THESIS

EVALUATING COASTAL FLOOD RISK ADAPTATION IN THE CONTEXT OF CLIMATE CHANGE IN SURABAYA, INDONESIA

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SEPULUH NOPEMBER INSTITUTE OF TECHNOLOGY
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Increased population and urban growth have made converting open spaces (non-clmate factors) that can cause flooding as well as Surabaya has delta system of coastal morphology, high rainfall (climate factors) and it also has a characteristic of low land. In addition, adaptation that government done is not appropriate, because applied adaptation is mostly based on sudden-onset hazards. There are serious limitations in existing evaluations of climate change adaptation. So, this research tries to evaluate flood risk adaptation in Surabaya to get better understanding in term of successful adaptation measure.

Mixed qualitative and quantitative method is used in this study. Sixteen sub-criteria were identified in literature review and had been cross checked with stakeholders. Multi-criteria analysis (MCA) was used to measure the success of adaptation strategies after finding evaluation criteria by using Delphi Analysis. The data input for evaluation is from interview result of eight stakeholders that chosen by using purposive sampling.

The results show there is no maladaptation in Surabaya coastal area because the evaluation value is close to the target. Moreover, the current adaptation measures are not successful yet although government spent more than 1,15 billion Rupiah for one adaptation. Problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. However, local people have enough awareness to face flooding. They no longer feel the flood as one of the threats, but they considered it as a matter limitation

they face every day. For recommendations, the need for a planning instrument and economic development are also regarded by key stakeholders as more important than an emergency system for anticipating routine hazards rather than just responding to incidental hazards.

Keywords: adaptation mesure, climate change, climate change adaptation, evaluation, flood risk adaptation, successful adaptation

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TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	Cover	i
	Preface	iii
	Abstract	v
	Table of Content	vii
	List of Tables	ix
	List of Figures	xi
1	**Introduction**	**1**
	1.1 Background	1
	1.2 Rationale of Study	3
	1.3 Problem of Statement	4
	1.4 Research Questions	5
	1.5 Research Objectives	5
	1.6 Scope and Limitations	5
2	**Literature Review**	**7**
	2.1 Urban Development in Coastal Cities	7
	2.2 Climate Change, Sea Level Rise, and Flood Risk	9
	2.2.1 Urban Flood Management	13
	2.2.2 Vulnerability of Coastal Cities	14
	2.3 Climate Adaptation Strategies	16
	2.3.1 Adaptation Types	17
	2.3.2 Definitions of Successful Climate Adaptation	21
	2.4 Evaluation of Adaptation Strategies	24
	2.4.1 Approach to Evaluating Successful Climate Adaptation	24
	2.4.2 Evaluation Criteria of Climate Change	27
	2.4.3 Evaluation Process of Climate Adaptation	32
	2.5 Analytical Techniques	35
	2.5.1 Multi Criteria Analysis (MCA) and Analytic Hierarchical Process	35
	2.5.2 Delphi Techniques	39
	2.6 Review of Urban Development and Climate Change in Surabaya	39
	2.7 Summary	43
3	**Methodology**	**47**
	3.1 Research Approach and Conceptual Framework	47
	3.2 Methodology	49

	3.3 Study Area	51
	3.4 Data Collection Methods	55
	3.4.1 Primary Data Resources	55
	3.4.2 Secondary Data Resources	59
	3.5 Data Analysis Methods and Techniques	60
4	**Overview of Study Area, Flood Risk, and Its Vulnerability**	**67**
	4.1 Overview of Surabaya City	67
	4.2 Climate Change Condition in Surabaya	78
	4.3 Flood Situation and Flood Vulnerability in Surabaya Coastal Area	80
	4.4 Overview of Disaster Risk Management in Indonesia in term Of Adaptation Measures	84
	4.5 Summary of Findings	85
5	**Evaluating Adaptation Measures**	**87**
	5.1 Past and On-Going Adaptation Measures Related To Urban Development	87
	5.2 Past and On-going Adaptation Measures based on Key Informants	92
	5.3 Selected Adaptation Measures for Evaluation	96
	5.4 Evaluation Process of Adaptation Measures	97
	5.4.1 Determining Evaluation Criteria Using Delphi Analysis	99
	5.4.2 Evaluate Performance of Flood Risk Adaptation in The Context of Climate Change	110
	5.5 Recommendations to Enhance Adaptation Strategies	124
	5.6 Summary Of Findings	128
6	**Conclusions and Recommendations**	**131**
	6.1 Conclusions	131
	6.2 Recommendations	133
	6.2.1 Applications of research results	133
	6.2.2 Limitations of this research	133
	6.2.3 Further studies	134
7	References	135
	Appendixes	139

LIST OF TABLE

TABLE	TITLE	PAGE
Table 2.1	Six Types of Maladaptation	22
Table 2.2	Factors in Determining the Success of Climate Change Adaptation	30
Table 2.3	Methods and Key Features for Evaluation	35
Table 2.4	Length of Surabaya coastal area	41
Table 2.5	Criterion and Sub Criterion Used in This Research	45
Table 3.1	Coastal Village Affected By Flood Risk	52
Table 3.2	Selected Area	53
Table 3.3	Data Collection Matrix	56
Table 3.4	List of Stakeholders	57
Table 3.5	Primary Data Resources	58
Table 3.6	Secondary Data Resources	59
Table 3.7	Data Analysis Techniques	61
Table 3.9	Criteria for Evaluating in MCA	65
Table 4.1	length of Surabaya coastal area	68
Table 4.2	Topography Condition of Surabaya Coastal Area	70
Table 4.3	Population in Surabaya Coastal Area in 2012	70
Table 4.4	Land Use in Surabaya Coastal Area	73
Table 4.5	Building Density in Coastal Area of Surabaya	74
Table 4.6	Length of Road in Study Area	74
Table 4.7	Maximum and Minimum Tidal in Surabaya Coastal Area (Northern Section)	76
Table 4.8	Maximum and Minimum Tidal in Surabaya Coastal Area (Eastern Section)	78
Table 4.9	Maximum Rainfall 1980-1990	80
Table 4.10	Tidal Range and Shifts The Coastline Due To Differences In Tidal	80
Table 4.11	Flood Risk in Several Areas	81
Table 5.1	Mangrove Area in Surabaya Coastal Area	89
Table 5.2	Scoring Result from Stakeholders	93
Table 5.3	Exploration of Evaluation Criteria	97
Table 5.4	Results of Stakeholders’ Perspective in Delphi Phase 1	99
Table 5.5	Exploration Result of Stakeholders Perspective in Delphi Phase 1	100
Table 5.6	Results of Stakeholders’ Perspective in Delphi Phase II	104
Table 5.7	Exploration Result of Stakeholders Perspective in Delphi Phase II	105
Table 5.8	Results of Stakeholders’ Perspective in Delphi Phase III	109
Table 5.9	Criteria and Sub-Criteria for Evaluating Adaptation Measure	111
Table 5.10	Value and Weighting for Three Adaptation Measures	117
Table 5.11	Criterion Score for Mangrove Conservation Area	118

Table 5.12	Criterion Score for Elevate Floor	120
Table 5.13	Criterion Score for Enhance Soft Skill and Entrepreneurship to Local People	121
Table 5.14	Level of Successful for Three Adaptation Measure	123

LIST OF FIGURE

FIGURE	TITLE	PAGE
Figure 1.1	Map of satellite image and impact risk areas of sea level rise	2
Figure 2.1	Literature Map	7
Figure 2.2	Adaptation to climate change and variability	21
Figure 2.3	Pyramid of Adaptation Evaluation	34
Figure 2.4	Steps and Roles in A Multi-Criteria Analysis	38
Figure 3.1	Conceptual Framework	47
Figure 3.2	Methodological Framework	49
Figure 3.3	Coastal Area in Surabaya	53
Figure 3.4	Step in Delphi Analysis in this Study	63
Figure 3.5	Step in MCA	64
Figure 4.1	Study Area	69
Figure 4.2	Population in Surabaya Coastal Area	71
Figure 4.3	Land Use Change in Surabaya	72
Figure 4.4	Building Density in Monokrembangan District	75
Figure 4.5	MSL Trend Year : 1984-2004	79
Figure 4.6	Flood due to Sea Level Rise in North Coastal Area of Surabaya	82
Figure 4.7	Vulnerability Map	85
Figure 5.1	Mangrove condition in Surabaya Coastal Area	90
Figure 5.2	Mangrove Conditions and Open area for Ponds	90
Figure 5.3	Flushing The River Before (Left) and After (Right) in Greges Krembangan River	92
Figure 5.4	Bozem in Krembangan District	93
Figure 5.5	small embankment which is built in front of house	94
Figure 5.6	Artificial embankment of bamboo	95
Figure 5.7	Hierarchy of Criteria and Sub Criteria on AHP Analysis	112
Figure 5.8	Assessment scores of AHP	113
Figure 5.9	Weighting Criteria from Expert Choice results	114
Figure 5.10	Output AHP for Effectiveness Criteria	114
Figure 5.11	Output AHP for Flexibility Criteria	114
Figure 5.12	Output AHP for inequality Criteria	115
Figure 5.13	Output AHP for Efficiency Criteria	115
Figure 5.14	Output AHP for Sustainability Criteria	116
Figure 5.15	Weighting Sub-Criteria from Expert Choice result	116
Figure 5.16	Combined Weighting of Criteria and Sub-Criteria	117
Figure 5.17	Criteria Percentage of Mangrove Conservation Area	119
Figure 5.18	Criteria Percentage of Elevating Floor Adaptation Measure	121

Figure 5.19	Criterion Proportion of Enhancing Skill and Entrepreneurship for Local People	123
Figure 5.20	Proportion of Each Criterion	124

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TABLE OF CONTENTS

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	Cover	i
	Preface	iii
	Abstract	v
	Table of Content	vii
	List of Tables	ix
	List of Figures	xi
1	**Introduction**	**1**
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	1.4 Research Questions	5
	1.5 Research Objectives	5
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2	**Literature Review**	**7**
	2.1 Urban Development in Coastal Cities	7
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	2.3 Climate Adaptation Strategies	16
	2.3.1 Adaptation Types	17
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	2.5.2 Delphi Techniques	39
	2.6 Review of Urban Development and Climate Change in Surabaya	39
	2.7 Summary	43
3	**Methodology**	**47**
	3.1 Research Approach and Conceptual Framework	47
	3.2 Methodology	49

3.3 Study Area 51
3.4 Data Collection Methods 55
3.4.1 Primary Data Resources 55
3.4.2 Secondary Data Resources 59
3.5 Data Analysis Methods and Techniques 60
4 Overview of Study Area, Flood Risk, and Its Vulnerability 67
4.1 Overview of Surabaya City 67
4.2 Climate Change Condition in Surabaya 78
4.3 Flood Situation and Flood Vulnerability in Surabaya Coastal Area 80
4.4 Overview of Disaster Risk Management in Indonesia in term Of Adaptation Measures 84
4.5 Summary of Findings 85
5 Evaluating Adaptation Measures 87
5.1 Past and On-Going Adaptation Measures Related To Urban Development 87
5.2 Past and On-going Adaptation Measures based on Key Informants 92
5.3 Selected Adaptation Measures for Evaluation 96
5.4 Evaluation Process of Adaptation Measures 97
5.4.1 Determining Evaluation Criteria Using Delphi Analysis 99
5.4.2 Evaluate Performance of Flood Risk Adaptation in The Context of Climate Change 110
5.5 Recommendations to Enhance Adaptation Strategies 124
5.6 Summary Of Findings 128
6 Conclusions and Recommendations 131
6.1 Conclusions 131
6.2 Recommendations 133
6.2.1 Applications of research results 133
6.2.2 Limitations of this research 133
6.2.3 Further studies 134
7 References 135
Appendixes 139

LIST OF FIGURE

FIGURE	TITLE	PAGE
Figure 1.1	Map of satellite image and impact risk areas of sea level rise	2
Figure 2.1	Literature Map	7
Figure 2.2	Adaptation to climate change and variability	21
Figure 2.3	Pyramid of Adaptation Evaluation	34
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Figure 3.2	Methodological Framework	49
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Figure 5.9	Weighting Criteria from Expert Choice results	114
Figure 5.10	Output AHP for Effectiveness Criteria	114
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Figure 5.12	Output AHP for inequality Criteria	115
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Figure 5.15	Weighting Sub-Criteria from Expert Choice result	116
Figure 5.16	Combined Weighting of Criteria and Sub-Criteria	117
Figure 5.17	Criteria Percentage of Mangrove Conservation Area	119
Figure 5.18	Criteria Percentage of Elevating Floor Adaptation Measure	121

Figure 5.19	Criterion Proportion of Enhancing Skill and Entrepreneurship for Local People	123
Figure 5.20	Proportion of Each Criterion	124

LIST OF TABLE

TABLE	TITLE	PAGE
Table 2.1	Six Types of Maladaptation	22
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Table 5.3	Exploration of Evaluation Criteria	97
Table 5.4	Results of Stakeholders' Perspective in Delphi Phase 1	99
Table 5.5	Exploration Result of Stakeholders Perspective in Delphi Phase 1	100
Table 5.6	Results of Stakeholders' Perspective in Delphi Phase II	104
Table 5.7	Exploration Result of Stakeholders Perspective in Delphi Phase II	105
Table 5.8	Results of Stakeholders' Perspective in Delphi Phase III	109
Table 5.9	Criteria and Sub-Criteria for Evaluating Adaptation Measure	111
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CHAPTER 1
INTRODUCTION

This chapter contains introduction which belongs exploration inhow to climate change related to flood in coastal area, what is adapatation. In addition, characteristics of Surabaya are explained in this chapter. Research objectiveand then scope and limitations are identified in this section.

1.1 Background

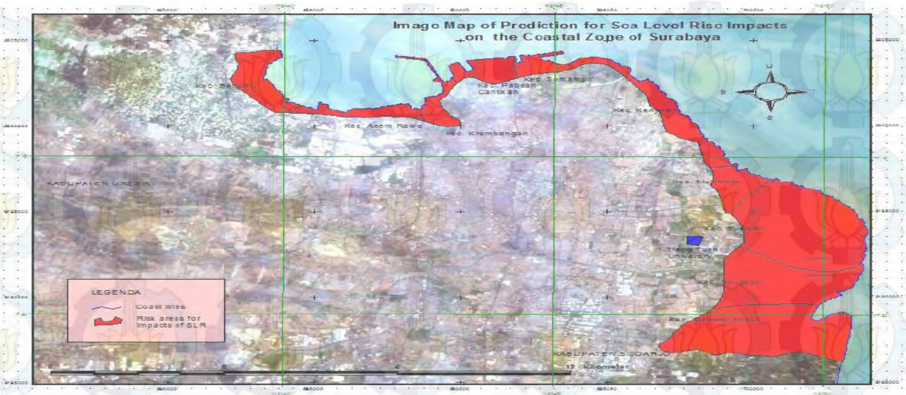
Urbanization or urban growth shows to the concentration of the human populations into separatedareas. It can be caused land use changes for commercial, industrial, transportation and residential purposes. This includes the densely populated centers, as well as adjacent suburban fringes or periurban and can be measured in various ways.

Concentration of the activities in urban areas like working, education, and entertainment make urban management complex. Hazard in urban areas depend on climate and non-climate factors of the cities. For example, one city can face one hazard like earthquake, while other cities face flood, or maybe some cities face more than one hazard at the same time. As a result, hazard can be made by man-made factors, natural factors, or combination of both factors.\

Floods risk is among the most powerful disasterin the world. People have lived and died because of floods, s a prominent role for floods within history, religions, and legends (Costa & Connor, 2004).Flood is a big problem in Indonesia, where most of its major cities are located in coastal areas. Indonesia’s capital city, Jakarta, was repeatedly suffers from flood risk and there is a big possibility that other cities in Indonesia also facing the same problem. Another major city in Indonesia facing the same problem as Jakarta is Surabaya, the capital of East Java Province, which have similar characteristics with Jakarta. Surabaya is located in low-lying land in coastal area, and surrounded by extensive land use conversion that can increase the discharge of the rivers that entering the city.

Surabaya city is the center of East Java and one of the coastal cities in Indonesia which has delta system of coastal morphology and it also has a characteristic of low land so that area has vulnerability to flood (Pamungkas, 2006). Topography of Surabaya is a low land with the height about 1-6 meters below sea level (Masterplan of Surabaya, 2013). That condition makes coastal area in Surabaya has flood potential.

In addition, Surabaya is a coastal city will be affected by SLR or sea level rise and SLT can impact directly on the ten sub-districts, namely: Benowo, Asem Rowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, Mulyorejo, Sukolilo, Rungkut and Gunung Anyar. These sub-districts will be affected because they are directly in contact with the sea Prasita (2013). Risk areas to the effects of sea level rise in the satellite images can be seen in Figure 1.1. Floods will occur mainly at high tide. Type in the tidal waters of Surabaya is a mixed semi-diurnal, which means in a day there is twice high tide and twice low tide but different in height and time. Then, coastal land use that will be affected is mostly mangrove conservation area, residential, tourist areas of Kenjeran, ports, and salt ponds.



Source: Prasita, 2013

Figure 1.1 Map of satellite image and impact risk areas of sea level rise

Flood’s effect will damage some aspects with the heavy destruction in aspects following: population aspect (victim who died), injured, float off, lost, and got disease, etc), economic aspect (loss of livelihood, traditional market malfunction, damage and loss of property, livestock and disruption of the community's economy), infrastructure aspect (damage of houses, bridges, roads, office buildings, public facilities, the installation of electricity, water and communications networks), environmental aspect (damage of ecosystem, tourism, land farming, water, and irrigation) (Departement of Disaster Management, 2007).

1.2 Rationale of Study

Indonesia is the one of most prone areas to various types of hazards, especially to floods. The record maintained by Centre for the Research on the Epidemiology of Disaster, has identifiedthree hundred and ninty main disasters in that country. There are about 135 flood risk occurred. In addition, in every year several areas of Surabaya, especially in the squatters and slums, suffers from a flood risk and affected many poor people. Then, Surabaya has a highly rainfall, with yearly average rainfall around 141.1 mm. The rainfall above 200 mm happens in February, March, April, November, and December (Ferita 2006).

There are conflicts between risk management, climate change adaptation and urban development in coastal area of Surabaya. That can be shown from big number of flood victims in that area (Immadudina, 2013). Adaptation that government done is not appropriate, this is because adaptation applied in there is only based on sudden-onset hazards, not long term strategies. Mismatches between government adaptation measures on the one hand and non-government or individual adaptation measures in urban areas on the other are important issues that have often been overlooked. It can be shown from that Department of Highways and Drainage has made an effort to reduce flooding in Surabaya. This can be seen in the preparation of the Master Drainage Plan Surabaya. The master plan applies the concept of operation of the house pump and a shelter boezem wastewater from the primary pipeline before the water was discharged into the sea. From the data, it turns out that the masterplan can not be applied to the fullest because there are only 33 stations out of a total of 66 stations by the Department of Highways (Departement of Disaster Management, 2007).

Then, like Greivingvet.al (2006) mentions that one studies the role of spatial planning in natural hazard risk management in several European countries found some very interesting conclusions are summed role of spatial planning in the management of major hazards such poor used to, such as limiting development in hazard-prone areas. Later than that, in many cases, the multi-hazard Approache there because there are so many organizations that deal with different types of hazards to work independently. They found a lack of coordinated activities between the stakeholders involved as well.

Adaptation measure is an issue which relevant at many levels such as local (region or city level), national (country level) and international levels (such as South Asia levelIt is very possible and important to identify the effectiveness in addressing adaptation measures were quite successful both in independent scale and in its scalar context (Adger et al, 2004). However, the success of a plan of adaptation depends on how such measures meet all the objectives of the adaptation program, and how the adaptation plan can affect the ability of others to fulfill its purpose. Then, a successful action for some individuals, organizations or government level may not be concluded as a successful adaptation by others. Then arguably, size adaptation success depends on scale application of the criteria used to evaluate it on any such scale.

1.3 Problem Statement

The increase in population and urbanization, the concentration of people in urban areas, land use conversion or change of land use has been made to convert openspace that have ecological functions. In addition, high population can put pressure on the development does not consider about the environment, such as changes in land use in conservation areas, changing green space for housing.

In addition, the high level of awareness and the various levels of concern about climate change coincided with a very limited knowledge in many countries (the European Commission's Directorate-General Communication, 2008; Downing, 2008; Dunlap 1998; Leiserowitz, 2010; Moser, 2008; Newport, 2010). However, studies of vulnerability to climate change are now generally considered to measure adaptation. Meanwhile, they go beyond to explain the adaptation measures that might be possible. Then, there is little research on the process of decision-making for adaptation measures, conditions that limit or stimulate adaptation strategies, and the role of non-climatic factors. Also, there are serious limitations in the curent evaluation of adaptation options. In addition, debate and discussion on the interpretation of adaptation measures and related terms that include resilience, adaptive capacity, and vulnerability of the base throughout the literature. However, yet relatively little research has focused on what constitutes a successful climate adaptation or empirical understanding how successful adaptation of maladaptations. According to the above causes gaps perceptive understanding or definition of success and failure in climate change adaptation mesures.

1.4 Research Questions

The questions in this research are:

1. What are characteristics of coastal development plan in Surabaya and their relationshipwithclimate risk andadaptation?
2. What are the criteria to evaluate climate adaptation measures?
3. How are the performance ofpast and on-going adaptation strategies?

1.5 Research Objectives

The main objectiveis to evaluateflood risk adaptation in the context of climate change using criteria for measuring the success of flood adaptation measures in coastal urban development context. To reach the main objective, the specific objectives are:

1. To assess past and on-going of flood adaptation strategies in term of development context in coastal city of Surabaya
2. Todetermine criteria of evaluating climate change adaptation in relation to coastal urban development
3. To evaluate performance of past and on-going adaptation measures and
4. To recommend how to enhance adaptation measures

1.6 Scope and Limitations

The scope in this research is focused in stakeholders' perception in past and on going adaptation measure in flood risk. Area of this study is focused in coastal area of Surabaya, has vulnerability of coastal flood. Then, this study will integrate current adaptation and urban development planning for sustainable development in order to make successful adaptation.

The Limitations: In this research, the vulnerability area of flood risk is described briefly and only focus on adaptation measure. Then, only local adaptation strategies are analyzed in this study. The selected adaptation measures are only considered on regional level and household level.

CHAPTER II

LITERATURE REVIEW

As describe of Figure 2.1, this chapter explores the basic concepts of urban development in coastal cities, explores definition of climate change, Adaptation concepts, and Evaluation of Adaptation concepts. In this chapter also explores vulnerability of coastal cities under the climate change impacts. In climate change sub section, the relationship between flood risk and vulnerability area is identified. Then, in Adaptation section, tries to identify adaptation types and what is successful adaptation. So, after understanding successful climate adaptation, in next sub section tries to review evaluation of adaptation measure containing approach for evaluating, criteria, and evaluation process. Finally, urban development in Surabaya is reviewed before summary of knowledge gaps.

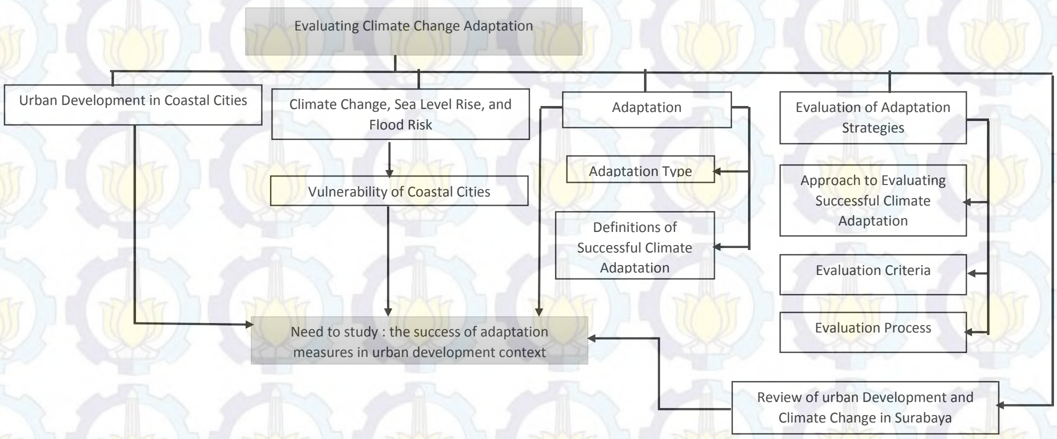


Figure 2.1 Literature Map

2.1 Urban Development in Coastal Cities

According to Nicholls (2004), many large cities in the world and capital in lowland or close to coastal areas or monitor, that's what makes the area potentially more vulnerable to SLR (sea level rise). In addition, coastal cities or beach usually has a large population and is the center of social and economic activities of national importance (Nordhaus, 2006) as the port for trade and services. Additionally, McGranahan et al (2006) have found that the settlements in the larger urban areas tend to be concentrated in the coastal areas with low elevation.

Planning is a system to support the development process to prove direction. Focusing on the scope and efficiency of the planning is the same as the integration plan, design patterns are classified into one type of Comprehensive or fragmented. According Kishiue et al (2005), the evaluation criteria used to test whether the pattern of urban planning can be considered comprehensive or not are as follows master plan, vision, scope, implementation and development agency leaders, planning tools, revision of the frequency plan.

Comprehensive pattern indicates the availability of vision and master plan/s which cover an entire area for its progress. The area is imageable as the all owing to good coordination among plans. Development of transportation infrastructure is incorporated into the plans as one of major growth factors rather than the answer to the demand. ―Fragmented” pattern denotes that vision and master plan/s are partially available in the area, but there is no means to make them integrated. The area which has several development directions and its image as a whole is vague. For the results, the development has been undertaken in that places without enough linkages among them and unexpected urban problems would be caused by losing the balance of the city aspects. Relationship of transportation infrastructure and urban development tends to be ‗mending‘ rather ‗guide-development‘. If the planning pattern of the city does not fall into the ―Comprehensive”, it is considered as ―Fragmented”. (Kishiue et al, 2005).

Fletcher & Smith (2007) said coastal zone is a growth area between sea and land, and possesses characteristics of both components. It receives influence from physical process and human activities, both from sea and land, with different scale of effects and functions (Tissier, et.al. 2004). The cooperation between human activities and physical process in the coastal zone determine characteristic of costal area and its environment. Most of coastal zones are located in alluvial plain or the delta region with the high concentrated population.

Coastal city as the part of urban areas with high human population more than one hundred thousand are living in vulnerable areas with have high risk of flood and other disaster and are influenced by hthe ydro-dynamically by an extensive body of surface salt or fresh water (Timmerman and White 1997). Thus, two-thirds of the world's large cities stood in areas that are vulnerable to global warming and sea level rise. Millions of people are vulnerable and at risk of flooding and intense storms. More than 180 countries have populations in the zone. And two thirds of those have urban areas of more than 5 million people and is under threat due to the 75% of people living in vulnerable areas in Asia at high risk for poorer nation. It can be known also that one-third of the world's 1,562 occurred flood disasters in Asia with half of the total around 120,000 human had been killed by floods risk living in that region.

The coastal environment is very significantt by economically and environmentally sensitive to several affecting factors, and physically vulnerable to several types of natural, man-made and man-enhanced hazards. As a Miliman and O‘Riordan said (2007), the development of coastal urban environment brought in more stakeholders which creates higher complexity in governance involvement of a wide range of stakeholders and interest groups are increasing and lead to more complex requirements in governance to guarantee physical and socio economic sustainability.

2.2 Climate Change, Sea Level Rise, and Flood Risk

Climate change can affect the coastal areas in different ways. Coastal areas are too sensitive to tidal and SLR (sea level rise), changes in the intensity and frequency of storms, warmer ocean temperatures, and then increases in precipitation. Then, improving atmospheric concentrations of CO_2 or arbon dioxide are causing the oceans to absorb more of the gas and more acidic. This rising of the acidity may have significant impacts on coastal and marine ecosystems. The impacts of climate change are likely to worsen many problems that coastal areas face. The coastal flooding, shoreline erosion and water pollution can affect the coastal ecosystems and coastal infrastructure (United States Environmental Protection Agency, 2012).

Sea Level Rise (SLR) is a series of processes tide. Tides are causing short-term rising sea levels and periodic (Sucia putri 2007). Effects due to rising sea levels to land referred to as the flood-tide, and Indonesian calls that ―rob” (Setiyono, 1994). SLR or sea level rise as the impact of human-driven climate change has significant implications to low-lying coastal areas and beyond. Small and Nicholls (2003) and McGranahan et al.(2007)mentioned the coastal are contains very valuable ecosystems and typically has higher human population densities than inland areas. Additionally it generates significant amounts of economic activity contributing to national wealth (Bijlsma et al., 1996; Sachs et al., 2001). In physical terms the biggest direct impacts of the sea-level rise include the inundation of low-lying areas, coastal wetland loss, shoreline erosion, saltwater intrusion, higher extreme water levels, and higher water tablesleading to coastal flooding (Leatherman and Nicholls, 1995). Nicholls et al. (2007) argued human-induced pressures on the coastal zone (such aswater abstraction, growing population, and the alteration of the hydrological regime that includes the damming of sediments) will exacerbate the effects of sea-level rise.

Increased human activity resulted in the increase in the quality and quantity of greenhouse gases in the atmosphere. This increase led to an increase in global temperatures. Global temperatures have increased by 0.6 ± 0.2 ° C since the last 19th century. As a result of global warming caused by humans, sea level gradually increased. Global sea level rise will reach a height of 9-88 cm by the year 2100 compared to 1990 (Church et al. 2001).

Flooding is a result of water overflowing river flow exceeds the capacity of carrying capacity of the river to overflow and flood plains or lower area surrounding (Yulaelawati, et al, 2008). Flooding can also be defined as a seasonal threat that occurs when water overflows from the existing channel and flood surrounding areas. Floods are the most frequent natural hazards occur and make the most losses, both human and economic terms. Ninety percent of natural disasters (excluding droughts) associated with flooding. The flood risk can cause the range of health impacts and risks such as injury and even death, contaminated drinking water, increased populations of the disease-carrying rodents and insects, hazardous material spills, moldy houses, and community displacement and disruption.

Type frequent flooding is a flash or shipment and tidal (General Guidelines for Disaster Management, 2007). A flooding is the situation in that water covers land with a specific time where it normally doesn‘t. Water usually comes from lakes, sea, rivers, sewers or canals, also be rainwater. Flood risk can be explained according to speed which called flash flood, the geography or the cause of flood risk. Manyl types of flood risk will be explored below together with severalhydrology aspects.

Yulaelawati and Shihab (2008) divided into three types of flood risk, three types following:

- River Floods

Rivers floods happen when rivers and streams cannot carry away all the extra water that falls as rain or comes from melting snow. The water rises in the rivers and streams and overflows onto normally dry land. Floods destroy farmland, wash away people's houses and drown people and animals. Towns and cities are flooded too.

- Coastal Flood

A flood starts when waves move inland on an undefended coast or overtop or breach the coastal defence works like dunes and dikes. The waves attack the shore time and again. When it is a sandy coast, each wave in a storm will take sand away. Eventually a dune may collapse that way.

Very characteristic of a coastal flood is that the water level drops and rises with the tide. At high tide the water may flow in and at low tide it may recede again. When a sea defence is breached, low tide is the time to repair the breach Coastal flooding can be caused by strong winds blowing waves onto the land.

Hurricanes and major storms produce most coastal floods. Very high tides and tsunamis also flood the coasts. In many countries, large groups of people live along the coasts and for these people coastal flooding can be very serious. Thousands of people have been drowned in coastal flooding in many parts of the world.

- Flash Floods

A flash flood is a quick flood caused by a sudden cloudburst or thunder storm. Huge amounts of water fall in a short time and in cities and towns the drains overflow and roads become flooded. Flash floods also happen in mountainous areas, where steep slopes cause the water to travel at high speeds. The rushing water erodes the soil, washing it away down the slopes. Flash floods often occur rapidly and with little warning.

Office of Public Works (2009) described many types of flood risk present different degrees and forms of its dangerous level to the people the environmentand, property due to the varying velocity, duration, depth, onset level and other risksthat associated with flood risk, as follows:

- Coastal Flood, this flood risk is caused by higher SLR (sea level rise) than normally SLR is, largely as theresult of the storm surges, as impact to overflowing onto the land. The coastal flooding is affected by the following three causes, which usually work in their combination:
  - High tidal level;
  - Storm surges that caused by low barometric pressure exacerbated
  - Winds (the highest surges can develop from hurricanes); and
  - Wave which is dependent on wind direction and wind speed, local topography and its exposure.
- Hinterland flooding, caused by drawn-out and, or the intense rainfall. Inland or hinterland flood risk might includes different types as follows :
  - Overland flow happens when the rainfall‘s amount exceeds infiltration capacity in the ground to absorb it. That can make inundation of water flows, make pond in natural basin and low-lying areas or behind the

obstructions. This happens as the fast response to make intense rainfall and eventually comes inpiped or drainage system.

- River flood risk occurs when water‘s capacity is exceeded or channel is restricted or blocked, and abundance the water spills out from channel onto nest low-lying areas or the floodplain. This situation may occur rapidly in the short rivers or for long time ago and some distances from where rain falls in the rivers with gentler gradient.
- Flood risk from the artificial drainage systems affects when water flowsand enters the system like urban storm of water drainage system, and exceeds its discharge capacity, finallysystem becomes blocked, and can‘t discharge due to the high level of water in receiving watercourse. This condition mostly happens as fast response to the intense rainfall. Work together with the overland flow, and it is often known as the pluvial flooding.

According to several research above, it can be concluded flood risk occurs because climate change factors and non-climate change factors and based on the theories of the type of flooding, the type of flooding that are being studied can be categorized as coastal flooding.

2.2.1 Urban Flood Management

Flood management in the urban areas is a complex decision-making process. Its main purpose is to define and implement all measures that can reduce the risk from flooding which human, natural and economic resources are subjected (Oliveri and Santoro 2000). In urban areas, objects that can be exposed to flood hazard are more various and have more complicated relationship each other compared to another type of land use, i.e., rural or agricultural.

Urban flood problem seems to be difficult to handle in developing countries. The reason for this is that firstly, developing countries have small, vulnerable economies and are common to be severely damaged when flood disaster strikes. Secondly, limited amount of resources to cope with flood hazard, particularly to investigate and evaluate possible strategies made government in developing countries often underestimate the existing flood hazard (Hansson, Danielson et al. 2008). Quality of human resources also limits the possible measures that can be implemented by government to protect the residents and their belongings in urban areas.

There are two main aspects in urban flood management; structural mitigation and non-structural measures. Structural mitigation measures are an effort to modify the characteristics of a flood (i.e., the volume and timing of flood waters, their extent and location, their velocity and depth), so that damage or susceptibility to people and properties can be reduced.

Non-structural measures are an effort to manage flood hazard by applying actions and regulations that can either reduce flood hazard, or to minimize the impact of flood in case disaster is unavoidable. (e.g. real-time forecasting and alert systems, information and training campaigns, tax adjustments, flood insurance programs).

2.2.2 Vulnerability of Coastal Cities

IPCC (2007) or usually it is called Intergovernmental Panel on Climate Change describes the vulnerability of climate change as degree to whichsocio-economic, biological, and the geophysical systems are affected and incapable to face withimpacts of the climate change.The different knowledges such aseconomics, anthropology, psychology, and also engineering use vulnerability term. Just in the human–environment relationships, vulnerability term has ordinary meaning, although contradict. The areas of geography and human ecology have particularly conceptualized the vulnerability to the climate variability (Adger 2006).

Since the early 1980s, the concept of vulnerability has been examined across a wide range of disciplines. Marandola and Hogan (2006) and Adger (2006) state that the study of vulnerability has been assessed in the disciplines of demography, geography, human ecology, economics, anthropology and psychology. The topic has also been approached from both natural science perspectives (such as engineering and natural processes) and social science perspectives (Roberts, Nadim & Kalsnes, 2009).

The multidisciplinary approach to the vulnerability concept leads to a multi interpretation of the concept and interchangeable meaning with other key concepts in DRM such as resilience and adaptation. Although there have been different interpretations of some of its basic terminology, Cutter (1996) and Adger (2006) argue that the varieties of interpretations indicate the importanceof the concept across the disciplines. In addition, Cutter et al. (2008) also illustrate the connections between vulnerability, resilience and adaptation indicating that a variety of meanings and relationships are used. However, greater definitional clarity is needed to progress research in areas such as vulnerability assessment (Cannon, 2008; Ionescu et al., 2009), a key concern of this research. It is essential especially for the purpose of modelling which builds the linkages between the three key concepts of DRM.

Adger (2006) said there are two major areas in vulnerability research that acted as the basis for the ideas which eventually led to the current research on physical vulnerability and the social systems in the holistic manner make analyzation in vulnerability as lack of the entitlements to resources and analyzing vulnerability to natural disasters. Several vulnerability studies consider on entitlements literature regarding the access to resources, on the political economy in exploring factors leading to the vulnerability, and O‘Brien (2005) mentioned that on social capital as the means of claiming entitlements and pursuing coping mechanisms.

Even though vulnerability research has been conducted since the 1980s, there are still different understandings of how this concept should be defined. Kates (1985) highlights the literal meaning of the word as ―the capacity to be wounded". Dow (1992) emphasises the importance of the term ‗capacity‘ as part of his definition of vulnerability and this emphasis is echoed in more recent vulnerability research (e.g. Wisner, Blaikie, Cannon, & Davis, 2008; Armas, 2008; Pitilakis, Alexoudi, Argyroudis, Monge, & Martin, 2006; Villagran de

Leon, 2006; Dwyer et al., 2004; Downing, Butterfield, Cohen, Moss, Rahman, Sokana, & Stephen, 2001; Adger & Kelly, 1999).

The concept of vulnerability is multi-layered as the responses of individuals, groups of individuals and social networks to hazards must be considered. Adger and Kelly (1999) suggest that the vulnerability level reflects the state or situation of the individuals, groups or communities affected by a disaster. Dwyer et al. (2004) and Villagran de Leon (2006) suggest an even broader range of research subject matter for vulnerability studies drawing on the terminology of ―human communities”. In fact, vulnerability research has been limited to partial or individual appraisal (e.g. Armas, 2008; Odeh, 2002). Even with this support for research into vulnerability assessment to extend beyond individuals to larger groups, the fact is that most has been limited to partial or individual appraisal.

2.3 Climate Adaptation Strategies

Human life on earth will certainly interact and adapt to natural conditions occur. Man with knowledge can provide a change to the "natural conditions", and vice versa, can form knowledge of human nature. Conditions dynamic nature makes humans are required to adapt adjust. Adaptation according Soemarwoto (1991), namely the ability of living creatures to adapt to their environment can be divided into a number of ways through 1. The process of physiological, morphological adaptation is Cultural or behavioral adaptation including the application of technology and social institutions, especially for living things. Holahan (1982) in a diagram was depicting the relationship between environmental conditions, psychological and behavioral phenomena.

Adaptation in the context adjust to the changes of the environment can be "adjusted" to the dwelling (a modified form of home or relocation of residence), livelihood or employment, and other forms of adaptation. In this study, adaptation is divided into two major parts shelter adaptation and adaptation activities.

Adaptation of residence is the desire to remain at its current location or plan to move the location of residence because of flooding disturbance. The adaptation in the form of activities, for example evacuate or remain in residence at the time of the flood, and other forms of activities in the context of adjusting to flooding were found in the field.

There are many factors in adaptation such as safety improvement or the protection of economic well-being. It can be done in many ways, by market exchanges Smit et al (2000) said, by extension of the social networks as Adger (2003) mentioned, or through actions of the organisations or individual to achieve their own collective goals or individual one. It can be initiated by individual to their own benefit. It can be set up of the actions by public and governments for protecting their citizens.

Many studies have focus at the city including the earlier work on the mega politan cities, for example Nicholls (1995), Klein et al (2003), and the city specific analysis of Kirkshen et al (2006) in New York, Ng and Mendelsohn in Singapore, the London Climate Change Partnership in London (LCCP, 2002), Sherbinin (2006) for Mumbai, Rio de Janeiro, Shanghai, TERI (1996) in Mumbai, and OECD (2004) in Alexandria.

Most of analyses, don‘t undertake quantitative for impact assessments, indeed such the efforts are now being undertaken in London city alone as mentioned by Hall etal. (2005). Those vulnerable cities in East and South Asia and even Africa havestarted with specific SLR impact assessments. In addition, Bigio (2003) considered cities such as Jakarta, Indonesia, then Egypt, Banjul, Bangkok, Thailand, also Tianjin, China as likely to be particularly affected though the quantitative analysis to inform adaptation decisions has not yet been undertaken. The parallel OECD study finds to face this actual gap.

2.3.1 Adaptation Types

Adaptation strategy contains a wide variety of interventions which reflects the multi-faceted nature. A typology is included below which excludes consideration of scale, and also encompasses both process type activities, in relation to building adaptive capacity and also direct interventions which deliver adaptation actions, such as the physical infrastructure. Many adaptation measures may cover severalits aspects.

In general, adaptation is an attempt to adjust to the environment. In the analysis of adaptation to the environment (environmental changes such as floods), the theme of the relationship between humans and the environment are becoming emphasis is behavior (behavior) of man (Yunus, 2010). More Yunus (2010), reveals itself based human behavior with among other things perceptions, preferences, and actions determine something and something created by a variety of factors. As stated Yunus (2010), human thinking in the earth's surface does not happen by itself, but due to the influence that comes from him (internal factors) as well as the influence that comes from outside himself.

Hardesty (1977) argued about the adaptations that: "Adaptation is the process through which beneficial relationships are established and maintained between an organism and its environment", that is, adaptation is the process of the establishment and maintenance of mutually beneficial relationships between organisms and their environment. Meanwhile, the ecologists culture (cultural ecologists) (Alland, 1975; Harris, 1968; Moran, 1982) defined, that adaptation is an adaptation strategy used by humans for life to respond to changes in environmental and social.

In the study of human adaptability to the environment, the ecosystem is the whole situation, where adaptability takes place or happen. Because human population scattered in various parts of the world, the context is very different adaptability. A population in a particular ecosystem adapts to the environmental conditions in ways that spesifi k. When a population or community began to adjust to a new environment, a process of change will begin and may take a long time to be able to adjust (Moran 1982). Sahlins (1968) emphasizes that the adaptation process is dynamic, because the environment and the human population continues and always changing. Smit et al., (1999) in her study of climate change, defines adaptation as an adjustment in the system of socio-economic-ecological response to conditions of climate and its impact. Smit and

Wandel (2006) also stated that human adaptation to global change is a process and the result of a system, to cope with and adapt to changes, stress, hazards, risks, and opportunities. In climate change adaptation are two roles that as part of the impact assessment with the keyword: (1) adaptation is done, and (2) the policy response to the keywords adaptation recommendations. Framework in mendefi niskan adaptation is the question: (1) adaptation to what?; (2) Who or what is to adapt ?; and (3) how the ongoing adaptation ?. This means that adaptation is the process of adaptation and adapted conditions.

Sunil (2011) defines adaptation to environmental uncertainty and disaster as handling the impacts that can not be avoided in a changing environment. Adaptations include adjustment in attitude towards the uncertain conditions. Adaptation is strongly influenced by socio-economic and ecological conditions specified. In the environmental changes that occur in coastal areas, the concept of adaptation refers to the strategy: (1) protection of the land area of the ocean, so that land use can be continued; (2) The property is adapting to its environment; and (3) avoid or migration strategy is to leave the coastal areas to safer areas.

A. Maladaptation

There has been so much attention which is focused on effectiveness of adaptation measures in decreasing climate change vulnerability, and so the potential impacts of climate change, it is hardly appreciated if done unwell; the adaptation interventions can exacerbate climate change‘s effects. This is called maladaptation. IPCC (2001) describes the maladaptation as ―any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli an adaptation that does not succeed in reducing vulnerability, but increases it instead”

Maladaptation is a condition in which an individual is unable to adapt to the environment, resulting in a gap between potential has with the environment. Maladaptation can happen to someone if they experienced any problems or obstacles are too heavy, giving rise to feelings of anxiety, helplessness, unhappy and similar symptoms.

More pragmatic identification of the maladaptation is any kind of the action that may involve one or mabe more of the following:

- Inefficient use of resources compared to other options (e.g. unnecessarily displacingdevelopment funds away from other concerns)
- Ineffective, for example relying on scenarios of future climatic risks that are not subsequentlyrealised and actions that have no other benefits)
- Inequitable reductions in vulnerability (or shifting vulnerability from one group toanother)
- Inflexible investments or decisions that may reduce the possibility for futureadaptation.

Refers to actions which tried to avoid or decrease climate change‘s vulnerability but end up encoureging it in other systems, sectors or social groups (Barnett and O'Neill 2010). Barnett (2011) said that maladaptation doesn‘t just refer to the unsuccessful adaptation measures (impliying that the action didn‘t have the desired impacts, but to actions that may have had the desired impactt but also produced unintended effects or consequences. The types of maladaptation described in the literature are summarised in Table 2.2.

It is significant therefore for considering these issues when the indicators are being conceptualized, particularly for the long-term and even short periods. While not actually specific to adaptation of climate change, these evaluations should also include whether the processes of change and the pathways to ‗success‘, are likely to show linearity or may indeed suffer periods of stagnation or reversal as a necessary step in the route towards long-term success. In other hands, the maladaptation means iinitial progress towards sthe uccess may lead to long-term increases in climate change‘s vulnerability.

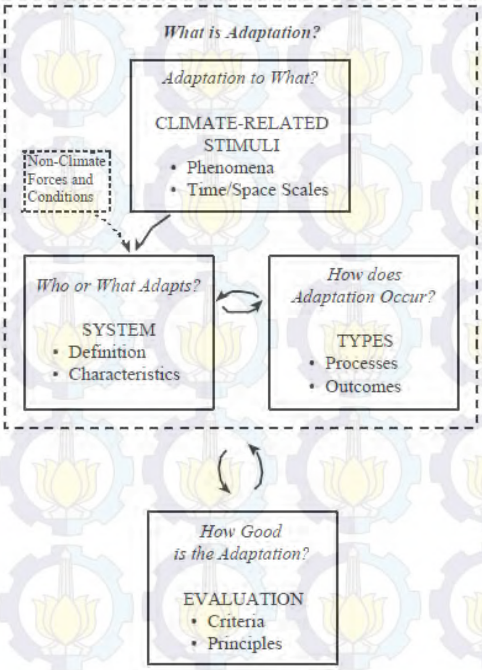


Figure 2.2 Adaptation to climate change and variability (Smit et al., 2000).

2.3.2 Definitions of Successful Climate Adaptation

Some papers in the climate change adaptation literature try to get a definition of successful adaptation. In a report for the Pew Center on Global Climate Change, Easterling et al (2004) offered the following definition:

"Successful adaptation is defined as one that follows a climate change causing adverse impacts and maintains a system at approximately the same level of welfare or services as was provided before the change in climate. If the adaptation can completely offset the loss from climate change, it is successful. Although less straightforward, adaptation also should be considered successful if it maintains services or welfare with a small or minimal loss")

Easterling proposedaudience was likely decision-makers, rather than the adaptation measure scholars. That is one of the first attempts for defining the term. The exploration of definition opens door to the development of the metrics that might have action for evaluating and characterizing the adaptation success. As an example, continued the economic vitality of the community, the ability of the area residents for maintainingcertain living standards, and provision of the clean water and other services, all of which can be calculated given sufficient data. The meaning does not, provide much guidance in the understanding how to measure the adaptation measures at different level or spatial scale or how to accommodate it for the effectst of changes such as in-migration or-migration. In addition, it poses the significant challenge, pushing empirical researchers to develop the methods to prove the degree to which prevention of related climate change which losses might be attributed and direct to success of the adaptation measures or may be the result of others.

Adger et al. (2005) focused more closely on various aspects of the concept of successful adaptation and set out a number of characteristics to paint a more holistic picture of success. They began with a simple definition: *"In the broadest terms, the success of an adaptation strategy or adaptation decision depends on how that action meets the objectives of adaptation, and how it affects the ability of others to meet their adaptation goals*" (p. 78). Understanding that means there is the possibility of a success essentially depends on the goals contained in the plan or program for adaptation, mungkinyang makes it more difficult to draw an overall experience and lessons learned from many cases. Adger and his colleagues put forward the need to evaluate the success rate of adaptation planning decisions that clearly impact on other objectives, provisions may help ensure a justice system that exists, but probably will cause the bar to the achievement of success.

Table 2.1 Six Types of Maladaptation

Maladaptation Type	Description
Increasing emissions	Adaptation is maladaptive if actions end up contributing toclimate change – for example, the increased use of energy intensive air conditioners in response to the health impacts of heat waves.
Disproportionate burden on others	Adaptation actions are maladaptive if, in meeting the needs ofone sector or group, they increase the vulnerability of thosemost at risk, such as minority groups or low-income households. Alternatively, the consequences of a maladaptive action could be shifted to another sector or group.
High opportunity costs	Approaches may be maladaptive if their economic, social, orenvironmental costs are

Maladaptation Type	Description
	higher relative to alternative actions.
Reducing incentiveto adapt	If adaptation actions reduce incentives to adapt – for example,by encouraging unnecessary dependence on others,stimulating rent-seeking behaviour or penalising early actors –then such actions are maladaptive.
Path dependency	Large infrastructural developments commit capital andinstitutions to trajectories that are difficult to change in thefuture, thus decreasing flexibility to respond to unforeseen changes in climatic, environmental, economic and socialconditions.
Increasing existing stressors	Adding further stress to already degraded ecosystems reduces their adaptive capacity to deal with climate change impacts. Forexample, actions like promoting plantations for carbons equestration may lead to reduced water availability downstream. which may place further stress on already degraded water ecosystems

Source: Barnett and O'Neill (2010).

To complete it, Adger propose that in assessing adaptation strategies in a spatial and temporal scale, it can use the general principles of policy appraisal (equity, effectiveness, efficiency, and legitimacy) to systematically evaluate specific decisions. While these criteria are useful to ensure that adaptation decisions are made under the principles of good governance, not sure how they help define the success of applications for adaptation to climate change in particular.

There is a lack of opinion and consensus about what is success in adaptation plans, ranging from large level (global) and it has an effect on the level below. In the end, successful adaptations seen in a very long period of time can even multi-decade based on the achievement of development objectives are sensitive to climate change. However, the assessment of long-term success does require monitoring and evaluation study to extend over a longer period than the ones associated with the projects and programs of a lifetime.

2.4 Evaluation of Adaptation Strategies

Evaluation for adaptation program has received a lot of attention recently. One is summarized by Tol et al. (1998), this is related to the cost estimates include the cost of the damage and the cost of benefits, adaptation is taken "self" rather than in response to the initiative of the government, and often a reaction to climate stimuli. The resulting cost estimates are very important in the "base case" (a reference or scenarios do-what) to evaluate both options and mitigation and adaptation policies. The second body of work deals with adaptation evaluative planned, mainly anticipatory, performed or directly influenced by the government as part of their policy response to climate change. This method is intended to evaluate the feasibility or utility or acceptance of potential adaptation measures or strategies. Carter et al., (1994) gives some very general measures for the evaluation. Smith and Lenhart (1996) proposed a net benefit and implementability as the main criteria for a more detailed set of proposed procedures for evaluating "anticipatory adaptation policies". Toll (1996) argues that the management options are evaluated in relation to the economic viability, environmental sustainability, public acceptance and behavioral flexibility. Titus (1990), Goklany (1995), Fankhauser (1997) and Klein and Tol (1997) describe a variety of principles and methods that have been proposed to identify, evaluate and recommend adaptation measures.\

2.4.1Approach to Evaluating Successful Climate Adaptation

Leurs et al. (2003) have developed a way to integrate related damage threshold, sensitivity, exposure, and the capacity of adaptation to indicate a result of vulnerability to harvest wheat in the Yaqui Valley of Mexico City. Then O'Brien et al. (2004) calculate the index for a climate and exposure to export competition and adaptive capacity in the agricultural sector in India and the countries that can produce a map showing which areas have some of the stress by making the area a significant vulnerability. O'Brien (2006) also examined the kerentanandalam aspects of agriculture in the country of Norway. This study potentially significant and relevant for policy makers, even though they are likely to be most effective when it is considered as a routine part of the planning and decision making in public (Smit and Wandel, 2006).

Empirical studies and evaluation of an example of a climate adaptation plan modern classified actually provide complementary to the type of vulnerability research that has been described. Evaluate the success of the adaptations made by the community with the most recent or current changes potentially fruitful evidence for the design of future adaptation strategies. Knowing when and how adaptation actions have been successfully able to help calibrate the use of resources and the design of strategies intended to address climate change in the future. For example, practitioners are trying to devise a plan can adapt their efforts on the model of the previous cases of success and continue to evaluate the relevant metrics as part of an adaptive management scheme intended to enhance adaptation efforts.

It is important, however, to carefully consider the contextual nature of challenges such as climate adaptation. Adaptation strategies and limits of these strategies can only be understood in the context of the analyzed system (Adger et al., 2009). So in order to provide the most useful research to inform future adaptation in modern society, researchers should examine adaptation in the context of the very recently. This implies the need to start by understanding the goals and objectives of modern societies and communities are trying to adapt.

Effective evaluation of the first successful adaptation efforts will identify potential adaptation purposes, then define the climate impacts associated with temporal and spatial scales encompassing appropriate and examine broad metric shows the effect on the original purpose. For example, winter tourism dependent region experiencing warmer winters may seek to maintain the overall level of economic output for the support of its citizens. Researchers may look to see if the output of the economy remain level or increase over that period. The next logical step would be to investigate the regional context to identify whether the policy, social response, cultural, and others can explain how certain communities adapted successfully to avoid serious economic decline and whether such adaptation, examined over several spatial and temporal scales, provide universal benefits or interfere with the achievement of social objectives.

Rather than using a conceptual approach, Preston et al (2009) developed a set of evaluation criteria for judging existing adaptation plans. Their examination of adaptation guidelines and planning documents focused largely on the inclusion of various procedural aspects of what they believed to be robust adaptation guidelines. Their review found numerous deficiencies in virtually every plan examined, but as they acknowledged, was limited only to what was proposed on paper and did not evaluate the success of any actual adaptation actions.

Doria et al (2009) used a variant of the ***Delphi technique*** to elicit expert opinions on a consensus definition of the concept. After three iterations with a panel dominated by welfare economists, they settled on a final definition: ―Succœssful‘ adaptation is any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social, and environmental sustainability". Of the 18 experts involved, 83.4 percent either agreed or completely agreed with that definition, although members of the same group tended to believe that expert elicitation was not well suited for defining subjective concepts like successful adaptation.Doria et al final definition. Focusing on risk reduction, instead of maintaining well-being, as was the case with Easterling et al. (2004) and Adger et al. (2005), which may make it more difficult to identify appropriate evaluation metrics. From the perspective of empirical research, however, the biggest drawback may be the inclusion of the term "sustainability," the authors intentionally undefined.

Taken together, the various definitions point towards the need to compare several types of results to various predetermined level, but differ in focus in both the risk / vulnerability and continued provision of various services. Moreover, this approach is very varied in scope, with some implications for the development of metrics that are relatively simple but warn others to take heed of the impact on many levels.

2.4.2 Evaluation Criteria of Climate Adaptation

Neil et al (2004) said that Adaptation to climate change, therefore, can be evaluated through generic principles of policy appraisal seeking to promote equitable, effective, efficient and legitimate action harmonious with wider sustainability. The criteria of evaluate adaptation are efficiency, effectiveness, equity and legitimacy are contested and context specific, and are based on competing values (Adger et al., 2003a).

- *Effectiveness in adaptation*

Effectiveness relates to the capacity of an adaptation action to achieve its expressed objectives. The effectiveness of adaptation can sometimes be directly measured, for example, the number of houses removedfrom high hazardlocat ions can be counted, but more often the effectiveness of an adaptation measure is more elusive: effectiveness depends on the sequence and interaction of adaptations over time.

- *Efficiency in adaptation*

Adapting to climate change entails costs, but should also yield significant benefits. At the scale of the individual organisation the costs will be those of implementation, including transaction costs and the costs of inaccurate prediction and the benefits, those of reduced impacts or enhanced opportunities.

- Equity and legitimacy in adaptation

The success of an adaptation action can be argued to depend not only on its effectiveness in meeting defined goals, but also on issues of equity and perceived legitimacy of action. It is important to note here that present-day adaptations to the risks from climate change are imposedon present-day society as a result of previous actions in perturbing the climate system. Equitable adaptations can be evaluated from the perspective of outcome (i.e. who wins andloses from the adaptation) as well as who decides on the adaptation to take.

Equity andlegi results timacy decisions both essential for endurance and finally perceivedsuccess adaptation. Equity is important for instrumental reasons: equitable development destructive potential welfare gains in the future and the development of less legitimacy have little opportunity for full implementation. Equity and legitimacy is also a goal in themselves (Low and Glee kids, 1998) in a fair public action defines both our relationship with nature worldandis component of long-term sustainability. In addition, equity defines the relationship of how individuals relate to and respect other parts of the community, local and global.

Successful adaptation that balances effectiveness, efficiency andequity through decision-making structures that promote learning andare perceived to be legitimate is an ideal from which much adaptation inevitably diverges.

OECD‘s Development Assistance Committee has agreed a standard set of international criteria to guide all evaluations of development assistance. These are: ***relevance, effectiveness, efficiency, impact and sustainability***.Table 2.3 sets out the five criteria of **Effectiveness**: Achieving objectives; **Flexibility**: How far can we adapt? **Equity**: Inequality dimensions to adaptation; **Efficiency**: Cost-effectiveness; and, **Sustainability**: The wider implications of adaptation. Frameworks for evaluating the success of climate change adaptation must recognize that CCAI occur at all scales, forcing reflection on what constitutes success at each level. Each of the following scales is relevant for developing adaptation evaluations:

- Globally and system-wide (e.g. effectiveness of global markets for risk transfer;adaptation in global commodity markets)
- Global finance delivery mechanisms (e.g. effectiveness of GEF adaptation funds orthe Adaptation Fund in promoting adaptation)
- National scales (e.g. efficacy of legislative and institutional arrangements)

- Across adaptation policies and programmes (e.g. implementation framework forNAPAs or programme-wide mechanisms like DFID/IDRC‘s Climate ChangeAdaptation in Africa programme)
- At the community-based project level (e.g. effectiveness of adaptation interventionson household vulnerability reduction)

Table 2.2 Factors in Determining the Success of Climate Change Adaptation

Measure	**Description**
Effectiveness: Achieving objectives	―An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including capacity building, information exchange and social learning. Complications arise when evaluations are extended to examine the impact of CCAI on poverty, as care must be taken that theachievement of adaptation objectives does not have a detrimental affect on level of poverty nor a negative longer-term impact onvulnerability. Therefore, all adaptation evaluations should include measures of the overall development impact the intervention has inaddition to any evaluation of how well it has achieved the objectives.” There is potential for conflict between funders and beneficiaries, and within different groups of beneficiaries which need to be addressed at the outset.
Flexibility: How far canwe adapt?	―Climate change is uncertain, due partly to an incomplete understanding of climate science, and partly to the fact that climate changewill impact upon a future world. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation. One response to this is to plan for the ‗worst case scenario‘. However, there are disadvantages to this approach, notleast because it is extremely expensive, and spending more money on adaptation (especially in relation to potential benefits in the farfuture) reduces resources available for pressing development needs now. Instead, there is a growing recognition that adaptationshould seek to avoid large up-front sunk costs, and focus instead on building capacity to improve current climate resilience, and on‗no regret‘ and ‗win-win‘ interventions, allowing for better

Measure	Description
	decisions downstream. Successful adaptation therefore has to be flexible,not least because of the potential range of climate changes projected under different emissions scenarios.”
Equity: Inequalitydimensions toadaptation	―Adaptation aims to reduce vulnerability to climate change shocks and stresses. However, vulnerability also depends on socioeconomicfactors, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups. With respect to equityand vulnerability, it is possible to consider: • Inequalities between sectors, e.g. ecosystems are particularly vulnerable to climate change because of low capacity to adapt. • Inequalities between regions, e.g. greater impacts from climate change in small island states compared to developed countries; • Inequalities within societies, e.g. cementing the voicelessness of excluded groups, or gender inequalities in access to educationor healthcare, lowering adaptive capacity. In some situations these interact. For example recent analyses in Africa, Asia and Latin America, for example, show thatmarginalised, primary resource-dependent livelihood groups are particularly vulnerable to climate change impacts if their naturalresource base is severely stressed or degraded by overuse or if their governance systems are not capable of responding effectively.” Adaptation interventions that are inequitable will undermine the potential for welfare gains in the future, and are unsustainable.
Efficiency: Costeffectiveness	―Efficiency or cost-effectiveness is typically used to compare the costs of alternative ways of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target. However, we note that cost-effectiveness only provides comparativeinformation between two or more options. It does not provide an analysis of whether an intervention is justified in itself. Secondly, inrelation to adaptation, it is unclear what level of ambition, in terms of reducing risk, to aim towards. This is particularly since communities have always dealt with climate variability and there will inevitably be residual risk in future. Successful adaptation will involve deciding on acceptable levels of risk (defined to some extent by communities, policy-makers and funders in a collaborative way) as a trade off with the resource invests needed to reduce this risk, and whether this should involve maintaining or improving on current levels of risk and

Measure	Description
	resilience accordingly." ―Financial markets can directly internalise information on climate risks and help transfer adaptation and risk-reduction incentives to communities and individuals. The insurance sector- especially property, health and crop insurance- can efficiently spread risks and help reduce the financial hardships linked to extreme events. There are also opportunities for ‗regulatory' incentives on adaptation where there is a high or very high likelihood of specific patterns of climate change. In some sectors, e.g. housing in areas of high hurricane risk, insurance markets may drive such change. Also, public awareness of specific risks will drive market-based adaptation response. Adaptation is not then restricted to projects or programmes but is a function of governments using climate change science for designing incentives and regulations and markets driving technological change in both processes and outputs of production."
Sustainability: Thewider implications of adaptation	―Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention's impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention.Thus there is potential overlap with the criteria of ‗Equity' (Social) and ‗Efficiency' (Economic), above (those adaptations which areequitable and efficient are more likely to be sustainable).― ―The characteristic of sustainability provides an opportunity to prioritise those adaptations, which offer ‗win-win' solutions – that isthose which offer ancillary benefits (social, economic, environmental) in the context of development, even if the anticipated climateimpacts were not to occur.Sustainable adaptation is likely to include strong elements of partnership-building, community engagement, education andawareness-raising, as well as focusing on interventions which are ‗mainstreamed' into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education)."

Source: OECD (2007)

Criteria for successful adaptation, like the ones set out above, will probably need to be tailored to reflect the challenges of evaluating adaptation at different scales.

2.4.3 Evaluation Process of Climate Adaptation

To predict the autonomous adaptation and provide inputs for policy adaptation, there is a need to improve knowledge of the processes involved in adaptation decisions. This knowledge includes information about the steps in the process, the reasons for the decision, the handling of uncertainty, the choice of the type of adaptation and time, conditions that stimulate or dampen adaptation, and the consequences or adaptation strategies or measures of performance (Burton, 1997; Rayner and Malone, 1998; Tol et al, 1998;. Basher, 1999;. Klein et al, 1999; Pittock, 1999;. Smit et al, 1999).

Decisions regarding the adaptation can be done in one of several scale, by private individuals, communities or local agencies, national governments, and international organizations organizasi. Where this adaptation consciously planned activities, either by public institutions or individuals, there is an interest in assessing the performance or the relative merits of the action and alternative strategies.

Then, in order to cut through the complexities involved in the evaluation of adaptation, we've compiled a pyramid diagram, to show the relevance, scale evaluation methods and indicators. What should not be done explicitly take into account the factors of success that we have previously identified - effectiveness, flexibility, equity, efficiency and sustainability - this needs to be fully explored by the evaluation method chosen and reflected in the indicator. The main point of the pyramid is to show the multi-scale nature of the effort required, and in particular the birth at the household level is an important, necessary starting at the international level. And through this integration, the peak of the business can be identified. The attached diagram is a first draft and can be developed further, and is used in a number of different situations.

This pyramid reflects the structure and financial development, but does not show how the ongoing knowledge of climate risks management and in particular an increase in the understanding of climate change will feed into this. This possibility will occur at all scales, with some interconnection. Measurement scientific dimensions of climate change impacts and adaptations assessment in relation to this, tend to have the most important at the local scale. It can also be framed to assess this dimension in particular, in relation to changes in the process, outcomes and behaviors. The use of well-established theory that changes in the community evaluation would seem to fit in here. Real need now is for climate change adaptation industry to engage with professionals who work in evaluating and developing a coherent strategy evaluation. Long-term benefits to the effectiveness of welfare Climate Adaptation may be large. Moreover, addressing this need for professional evaluation will expand the evidence base available to a political debate on the funding of adaptation. Finally, while developing a coherent framework for critical evaluation and effort should be put into developing this, as acquainting professionals on the evaluation of adaptation to climate change, will also be important to ensure that the framework is efficient and effective.

Then, to evaluate the completeness of adaptation planning is currently done by the developed countries, conduct an evaluation methodology that links theory with evaluation guidelines for adaptation planning is developed by a community of practitioners. One of the classical model for evaluation in various disciplines of policy is the use of Logic Frameworks. Logical Framework Analysis (LFA) has formed the basis for evaluation in development for decades as evidenced by the evaluation protocol for the United States Agency for International Development and the Australian Agency for International Development (USAID 1973; Rosenberg and Posner 1979; Cummings 1997; AusAID 2005). LFA approach combines the analysis of (a) the relationship between the goals and objectives of the program; (b) the activities that these objectives can be realized; (c) inputs and resources necessary to carry out these activities; and (d) the output arising from the implementation of the activities identified.

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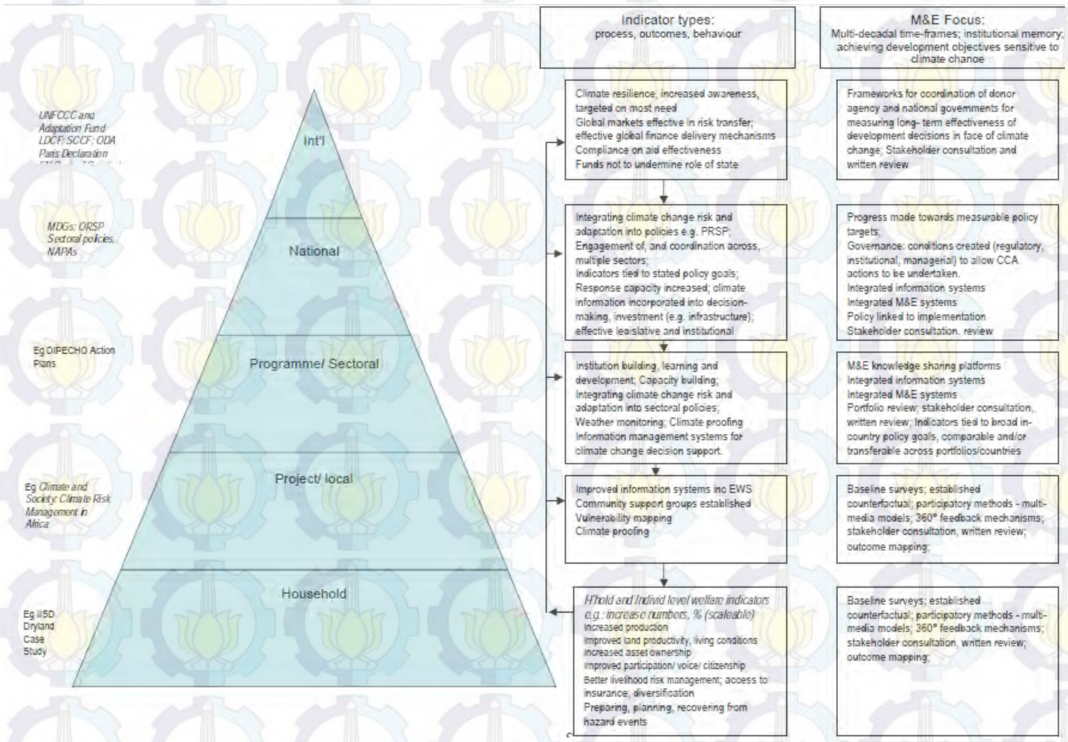

Figure 2.3 Pyramid of Adaptation Evaluation (source: IDS, 2008)

2.4.3.1 Tools and Methods for Evaluation of Adaptation Measures

The World Bank guide (2004) provides a useful summary of evaluation methods, and key points are extracted in Table 2.4 below.

2.5 Analytical Techniques

2.5.1 Multi-criteria analysis (MCA) and Analytic Hierarchical Process (AHP)

Multicriteria analysis was introduced since 1970 by Benjamin Franklin was a statesman United States (Jones et al., 2000). Franklin‘s findings of this assessment technique are the technique of choice is a study of double and usually conflicting (Azar, 2000). This multicriteria analysis approach was used with the flag (Flag Approach) to measure the sustainability of agricultural land use in Lesvos, Greece (Hermanides and Nijkkamp, 1997). The same is also used to select an alternative scenario development Buccoo Reef Marine Park using approaches regime (Regime Approach), (Brown et al., 2001). Intended using Regime method approach to assess rationally in choosing a unique multiple optionsare not real and can not be compared (Hinloopen et al., 1982).

Table 2.3 Methods and Key Features for Evaluation

Methods	Key Features
Performance Indicators	What can we use them for? • Setting performance targets and assessing progress toward achieving them. (withstakeholders) • Identifying problems via an early warning system to allow corrective action to betaken. • Indicating whether an in-depth evaluation or review is needed.
Logical FrameworkApproach	What can we use it for? • Improving quality of project and program designs—by requiring thespecification of clear objectives, the use of performance indicators, andassessment of risks. • Summarising design of complex activities. • Assisting the preparation of detailed operational plans. • Providing objective basis for activity review, monitoring, and evaluation.
Theory BasedEvaluation	Theory-based evaluation has similarities to the LogFrame approach but allows a much more in-depth understanding of the

Methods	Key Features
	workings of a program or activity—the ‗program theory‘ or ‗program logic.‘ In particular, it need not assume simple linear cause-and effectrelationships What can we use it for? • Mapping design of complex activities. • Improving planning and management.
Formal Surveys	What can we use them for? • Providing baseline data against which the performance of the strategy, program,or project can be compared. • Comparing different groups at a given point in time. • Comparing changes over time in the same group. • Comparing actual conditions with the targets established in a program or projectdesign. • Describing conditions in a particular community or group. • Providing a key input to a formal evaluation of the impact of a program orproject. • Assessing levels of poverty as basis for preparation of poverty reductionstrategies.
Rapid AppraisalMethods	What can we use them for? • Providing rapid information for management decision-making, especially at theproject or program level. • Providing qualitative understanding of complex socioeconomic changes, highlyinteractive social situations, or people‘s values, motivations, and reactions. • Providing context and interpretation for quantitative data collected by moreformal methods.
Participatory methods	What can we use them for? Learning about local conditions and local people‘s perspectives and priorities to design more responsive and sustainable interventions.

Methods	Key Features
	Identifying problems and trouble-shooting problems during implementation. Evaluating a project, program, or policy. Providing knowledge and skills to empower poor people.
Public ExpenditureTracking Surveys	Public expenditure tracking surveys (PETS) track the flow of public funds and determine the extent to which resources actually reach the target groups. What can we use them for? • Diagnosing problems in service delivery quantitatively. • Providing evidence on delays, _leakage,‘ and corruption.
Cost benefit and CostEffectiveness Analysis	Cost-benefit analysis measures both inputs and outputs in monetary terms. Costeffectiveness analysis estimates inputs in monetary terms and outcomes in non-monetary quantitative terms (such as improvements in student reading scores). What can we use them for? • Informing decisions about the most efficient allocation of resources. • Identifying projects that offer the highest rate of return on investment.
Impact Evaluation	What can we use it for? • Measuring outcomes and impacts of an activity and distinguishing these from theinfluence of other, external factors. • Helping to clarify whether costs for an activity are justified. • Informing decisions on whether to expand, modify or eliminate projects,programs or policies. • Drawing lessons for improving the design and management of future activities. • Comparing the effectiveness of alternative interventions. • Strengthening accountability for results.

Source: World Bank (2004)

Methods regime is one of the multicriteria assessment method based on the two data inputs, namely: (1) the matrix effect, and (2) a collection of weights that accompany the effects of its value. Impact matrix represents the values of the indicators are estimated for each scenario. The results of the research policy with the method of this regime are the ranking scenario, so it can choose which scenario is most desirable. As a final step will be a comprehensive assessment of the existing scenarios. Performance of various scenarios is compared, and then communicates with the decision makers.

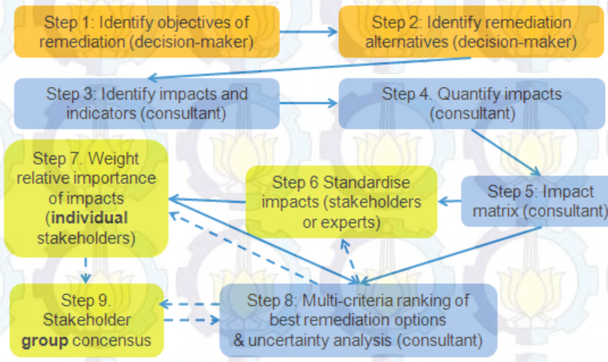

Figure 2.4 Steps and Roles in A Multi-Criteria Analysis

Analytical Hierarchy Process (AHP) is a method to solve a complex situation is not structured into several components in a hierarchical arrangement, by giving the subjective value of the relative importance of each variable, and specifies which variable has the highest priority in order to affect the outcome of the situation.

The decision making process is basically choosing a best alternative. As did the structuring issues, determination of alternatives, penenetapan possible value for the variable aleatori, settler value, preference requirements with respect to time, and specifications for the risk. However widening alternatives that can be set and the value assessment terperincinya possibilities, limitations that still surrounds is the basis of comparison in the form of a single criterion.

The main equipment Analytical Hierarchy Process (AHP) is to have a functional hierarchy with the main input of human perception. With hierarchy, a complex and unstructured problems can be solved in the group-group and organized into a hierarchical form.

2.5.2 Delphi Techniques

Delphi method is a modification of the technique brainwriting and surveys. In this method, the panel used in the movement of communication through several questionnaires contained in the article. Delphi technique was developed in the early 1950s to obtain an expert opinion. The object of this method is to obtain the most reliable consensus of an expert group. This technique is applied in various fields, for example for forecasting technology, public policy analysis, education innovation, program planning and others - others.

Delphi method was developed by Derlkey and associates at the Rand Corporation, California in the 1960s. Delphi method is a method of aligning a group communication process communication that is achieved effective process in getting the solution of complex problems.

Delphi approach has three distinct groups, namely: decision makers, staff, and the respondent. Decision makers will be responsible for the output of the Delphi study. Working groups consisting of five to nine members are composed of staff and decision makers, in charge of developing and analyzing all questionnaires, evaluation and data collection necessary to revise the questionnaire. The group is led by a coordinator staff who must have experience in the design and understand the Delphi method and recognize problem areas. The task of the staff coordinator is to control the staff in typing. Mailing questionnaires, split and process yield and schedule meeting belong here. Respondents are people who are experts in the matter, and those who agreed to answer the questionnaire.

2.6 Review of Urban Development and Climate Change in Surabaya

Albrechts (2006) said that spatial planning contains process of forming, allocation, harmonizing, and sizing the land or space for multifunction uses. That is the job usually implemented by the planning agency with the input from several disciplines (planners, transport analyst, geo-information specialist, and also economist. Based on the locations under the consideration, the spatial planning can be catagorized into national (country level), state (provincial level), district (regional level) and detailed spatial planning. Classification is based on extent of planning, how detail spatial plan is. The regional level provides guidelines on how area or space is zoned, controlled, and utilized but in general. The detailed spatial planning has legally binding status. It covers the whole area of city or little part of the city, and output map of spatial plan produced at large scale, with the scale around 1:500 to 1:5,000 or maybe larger. Many planning scenarios need few detailed information, and then very detailed is may not be required or even not available such as geological and hazards risk map usually not available in the large scale.

City spatial plan was done by private consultant who the close supervision from the governmental advisory team that consist officials people from different agencies. These agencies involved are Public Works, City Planning, Environment, Local Land Administration, Mining, Forestry, and Investment Coordinating Agency. At the fact of current city spatial plan form is the revision of previous spatial plan. Usually, it belongs of the evaluation on implementation and applicationof the previous spatial plan, the adjustment to current condition and a new development planning scenarios. The public participation was determined by inviting several communities and maybe business organisation for attending public meeting and FGD (focus group discussions). Finally, city spatial planning policy needs the approval and permits from local legislative or representative people and was accomplished as the local government regulation/policy.

In the district or city level, two types of city spatial plan were developed, that is RTRW (Rencana Tata Ruang Wilayah: General Spatial Plan) and RDTRK (Rencana Detil Tata Ruang Kota: Detailed City Spatial Plan). The latest RTRW and RDTRK are to be effectively implemented for 2010 to 2030. The development of them was based on Law 26/2007. However, there is a confusing situation in this case. Some government regulations required as a technical guideline were not yet issued. This includes government regulation on how spatial planning should be executed, how public participation be conducted and what are the map standard and specification. Therefore, provincial and district level government were forced to use new law but with old technical guidelines based on the previous law. With these circumstances, evaluated the RTRW 2010-2030, RDTRK 2000-2010 and RDTRTK 2010-2030 of the coastal city of Surabaya were evaluated. The following aspects were analyzed: how the spatial plan linked to the idea of disaster risk reduction, how the spatial plan address the issue of disaster risk reduction and how the spatial plan map represent disaster risk reduction effort.

The coastal area of Surabaya consists of 11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region
- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region.

Districts in Surabaya coastal area have 52, 6 km² of the total length of coast. The detail of length of coast follows:

Table 2.4 Length of Surabaya Coastal Area

No	**District**	**Area (km²)**	**Length of Coastal Area (km²)**
1	Benowo	23.73	3.9
2	Asemrowo	15.44	6.2
3	Krembangan	8.34	3.9
4	Pabean Cantikan	6.8	9.8
5	Semampir	8.76	3.4
6	Kenjeran	7.77	3.4
7	Bulak	6.72	7.0
8	Mulyorejo	14.21	2.8
9	Sukolilo	23.68	6.3

No	District	Area (km^2)	Length of Coastal Area (km^2)
10	Rungkut	21.08	4.4
11	Gunung Anyar	9.71	1.5
	Total	146.24	52.6

Source: Department of Agriculture, 2009

Flooding due to sea level rise potentially inundate coastal areas in Surabaya. Flooding occurs in 1st and 20th of every month but the height of the tide influenced the position of the earth, moon, and sun. Flooding due to sea level rise in coastal areas of Surabaya has a height of 0-1.5 meters. Flood elevation in each region is determined by the height of the topography due in accordance with the nature of the water that flows from high places to low places. In Surabaya, ebb and flow occur once time whitin one day. That is called diurnal tide which has tidal periode of 24 hours 50 minutes (BMKG Maritim Tanjung Perak, 2011). Flood due to sea level rise had been occurring in Krembangan on June, 2009 (Detik Surabaya, 2009). That flooding drown housings in Krembangan district with the height of 60 cm and duration of that is 4 hours. And then, on July 2010, flooding in Krembangan District had 20 cm height and the duration is 3 hours. Besides that, flooding occurred in Tanjung Perak Port Area in Februari 2010 with the sea level rise was 130 cm above mean sea level (Immadudina, 2011).

Because Surabaya has vulnerability to flood risk, the government has tried to make policy adaptation of urban and regional development to the SLR. Based on Firman at al (2008) on his study about Sea level Rise in java's North Coast Region: Implication for Urban Development Policy and planning which held in several cities named Jakarta, Semarang, and Surabaya, they identified existing adaptation strategy for three cities, as follows:

1. Rising awareness of decision makers that SLR will greatly affect urban and regional development in coastal regions.
2. Incorporating short-run and long-run impacts of SLR in the urban and regional development planning in coastal area
3. Formulating mitigation and adaptation policy at national and regional level

4. Developing inter local-government cooperation to deal with impacts of SLR
5. Improvinf the capacity of governmental institutions at all levels (national, regional, and local), including technical capacities.

In that report, also identified spatial planning for Jakarta, Semarang, and Surabaya Metropolitan Area as Adaptation Policy, which are:

1. Integrated urban and regional development at macro (Java), meso (metropolitan areas) and micro (cities) level, which take into consideration vulnerabilities and risk of SLR and other potential national disasters.
2. Establishment of institutional governance for regional and urban development in Java North Coast Areas, ehich should involve inter-local government cooperation, to deal with impacts of SLR
3. Improvement of local government capacity in adaptation and mitigation, especially the local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang) and other related departements.

2.7 Summary

A lack of discussion of causal factors and relevant adaptations may influence the level of vulnerability at a future time. The vulnerability level will be affected not only by the causal factors but also by certain actions from stakeholders or adaptations. The gap emerges from vulnerability research results assessment particularly for determining vulnerability levels based on certain factors (e.g. Armas, 2008; Rygel et al. 2006; Odeh, 2002; Gabor & Griffith, 1980). The results of these assessments are often used inappropriately in deciding stakeholders‘ actions to reduce community vulnerability (Barnett et al., 2008). Therefore, there is an urgent need to integrate discussion of causal factors with the selection of stakeholders‘ actions in vulnerability assessment.

In addition, a major gap which important for this research is the lack of understanding of adaptation at individual and household levels, particularly those that are multi-local and that go beyond sedentary, productive activities, and of the underlying systems that may assist or directly enable adaptive capacity. Then, mismatches between governmental adaptation measures on the one hand and non-governmental or individual adaptation measures in urban areas on the other are important issues that have often been overlooked. No discussion exists on intermediary institutions that can facilitate flow of information, as well as enable or constrain adaptive measures.

Although researchers possess a long record of human adaptation to climate variability and other environmental changes (Adger et al., 2007), little of that record has been analyzed and synthesized in a manner conducive to providing lessons for efforts to adapt to future climate variability and change.

Then, vulnerability research is a weak correlation between vulnerability and other concepts within and beyond disaster risk management. To some degree, the relationship between policy and vulnerability analysis has received little focus as the majority of the existing research has stressed mapping and the level assessment results (e.g. Armas, 2008; Preston et al., 2008; Rygel et al., 2006; Brenkert & Malone, 2005; Odeh, 2002; Gabor & Griffith, 1980). Furthermore, Adger et al. (2004) state that the importance of adaptive capacity as a function of adaptation will influence future levels of vulnerability.

The adaptation itself is a part of public policies and planning systems. The quantitative approach in dynamic analysis could give a ranking system based on these comparisons. The rank will sort the future levels from the highest to the lowest. Therefore, the most effective adaptation can be distinguished from the lowest future vulnerability level after applying certain scenarios through the modelling process. The information on the most effective adaptation can finally enhance the quality of public policies and planning systems.

Adaptation requires largescale investment is likely to be episodic and staggered. It is likely to be triggered through extreme events that raise the consciousness of climate change within policy making and hence giving legitimacy to governmental action. This section is also arguedthat adaptation operates at different spatial and societal scales and that success or its sustainability needs to be evaluated against different criteria at these different levels. Elements of effectiveness, efficiency, equity and legitimacy are important in judging success. From this literature review, the criteria used to evaluation is identified. Here is the criterion, and then it will be explained to sub-criterion.

Table 2.5 Criterion and Sub Criterion Used in This Research

Measure	Description	Sub-Criteria
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including **capacity building, information exchange and social learning.**	• Enhancing policy, planning for adaptation measure • Legal and regulatory • Integration with development policies and planning • Institutional mechanism, capacities and structures
Flexibility: How far canwe adapt?	Climate change is uncertain, due partly to an incomplete **understanding of climate science**, and partly to the fact that climate changewill **impact upon a future world**. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation.	• Hazards risk • Scientific and technical capacities and innovation
Equity: Inequalitydimensions toadaptation	Adaptation aims to **reduce vulnerability** to climate change shocks and stresses. However, vulnerability also depends on **socioeconomicfactors**, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect	• Impact data • Environmental and natural resources • Livelihood • Culture, attitudes, education

Measure	Description	Sub-Criteria
	especially vulnerable groups	
Efficiency: Costeffectiveness	Efficiency or **cost-effectiveness** is typically used to compare the **costs of alternative ways** of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target.	• Financial instruments • Cost recovery for adaptation
Sustainability: Thewider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention‘s impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention. Sustainable adaptation is likely to include strong elements of **partnership-building, community engagement, education andawareness-raising**, as well as focusing on interventions which are _mainstreamed‘ into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education).	• Public awareness, knowledge, skill • Information management and sharing • Learning and research

CHAPTER III

METHODOLOGY

This study is based on exploring and describing the current situation of adaptation measure in Surabaya, Indonesia. Then, howurban development integrated to adaptation measure. This chapter tries to explore methods and framework which will be used in analysis.

3.1 Research Approach and Conceptual Framework

Based on vulnerability in coastal area related to adaptation measure which has been done there, the specific objective of this study is to get overall criteria that can be used in evaluation, then focus on communities that vulnerable on flood to know the successful of adaptation. After condition of adaptation is shown, then it can be integrated with urban development for recommend the possible adaptation based on vulnerable area. This is conceptual framework that used in this research:

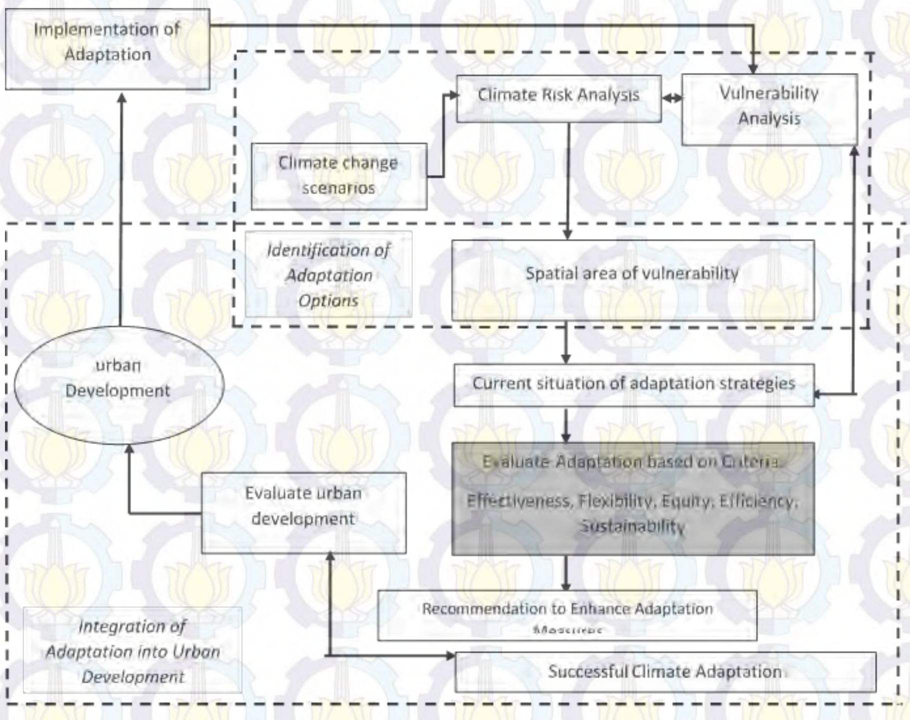

Figure 3.1 Conceptual Framework

A conceptual framework from this study is shown in Figure 3.1. It shows that determine adaptation strategies is needed to be thought after climate risk analysis. Identification of Adaptation starts with projections/scenarios for future development of climate parameters. Risk analysis considers the probability and impacts of harmful events such as floods, drought/water scarcity and etc. The impacts of these events are represented by vulnerability indices, determined using a vulnerability assessment that is conducted at the village and household levels. The combination of vulnerability and risk analyses allows for the identification of areas to be prioritized for adaptation actions (spatial area of vulnerability).

Based on vulnerability area and adaptation measure which is in urban development policy, current situation of adaptation will try to identify. From current situation of the adaptation, criteria for making adaptation successful will be shown. In addition, exploration of success criteria of adaptation will be done after evaluating urban development and analyzing current adaptation strategies. Final results will be synergized with and integrated into urban development and the successful practices of adaptation.

In addition, evaluation of adaptation measure plays two critical roles in ensuring effective adaptation: they support the long-term process of learning "what works" in adaptation and they provide a tool to manage the work in the context of the uncertainty surrounding climate change impacts. Integration of adaptation into urban development is a main objective in evaluation process above to strengthen connections between bottom-up and top-down information and decision making. Evaluation of adaptation is one of the weakest areas of adaptation practice. Of those evaluations carried out to date, most have been undertaken as part of ongoing implementation, whilst only a few have focused on evaluating interventions after completion. Given this panorama, there are increasing calls for an integrated evaluation framework for adaptation which is more closely aligned with development planning.

3.2 Methodology

Figure 3.2 shows the metholodology of study in five task conducted for evaluating adaptation measures in which primary and secondary data will be use to support In that figure explains about every task that have to through to get the successful adaptation measures. In Figure 3.2, there are several task that have to do it to achieve the main objective in Chapter 1. The main objective 1 is assessing current situation of adaptation strategies in term of development context in coastal city of Surabaya. Several task that have done in this study, namely:

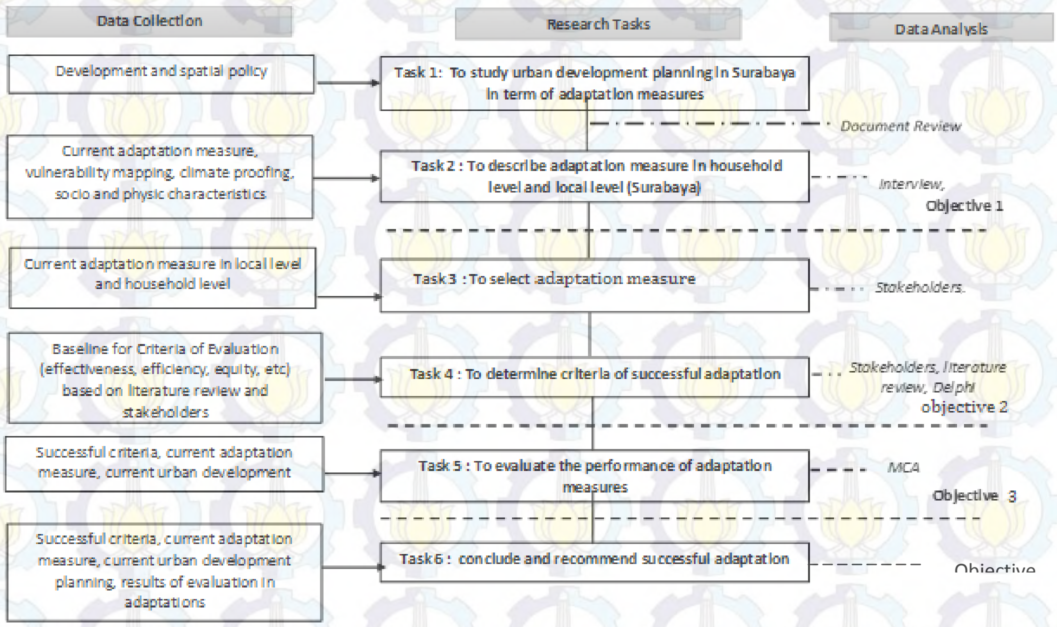

Figure 3.2 Methodological Framework

Task 1: to study urban development planningin term of characteristics and climate change in Surabaya

In this first task tried to get current and future condition of Surabaya's condition based on urban planning documents. This task have been done based on review of urban development planning document in Surabaya and its applications in that area including vulnerability and flood risks in Surabaya. This task is the first step to deal with flood problem, knowing the climate change characteristic to support adaptation measures is very important to know the effectiveness of the adaptation measure.

Task 2: To describe current adaptation measures

In this task used interview techniques to know the adaptation measure which have been done by local government and local people. In this task, also explain about characteristics and profile adaptation measures in that area. Observation and photograph also did in this task to support evidence of adaptation measure in term of flood riks. .Identify existing adaptations are needed to know what kind of adaptation strategies that already happened to deal with flood and also to know the impact of existing adaptation strategies if there are any impacts. In this task to get baseline information about existing adaptation strategies and plan adaptation strategies, interviewing expert (local government, NGO and local community)

Task 3: To select climate adaptation measures for evaluation

Through by people perception, the study is conducted to select and prioritize adaptation measure done in task 2.In this task, stakeholers are also used to help prioritizing the current adaptation measure. Scoring analysisis conducted to reach the goal of this task by stakeholders' perception.

Task 4: To determine criteria of successful adaptation

There are many criteria involves to evaluate adaptation measure. Hoewever, in this task found out criteria that are from resident perceptions and government perceptions. To conduct this task, Delphi analysis used with involved stakeholders.Criteria which are found in literature review will be crosschecked into stakeholders to get appropriate criteria that suitable in study area. The steps of Delphi analysis is explained on later section (section 3.5).

Task 5: To evaluate performance of current adaptation measures

After criteria found, in this task we used those criteria to evaluate current adaptation strategies. In this section selected different adaptation strategies by making list of adaptations strategies to deal with flood vulnerability that happened in selected area. The choosen adaptation strategy is based on stakeholder's perception. Then used scoring analysis (MCA) is in order to end up with effective and adaptation measures in developing adaptation strategies plan to deal with the problem of flood risk because of climate change and also deal with the vulnerable that happened in the selected area. Scoring analysis approach was a method to evaluate different type of adaptation strategies on wide of rage of attribute and to prioritize objectives while evaluating strategies. The performance of criteria assessed is effectiveness and benefits of each adaptation strategies. In this task, questionnaire (**see in appendices C and E**) of evaluation criteria will be distributed to stakeholders involved (list of stakeholders can be seen in later section).

Task 6 Conclude and Recommends for Enhancing Adaptation Measures

From all task above, integrating with results of evaluation and urban development, stakeholders, the study leads to conclude and recommend successful practices in adaptation. This study also recommended future research that can full fill the gap. In this task also recommend about futher studies which will not conducted in this study (knowledge gaps in this study) and also recommend to local government how to improve adaptation strategies become more successful in study areaa

3.3 Study Area

In Planning Document of Surabaya (Rencana Tata Ruang Wilayah Kota Surabaya), the city is devided to many areas. One of that area is coastal area which have special development such as Management of Coastal Areas and Small Islands (Pengelolaan Wilayah Pesisir dan Pulau-Pulau Kecil). The coastal area of Surabaya consists of 11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region

- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region

Districts in Surabaya coastal area have 52, 6 km² of the total length of coast. The detail of study area boundary is shown from Figure 3.3 below. Then, Based on previous study which is conducted by Prasita (2013), coastal village which is potentially affected directly by flood are shown in Table 3.1. From 32,639 Ha total area about 25,919 Ha or 80.72% of total area located in low land with –0.5 up to 5 m SHVP or 3 up to 8 m height. By this condition the area susceptible to inundate if one-meter increasing of sea level rise.

Table 3.1 Coastal Village Affected By Flood Risk

No	**Distrricts**	**Vilage**
1.	Benowo	Romo Kalisari
		Tambak Oso Wilangun
2.	Krembangan	Monokrembangan
		Perak Barat
3.	Pabean Cantikan	Perak Utara
		Perak Timur
4.	Kenjeran	Kedung Cowek
5.	Mulyorejo	Dukuh Suterojo
		Kalisari
		Kejawan Putih Tambak
6.	Sukolilo	Keputih
7.	Rungkut	Medokan Ayu
		Wonorejo
8.	Gunung Anyar	Gunung Anyar

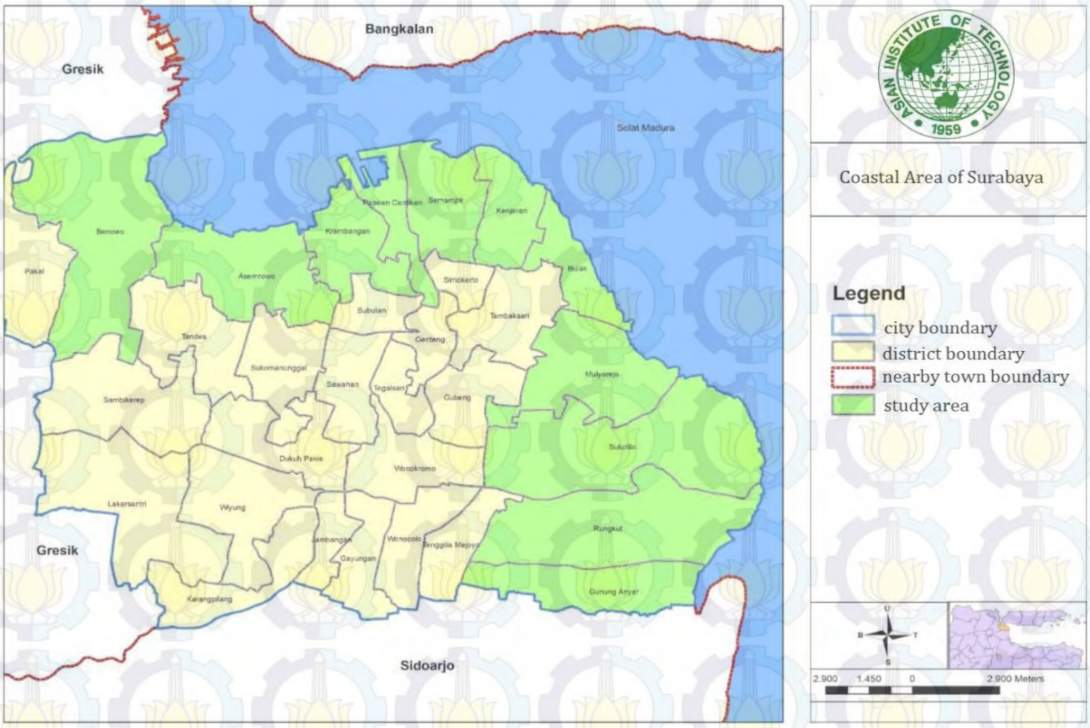

Figure 3.3 Coastal Areas in Surabaya

Source: City Planning Document of Surabaya (2013) with author's modification

However, Immadudina (2011) identified spatial area of vulnerability related to Sea Level Rise in coastal area of Surabaya. These area are Krembangan District, Pabean Cantikan, Semampir, and Kenjeran District. So, based on comparation of previous studies which are conducted by Prasita (2004) and Immadudina (2011), the selected areas to **distribute questionnaire to household** are shown in Table 3.2 below.

Table 3.2 Selected Areas

No	District	Village	Population (people)
1.	Krembangan	Monokrembangan	38.767
		Perak Barat	20.050
2.	Pabean Cantikan	Perak Utara	31.104
		Perak Timur	16.739
3.	Kenjeran	Kedung Cowek	11.388
	Total		118.048

Source: National Statistical Agency, 2013

Based on Firman at al (2008) on his study about Sea level Rise in java's North Coast Region: Implication for Urban Development Policy and planning which held in several cities named Jakarta, Semarang, and Surabaya, they identified existing adaptation strategy for three cities, as follows:

1. Rising awareness of decision makers that SLR will greatly affect urban and regional development in coastal regions.
2. Incorporating short-run and long-run impacts of SLR in the urban and regional development planning in coastal area
3. Formulating mitigation and adaptation policy at national and regional level
4. Developing inter local-government cooperation to deal with impacts of SLR
5. Improvinf the capacity of governmental institutions at all levels (national, regional, and local), including technical capacities.

In that report, also identified spatial planning for Jakarta, Semarang, and Surabaya Metropolitan Area as Adaptation Policy, which are:

1. Integrated urban and regional development at macro (Java), meso (metropolitan areas) and micro (cities) level, which take into considerantion vulnerabilities and risk of SLR and other potential national disasters.
2. Establishment of institutional governance for regional and urban development in Java North Coast Areas, ehich should involve inter-local government cooperation, to deal with impacts of SLR
3. Improvement of local government capacity in adaptation and mitigation, especially the local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang) and other related departements.

In the dry season, Head of Planning Urban Development (BAPPEKO) made concentration to face flood in Surabaya. Governments do the dredging of the river and made installation of pumps in whole area of Surabaya. Dredging of the river flow is also enhanced in the northern region that led to bosom or reservoirs in Morokrembangan, before the water is discharged into the sea. There are many bosoms in Surabaya including Morokrembangan, Kalidami, Bratang, Rungkut Industri, Wonorejo, Kedurus, dan Jurang Kuping. Generally, bosom is usually used by people to control and keep water (water storage). In addition to these functions also take advantage of the community as fish farming and irrigation fields.

To address flood riak in Surabaya, also improved maintenance of existing pumps in 68 units located in 21 different regions of the pump house in puddles in Surabaya. The pumps are expected to cope with and control flooding in the city. In addition, Surabaya City Government efforts to get help from the Netherlands in the form of a grant of 200 thousand Euros, or approximately USD 1.73 billion.

In addition, adaptation strategies to flood risk have been identified from Masterplan of Surabaya East Coastal Area (Pantai Timur Surabaya). In this area, government has made mangrove afforestation in East Area of Coastal Surabaya because this area is located in the end of the watershed

3.4 Data Collection Methods

Data will be used in this study is mixed data (qualitative and quantitative data). Qualitative data included stakeholder knowledge in determine criteria to evaluate adaptation measures. Quantities data included the information that includes number, such as the existing condition in this study area, such as: environmental, economic, social vulnerable that affected flood and climate factors (precipitation, temperature, river discharge, and sea tide) to describe vulnerable area. Table 3.3 shows data collection that will support in this study and describes techniques how to get these data. From table 3.3, the data can be divided into 2 these are primary and secondary data resources.

3.4.1 Primary Data Resources

The research is dependent on primary data collection, such as: field observation and photograph, in-depth interview and questionnaire with semi structured questionnaire interview with main stakeholder and local people.

- *Observation and photograph*

Observation will be conducted for documentation and knowing the existing environment spatially from study area.

- *Interview to stakeholders*

Interviews were conducted on-site and off-site research. Stakeholders are chosen by using a **purposive sampling or non-probability sample**. So this technique can determine the proper experts for this study sampled directly (related parties as a resource). Focused main stakeholder is semi structured interview. Interview in this study is used for determining criteria using Delphi Analysis and measuring the criteria regarding the successful of adaptation. The selected stakeholders are Town Planning Office, Department of Public Works of Water Management, Regional Disaster Management Agencies (BPBD), Ministry of Public Work, and Academician. For the list of stakeholders involved in this interview, see **Table 3.4**.

Stakeholders that have been selected to provide information from government offices as stakeholders is stakeholders who hold decision-making power in the future. Stakeholders that have been selected based on their expertise in this study or in connection with this research. In addition to interviews, questionnaires are used to obtain information that can cover a large area and is associated with this research.

Table 3.3 Data Collection Matrix

Research Question	**Key Body of Evidence**	**Data/Information**	**Source/s**	**Technique of Data gathering**
What are characteristics of urban development plan in Surabaya and their function and importance to the society in terms of	- Overall explanation of urban development - The situation of existing policy and plan	- Master Plan of City - Land use Map - Urban Planning Law - Climate change scenario in Surabaya - Flooding	- Departement of Ciy Planning Surabaya - Departement of Disasater Management	Document Review

Research Question	Key Body of Evidence	Data/Information	Source/s	Technique of Data gathering
adaptation measure?	of urban planning - Results of existing city development	maps - Land use maps		
What are the criteria to evaluate adaptation measure?	Identification of criteria in successful adaptation	- Data about current adaptation	• Local people • Departement of Ciy Planning Surabaya • Departement of Disasater Management	• Interview with stakeholders
How are the performance of current adaptation strategies in relation to urban development in Surabaya?	• Explananti on of government and local community adaptation • Explanation of past and on-going solution • Explanation of city development • Result of criteria of evaluation	- GIS Map - Adaptation by government and local people	• Key informants • Surabaya City Planning Departement • Disaster management Departement • Departement of Ciy Planning Surabaya • Departement of Disasater Management • Departement of Public Works	• Interview to stakeholders and head of districts

Table 3.4 List of Stakeholders

No	Stakeholders
1	Town Planning Agencies (Bappeko)
2	City Department of Spatial Planning (Dinas Tata Kota dan Tata Ruang)

3	Regional Disaster Management Agencies (BPBD)
4	Academician
5	Agency for Environmental Management (BLH)

This table below shows design of primary data which used in questionnaire to get performance of adaptation measure in Surabaya Coastal area. Primary data used as mention before, photograph is used to show the condition of Surabaya Coastal Area and questionnaire to evaluate adaptation measures in the study area.

Table 3.5 Primary Data Resources

No	Data	Source	Agency
1.	Baseline of charcteristics of coastal development plan	Stakeholders from government and local people	Departement of Public Works, local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang), Departement of Marine.
2.	Baseline of adaptation measures • Current adaptation in household level • Current adaptation in local government		Local people
3	Baseline for Criteria of Evaluation (inequality dimensions) • Impact data • Environmental and natural resources • Livelihood data • Culture, attitudes, education (social data)		
4	Prioritized and scoring about evaluation criteria	Stakeholders from government and local people	Local people Local government

3.4.2 Secondary Data Resources

A secondary survey was also conducted to collect data related to government and non government publications. These data were especially significant for coverage of quantitative variables. Moreover, some of the data from both government and non-government publications can justify characteristics of the community.

Secondary Data Sources Secondary data is data that is collected through a text document and can document unpublished or published and can be obtained from the relevant agencies (government offices, and universities) and organizations (NGOs) such as: a report or document review. Secondary data can be obtained from other sources, including some reports, journals, books, documents and internet workshops. For this study, the use of secondary data sources from multiple reports / studies that local governments do, the journal in the same case but a different location, workshops and Internet documents can also be used as a reference to support this research

Table 3.6 Secondary Data Resources

No	Critical Information Set	Data Sources
1.	Baseline for urban development characteristic • Integrated Coastal Zone Management Document • RTRW (Rencana Tata Ruang Wilayah: General Spatial Plan) and RDTRK (Rencana Detil Tata Ruang Kota: Detailed City Spatial Plan) of Surabaya	• Bappeko • BPDB • Department of Public Works • Departement of City Planning • Departement of marine and Fishery
2.	Baseline for Adaptation Measure • Vulnerability Map • Vulnerable group who works in vulnerable sector • Climate proofing • Hazards event • Adaptation policy, project, etc	• BAPPEKO • BPBD • BMKG • Department of Public Works • Departement of marine and Fishery • Agency of National Land • Agency of National Statistic

From table 3.6 above, there are many data will be used in this research which are from secondary data. Baseline will be used are urban development baseline, adaptation baseline, and evaluation baseline. For urban development baseline will be found in local planning agency such as BAPPEKO and related agencies which are have role in Surabaya planning. Then, baseline for adaptation measures will be identified from Departement who works directly to adaptation measure like Departement of Public Works and Department of Marine. This is because of limitation of this research which concern adaptation in local and household level.

So, based on the stages of my research and sampling method, the data collection process included a Delphi Questionnaire, Semi-structured Telephone Interviews and a Secondary Survey. All three instruments of data collection accommodated both qualitative and quantitative data. Moreover, those three instruments also valued the explanation of relevant key persons whose input was a significant factor in defining the qualitative data. These explanations were critical because of the lack of systematic documentation of past floods.

3.5 Data Analysis Methods and Techniques

This reaserch uses Quantitative and Quantitative Methods. Quantitative includes scoring for for weighting criteria. In this research, weighting criteria is used to weighting factors that is used to get the appropriate adaptation to deal with the flood problem in Surabaya. Qualitative Methods is used to exploring adaptation criteria given by stakelokders using Delphi Analysis.

Analysis of data from interviews tends to focus either on the language (discourse or narrative analyses) or the content of interviews (King and Horrocks 2010). This analysis focused on the content. The major activity of data analysis involved categorising data based on themes and topics. Some of these were inductive, they became evident from interview responses, but most were deductive, organized by the nine adaptation options.Table 3.7 below shows summary of data analysis methods and techniques that will be used in this research.

Table 3.7 Data Analysis Techniques

No	Objectives	Task	Data	Analysis Techniques
1	To assess current situation of adaptation strategies in term of development context in coastal city of Surabaya	To study urban development planning in Surabaya in term of adaptation measures	Current situation of urban development planning	Descriptive (review documents)
		To describe adaptation measure in household level and local level (Surabaya)	Current situation of adaptation measure	Descriptive
2	To assess criteria of evaluating climate change adaptation in relation to coastal urban development	To select adaptation measure	Current situation of adaptation, Vulnerability Map	Descriptive, scoring
		To find out criteria of successful adaptation	Criteria based on literature review and stakeholders	Delphi
3	To evaluate the performance of adaptation measures	To evaluate the performance of adaptation measures	Successful criteria, current adaptation measure, current urban development planning	MCA (Multi Criteria Analysis), AHP,
4	To recommend adaptation measures	conclude and recommend successful adaptation	Successful criteria, current adaptation measure, current urban development planning, results of evaluation in adaptations	descriptive

From the table 3.4, this research will use specific methods to reach the aim of this research. The methods will explain below.

- **Decriptive analysis**

  This method is used to describe that already determined with the available existing data, so the data can be visualization in map. this method uses Microsoft excel with using percentage or graphic to describe the condition. In this descriptive analysis describes about urban development characteristics.

- **Delphi analysis**

In the Delphi Policy, I value the importance of avoiding face-to-faceinteractions among stakeholders as one of the main characteristics inachieving objective consensus. Consensus was confirmed by discussing onestakeholder’s opinions with others and/or clarifying their first round results withthose of the next round. In addition, avoiding stakeholders meeting face-tofaceminimised the bias from superior-subordinate relationships, prevented theneed for stakeholders to travel from distant locations and reduced the effect ofdiffering communication skills among key stakeholders. These advantageshave also been identified by Ley and Anderson, 1975; Mitchell, 1991; Bunting,2008; and Linstone and Turoff, 1975. These advantages are importantparticularly for my case study which has the potential bias based on theirrelationships, locations and communication skills among stakeholders.

Focusgroup discussion on this case study which need a face to face meeting will bepredicted to increase the bias among stakeholders.Furthermore, an iterative questionnaire in Delphi can increase the validity ofstakeholders’ responses. The iterative questionnaire (as in Franklin & Hart,2007; Briedenhann & Butts, 2006; Linstone & Turoff, 1975; Ley & Anderson,1975) gives two-fold benefits: 1) minimises misunderstanding betweenresearchers and stakeholders and 2) enhances stakeholders’ understandingof vulnerability and DRM. Since the current responses to DRM in my casestudy related mainly to the immediate response to emergency situations, therewas a pressing need to expand the understanding of stakeholders to includethe mitigation, preparedness, response and recovery stages (Shah AlamKhan, 2008; FEMA, 2006; and Atmanand, 2003).

Delphi analysis is used to strengthen the results of the criteria to evaluate the adaptation strategies. Respondents used are stakeholders who have selected to obtain fixation of the criteria of successful adaptation.

Interview of Delphi can be seen in **appendix B**. The stakeholders involved in Delphi Analysis can be seen at **table 3.4**. This is steps for Delphi Analysis in this research;

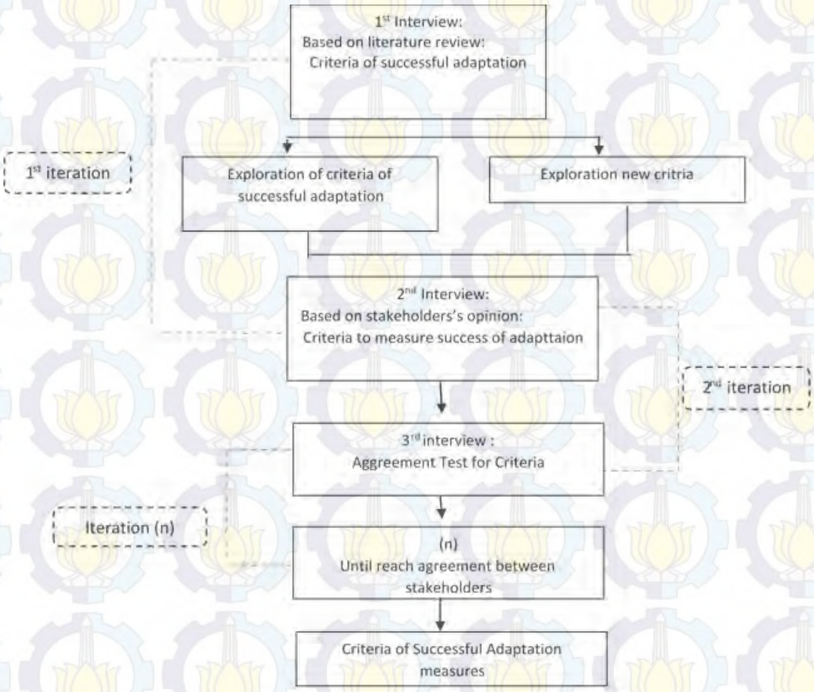

Figure 3.4 Steps in Delphi Analysis in this Study

1. Interview Stakeholders for Exploration Criteria for Evaluating Adaptation Measure. To conducted exploratory Criteria against stakeholders / key informant interviews. Based on objectives, the interview was conducted semi-structured interview technique.
2. Data Reduction and Display Results interview
   After finished with exploration of evaluation criteria by stakeholders, data reduction used to validation evaluation criteria.
3. Iteration Conclusion of Criteria Evaluation for Adaptation Measure
   Iteration is intended to ensure (cross check), whether criteria in accordance with the results of the interview summary meaning given by the respective stakeholders. From the identification of critria based on each stakeholder opinion, and then simplified, or grouped substantially. To other criteria(**see table 3.7**) that have not

mentioned by all stakeholders, will be cross check against the other respondents. So it can be formulated or inferred the criteria for measuring adaptation measures. This Figure below shows steps of Delphi analysis.

In the analysis stage of the Delphi Policy Technique, I used a qualitative approach rather than quantitative. I avoided relying only on quantificationbased analyses such as a Likert scale or tallying. While these methods may have increased the consistency of the analytical process, it may have also weakened its sensitivity to the variety of stakeholders' opinions and backgrounds, as aggregate values derived from a Likert scale do not allow for differing levels of competency among stakeholders. As Delphi is a qualitative based analysis, the competency of different stakeholders had to be valued proportionally.

- **Multi Criteria Analysis and AHP analysis for Evaluation**

Multi-criteria analysis is undertaken to make a comparativeassessment between projects or heterogeneous measures.In the evaluation field, multi-criteria analysis is usually an ex anteevaluation tool, and is particularly used for the examination of theintervention's strategic choices.In ex post evaluations, multi-criteria analysis can contribute to theevaluation of a programme or a policy through the appraisal of itsimpacts with regards to several criteria.In this analysis, stakeholders will be provided questionnaire based on previous analysis. Then, they must fill criteria of evaluation and after that MCA can be conducted to evaluate the selected adaptation strategies. This is the scoring scale to fill the questionnaire. AHP Questionaire can be seen at **Appendix C**.

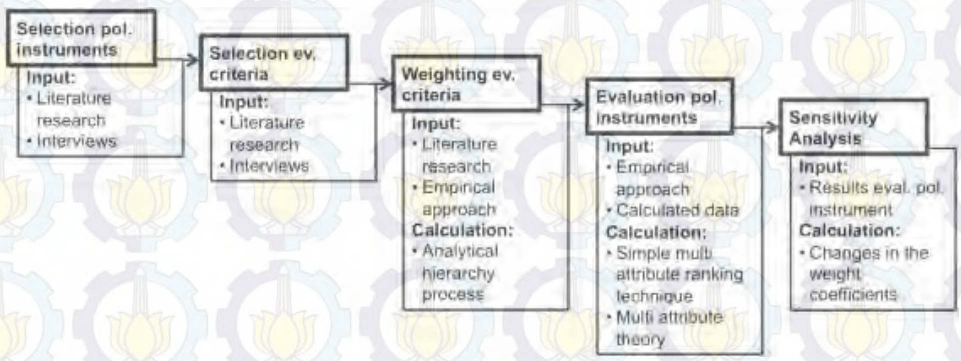

Figure 3.5 Steps in MCA

Level of importance of each criterion in this study was obtained from the interview process by seeking the perception of various stakeholders. Stakeholders were taken here is at the level of decision-making authority - the relevant agencies. The interview process is done by using a questionnaire in which stakeholders are asked to rank criteria - criteria, ranging from the most important criteria to the lowest interest rate. From these interviews, the survey results can be determined weight of each criterion then. The weighting process to get the weight or importance of each criterion is generally done with the following methodology:

- Make pairwise comparison matrix for each respondent to obtain criterion weights of each respondent
- Creating the average weight for all stakeholders.

The data input for MultiCriteria Analysis are Criteria from stakeholders combined with literature review and sub criteria. The value of these criteria os based on stakeholders's perception. So, Chiisen stakeholders gave their opinion to measure criteria. Scoring scale is used to help multi-criteria analysis. The scoring questionnaire can be seen at **Appendix E**. This table below shows criteria and how to measure criteria.

Table 3.9 Criteria for Evaluating in MCA

No	Main Criteria	Sub-Criteria	Value
1.	Effectiveness	Enhancing policy, planning for adaptation measure	Qualitative value 1 : Definitely disagree 2 : Mostly disagree 3 : Neutral 4 : mostly agree 5 : definitely agree
		Legal and regulatory	
		Integration with development policies and planning	
		Institutional mechanism, capacities and structures	
2	Flexibility	Hazards risk	
		Scientific and technical capacities and innovation	
3.	Inequality	Impact data	
		Environmental and natural resources	
		livelihood	
		Culture, attitudes, education	

No	Main Criteria	Sub-Criteria	Value
4.	Efficiency	Financial instruments	
		Cost recovery for adaptation	
5.	sustainability	Public awareness, knowledge, skill	
		Information management and sharing	
		Learning and research	

CHAPTER IV
OVERVIEW OF STUDY AREA, FLOOD RISK, AND ITS VULNERABILITY

4.1 Overview of Surabaya City

Surabaya city is a capital of East Java Province located on foreshore. Its main activities are manufacturing and trading with major air and seaport facilities. Surabaya also plays a role as a centre of development for eastern part of Indonesia.In geographical, the city of Surabaya is located in the south latitude and east longitude between 7°12 'to 7°21' south latitude and 112°36 ' to 127°54' east longitude. The total area of the city of Surabaya is 32 639 hectares which is divided into five regions maid mayor, 28 regions/districts and 163 villages.

In Regional context, Surabaya City plays a role as a center of development in East Java Province. Surabaya and its surrounding regencies formed a greater urban area known as “Gerbang Kertosusila” or GKS, which is an acronym for the regencies (Kabupaten) of Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo and Lamongan.

In the context of GKS, development of Surabaya City is a part of Surabaya Metropolitan Area (KMS), which plays a role as:

- Center of economic activities in East Java, Bali, and other Eastern Indonesia regions, with thepresence of Tanjung Perak Port as its main support.
- Center of regional development in East Java Province
- Urban Center for social-economic activities in “Gerbang Kertosusila” region.

Recent urban development has spread south from Surabaya to Sidoarjo, where both industrial and residential growths have been vigorous. To the west, Gresik is emerging as a major industrial centre as well, with significant residential development to be expected. The study is done in the districst that are located in the Coastal Zone of Surabaya. Coastal subdistrict in Surabaya has an area of 146.24 km².The coastal areas of Surabaya consist11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region
- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region.

Then, Districts in Surabaya coastal area have 52,6 km² of the total length of coast. The detail of length of coast follows:

Table 4.1 Length of Surabaya Coastal Area

No	**District**	**Area (km²)**	**Length of Coastal Area (km²)**
1	Benowo	23.73	3.9
2	Asemrowo	15.44	6.2
3	Krembangan	8.34	3.9
4	Pabean Cantikan	6.8	9.8
5	Semampir	8.76	3.4
6	Kenjeran	7.77	3.4
7	Bulak	6.72	7.0
8	Mulyorejo	14.21	2.8
9	Sukolilo	23.68	6.3
10	Rungkut	21.08	4.4
11	Gunung Anyar	9.71	1.5
	Total	146.24	52.6

Source: Department of Agriculture, 2009

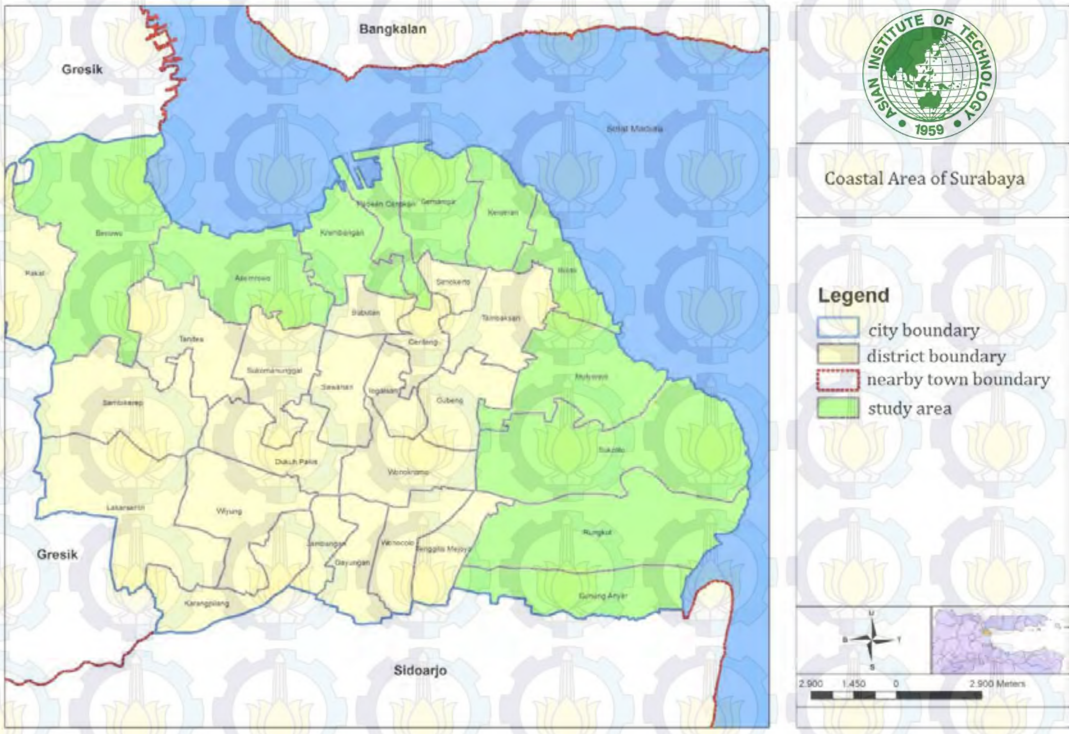

Figure 4.1 Study Area

4.1.1 Topography and Soil Type

Most of the areas in coastal Surabaya are low-lying lands. Topographic conditions in the study area vary in height 0-6 meters above sea level, except in the south with a height of 25-50 meters above sea level. The ground slope range are 0-2% in low-lying areas and 2 -15% sloping hilly areas (Spatial Plan of Surabaya 2009-2013).

The soil type in the study area consists of four types of hydro alluvial, alluvial gray, taupe alluvial and taupe gromosol. Almost the entire area of research has classified the land of fine-grained alluvial type with a depth of more than 0.9 m. Mainland alluvium (alluvial) contains gravel, gravel, clay, and fractions of local fossils. The spread of these rocks are in most towards the coast. This land is relatively impermeable because it produces a low water absorbing power.

From table 4.2, it can be seen that the existing topography in coastal areas are categorized as low / flat. Lowest elevation can be found in some villages and farms as Greges langon (district. Asemrowo), Hamlet Sutorejo (district. Mulyorejo) and Medokan Ayu (Rungkut). In regard to disaster mitigation, some villages which have become a lower elevation to be seen associated with susceptibility to both flooding due to high rainfall and runoff discharge and sea level rise.

Table 4.2 Topography Condition of Surabaya Coastal Area

No	District	Village	Elevation (mdpl)
1	Benowo	Tambak Oso Wilangon	2,28 -6,66
		Roomokalisari	2,29-4,28
2	Asemrowo	Kalianak	2,34 – 3,57
		Genting	3,02 – 4,68
		Asemrowo	2,15 – 4,75
		Greges	1,98 – 3,28
		Tambak Langon	1,99 – 3,03
3	Krembangan	Monokrembangan	2,19 – 7,28
		Perak barat	0,90 – 4,50
4	Pabean Cantikan	Perak Utara	0,90 – 4,52
5	Semampir	Ujung	2,61 – 4,72
6	Kenjeran	Tambakwedi	
		Bulakbanteng	2,49 – 4,30
7	Bulak	Bulak	2,09 – 3,04
		Kompleks Kenjeran	2,57 – 3,23
		Kedungcowek	2,41 – 5,48
		Kenjeran	2,08 – 3,52
		Sukolilo	2,28 – 6,12
8	Mulyorejo	Kejawan Putih	2,51 – 3,75
		Kalisari	2,51 – 4,22
		Dukuh Sutorejo	2,51 – 2,81
9	Sukolilo	Keputih	2,21 – 3,70
10	Rungkut	Medokan Ayu	2,28 – 3.12
		Wonorejo	2,30 – 4,52
11	Gunung Anyar	Gunung Anyar Tambak	2,39 - 3,36

Source : Office of Energy and Mineral Resources East Java, 2009

4.1.2 Total and Population Density

The total of population in Surabaya Coastal Area in year 2012 is 1.082.776 people. From the Figure 4.2 and table 4.2, the most crowded area is Semampir District with the total population is 205.439 people.

Table 4.3Population in Surabaya Coastal Area in 2012

No	District	Population			Area (ha)	Population Density
		Male	Female	Total		
1	Benowo	27.586	27.324	54.910	2373,99	23,12984
2	Asemrowo	23.445	22.177	45.622	1544,1	29,54601
3	Krembangan	65.183	64.420	129.603	834,14	155,3732
4	Pabean Cantikan	46.556	46.056	92.612	679,55	136,2843
5	Semampir	103.414	102.025	205.439	876,75	234.3188
6	Kenjeran	76.722	75.189	151.911	777,01	195,5071

No	District	Population			Area (ha)	Population Density
		Male	Female	Total		
7	Bulak	20.981	20.761	41.742	672,52	62,06804
8	Mulyorejo	43.820	44.303	88.123	1421,28	62,00256
9	Sukolilo	55.700	55.568	111.268	2368,28	46,98262
10	Rungkut	54.048	53.906	107.954	2108,16	51,20769
11	Gunung Anyar	26.880	26.712	53.592	971,96	55,13807
	Total	544.335	538.441	1.082.776		

Source: Office of Population and Civil Registration Surabaya, 2013

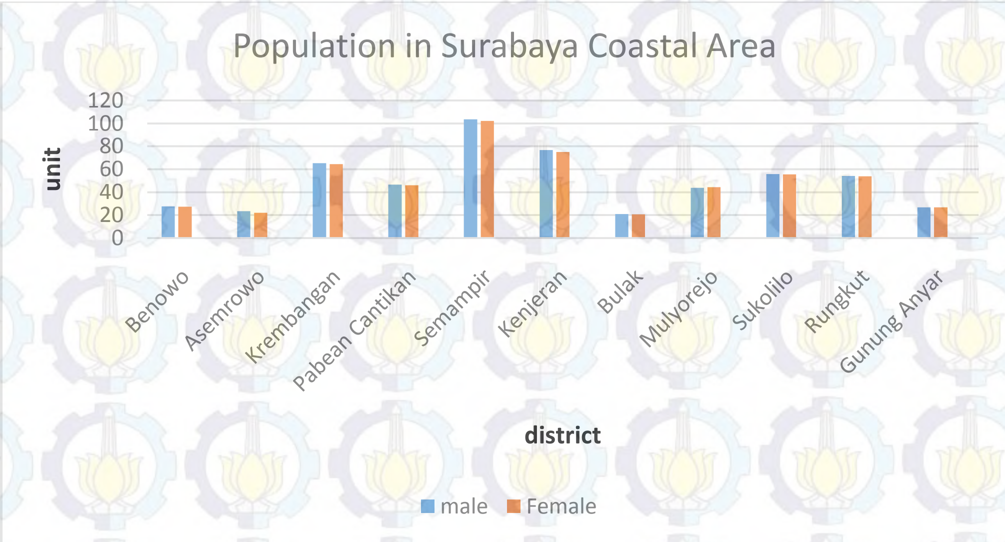

Figure 4.2 Populations in Surabaya Coastal Area

Source: Office of Population and Civil Registration Surabaya, 2013

4.1.3 Land Use

Land use in Surabaya City consists of both urban and rural activities. Urban land use consists of housing, commercial, industrial, offices and public service buildings, while rural activities consists of agricultural fields and fish ponds. The urban area is mainly in the central, southern and northern part of the city, but spreading to newly developing areas to the west and east of the city centre. Build up areas in Surabaya City in 2001 made up 63% of the whole city, while the rest are non-built-up areas such as agricultural, fishery, and vacant land. Fishery is a biggest component of non-built-up areas in Surabaya City.

There is a constant expansion of land in Surabaya City due to sedimentation process in the eastern coast regions and the presence of an island

(Galang Island) in the northern region of Surabaya. This expansion causes the morphologic form of eastern coast of Surabaya City constantly changed.

The majority of land use in Surabaya Coastal Area is water bodies that has area is 106041, 56 ha. Then housing as 47137,96 ha, and industry with the area is 15275,22 ha. From the table above, it can be concluded that the land use in Surabaya Coastal Area is dominated by water body since the main fuction is fisheries and have to rely on pond for their livelihood. Then, land use in Surabaya is used by housing with the total area is 47137, 96 hectare. In this study area, the housing can be divided into 2 types, namely formal settlements and informal settlements.

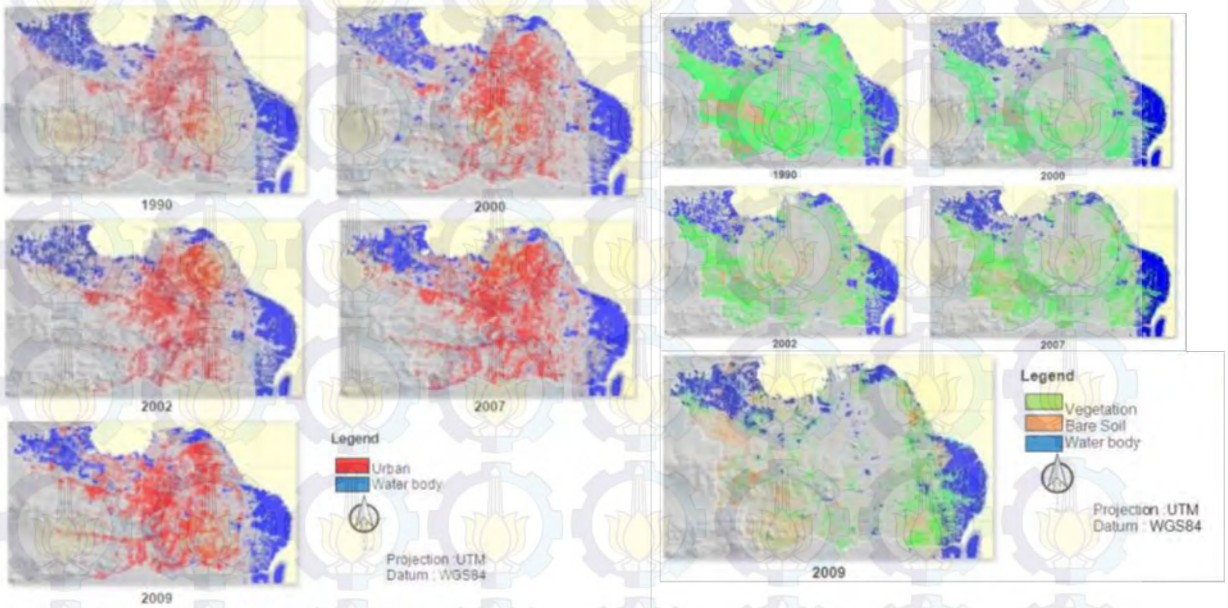

Figure 4.3 Land Use Changes in Surabaya

Table 4.4 Land Use in Surabaya Coastal Area

No	District	Public Facility	Industry	Trade and Service	Housing	Rice field	Pond	Wasteland	Military land	Port
1	Benowo	172,328	1156,18	3,02	2699,18	1114,25	19842,8	1356,38	-	-
2	Asemrowo	145,52	10453,94	174,86	1781,31	129,31	2280,24	389,95	-	-
3	Krembangan	240,24	234,93	618,45	3692,24	47,96	-	1219,02	2677,42	-
4	Pabean Cantikan	155,42	854,99	981,48	1725,85	72,6	-	-	148,47	1830
5	Semampir	22,67	758,67	-	3158,97	-	-	20,72	4536,64	-
6	Kenjeran	-	-	-	4717,74	102,6	557,8	-	-	-
7	Bulak	723,791	301,525	-	2278,58	327,38	50206	77,56	-	-
8	Mulyorejo	1268,7	33,80	375,87	8561,77	42,64	3574,94	1857,2	-	-
9	Sukolilo	1422,45	-	194,66	8018,74	2886,8	14917,8	1460,13	39,72	-
10	Rungkut	322,679	734,53	271,8	7175,12	743,36	11859	1922,17	-	-
11	Gunung Anyar	156,203	746,656	10,9	3328,46	3050,91	2802,56	2,7	-	-
	Total	4630	15275,22	2631,96	47137,96	11437,81	106041,14	8305,83	7402,25	1830

Source: Spatial Plan of Surabaya, 2013

4.1.4 Building Density and Road Conditions

The study area has 211.716 buildings with the building dnsity of 205,06 buildings/ha. The highest number of buildings is in districts Semampir which has 32 629 units and the lowest number of buildings is located in the District Bulak which the number is 7456 units. Then the highest density building is in the District are Semampir with the density is 37.22 units / ha and the lowest is in districts Benowo which has density building as 4.10 units / ha. The building density of Surabaya Coastal Area is showed at table below.

Table 4.5 Building Density in Coastal Area of Surabaya

No	District	Area	Total building	Building Density
1	Benowo	2373,99	10981	4,10
2	Asemrowo	1544,1	11319	7,33
3	Krembangan	834,14	27315	32,75
4	Pabean Cantikan	679,55	19515	28,72
5	Semampir	876,75	32629	37,22
6	Kenjeran	777,01	27513	36,01
7	Bulak	672,52	7456	11,00
8	Mulyorejo	1421,28	19698	13,86
9	Sukolilo	2368,28	18231	7,7
10	Rungkut	2108,16	24013	11,39
11	Gunung Anyar	971,96	13046	14,98
	Total	14627,74	211716	205,06

Source: City Planning Agency, 2010

However, the total of length road in Surabaya coastal area is 496,634 meter with the longest road is in Rungkut district which has length about 104.759 meter and the shortest road is in Asemrowo District which has 12.764 meter. Table below shows the length of road in Surabaya Coastal Area.

Table 4.6 Length of Road in Study Area

No	District	Road Length	Percentage of damaged road
1	Benowo	15.969	48,80%
2	Asemrowo	12.764	62,10%

No	District	Road Length	Percentage of damaged road
3	Krembangan	46.843	44,40%
4	Pabean Cantikan	31.955	30,48%
5	Semampir	27.284	31,65%
6	Kenjeran	30.717	38,15%
7	Bulak	16.567	43,46%
8	Mulyorejo	74.166	4,92%
9	Sukolilo	88.794	37,01%
10	Rungkut	104.759	1,70%
11	Gunung Anyar	46.816	32,30%
	Total	496,634	

Source: Ministry of Public Works, 2010

Figure 4.4 Building Densities in Monokrembangan District

4.1.5 Oceanography

4.1.5.1 Wind

Wind characteristics in the study area is influenced by the West and East monsoon season. Based on wind data obtained from the Port of Tanjung Perak Surabaya by BMKG, the wind in the region in November of the dominant wind direction is from the west then turns east in December to March and changed from the east in April. Then from May to October at the Port of Tanjung Perak wind direction is from the east.

4.1.5.2 Tidal

The study area consists coastal area and low-lying area effected by sea levek rise. Based on Meteorological and Geophysics Agency in Tanjung Perak

(BMKG), the tide condition in coastal area of Surabaya is devided by two zonings/sections that are northern section and eastern section. The zoning/section is based on the maximum height of the tides.

A. The tidal in Northern Section

Districts included in the northern section are Benowo, Asemrowo, Krembangan, Pabean Cantikan and Semampir District. The zone of northern tidal is lower than those of east coast in Surabaya. That is because the northern coastal zone of Surabaya is close to the island of Madura, which is indirectly reducing the height of sea waves. The maximum pairs in this region are only 150 cm of sea level on average. The cause of the low high tide in the north zone of the coastal Surabaya Madura Island in addition to the well caused due to a bottle neck region between the islands of Java and Madura islands resulting in waves and ocean currents of the open sea not to fully enter into the northern coastal zone of Surabaya. Based on data from the Meteorological and Geophysics Agency in Tanjung Perak (BMKG), high tidal began to commemorate the mainland or cause flooding due to sea level rise at a height ranging from 100 cm.

Table 4.7 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Northern Section)

No	Month	2007		2008		2009		2010	
		Min	max	min	max	min	max	min	max
1	January	40	130	40	120	50	130	50	130
2	February	50	120	60	120	60	120	60	110
3	March	70	100	60	100	50	110	50	100
4	April	50	110	60	110	50	120	40	130
5	May	40	130	50	120	50	140	40	130
6	June	50	130	50	130	40	140	60	140
7	July	50	130	40	130	40	130	40	130
8	August	50	110	50	120	60	110	60	120
9	September	70	100	70	100	50	90	60	100
10	October	50	120	60	110	50	110	50	120
11	November	50	130	60	130	40	130	50	130

No	Month	2007		2008		2009		2010	
		Min	max	min	max	min	max	min	max
12	December	50	140	50	140	50	140	40	130

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

B. The Tidal in Eastern Section

District that includes the eastern zone are Kenjeran districts, District Bulak, District Mulyorejo, District Sukolilo, the District and the District of Mount Newer Rungkut. Water tidal conditions in the eastern coastal zone of Surabaya are higher than in the northern coastal zone of Surabaya. Due to the location of the coastal zone, east of Surabaya is directly opposite to the open sea, the tide level of maximum height in this zone is 170 cm of sea level on average. Based on data from the Maritime BMG tide Tanjung Perak, coastal zone of the north began to inundate the land or cause flooding due to sea level rise on tidal height from 120 above sea level.

Table 4.8 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Eastern Section)

No	Month	2007		2008		2009		2010	
		min	max	min	max	min	max	min	max
1	January	50	150	60	150	60	160	60	150
2	February	60	130	70	130	60	140	80	130
3	March	70	130	80	120	60	130	60	130
4	April	60	150	60	140	60	150	60	140
5	May	60	160	50	160	70	160	60	150
6	June	60	160	60	160	80	160	50	160
7	July	50	150	60	160	80	170	40	150
8	August	60	130	60	160	70	150	60	140
9	September	70	130	60	120	80	130	70	120
10	October	70	150	60	160	80	150	70	140
11	November	60	160	60	160	70	170	70	150
12	December	60	160	60	160	80	170	80	160

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

Table 4.8 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Eastern Section)

No	Month	2007		2008		2009		2010	
		min	max	min	max	min	max	min	max
1	January	50	150	60	150	60	160	60	150
2	February	60	130	70	130	60	140	80	130
3	March	70	130	80	120	60	130	60	130
4	April	60	150	60	140	60	150	60	140
5	May	60	160	50	160	70	160	60	150
6	June	60	160	60	160	80	160	50	160
7	July	50	150	60	160	80	170	40	150
8	August	60	130	60	160	70	150	60	140
9	September	70	130	60	120	80	130	70	120
10	October	70	150	60	160	80	150	70	140
11	November	60	160	60	160	70	170	70	150
12	December	60	160	60	160	80	170	80	160

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

4.2 Climate Change Condition in Surabaya

4.2.1 Sea Level Rise

The rate of sea level rise is obtained based on the analysis of data from multi-mission satellite altimetry the Topex / Poseidon, Jason-1 and Jason-2 over a period of 19 years ie October 1992 to September 2011 the trend of sea level rise per year in the waters of Surabaya and surrounding areas generally ranged from 5.4 to 5.8 mm / year (AVISO, 2012).

Based on data from satellite altimetry, sea level rise (years 1992-2011) in the city of Surabaya is increasing about of 5.69 mm / year. While research has been conducted by Abdurrahchim (2002) that in the benchmark calculations using observations on the ground that the rate of sea level rise in the city of Surabaya is equal to 5.47 mm / year. So that there is little difference about 0.22 mm between the two calculations. This difference is relatively small.

Karsidi (2011) mentioned that the results of monitoring of sea level rise from satellite altimetry published by the French AVISO shows a consistency with the data of sea level rise from the observation station network operated by the National Tidal Bakosurtanal. Differences that may occur can be attributed to differences in methods of calculation of observation.

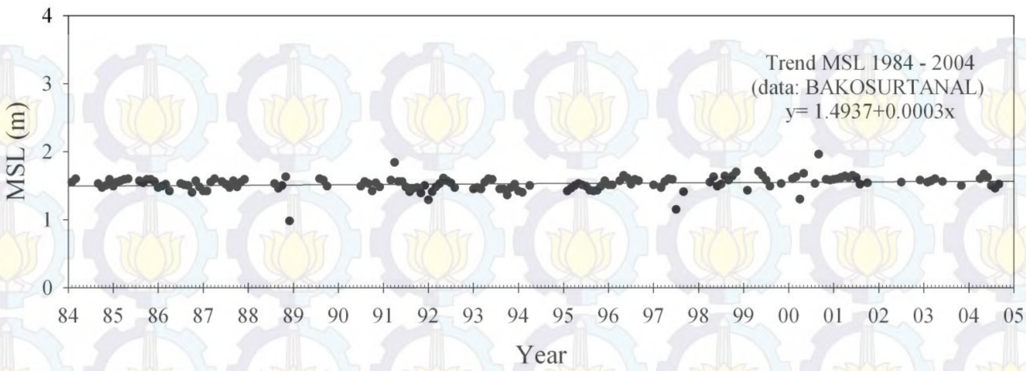

Figure 4.5 MSL Trend Year : 1984-2004

Source: Budiarto, 2011

4.2.2 Climatology Condition

4.2.2.1 Climate

As cities in the tropics, Surabaya has two distinct seasons: the rainy season and dry season. The rainy season usually starts from November to April and the dry season from July to October, while the May-June and October-November is a transition month of season changes.

Based on data from the Environment Agency, the climate in the study area is affected by a significant difference between wet and dry seasons. The rainy season lasts from November to April and the dry season lasts between May and October. Increase in high rainfall during the period of November to February, is caused by summer wind from North. The winds from the southeast bring colder air from Australia during the dry season. The average monthly temperatures are between 21°C in August to reach 34°C in April. In the rainy season the average humidity is 80% per month, while in the dry season down to 60%. The average annual rainfall at Tanjung Perak Rain Station of the year 1955 - 1998 is 1560 mm, average of 90% occurs during the rainy season. The highest monthly rainfall occurs in January, which is more than 300 mm, while the lowest 23 mm in August (Spatial Plan of Surabaya, 2013).

From the readings of precipitation at 10 stations managed by Meteorology and Geophysics Agency and the Department of Public Works-Water Resources Brantas Surabaya showed that maximum rainfall occurring during 1980-1990 are as follows:

Table 4.9 Maximum Rainfall 1980-1990

year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
avarage (mm)	105.37	97.47	101.61	107.90	109.80	97.74	90.70	89.30	101.38	79.40

Source: Department of Public Works-Water Resources Surabaya

4.2.3 Shorelines Changing

In a vulnerability analysis conducted by Sulma (2012), how quickly a part of the coastline has suffered abrasion (erosion) or accretion (addition) can be used as indicators of the vulnerability of the region where the region that experienced the most rapid abrasion will increase the level of vulnerability to sea level rise.

Table 4.10 Tidal Range and Shifts the Coastline Due To Differences in Tidal

No	Sampling Time		Tidal Height (m)	the shifting shoreline in Slope 0,2° (m)
	Date	Time		
1	05 October 1979	08:47 am	2,0	172
2	28 March 1989	09:08 am	1,7	86
3	17 August 2000	09:26 am	2,0	172
4	01 September 2011	09:29	1,5	-

Source: Sulma, 2012

Based on the analysis of shoreline change over a period of 32 years (1979-2011), it is known that the areas experiencing the greatest change in the form of accretion or advanced is the beach in the coastal village Kalisari, District Mulyorejo, Surabaya with shoreline change rate of 38.9 m / years. Other regions are also experiencing fairly rapid accretion is in the Village Keputih, Surabaya (estuary Keputih).

4.3 Flood Situation and Flood Vulnerbility in Surabaya Coastal Area

Major factors in the increase in severity of flooding in Surabaya are land development and increased urbanization. In addition, sea level rise has contributed to flood but it is not significantly contributed. However, the impact of proposed developments on drainage and flooding is not considered when building permits are issued. Developers are not required to provide adequate drainage for their developments or to bear the costs of improvements to the primary and secondary drainage systems which their development necessitates.

According to Surabaya Drainage Master plan Report (SDMP, 2000), due to an unusually heavy flood caused by La Nina, a detailed survey of flooding was carried out during the end of the 1998/99 wet season. Flooding caused by intense rainfall has been identified in 148 separate areas throughout Surabaya. The results of the survey showed that area affected by flooding in Surabaya City is up to 14.5% of the total area. Built-up areas include housing, commerce, industry, public facilities, roads etc. Within Surabaya city that were affected by 1999 flood is 15,826 ha or 22.7% of the total built-up areas in Surabaya City.

Flooding due to sea level rise has potentially effect on districts located in coastal area; those are Benowo, Asemrowo, Krembangan, Pabean Cantikan, Semampir, Kenjeran, Bulak, Mulyorejo, Sukolilo, Rungkut dan Gunung Anyar. The flood always occurs between first date of month and 20th every month but the height of tidal is affected by the position of the earth, moon and sun. If the tide along with high rainfall, it will increase the height of the flooding in the region. Flooding due to sea level rise in the coastal area of Surabaya has a height of between 0 - 1.5 m. Flood elevation in each region is determined by the height of the topography in the region due in accordance with the nature of the water that flows from high places to the lower place. In the study area, in one day occurred one time and one time ebb tide (BMKG Maritime Tanjung Perak 2011).

Table4.11 Flood Risk in Several Areas

No	Location	inundation heights	Source	Date
1.	400 houses and school in Krembangan districts	± 90 cm	Media Indonesia	27 May 2009
2.	Kalianak Road, Perak Port	± 1 meter	BMKG Maritim Perak	20 Feb 2010
3.	Villages and school in West Perak Sub District	± 30 cm	Media Indonesia	15 July 2010
4.	Housing in Krembangan District	± 60 cm	Television news	21 December 2010

No	Location	inundation heights	Source	Date
5.	Kalianak Road and Margomulyo Road	± 30 cm	Berita Jawa Timur	31 January 2011
6.	Bulak District and Krembangan District	± 30 cm	Immadudina	March 2011 and April 2011

Source: compilation of several resources, 2014

Source: compilation of several resources, 2014

Figure 4.6 Flood due to Sea Level Rise in North Coastal Area of Surabaya

Ascommunity's perception, the flood due to sea level rise, how the floods occur; on how high stagnation and duration of flood; and the impact of the flood are identified. These are the things that become the basis of community in assessing the risk of flood over their lives. In this case, people assume that flooding occurs as a common natural phenomenon (interview results, 2014).

According to their knowledge, the flood tide of sea water is the result of the interaction of waves and wind. They understand that the flooding would be even greater, when the waves during high tide driven by big wind. As a result, sea water flows to the land getting bigger and bigger, and stagnation becomes increasingly high. Although the time of stagnation and high of tidal can not be known with certainty by the community, there are some people who take advantage of the data from the port, to see the ocean tide height predictions for the anticipation of flooding. However there is also figure the heigh of tidal from Javanese calendar calculation, because it feels easy to understand, and they do not need to search for information to the port.

They no longer feel the flood due to sea level rise as one of the threats, but they considered it as matter limitations they face everyday. Although people think of flooding as a natural phenomenon and become part of the natural process that occurs due to the tide, but people feel the change of height of inundation. Based on interviews and field observations, as well as data from flooding due to sea level rise that occurred in the five villages have the following impacts:

1. In residential areas
   - Damage to the home such as walls, doors, and windows
   - Damage to household furnishings and transportation
   - Damage to the environment
   - The emergence of long puddle in the road environment and drainage
   - Trash were spread on homes that do not have sanitation
   - Itching disease and diarrhea due to polluted environment

2. In the Area of Ponds

Loss of fisherman because crop failure. It happen because of the loss of fish or shrimp when the flood came in and the level of water reaches the limit of pond dikes. Based on interviews, losses can reach 50% to 90%.

Then, based on Immadudina (2011), the process of determining the zone level analysis of flood vulnerability due to sea level rise in the coastal area of Surabaya taking a combination of four aspects, namely environmental, physical aspects, social aspects. To determine the level of vulnerability in the study area, there is map obtained from spatial patterns of vulnerability as a result of floods sea level rise based on the influence of environmental aspects, physical aspects, social aspects and economic aspects in the Coastal Zone of Surabaya. The highest levels of vulnerability are Krembangan Districts, pabean Cantikan Districts, and Kenjeran District, respectlively.

Coastal Area Surabaya proportion of potentially dangerous zone flooding due to sea level rise to the classification of very high danger zone has an area of 4889 acres, with extensive proporasi 33.4% of the total study area. While the zones with high hazard classification on the study region have an area of 2346 acres with a proportion of 16% of the total land area of research.

4.4 Overview of Disaster Risk Management in Indonesia in term of Adaptation Measures

Indonesian Disaster Risk Management, established in 1966. In 1979 it was revised by Presidential Decree No. 28 and renamed the National Coordination Board for Natural Disaster Management. In 1990 the need to include human-made disasters as subject matter for Indonesian DRM prompted changes to the board based on Presidential Decree No. 43. With those changes, the board changed its name to the National Coordination Board for Disaster Management. Further changes to the form of the DRM Board in Indonesia have occurred since then. In 2001, the board changed name again to the National Coordinating Board for Disaster Management and Internal Displaced People (Badan Koordinasi Nasional Penanggulangan Bencana dan Penanganan Pengungsi). This new board was based on Presidential Decree No. 3. It sat under the Ministry of Social Welfare.

Changes were again made in response to the extraordinary scale of the impact of the 2004 Aceh Tsunami. These changes were based on the ratification of the Government Rule No. 83 in 2005. The board was renamed the National Coordinating Board for Disaster Management (Badan Koordinasi Nasional Penanggulangan Bencana).

Even though there were changes to the form of DRM organisation in Indonesia from 1966 to 2005, the core characteristics of past management patterns were reactive actions from government in response to a disaster. A variety of different types of government organisations had similar functions in that they reactively coordinated other ministries or other government agencies in responding to disaster events.

They were ad hoc governmental agencies for handling disasters. The ad hoc nature meant that the agency had a role only in supporting other government agencies for particular events. This arrangement at the national level also became the pattern at the local levels (both provincial and municipal). Therefore, the coordination placed a greater focus on the emergency response rather than an integrated approach to disaster management.

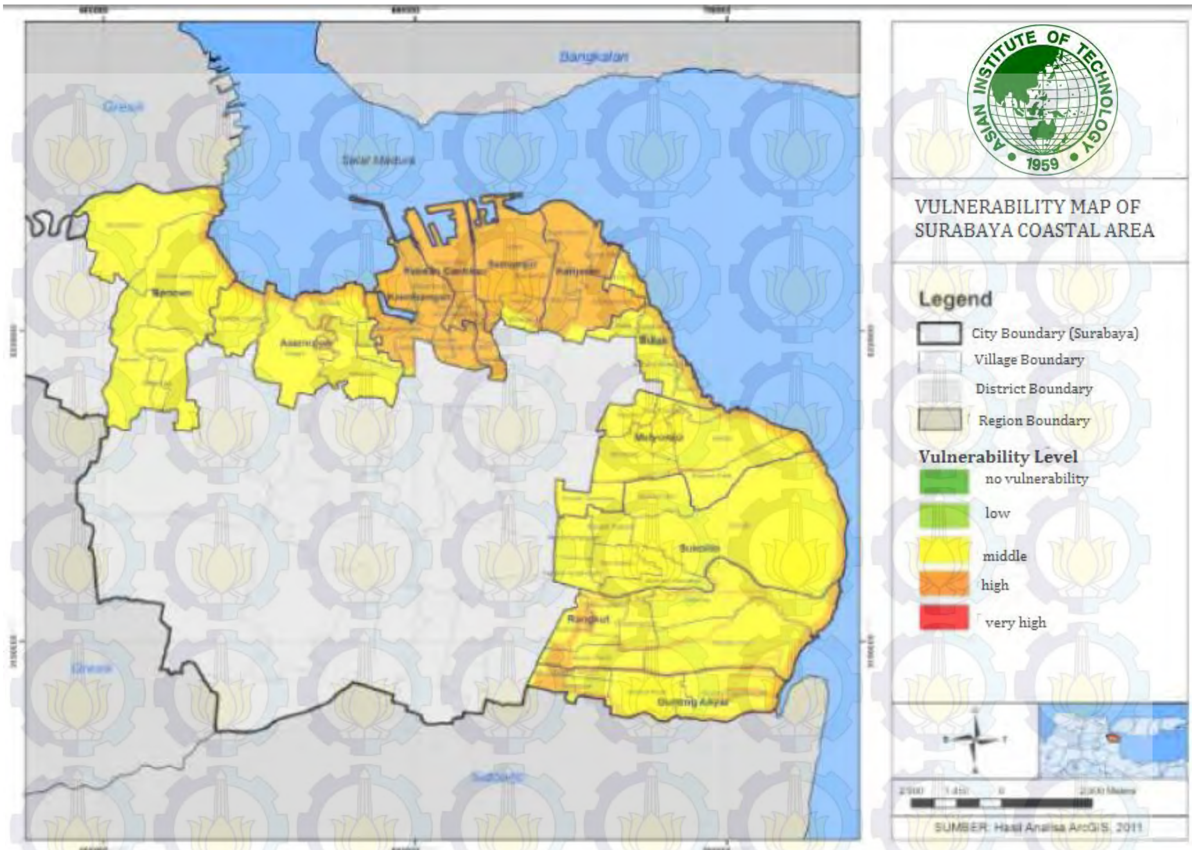

Figure 4.7 Vulnerability Map

Source: Immadudina (2011)

At the provincial level, in relation to Act No. 24 on Disaster Management in 2007, East Java Province had already established a Regional DisasterManagement Board (BPBD). The board is directly under the provincial governor of East Java Province. The existence of the board indicates that the provincial government has specific interests and concerns for DRM.

4.5 Summary of Findings

Major factors in the increase in severity of flooding in Surabaya are land development and increased urbanization. In addition, sea level rise has contributed to flood but it is not significantly contributed. As community's perception about flooding, how the floods occur; on how high stagnation and duration of flood; and the impact of the flood are identified. These are the things that become the basis of community in assessing the risk of flood over their lives. In this case, people assume that flooding occurs as a common natural phenomenon.

Although people think of flooding as a natural phenomenon and become part of the natural process that occurs due to the tide, but people feel the change of height of inundation. Then, the impacts of flooding in that area are :

- Damage to the home such as walls, doors, and windows
- Damage to household furnishings and transportation
- Damage to the environment
- The emergence of long puddle in the road environment and drainage
- Trash were spread on homes that do not have sanitation
- Itching disease and diarrhea due to polluted environment
- Loss of fisherman due to crop failure.

CHAPTER V
EVALUATING ADAPTATION MEASURES

Based on a synthesis of the literature on urban development in Surabaya, it broadly divided into 2 based programs implementing the program, the Government and non Government. On the side of government are the Village, the Central Government and other governments, non-government while such NGO. This identification serves to determine the public's perception of the program handling the problem of flooding, whether existing programs have helped to reduce the risk of flooding, or otherwise does not reduce the risk of flooding. According to document reviews of Coastal Zone Planning, General Spatial Plan, Detailed City Spatial Plan, and respondent's interview, the current adaptations has been identified.

5. 1 Past and On-Going Adaptation Measures Related To Urban Development

In Indonesia, disaster risk management including adaptation and mitigation has become a major concern, particularly after the Boxing Day 2004 Tsunami in Aceh Province. The substantial impacts of the tsunami prove that risk management was lacking. In response, national level regulations have been ratified such as the National Act 24/2007 on Disaster Management, the National Action Plan on Disaster Risk Reduction 2006-2009, and others. The purpose of the new regulations (ratified in 2008) is to develop clear requirements as to how disaster risk reduction should be delivered by both governmental and non-governmental organizations. Government Regulation No. 8 and 21 from 2008 describes the roles and responsibilities at the national board level for organizing disaster management. Other government regulations are in 2008 (no. 22 and 23) outline funding and other support systems, and the involvement of international organizations and NGOs.

Indonesia is also facing a new direction in its planning system due to the recent ratification of two major acts of parliament, namely the Planning Act no.

26/2007 and the Small Islands and Coastal Management Act no. 27/2007. Both of these Acts recognize disaster events as one of the most important issues requiring management. . According to document reviews of Coastal Zone Planning, General Spatial Plan, Detailed City Spatial Plan, and respondent's interview, the current adaptations has been identified as follows:

A. Build Long Storage and box culvert in coastal area

According to interview with governments, it can be known that Surabaya City Government is doing various projects for flood prevention and flood control. The famous projects are build long storage and box culvert in Surabaya coastal area such as Ahmad Yani Street, Rungkut Street. Based on interview with Myrna, Planning Staff in Town City Planning Agency, that project used more than 1,15 billion Rupiah. This long storage will launch from the water flow towards Kalimir Ketintang Road area, continues to Jagir, until finally into the sea. Thus, the presence of a variety of efforts to control and flood control in the city, undoubtedly puddles in the city of Surabaya will be reduced. According to the Spatial Plan City of East Coast development of new long storage will be implemented along the eastern side of the north east coast. Then for channel maintenance program will be implemented in Kali Kepiting, Kali Dami, Bokor Kali, Kali Wonorejo, and Kali Kenjeran.

B. Mangrove Conservation Area (Soft Protection)

One of adaptation strategy conducted by the government of Surabaya in East of Coastal Zone is the conservation of mangroves to cope with flooding due to sea level rise. Location mangrove is in around the village with different conditions. The mangroves are also on the outskirts of the pond as well as following sometimes small streams in the area of aquaculture. Locations of mangrove are also in along the Kali Wonokromo with different thicknesses.

Mangroves in the study area can be seen along of coastal area in Surabaya. The mangrove consist many species: Avicennia sp., Rhizophora sp, Sonneratia sp, and Bruguiera sp, Nypha sp, Hibiscus tiliaceus, Ficus sp. Based on data which got from Ecoton in 2002, the mangrove area in Surabaya coastal area is 3200 hectare. But, because of many activities around mangrove area so in 2008, its area is decreasing becoming 1180 ha.

Mangrove forest with the high density distribute near the sea in coastal area while the spread of mangroves in the area of aquaculture have lower density. The following table will explain the distribution of mangrove forest area.

Table 5.1 Mangrove Area in Surabaya Coastal Area

No.	Villages	Area of Mangrove (Ha)
I.	Mulyorejo Districts	
	Dukuh Sutorejo Village	1,81
	Kalisari Village	71,95
	Kejawan Putih Tambak Village	40,71
	Total Mulyorejo District	114,47
II.	Sukolilo District	
	Keputih Village	146,71
	Total Sukolilo District	146,71
III.	Rungkut District	
	Wonorejo Village	7,88
	Medokan Ayu Village	55,79
	Total Rungkut District	63,67
IV.	Gunung Anyar District	
	Gunung Anyar Tambak	20,21
	Total District Gunung Anyar	20,21
Total		345,06

Source : Town City Planning Agency and Citra Landsat, 2011

Mangrove forest area located along the coast of the east coast when conditions are dwindling with the development or manufacture of new coastal land around the pond, so the presence of mangroves are increasingly threatened, needed socialization to the community fish farmers to know where the boundaries are defined as the area of pond area or areas designated as protected areas for the development of mangrove protected area.

Figure 5.1 Mangrove condition in Surabaya Coastal Area

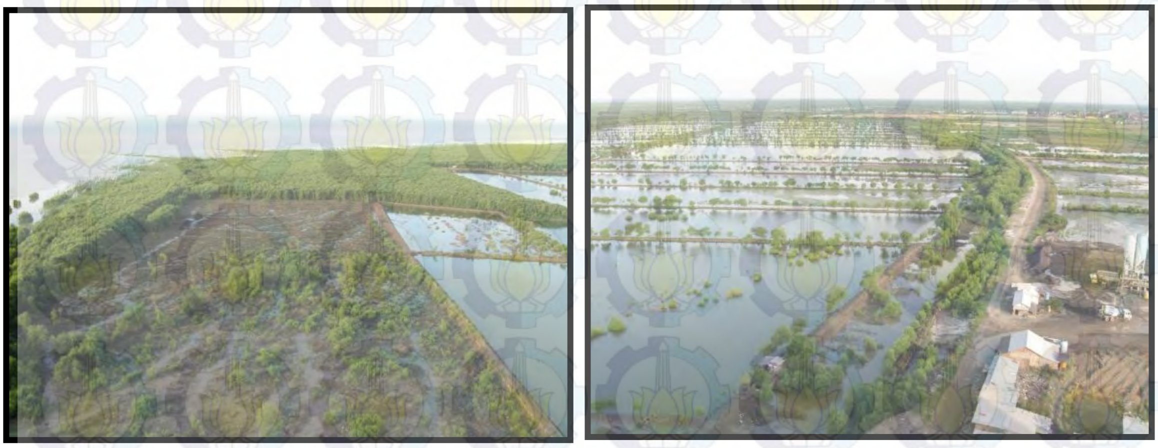

Figure 5.2 Mangrove Conditions and Open Area for Ponds

The Surabaya government had discussion with public about the conversion of mangrove to pond and public told them their inspiration. Recommendations or suggestions from the public related to the problems above include :

a. Rezoning of protected areas and mangrove protected area boundaries.
b. Development of residential areas will be restricted territory in accordance with the limits of protected areas so that the direction of development of residential areas not led to the conversion of land from the fishery ponds function towards the settlement function.
c. Enhance Soft Skill, Entrepreneurship, and Preparedness for Local People

The government has done a fishing community empowerment with the framework of Community-Based Fishing System Management. Government programs that have been conducted have not been getting the maximum results due to the lack of community involvement in the development process. The development process consists of planning, implementation, monitoring, and evaluation. This development approach for using a top-down approach has shifted into a bottom-up approach. In community development, bottom-up approach is the starting point. The community is involved from an early age, ranging from planning, implementation, and monitoring and evaluation program to be implemented. In the Community-Based Fishing System management, the community has given skill to improve their fishing skill and make added-value with their products. It can help them to be creative and face the flood risk if flood come, their livelihood can be saved.

In addition, disaster response training conducted by BPBD (Regional Disaster Management Agency). Community gathered to get emergency response training for disaster. Then, a risk map also disseminated to the public. Department of Education in collaboration BPBD designs a program with the theme of Disaster Management School. BPBD through of Emergency and Logistics put together a program that involves elements of structured education to disseminate disaster. In this activity, the participants were given a view of the concept of the program to the students in their respective areas. Activities conducted at Hotel Utami, Sidoarjo is also invited steering committee BPBDs E, ITS Centre for Disaster Studies, Surabaya University and Education Department officials in East Java.

C. Flushing or Clean the river and Built Bosom

Surabaya city government and local people jointly make efforts to prevent flooding, the start of building a culvert and ditch cleaning water in the villages. Not only that, Surabaya City Government is also making a mini bozem or rainwater catchment reservoirs. Now there are nine mini bozem built and operated which are in Dukuh Kupang Timur, Bundaran Satelit, Dukuh Kupang Barat, and Darmo Permai.

Figure 5.3 Flushing the River before (Left) and After (Right) in Greges Krembangan River

City Government also has six bozem ready to accommodate large size and infiltration of rainfall, which Bozem Morokrembangan with an area of 79.5 hectares, Kedurus with 37 hectares, Bratang with an area of 1.4 hectares, Kali Dami with an area of 2.7 hectares, Jurang Kuping with area of 3.7 hectares and Wonorejo with an area of8.5 hectares Wonorejo. Head of City Development Planning Agency (Bappeko) Surabaya Hendro Gunawan said that to minimize flooding, the local government also makes infiltration wells and build water channels and culverts. He said the construction of culverts at 21 locations there is also completed, of which at Sidotopo Wetan Street, Sukolilo, Kenjeran, Dukuh Kupang XX, and Saluran Balongsari Makam. For rehabilitation of clogged channels also conducted in 22 locations of which are in Pegirian, Medokan Ayu Downstream, Greges, Tanjungsari, Simorejo and Nambangan. There is also a water channel dredging in the channel, 12 of them is in line at Indragiri Road, Dr. Sutomo, Rungkut, Indragiri, Sriwijaya Street, and in some other places.

5. 2 Past and On-going Adaptation Measures based on Key Informants in Surabaya Coastal Area

The process of perception and attitude of the people to stand the coastal flood is the start for the adaptation to deal with the pressure of the impact of the coastal flood. In addition, adaptations which happen in study area is not only making modification to their shelter but also water supply and waste management, the community is also responding to the tidal flood take to protect themselves and their families.

The response is community's reaction when flood occurred. Actions from community are displaced or moved and or stay at home when the flood happen. However, the community response was also influenced by the condition of their home (old) that reflects society occupying and living in the area. Adaptation to flood risk is an adaptive strategy that is conducted and applied the changes people for life in a social environment. Adaptations which have done by the community in that area are following:

A. Restoration and Protect River and Canal

River and canal restoration in villages (kampoeng) is an initiative from head of communitie for their communities to clean the river and canal near their house for preventing the flood. This event is done by all of communities in the study area. Based on interview with Head of Krembangan, then, in Asemrowo and Medayu Utara, the communities joined together to cleaning the canal and culverts around their houses. Citizen participation was well received and award from Surabaya city government for its initiatives to help face flooding because without public support, it would be difficult to handle.

Figure 5.4 Artificial Ponds in Krembangan District

Aspirations of the people which ask for new canal are followed. The advocacy to people for not throw garbage also aggressively implemented because the main cause of the breakdown of the channel so that the flood happen. For this achievement, Head of Krembangan District said, Surabaya is one example of a city where the meeting of political will and citizen participation has been successful in reducing flooding problems are often considered as impossible to overcome the city.

B. Adaptation Done at Commity's Housing

Adaptation in the community performed by making embankments, elevate the house and roof, raised floor, making the water channel around the house. The conditions for the people are considered a routine event and how to overcome them waiting for the puddle recede by itself. The most common action done on their home is a raised floor for those who can afford so that the floor is higher than the road, or they make a small embankment in front of their homes. Elevating the foundation of the house by each individual or create a dike on the front porch that can impede water into the house. This is done in accordance with the financial capability of each individual or household.

They also modify their houses from 2 to 4 floors. They were conscious of adding "space" vertically to avoid flooding. This is evidenced also by the placement of items such as televisions, refrigerators, coffee table, and other valuables placed at a higher level.

Figure 5.5 Small Embankments which is built in Front of House

In addition, in Krembangan where always routinely flooded 30 cm every month because of sea level rise also made small embankment. The most common action done on their home is a raised floor for those who can afford so that the floor is higher than the home environment, or they make a small embankment in front of their homes or on the front of the terrace.

C. Adaptation Done at Community's Pond

Adaptation to the ponds is done to reduce the impact and costs of coastal floods done by creating dikes, installing nets or waring around the ponds, elevation dikes, drainage ponds and pools liaison between planting and care mangroves around the coast and ponds. Planting mangroves also serve to reduce the impact of tidal flooding such as land loss and coastal erosion.

Make dike of bamboo filled by land along the edge of the road that limit coastal areas with embankments breached the settlement area. This activity is a non-governmental activities performed by involving some communities. Making artificial embankment of bamboo at the mouth of a canal to hold the sand in order not to fall and hold the sand of the sea into the channel when the flood tide came.

Figure 5.6 artificial embankment of bamboo

Based on explanation above, it can be concluded that current adaptation which is happen in study area following

1. Build Long Storage and box culvert in coastal area
2. Mangrove Conservation Area

3. Enhance Soft Skill of Community (preparedness and entrepeneurship)
4. Restoration and Protect River and Canal
5. Modify Floor (Adding number of Floor)
6. Built Small Embankment in front House
7. Elevate the House
8. Making artificial embankment of bamboo in pond
9. Maintenancemangrove in ponds

5. 3 Selected Adaptation Measures for Evaluation

After identified on-going and past adaptation measure in section 5.1 and 5.2, the selected adaptation measures has been done by scoring analysis. Stakeholders involved scoring adaptation strategies are Town Planning Agency, City Department of Spatial Planning, Regional Disaster Management Agencies, and Agency for Environmental Management (BLH), and Head of Districts from three districts (Krembangan, Pabean Cantikan, and Kenjeran). The result of scoring can be shown on the table below

Table 5.2 Scoring Results from Stakeholders.

No	Adaptation Measure	S1	S2	S3	S4	S5	S6	S7	Results
1.	Build Long Storage and box culvert in coastal area	3	1	6	6	9	9	4	38
2.	Mangrove Conservation Area	2	2	1	1	3	1	1	11
3.	Enhance Soft Skill of Community (preparedness and entrepeneurship)	1	6	3	2	4	3	3	22
4.	Restoration and Protect River and Canal	8	3	7	7	7	7	8	37
5.	Modify Floor (Adding number of Floor)	5	7	5	4	6	8	9	44
6.	Built Small Embankment in front House	6	8	4	8	5	6	7	44
7.	Eletave the House	4	4	2	3	1	2	2	18
8.	Making artificial embankment of	9	5	9	9	8	5	6	51

No	Adaptation Measure	S1	S2	S3	S4	S5	S6	S7	Results
	bamboo in pond								
9.	Maintenance mangrove in pond	7	9	8	5	2	4	5	40

Source: Analysis Result (2014)

Note:

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies

S4 : Agency for Environmental Management

S5 : Head of Krembangan

S6 : Head of Pabean Catikan

S7 : Head of Kenjeran

According to stakeholder's perception above, the first, second and third priorities are mangrove conservation area, elevate floor's housing, and enhance soft skill of community, respectively. This three adaptation measures will be evaluated in the next section of this chapter.

5.4 Evaluation Process of Adaptation Measures

Criteria from literature review (**chapter 2**) need to be crosschecked to stakeholders to get the appropriate criteria for evaluation. Before distributed to stakeholders, the criteria has been explored to get sub-criteria by descriptive analysis from literature review. Then, the stakeholders would check the cub-criteria to get evaluation sub-criteria. Here is each criterion and its explanation.

Table 5.3 Exploration of Evaluation Criteria

Measure	Description	Sub-Criteria
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively	• Enhancing policy, planning for adaptation measure • Legal and regulatory

Measure	Description	Sub-Criteria
	straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including **capacity building, information exchange and social learning.**	• Integration with development policies and planning • Institutional mechanism, capacities and structures
Flexibility: How far canwe adapt?	Climate change is uncertain, due partly to an incomplete **understanding of climate science**, and partly to the fact that climate changewill **impact upon a future world**. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation.	• Hazards risk • Scientific and technical capacities and innovation
Equity: Inequalitydimensions toadaptation	Adaptation aims to **reduce vulnerability** to climate change shocks and stresses. However, vulnerability also depends on **socioeconomicfactors**, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups	• Impact data • Environmental and natural resources • Livelihood • Culture, attitudes, education
Efficiency: Costeffectiveness	Efficiency or **cost-effectiveness** is typically used to compare the **costs of alternative ways** of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target.	• Financial instruments • Cost recovery for adaptation
Sustainability: Thewider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention's impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity	• Public awareness, knowledge, skill • Information management and sharing

Measure	Description	Sub-Criteria
	likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention. Sustainable adaptation is likely to include strong elements of **partnership-building, community engagement, education andawareness-raising**, as well as focusing on interventions which are 'mainstreamed' into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education).	• Learning and research

Source: Analysis Result (2014)

5.4.1 Determining Evaluation Criteria Using Delphi Analysis

Identification of criteria for the evaluation is done based on the study of literature and has been crosschecked with stakeholders to determine the existing condition in the evaluation. The Delphi Questionnaire can be seen at **Aappendix C**. There are many steps done in the determination of the evaluation criteria, namely

I. Phase I

At this stage of the research is conducted (exploration) the opinion of the respondents about the evaluation criteria. The method used to obtain these criteria is through semi-structured interviews as mention in chapter 3 (methodology section). Respondents as expert (see **section 4.4**) may add criteria to offer and there is also the possibility of reducing the existing factors. The results are as follows:

Table5.4 Results of Stakeholders' Perspective in Delphi Phase 1

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	S2	S3	S4	S5
1	Effectiveness	Enhancing policy, planning for adaptation measure	A	A	A	A	A
		Legal and regulatory	A	A	A	A	A
		Integration with development policies and planning	A	A	A	A	A

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	**S2**	S3	**S4**	**S5**
		Institutional mechanism, capacities and structures	A	A	A	A	A
2	Flexibility	Hazards risk	A	A	A	A	A
		Scientific and technical capacities and innovation	D	D	A	D	D
3	Inequality	Impact data	D	A	A	A	A
		Environmental and natural resources	A	A	A	A	A
		livelihood	A	A	A	A	A
		Culture, attitudes, education	A	A	A	A	D
4	Efficiency	Financial instruments	A	A	A	A	A
		Cost recovery for adaptation	A	A	A	A	A
5	Sustainability	Public awareness, knowledge, skill	A	A	A	A	A
		Information management and sharing	A	A	A	A	A
		Learning and research	A	A	A	A	A

Source: Analysis Results, 2014

Note:

A : Agree

D : Disagree

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies – Disaster Expert

S4 : Academician

S5 : Agency for Environmental Management

From the exploration results of Delphi Phase 1 obtained the opinion of the respondents about the influence on the evaluation criteria of adaptation measure. For more details, here is a description of the exploration of the respondents:

Table 5.5 Exploration Result of Stakeholders Perspective in Delphi Phase 1

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
1	Enhancing policy, planning for adaptation measure	Adaptation must be in accordance with RPJMD (Planning Policy) and in evaluating the adaptation must be in accordance with the targets that set out in the policy and vision of the adaptation project	
2	Legal and	Legality is needed in the evaluation of	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
	regulatory	adaptation because during this time many NGOs and people who walk on their own. To support the success of adaptation then there should be legalized so that the government can also help realize the adaptation program if there are constraints	
3	Integration with development policies and planning	Adaptation program involving many parties who are affected. In this case the government and the public should be able to integrate in terms of adaptation strategies to achieve upon the success. An example is the reclamation project is a program of the government but if the people around are not willing to accept the government should integrate it with local people. There are some things that need to be right on target and not a lot of conflict.	
4	Institutional mechanism, capacities and structures	Evaluation of the mechanism is very important in evaluating the success of an adaptation project. Because the organizational structure is closely related to human resources. And institutions in Indonesia that specifically deal with the CC does not exist, therefore there must be translated into capacity building programs of disaster	
5	Hazards risk	In evaluating adaptation strategies urgently need to know the risk in advance, priority areas to determine the level of risk of climate change. Successful adaptation therefore has to	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		be flexible, not least because of the potential range of climate changes projected under different emissions scenarios.	
6	Scientific and technical capacities and innovation	Every country need to develop the capacity to produce and use science Due to the uncertain and dynamic nature of climate change impacts.	Many researchers have done already. The amount of research is not a barometer of success of an adaptation strategy. This is because the implementation of the research that is less because bad mechanism. Institution is supposed to be responsive to implement existing research
7	Impact data	these data are required to support climate change adaptation needs. However as the impacts of climate change vary by location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.	The availability of impact data is difficult because of lack of facilities. The important thing is human resources. Pro public rogram will make the successful adaptation
8	Environmental and natural resources	Availability of natural resources is very influential to measure adaptation. For example, the government can use natural resources without damaging the existing programs to support the adaptation. For example, mangrove. With maintenance of the mangrove, the government can obtain a lot of benefits that hold seawater ashore and can create new skills to the community in supporting the mangrove tourism.	
9	livelihood	it can be used to measure the level of	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		success. Because residents get new opportunities, then the affected communities can feel the success of the adaptation program	
10	Culture, attitudes, education	A change in attitude of society to cope with floods is a reflection of the success of adaptation projects	Not too important for evaluation. Because programs that have so far followed the customs of the people and the training has not been entirely successful behavior change
11	Financial instruments	Financial instrument is very important, here we can find out whether the money that was spent for the appropriate adaptation project	
12	Cost recovery for adaptation	The project has not been successful adaptation must be considered on performance cost-recovery and get the better target to benefit.	
13	Public awareness, knowledge, skill	To be successful, climate change adaptation strategies may require skills and knowledge of local people. It is challenge for government to increase skill sets to effectively use climate change data.	
14	Information management and sharing	providing information including information needed to identify adaptation and measure the adaptation is successful or not. It can show their sustainability to adaptation measures.	
15	Learning and research	This is important because the actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable. The existence of learning and research will determine the	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		sustainability of adaptation projects	
New Sub-Criteria		**Maintenance and Operation Cost**:to evaluate adaptation measure should consider about maintenance and operation cost too because it shows the efficiency of funding which government spent.	

Source: Interview Results, 2014

II. Phase II

According to the results of the first phase, there is an additional sub criterion in the evaluation from the opinion of the respondents. Additional criterion is the efficiency of the M & O costs. So, 16 sub-criteria will be processed at the interview phase II. Phase II is the first iteration. This iteration is to reduce the sub-criteria necessary to obtain the agreement of the respondents about criteria affecting the evaluation of adaptation measures in Surabaya. The results of the first iteration can be seen in the following table.

Table 5.6 Results of Stakeholders' Perspective in Delphi Phase 1I

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	**S2**	**S3**	**S4**	**S5**
1	Effectiveness	Enhancing policy, planning for adaptation measure	A	A	A	A	A
		Legal and regulatory	A	A	A	A	A
		Integration with development policies and planning	A	A	A	A	A
		Institutional mechanism, capacities and structures	A	A	A	A	A
2	Flexibility	Hazards risk	A	A	A	A	A
		Scientific and technical capacities and innovation	A	A	A	D	A
3	Inequality	Impact data	D	A	A	A	A
		Environmental and natural resources	A	A	A	A	A
		livelihood	A	A	A	A	A
		Culture, attitudes, education	A	A	A	A	D
4	Efficiency	Financial instruments	A	A	A	A	A
		Cost recovery for adaptation	A	A	A	A	A
		Maintenance and Operation Cost	A	A	A	A	A
5	Sustainability	Public awareness, knowledge, skill	A	A	A	A	A
		Information management and sharing	A	A	A	A	A
		Learning and research	A	A	A	A	A

Source: Interview Results, 2014

Note:

A : Agree

D : Disagree

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies – Disaster Expert

S4 : Academician

S5 : Agency for Environmental Management

From the results of interviews Delphi phase II obtained the opinion of the respondent about the sub-criterion of evaluating adaptation measures.

Table 5.7 Exploration Result of Stakeholders Perspective in Delphi Phase II

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
1	Enhancing policy, planning for adaptation measure	Adaptation must be in accordance with RPJMD (Planning Policy) and in evaluating the adaptation must be in accordance with the targets that set out in the policy and vision of the adaptation project	
2	Legal and regulatory	Legality is needed in the evaluation of adaptation because during this time many NGOs and people who walk on their own. To support the success of adaptation then there should be legalized so that the government can also help realize the adaptation program if there are constraints	
3	Integration with development policies and planning	Adaptation program involving many parties who are affected. In this case the government and the public should be able to integrate in terms of adaptation strategies to achieve upon the success. An example is the reclamation project is a program of the government but if the people around are not willing to accept	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		the government should integrate it with local people. There are some things that need to be right on target and not a lot of conflict.	
4	Institutional mechanism, capacities and structures	Evaluation of the mechanism is very important in evaluating the success of an adaptation project. Because the organizational structure is closely related to human resources. And institutions in Indonesia that specifically deal with the CC does not exist, therefore there must be translated into capacity building programs of disaster	
5	Hazards risk	In evaluating adaptation strategies urgently need to know the risk in advance, priority areas to determine the level of risk of climate change. Successful adaptation therefore has to be flexible, not least because of the potential range of climate changes projected under different emissions scenarios.	
6	Scientific and technical capacities and innovation	Every country need to develop the capacity to produce and use science due to the uncertain and dynamic nature of climate change impacts.	Research is already a lot. The amount of research is not a barometer of success of an adaptation strategy. This is because the implementation of the research that is less because less mechanism. Institution is supposed to be responsive to implement existing research
7	Impact data	the data needed to support climate change adaptation needs. However as the impacts of climate change vary by	It doesn't matter for impact data availability because the data can not be found because of lack of

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.	facilities. The important thing is human resources. Pro public rogram will make the successful adaptation
8	Environmental and natural resources	Availability of natural resources is very influential to measure adaptation. For example, the government can use natural resources without damaging the existing programs to support the adaptation. For example, mangrove. With maintenance of the mangrove, the government can obtain a lot of benefits that hold seawater ashore and can create new skills to the community in supporting the mangrove tourism.	
9	livelihood	Livelihood so can be used to measure the level of success. Because residents get new opportunities, then the affected communities can feel the success of the adaptation program	
10	Culture, attitudes, education	A change in attitude of society to cope with floods is a reflection of the success of adaptation projects	Not too important for evaluation. Because programs that have so far followed the customs of the people and the training has not been entirely successful behavior change
11	Financial instruments	Financial instrument is very important, here we can find out whether the money that was spent for the appropriate adaptation project	
12	Cost recovery for adaptation	The project has not been successful adaptation must be considered on performance cost-recovery and get the better target to benefit.	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
13	Maintenance and Operation Cost	Evaluate adaptation measure should consider about maintenance and operation cost too because it shows the efficiency of funding which government spent. Cost-effective can be seen from the M&O Cost too	
14	Public awareness, knowledge, skill	To be successful, climate change adaptation strategies may require skills and knowledge of local people. It is challenge for government to increase skill sets to effectively use climate change data.	
15	Information management and sharing	providing information including information needed to identify adaptation and measure the adaptation is successful or not. It can show their sustainability to adaptation measures.	
16	Learning and research	This is important because the actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable. The existence of learning and research will determine the sustainability of adaptation projects	

Source: Interview Results, 2014

III. Phase III

From the results of interviews Delphi Phase II there are several sub criteria has agreed to be the criteria that will be used to evaluate adaptation strategies. Sub-criteria are scientific and technical capacities, impact data, social criterion (culture, attitudes, education). The sub criteria that have not reached a consensus and not agreed upon by all respondents, conducted more interviews processing phase III. As the sub-criteria to achieve a consensus and agreed together.

Table 5.8 Results of Stakeholders' Perspective in Delphi Phase III

No	Sub-Criterion Will Be Used in Evaluation	Stakeholders				
		S1	S2	S3	S4	S5
1	Is scientific and technical capacities important and innovation can be used in evaluation to adaptation measure?	A	A	A	A	A
2	Is impact data important and can be used in evaluation to adaptation measure?	A	A	A	A	A
3	Is culture, attitudes, education and can be used in evaluation to adaptation measure?	A	A	A	A	A

Source: Interview Result, 2014

Note: A : Agree
D : Disagree
S1 : Town Planning Agency
S2 : City Department of Spatial Planning
S3 : Regional Disaster Management Agencies – Disaster Expert
S4 : Academician
S5 : Agency for Environmental Management

From the interview Delphi Phase III consensus obtained from the respondents regarding the adaptation criteria. For more details, here is a description of the exploration results of the respondents:

1. **Sub Criteria : scientific and technical capacities**
   They agreed because every country need to develop the capacity to produce and use science due to the uncertain and dynamic nature of climate change impacts. The actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable to make adaptation measure success.
2. **Sub Criteria : availability of impact data**
   The data needed to support climate change adaptation needs. However as the impacts of climate change vary by location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.
3. **Sub Criteria : culture, attitudes, education**
   A change in attitude of society to cope with floods is a reflection of the success of adaptation projects

Based on the analysis Delphi to get consensus on the cub-criteria to evaluating of adaptation measures, then the exact sub-criteria following:

1. Enhancing policy, planning for adaptation measure
2. Legal and regulatory
3. Integration with development policies and planning
4. Institutional mechanism, capacities and structures
5. Hazards risk
6. Scientific and technical capacities and innovation
7. Impact data
8. Environmental and natural resources
9. Livelihood
10. Culture, attitudes, education
11. Financial instruments
12. Cost recovery for adaptation
13. Maintenance and Operation Cost
14. Public awareness, knowledge, skill
15. Information management and sharing
16. Learning and research

5.4.2 Evaluate Performance of Flood Risk Adaptation in The Context of Climate Change

According to analysis result in **section 5.3**, the selected adaptation measures are mangrove conservation area, elevate floor house, and enhance soft skill of community. To evaluate this adaptation measure, it has been used criteria from earlier section (**section 5.4.1**) which has been crosschecked by stakeholders. Then, questionnaire had been distributed to stakeholders who involved. The stakeholders involved is same as with stakeholders in Delphi Analysis, four people from local government, one academician, and there representative of District Head (Krembangan, Pabean Cantikan, and Kenjeran). The detailed of stakeholders is showed below:

- Government

Government as policy makers and decision makers in adaptation is the most important stakeholders. In this study, the respondents from government to evaluate adaptation strategies are Town Planning Agency of Surabaya (Bappeko), Department of Public Works - City Department of Spatial Planning, Agency for Environmental Management

- Representative of Local People

Respondents who used to represent the community comes from the district head who reside in flood prone areas namely Head of Krembangan District, Head of Pabean Cantikan District, and Head of Kenjeran District.

- Academician

Academics will be represented by a lecturer of urban and regional planning in one of university in Surabaya. In consideration, the problem of flooding adaptation is one of the objects of study in this study program. Opinions and judgments of those who understand the science of waste management is what is expected to be input in the study.

- Practitioners

The practitioners include operators or parties who were involved directly in the project adaptation, at least in the scale communal or residential, directly. The opinions and judgments of experienced composting activities, is one of the considerations in making this data. In this case, people from disaster expert in Regional Disaster Management Agencies were chosen.

5.4.2.1 Analytic Hierarchy Process Analysis

The process of assessing the success of adaptation in this study was done by a multi-criteria using AHP method. . In using AHP, the decomposition needs to be done to identify problems with the criteria and sub-criteria used. The main criteria in assessing the success of adaptation strategies are obtained in the previous Deplhi analysis whichhas been adjusted. Table of criteria and sub-criteria used to evaluate the success of adaptation strategies is showed below.

Table 5.9 Criteria and Sub-Criteria for Evaluating Adaptation Measure

No	**Main Criteria**	**Criterion Code**	**Sub-Criteria**	**Sub Criterion Code**
1.	Effectiveness	C1	Enhancing policy, planning	SC1
			Legal and regulatory	SC2
			Integration with development policies and planning	SC3
			Institutional mechanism, capacities and	SC4

No	Main Criteria	Criterion Code	Sub-Criteria	Sub Criterion Code
			structures	
2	Flexibility	C2	Hazards risk	SC5
			Scientific and technical capacities and innovation	SC6
3.	Inequality	C3	Impact data for flooding	SC7
			Environmental and natural resources	SC8
			Livelihood to people surrounding	SC9
			Culture, attitudes, education conditions	SC10
4.	Efficiency	C4	Financial instruments	SC11
			Cost recovery for adaptation	SC12
			Maintenance and Operation Cost	SC13
5.	sustainability	C5	Public awareness, knowledge, skill to people surrounding	SC14
			Information management and sharing	SC15
			Learning and research related to enhancing adaptation measure	SC16

This multi-criteria analysis makes the analytic hierarchy process, with the main objective (goal) are in the top position, followed by the main criteria, sub-criteria, and alternatives issues. Hierarchy of research that has been compiled (Figure below) is the basis for the preparation of the questionnaire and data processing.

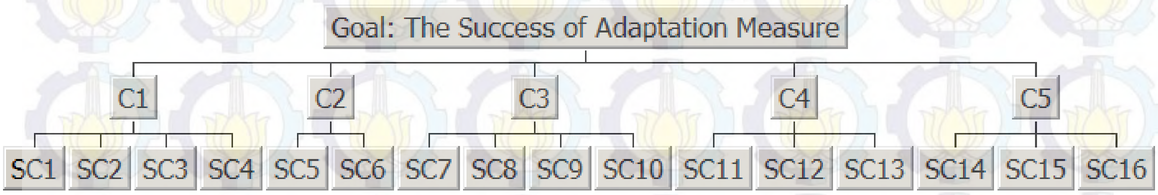

Figure 5.7 Hierarchies of Criteria and Sub Criteria on AHP Analysis

Assessment procedure in AHP pair wise comparison refers to the assessment scores that have been developed by Thomas L Saaty, as shows in Figure 5.8. In determining priority of criteria and sub-criteria analysis techniques is used AHP (Analythical Hierarchie Process) with individual pairwaise (of Expert Choice software 11).

Degree of importance	Definition
1	Equal importance (no preference)
2	Intermediate between 1 and 3
3	Moderately more important
4	Intermediate between 3 and 5
5	Strongly more important
6	Intermediate between 5 and 7
7	Very strongly important
8	Intermediate between 7 and 9
9	Extremely strongly more important
1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9	Reciprocals of 2, 3, 4, 5, 6, 7, 8, and 9

Figure 5.8 Aassessment Scores of AHP

AHP technique to compare the level of interest among criteria and sub-criteria based on the expert opinion. The results of the questionnaire input from the respondents can be seen in **Appendix D.**

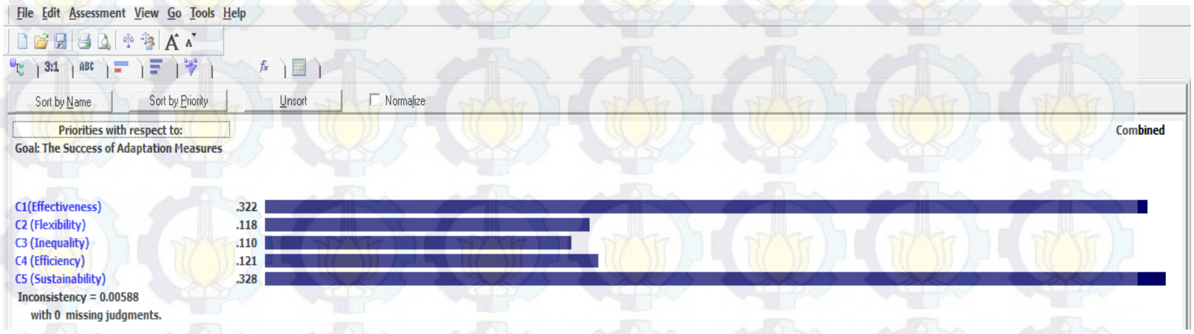

Figure 5.9 Weighting Criteria from Expert Choice Results

From the analysis obtained the weight of each criteria and sub-criteria as follows:

A. Effectiveness Criterion Weighting

Based on the analysis results obtained AHP weight values for each sub-criterion of effectiveness criterion are Enhancing policy, planning (0.385), Legal and regulatory (0.167), Integration with development policies and planning (0.147), and Institutional mechanism, capacities and structures (0.3) with a value of 0.00023 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.000233, sub criteria of the effectiveness is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

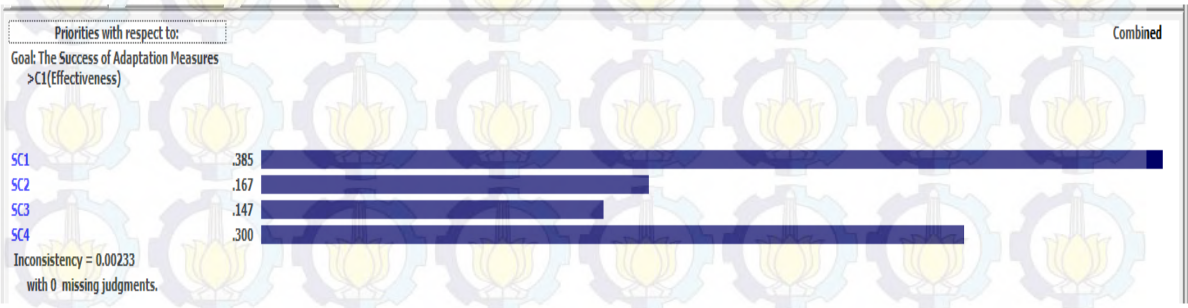

Figure 5.10 Outputof AHP for Effectiveness Criteria

B. Flexibility Criterion Weighting

Based on AHP result, the criteria consist of many sub-criteria. These are hazard risk (0.547) and scientific and technical capacities and innovation (0.453) with the inconsistency is 0.00. That means the criteria is valid can be used for evaluation. Output from Expert Choice for Flexibility is shown in figure below:

Figure 5.11 Output of AHP for Flexibility Criteria

C. Inequality Criterion Weighting

Based on AHP result, the inequality criteria consist of many sub-criteria. These are impact data for flooding (0.363), availability of environmental and natural resources(0.176), livelihood to people surrounding (0.221), and culture, attitudes, education conditions (0.240) with the inconsistency is 0.00. That means the criteria is valid can be used for evaluation. Output from Expert Choice for Inequalityis shown in Figure 5.12:

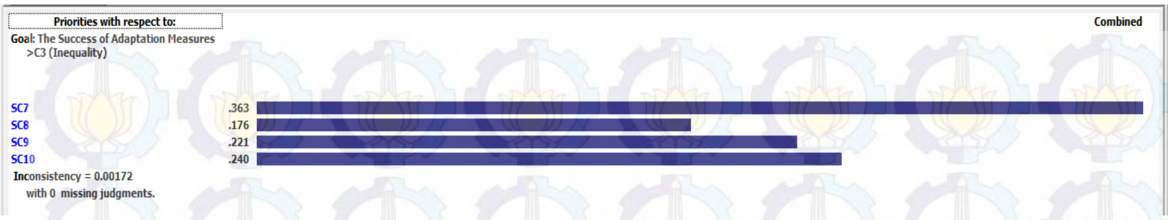

Figure 5.12 Output of AHP for inequality Criteria

D. Efficiency Criterion Weighting

Based on the analysis results obtained AHP weight values for each sub-criterion of efficiency criterion are financial instruments (0.537), cost recovery for adaptation (0.23), and maintenance and Operation Cost (0.323) with a value of 0.000208 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.000208, sub criteria of the efficiency is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

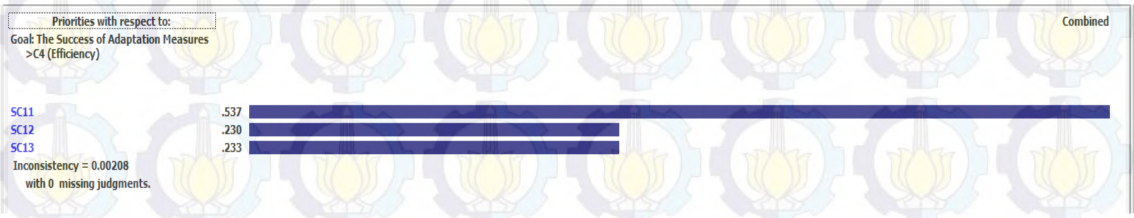

Figure 5.13 Output of AHP for Efficiency Criteria

E. Sustainability Criterion Weighting

According to the analysis results obtained AHP weight values for each sub-criterion of sustainability criterion are public awareness, knowledge, skill to people surrounding (0.336), Information management and sharing (0.258), and Learning and research related to enhancing adaptation measure (0.407) with a value of 0.00095 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.00095, sub criteria of the sustainability is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

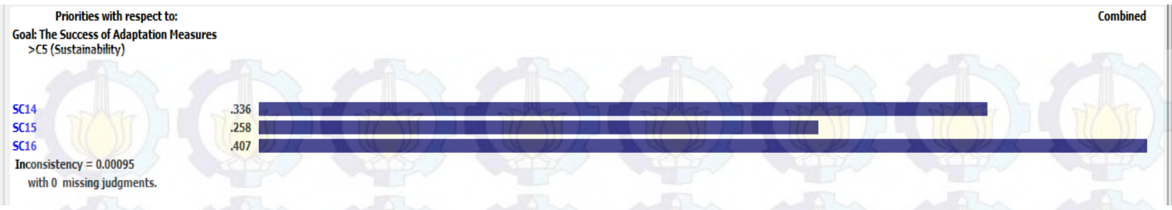

Figure 5.14 Output of AHP for Sustainability Criteria

As for the result of a combination of all criteria and sub criteria weighting shows as follows:

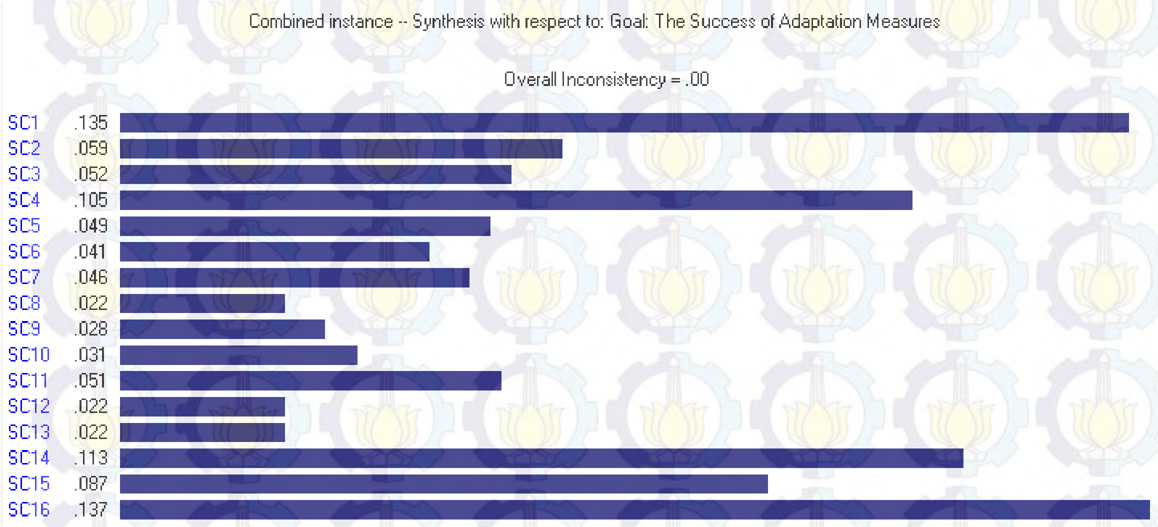

Figure 5.15 Weighting Sub-Criteria from Expert Choice Result

5.4.2.2 Ranking Method Using Scoring

This hierarchy below shows each criterion and sub-criterion with the weight. This weighting will be calculated with scoring in the later section to know the successful of criteria based on stakeholders's perception. To get the score or value, scoring scale is used to help in this multicriteria analysis. In ranking method, every criterion consideration is ranked in order of the stakeholders' preference. To generate for each evaluation unit, each criterion was weighted according to the estimated significance for evaluating adaptation measure.

Basically, the evaluation of adaptation measures is to compare the performance indicators of the achievement of targets set by the researcher. In this section will be made a remedy worksheets provide an assessment and evaluation of the adaptation measure. But to give a score to each sub-criterion, the determination of value is done in accordance with the adaptation measures that will be evaluated (see **appendix E** for evaluation questionnaire). Each adaptation measure has a value and the class individually.

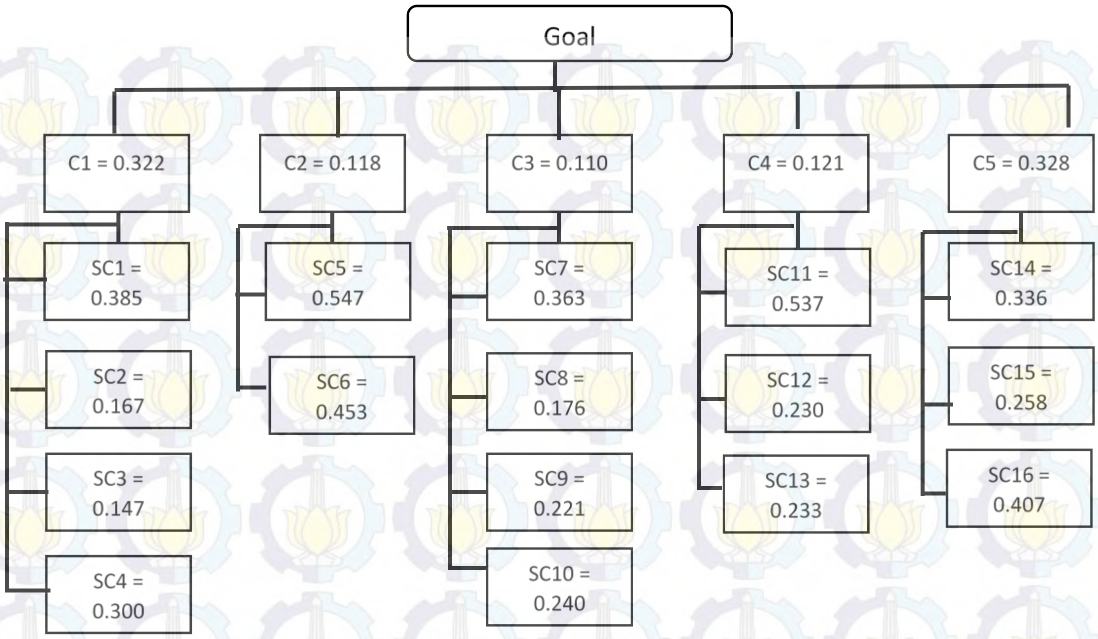

Figure 5.16 Combined Weighting of Criteria and Sub-Criteria

In the scoring scale, a number of questions are formulated and answered by selected stakeholders (see the **appendix F**). The number of questions is 16, according to the number of sub-criteria. In every response is given by value. With a purposive sampling, the sample size is eight people. Then the maximum value for the question is 16 x 8 = 128 and the minimum is 8 final score was obtained by summing the numbers for each answer. The amount or maximum rating for the 16 questions is 8 x 16 = 128 points and the minimum is 16 points. So scores ranged 16 - 128 of this amount will be multiplied by the weight and will obtain the level of success of a program against goals and targets have been achieved. From the results of the distribution of questionnaires to the stakeholders' perceptions of the obtained results of analysis of the sub-criteria as follows:

Table 5.10Value and Weighting for Three Adaptation Measures

No	Sub-Criteria	Value			Weighting
		Mangrove	Elevate Floor	Enhance Skill	
1.	Enhancing policy, planning	0.775	0.625	0.625	0.385
2.	Legal and regulatory	0.85	0.575	0.625	0.167
3.	Integration with development policies and planning	0.725	0.575	0.6	0.147
4.	Institutional mechanism, capacities and structures	0.45	0.575	0.375	0.300
5.	Hazards risk	0.575	0.725	0.5	0.547

No	Sub-Criteria	Value			Weighting
		Mangrove	Elevate Floor	Enhance Skill	
6.	Scientific and technical capacities and innovation	0.55	0.65	0.475	0.453
7.	Impact data for flooding	0.575	0.525	0.575	0.363
8.	Environmental and natural resources	0.55	0.6	0.725	0.176
9.	Livelihood to people surrounding	0.6	0.625	0.675	0.221
10.	Culture, attitudes, education conditions	0.425	0.625	0.425	0.240
11.	Financial instruments	0.525	0.55	0.525	0.537
12.	Cost recovery for adaptation	0.525	0.5	0.5	0.230
13.	Maintenance and Operation Cost	0.45	0.55	0.65	0.233
14.	Public awareness, knowledge, skill to people surrounding	0.575	0.725	0.7	0.336
15.	Information management and sharing	0.575	0.6	0.725	0.258
16.	Learning and research related to enhancing adaptation measure	0.6	0.675	0.65	0.407

Source: Analysis Result, 2014

Value will be used to calculate the percentage the success of adaptation measures. In the next sub-section, the value will be multiplied with weigh to get the percentage.

5.4.2.3 Calculation of Criterion Score

- Mangrove Conservation Area

Criterion score is obtained from multiplying the amount of weight by a score of adaptation measures in the same criteria. Here is the calculation of the score criteria.

Table 5.11Criterion Score for Mangrove Conservation Area

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.775	0.385	0.298	5.967
		Legal and regulatory	0.850	0.167	0.142	2.839
		Integration with development policies and planning	0.725	0.147	0.107	2.131
		Institutional mechanism, capacities and structures	0.450	0.300	0.135	2.7
2	Flexibility	Hazards risk	0.575	0.547	0.315	6.291
		Scientific and technical capacities and innovation	0.550	0.453	0.249	4.983
3.	Inequality	Impact data for flooding	0.575	0.363	0.209	4.174
		Environmental and natural resources	0.550	0.176	0.097	1.936
		Livelihood to people surrounding	0.600	0.221	0.133	2.652
		Culture, attitudes, education conditions	0.425	0.240	0.102	2.04

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
4.	Efficiency	Financial instruments	0.525	0.537	0.282	5.638
		Cost recovery for adaptation	0.525	0.230	0.121	2.415
		Maintenance and Operation Cost	0.45	0.233	0.105	2.097
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.575	0.336	0.193	3.864
		Information management and sharing	0.575	0.258	0.148	2.967
		Learning and research related to enhancing adaptation measure	0.6	0.407	0.244	4.884
Total						57.58

Source: Analysis Result, 2014

From table above, the mangrove conservation area has level of successful by **57.58%.** In addition, the graph below shows the proportion every criterion for mangrove conservation area. In that graph, there are two criteria which have same percentage by 19 % that are inequality and flexibility. However, the highest percentage is effectiveness criterion which has value as 20%.

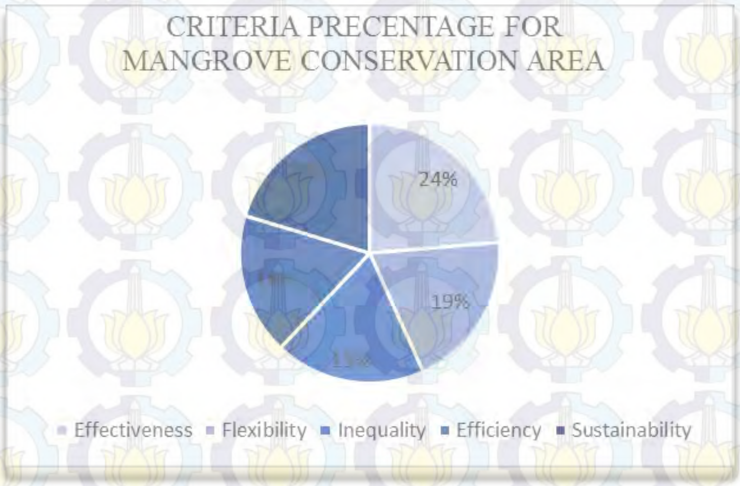

Figure5.17: Criteria Percentage of Mangrove Conservation Area

- Elevating Floor

To the adaptations made by this community, the criteria will also be given a score to get the right value to measure the success rate of this adaptation. Table 5.12 show the calculation of each criterion for elevating floor.

According to calculation provided in the table below, this adaptation measure occupied more percentage than previous adaptation (mangrove conservation area adaptation measure). This adaptation measures has around **61.62%** then the proportion of each criterion can be seen at graph below. In this adaptation measure, the sustainability and inequality have same percentage by 19%. In addition, effectiveness and efficiency also have same percentage by 22%.

Table 5.12 Criterion Score for Elevate Floor

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.625	0.385	0.241	4.812
		Legal and regulatory	0.575	0.167	0.096	1.920
		Integration with development policies and planning	0.575	0.147	0.084	1.690
		Institutional mechanism, capacities and structures	0.575	0.300	0.172	3.45
2	Flexibility	Hazards risk	0.725	0.547	0.396	7.931
		Scientific and technical capacities and innovation	0.65	0.453	0.294	5.889
3.	Inequality	Impact data for flooding	0.525	0.363	0.190575	3.8115
		Environmental and natural resources	0.6	0.176	0.1056	2.112
		Livelihood to people surrounding	0.625	0.221	0.138125	2.7625
		Culture, attitudes, education conditions	0.625	0.240	0.15	3
4.	Efficiency	Financial instruments	0.55	0.537	0.29535	5.907
		Cost recovery for adaptation	0.5	0.230	0.115	2.3
		Maintenance and Operation Cost	0.55	0.233	0.12815	2.563
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.725	0.336	0.2436	4.872
		Information management and sharing	0.6	0.258	0.1548	3.096
		Learning and research related to enhancing adaptation measure	0.675	0.407	0.274725	5.4945

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
Total						61.6125

Source: Analysis Result, 2014

- Enhance Soft Skill and Entrepreneurship to Local People

Criterion score is obtained from multiplying the amount of weight by a score of adaptation measures in the same criteria. Here are the score calculation criteria for adaptation strategies Enhance Soft Skills and Entrepreneurship to Local People. Table 5.13 shows criterion score for the third adaptation measure.

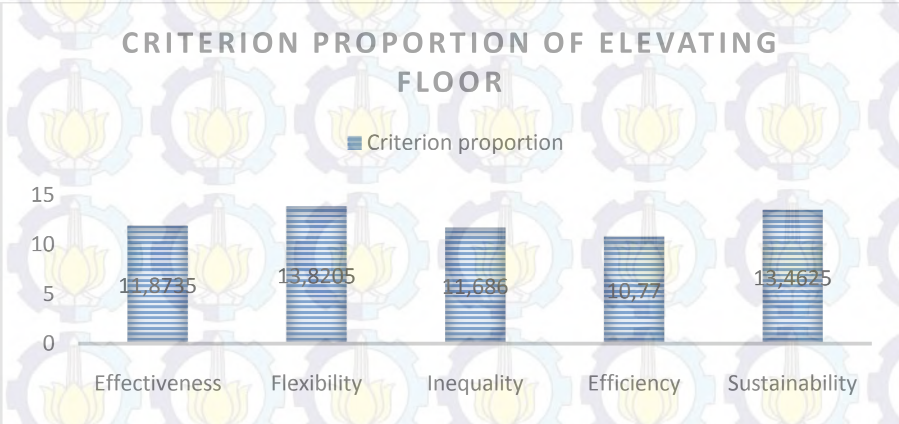

Figure 5.18: Criteria Percentage of Elevating Floor Adaptation Measure

Table 5.13 Criterion Score for Enhance Soft Skill and Entrepreneurship to Local People

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.625	0.385	0.241	4.812
		Legal and regulatory	0.625	0.167	0.104	2.087
		Integration with development policies and planning	0.6	0.147	0.088	1.764
		Institutional mechanism, capacities and structures	0.375	0.300	0.112	2.25
2	Flexibility	Hazards risk	0.5	0.547	0.273	5.47
		Scientific and technical capacities and	0.475	0.453	0.215	4.303

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
		innovation				
3.	Inequality	Impact data for flooding	0.575	0.363	0.208	4.174
		Environmental and natural resources	0.725	0.176	0.127	2.552
		Livelihood to people surrounding	0.675	0.221	0.149	2.983
		Culture, attitudes, education conditions	0.425	0.240	0.102	2.04
4.	Efficiency	Financial instruments	0.525	0.537	0.281	5.638
		Cost recovery for adaptation	0.5	0.230	0.115	2.3
		Maintenance and Operation Cost	0.65	0.233	0.152	3.029
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.7	0.336	0.235	4.704
		Information management and sharing	0.725	0.258	0.187	3.741
		Learning and research related to enhancing adaptation measure	0.65	0.407	0.264	5.291
Total						57.141

Source: Analysis Result, 2014

From the table above, it can be seen that percentage of this adaptation measure is **57.141%.**The score of this adaptation is lower than the other but it is not much difference with first adaptation (mangrove conservation area. To know the proportion of each criterion, the graph below is showed.

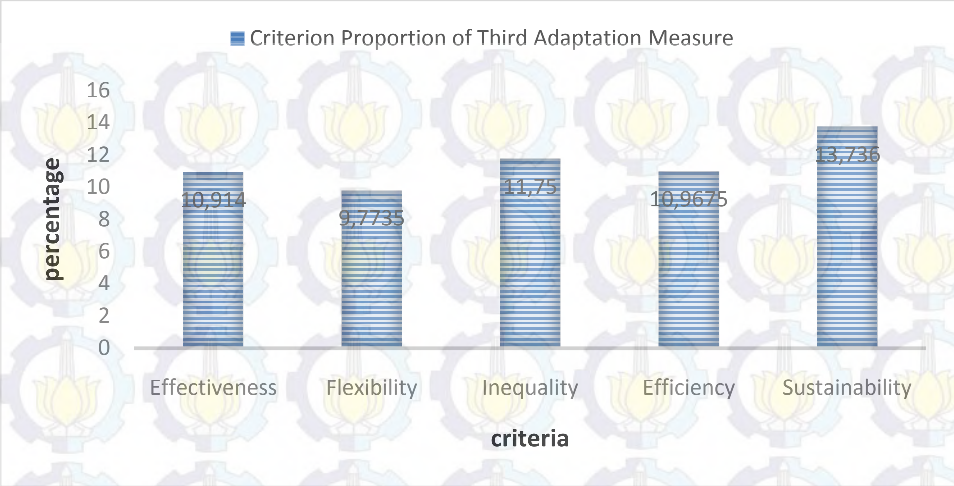

Figure 5.19: Criterion Proportion of Enhancing Skill and Entrepeneurship for Local People

Table 5.14 Level of Success for Three Adaptation Measure

No	Criteria	Adaptation Measure		
		Mangrove Conservation (%)	**Elevating Floor (%)**	**Enhancing Soft Skill (%)**
1.	Effevtiveness	13.63	11.87	10.91
2.	Flexibility	11.27	13.82	9.77
3.	Inequality	10.80	11.69	11.75
4.	Efficiency	10.15	10.77	10.97
5.	Sustainability	11.71	13.46	13.74
	Total	**57.58**	**61.61**	**57.14**

Source: Analysis Results, 2014

According to calculation above, it can be known that the most successful adaptation measure is elevating floor. This adaptation is adopted by communities who live in coastal area. Criterion of Sustainability is the highest score in this adaptation, and then followed by flexibility which has score with 13.8%.

Then to assess the success, a standard traffic light system is used. Traffic light system uses three colors: green with a threshold of more than 68% means that the achievement of the criteria already achieved, yellow color with a threshold of 52% to 68% means that the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats. The red color with a threshold of less than 52% which means that the achievement of an adaptation program actually below the target set and require immediate repair. The threshold is determined based on the characteristics of the overall criteria score. For this explanation, it can be concluded that three adaptation measure that choosen are in yellow color. Then, figure 5.20 shows the compilation each criteria for each adaptation measures. The sustainability criterion is the most successful criteria of adaptation measures although its score has bit differences with others. The second successful criterion is effectiveness, it means all of adaptation measures have been achieved the targets but the score of this criterion is in yellow threshold.

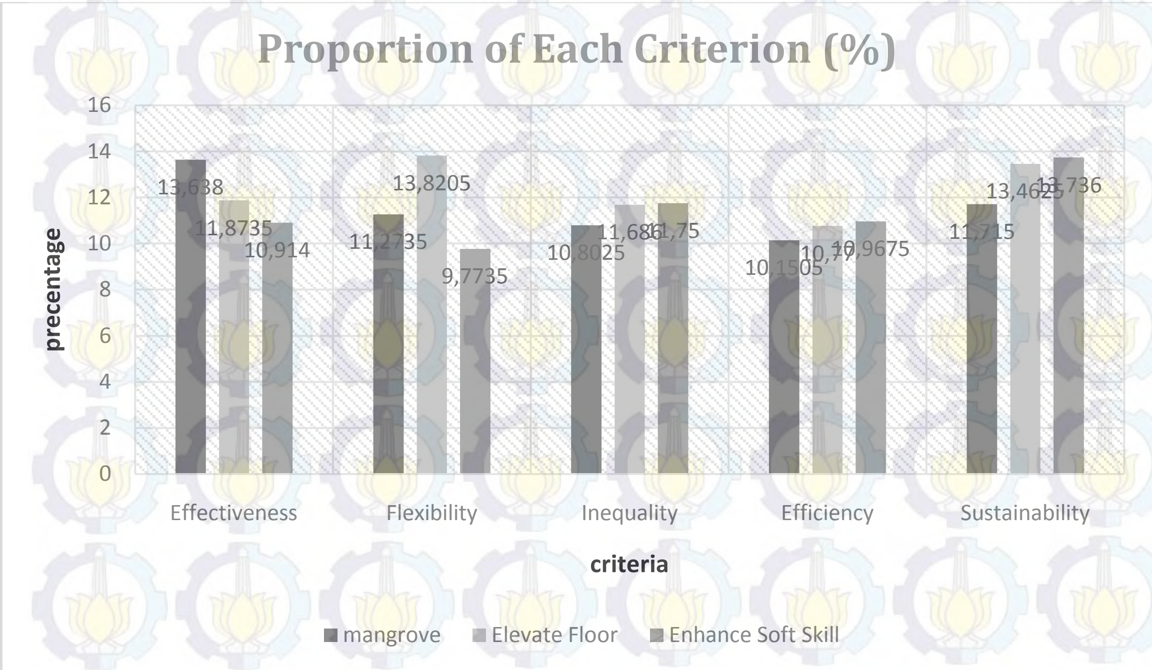

Figure 5.20 Proportion of Each Criterion

5.5 Recommendations to Enhance Adaptation Strategies Based Under the Current Situation

A key aim of this section is the development of recommendations to assess the successful of adaptations for reducing future vulnerability levels to flooding. Chapter 4 providesthe situation of flooding and chapter 5 provides an assessment of current adaptations under current conditions. Based on the assessment and evaluation results in early section, I concluded that all of criteria will make a significant contribution to enhancing the adaptation of disaster responses. However, future environmental conditionsalso need to be taken into account. In particular, extreme rainfall events arepredicted to increase under future climate change scenarios (Solomon et al.2007; Olsson, Gidhagen, & Kawamura 2011 and Mullan, Mortlock & Fealy2012).

In the early section, the results of successful criteria have been identified indicating that three of chosen adaptation measures is in yellow color, the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats. In this section, the recommendations will be identified how to enhance adaptation measure based on the type of adaptation measure. The three selected adaptation measures include household adaptation (elevated floor) and city level adaptation (mangrove conservation and enhance soft skill of the people). The recommendations to enhance adaptation measures at the city level are identified as follows:

1. Integrating adaptation application with the policy and actual condition of the area

   The effectiveness percentage is avarage in 12.14%. It is important for assessing the **effectiveness of adaptations** scenarios and should be used to inform international and national policy for disaster risk management related to adaptation measures and be made available at more regional and local scales for regions and communities that are particularly vulnerable to disasters. Strengthening the effectiveness criterion can be done with the procurement monitoring and evaluation of programs for adaptation. The evaluation is done ex-ante and e-post in order to create an integrated adaptation.

   In addition, to reach the integrated adaptation, the Municipal Government should cooperate with NGOs (local and non-local) in emergency situations. Current actions of NGOs are not normally integrated with government activities. In the case of a flood emergency, some coordination occurs, but is generally at a technical level such as in collecting and organizing disaster relief assistance, and conducting search and rescue activities. Both local and outside stakeholders, excluding the BPBD, support these coordination initiatives.

2. Enhancing Spatial Plan

   Enhancing spatial plan can also enhance the **effectiveness criterion** of adaptation. Enhancing spatial plan implementation can be significant recommendations for adaptation measure. The spatial plan implementation involves controlling land use. The land use control will regulate the mix of built-up areas and open space both in upstream areas and it will also prevent buildings and houses being located on risky land or in potentially inundated areas. The building code within the spatial plan will regulate the appropriate types of buildings for the area.

In addition, the spatial plan will also allocate appropriate infrastructure to support local community's livelihoods. As a result, the spatial plan can be used not only in the mitigation stage but also in the preparedness and response stages.

3. Reforestation and flood infrastructure redevelopment

    Reforestation remains effective in reducing the impact of floods on **all sub criteria in equality**. This is indicated by the most same values on every sub critrion in both comparisons. Therefore,reforestation is a sustainable approach for minimising the impact offloods for the near future.

    Reforestation can be done with converting non-forest land use types or replanting the forest. Reforestation will increase the amount of green open space as well as the density of trees. Both of these effects will increase the amount of rainfall infiltration to the soil. This increase in infiltration will reduce the run-off water which in turn reduces the amount of water in the plain and river. Consequently, there will be a reduction in the scale of inundation.

    Then, the adaptation of flood infrastructure redevelopment has consequences for the capacity of flood infrastructure. Infrastructure redevelopment will not reduce the amount of water but will manage the flowing water. The increase in embankment height will increase the river capacity while the increase in capacity of drainage system will increase weekly water discharge back to the river.

    The Infrastructure Redevelopment Adaptation was shown to be most effective adaptation by stakeholders under current conditions. However, under the climate change, it is shown to be no longer effective andcannot therefore be regarded as a sustainable approach. It will only help thevillagers in the short term but not in the longer term.

4. Providing research related to flood risk

    This recommendation has aim to develop researches related to flood risk which can improve proper handling of adaptation efforts and improving knowledge and awareness of disaster in this area too.

However, recommendations to enhance adaptation measures at household level should be applied to support the success adaptation measure at all. There are recommendations to enhance household-adaptation:

1. Promoting household income and creating other sources of income

Promoting income is proposed by creating alternative economic activities, particularly during floods and increasing productivity of current sources of income such as paddy and aquaculture. Promoting income will logically increase community's savings. With better savings, households will have better financial capacity. The increased savings are assumed will provide better capacity to the households in responding to coming floods. Therefore, this increased capacity is thought to decrease community vulnerability (Gaillard, Maceda, Stasiak, Le Berre, Espaldon, 2009; Fussel, 2012; Brauch, 2011).

For livelihood, the local community who has proffesion as farmer can combine their main source of income. For example, some paddy field farmers combine their rice field with aquaculture. When the local community have no savings, they will regularly catch fish in swamp areas to fulfil their daily needs.

Kenaf planting is one of the alternative sources of income particularly in the inundated swamp areas. Since the majority of people in the community rely on a day-to-day income source, the villagers often experience a shortage between income and expenditure, especially in emergency conditions. That means saving isn't feasible for the local community. Therefore, creating other sources of income will be expected to enhance community's economic stability.

2. Implementing insurance mechanism

The adaptation of Insurance can effectively enhance **the efficiency criterion** by reducing the **cost recovery sub-criterion**. This meansthat the adaptation can minimise the number of collapsed houses onlyduring floods. Moreover, insurance can also minimise the economic losses of middle and highincome families.

Insurance helps community by providing money for their houses after flood events. This mechanism will avoid community spending their savings on house repairs. Sometimes, the cost of house repairs makes them incapable of recovery. Furthermore, people may sell paddy fields to get money. An insurance mechanism has the added benefit of decreasing the need for government spending in assisting the victims. Major government assistance funds are spent on rehabilitation and reconstruction programs including reconstruction programs for low income people. Involving the low income people will decrease this government spending too. Consequently, the funds can be spent on other type's ofexpenses in disaster adaptation or mitigation.

However, a lack of understanding of the benefits of insurance is one major challenge. Insurance is still perceived as a luxury and new for most people especially the poor in developing countries (Feyen, Lester & Rocha, 2011; Radermarcher & Brinkmann, 2012). Consequently, there is a need to promote the idea of sharing the risk within the community. One approach to communicating the idea of insurance is to draw an analogy with the tradition of 'lumbung padi' whereby villagers collect some of the harvest from the paddy field for public storage. This long tradition in Indonesian villages makes the sharing of food feasible particularly in a famine situation. The other challenge is the unwillingness of the government to approach insurance companies and provide assistance to low income earners to pay premiums. Kousky & Kunreuther (2009), Kron (2009), Hofman (2007) and Atmanand (2003) provide examples of how governments can contribute to subsidizing villagers' involvement in insurance for disasters.

The other effective economic adaptation is the Cash Transfer Program. This has a similar effect to theInsurance Adaptation, specifically in minimising the broken houses.The CashTransfer Program will effectively increase low income families' savingswhich in turn minimises villagers' dependency ongovernment assistance. Therefore, in the case of a shortage ofgovernment assistance, a low income family can still repair theircollapsed house with partial government assistance.

5.6 Summary of Findings

There are nine adaptation measures which were identified during the document review and interview with stakeholders. However, according to scoring analysis, the three selected adaptation measures which have high prioritizes are (i) mangrove conservation, (ii) elevating floor, and (iii) enhancing soft skill and entrepreneurship for local people.

Based on AHP and scoring analysis, the percentage of success for Conservation mangrove, elevating floor, and Enhancing soft skill are 57.57%, 61.61%, and 57.14% respectively. According to traffic light threshold, all adaptation measures that choosen is in yellow color. It means that the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats.

According to analysis results, problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The integration among them is crucial due to the important role of the planning system and the planning profession in disaster management (Bosher, Dainty, Carrillo & Glass, 2007). The need for a planning instrument is also regarded by key scholars as more important than an emergency system for anticipating routine hazards rather than just responding to incidental hazards (Handmer & Dovers, 2007).

The interviews conducted as part of this study revealed that stakeholders place major importance on improving and redeveloping flood infrastructure to minimize flood impacts. Flood infrastructure redevelopment can be in the form of improving river embankments, improving drainage systems and building dams. Reforestation has not been a major concern since most of the stakeholders focus on reactive and segmented actions. Furthermore, because reforestation is required upstream of the village, this action may seem less under their control and is therefore not a focus of their attention.

By combining the strategies of each criterion, it can be concluded that strategies to enhance adaptation measures in study area are: (i) Integrating adaptation application with the policy and actual condition of the area, (ii) Enhancing Spatial Plan, (iii) Reforestation and flood infrastructure redevelopment, (iv) providing some research and its implementation, (v) Promoting household income and creating other sources of income, (vi) Implementing insurance mechanism.

However, these strategies are only effective in improving specific sub criteria, and theyare associated with increasing impacts in other sub criteria. For this reason they cannot be categorised as effective approachesin isolation, although they perform better when applied together with other adaptations.

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CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

In this part includes conclusions and recommendations regarding results of research. Conclusion part describes about the result of main objectives and specific objectives too, whilst for recommendation part explains the further directions of this research, such as: application of research result and limitation and further studies of this research.

6.1 Conclusions

While evaluation of adaptation measure has the potential to improve responses to floodevents and hence reduce their impacts on communities, current adaptation are limited and lack a strong predictive capacity. More sophisticated tools are needed to adequately represent the multiple dimensions of adaptation under the vulnerability and tosupport decision-making. This thesis has demonstrated that MCA has the potential to meet this need by evaluating flood in acommunity vulnerability usingthe Delphi Technique, secondary surveys and semi-structured interviews.

The main objective of this research is to evaluate climate change adaptation using criteria for measuring the success of coastal flood adaptation measures. According to the evaluation results, problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats.

To asses past and on-going adaptation measures, document review and interview had been done. There are nine adaptation measures which were identified during the document review and interview with stakeholders After knowing the adaptation that occurs in study area, three selected adaptation measures which have high prioritizes are (i) mangrove conservation, (ii) elevating floor, and (iii) enhancing soft skill and entrepreneurship for local people.

Surabaya government has spent big amount of money to do adaptation measure projects. In the adaptation process, they involve community from an early age, ranging from planning, implementation, and monitoring and evaluation program to be implemented.

To determine criteria of evaluation, literature review and Delphi Analysis have been conducted. Identification of criteria for the evaluation is done based on the study of literature and has been crosschecked with stakeholders to determine the existing condition in the evaluation. Criteria of effectiveness, efficiency, equity, flexibility and sustainability are said important in judging success. The sub-criteria that found in the literature is fifteen sub-criterion, but after conducted Delphi with three stages, agreement of stakeholders is found with one new sub-criterion (Maintenance and Operation Cost).

Evaluating the success of adaptation measures is done by MCA analysis. The result shows the percentage of success for conservation mangrove, elevating floor, and enhancing soft skill are 57.57%, 61.61%, and 57.14% respectively. According to traffic light threshold, all adaptation measures that chosen are in yellow color. It means that the achievement of adaptation measure is not achieved yet though the value is close to the target. Problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The integration among them is crucial due to the important role of the planning system and the planning profession in adaptation measure under disaster risk management.

The three selected adaptation measures include household adaptation (elevated floor) and city level adaptation (mangrove conservation and enhance soft skill of the people) having different recommendations. For the city level, the need for a planning instrument is also regarded by key stakeholders as more important than an emergency system for anticipating routine hazards rather than just responding to incidental hazards such as integrating adaptation application with the policy and actual condition of the area, Enhancing Spatial Plan, and Reforestation and flood infrastructure redevelopment. Then, economic development such as promoting household income and creating other sources of income, implementing insurance mechanism are regarded as significant ways to reduce people vulnerability.

6.2 Recommendations

6.2.1 Applications of research results

According to the main results of this study, focusing attention on adaptation measures will be a key to reducing community vulnerability to flood in the case study presented. This study also presents about problems and condition of ongoing and past adaptation measure, it can used by government as consideration in decision-making and monitoring process to face flood risk and it will improve the capacity of decision-makers to minimize the impacts of future disasters. Then, the results of each criteria show in yellow indicators, it should be reviewed to know which adaptation measure is still integrated and good and which one is not good and doesn't fit with actual condition of the study area. Then, the recommendation to enhance adaptation strategies can be adopted by area which have same characteristic with study area.

This study proposes a way of recommendations for adaptations under disaster risk management. Lack of integration that shows in this study's results can be suggestion to decision-makers. This integration is important to provide decision support systems for disaster assistance both from governments and non-government organizations. This kind of decision support system is needed to increase the degree of effectiveness of the chosen adaptations in the future.

Because of people in this study area have enough awareness to flood (based on key informants), it can be sustainable modal to human empowerment and it can make easy for government to do human capital strategies such as training to save from flooding and other hazards.

6.2.2 Limitations of this research

This research only focuses on stakeholder's perception including representative of local people to evaluate the criteria of adaptation measures. Then, only local adaptation strategies are analyzed in this study. It will be good to also evaluate the regional and national adaptation strategies.

Flood vulnerability mapping in this study is not enough to explain the extent of flood problems in urban area, because urban settlement has various object that can be influenced differently by flood. This study was tried to describe vulnerability of flooding generally, and due to some limitations, especially time constraints, vulnerability was based on assumptions, previous study, and local experiences, not by actual vulnerability.

Most of the criteria in this research are qualitative. Measuring qualitative criteria in a quantitative manner may produce other errors in the results. Therefore, value is used for every qualitative variable. The use of grounded theory in analyzing the stakeholders' opinions can also increase the confidence of the results. In addition, since there is no complete documentation of the impacts of past floods, the condition of flood risk impacts including damaged houses are established by considering available data together with key informants' responses.

6.2.3 Further studies

Recommendations for next studies are needed to explore about recommendation to improve adaptation strategies to deal with flood risk based on criteria results. In addition, this research conducted in coastal area of Surabaya, with some adjustments this analysis can be applied to other case studies or hazard types with different types of climate change hazard in other areas. Assessing other possible adaptations in a variety of cases will improve the concept and practice of vulnerability assessment and evaluation of adaptation measures.

Study about community's perception can be conducted to know in deep about how community face flooding and how they survive because the finding here shows community no longer feel the flood as one of the threats, but they considered it as a matter limitations they face every day. Research by quantitative criteria in the next study can improve the results and may produce less error.

REFERENCES

Adger, W.N., Arnell, N.W. and Tompkins, E.L.(2005). Successful adaptation to climate change across scales.*Global Environmental Change* 15, 77-86.

Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R.S., Smit, B. and Takahashi, K. (2007), *Assessment of adaptation practices, options, constraints, and capacity*, in Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds.), Climate Change 2007: Impacts, Adaptation and Vulnerability.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. and Wreford, A.: (2009), *Are there social limits to adaptation to climate change?*, Climatic Change 93, 335-354.

Albrechts, L. (2006). *Shifts in strategic spatial planning? Some evidence from Europe and Australia*. Environment and Planning A 38(6): 1149-1170.

Baker, E. J. (1977). *Public Attitudes toward Hazard Zone Controls*. Journal of the American Planning Association 43(4): 401 - 408.

Basuki, S., (2000), Rate and trend of land subsidence in the eastern part of Semarang (in Indonesian), *Media Teknik*, No. 3, 2000.

Bakornas PB. (2007). Guidelines for Flood Control 2007-2008. Jakarta.

Beach, D. (2002). Coastal Sprawl: *The Effects of Urban Design on Aquatic Ecosystems in the United States. Pew Oceans Commission*. http://www.pewtrusts.org/our_work_report_detail.aspx?id=30037.

Coburn et al, (1994), *Disaster Mitigation*, UNDP, Cambridge Architectural Research Limited

CCSP (2009). Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region . A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Titus, J.G. (Coordinating Lead Author), K.E Anderson, D.R. Cahoon, D.B. Gesch, S.K. Gill, B.T. Gutierrez, E.R. Thieler, and S.J. Williams (Lead Authors). U.S. Environmental Protection Agency, Washington, DC, USA

Doria, M.d.F., Boyd, E., Tompkins, E.L. and Adger, W.N.: (2009), „Using expert elicitation to define successful adaptation to climate change,‟ *Environmental Science & Policy* 12, 810-819.

Dahuri, R (1966). Integrated Management of Coastal and Marine Resources.Jakarta: Pradnya Paramita, 2001

Fleischhauer, M., S. Greiving, (2005). Spatial Planning in the Focus of Hazard and Risk Assessment/Management in Europe. EURO-RIOB Conference, Wroclaw, 19-21 October 2005.

Fletcher, S., H.D. Smith (2007). "Geography and Coastal Management", *Coastal Management* 35(4):419-427.

Greiving, S., M. Fleischhauer, et al., Eds. (2005). Report on the European scenario of technological and scientific standards reached in spatial planning versus natural risk management. Dortmund, ARMONIA Project, European Community.

Greiving, S., M. Fleischhauer, et al. (2006). "Management of natural hazards in Europe: The role of spatial planning in selected EU member states." *Journal of Environmental Planning and Management* 49(5): 739-757.Hyogo Framework for Action 2005–2015, 2005

Hsu, C and Brian A Sandford (2007). The Delphi Technique: Making Sense of Consensus. The Ohio State University and Oklahoma State University

IPCC.(2001). Climate Change 2001: Impacts, Adaptation & Vulnerability: *Contribution of Working Group II to the Third Assessment Report of the IPCC*. In J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken and K. S. White, eds. Cambridge, UK: Cambridge University Press. 1000 pp

IPCC Summary for Policymakers. (2007). The Physical Science Basis. Contribution of Working Group I to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press*

Jennings, T.L.: (2009), „Exploring the invisibility of local knowledge in decision-making: the Bostcastle Harbour flood disaster,‟ in Adger, W.N., Lorenzoni, I. and O'Brien, K. (eds.), *Adapting to Climate Change: Thresholds, Values, Governance, Cambridge University Press, Cambridge*, UK, pp. 240-254.

Pamungkas, A. (2006). Feasibility Assessment of Flood Disaster Mitigation Techniques in Indonesian Context. Surabaya

Kodoatie, R. J. (2005). *Introduction to Management Infrastructure*. Yogyakarta: Pustaka Pelajar

Kodoatie, R.J. (2008). *Integrated Water Resources Management*. Yogyakarta: ANDI.

Kodoatie, R. J. (2010). *Spatial Water*. Yogyakarta: ANDI: Pustaka Pelajar.

Nordhaus, W. D (2006). *The Economics of Hurricanes And Implications Of Global Warming*. Yale University. USA

McGranahan, G (2000). *The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones*. London. UK

Maskrey, A. (1998). Community Based Disaster Management, CBDM-2 Hand-out: ADPC

Meiviana, A., D.R. Sulistiowati dan M.H. Soejachmoen. 2004. *Earth is getting hotter*: Threat of Climate Change in Indonesia. Yayasan Pelangi. Jakarta.

O'Brien, K., Eriksen, S., Sygna, L. and Naess, L.O.: (2006), „*Questioning Complacency: Climate Change Impacts, Vulnerability, and Adaptation in Norway*,‟ Ambio 35, 50-56.

O'Brien, K., Lieichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L. and West, J.: (2004), „Mapping vulnerability to multiple stressors: climate change and globalization in India,‟ *Global Environmental Change* 14, 303-313.

Office of Public Work. (2009). *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. