government that have been implemented by the community

Summary of government activities and the response from the public to activities of non-structural is presented in Table 4.19.

Table 4.19:. Government activities in improving disaster-handling capacity that is non-structural and community response

No	Government activities	Community response
1	Socialization to the residents to know and care about their neighborhood before the coming of rainy season	Clean up the environment, clean drains/ sewers, clean up disposal garbage
2	Prohibit mining/dredging and construction of settlements in areas of steep hills, in conservation area for green line and in areas prone to disasters	There are still residents who build houses in steep hill areas because of economic reason
3	Give early warning to residents especially those who live in slope areas and areas prone to disasters so that they be more cautious towards the possibility of disaster	Early warning given is not yet effective
4	Urge citizens to maintain the cleanliness of environment and river by doing community service	Work in mutual cooperation to clean up drains/rivers
5	Maintain drainage channels in Semarang	Carried out
6	Normalize rivers that may cause floods	Yet effective
7	Prepare Disaster Handling Command Post for 24 hours	Disaster Handling Command Post is not yet effective

Chapter 5 VULNERABILITY AND ADAPTIVE CAPACITY MAPPING

5.1 Methodology for Vulnerability and Adaptive Capacity Mapping

For defining capacity and vulnerability indices, we used 2005 socio-economic survey data by '*kelurahan*' (villages) from National Bureau of Statistics (BPS) while for some of biophysical data were obtained from related sector or generated based on satellite interpretation with GIS techniques (Table 5.1). All the data were weighted according to their relative importance in shaping vulnerability (V) and capacity (C) to adapt.

Table 5.1:..Indicators used for defining Vulnerability and Capacity and the corresponding weights

A	**Capacity**	**Weights**	**B**	**Vulnerability**	**Weights**
A1	Electricity Facility	0.05	B1	Number of household living in River Bank	0.05
A2	Working People based on Education Background	0.30	B2	Number of Building in River Bank	0.05
A21	*Nursery –Junior High School*	*0.30*	B3	Drinking Water**	0.20
A24	*Senior High School/Univ.*	*0.70*	*B31*	*Good*	*0.10*
A3	Main Source of Income	0.30	*B32*	*Medium*	*0.20*
A4	Health facility*	0.10	*B33*	*Bad*	*0.30*
A41	*Puskesmas*	*0.20*	*B34*	*No-service*	*0.40*
A42	*Polyclinic*	*0.30*	B4	Population density	0.10
A43	*Posyandu*	*0.20*	B5	Poverty	0.20
A44	*Midwifes Clinic*	*0.10*	B6	Fraction of Coastal***	0.10
A45	*Med. Doctor Clinic*	0.20	B7	Fraction of River***	0.10
A5	Road Infrastructure	0.25	B8	Non-Green Open Area****	0.20

Note: *In term of facility, Polyclinic is better than Puskesmas as it is managed and operated by Private company, but the cost of health services is much higher than the government's one (Puskesmas). ** Data obtained from the Semarang Drinking Water State Company (PDAM Office) and divide by population. *** Data were generated from Satellite and topographic map.

To measure relative position of Kelurahan in term of their vulnerability and capacity to adapt, we develop capacity (CI) and vulnerability indices (VI). The Capacity Index (CI) is developed using five main indicators (A1, …, A5). Indicator A1 is percentage of household in the village that uses electricity facility which represents the level of wealth of communities of the villages. Indicator A2 is education which may represent the capacity of community in the villages in managing the risk. The higher the education is the better their capacity in managing the risk is. This indicator consists of two sub-indicators namely number of working people with education background of Nursery up to junior high schools and that with Senior High

School up University. All the values of the sub-indicators were normalized by population of each *Kelurahan*. In order to get values of the indicators ranges from 0 to 1, all the values in this indicator were divided by its maximum value.

Indicator A3 is main income source of community in the village. For villages where main source of income of the community is strongly influenced by climate variability will have low capacity score. The values of the indicator by main source of incomes are presented in Table 5.2. In this case for example, village in which agriculture is the main source of income of the community, the value of the indicator is 0.25.

Table 5.2:..Indicator value according to types of main income source of community in the village

No	Main source of income	Score (Indicator value)
1	Agriculture	0.25
2	Mining and processing industries	0.50
3	Trading, transportation and communication business etc	0.75
4	Services	1.00

Indicator A4 is health facility which represents access of community to health facilities. The better the health facility in the *Kelurahan* is the higher the capacity of the *Kelurahan* is. This indicator is further divided into 5 sub-indicators namely number of Polyclinic (Pl), Child Community Services (*Posyandu, Ps*), Health Community Services (*Puskesmas, Pk*), Midwifes Clinic (B) and Doctor Clinics (D). All the values of the sub-indicators were normalized by population size of the corresponding *Kelurahan*. The scoring value of I_{A4} in each *Kelurahan* was calculated using the following formula:

$$I_{A4i} = 1/P_i * (0.3*Pl_i + 0.2*Ps_i + 0.2*P_{ki} + 0.1*B_i + 0.2*D_i)$$

Since the scoring value of this indicator is very small, all the values were divided with the highest score in order to get scoring values of the indicator ranging from 0 to 1.

Indicator 5 is dominant type of road infrastructure. For this data we define village where the dominant road infrastructure is made from aspalt will have value 1 while for those with non-aspalt will have value 0. The formula to calculate the CI is the following:

$$CI_i = \sum_{j=1}^{5} w_{ij} * A_{ij}$$

Where subscript-i^{th} represents village-i^{th} and w_{ij} is weight value for indicator A-j^{th} of village-i^{th}. The selection of the weight values was subjective, based on understanding and knowledge of experts on relative important of the indicators in

determining the level of capacity. With this formula, the higher the capacity index value is, the higher the capacity of the village is similar with the Capacity Index (CI), the vulnerability index was also developed using the same approach. There nine main indicators (B1, …, B8) as defined in Table 4. Indicators B1 is percent of household in the *Kelurahan* living in the river bank. As the value of this indicator will be very small, to have values of the indicators ranges from 0 to 1, all the values in this indicator were divided by its maximum value. Indicator B2 is number of building situated in the river banks. All the values of this indicator were normalized by maximum number of building situated in the river banks.

Indicator B3 is fraction of *Kelurahan* that received drinking water service. *Kelurahan* where most of the community gets drinking water from Drinking Water State Company (PDAM) will be less vulnerable to drought impact as the PDAM normally still can supply enough drinking water irrespective of season (dry or wet). The data of this indicator is in the form of area of each village that receive good (G), medium (M), bad (B) and no service (N) from Drinking Water Company. The scoring value of this indicator was calculated as the following:

$$I_{B3i} = 1/A_i * (0.1*G_i+0.2*M_i+0.3*B_i+0.4*N_i)$$

Where A_i is the total area of *Kelurahan-i*. As the value of this indicator will be very small, to have values of the indicators ranges from 0 to 1, all the values in this indicator were divided by its maximum value.

Indicator B4 is population density in which the higher the population density the higher level of the exposure of the people to hazard. This puts the *Kelurahan* into more vulnerable *Kelurahan*. To get values of the indicators ranges from 0 to 1, all the values in this indicator were divided by its maximum value.

Indicator B5 is number of poor household. Values of this indicator are normalized with population size of the *Kelurahan*. Indicator B6 is fraction of coastal area in the *Kelurahan*. The *Kelurahan*s with high fraction of coastal area will be more vulnerable than the *Kelurahan* with have less fraction of coastal area, as the level of exposure of these *Kelurahan*s to the impact of sea level rise will be higher than those situated in the inland. Coastal fraction is determined by dividing area being affected by tide+100 m in each *Kelurahan* with total area of the corresponding *Kelurahan* (Figure 5.1). This inundation due to high tide is usually used as an indicator of *rob* as a result of temporary sea level rise, while the addition of a distance of 100 meters is used to anticipate extreme tide.

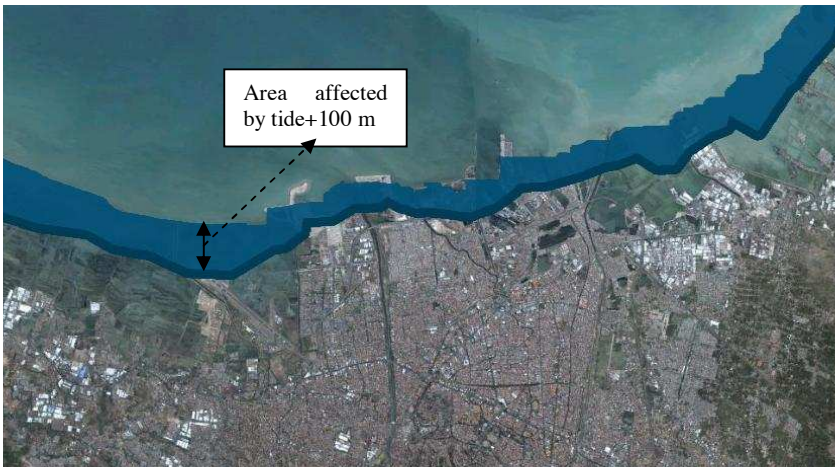


Figure 5.1: *Coastal area which is affected by tide + 100 m*

Indicator B7 is fraction of river which was determined based on river order. The river order is determined using Strahler's method (1986). In this method, the river's network is notated as a number based on its (order) level. The upper stream of the river is given notation number equal to 1, thus, it is called as order-1. The segment of the river where we can find the confluence between order-1 is defined as the 2nd order of the river, and the confluence between the 2nd orders represents the 3rd order. Based on these rules, part of the river that is formed as a result of the confluence between a particular order-level is considered as the next level of this order. However, in the case where two orders with different levels meets at a particular segment, this can be referred to the highest level of the orders. Figure 5.2A illustrates the highest order of the river indicated by the red line. In this case, the river has 4-order as the highest level. This highest order is usually represented by the location of the accumulation of surface flow, which very often becomes the target of flooding. In this study, the wide of targeted flooding area as shown in Figure 5.2B is assumed to be as far as 100 meters to the left and right sides of that segment. Indicator B8 is non-green opened area which will determine the capacity of land in absorbing rainfall. This data was taken from Revised Spatial Plan of Semarang 2010-2020 (Bappeda, 2007).

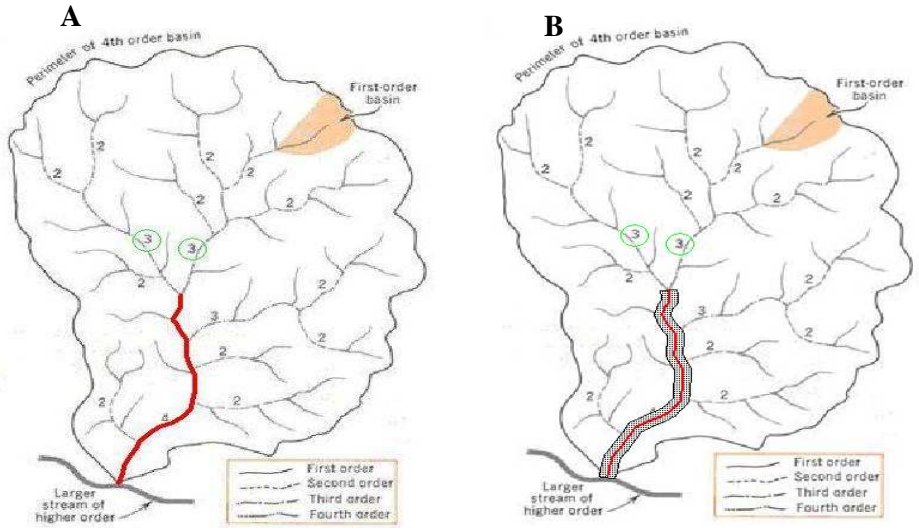


Figure 5.2:. Determination of the highest order stream (A) & estimation of the wide of its water surge (B)

The formula to calculate the CI is the following:

$$VI_i = \sum_{j=1}^{5} w_{ij} * B_{ij}$$

Where subscript-i^{th} represents *Kelurahan*-i^{th} and w_{ij} is weight value for indicator B-j^{th} of *Kelurahan*-i^{th}. The selection of the weight values was subjective, based on understanding and knowledge of experts on relative important of the indicators in determining the level of capacity. With this formula, the higher the index, the more vulnerable the *Kelurahan* is.

5.2 Classification of *Kelurahan* (Villages) Based on Vulnerability and Capacity

To classify the villages based on their vulnerability and capacity level, all VI and CI values of all Kelurahan were subtracted by 0.5. As the VI and CI values range from 0 to 1, by subtracting the index values with 0.5, the VI and CI will range from -0.5 to +0.5. The relative position of Kelurahan according to their VI and CI is determined based on their position in the five Quadrants as shown in Figure 5.3. Kelurahans situated in Quadrant 5 will have high VI and Low CI. Whereas Kelurahans situated in Quadrant 1 will have low VI and high CI. Using this classification system, if *Kelurahan*s situated in Quadrant 5 are exposed to certain hazards, the impact would be more severe compare to *Kelurahan*s Situated in Quadrant 1.

