FINAL REPORT

Adaptive Behavior Assessment Based on Climate Change Event: Jakarta's Flood in 2007

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1.0 INTRODUCTION

1.1 Statement of Problem

Climate risk events cause much devastation to human life. Ironically, climate risk events are, to a large extent, brought about by human activity. The major direct impacts of human activity include drainage of coastal wetlands, deforestation and reclamation, and discharge of sewage, fertilizers, and contaminants into coastal waters. (Nichols, R.J., 2007). The climate risk event caused the people in the urban areas are most at risk of sea level rise, flooding and landslide, as well as poor water quality and shortage.

An archipelagic country, Indonesia has the fourth longest coast line in the world (UN, 2008). Being a low- to middle-income nation, Indonesia is clearly vulnerable to climate risk events, particularly to sea level rise and flooding. Figure 1 shows that among all climate risk events that happened in Indonesia in 2007, flooding occured the most. Floods in 2007 caused much devastation to Jakarta, inundating 70% of the city and causing economic losses that reached US$ 840 million (Ministry of National Development Planning, 2007).

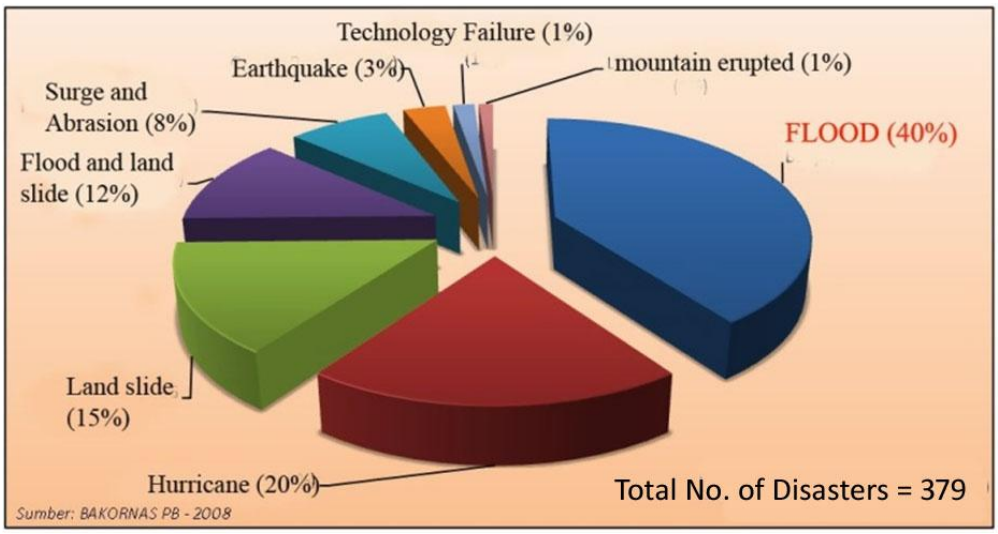

Figure 1 The Number of Disasters that Happened in Indonesia in 2007
(Source: Bakornas PB-2008)

Muara Baru, a lowland and coastal area in Jakarta, was the most severely affected area by the 2007 flood, inundating more than 4000 houses in waters that reached up to two meters high. Muara Baru was affected the most because of the lack of community capacity to adapt to climate change-related risks. This, despite the people's knowledge that coastal communities often face life-threatening risks from the increased intensity of flooding and riverbank erosion that climate change brings.

Reducing risks from climate induced events such as floods is not only a responsibility of the community itself. Also responsible are government agencies that are mandated to be at the forefront of disaster risk management and climate risk management. This study aimed to identify the adaptation actions undertaken by local communities and government agencies to deal with Jakarta flooding.

1.2 Research Objectives

The research project is aimed to:

- measure the vulnerability of Jakarta to to extreme flood event;
- determine how LGUs and community organizations have coped with floods;
- determine the adaptive capacity of households to flooding event in the study areas; and
- determine adaptation possibilities: those that have been adopted, and can be re-adopted in the future as well as the innovations in adaptation.

2.0 RESEARCH METHODS

2.1 Secondary Data Collection Method

Document research method was conducted to enrich data collection. Data was obtained from various sources such as resources from the web, journals, and research reports from educational institutions, and government agencies. This method was used to combine the information that was obtained from interviews and from literature or document research.

2.2 Questionnaire Survey

Questionnaire survey was conducted to determine the adaptation behavior of the household and communities in the project site. The survey was conducted among 197 respondents from the community. The following are some information that was obtained:

- Adaptive Capacity Indicators: Characteristics of Household, Infrastructure Indicator, Economic Indicator, Technology Indicator, Social Capital Indicator, and Skill and Knowledge Indicator
- The Impact of Extreme Flooding and Adaptation Behavior to Flooding Event
- Adaptation Option, Barriers, and Recommendations

2.3 Key Informant Interviews

We conducted 10 key informant interviews. Four of our interviewees were from national government agencies, 4 (four) persons from provincial government agencies and 2 (two) interviewees were from community organization. The questions in the interview

enabled us to get information on adaptation strategy and action in response to the flood disaster.

a ***Government Agency (National Scope):***

- National Disaster Management Agency or Badan Nasional Penanggulangan Bencana (BNPB)

  This agency implements disaster management policy and handles the refugee.

- Meteorology, Climatology, and Geophysical Agency or Badan Meteorologi, Klimatologi, dan Geofisikan (BMKG)

  BMKG carries out the government duties in meteorology, climatology, air quality, and geophysics as required by legislation. It also has the authority to evolve a national policy for meteorology, climatology, geophysics.

- Ministry of National Development Planning or Badan Perencanaan dan Pembangunan Nasional (Bappenas)

  This agency oversees the legal regulations in the planning and implementation, financing and control, foreign cooperation, and cross-sector issues. At the macro level, this agency has a special power in the policies of national development planning as a whole.

- Ministry of Marine Affairs and Fisheries or Departemen Kelautan dan Perikanan (DKP)

  Apart from handling the marine and fishery sector, DKP is also tasked to enhance the foles of these sectors so that they will be able to contribute significantly to national economic development. One of the agency's program gols is to reduce the extent of damage and violations in the utilization of marine and fishery resources.

b. Government Agency (Provincial Scope)

- The Government of Jakarta Province

  This agency has the authority to manage, coordinate, and solve problems related to all of the government business at the provincial level.

- The Government of North Jakarta Municipality

  This agency has almost similar authority with the government of Jakarta Province on handling all of the government business but narrower in scope, that is for North Jakarta only.

- Public Work Agency of Jakarta Province

  This agency has authority to conduct the development strategy and infrastructure development and see to it that infrastructure capacity, energy, and mineral resources are enhanced based on good environment.

- Environment Planning Agency of Jakarta Province

Government agency that is envisioned to create an environmentally sustainable city.

c. Community Organization

- Indonesian Red Cross or Palang Merah Indonesia (PMI)

  A national organization in Indonesia that is concerned with the social humanity sector. PMI holds fast to the seven basic principles of the Red Cross International Movement and Red Crescent Moon, including humanity, equality, volunteering, independence, unity, impartiality, and totality.

- Forum on Environment (in Jakarta) or Wahana Lingkungan Hidup Indonesia

  This is the largest community-based non-profit organization with an independent environment organization in Indonesia. Its members are people from non-government organizations (NGO), nature lovers, and self-help groups.

d. *Focus Group Discussion*

Focus group discussion has been conducted once, on 23 April 2009. It focused on adaptation options (before, during, and after the event) of selected climate change event (Jakarta's Flood). It provided a forum where government agencies, experts, NGOs, and local communities discussed issues about the flood.

2.4 Data Processing and Analysis

Data from institutional sources was processed only with qualitative descriptive analysis method while data from households was processed not only with qualitative descriptive analysis method but also quantitative analysis method. This included descriptive, one way ANOVA, and Multiple Linear Regression. Each method is explained below:

- ***Qualitative Descriptive Analysis Method***

Data from interview and FGD were collected and processed qualitatively. Qualitative analysis was applied to information on people's knowledge and attitude, and institution and social networks. Institutional and policy analysis was also used in examining adaptive behavior of institutions and other stakeholders. Assessment was conducted based on the following scale rating to answers of questions in the survey instrument:

1= No, not at all

2= To a very limited extent

3= Some activity but significant scope for improvement

4= Yes, but with some limitations in capacities and resources

5= Yes, with satisfactory, sustainable and effective measure in place

- ***Quantitative Analysis Method***

The association quantitative analysis method was used to analyze the factors which influence the adaptive capacity of households. The factors of statistics analysis method used two types of scales: nominal and interval-ratio scale. To test the correlation between nominal scale and interval-ratio scale, one way analysis of variance (ANOVA) model was used to make quantitative analysis. If both types were interval-ratio scale, linear regression model was used. SPSS 15.0 software was used to build the one way ANOVA model and the linear regression model.

1. Descriptive

To analyze data quantitatively, descriptive statistics was also used.

2. One Way ANOVA

Analysis of Variance (ANOVA) is a statistical technique for determining the existence of differences among several population means. ANOVA is not used to examine whether the means of more than two different samples significantly or not. One of computer software to analyze ANOVA model is SPSS.

3. Multiple Linear Regression Model

Multiple linear regression model is simple regression that discusses the correlation between two variables: dependent variable Y and independent variable X. The main purpose of this model is to measure correlation intensity between two variables and make both prediction and assessment of Y value upon the X value. Of the three methods in data processing using SPSS application, namely, backward elimination, forward elimination, and stepwise elimination, this study used stepwise eimination.

3.0 STUDY SITE: MUARA BARU, JAKARTA

3.1 Scope of Study Areas

Muara Baru is located in the coastal area of Jakarta whose land is less than 1 m above sea level and also passed through by river. There were two main reasons for choosing Muara Baru as the study area. The first reason was the geographical factor. The second reason was the socio-economic factor because the population in these study sites have relatively low income or receive below regional minimum wages. The last reason and the most important one is the people's lack of community awareness to keep their environment healthy and clean.

3.2 Climate and Weather Condition in Jakarta

The temperature range in North Jakarta City during the day is 23.2-36 ^{o}C. The average temperature is 27 ^{o}C and average anomaly of temperature each month ranges from 0.6 ^{o}C to 3 ^{o}C. Meanwhile, rainfall average during the year 2007 is 199.5 mm^2. Annual rainfall range is 90.3-642.3 mm^2. The rainy months are at the beginning of the year, from January to April and at the end of the year from November to December. Rainfall on

average per year is 142.54 mm, with February being the most rainy (average of 23 days for a recorded high of 642.3 mm^2 rainfall).

3.3 Causes of Tidal Flood in Jakarta in 2007

There are three causes of the 2007 tidal flood in Jakarta, first being natural (the position of the moon when it is at its closest to the earth), and the rest largely man-made. Subsidence of land in Jakarta has been caused by population pressure and the excessive pumping of underground water. The third cause is the increase in the sea level primarily due to the melting of glaciers and ice caps, which cause the sea level to rise for about 5 mm/year. The floods that hit Jakarta on February 2007 reached up to 195 cm with the tide height reaching up to 220 cm.

3.4 Damage Caused by the 2007 Flood

Flood Damage in Jakarta

The Jakarta Flood in 2007 caused almost 60% of the city to be inundated in up to five meters of flood water (see Table 1). Thousands of people in Jakarta and surrounding areas were forced to flee. The flood also caused destruction in the railways. Table.2 – 3 summarizes the damage in Jakarta due to flood disaster on February 2007.

Table 1 Data on Flood Event on 6th February 2007

District	Number of Refugees	Height of Water
Central Jakarta	90,912 persons	100 cm
East Jakarta	41,900 persons	
South Jakarta	73,500 persons	
West Jakarta	2,287 persons	60-120 cm
North Jakarta	24,158 persons	50-150 cm
Total	232,037 persons	

Source: WALHI (2007) in www.vhrmedia.net (2009)

Table 2 Cost of the 2007 Flood Damage to Jakarta

Agency	Damage Cost (US$)*
Indonesia Entrepreneur Association	US$ 105,000,000
Indonesia Nation Bank/Bank Negara Indonesia (BNI)	US$ 273,000
Electricity Nation Company/ Perusahaan Listrik Negara (PLN)	US$ 5,300,000
Indonesia Telecommunication Company/PT. Telkom Indonesia	US$ 157,000-315,000
Public Transportation	US$ 747,000
Mandala Airline	US$ 105,000

*) 1 US$ = Rp 9,500
Source : Tempo, Republika (2007) in www.vhrmedia.net (2009)

Table 3 Damage Cost of Flood on 7th February 2007

Agency	Damage Cost (US$)
Indonesia Train Company /PT Kereta Api	US$ 757,000
PT Asuransi Bintang Tbk.	US$ 4,730,000
PT Bank Mandiri Tbk	US$ 1,050,000

*) 1 US$ = Rp 9,500
Source : Tempo, Republika (2007) in www.vhrmedia.net (2009)

4.0 INSTITUTIONAL ADAPTIVE CAPACITY ASSESSMENT

4.1 Analysis of Local Government Adaptive Capacity

The government plays a very important role in determining the capacity of the country or the region to adapt to disaster. Table 4 lists all the government agencies that have contributed to flood responses in our study sites. The list includes national flood disaster-related agencies and administrative bodies from the national to the local levels.

Table 4 Agencies that Contributed to Flood Responses in the Study Sites

Agencies	Role/responsibility/assistance	
	Flood control, adaptation, and mitigation	**Relief and compensation**
Nation Disaster Management Board	√	√
Meteorology, Climatology, and Geophysical Agency	√	-
National Development Planning Board	√	-
Government of Jakarta Province	√	√
Government of North Jakarta Municipality	√	√
Public Work Division of Jakarta Province	√	√
Environment Controlling Board of Jakarta Province	√	√
Indonesia Red Cross	√	√

Source: Analysis, 2009

We have examined the institutional capacity of the key players that took part in the 2007 flood responses. Furthermore, the indicators used to assess adaptive capacity of local government units were categorized into: a) institutions and governance; b) risk assessment, monitoring and warning; c) knowledge, education and information; d) climate change adaptation; and e) underlying factors.

4.1.1 Institutions and Governance

In this section, we tried to assess how institutions and governance at the local level addressed adaptation to flood. This is reflected in terms of frameworks and structures, effectiveness of organizations in performing their tasks, programs and policies, and human and financial resources (Table 5).

Table 5 Adaptive Capacity of LGUs Based on Institution and Governance Indicators

Local Government Unit	Indicators									
	Frameworks and Structures		Effectiveness of Organization		Programs and Policies		Human Resources		Financial Resources	
	Description	Score	Description	Score	Description	Score	Description	Score	Description	Score
National Disaster Management Board	All institutions working for climate change adaptation work within the Disaster Management Law, where they have limitations in capacities and resources. Central and local governments were responsible for the implementation of disaster management.	4	Many barriers, especially due to the limited budget and human resources made organizations less effective in dealing with disasters related to climate change.	3	Play key role in planning and implementing disaster management.	4	Providing training in adaptation to CC-related event to community leaders but has limited resources	3	Adequate budget allocated to enable adaptation to CC-related event	4
Meteorolog, Climatology, and Geophysical Agency					Has responsibilitiy in evolving national policy and supporting the national development. Focus on study-related events, but could not function effectively.	3	Providing training in adaptation to CC-related event to community leader but has limited resources	3	Very limited budget allocated to adaptation to CC-related event	2
National Development Planning Board					Produces the legal regulations in the national development planning.	4	Very limited involvement to provide training in adaptation to CC- related event	2	Very limited budget allocated to adaptation to CC-related event	2
Government of Jakarta Province					Play key roles in integrating all sectors to better deal with disasters, especially floods, but could not function effectively.	3	Very limited capability to provide training in adaptation to CC-related event	2	Adequate budget allocated to enable adaptation to CC-related event	4

Public Work Division of Jakarta Province					Has the authority to conduct the development strategy and infrastructure development and has the vision to achieve enhancement of infrastructure capacity, energy, and mineral resources based on environment conception.	4	Providing training in adaptation to CC-related event to community leader	4	Adequate budget allocated to enable adaptation to CC-related event	4
Environment Controlling Board of Jakarta Province					Responsible for the transformation of Jakarta into an environmentally sustainable city but could not function effectively.	4	Provided adaptation training and cooperation with UNDP and ministry of forestry and environment	5	Adequate budget allocated to adaptation but significant scope for improvement	3
Government of North Jakarta Municipality					Play key roles in integrating all sectors to deal with disasters, especially in coastal area but could not function effectively.	3	Very limited capability to providing training in adaptation to CC related event	2	Adequate budget allocated to adaptation but significant scope for improvement	3
Indonesia Red Cross					Worked together with WWF on climate change adaptation strategies.	5	Providing adaptation seminar and cooperation with WWF.	5	Adequate budget allocated to enable adaptation to CC-related event	4
Average Score		**4**		**3**		**3.8**		**3.3**		**3.3**

Source: Analysis, 2009

Note:

1- No, not at all; 2- To a very limited extent; 3- Some activity but significant scope for improvements;

4- Yes, but with some limitations in capacity and resources; 5- Yes, with satisfactory, sustainable and effective measures in place.

Framework and Structure for Disaster Adaptation and Mitigation

The fundamental basis for disaster adaptation and mitigation in Indonesia is outlined in Law Number 24 of 2007 entitled “Disaster Management” and lowered into the Regulatory of The Head of National Disaster Management Agency Number 4 of 2008 about “Guidelines for Disaster Management Plan”. The process of disaster management planning is as follows: (1) identification and assessment of hazard; (2) introduction of vulnerabilities; (3) analysis of the possible impacts of disaster; (4) disaster management action choices; (5) Analysis of occurred impact from response mechanism to disaster; and (6) allocation of tasks and roles of the agencies

4.1.2 Risk Assessment, Monitoring, and Warning

Based on interviews of the staff of government agencies, there are different levels of adaptive capacity for each government agency in conducting risk assessment, monitoring, and warning of climate change-related event.

Table 6 Adaptive Capacity of LGUs Based on Risk Assessment, Monitoring, and Warning

Local Government Unit	Indicators					
	Climate Change Related Risk Assessment		Early Warning System		Climate Change Risk Management System	
	Description	Score	Description	Score	Description	Score
National Disaster Management Board	Involved the representative of the local community to conduct climate change related risk assessment but not in regular meeting	**3**	Provided early warning system in vulnerable area but it is not effective	**4**	Significant scope for improvement in providing risk management in risk area	**3**
Meteorology, Climatology, and Geophysical Agency	Involved the representative of the local community to conduct climate change related risk assessment but not in regular meeting	**3**	Provided early warning system in vulnerable area	**5**	Provided risk management in risk area but has limited resources	**4**
National Development Planning Board	Conducted climate change related risk assessment but to a limited extent	**2**	Provided early warning system in vulnerable area but its work is not effective	**4**	Provided risk management in risk area but to a limited extent	**4**
Government of Jakarta Province	Conducted climate change related risk assessment but to a limited extent	**2**	Provided early warning system in vulnerable area	**5**	Significant scope for improvement in providing risk management in risk area	**3**
Public Work Division of Jakarta Province	Carried out regular meetings with representative/s of the local community to conduct climate change related risk assessment	**4**	Provided early warning system in vulnerable area	**5**	Provided risk management in risk area and monitored hazard and risk	**5**
Environment Controlling Board of Jakarta Province	Conducted climate change related risk assessment but to a limited extent	**2**	No, there are no early warning systems	**1**	No, there are no management systems to regularly monitor hazard and risk	**1**
Government of North Jakarta Municipality	No, did not provide climate change related risk assessment at all	**1**	Providied early warning system in vulnerable area	**5**	Significant scope for improvement in providing risk management	**3**
Indonesia Red Cross	Carried out regular meetings with WWF on climate change adaptation strategies	**4**	No, there are no early warning systems	**1**	Significant scope for improvement in providing risk management in risk area	**3**
Average Score		**2.6**		**3.8**		**3.4**

Source: Analysis, 2009

Note:

1-No, not at all;

2- To a very limited extent;

3- Some activity but significant scope for improvements;

4- Yes, but with some limitations in capacity and resources;

5- Yes, with satisfactory, sustainable and effective measures in place.

4.1.3 Knowledge, Education, and Information System

Most of the agencies working on climate change adaptation such as Public Work Division, National Disaster Management Board, and the Meteorology, Climatology, and Geophysics Board have been disseminating knowledge, education, and information on climate change-related risk to key stakeholders and the community.

Table 7 System for Disseminating Information on Climate Change-Related Events, Information Channels, End-Users and Transmittal Time

Information Dissemination Medium	Info Channels	End-User	Transmittal Time
▪ Radio ▪ Print media (newspapers) ▪ Internet ▪ TV ▪ Documents ▪ Meeting of key stakeholder (mostly information only accessible to key stakeholder)	▪ Most of agencies working on climate change adaptation such as Public Work Division; National Disaster Management Board; Meteorology, Climatology, and Geophysics Board ▪ National and local broadcast media (TV and radio) ▪ Related website/s ▪ NGO	▪ Key stakeholders, including the village head ▪ Community organization ▪ Households	Varies from one place to another but usually takes a long time.

Source: Analysis, 2009

Table 8 Adaptive Capacity of LGU on Dissemination of Knowledge, Education, and Information

Local Government Unit	Indicators							
	Information and Management Exchange		Community Training		Public Awareness		Training Drills and Rehearsal	
	Description	Score	Description	Score	Description	Score	Description	Score
National Disaster Management Board	Information on climate change-related risk readily available to key stakeholder but with some limitation in capacity and resources	**4**	Effective community-based training for all members with some limitations in capacity and resources	**4**	There are initiatives to inform the community but with some limitations in capacity and resources	**4**	Did not conduct the training drills and rehearsal	**4**
Meteorology, Climatology, and Geophysical Agency	Information on climate change related risk readily available to key stakeholders	**5**	Effective community based training work for all members of the community	**5**	There are initiatives to inform the community but with some limitations in capacity and resources	**4**	Did not conduct the training drills and rehearsal	**1**
National Development Planning Board	Information on climate change related risk readily available but with significant scope for improvement	**3**	Has not established any community-based training.	**1**	No public education initiative to inform the community.	**1**	Did not conduct the training drills and rehearsal	**1**
Government of Jakarta Province	Information on climate change related risk readily available but with significant scope for improvement	**3**	Effective community-based training for all members with some limitations in capacity and resources	**4**	There are initiatives to inform the community but with some limitations in capacity and resources	**4**	Had training drills and evacuation rehearsal but has significant scope for improvement	**3**
Public Work Division of Jakarta Province	Information on climate change related risk readily available to key stakeholders	**5**	Effective community based training work for all members of the community	**5**	There are effective initiatives to inform the community	**5**	The training drills and evacuation rehearsals were done effectively with the local civil organization	**5**
Environment Controlling Board of Jakarta Province	Information on climate change related risk readily available but with significant scope for	**3**	Community based training work not too effective	**2**	There is very limited possibility to do public education	**2**	There is very limit ed possibility to do training drills and evacuation rehearsal	**2**

Local Government Unit	Indicators							
	Information and Management Exchange		Community Training		Public Awareness		Training Drills and Rehearsal	
	Description	Score	Description	Score	Description	Score	Description	Score
	improvement							
Government of North Jakarta Municipality	Information on climate change related risk readily available but to a very limited extent	**2**	Not established any community based training.	**1**	There are public education initiatives to inform the community but with significant scope for improvements	**3**	Did not conduct the training drills and rehearsal	**1**
Indonesia Red Cross	Information on climate change related risk readily available to key stakeholders	**5**	Effective community-based training work for all members of the community	**5**	There are public education initiatives to inform the community but with some limitations in capacity and resources	**4**	Did not conduct the training drills and rehearsal	**4**
Average Score		**3.8**		**3.4**		**3.4**		**2.6**

Source: Analysis, 2009

Note:

1- No, not at all; 2- To a very limited extent; 3- Some activity but significant scope for improvements;

4- Yes, but with some limitations in capacity and resources; 5- Yes, with satisfactory, sustainable and effective measures in place.

4.1.4 Climate Change Adaptation

Availability of technology or infrastructure is necessary to support work on climate change adaptation. However, not all agencies have the necessary technology and infrastructure facilities to enhance adaptation to climate change-related risk. Table 9 shows the structural and technological adaptation done by the Public Work Division.

Table 9 Adaptive Capacity of LGU Based on Structural, Behavioral, Technological, and Financial Factors

Indicators	Adaptation	Advantages
Structural	Building the East Flood Canal	- Controlling the headwaters flow - Managing the water flows to the city - Building water conservation to refill the artesian
	Building more polders	Reducing water flows to the city
	Constructing dam along the coastline in North Jakarta (Pasar Ikan, Marunda and Kepulauan Seribu)	Reducing water flows from sea level rise
	Developing the green area for water infiltration (Is this perhaps filtration? Or maybe intrusion?)area	Reducing water flows to the city
	Developing the integrated coastal plan	Improve the function of coastal area as downstream area
	Maintaining flood control pumps and channels	Reducing water flows to the city
	Maintaining the West Flood Canal	Upgrading the water system in west Jakarta.
	Normalizing rivers and channels	Upgrading the capacity of rivers and channels to intercept flood water
	Planning and developing lakes as water reservoir	- Reducing water flows to the city - Building water conservation to refill the artesian
	Revising the Master Plan for Flood Control	Upgrading the plan of flood control by incorporating the climate change factor.
Behavioral	Develop disaster risk management for flood and drought events	Reducing the damage due to disaster
	Increase the maintenance for water infrastructure to support food security	Maintaning food supply during climate change
	Step up water conservation campaign	Increase the people's participation in adapting to water scarcity
	Reforestation by planting mangrove along the rivers in Jakarta	Reduce flood from overflowing river
Technological	Biopori well	- Adaptation to water scarcity - Accelerate the absorption of water/flood into the ground
	Early warning system development program	Increase local adaptive capacity
Financial	Allocation for reforestation along east flood canal	Will support adaptation action
	Department of Fishery and Ocean allocated financial resource for changing climate adaptation action	Will support adaptation action

Source: Analysis, 2009

4.1.5 Underlying Factors

The LGUs' concern to reduce climate change risks may be expressed through other local initiatives such as protection of environment and natural resources, socio-economic measures to improve resilience of the community, and public-private partnership.

4.2 Analysis of Community Organization's Adaptive Capacity

The adaptive capacity of local community organization to respond to flood disaster was assessed by considering six aspects: human resources, economic and financial resources, institution and network, knowledge and skill, technology, and infrastructure.

4.2.1 Human Resources

As the only organization of fishermen in Indonesia, all Indonesian Fishermen Association or *Himpunan Nelayan Seluruh Indonesia* (HNSI) has a clear structure in the allocation of human resources from the central to the local levels.

4.2.2 Economic and Financial Resources

HNSI has three main finance sources - membership fees, donations, and partnership. As organizations that work together on an ongoing basis with the government, most of its financial resources come from various forms of partnership with government agencies, especially with the Marine Affairs and Fisheries Board. Table 10 summarizes the economic/financial resource indicator of the community organization.

Table 10 Economic and Financial Resource Indicator of Community Organization

Financial sources	Membership fees, donations, and partnership
Set financial resources for disaster	Yes, providing financial resources
If Yes, activities for adaptation budget	For infrastructure development, community assistance, and advocacy.

Source: Analysis, 2009

4.2.3 Institution and Network

Structurally, HNSI exists independently from the government although the Ministry of Marine Affairs and Fisheries has been its close partner and has therefore gained an important role in the field of marine and fisheries cooperation.

Table 11 Institution and Network Indicator of Community Organization

Indicator	Explanation
Organize meeting each year	-Weekly meeting for Internal Staff -Monthly meeting for Accountability Report -Monthly meeting for local council meeting -Yearly meeting for evaluation -Monthly meeting with local governments
Members contribute in case of emergency	Yes, in terms of personal time, financial support, and information.
Clear structural membership	Yes, from the central to the local level
The leaders have memberships in other network organization	Yes
Participate in decision making, planning and program activities on CCA with LGU	Yes
Get any support from other organization when responding to CC event	Yes
Kinds of support	Assistance and advocacy support
Who gives support	Governments and other related institutions

Source: Analysis, 2009

4.2.4 Knowledge and Skills

The knowledge and skill indicator shows that this organization has adequate adaptation capacity. But, as mentioned earlier, most members of HNSI have low levels of education and therefore have a relatively minimal knowledge of adaptation. Thus, adaptive capacity has not been fully tapped yet.

4.2.5 Technology

Technology indicator is determined by how the organization gets and disseminates information, the communication equipment they have access to and use, the time it takes them to disseminate information, and the type of transportation they use. Table 12 shows the technology indicators of the community organization.

Table 12 Technology Indicator of Community Organization

Indicator	Explanation
Get information on oncoming climate change events from	– Broadcast Meteorology, Climatology, and Geophysics Board – Broadcast Marine Affairs and Fisheries Board
Spread information about the forthcoming event by	Meeting
Communication equipment owned by organization	Land phone, fax machine, website.
Time to disseminate information to the member	Varies from one place to another

Source: Analysis, 2009

4.2.6 Infrastructure

The specific infrastructure that increases the capacity of organization to reduce disaster risks from climate change events is an evacuation centre. Evacuation center is important in vulnerable areas like Muara Baru to keep the community and their valuables safe from floods.

4.3 Adaptation Strategies By the LGUs and Community Organization in Response to Floods in Muara Baru

The central and local governments and the community have been implementing adaptation strategies to help soften the impact of floods and their accompanying hazards.

1. Department of Public Works and Local Government of Jakarta

The Department of Public Works and Local Government of Jakarta has been imnplementing structural adaptation by constructing a sea dyke to reduce disaster risk due to climate change event in North Jakarta.

2. Department of Marine Affairs and Fisheries

The Department of Marine Affairs and Fisheries has been implementing a participatory program with a local community to improve adaptation to flooding disaster in the region.

3. Community Organization

The community organization, with the help of the community, also works collectively to improve areas to to reduce vulnerability to flooding. These are: (1) raising the road elevation from the Fishing Port "Samudra Nizam Zachman" gate to Marliana intersection ±700 m and (2) cleaning the drainage heading to Pluit Reservoir.

5.0 HOUSEHOLD ADAPTIVE CAPACITY ASSESSMENT

5.1 Analysis of the Household Vulnerability during the Flood

5.1.1 Analysis of the household vulnerability indicators

Vulnerability is the degree of damage or harm to a system caused by climatic change. It is not only determined by the sensitivity of the system to climatic change, but it is also related on ability to adapt to the new climatic conditions (IPCC, 1996). Table 13 shows the household damage based on data from a primary survey of Muara Baru community. Each item will be explained in the context of correlation with vulnerability.

Table 13 The Household Damage

Item		Affected household	Ave.damage (US $)	Max (US $)	Sum (US $)	Sum All
Household Property	House	55.1%	185.57	7368	35258	61442
	Appliance	38.5%	93.88	5263	17873	
	Vehicle	13.3%	41.11	3158	7811	
	Amenities	5.1%	2.35	211	447	
	Others	3.1%	028	53	53	
Household Production	Crop and Aquaculture	0%	0	0	0	495
	Livestock and Poultry	0%	0	0	0	
	Aquaculture Farm	0%	0	0	0	
	Fishing	0%	0	0	0	
	Household Business	3.6%	0.94	126	179	
	Others	3.1%	1.66	316	316	
Forgone Income	Income/Wages	41.5%	65.32	4398	4398	7030
	Business	17.9%	30.47	2632	2632	
	Others	0%	0	0	0	
Lives and Safety	Dead	0%	0	0	0	2067
	Injured	5.1%	10..15	1579	1928	
	Diseases	7.7%	0.62	53	118	
	Others	3.1%	0.11	21	21	

Houses sustained the most serious property damage

In Muara Baru settlement, most (47.69%) of the houses are of permanent materials , while the rest (42.63%) are of semi-permanent materials, thus the reason for heavy damage to residential property caused by flood.

Appliance and vehicle damage

The survey indicated that the reasons why the appliances have more serious damage are: there are some appliances that are so difficult to be quickly moved to higher places; only half of the households have a higher or safer place to put the appliance in (for example: a second story) that could be easily reached; and some electric appliance are very sensitive to water and could not be repaired after the flood. Many vehicles were submerged by the flood.

5.1.2 Analysis of the Factors Influencing Household Vulnerability

The extent of vulnerability shows the ability by which a household is able to adapt to flood-related events.

A Analysis of factors influencing household vulnerability using descriptive variables

The population structure of the household

- The total number of household members could be said to be directly proportional to household vulnerability. Larger family members would be more difficult to household

evacuate from flood than smaller one. Moreover, the larger family members will also possibly increase the total lost of household.

- The proportion of labor in the household also has a correlation with household vulnerability. That means more labor would make the households have more labor supports to adaptive flood before it comes. The proportion of the labor in the total member of a household is also reflects the age structure of the household's members because which the labors usually about 15-60 years old who will easier prevent the damage and make evacuate action.

The household's economic structure:

- The proportion of the non-farming income in the total income of a family presented the household income structure. The non-farming income is an income from business which usually in small scale to support family incomes. The most greatly impact from the flood event is a non-farming income which can be loss about 50% from the normal income.

The type of house structure:

- The type of house structure is also a vulnerability factor. It has an inverse correlation with household vulnerability.

The household's social capital:

- Whether a member of the family joined a community organization presented the social ability. The assumption is if there's somebody take part in the organizations of community, the household would have more social abilities and network for flood adaptation. In general, it has an inverse correlation with the household vulnerability.

The household's skill and knowledge:

- If the household had access to training about disaster preparedness in the last five years presented the convenience of the information access. In general, it has inverse correlation with the vulnerability. By being trained, they would have much knowledge better about what should do to protect their properties and prevent the damage.

Others:

- The time for receiving early warning information before flood for households presented the convenience of the information access. Earlier warning information would make households have more enough time for flood adaptation and will have a better preparation to confront the flood event. This would lead to less losses and low vulnerability.
- Time for household to recover has inverse correlation with the household vulnerability. If the household could recover sooner, it means they could decrease vulnerability.

B. Analysis of the factors influencing household vulnerability using one-way analysis of variance

To analyze the adaptive capacity of households to the flood disaster, we surveyed 190 household samples. We have eliminated outlier data to ensure the exactness of the quantitative analysis. The estimated results of the one way anova model is as follows:

Table 14 The estimated results of the one way anova model

Nominal scale	Interval-ratio scale (total loss of household)	
	Mean	Significant value
Degree of permanence of houses		0.002
▪ Permanent (e.g. all walls are made of brick or strong wood)	258.50	
▪ Semi permanent (e.g. part of wall is brick, & other is wood)	308.18	
Membership in a community organization		0.000
▪ No	65.80	
▪ Women	81.60	
▪ Youth	303.25	
Training in disaster preparedness in the last 5 years		0.558
▪ No	287.73	
▪ I got trained in disaster preparedness	384.49	
▪ I learned from television/radio/newspaper	426.30	
▪ I learned from relatives/friends/neighbors, my own experiences	447.38	
▪ Others	526.30	

(Source: One Way Anova Model on SPSS 15.0, 2009)

ι) The degree of permanence of the house structure is significantly related to the total loss that represented the vulnerability.

ιι) Membership in a community organization is significantly related to the total loss of households at 5% level.

ιιι) *Whether the households ever got trained on disaster preparedness in the last five years* has no significant effect on the total loss of households.

5.2 Analysis of the Adaptive Capacity of Households

5.2.1 Analysis of the Adaptive Capacity Indicators

Analysis of the adaptive capacity of households to climate change-related events require a look into five indicators: characteristics of households, infrastructure, economic, technology, social capital, and skill and knowledge indicator.

A. Characteristics of Household

To assess the level of adaptive capacity of local communities, we interviewed 190 respondents. The survey respondents were mostly women (65.3%) of whom more than half (54.2%) were housewives. A little over a third (35.3%) of the respondents were heads of households and the rest were the other members of the family (i.e., son, daughter, grandchildren). The age of most respondents was between 25-44 years (Table 15).

Table 15 Gender, Relationship to Head of Household, and Age of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender of Respondents	Male	66	34.7	34.7	34.7
	Female	124	65.3	65.3	100.0
	Total	190	100.0	100.0	
Relationship to HH	Head of household	67	35.3	35.3	35.3
	Spouse	103	54.2	54.2	89.5
	Son/daughter/ Grandchild	14	7.4	7.4	96.8
	Parent	4	2.1	2.1	98.9
	Other	2	1.1	1.1	100.0
	Total	190	100.0	100.0	
Age of Respondents	15-24	17	8.9	8.9	8.9
	25-34	66	34.7	34.7	43.7
	35-44	62	32.6	32.6	76.3
	45-54	31	16.3	16.3	92.6
	55-64	13	6.8	6.8	99.5
	>65	1	.5	.5	100.0
	Total	190	100.0	100.0	

(Source : Analysis, 2009)

Table 16 shows that the level of education in Muara Baru is low. Many of the respondents (42.6%) finished a 6-year formal education which means that they only reached the primary level of schooling. Only a few (4.7%) of the respondents completed bachelors degrees.

Table 16 Years of Schooling

	Years of schooling	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	3.2	3.2	3.2
	2	1	.5	.5	3.7
	3	3	1.6	1.6	5.3
	4	1	.5	.5	5.9
	5	3	1.6	1.6	7.4
	6	81	42.6	43.1	50.5
	7	1	.5	.5	51.1
	8	2	1.1	1.1	52.1
	9	33	17.4	17.6	69.7
	12	42	22.1	22.3	92.0
	13	1	.5	.5	92.6
	14	1	.5	.5	93.1
	15	9	4.7	4.8	97.9
	17	1	.5	.5	98.4
	18	3	1.6	1.6	100.0
	Total	188	98.9	100.0	
Missing	System	2	1.1		
Total		190	100.0		

(Source: Analysis, 2009)

About 70% of the respondents had been living in Muara Baru for more than nine years. Most of the population are immigrants who have preferred to settle and live in Jakarta. Houses in Muara Baru, mostly of about 9 m^2, 16 m^2, and 36 m^2 floor area, are very densely built together and can only be accessed through one meter-wide foot paths. Despite their small size, these residential structures are often tightly packed with residents more than they can actually comfortably house.

B. Infrastructure Indicator

In general, Muara Baru has poor infrastructure. Most house types are semi-permanent. About one fourth (26.84%) rent their house while the rest own them. Many of them (47.69%) have permanent houses but also a good number (42.63%) live in semi-permanent structures that do not have access roads and utilities such as water and electricity.

C. Economic Indicator

Table 17 shows that most of respondents (71.6%) owned the land in which they live. These lands have an area of 21-40 m^2.

Table 17 Land And Properties Of Respondents

No	Land type/ property type	Ownership (%)		
		Owned	Rented	Other
	Land holding			
1	Residential land, including garden	71,6%	26,8%	1,6%
	Cultivation/Farm land	0	0	0
	- In which : With irrigation system			
2	Without irrigation system			
3	Forest land	0	0	0
4	Aquaculture	0	0	0
5	Others	0	0	0
	Property			
6	Vehicle/car	4,2%	0,5%	0
7	Motorbike	51,9%	0	0
8	Boat	0%	0	0
9	Others	0	0	0

(Source : Analysis, 2009)

Many of the households in Muara Baru have their own motorbikes (48.42%) and only a few own a car (4.7%).

Table 18 Ownership of Vehicles

No	**Vehicle**	**Percentage of HH that Own Vehicle/s**			
		0 unit	**1 unit**	**2 units**	**3 units**
1	Car	95.26%	4.74%	0%	0%
2	Motorbike	48.42%	48.95%	2,11%	0.53%

(Source: Analysis, 2009)

D. Technology Indicator

The people in Muara Baru have already adapted to living in a flood-prone area since the place is hit by flood almost every year. Only a few of them need to evacuate to safer places during floods because most had already built two-storey houses to cope with the frequent flooding.

E. Social Capital Indicator

Generally, the people in Muara Baru cope with floods through mutual help. Only a few respondents turned for help outside the household. Some approached their relatives (13.76%) and a lesser number of respondents turned to a government agency (9.47%). Most of the respondents (53.71%) said that they could not find anyone who could help them. Majority of the respondents (93.68%) were not members of community organizations. Of the few (5.2%) who were members of community organizations, most (83.3%) were actively involved in organization activities.

F. Skill and Knowledge Indicator

Workshops and training sessions attended by the respondents covered topics on enhancing community awareness of hazards and risks, understanding the nature of natural disasters, how to prevent or reduce losses and damage due to natural disasters, how to respond when natural disaster strikes, and what to do after the disaster strikes (e.g. first aid treatment, search and rescue, epidemic control, etc). Almost all respondents said that there was no traditional knowledge on disaster management that was useful in dealing with natural disasters (Table 19).

Table 19 Traditional Knowledge

No	Traditional Knowledge on Disaster Management	Number of Household Head using and not
1	No, I do not have traditional knowledge on disaster management	159
2	Evacuate to higher places	3
3	Yes, move things to higher places	2
4	Yes, take note of the full moon as a sign of high tide	20
5	Yes, keep the environment healthy and clean	2
6	Yes, make a simple boat	2
7	Yes, prepare a small dyke in front of the house	2
Total		190

(Source : Analysis, 2009)

5.2.2 Analysis of Factors That Influence Adaptive Capacity of Households

Adaptive capacity of households is assessed through the recovery time of households from the flood. Recovery time varies from household to household depending on how equipped they are for floods and the attendant risks.

A. Hypothesis

Our research team made the hypothesis that the factors which influenced adaptive capacity are:

i Characteristics of households: age, years of schooling finished, number of years of local living, and total number of household members;

ii The infrastructure of households: degree of permanence of the house structure;

iii Economics of households: area of residential land;

iv Technology of households: distance between houses and municipality hall;

v Social capital of households: whether they get help from outside during flood events; membership in any community organizations;

vi Knowledge and skill of households: whether they have ever trained in disaster

preparedness in the last five years, time that it takes them to take action to cope with a climate change-related event; and

vii Total loss of household due to floods.

B. Models Settings

To analyze the adaptive capacity of households to flood disaster, we surveyed 190 households. We have eliminated outlier data to ensure a precise quantitative analysis. The valid samples are 161 households. We used association statistical analysis method to analyze the factors which influence the adaptive capacity of households.

The factors were divided into two types of scale. First is nominal scale and second is interval-ratio scale. To test the correlation between nominal scale and interval-ratio scale, we used one way anova model to conduct quantitative analysis. If both types were interval-ratio scale, we used linear regression model. The linear regression model is as follows:

$$Y = a + bx_1 + cx_2 + dx_3 + ex_4 + fx_5 + \varepsilon$$

Y represented the adaptive capacity of households, using the recovery time of households from flood to express the variable; x_1 represented the characteristics of the households such as age, years of schooling finished, number of years local living, and total number of household members; x_2 represented the economics of households including area of residential land; x_3 represented the technology of households including distance between houses and municipal hall; x_4 represented the knowledge and skills of households including time that it takes them to act in order to cope with the event; and x_5 represented total household loss as caused by the flood. ε represented random error item; a, b, c, d, e, and f represented the parameters to be estimated and the constant.

C. Model Estimation and Analysis

We used SPSS 15.0 software to build the one way anova model and the linear regression model. The estimated results of the one way anova model are shown in Table 20:

Table 20 The estimated results of the one Way Anova Model

Nominal scale	Interval-ratio scale (recovery time of households from Flood)	
	Mean	Significant value
Degree of permanence of the houses		0.060
Permanent	2.145	
Semi permanent	2.829	
Not permanent	3.375	
Whether they get help from outside		0.598
Help from my friends	2.000	
Help from government agency	2.417	
Help from my relatives	2.507	
No one	2.628	
Other	3.409	
Whether they have been members of any community organizations		0.000
No	2.404	
Women	8.000	
Youths	*1.750	
Other	4.833	
Wheter they have ever completed training on disaster preparedness in the last 5 years		0.103
No	2.354	
Learned from television/radio/ newspaper	2.417	
Got trained in disaster preparedness class/training	2.787	
Learned from relatives/friends/neighbors	5.343	
Others	5.500	

(Source: Output of One Way Anova Model on SPSS 15.0, 2009)

i There is no significant difference between a household sheltered in a permanent structure and that which is sheltered in a semi-permanent or temporary structure in the amount of time that it takes them to recover from a climate change-related event and in the case of Muara Baru, from floods. The average recovery time of households has no significant bearing on the type of house where they live.

ii Social capital of the households has no significant effect on their recovery time from floods. Whether or not they get help from outside will not shorten the Muara Baru households' recovery time.

iii Membership in community organizations by the households of Muara Baru has a significant effect on their recovery time from floods.

iv Whether the households have ever trained or not on disaster preparedness and recovery in the last five years has no significant effect on the recovery time of households from flood events.

v The estimated results of the linear regression model is as follows (Table 21):

Table 21 The estimated results of the Linear Regression Model

Independent variables	**Dependent variable (recovery time of households from flood)**	
	Constanta	**Correlations value**
Age of households	-	0.061
Years of schooling finished	-	0.070
Number of years local living	-	-0.056
Total number of household members	0.197	0.182
Area of residential land	-	0.050
Distance between houses and municipality hall	-	-0.068
Time to take action to cope with the event	0.051	0.121
Total loss of households caused by flood	0.001	0.438
Constanta (a)		1.287
Valid samples		161
Adjusted R^2		0.224
Significant value		0.000
Durbin watson		1.845
Eigenvalue		2.586
Condition index		1.000

(Source: Output Of One Way Anova Model On SPSS 15.0, 2009)

ii Characteristics of households including age, years of schooling finished, and the number of years of local living did not have significant effect on the recovery time of households from flood events. The correlation value of each variable was too low to conclude that these variables influence the recovery time of households.

ii The characteristics of households including the total number of household members significantly affected the recovery time of households at 5% level. An increment of one member to the total number of household members affected the recovery time by 0.197 days (5 hours).

iii The economic situation of households including area of residential land had no significant effect on the recovery time of households from a flood event. The correlation value of this variable is only 0.050, too low to conclude that it influences the recovery time of households.

iv The technology use of households, including the distance between houses and municipality hall, had no significant effect on the recovery time of households after a flood event. This variable only had a -0.068 correlations value. This shows that the distance from the houses and the municipality hall does not reduce the recovery time of households from flood events.

v The knowledge and skills of households including the time that it took members to take some action to cope with the flood event was significant with the recovery time of households at 5% level. Other factors being equal, if the time that it takes them to act in order to cope with the event increased by one hour, then the recovery time of households will increase by 0.051 days (1 hour 13 minutes). Longer time to cope with the event means longer time to recover from it.

vi. Total loss borne by the households because of the flood significantly affects the recovery time of households at 5% level. Other factors being equal, if the total loss sustained by the households increases by 1 US$, the recovery time of the households will increase by 0.001 days (2 minutes). Obviously, households need longer time to recover from flood events as their total loss increases.

5.3 Analysis of the Community and Household Adaptation Behavior

The frequency of flooding events in Muara Baru area has made the people adapt to the condition. However, adaptation strategies of households are not yet strong enough to deal with flooding and as a result, they do not have a culture of disaster resilience.

Receipt of Early Warning Information/Advisory

Only a small number of households (35%) received warning information while 65 % of the households did not. According to the households included in the study, the average time that they received the warning was about 4.3 days before the event came and the longest time that they received the information is 30 days before the event happened.

External Assistance

Most of the respondents received assistance from their own neighbors and NGOs. Only a few (3.6%) said that local government helped them and 9% said they got assistance from neighbors. Records indicated that there was no direct assistance from the national government because this type of disaster was not categorized as a national disaster.

Table 22 The number of households that received assistance before the event

No	Type of Assistance	Source Of Assistance				
		National	Local Government	Relatives/Friends	Neighbor	NGO
1	Labor Support	0	0	0	5,30%	5,30%
2	Financial Support	0	0	0	1,10%	1,10%
3	Construction Materials	0	0,50%	0	0	0
4	Emergency Response Equipment	0	2,60%	0	0,50%	1,60%
5	Basic Necessities	0	0,50%	0	2,10%	1,10%
6	Production Support	0	0	0	0	0
7	Other	0	0	0	0	0
Total		0	3,60%	0	9,00%	9,10%

(Source: Analysis, 2009)

From the Table 23 and 24 below, it can be seen that both during and after the event, the households received assistance mostly from NGOs (11.6%). Some of them received assistance from their neighbors (6.9%) and from local government (7.3%).

Table 23 The number of households that received assistance during the flood event

No	Type of Assistance	Source Of Assistance				
		National	Local Government	Relatives/ Friends	Neighbor	NGO
1	Labor Support	0	0	0	0	0
2	Financial Support	0	0	0	3,20%	3,20%
3	Construction Materials	0	0	0	3,20%	2,60%
4	Emergency Response Equipments	0	0	0	0,50%	1,10%
5	Basic Necessities	1,05%	0,50%	0	0,00%	4,70%
6	Production Support	0	6,80%	0	0	0
7	Others	0	0	0	0	0
Total		1,05%	7,30%	0	6,90%	11,60%

(Source: Analysis, 2009)

The households received more assistance after than during and before the event. Most of the assistance they received was from the NGOs (29.9%) and local government (24.30%).

Table 24 The number of households that received assistance after the event

No	Type of Assistance	Source Of Assistance				
		National	Local Government	Relatives/Friends	Neighbor	NGO
1	Labor Support	2,16%	0,50%	0	3,20%	0
2	Financial Support	0	0,50%	0	0	0,50%
3	Construction Materials	0	0,60%	0		0,50%
4	Emergency Response Equipments	2,10%	11,60%	1,10%	5,30%	10,00 %
5	Basic Necessities	3,20%	11,10%	2,10%	4,70%	18,90 %
6	Production Support	0		0	0	0
7	Other	0		0	0	0
Total		7,46%	24,30%	3,20%	13,20%	29,90 %

(Source: Analysis, 2009)

On the question of the kind of assistance that the households needed most, many respondents said that they needed financial assistance (46.32%) and that they needed to build stronger house structures (34.7%).

5.3.1 Analysis of the adaptation behavior households have taken and their effectiveness

Adaptation behavior and options were measured from three reference points, the adaptation options that households took before, during, and after the event.

A. Adaptation Behavior Before The Event

Table 25 shows that before the event, some of the respondents (19.47%) decided to improve their houses and reinforce the parts of their houses that are vulnerable. Analysis of their actions by comparing each item in Table 26, their actions have been effective up to 12.11% of effectiveness value, even though only 4.21 % of them said that their action was quite effective.

Table 25 Adaptation option that household adopted before the event

No	Adaptation Option	The Number of HH According to Reason for Choice af Adaptation Option (%)						% of Total HH Adopted
		It Is cheap	Recom-mended by neighbor/ experts	Govern-ment-recom-mended	Everyoneis doing it	Our Ancestors have been doing it	Other reason	
1	Reinforce and repair house and vulnerable parts	2,63%	5,26%	0,00%	9,47%	0,00%	2,11%	19,47%
2	Build mezzanine	1,58%	2,11%	0,00%	4,21%	0,00%	0,00%	7,89%
3	Reinforce breeding facilities, ponds and dykes	0,00%	0,00%	0,00%	1,05%	0,00%	1,05%	2,11%
4	Prepare evacuation means	0,00%	1,05%	1,05%	0,00%	0,00%	0,00%	2,11%
5	Plant trees along the river, around garden	0,00%	0,53%	0,00%	0,53%	0,00%	0,53%	1,58%
6	Cut, trim trees near the house	0,00%	0,53%	0,00%	0,00%	0,00%	0,00%	0.53%
7	Move family members to safe place	1,58%	3,16%	0,00%	4,21%	1,05%	1,05%	11,05%
8	Move livestock, and household items to safe place	2,11%	2,63%	0,00%	8,42%	0,00%	1,05%	14,21%
9	Update regularly warning information	0,00%	0,00%	1,05%	1,05%	0,00%	1,05%	4,21%
10	Contribute cash or material items to a local fund for anti-disaster activities of local communities	0,00%	0,00%	0,00%	0,53%	0,00%	0,00%	0,53%
11	Buy and store foods, drinking water and other necessities	0,53%	0%	0,53%	2,11%	0,53%	1,58%	5,26%
12	Others	1,05%	0,53%	0,00%	3,68%	0,00%	1,58%	6,84%

(Source: Analysis, 2009)

Table 26 Effectiveness of adaptation before the event

No	Adaptation Option	The Number of HH According to Reason for Choice of Adaptation Option (%)				% of Total HH Adopted
		Not effective at all	Fairly effective	Effective	Very Effective	
1	Reinforce and repair house and vulnerable parts (e.g. window, wall)	0,00%	4,21%	12,11%	3,16%	19,47%
2	Build mezzanine	0,00%	1,58%	5,79%	1,05%	7,89%
3	Reinforce breeding facilities, pond and dykes	0,00%	0,00%	1,05%	1,05%	1,05%
4	Prepare evacuation means	0,00%	1,05%	1,05%	0,00%	2,11%
5	Plant trees along the river, around garden to protect against wind and prevent soil erosion	0,00%	0,53%	1,05%	0,00%	1,58%
6	Cut, trim trees near the house	0,00%	0,00%	0,53%	0,00%	0,53%
7	Move family members to safe place	1,58%	1,05%	8,42%	1,58%	11,05%
8	Move livestock, and household items to safe place	0,05%	2,63%	10,00%	1,05%	14,21%
9	Update regularly warning information	0,00%	2,63%	1,58%	0,00%	4,21%
10	Contribute cash and material items to a local fund for anti-disaster activities of local communities	0,00%	0,00%	0,53%	0,00%	0,53%
11	Buy and store foods, drinking water and other necessities	0,00%	4,21%	1,05%	0,00%	5,26%
12	Others	0,00%	1,58%	3,68%	1,58%	6,84%

(Source: Analysis, 2009)

B. Adaptation Behavior After The Event

The second reference point is the adaptation options households adopted during the event. Table 27, combined with Table 28, shows that most respondents at the time of flood events take three actions, namely, to stay in a shelter and wait for the disaster to die down or subside, move family members to safer place, and clean the house when the flood water goes down. The respondents who took the first action (9.47%) said that it was very effective. The Muara Baru is a corporate community where neighbors helped each other and assisted the injured and evacuated them to a safer place during the flood (12.63% of respondents).

Table 27 Adaptation option that households adopted during the event

No	Adaptation Option	The Number of HH According to Reason for Choice of Adaptation Option (%)						% of Total HH Adopted
		It is cheap	Recom-mended by neighbor/ experts	Govern-ment-recom-mended	Everyone is doing it	Our ancestors have been doing it	Other reasons	
1	Reinforce houses	0,53%	0,53%	0%	0,53%	0%	3,16%	4,74%
2	Cut, trim trees near the house	0%	0 %	0 %	1,05%	0,53%	0%	1,58%
3	Move family members to a safe place	1,58%	8,95%	0,53%	12,63%	0,53%	1,58%	25,79%
4	Move livestock and HH Items to safe place	0 %	2,11%	0 %	4,21%	0%	1,05%	7,37%
5	Keep staying in the shelter, waiting the disaster subside or die down	4,21%	2,11%	2,11%	13,16%	1,58%	3,16%	26,32%
6	Clean house or items when floodwater goes down	10,00 %	0 %	0,53%	12,11%	1,05%	0,53%	24,21%
7	Keep the tract of disaster information	0 %	0 %	0 %	0,53%	0,53%	0 %	1,05%
8	Help neighbors who are injured and evacuate them to safer places	1,58%	1,58%	1,05%	3,68%	0%	4,74%	12,63%
9	Others	1,05%	0%	0,53%	1,05%	0 %	0,53%	3,16%

(Source: Analysis, 2009)

Table 28 Effectiveness of Adaptation during the Event

No	Adaptation Option	The Number of HH According to Reason for Choice of Adaptation Option (%)				% of Total HH Adopted
		Not Effective at all	Fairly effective	Effective	Very effective	
1	Reinforce houses	0%	2,63%	2,11%	0%	4,67%
2	Cut, trim trees near the house	0%	0%	1,05%	0,53%	1,58%
3	Move family members to safe place	0%	2,63%	20,00%	3,16%	25,79%
4	Move livestock and HH Items to safe Place	0%	3,68%	3,68%	0%	7,37%
5	Keep staying in shelter and wait for the disaster to die down or subside	0,53%	4,21%	12,11%	9,47%	26,32%
6	Clean house or items when flood water goes down	0%	4,21%	12,63%	7,37%	24,21%
7	Keep the tract of disaster information	0%	0%	1,05%	0%	1,05%
8	Help injured neighbors to be evacuated to safer place	0%	0,53%	11,05%	0,5%	12,63%
9	Others	0%	0,53%	2,11%	0,53%	3,16%

Source: Analysis, 2009

C. Adaptation Behavior After The Event

After the event, households have adopted various adaptation options. Most of the respondents (31.58%) decided to treat their water source and clean their environment while 30% repaired and strengthened their houses.

Table 29 Adaptation Options That Households Adopted After The Event

No	Adaptation Option	The Number of HH According to Reason for Choice of Adaptation Option (%)						% of Total HH Adopted
		It Is Cheap	Recom-mended by neighbor/ experts	Govern - ment recom-mended	Everyo ne doing it	Our ancestors have been doing it	Other reasons	
1	Small repaired/ strengthened houses and items	3,16%	3,68 %	1,05%	7,37%	1,05%	13,68%	30,00%
2	Rebuilt houses	0,53%	0%	2,11%	4,21%	0 %	9,47%	16,32%
3	Consolidated dykes, roads, etc	0%	0,53%	4,74%	6,32%	0,53%	0	12,11%
4	Treated and cleaned water source and the environment	0,53%	1,58%	6,84%	21,05%	0%	1,58%	31,58%
5	Repaired dams	0,53%	0,53%	0,53%	1,58%	0,53%	0,53%	4,21%
6	Migrated to other area/job	0 %	0%	1,05%	0,53%	0 %	0%	1,58%
7	Coped with financial shortage	0 %	0 %	0%	0%	0 %	2,00%	2,00%
8	Asked for aid from govt	0 %	0%	0 %	0 %	0%	0,53%	0,53%
9	Asked for support from relatives	0,53%	0,53%	0%	0%	0 %	0,53%	1,58%
10	Contributed person-day and money	0 %	0%	0%	0%	0% %	0,53%	0,53%
11	Others	0%	0%	1,58%	0%	0,53%	0,53%	2,63%

(Source: Analysis, 2009)

Table 30 Effectiveness of Adaptation Option

No	Adaptation Option	The Number of HH According to Reason for Choice of Adaptation Option (%)				% of Total HH Adopted
		Not Effective at all	Fairly effective	effective	Very effective	
1	Repaired/ strengthened houses and items	1,05%	6,32%	24,74%	2,63%	34,74%
2	Reconstructedhouses	1,05%	3,68%	14,74%	1,58%	21,05%
3	Consolidated dykes, roads, etc	0%	2,11%	6,84%	4,21%	13,16%
4	Treated water source and cleaned the environment	0,53%	3,16%	26,32%	3,68%	33,68%
5	Repaired dams	0,53%	0,53%	2,63%	0,53%	4,21%
6	Migrated to other area/job	0%	0,53%	1,05%	0%	1,58%
7	Coped with financial shortage	0%	1,05%	0%	0%	1,05%
8	Asked for aid from govt	0%	0,53%	0%	0%	0,53%
9	Asked for support from relatives	0%	1,05%	1,05%	0%	2,11%
10	Contributed person-day and money	0%	0%	1,05%	0%	1,05%
11	Others	0%	0,53%	1,58%	0,53%	2,63%

(Source: Analysis, 2009)

5.3.2 Analysis of Barriers to Adaptation to Flood Event

A. Barriers to Adaptation Before The Event

There are some adaptation options before the event that the households knew how to undertake but did not.

Table 31 Barriers to Adaptation before the Event

Adaptation That HH Did Not Undertake	Barriers to Adaptation	
Vertical build-up of the house/built 2-storey house	▪ Financial constraint ▪ Government responsibility ▪ Did not know when the event occurred ▪ Did not know how to do action	▪ 70.8 ▪ 16.67 ▪ 4.17 ▪ 3.3
Moved valuables to higher places	▪ Did not know how to do it ▪ Did not know when the event occurred	▪ 19.3 ▪ 71.7

(Source: Analysis, 2009)

(1) Strengthened and Built Higher Dyke/Sea Wall

Structural adaptation is the best adaptation option for communities in coastal areas or those located on areas with low elevation since they are vulnerable to be hit by high tide.A well constructed dyke could be an effective adaptation option to reduce risks caused by floods.

(2) Vertical build-up of the House

Most of the respondents (70.83%) could not undertake vertical build-up of their house because of financial constraints. . According to them, this adaptation option is very important but when they compare the expenses of vertical build-up and the losses after flood events, the residents found out that it is still cheaper just to let it be not undertake construction for a second floor to houses. To overcome this problem, the Government should give financial aid, i.e., soft loan. Moreover, it would be to the advantage of the residents if they save up money in order to have a second built and for them to be more responsive to disaster.

(3) Moving Valuables to Higher Places

More than half of respondents in Muara Baru did not move valuable things to higher places, because they did not know that the event would occur. Floods often come suddenly andpeople would usually not have anymore time to prepare for them.

B. Barriers to Adaptation During The Event

There are some adaptations during the event that households knew to undertake but did not:evacuating family members and valuables to higher ground.

C. Barriers to Adaptation After The Event

There are some adaptations options after the event that the households know should be undertaken but which they did not undertake. This information is shown in Table 5.20:

Table 32 Barriers to Adaptation After The Event

Adaptation That HH Did Not Undertake	**Barriers to Adaptation After**	
	Barriers	**No of HH (%)**
Act collectively to repair dyke and reconstruct drainage	▪ Financial constraint ▪ Do not know how to do it ▪ Have to act as a group or community ▪ It is government responsibility	▪ 27.72 ▪ 4.55 ▪ 40.91 ▪ 18.16
Repair house and damaged items	▪ Financial constraint	▪ 100
Reconstruct houses with more durable materials	▪ Financial constraint ▪ Did not know how to do it	▪ 50 ▪ 50

(Source: Analysis, 2009)

There are three actions that respondents did not undertake after the flood, namely, reconstruction of the dyke and drainage, repair of damaged valuables, and reconstruct houses using more durable materials.

5.3.3 Collective adaptation measures corporate community value. Almost half of the respondents said that they worked collectively although more than a third (37.37%) said that they worked independently because did not know otherwise.

5.3.4 The options that the experts recommended and households' acceptance of the recommendationsThe survey measured the acceptance by the people in Muara Baru of the adaptation possibilities recommended by experts. More than half of the respondents (58-64.21%) agreed on the possible actions recommended by experts.

1. Building a community safe shelter

Muara Baru has no community safe shelter, thus, many respondents agreed that it will be good to build one. Many respondents (21%) did not see the need for a community safe shelter because building one will cost a lot of money while the others did not anymore see the need for one because their houses are already safe from flood, even they still doubt to government willing be able to build a safe shelter.

2. Relocate community at risk to a safer place

The second option is to relocate the community at risk to a safer place (Table 5.29). Most of the respondents showed their intention to do the mentioned action. They also considered transferrring to a place that has a healthier environment than Muara Baru.

3. Emergency Response Equipment

Majority of the respondents considered having emergency response equipment asan important adaptation option since it will reduce the damage that disasters will cause

1. **Strategies To Improve The Capacity Of Households to Adapt to Extreme Climate EventsThe capacity to adapt to climate change needs to be developed hand in hand with the need to increase efforts to reduce emissions.**

This study identified the following five indicators to improve adaptive capacity:

1. Economic Capacity

Economic capacity is a main determinant of vulnerability and adaptation of households. The wealthy households are in a better position tocope with disasters than the poor or low income households. Therefore, improving economic capacity is a fundamental approach towards strengthening the capacity of households for disaster resilience.

2. Technical Capacity

Since technology is an effective way to improve the resilience of community to floods, communities should have or improve their (a) early warning system through technology advancement and (b) information system and database on climate change impact.

3. Knowledge and Skill

Improving of knowledge and skills is an important thing to do because it is a key to the community'sadaptive capacity.

4. Infrastructure

Improving existing infrastructure and rehabilitating dams and reservoir is one way of increasing community resilience to flood events.

5. Social Capital

One of the community vulnerability factors in Muara Baru is the lack of interaction and good relationships among households. Social capital is important in order to enhance adaptive capacity, therefore the need to improve this aspect.

6 CONCLUSION AND RECCOMENDATION

Jakarta province is highly vulnerable to climate change event particularly sea level rise and flooding. Almost yearly, this province, especially the north Jakarta area is devastated by tidal floods,. There are three causes of tidal floods in Jakarta, the main reason is when the moon is at its closest to the earth. Secondly, there is subsidence of land in Jakarta due to many high buildings and excessive use of water and thirdly, there is sea level rise to about 5mm/year due to melting of glaciers and ice cap.

Assessment of institutional adaptive capacity shows that the government agencies and local community organizations have inadequate capacity to deal with climate risk related event. The institutional adaptive capacity of local government units was examined in terms of the following factors: institutional and governance; risk assessment, and monitoring and warning; knowledge, education and information; and climate change adaptation technology.

The study also showed that households are extremely vulnerable to extreme climate events, in this case, to floods. This is indicated by the following factors: the proportion of labor to the total number of members of a household, availability of wage labor and non-farming income in a family, the permanence of a house structure of the household, membership of a family in community organizations, training, the time lapse between receiving early warning information and the actual occurrence of the flood, and the amount of time that a household is able to recover from the flood event.

There are some important things that need to be considered by government, community, and households to facilitate the adaptation process to climate change and the attendant risks: (1) access to information; (2) early warning system; (3) coordination among government agencies, community, and households in resource management; (4) fulfillment of the five basic needs of food, clean water, sanitation, health services and temporary dwelling place, including clothing, room to sleep, and healthy environment; (5) safety guarantees of the people's assets; and (5) implementation of the recovery phase. Table 33 shows some strategies that could be implemented by government, community, and household to support the adaptation process and to reduce risks brought about by extreme weather events caused by climate change.

TABLE 33 ADAPTATION STRATEGY

	GOVERNMENT UNIT	COMMUNITY	HOUSEHOLD
Structural Adaptation	▪ Construct dam along the coastline in North Jakarta ▪ Develop the green area for water infiltration area ▪ Develop an integrated coastal plan ▪ Maintain pumps and channels of flood control ▪ Plan and develop lakes as water reservoir	▪ Provide disaster evacuation space ▪ Make an evacuation line ▪ Build sea wall with self help communities ▪ Recover sea dykes, roads, and drainage with self-help communities	▪ Build flood wall using sandbags ▪ Reinforce the house and facilities with hard and protective construction
Behavior Adaptation	▪ Develop disaster risk management from flood and drought ▪ Increase the maintenance for water infrastrucure to support food security ▪ Step up water conservation campaign ▪ Plant mangrove along the rivers in Jakarta ▪ Implement beach protection program and involve community to preserve ecosystem and environment	▪ Coordinatewith commune level in order to provide evacuation equipment (rope, rubber boat, and life vest ▪ Persuade the public to maintain environmental clean ▪ Provide evacuation team to help local community ▪ Respond to disaster and prepare to evacuate ▪ Send goods disaster assistance for affected people in community ▪ Mobilize disaster goods assistance to community ▪ Evaluate government policy in the case of disaster response action based on the fact of loss economy caused by the damage	▪ Involve the community in emergency response work maintain drainage channel ▪ Reduce household waste into productive goods by recycling them ▪ Prepare the family kit/bag for items such such as food, first aid, medicine, etc., in one bag (emergency bag) ▪ Protecti valuable properties in higher place ▪ Implement disaster preparedness working program in local community ▪ Relocate in safe place ▪ Protect the valuables immediately and put them in higher place. ▪ Calli institutions that are involved in mitigating disaster risks, such as the Red Cross and national disaster management offices.
Technology Adaptation	▪ Biopori/recharge well ▪ Develop an early warning system development program	▪ Provide early warning system in commune level ▪ Make prediction tidal calendar	▪ Use a water pump to remove water in the home because of the flood
Financial Adaptation	▪ Allocate budget from local Income for reforestation along east flood canal ▪ Department of Fishery and Ocean allocated financial resource for adaptation action ▪ Increase taxes for groundwater usage in order to avoid excessive usage/tapping of groundwater.	▪ Collect funds from each household for environmental clean up in local community ▪ Raise funds to help affected people ▪ Distribute fund disaster assistance	▪ Allocate special budget for disaster preparedness ▪ Explore other income sourcesLook for soft loans for business capital

(*Source: Analysis, 2009)*

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