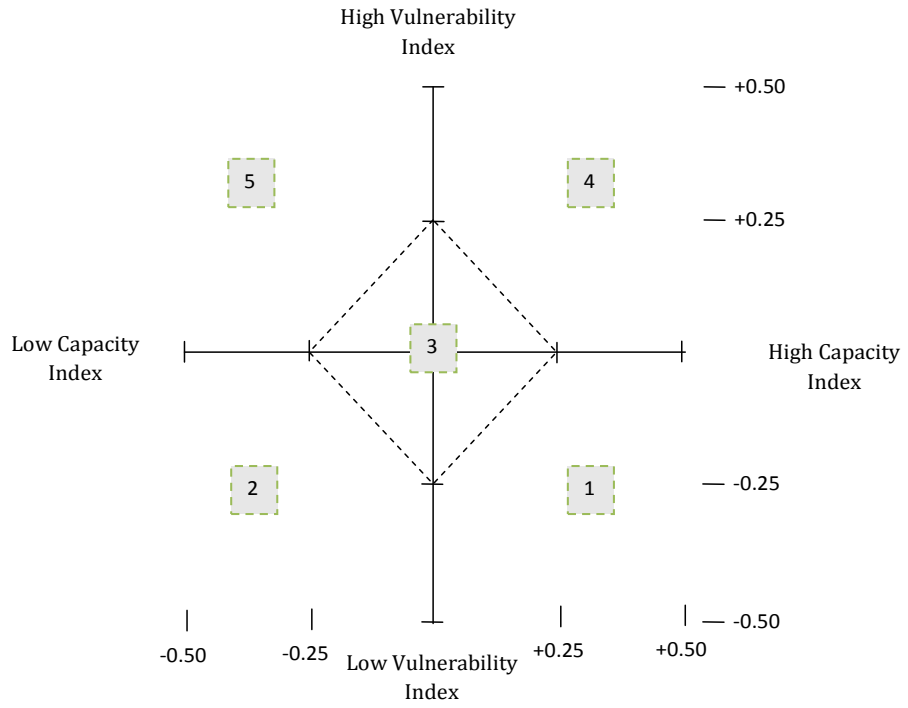


Figure 5.3: *Classification of the villages based on their coping capacity index (Quadrant 1-5)*

To assess the change of V and C in the future, we only consider the change of population density (based on government projection), health facility [based on Semarang City Facilities Plan in 2020 and 2030), and non-green opened area as defined in the revised spatial plan of Semarang 2010-2020 (Bappenda, 2007). Factors used for normalizing the score of these corresponding indicators in 2025 and 2050 were the same as those of the baseline year 2005.

Figure 5.4 shows the index value for the vulnerability and capacity for each village in Semarang. In the baseline condition (2005), vulnerability index ranged from 0.16 until 0.53, in 2025 VI ranged between 0.17-0.55, while the projection for 2050, VI ranged from 0.17 to 0.58. Based on these results can be explained that the level of vulnerability more wide, yet still be considered stable, given the analysis results for the projection into the future (2025 and 2050) at a level that can be said the same with baseline conditions in 2005, the index value is only shifted slightly. This indicates that in the same environmental conditions, the ability to adapt more increases ahead. The condition is also indicated by the increased value of CI index. In 2005, CI values varied in the range of 0.42-0.90, but the projection for 2025 showed the index values are in the range of 0.49-0.92, and the projection in 2050 showed an index value was about 0.50-0.95.

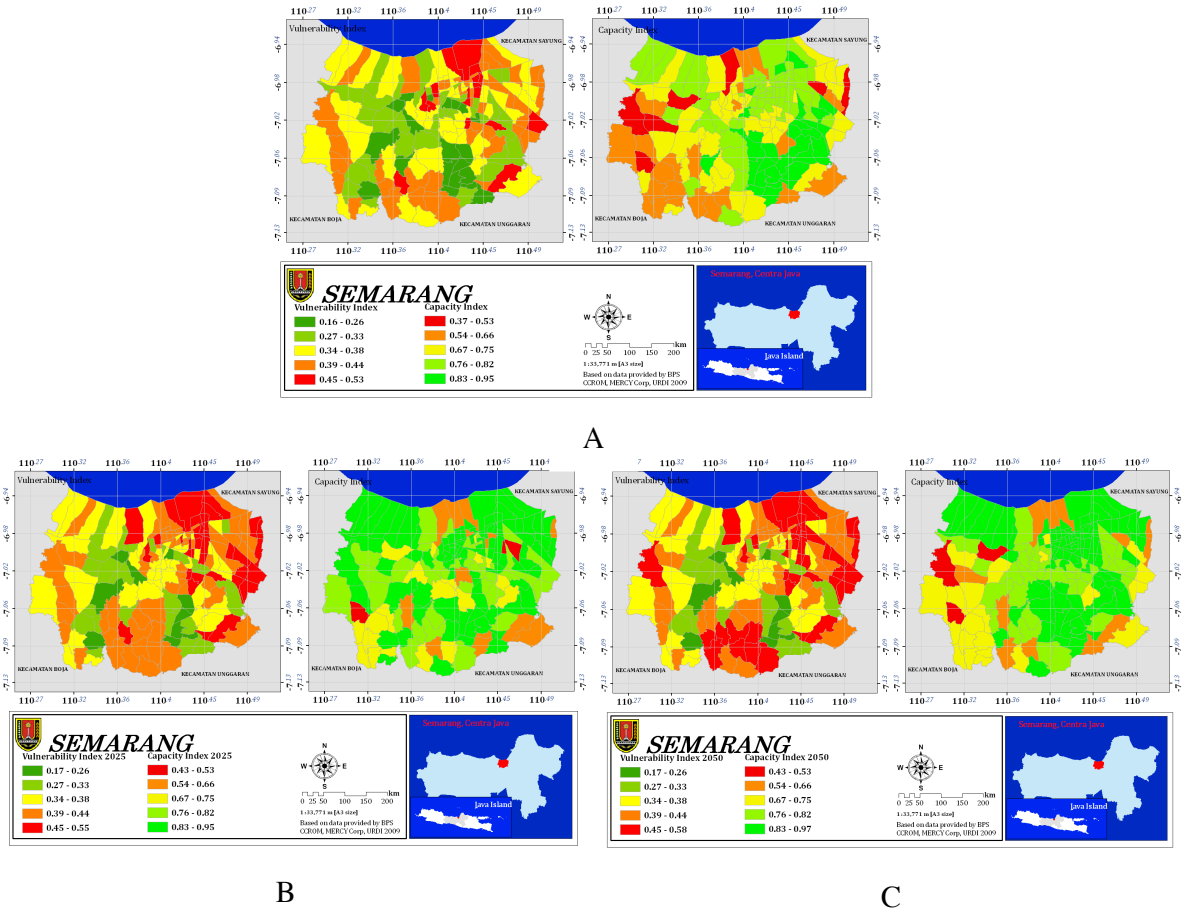


Figure 5.4: *Current and Future vulnerability and Capacity indices of Kelurahan of Semarang City Baseline, (B) 2025, (C) 2050*

Figure 5.5 shows number of Kelurahan according to their coping capacity index (quadrant) at present and in the future. It was indicated that at present about 6% of Kelurahans have high coping capacity index (Kelurahans with high vulnerability and low capacity index or high coping capacity index), 38% in Quadrant 4, 27% in Quadrant 3, 3% in Quadrant 2 and 27% in Quadrant 1 (Kelurahan with low vulnerability and high capacity index). Kelurahan at Quadrant 5 include Bandarhardjo, Bengetayu Kulon, Bubakan, Gunung Pati, Kudu, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo and Wonoplumbon. In 2025 and 2050, one Kelurahan in Quadrant 5 will move to Quadrant 4 indicating that there is an improvement of its coping capacity index. However, coping capacity index of some Kelurahans in Quadrant 3 may change to Quadrant 4 in the future. This suggests that coping capacity of these Kelurahans would decrease in the future (see map in Figure 5.6).

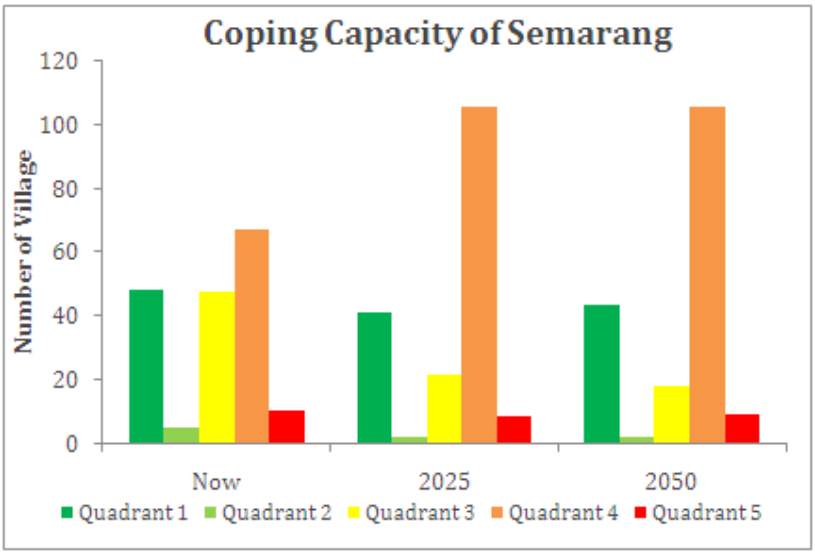


Figure 5.5:. Number of Kelurahans according to the coping capacity index (quadrant 1-5) at present and in the future (2025 and 2050)

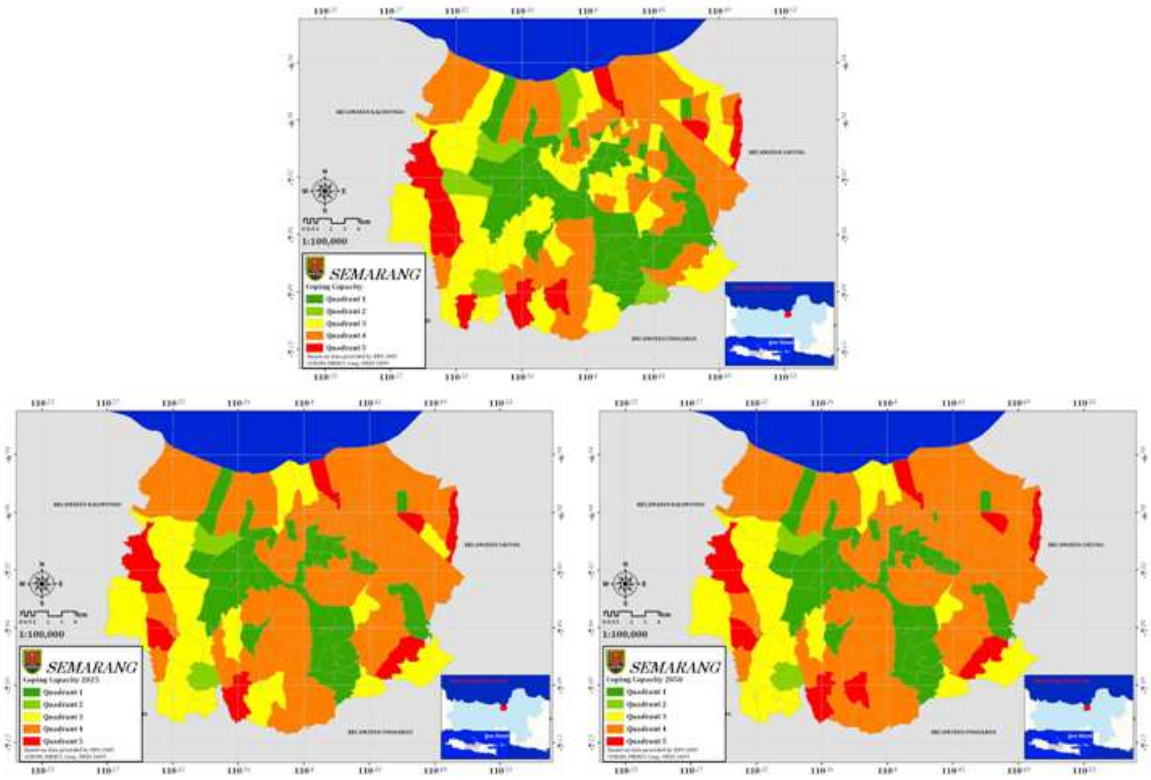


Figure 5.6:. Coping Capacity Index of Kelurahans at Semarang city

Chapter 6 CLIMATE RISK ANALYSIS

6.1 Methodology for Climate Risk Mapping

To assess current and future climate risks, we adopt definition of climate risk as suggested by Beer and Ziolkowski (1995) and Jones et al. (2004). The risk is defined as a function of the probability of unexpected climate event to occur and the consequence of the unexpected climate events if it occurs. Thus the risk can be presented in the form of risk matrix (Table 6.1). From Table 6.1, we can define the climate risk will be very high if the likelihood of unexpected event to occur is very likely and the consequence of the events is catastrophic.

Table 6.1:.. Matrix of risk as a function of probability of unexpected event to occur and the consequences if the unexpected events occur.

Likelihood / Consequences	The probability of unexpected event to occur		
	Very Likely	Likely	Unlikely
Catastrophic	*Very High*	*High*	*Medium*
Critical	*High*	*Medium*	*Low*
Marginal	*Medium*	*Low*	*Very Low*

The consequence of the events will depend on the coping range which is shaped by a range of biophysical, social and economic factors. In this context, the coping range can be represented by the vulnerability and capacity indices. Thus if the unexpected event occurred in *Kelurahan* with high vulnerability and low capacity index, the consequence of that event is expected to be high. If it occurred in *Kelurahan* with low vulnerability and high capacity, the impact is expected to be low. In this study, we adopted five level of coping capacity index as shown in Figure 5.3. To allow multiple climate hazards being accommodated in the matrix of climate risk, we modify the likelihood of unexpected event defined in Table 6.2 as an index, called composite climate hazard index (CCHI).

The Climate Hazard Index (CHI) is calculated as the following:

$$CCHI_i = \sum_{j=1}^{n} w_{ij} * CHI_{ij}$$

Where $CCHI_i$ is composite climate hazard index of *Kelurahan-i*, w_{ij} is the weight of climate hazard-*j* at *Kelurahan-i* and CHI_{ij} is index of climate hazard-*j* of *Kelurahan-i*. Types of climate hazard being analysed in this study are flood, drought, land slide and sea level rise (robs). Strong wind is very rarely in the city therefore we exclude this in the analysis. The weight and the formula used to calculate the index the

climate hazard is given in Table 6.2. The adjusted matrix of climate risk is presented in Table 6.3.

Table 6.2: Weight and formula for calculating climate hazards index

Type of hazard	Weight*	Formula
Flood	1.25	Probability of having monthly rainfall of more than 302 mm multiplied by average of area of *Kelurahan* being impacted by flood. In order to get the index value of between 0 and 1, the calculated value is normalized by the maximum value
Drought	1.50	Probability of having dry month with length of more than 6 month multiplied by number of dry month above the 6 month (DM_{6+}). Dry month is defined as month with rainfall of less than 84 mm. If total length of dry month is 8 month, the DM_{6+} = 2 months. In order to get the index value of between 0 and 1, the calculated value is normalized by the maximum value.
Land slide	0.75	Probability of having monthly rainfall of more than Q2 multiplied by slope indicator of the corresponding *Kelurahan*. *Kelurahan* that has locations with slope of more than 45^{o}, the indicator value will be equal to 1, otherwise zero.
Sea Level Rise	1.00	Fraction of *Kelurahan* area being inundated by the sea level rise
Max CCHI	4.50	

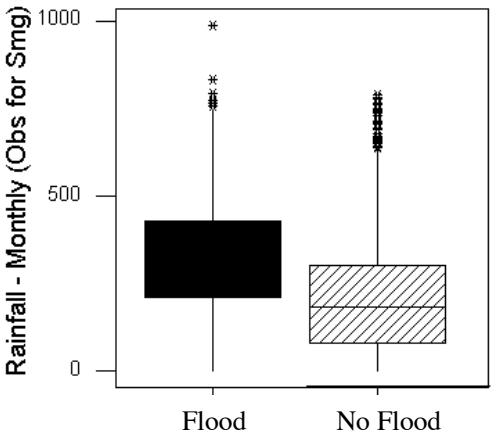
Note: The weight is very subjective and determined based on Expert Judgement. Drought has the highest weight as its impact may be more severe than flood due its duration and extend of impacted area. Impact of flood, land slide and sea level rise is more localized than that of drought.

Table 6.3:..Matrix of Climate Risk according the coping capacity index and composite climate hazard index

Coping Capacity Index	Composite Climate Hazard Index (CCHI)		
	More than 3.5	Between 2.0 and 3.5	Less than 2.0
5	*Very High*	*High*	*Medium to High*
4	*High*	*Medium to High*	*Medium*
3	*Medium to High*	*Medium*	*Medium to Low*
2	*Medium*	*Medium to Low*	*Low*
1	*Medium to Low*	*Low*	*Very Low*

Methodology for defining critical rainfall causing flood (302 mm) and the one causing drought (84 mm) was based on statistical distribution of the monthly rainfall

data from 27 stations (1989-2007) under hazards and without hazard condition. The data of flood and drought hazards were taken from Bappeda (2007). From Box plot (Figure 6.1), it was found that the monthly rainfall during flood years is relatively larger than in no flood years. The average of rainfall amount is estimated around 324 mm when the flood occurred, and 205 mm when there was no flood. For this study, we define the threshold of monthly rainfall associated with the flooding events as the 3rd quartile of monthly rainfall distribution, where in this case, equal to 302 mm. This threshold value means that if the monthly rainfall is more than 302 mm, the chance of having flood disaster is large.



Note :

	Flood	No Flood
Mean	324	205
Q1	210	78
Q2	307	181
Q3	428	302
Min	1	1
Max	987	790

Figure 6.1:Box plot of monthly rainfall in wet season during flood and no-flood years

For drought, Box plot of monthly rainfall during dry season under drought years and no drought years (Figure 6.2) suggests that there is distinct different between distributions of monthly rainfall during drought and no drought year. Therefore, we define that the critical threshold for monthly rainfall during dry season causing droughts is the 3rd quartile of monthly rainfall distribution in drought conditions, i.e. 84 mm.

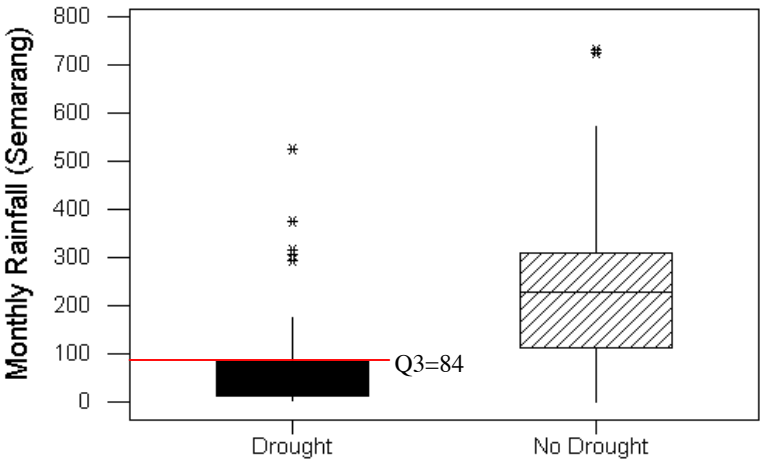


Figure 6.2:Comparison between monthly rainfall during drought and no drought events.

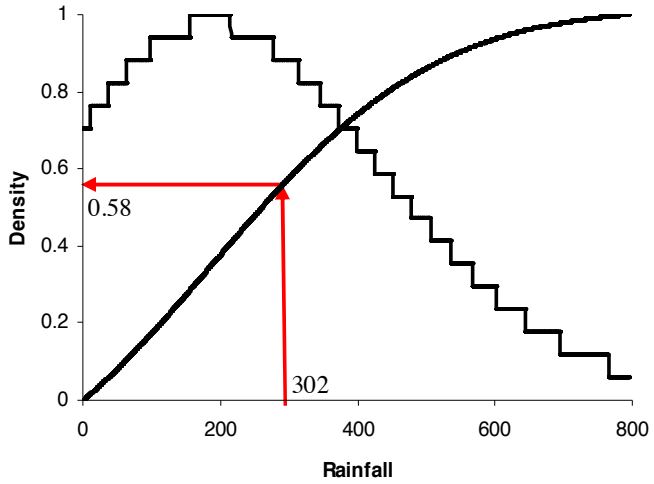


Figure 6.3:Empirical Cumulative Distribution Functions (eCDF) and Scaled Density Function of observed rainfall over Semarang and the threshold of having flood.

```
10     0 0000000011
(6)    0 222223
 5     0 45
 3     0 6
 2     0
 2     1 1
 1     1
 1     1
 1     1
 1     1
 1     2
 1     2
 1     2 5
```

Jan. 2000

Feb. 1999

Figure 6.4:Distribution of flood affected area.

Figure 6.4 demonstrates a stem-leaf diagram of flood affected area in the Semarang city. Branches in the figure are equal to hundreds, while leaves are tens. It is found that there were 21 months of flood events with an average of 1.2 months per year during the period of January 1989 to May 2007. Most of the inundated area were less than 100 ha, with only two flood events affecting more than 100 ha, i.e. in January 2000 (115 ha) and February 1999 (257 ha).

Figure 6.5 demonstrates that the flood inundated area over Semarang city will increase along with the increasing of rainfall amount. However, although there seems to be a linear relationship between rainfall amounts and the inundated area, similar rainfall amount will have different effect on the same area. For example as shown in Figure 6.4, a total rainfall amount of 375 mm may cause no effect to the flooding area (equal to zero) in one chance but could cause significant impact of disaster with considerable inundated area in the city in another chance. This could be related to the dissimilarity in the occurrence of extreme rainfall defined by its frequency and intensity. An extreme rainfall occurs intensely and continuously at a time more than a day, could create more catastrophic impact than several rainfall events that occur discretely with long enough time interval, although the total of monthly rainfall are

similar. Another possibility is that the spreading of flooding area could be also caused by the rainfall event that occurred in the upstream area that brings water runoff into the region. However, such kind of event has a relatively small probability if the rainfall in the region is low (Figure 6.5).

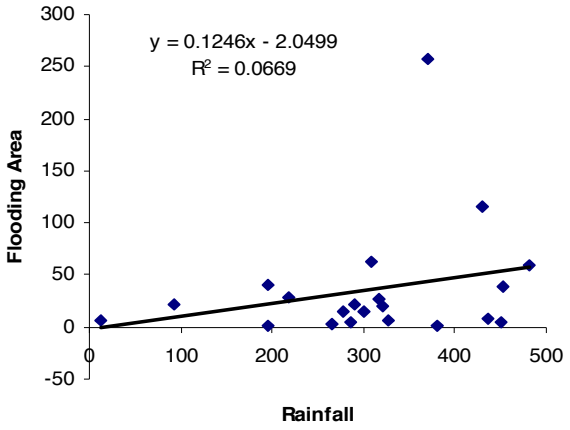


Figure 6.5:*Scatter plot of relationship between monthly rainfall and flood affected area.*

6.2 Classification of Kelurahan (Villages) Based on Level of Their Exposure to Climate Risk

Figure 6.6 shows a composite climate hazard index (CCHI) baseline year 2005, and the A2 scenario in 2025, A2 2050, B1 2025 and B1 scenario in 2050. Based on the analysis carried out showed that most areas of Semarang was in the range of index of equal or less than 2.0 (shown in green), and only a small portion with the CCHI of more than 2.0 (shown in yellow and red). The high CCHI index is only in a small part of the northern part of Semarang.

The study suggested that in 2005, the CCHI in most areas of Semarang City was mostly less than 2.0, and only a small portion of more than 2.0 which is situated in a small part of the northern part of Semarang. In the future, A2 scenario, areas of index> 2 has decreased in 2025, but increased slightly in 2050. Kelurahan with high CCHI both at present and in the future is *Kelurahan* Tanjung Mas, Semarang Utara Sub-district.

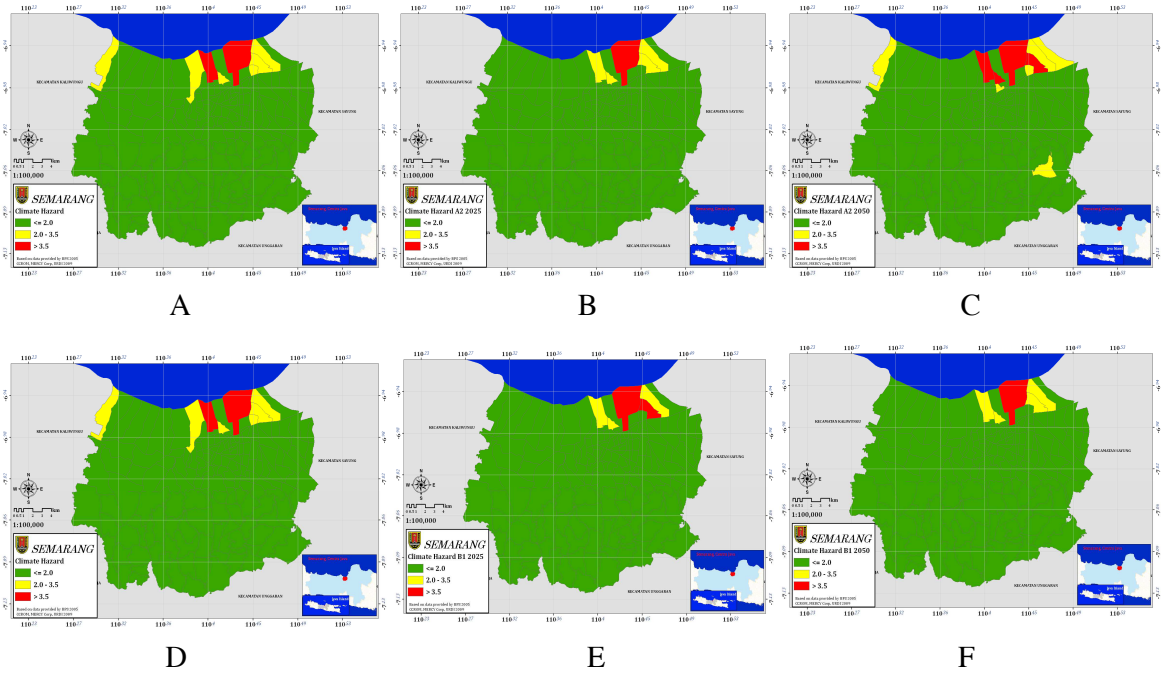


Figure 6.6:Composite Climate Hazard Index of Semarang City (A)& (D) Climate Hazard Baseline, (B) Climate Hazard A2 2025, (C) Climate Hazard A2 2050, (E) Climate Hazard B1 2025, (F) Climate Hazard B1 2050. Note: Green (<2.0), Yellow (2.0-3.5), Red (>>3.5)

Classification of Kelurahan based on the level of exposure to climate risks is shown in Figure 6.8. It shows that there are no Kelurahan with Very High (VH) Climate Risk Category at present (baseline conditions). The highest category is only Medium to High (M-H). There are about 15 Kelurahans (8%) with M-H risk category. These include Bandaharjo, Bangetayu Kulon, Bubakan, Gunungpati, Kudu, Mangkang Kulon, Mangkang Wetan, Mangunharjo, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo, Tanjungmas, Tanjungmas, Tugurejo, amd Wonoplumbon. The remaining are 63 Kelurahans (36%) as M (Medium) risk, 47 Kelurahan (27%) as L-M (Low to Medium) risk, 6 Kelurahans (3%) as L (Low) risk and 46 Kelurahans as VL (Very Low) risk. In the future (2025 and 2050), more Kelurahans will be exposed to higher climate risk, particularly under scenario SRESA2 (Figure 5). There would be two Kelurahans would move from M-H to High climate risk category, namely Mangunharjo Village at Tugu Sub-District and Mangunharjo Village at Tembalang Sub-District. While many of Kelurahans with L-M risk category would move to Medium risk category (Figure 6.7).

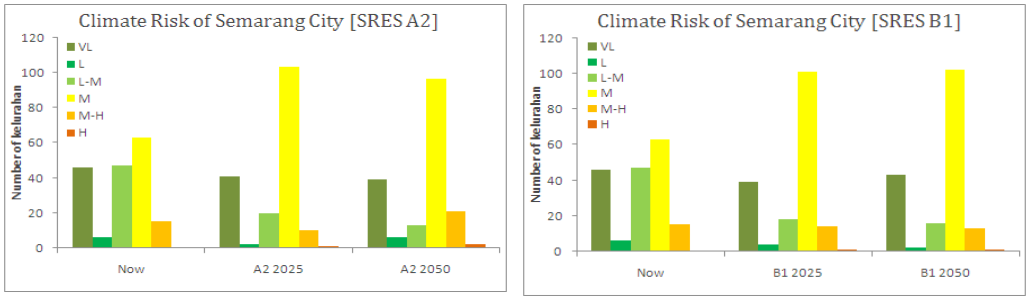


Figure 6.7:. Number of Kelurahan by climate risk index category

The above analysis demonstrated that how change in socio-economic and biophysical conditions will change coping capacity of the Kelurahans. Adaptation programs should be prioritized in Kelurahan with high vulnerability index and low capacity index and being exposed or potentially exposed to high climate hazard index. To reduce the level of risk of Kelurahan to the impact of climate change, the infrastructure and community development programs should be directed to improve socio-economic and biophysical indicators shaping the vulnerability and adaptive capacity of the Kelurahans.

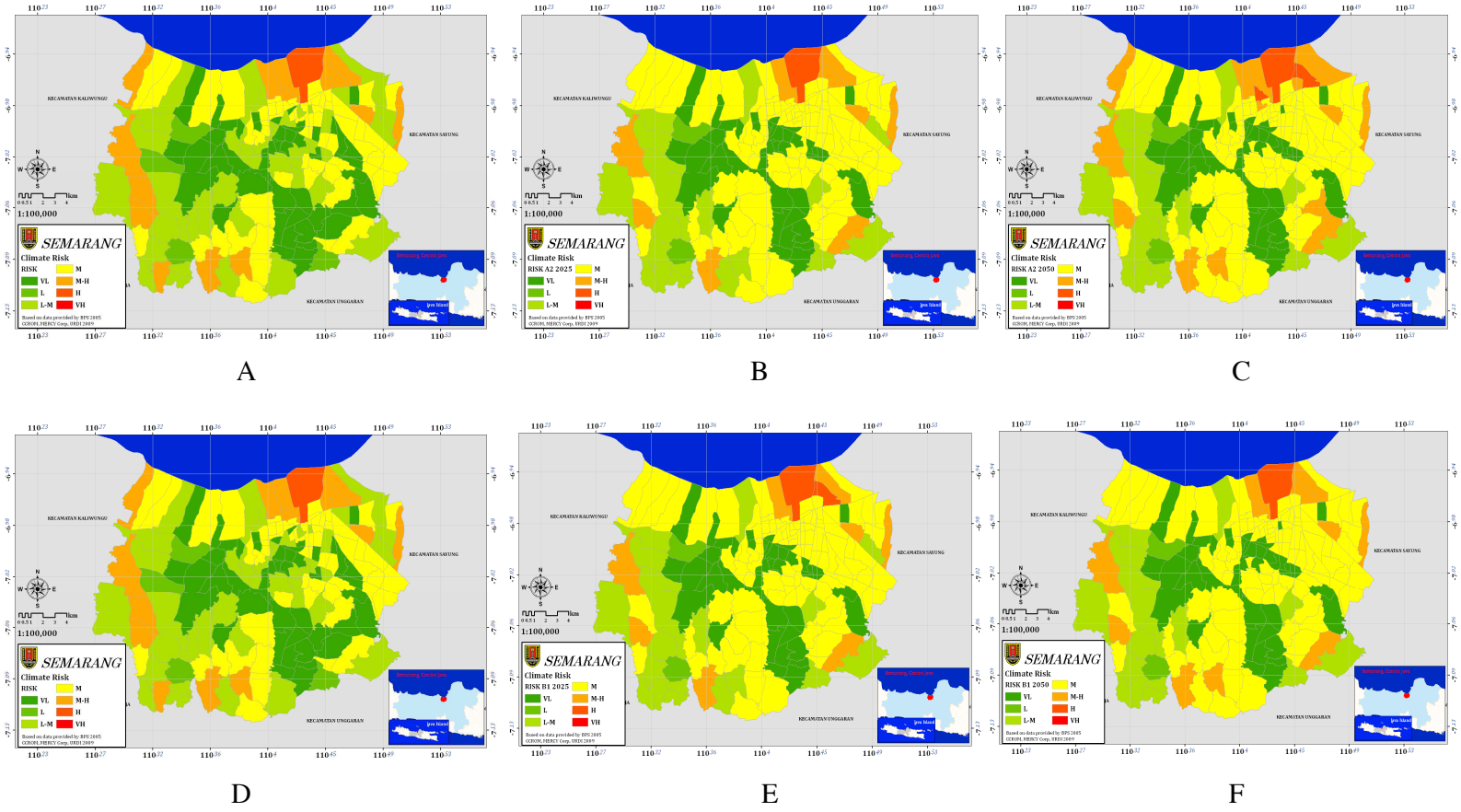


Figure 6.8:Classification of Kelurahan based on their level of their exposure to climate risk
(A)& (D) Climate risk baseline, (B) Climate risk A2 2025, (C) Climate risk A2 2050, (E) Climate risk B1 2025, (F) Climate risk B1 2050

Chapter 7 GOVERNANCE AND INSTITUTIONAL SYSTEM

Governance and institutional analysis consists of three main analysis including the stakeholder analysis, assessment of effectiveness of current initiatives and programs (short and long term) cope with future climate risks and assessment of local government capacity and institutional to integrate climate change into development planning.

7.1 Roles of Stakeholders and Existing Programs in Delivery and Management of Key Climate-Affected Sectors

Stakeholder mapping and analysis conducts through some steps as follow: (i) to identify stakeholder that has both direct and indirect relationship with climate change sector, (ii) to analyse roles, responsibility and contribution of each stakeholders to climate change, (iii) to map stakeholder interest and strength in providing and managing sectors that related to climate change.er

Stakeholder can be classified into several categories namely: central government (line ministry/department and non-departmental government institution), provincial government, city/district government, private sector, non-government organisation (NGO), university, multilateral/bilateral organization, community based organisation (CBO), association, etc. Stakeholder can also be classified based on its scope/position, which are internal stakeholders from inside Semarang City such as local government, NGO's, local universities, private sector etc and external stakeholders from outside the city such as central government, provincial government, international donor agencies, etc.

All of stakeholder has role to improve environment condition as well as strengthening community to anticipate the climate change hazard. City of Semarang is among Indonesian city that potentially affected by the climate change. Currently the city is facing serious problems on flood and *robs* as well as water and sanitation. Table 7.1 shows stakeholders that related to flood and *rob* as well as water and sanitation in city of Semarang.

7.1.1 Role of stakeholder in flood and rob management

Semarang faces serious problems in flood and *robs*. Some programs have been conducted to address the issues, but the problems remain and negatively impact the city. Central government through Directorate General of Water Resources is managing 6 rivers in central java, while Directorate General of Human Settlements of Public Work Department is managing housing, drainage and sanitation in order control flood and *robs* in Central Java, including City of Semarang.

Beside from central government, international donors and foreign countries also contribute to address flood and *robs* problems in the city. For instance, the government of Japan through JICA is implementing megaproject for flood management at Goa Kreo. The budget for this project reached IDR 1.7 trillions. It is expected that the project will complete in 2013 and solve flood and *robs* problems at

seven sub-districts at Central Semarang. In other project, the government of Netherland through *Hoogheemraadschap van Sceieland en de Krimpenerwaard (HHSK)* is constructing Banger Pilot Polder. The polder is expected to control the water from the sea so it will minimize the *robs* problems that often hit the coastal area of Semarang.

Central Java Provincial Government as a vertical institution has an important role to coordinate and facilitate regional partnership among cities in Central Java to manage flood as well as to give assistance through provincial budget.

While the Government of Semarang City, as the main actor of flood and *robs* control in the city, has a big role to manage and solve the problems that frequently attack the city. Fire and Disaster agency is among the agency that has roles to manage the problem.

Beside the government, non government organization such like private sector, non governmental organization and community organization also significantly contribute to reduce the flood and *robs* impacts.

Table 7.1:. Stakeholders that related to Flood/rob and water-sanitation

Stakeholders	Sector related to climate change	
	Flood and Rob	**Water and Sanitation**
Central Government		
• Directorate General of Water Resources	V	
• Directorate General Human Settlements		V
• Vertical Unit of River Management Pamali Juwana	V	
Internasional Donor		
• Japan International Cooperation Agency (JICA)	V	
• Government of Netherland	V	
• GTZ	V	
Central Java Provincial Government		
• Local Planning Board	V	V
• Environment Board	V	V
• Disaster Management Board	V	
• Health Agency		V
• Spatial Planning and Human Settlements Agency	V	
• Water Management Agency	V	
City of Semarang		
▪ Local Planning Board	V	V
▪ Environment Board	V	V
▪ Health Agency		V
▪ Water Management and Energy and Mineral Agency	V	
▪ Fire and Disaster Agency	V	
Non Government Agency		
▪ Bintari Foundation	V	
University		
▪ University of Sugiyapranata	V	V
▪ University of Diponegoro	V	V

7.1.2 Role of stakeholder in water and sanitation

Access to clean water and sanitation is main foundation for healthy and welfare community. Unfortunately, many areas still face the problem to fulfill the need of healthy water and sanitation. City of Semarang is among the city that lack of access to water and sanitation. According to Central Java working group of water, Department of Public Work, in 2004 Local Government water enterprises (so called PDAM), Tirta Moedal, only able to serve 46% of the community. But the recent data shows that it increases significantly into 58% in 2008. However, this number also indicates that about 42% of the communities still do not have access to drinking water from PDAM.

Similar condition also found in sanitation sector. In general, sanitation coverage of city of Semarang reachs 93.27% (Percik Magazine, 2008). This number is very good. But, this number also indicates that few people still face problem in sanitation. It is noted that about 10% of community who live at slump area and consider as poor people in 16 villages have problems with sanitation. About half of them live in poor sanitation facility such as not having own toilet and highly depend on public facility without waste management system.

Although water and sanitation are not only local government responsibility, but as the main stakeholder in development practice, local government has important role to improve water and sanitation service. However, until now, local government still does not have master plan about water and sanitation. But, in 2010, through community sanitation program (Sanimas), local government will develop master plan of water and sanitation in order to increase and broader the coverage of water and sanitation in the city.

7.1.3 Stakeholder analysis

The purpose of stakeholder analysis is to identify roles and responsibilities of each stakeholder in climate change sector. It also identifies stakeholder potential contribution to manage climate change sector (Table 7.2).

Table 7.2:Stakeholder Roles and Contributions for Climate Change

Stakeholders	Roles, Task and Responsibility	Potential Contribution to manage Climate Change Sector
Central Government		
Directorate General of Water Resources	Formulating and implementing policy and technical standard on water resources through: formulating technical policy, programming and budgeting, policy implementation, water resources management, supervision and technical assistance, investment pattern and financing system	▪ Formulating national policy and strategy on water resources and flood management. ▪ Coordinating and facilitating assistance and partnership on flood management. ▪ Providing technical assistance on flood management through

	development, formulating norm, standard, guideline and manual on water resource and administrative matters	national budget.
Directorate General of Human Settlements	Formulating and implementing policy and technical standard on human settlements through formulating policy, programming and budgeting and performance evaluation, technical supervisiom and formulating norm, standard, guideline and manual, facilitating infrastructure development and management, developing investment pattern and financing system, technical assistance and infrastructure monitoring in human settlements sector such as vertical housing, slum and fisherman settlement, water and sanitation, building and disaster management.	▪ Formulating national policy and strategy on human settlements sector ▪ Coordinating and facilitating assistance and partnership in livable settlement provision, water and sanitation, building inspection. ▪ Providing technical assistance on settlement development, water and sanitation and building management
Vertical Unit of River Management Pamali Juwana	As a technical board that conduct water management which include planning,implementing, operational and maintenance of water resources especially at Semarang rivers.	• Assisting water resources and river management plan and pattern • Water resource operation and maintenance • Data and information on water resources • Community based development on water resources management
City of Semarang		
Local Development Planning board	Formulating and implementing local policy on development planning through : formulating technical policy, coordinating planning formulation, supervision and other tasks	▪ Formulating and coordinating planning and programming accross sector and accross region (climate change related sectors) ▪ Facilitating the integration of climate change related issue into development planning ▪ Coordinating and mobilizing financial resources for climate change related program and activities ▪ Monitoring and evaluation of climate change related

		programs and activities
Environmental Management Board	Formulating and implementing local policy on environmental issue through: formulating technical policy, providing assistance on technology development and environmental control, supervision and other task related to environmental issue.	▪ Formulate environmental improvement program ▪ Conduct monitoring on industrial and community activities that have potential to harm the environment as well as reduce the quality of environment. ▪ Support the utilization of environmental friendly technology
Health Agency	Conducting local government policy and program in health sector base on authonomy principles through:policy formulation and program implementation as well as other health program such as community health service, prevent, protect and promote community and family health.	▪ Fomulate community health policy and program ▪ Contribute to climate change issue especially on health promotion program ▪ Developing emergency unit ▪ Developing mobile health center to bring health center closer to community. ▪ Human resources improvement program
Water Resouce Management and Energy and Mineral Resource Agency	Implementing local government program in water and mineral management sector such as formulating and implementung water and mineral management, public service as well as environmental friendly technology.	▪ Formulating monitoring and evaluation of water resources management program
Fire Protection Agency	In charge in disaster management and conduct government program on technical assistance, operational and maintenance of disaster.	▪ Formulating and implementing disaster management programs ▪ Formulating and implementing disaster management programs so that community would be more responsive to disaster issues. ▪ Assist building owner about disaster issues.
Non Govermental organisation		
▪ Bintari (Bina Karta Lestari Foundation)	Bintari is an NGO that has concern to protect environment and support sustainable development especially in solid and liquid waste and clean production, environment education, and land conservation	▪ Waste management ▪ Partnership for environment education ▪ Coastal management
University		
▪ Universitas Negeri Semarang (UNES)	Developing partnership with local government to conduct	▪ Conducting research and policy analysis on solid

	research and development on climate change related issue Providing community services Increasing education for community	waste management and environmental education
▪ Unika Sugiyapranata,	Developing partnership with local government to conduct research and development on climate change related issue Providing community services Increasing education for community	▪ Conducting research on housing and settlement issues; ▪ Promoting sustainable and environmentally friendly building design
▪ University of Diponegoro, Urban and City Planning Research Institute	Developing partnership with local government to conduct research and development on climate change related issue Providing community services Increasing education for community	▪ Conducting research and policy analysis on climate change resilience planning ▪ Conducting research on sectoral issues of climate change
Swasta/Dunia Usaha		
▪ PT Aqua Farm	▪ Conducting environmental friendly activities ▪ Conducting environment improvement programs both as part of corporate social responsibility and its interest on environmental protection	▪ Using environment friendly technology ▪ Conducting environment improvement programs both as part of corporate social responsibility and its interest on environmental protection
▪ PT. Djarum Peduli Lingkungan	▪ Conducting environment improvement programs both as part of corporate social responsibility and its interest on environmental protection	▪ Conducting environment improvement programs both as part of corporate social responsibility and its interest on environmental protection

The management of climate change sector in City of Semarang involved stakeholder both from internal and external of the city. Each stakeholder has their own roles and contribution to adapt and strengthen community to climate change. This partnership is a pre-condition to create community that has capacity to adapt to climate change. But in fact, local government of Semarang plays the major roles in climate change both for financial support and implementing program. However, the role of provincial government claims not too significant but have more roles in coordinating programs and policy from some cities. In addition, program and activities that related to climate change is going partially with limited coordination among stakeholders.

However, it is found that local NGO's also actively contribute to programs and activity to improve environmental condition of the city. The partnership between

NGO's and local government also give quiet significant contribution to the improvement of environment quality. In addition, donor agencies also play significant role to protect city of Semarang from flood and *rob* that often hit the city. This indicates that City of Semarang is among the city that has concerns to climate change issues and eager to strengthen community to adapt to climate change.

7.2 Assessment of effectiveness of current initiatives and programs (short and long term) cope with future climate risks

Longterm and Medium Term Development Planning

The planning process at local level are strongly influenced by existing national laws and regulations, it is therefore important to briefly look into the laws and regulations.

Law No. 17/2003 on State Finance regulates stages in the district-level budgeting process. It said that district budget should be based on District Annual Work Plan (RKPD).

Law No. 25/2004 on the National Development Planning System primarily provides the legal basis for the interconnected planning system which includes long-term, medium-term and annual development plans, at the national as well as at the local levels, sectoral (per department/ministry at the national level and per SKPD at the local level). The main aim of this development planning system is to ensure that all development efforts in the country are conducted efficiently, effectively and leading toward the realization of stated development targets. The law also affirms that the Government Work Plan at the national level and the Local Government Work Plan (RKPD) should respectively become the reference for the national annual budget and local budget.

Law No. 32/2005 on Local Government has the intention to integrate planning and budgeting processes into one low. This law reaffirms the various types of development plans, which include long term plan with a 20 year period, medium term with a 5-year period and the annual plan (RKPD).

The connection between Law No. 17/2003, Law 25/2004 and Law 32/2004 can be theoretically illustrated in the Figure 7.1.

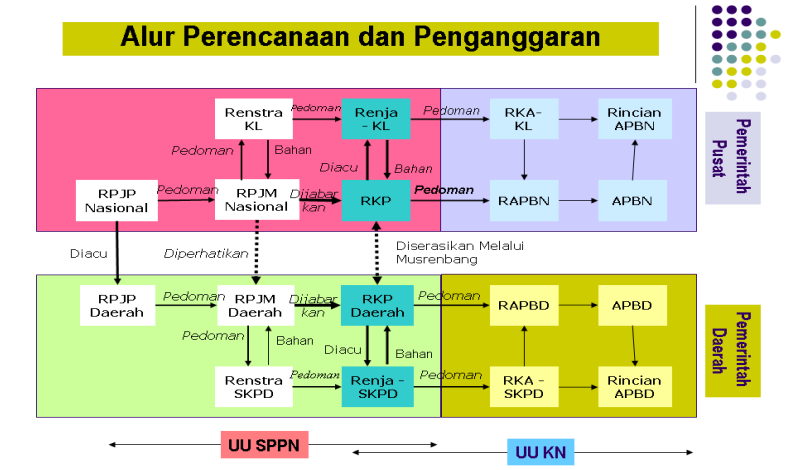


Figure 7.1:Integrated System of Planning and Budgeting at National and Regional/Local Levels

Beside those local development planning and budgeting laws, there are other laws related with spatial management and disaster management which should also to be considered in climate change adaptation planning.

Law No. 24/2007 on Disaster Management regulates steps need to be taken in disaster management including pre-disaster, emergency response and post-disaster management. The main substances of Law 24/2007 are consisting these following aspects: (i) roles and responsibilities of national and regional/local government in each disaster management stages; (ii) institutionalization at national and regional/local level in disaster management, (iii) the right of community in disaster management, (iv) the involvement of international organization and business sector, (v) controlling mechanism on disaster management, (vi) sanction mechanism.

Law No. 26/2007 on Spatial Planning provides policy and strategy to integrate the use of natural resources and man-made resources as well as to protect spatial function and negative impacts on natural environment. The implementation strategy of spatial planning consist of: (i) application of consistent zoning regulation as part of detail spatial plan, (ii) systemic spatial utilization control mechanism through zoning regulation, permit system, incentive and disincentive;, (iii) consistent law enforcement.

On the Semarang City Long Term Development Plan 2005-2025, it is stated the long term vision to achieve Semarang City as Religious Metropolitan which based on trade and services. One of the mission is to achieve and develop sustainable infrastructure and regional development. The Semarang City government put the emphasis on the importance of mitigation efforts on natural disaster which considered geological condition of Semarang City. Some initiatives could be done to develop the capacity of community in response to natural hazard such as application of early warning system and information dissemination on hazard risk. It is also needed to identify and to map the vulnerable areas of natural disaster in the city. This will provide valuable benefit to the community and protect their assets.

On the Semarang City Medium Term Development Plan 2005-2010 which has stipulated on local regulation no. 04 of year 2005, it is stated the mid-term vision which is to achieve Semarang as Religious Metropolitan City based on trade and services. This vision is quite similar with the long term vision. To achive its vision, there are at least 6 (six) missions as follows:

- To develop religious human resources through improving their belief, education, community health level especially health access to the poor and the capacity on science and technology;
- To strengthen the implementation of local autonomy and good governance through improving good quality of public services, financial self reliance, local apparatus profesionalism which supported by technology-based government infrastructure;
- To stabilize democratic political, social and cultural situations and to strengthen conducive safe and order through law enforcement, safe culture and human right;
- To improve city economic performance which integrated with economy actors based on trade and services, investment climate and strengthening local, regional and international economic cooperation;
- To provide social protection through managing the people whose problem with social welfare, street children, beggars and homeless, disaster victims, etc;
- To achieve the consisten spatial planning implementation in order to achieve optimum spatial pattern and structure supported by effective and efficient infrastructer development and sustainable natural resources.

In relation with disaster management, Semarang City Government has formulated Local Action Plan on Disaster Management 2008-2012. This document is a guidance for mitigation efforts on disaster within the next five years. The action plan consist of a set of programs and activities from all stakeholders and their responsibilities. There is also government priority and strategy to reduce natural hazard and to develop the readiness and community resilience in response to disaster risks.

Problems on Planning and Programming

Eventhough there are some documents on development planning, spatial planning and disaster management, but there are some related problems wih planning and programming facing by local government in Semarang. These problems are:

- ***Lack of integration, coordination and vision-mission in climate change management.***

Climate change management considers as new concept and not fully understand by all stakeholders at the local level. The concept of climate change management, including mitigation and adaptation, are not familiar and well understand by the stakeholders. In addition, both local governments also yet have and issued special policy or program that related to climate change for both middle term (5 year plan) and long term (20 year plan).

- ***Lack of budget allocation to support climate change***

Climate change program and activity are part of environmental planning in general. It indicates that the local government concerns on environmental issues is still low, as reflect from the minimum budget allocation for local government agency which in charge with environmental issue.

- ***Ineffective spatial planning to mitigate and adapt the impact of climate change.***

Currently, city spatial planning of Semarang is under revision to make it line with Law no. 26/2007 about spatial planning. However, the effectiveness of city spatial planning in term of mitigation and adaptation of the impact of climate change needs to increase gradually. Some problems that potentially cause the difficulty to implement spatial planning are include inconsistency the implementation of spatial planning, land use change such as areas along the river and others.

- ***No formal board or institution that formed to address local disaster.***

According to law no. 24/2007, it is a condition for the city to have Local Disaster Board. However, until now, both cities still do not have the particular board. The field survey indicate that both cities are in processing the development of the particular board and it is hoped that in early year 2010 the cities will have local disaster board.

Programs and Activities that related with Climate Change

a. Programs and activities from local budget

Climate change involves various sector and activities. The assessment of climate change program and initiatives at local level is based on sectoral data. As one of the cities that potentially face problems due to climate change, city of Semarang has been implemented several programs that indirectly related to climate change. However, generally all of the programs were created as response to address problems that the city face. It happens because the concept of climate change is not yet adopted in local government policy concept and program. But it did not mean that the programs were not reflected to local government concern on environment protection and improvement. One of the main obstacles in implementing the programs were lack of coordination among sectors which led to minimum impact of the program to environment as well as community as beneficeries.

Table 7.3: Allocation of budget in each sector for implementing Climate Change related program

Sector	% Budget Related to CI		
	2006	2007	2008
Health	20%	41%	6%
Public Work	20%	26%	37%
Housing	0%	0%	30%
Development Planning	0%	1%	20%
Environment	87%	35%	15%
Agriculture	0%	7%	22%
Forestry	0%	0%	100%
Fishery	9%	9%	49%
Spatial Planning	23%	0%	0%

In term of budget, the allocation of budget of each sectors still very low. Even worse, the amount environmental budget was decrease significantly from 87 percent in 2006 into 15 percent in 2008. Similar condition also found that overall budget, even each year budget for program that related to climate change increased but the budget was not enough to solve city problems. As seen in table 7-3 and 7-4, in last three years, local government only allocate 5-6 percent of its budget for program that related to climate change. In additon, the programs were more to address the problems rather than to adapt or mitigate climate change.

Table 7.4:Budget Percentage Related to CC in Semarang City

	2006	2007	2008
Total LG Budget (in IDR Billion)	927.3	1.127	1.325
Budget Related to CC (in IDR Billion)	48	64	72
Percentage	5%	6%	5%

It indicates that climate change issues is not yet integrated into local government priority and program. It understands because climate change issue was not clearly stated in local development planning. However, the Semarang City should give more attention to put climate change as strategic development issue in the future.

b. Central government program

Central government has also contributed to environmental improvement in Semarang. One of national related program is a National Movement of Rehabilitation of Land and Forestry. This movement was started in 2007 with the activities are as following: community forestry, city greening, bio-pore and others.

In order to reduce flood and *rob* problems, there are on going projects supported by central government and international agencies like JICA and The Netherlands government.

In cooperation with the government Netherland through *Hoogheemraadschap van Sceieland en de Krimpenerwaard* (HHSK), city of Semarang develops Banger Pilot

Polder. The project was planned in year 2000 and will be implemented in 2010. The investment value of the project is US$ 3.3 million for phase I, US$ 260.000 for phase II, US$ 960.000 for phase III, US$ 10 million, US$ 140.000 for phase IV, US$ 550 million for phase V, and US$ 620.000 for phase VI. All of the budget comes from The Netherland Government and Indonesian Government.

Then, to solve flood and *robs* problems, local government also get assistance from *Japan Bank for International Cooperation* (JBIC) about IDR 1.7 Trillion (USD 188 Million) to normalize Kali Asin, Kali Semarang and Kali Baru. It is expected that project will be completed in 2013.

In addition, some other program also implemented in the city such like PNPM Urban, NUSSP, Natural Resource Management Program and others. The city government also assisted by Central Java Province implement programs to strengthen community, especially poor people to anticipate climate change.

c. Program and activity from non-government

Private sectors and non governmental organisation also has significant role in climate change adaptation. In city of Semarang, several private sectors have actively involved to improve environment such as Aqua Farm Nusantara, PT. Djarum Peduli and other enterprises.

Similarly, non governmental organisation also contribute to the improvement of environment in the city. Bina Karya Lestari Foundation (Bintari) is among local NGO that actively involve in environment improvement. The NGO's developed cooperation with several donor agencies to support environment improvement. One of the program called Waste Decentralisation at Bukit Kencana Complex. In this project the NGO's together with Gtz-ProLH ProLH was created effective waste management system by reduce and reuse waste through community participation. In this process, community manage the waste by Takura System. This project has significantly decrease number of waste until 40% in the area. Other programs ofthe NGO's shows in Table 7.5

Table 7.5:Bintari's Programs

Program	Purpose	Partner and Source of Budget
Teacher and Community Environemtal Supervisor Program		Kitakyushu International Techno-cooperative Association (KITA), JICA, and City of Semarang
Waste Decentralised at Bukit Kencana Complex	Create effective system to reduce and reuse waste	Gtz-ProLH
Land rehabilitation	Rehabilitate land	Gtz-ProLH
Clean Coastal Program	Increase environment quality along coastal area	Dinas Kelautan dan Perikanan Kota Semarang
Environment Education for Student	Increase student understanding and awareness to environment issue.	Edcuation Agency of Central Java

Other institutions that routinely active in environmental improvement which include University of Diponegoro and Lapaas. The programs are supported by donor agencies as well as local government. The purpose of the program are mainly to improve the environment as well as strengthen community to climate change.

7.3 Assessment of Local Government Capacity and Institutional to Integrate Climate Change into Development Planning

Although, local government is the main actor in managing city-climate hazard, but the role of other stakeholders are also important. It is important also to know the capacity of local government and its institution to integrate the climate-change issue into development planning. There are at least 6 (six) aspects will be analysed including the role of stakeholder, existing laws and policies, the availability of planning document, institutional capacity, financial capacity and program implementation. This following table 7.6 is summarized the analysis result.

In terms of stakeholder involvement, there were some good examples on the stakeholder partnership on climate change related issues in Semarang (i.e mangrove plantation coordination, flood management, etc). These partnerships are also involved not only local stakeholders but also international donor agencies. It needs more coordination and integration among stakeholder activities in order to improve the benefits of activities.

Related with law and regulation, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. The problems is local government doesn't have capacity to elaborate the aspects into planning document. It needs the technical assistance and capacity building program to improve the understanding and capability of local government officers.

In 2010, the Semarang City Government will formulate a new medium term development plan for 2011-2014 as resulted from the direct election which will be taken in April 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. It needs political commitment and comprehensive understanding from the City Team to introduce the issues.

Related with institutional capacity of local government, there are some strengths related with the establishment of city team, central government and donor support on financing opportunities and some project implementation done by stakeholders. While in the weakness are mostly related with the need to have better coordination across sectors and across regions in order to reduce the ineffectiveness project implementation. It is also pointed out the need to strengthening the City Team as champion to introduce and to integrate climate-changes issue into local planning document.

Table 7.6: Assessment of Local Government and Institutional Capacity to Integrate Climate Change into Development Planning

Component	Strenghts	Weakness
The Role of Stakeholder	• There is partnership among relevant stakeholder • Any support from international donor and cooperaton agencies	• The roles and contributions of stakeholder are still partial and not yet integrated into policy
Existing laws and policies	• There is a law required the local government to formulate planning document which considering disater mitigation and adaptation and climate changes	• Lack of understanding on how to formulate operational strategy in order to elaborate the required-aspect of the law into planning document
The availability of planning document	• The next mid-term plan for 2011-2014 will be formulated and also the draft of spatial plan is on-going revision – this is an opportunity to integrate climate-change issues as well as disaster management into planning documents • There is an disaster management action plan document which already formulated and agreed by stakeholder (as an input for the new planning document)	• Lack of capacity in formulating and elaborating disaster mitigation and adaptation and climate change aspects into planning document • Disaster management action plan doesn't have legal basis to be implemented as guidance for local stakeholders
Institutional Support	• The establishment of city team to for climate change (under ACCCRN project) • The availability of donor program and activity as media for stakeholder communication	• The disaster management board is not yet established • Representativeness of people in city team is individual and ad-hoc – not really represented the institution
Budget capacity	• There is commitment to support for climate change program. • Budget-support from central government through decocentration and task-assistance • International donor support	• Limited budget allocation for climate-change related activities (5% of total budget) • Lack of coordination among agencies lead to program duplication and overlapping
Program implementation	• Program and activity has done and implementing by stakeholder	Lack of coordination accross sector and accros-region

Based on facts mentioned in previous section, there are some steps need to be taken to achieve urban climate-resilience planning as follows:

- Strengthen capacity of local government in integrating climate change into long-term development planning. Strong scientific works on climate change scenarios and climate change impacts in Semarang City will be required to assist local government in developing horizon plan of adaptation[5] to climate change. Technical assistance and capacity building program for local government officers is required to enable them in developing horizon plan of adaptation.

- Integrate climate change adaptation framework into City of Semarang planning and spatial planning document

    - ✓ Set up methodology and substance for developing and revision of City Spatial Planning RTRW) with climate change issues and impacts
    - ✓ Set up methodology and substance for Medium Term Planning (RPJMD) of City of Semarang related to climate change issues and impacts
    - ✓ Increase stakeholders (government, community and private) understanding and concern about climate change through shared learning, communication strategy and capacity building program;

- Increase community resilience on climate change through finding and developing several efforts and local wisdom through climate change adaptation pilot project

[5] Horizon plan of adaptation relates to the lifetime of decision-making associated with a particular activity – how far into the future is it planned. Thus it is the period of time over which a particular adaptation program is planned to be implemented (Jones et al., 2004).

Chapter 8 ADAPTATION ACTION PLANNING

Adaptation is a quality that enables oneself to change or to change one's surroundings in order to become better suited for survival. It is a key component of resilience, the more adaptive a person or people the more they are able to cope with changes which may happen to them. From the Community Based Vulnerability Assessment, we look at not only existing adaptations that communities and individuals have developed, but also at the potential for future adaptation in times of stress. Again this is a speculative study but one can discern a capacity for adaptation by seeking to identify those qualities and capacities people may have to adapt.

Survival in the urban world of developing countries is not for the weak. Considering that many who move there may have been born in countryside surroundings, more used to natural cycles, plentiful agricultural production and ages old activities which may require little or no schooling, moving to the city presents a wholly different set of challenges. Thus for migrants to the city life is fraught with adaptation and survival strategies, to a market economy, to constantly shifting opportunities, to unpredictable events that are out of one's immediate control. The urban poor demonstrate that they are amongst the most adept at developing adaptation strategies as they seek to consolidate themselves in an often hostile urban context that many are unfamiliar with and initially unequipped to thrive in. It is thus necessary to challenge our notions about who and what is adaptive since we are not simply discussing vulnerability, but the capacity to adapt in times of challenge. The simple existence of such large numbers of poor, finding a living, housing, building communities in often the most challenging places is testament to a high adaptive quality.

Adaptation strategies will be assessed through the optic of their capacity for resilience to climatic phenomena, but they are in no way merely limited to responding to physical risks such as flooding. Since adaptation cannot eliminate extreme weather risks I look at ways in which impacts are limited, either by responding to them, or preparing for, them adequately. We look initially at the multiplicity of different ways in which communities in each city have developed adaptation strategies, what they are and what contribution they make to increasing resilience. Then we seek to extract lessons and factors that may contribute to each of these strategies being viable and successful.

8.1 Adaptation Strategies

Below are described some of the different adaptation strategies that have been observed in the communities studied during the Community Based Vulnerability Assessment. While they all relate to adaptations to severe climate events they also relate to survival adaptations borne by the need to adapt and survive in the city. These two ideas are very much interlinked. Beneath the list an analysis is performed to gather lessons about what makes these adaptations viable, what are factors that may contribute to determining their success, as well as any constraints and opportunities. Another table also describes the ways in which such adaptations contribute to disaster response, preparedness and resilience.

- Data collection and modernization:

The neighborhood government of Tandang has developed detailed maps of the territory, roads, and community assets, as well as risk maps that locate areas and types of risk. The maps give the neighborhood government a vital resource with which to identify areas that are most vulnerable and thus prepare in the event of a climate threat with early warning systems. They also allow a more informed response to be organized in the event of a sudden disaster.

- **Reused and adaptable housing materials:** Those families who live in Sukorejo whose homes suffer from continual land movements and landslides have to repeatedly reconstruct parts of their homes that are damaged. Instead of building their homes out of cement or materials that require costly investment (but which may be vulnerable to cracking) they use recycled scrap materials. The materials come from a scrap yard nearby, mostly pieces of lumber and tin siding. This proves more adaptable to their situations as they can be incrementally improved, modified and worked with only a hammer and nails. If it breaks then parts can be replaced or used again. Importantly such materials are also inexpensive compared to the cost of cement and more permanent building materials and they are easy to transport.

- **Developing alternative access to basic services:**

In the absence of local government provision of water communities have found alternative sources, often at great expense. In the community of Tandang local residents have dug wells that are often go over 40 meters in depth, an astonishing feat. In the community of Kemijen the lack of access to PDAM water has meant that a large number of families have had to buy from private providers in the community. In doing so they are adapting to the local constraints but this is often comes at a costly price.

- **Informal social safety nets:** In some of the surveyed communities we learned that when someone passes away that that the neighbors will come together and help to support the family with the expenses (funeral rites, casket, the costs of hosting a wake and immediate needs) for a period of 30 days. This is based upon cultural beliefs but is an interesting example of community solidarity to help support the unfortunate in their time of need.

- **Savings groups:** Community savings groups (Arisans) are made up of neighbors and friends who come together weekly to collect small amounts of money. Each member will contribute the same amount of money per meeting and every session an alternating member of the group will take the whole lot. The groups are organized in relation to the capacity of different families to save, the payout also varies depending upon the amount contributed. The average group seems to be made up of 8 – 10 persons, usually women, who save between 10,000 and 20,000 Rp. per week. There are however groups who

save in increments of 50,000 to 100,000 Rp. This adaptation to lack of capital leverages the collective savings capacity of neighbors and communities and allows a degree of financial freedom for the beneficiaries to invest in larger than usual capital investments.

- **Flexible economic survival strategies:** Urban poor residents, some who have been moved away from previous employment centers during relocation programs, have developed flexible economic survival strategies. These have proven flexible to market conditions allowing those with limited education and skills to use their capacities to gain employment and income. Few are the jobs of urban poor area residents in wage paying sectors (such as government workers), those who do have such jobs mostly work in workshops and as mechanics. Most work is in the informal sector as street vendors (Kaki Lima) and parking assistants (Sukorejo). Other examples of economic survival strategies are small enterprises such as that found in Tandang where a women made shopping bags from reused twine, selling over 300 units a week. The success of small enterprise and informal employment depends upon the ability to adapt to the market and exploit opportunities.

- **Switching from fish/ shrimp farming to processing of fish/ shrimp:** In 2000 the price of shrimp declined inexplicably negatively affecting the sales made by the community of Mangunharjo in their local market. In response the community decided to process shrimp into different kinds of products, such as *krupuk* a popular Indonesian dish. By setting up a home industry and diversifying their product they have been able to survive the decline of prices for shrimp and now earn more money from processed products than just fish/ shrimp.

- **Raising community capital to leverage government support:** Joint investment projects in which the local community raises capital and the local government adds funds have successfully meant that infrastructure projects have improved neighborhood conditions over time in Tandang. One such national government program PNPM will combine government funding (30%) with locally raised capital (70%). The projects are directed towards physical improvements such as staircases, drainage, retention walls, and paving roads, thereby improving access and reducing risk of erosion and landslides. The key element of such a scheme is the community's ability to leverage government funds with their own, effectively making their own money go further. The adaptation is thus the creation of a financial partnership with government, and sustaining it over time, to incrementally improve public spaces and infrastructure in their communities.

- **Political engagement and local community organization**: Engagement of local communities with city government in a productive relationship takes leadership and willingness on behalf of both government and community members to make it work. Doing so brings citizen concerns to the fore and also allows for a better application of government services and programs in serviced communities. Converting social capital into political capital is an effective adaptation that may gain the community allies and access to projects and resources. Alternatively a lack of political engagement can lead to marginalization from much needed resources and political will necessary to secure projects.

- **Industrial waste used to create foundations:** The use of industrial waste, such as ash in sandbags, to shore up housing foundations and provide walking paths is an example of an improvised adaptation in the face of a lack of natural resources. The community members in Kemijen, who work in factories by the port and have access to industrial waste products, are able to carry them home and use them to improve the physical environment around their homes. Despite not being very durable they are free and respond to an immediate need.

8.2 Lessons Learned from the Communities

The adaptation strategies identified above offer us an insight into understanding what exactly determines viable and successful strategies. For these strategies to have been developed and implemented they must have been made possible some how, so what factors have made them possible, and why has the community chosen these ones? Although a comprehensive analysis can only realistically be made in the wake of a severe climatic event we can glean clues that allow us to identified factors which contribute to good and effective adaptation strategies. Below are some of the common qualities that seem to be present in the adaptation strategies listed above:

- **Quite simply 'they work'**: The adaptation strategies above are a very practical response to the overriding threats and realities of the populations studied. Their responses have been developed because they work for them, not because they sound like good ideas or have potential. This is a very important point to recognize, success may not necessarily be defined as having large scale impact, what is more important is that in a very practical sense these adaptations have real bearing and effect on their everyday lives.

- **They are inexpensive and work with what materials are available:** Adaptation strategies may take time to develop, so they develop by a consistent application of time and resources, and for the urban poor resources are scarce. Evolution is almost always incremental and from inexpensive, or free, materials. Such examples include the scavenged housing materials from a nearby scrap heap, or even community savings groups that collect very minimal amounts. These are what people can afford and that make sense to them.

- **Accessible in times of need:** Adaptation strategies also have to be accessible when you need them the most, in times of distress. In order to raise capital to recover from a flood a family may sell their television, motorbike or other fungible assets, rather than go through a bureaucratic process of applications that might imply lengthy paperwork. Generally in the city people want access to resources quickly and this is a very important characteristic of adaptation strategies that work, they are easily managed and accessed.

- **They don't rely upon big government projects or interventions:** In a country in which government resources are scarce and response may be lacking urban poor communities do not wait for government to save them. They save themselves. Thus they have developed reliance upon community organization and initiatives that better respond to their needs within their own means. While government intervention is appreciated and instrumental local self-reliance seems to be a key characteristic of adaptation strategies.

- **Adaptation to severe climate events must work together with other adaptation strategies:**

Those most affected by climate change may not know or care to plan for it if it doesn't benefit other aspects of their lives. Since the urban poor have a very practical outlook those adaptations that are successful for them are those that work with other strategies that they are concerned about, such as health, housing, education and livelihoods. If something can make them safer and also deliver on making them

wealthier then that is what they are likely to seek. Safety for its own sake is not a motivating factor, but when other benefits can be derived then the solution becomes workable.

- **The whole is greater than the sum of the parts:** Many of the adaptation strategies are successful because they harness the collective efforts and strengths of people. They are rarely individual efforts. There is not only a willingness to work together but an affirmation that by doing so the outcome will be better. People are concerned about each other and when this concern translates in collective action the results can be significant.

- **Leveraging government support leads to better results**: When communities are able to work together with local and city government (and vice versa) adaptation strategies seem to have been successful. For example community investments when matched or leveraged with government investments were able to make a significant and lasting impact on the neighborhood's conditions.

- **More access to information can lead to better outcomes:** Vulnerable communities have to constantly evaluate their situation, be it economic, housing or health. Adaptation strategies that can help them to have more access to information and thereby make better decisions about their situation will lead them to better outcomes. At a very simple scale the knowledge of different savings groups or different interest rates from local lenders can greatly increase their economic options and reduce their vulnerability. Urban poor communities are usually isolated and so successful adaptation strategies seem to increase access to information.

8.3 Pilot Project in Semarang as Adaptation Action Planning

Semarang are looking for pilot model to test the approach that can contribute to city resilience planning. Pilot activities test innovative and potentially replicable interventions to enhance climate resilience. During the engagement phase of this initiative that there will be significant opportunity to implement small scale projects prior to the development of multi-stakeholder city level climate change resilience action plans.

The objectives of pilot implementation are:

- To prepare for climate change impact at the city level
- To engage city level stakeholders (city government, NGOs, universities, CBOs, private sectors, community groups)
- To implement the pilot projects that test climate change resilience strategy
- To test the adaptive capacity of the community

The subject of pilot project implementation is vulnerable people who affected by climate change impact. The beneficiaries are women, children, elderly and men, both in terms of increased awareness, increase local capacity, influence local policy etc. The activities of pilot project should also meet or in line with these criteria:

1. Replicability

2. Addressing current and future risks

3. Benefit to local community

4. Innovation

5. Collaboration

6. Scalability

7. Sustainability Strategy

There are some additional criteria that should be conducted by the implementer of pilot project:

- Implementation of pilot project has to be related to the local problems at local administrative or cross border administrative communities on issues of environment, health, education, social, economy in which related to the impact of climate change.

- Implementation of pilot project directed for adaptation and response effort activities to the impact of climate change, such as: erosion, flooding, drought, landslide, and etc.

There 4 selected pilot projects of Asian Cities Climate Change Program (ACCCRN) as contributin of development goals and addressing climate change impacts in Semarang:

1 Land Arrangement Models In Sub District of Sukorejo, City of Semarang by State University of Semarang
2. Micro Finance Program: Community Based Revolving Fund for Improving Sanitation in Sub District of Kemijen, City of Semarang by Perkumpulan Perdikan (Local NGO)
3. Coastal Community Adaptation In Tapak Tugurejo As Resilience Community Coping Climate Change by BINTARI (Local NGO)
4. Adaptation to Cope Climate Change Impacts (Landslide and Cyclone) in Sub District of Tandang, City of Semarang by Centre of Planning and Public Participation

Pilot projects are necessary to help local government to better understand how climate change will impact communities and sectors, how current capacity has to be strengthened and spatial plan to be improved to form climate change-resilience city and how to use the good lesson learnt from pilots in designing long term policies and strategies to address climate change. For further explanation, see detail Table 8.1 of pilot project summary.

8.4 Adaptation and Resilience

The following table (Table 8.2) attempts to categorize how the abovementioned adaptations may be understood (i) as contributing to resilience, and (ii) by reducing the impact of climate events by facilitating disaster preparedness and disaster response. It is in this way that adaptation strategies can build resilience, by preparing in advance they can help reduce risk and/ or facilitate a response that allows them to bounce back and recover.

Constraints and opportunities to strengthen adaptive capacity: Below is detailed an analysis on what the existing factors that adaptation depends upon, what are the constraints that may exist that limits it occurring and what are the opportunities that currently exist in the studied communities that can provide a basis for further progress in building resilience.

What are the factors upon which adaptation may depend upon?

Money	Lack of access to capital may limit capacity to make investments.
Capacity levels	Lack of ability to adapt to different conditions.
Understanding	Necessary to learn about adaptations and threats and how to respond.
Access to information	Information can empower by giving tools to access knowledge and resources.
Collaboration and engagement w/ local government	Marginalization from decision-making can exclude from access to information, resources and tools necessary to adapt effectively to different conditions.
Migration and growth rates	Overburdened capacity can limit the ability to be flexible and cope with change effectively.
Public service delivery	Ability to develop can hinder or stimulate development and adaptation.
Mobility	Physical access to resources, information and tools depends upon physical access.

What are the constraints to developing adaptive strategies?

Information	Urban poor communities have less access to information so are not as informed about changes and opportunities in their environment.
Access (political, economic and physical)	Disadvantaged communities often suffer from isolation, physical, economic and political, which reduces their opportunities
Capital (both from local population and local government)	With adequate resources vulnerability can be greatly reduced and open up many possibilities for adaptation. Lack of local investment (by government and by the population) hinders the development of alternatives.
Community collaboration	Lack of community collaboration and cohesion can undermine collective processes and projects, and can diminish the voice that a community has in making claims.

Institutional + jurisdictional collaboration	An inability for local governments to coordinate their actions institutionally (between different departments) and in space (across different jurisdictions) can hinder the effective implementation of programs, projects and initiatives that could assist adaptation strategies (eg. offer quality health and water services).
Natural resources	A lack of natural resources can hinder the capacity to adapt by limiting the tools accessible to develop changes and adaptation strategies, or make it much more costly.
Dependence on outside factors that cannot be controlled	Economic futures are not determined by local dynamics and factors, they occur in different cities and far off countries. Much of the livelihoods of local population depends upon factors that are far away and out of the control of local populations.

What are opportunities present?

Existing cases that exist and work	There are many adaptations currently being used and developed within the study sites that can be shared and their benefit spread. They have already proven useful and effective.
Possible social networks of people in similar situations with know how	Pooling of collective knowledge can help to assist adaptation strategies by opening up access to social capital, information, tools and potentially political influence.
Local level neighborhood government	Many local governments are very keen to assist their populations, have skills and willingness to improve the conditions that can lead to adaptation. Good will should be harnessed and encouraged.
City and national government programs (eg. PNPM)	Existing programs and policies at the city and national levels are designed to improve conditions for local residents but they often are not articulated with local initiatives. If understood and better coordinated they can assist adaptation strategies.
Materials and know-how from industries and economic activities	Existing economic activities can serve as resources and political support. Not only are many residents currently employed giving them know-how, they also use left over resources, and gain valuable financial income from them. Politically they could be a powerful ally.
Local leadership	Local study communities demonstrated strong leadership, a quality that is essential to bring about change and ensure resilience.
Community cohesion	Communities also demonstrate high levels of collaboration and cohesion making collective projects possible.
Local civil society organizations	The existence in both cities of local civil society organizations indicates that there are human resources that can contribute to social change processes that assist communities with which to collaborate with.

8.5 Specific Ideas to Strengthen Adaptive Capacity

The strategies and projects below offer a few possible ideas as to how to strengthen adaptive capacity in Semarang. A preference has been given to know-how and experiences that are already being the practiced within the study sites. Lessons can be easily learned and transferred from such cases since (i) they are already proving

themselves as workable and (ii) they would be more easily introduced from communities and groups which come from a similar context rather than brought in from outside agents. Other ideas look to capitalize on the lessons learned and address specific issues related to vulnerability in the multiple dimensions in which it presents itself.

Invisible cities, making them visible: In the case of certain hitherto unrecognized or undocumented communities, such as the neglected and forgotten urban poor of Sukorejo, a community level census and survey would help to document exactly what needs these people may have. As yet there is little appreciation or understanding of these people's needs or conditions. Local government may not feel the need to provide them with services or enter into dialogue with them since they are not aware of the scale or nature of this need. They conveniently occupy an ambiguous invisible space. By better documenting these areas local neighborhood-level government could have a better idea about what services are necessary (how many people need access to a health center, or pupils in a classroom) and as a result could receive budget corresponding allocations.

Subsidies: Given the precarious economic situation faced by urban poor communities certain social services are simply out of reach. Government could assist by subsidizing access to these services to ensure that the urban poor can benefit from them. Subsidies for education and water would help bolster resilience and reduce vulnerability in many urban poor communities. For example in the case of RW 5 in Kemijen the community's lack of access to capital to pay for the installation fee for the city's water service (PDAM) means that they rely heavily on private water sellers, paying disproportionately high prices. A connection subsidy would help significantly lower their costs. If an education subsidy could secure the retention in school until they finish high school they could access a whole range of employment in the city and not rely exclusively on fishing related jobs.

Sharing community narratives + networks: Many urban poor communities live a very isolated existence in which they are often unaware that their realities are very similar to other urban poor communities not far away, in the same city. This denies them the opportunity to share information between themselves, learn from each other and build social networks that could build resilience. By encouraging exchange and meeting of communities could encourage the formation of social networks, sharing of information and learning. One potential benefit for example would be the socialization of different consequences of community relocation programs, sharing the different narratives and consequences of the relocation of Sukorejo and Tandang communities. Urban populations who are set to be relocated would profit by gaining knowledge useful for negotiating relocation conditions and compensation with local government or land developers. This would help to address information asymmetries and strengthen urban poor communities.

Low cost financing of incremental housing improvements: It is evident that urban poor residents can improve their own housing conditions and thereby significantly reduce their vulnerability to climate risks. Incremental, small scales changes help to gradually build more robust and resistant homes and stay within limited budgets. By making accessible financing available families can purchase materials and slowly improve their homes by themselves, not waiting to rely on government projects or the accumulation of large amounts of savings. Small improvements, such as better

roofing for example, can significantly reduce vulnerability in a place that is prone to cyclones and heavy winds.

Neighborhood Vulnerability Index: A number of communities have been identified as possessing qualities that make them highly vulnerable to climate change. Through progressive investments in projects and improvements some of these qualities can be reduced over time and thereby reduce the neighborhood's vulnerability. It would be useful to see how progress is being made over time, this would allow groups to know what strategies are working and what areas needs more targeted assistance. By compiling a database which can monitor progress in time and space the neighborhood would have a gauge of how it is doing to reduce its vulnerability, and how it may compare to other areas in this regard.

Detailed maps for local neighborhood government use: The neighborhood government (*Kelurahan*) of Tandang demonstrates a useful disaster preparedness and response measure. By keeping detailed maps at hand that identify assets, populations and categorize hazards they can better prepare for a climate related disaster, such as for example setting up early warning systems. Such maps would be also be a vital resource for disaster response: in the event of a landslide for example as they could provide an instant database of community assets from which to launch a rescue or reconstruction initiative. Access to information, in a clear and accessible format is essential to reducing vulnerability and strengthening resilience; maps and a community database can help provide this.

Alternative social safety nets: At the moment there is little in the way of a consolidated policy which serves as a social safety net disaster for those families whose homes and property damaged are extreme weather event which leaves. Local government can only provide scarce resources that are generally described as insufficient. Affected communities end up relying upon private foundations and charity, or their own survival skills. However other social safety nets could be explored which may keep in store resources in reserve. A city warehouse that could collect and hold items, or a bank account that could store donations, are possible models that put away resources in a fund for future events. A city Task Force would be charged with managing such a fund and determining its use.

Broad based coalition to deal with climate change issues: It might be thought that climate change concerns only the urban poor, but there are many more constituencies who are potentially affected with which to create large coalitions and push for government response to the issue. This is the case in Semarang where large industries and urban poor populations would form an unlikely ally as both live in the highly affected port area of the city. But articulating such broad based coalitions may garner greater visibility and political support.

Table 8.1: *Pilot project in Semarang*

Pilot Project	Author/ Institution	Climate Risk Being Address	Objectives	Expected Result	Beneficiaries
Land Arrangement Models In Sub District of Sukorejo, City of Semarang by	State University of Semarang	Based on problems of Landslide and Drought in Sub District of Sukorejo.	Provide guidance and information to the public about the role of land arrangements in minimizing the disaster Make a directive model of conservation in the form of pilot project conservation of plants, planting patterns direction and terrace Creating catchment wells, Bio pores, and greening Develop conservation model in order to minimize erosion disasters, drought, and floods.	Transfer technology of land settlement as a model of environmental management efforts Increased knowledge and awareness of the importance of environmental management, especially in conducting cultivation and land conservation to prevent and reduce flooding Efforts to establish cooperation with local governments to provide input about improvements 'greening legislation'.	Pilot project activities carried out in 2 (two) locations of prone of landslide and drought. • Pilot activities of Bio pores and catchment wells will be made at 4 (four) catchment wells and several bio pores in Sub District of Sukorejo (Wards number 6, 7, 9 and 10)

Micro Finance Program: Community Based Revolving Fund for Improving Sanitation in Sub District of Kemijen, City of Semarang	Perkumpulan Perdikan (Local NGO)	PERDIKAN will be conduct intervention to the female-headed family in the low laying coastal area that prone to the flood and tidal-flood. Other issues are bad sanitation, land subsidence, water scarcity	Micro Finance Program: the development of revolving fund model that will be improves sanitation condition, and the livelihood of poor female-headed families that will be replicable for other areas.	Planning and assessment of female-headed families; Discussion with Community Resilience Board (BKM Kemijen) and neighborhood groups. Building about concept of sanitation saving activity implementation. Regular meeting of female-headed families. Serial thematic FGD in 10 RT (neighborhood groups) Sanitation saving activity (implementation of revolving fund) for 25 female-headed families Climate Change Festival	• Direct beneficiarry is 25 (twenty five) poorest female-headed family and have no economical source to get first round of the revolved fund. • The indirect beneficiary is 500 people who lived in Kemijen Sub District for replicability.
Coastal Community Adaptation In Tapak Tugurejo As Resilience Community Coping Climate Change	BINTARI (Local NGO)	Coastal erosion	Accelerating the development process of breakwater by adopting the community technology of using used tires. Conducting community-based mangrove conservation on the critical land. Strengthening community organizations of fish ponds farmers and fishermen in Tugurejo in realizing the conservation of coastal areas.	Increasing the number of used tires installment for 120 meter length for the breakwater Planting mangrove by local nurseries as many as 20,000, with the composition of 15,000 for the existing species in Tapak Tugurejo (Rhizopora Mucronata, Rhizopora Stilosa and Avicenia Sp) and 5,000 is a new species of Rhizopora apiculata and Bruguera. Setting up stakeholder platform in the management of coastal	Community in Tugurejo rely on fishery cultivation sector in fish ponds and fisherman activities

				conservation of Semarang city consists of related governmental institution in Semarang City, Universities, Community Groups, NGOs, and Private.	
Adaptation to Cope Climate Change Impacts (Landslide and Cyclone) in Sub District of Tandang, City of Semarang	Centre of Planning and Public Participation (Local Institution)	Based on problems of landslide and Cyclone in Sub District of Tandang.	Preparing the community in adopting EWS (Early Warning System), including the formation of disaster preparedness committe in local level and Local Action Plan. Implementation the landslide disaster handling with vegetation	Forming community organization in local level that are available to be empowered in facing climate change impact (both for the moment and the future) especially for landslide and cyclone threatening. Availability Tandang Community Action Plan Document as a new innovation in facing climate change impact especially for landslide and cyclone threatening. Testing the new innovation based on community participation in facing climate change impact especially for landslide.	8 Neighborhoods Tandang Sub-district that vulnerable for landslide and cyclones threatening

Table 8.2: *Adaptation and Resilience in Semarang*

Adaptation	**How does it contribute to resilience?**	**Dimensions it impacts**	**Prepared-ness**	**Response**
Data collection and modernization	Increases capacity to understand community needs, risks and prepare for crisis. Also helps respond better to it.	- Institutional - Governance	Yes	Yes
Re-used materials for housing	Increases self sufficiency and improvisational skills	- Housing	No	Yes
Alternative access to services	Provides services such as water where they were unavailable.	- Economic	No	No
Informal social safety nets	Provides much needed resources in times of crisis when other sources are unavailable.	- Economic - Social	Yes	Yes
Savings groups	Provides access to cash and resources through collective action, builds social capital and collaboration.	- Economic - Social	Yes	Yes
Flexible strategies shrimp home industry	Demonstrates ability to be flexible in pursuing economic strategies in response to market conditions.	- Economic	Yes	No
Joint infrastructure projects (community-government)	Develops the infrastructure and integrity of neighborhoods; builds social capital and improves governance by developing relationships with local government.	- Social - Political - Physical	Yes	Yes
Political engagement	Improves community capacity to leverage their position and affect decision making to their benefit; increases capacity to organize around certain issues.	- Political	Yes	Yes

CHAPTER 9. CONCLUSION & RECOMMENDATION

Based on historical data, it was clear that climate of Semarang City has changed. The most tangible evidence can be seen from the increasing trend of mean surface temperature over the last 100 years in the city. The change in seasonal rainfall was also found in the historical data, indicating a shift in the monsoon onset and a change in the frequency of extreme rainfall. Global warming due to the increase of CO_2 concentration in the atmosphere under SRESA2 and SRESB1 scenarios will change future climate of Semarang City. Wet season (DJF) rainfall may generally decrease in the future particularly in the center of the city, while the dry season (JJA) rainfall might increase. However, further studies to refine climate change scenarios in Semarang City using regional climate models and statistical downscaling is necessary.

Impact of extreme climate event were analysed in terms of four major hazards: flood, drought, landslides, and sea level rise. In general, flooding usually occurs in locations with lower elevations in coastal areas or basins, or in places with poor drainage system. While erosion and landslides occurred in the hills/mountains that has a high slope. Floods provide the greatest impact on the residential sector, transportation, and health, agriculture, fisheries, drainage and infrastructure. Meanwhile drought affects drinking water sector, health, agriculture and fisheries. Social impacts caused by floods and drought can be seen from the social relations/kinship, labour relations, production and transaction patterns of criminality.

As flood and drought are the two common climate hazards in Semarang City, communities have developed their own way to adapt. Most communities in coastal areas raise the floor level and build a dike to adapt to flood. While in non-coastal areas, they build a dike, and temporarily moved to other locations which are not affected by flood. During drought season, adaptation measures undertaken communities in coastal areas is to buy clean water, whereas in non coastal region is to reduce the amount of water consumption. Forms of adaptation can also be seen on a living strategy.

About 77 Kelurahans (44%) have high vulnerability index. Of 77 Kelurahans, about 10 kelurahans have low adaptive capacity index and the other 67 Kelurahans have high capacity index. The impact of climate hazards that hit Kelurahans with high vulnerability index and low capacity index will be more severe than in Kelurahans with high vulnerability index and high capacity index. Kelurahan with high vulnerability index and low capacity index are Bandarhardjo, Bengetayu Kulon, Bubakan, Gunung Pati, Kudu, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo and Wonoplumbon.

Semarang City is already exposed to multiple climate hazards, i.e. flood, drought, landslides, and flood due to high tide (robs). Based on composite climate hazards index (CCHI, a function of frequency and intensity of the four hazards), Kelurahans situated in a small part of the northern part of Semarang have high CCHI. Kelurahan with the highest CCHI is *Kelurahan* Tanjung Mas, Semarang Utara Sub-district.

Information on vulnerability index, capacity index and composite hazard index should be used to determine prioritized area for climate change adaptation programs. These three indices indicate the level of risk of Kelurahan to be exposed to climate change impact. Climate Risk Index of Kelurahan with high vulnerability index, low capacity index, and high composite climate hazard index is considered as Very High, while the one with low vulnerability index, high capacity index, and low composite climate hazard is considered as Very Low. Climate Risk Index of Kelurahans at Semarang City mostly between these two categories, namely High (H), Medium to High (M-H), Medium (M), Medium to Low (M-L), Low (L) and very low (VL). Under current condition, Kelurahans with climate risk of index of between M-H include Bandaharjo, Bangetayu Kulon, Bubakan, Gunungpati, Kudu, Mangkang Kulon, Mangkang Wetan, Mangunharjo, Mangunsari, Ngadirgo, Penggaron Lor, Podorejo, Tanjungmas, Tanjungmas, Tugurejo, and Wonoplumbon. In the future, there would be two Kelurahans would move from M-H to High climate risk category, namely Mangunharjo Village at Tugu Sub-District and Mangunharjo Village at Tembalang Sub-District. While many of Kelurahans with L-M risk category would move to Medium risk category.

Climate change management (adaptation and mitigation) is considered as new concept and not fully understood by all stakeholders at the local level. No special policies or programs related to climate change for both middle term (5 year plan) and long term (20 year plan) are issued. Capacity of local government in integrating climate change into long-term development planning is still limited. This can be understood as climate change is a complex issue. Strong scientific works on climate change scenarios and climate change impacts in Semarang City will be required to assist local government in developing horizon plan of adaptation to climate change. Technical assistance and capacity building program for local government officers is also required to enable them to use science-based information for developing the horizon plan of adaptation.

A number of good conditions exist at Semarang City that can positively contribute the process of developing resilience city to climate change. In the existing laws and policies, it is clearly mentioned that the planning document should consider disaster mitigation and adaptation and climate-change issue. The Semarang City Government is also in the process of formulating a new medium term development plan for 2011-2014 as resulted from the direct election which will be taken in April 2010. This is a good opportunity to integrate the climate change aspect into the document, so that it can be legally-binding. Managing current and future climate risk needs political commitment. However, there may be some problems with planning and programming facing by local government in Semarang. These problems are lack of integration, coordination and vision-mission in climate change management, lack of budget allocation to support climate change, ineffective spatial planning to mitigate and adapt the impact of climate change and no formal board or institution that formed to address local disaster.

The City Team, a team represented by various stakeholders from government bodies, academia and NGOs, community leaders has been formed for formulating climate change programs for the Semarang City as part of Asian City Climate Change Resilience Network (ACCCRN). Government of Semarang City is also in the process of establishing Local Disaster Board. It is planned that this board will be established in early year 2010. The presence of this board is important to ensure the effective implementation of hazards and climate change programs by

various stakeholders. The role and function of this board in addressing climate change issues should be considered. The City Team should involve in the process of establishing the board.

To have resilience city to climate change, it is important to understand how people, community, and sectors response to current climate risk and how the current capacity should be developed to strengthen the capacity in managing future climate risk. Particular pilot projects are needed to get lesson learnt how climate risk can be well managed and how to use the lesson learnt to improve the climate change adaptation plan.

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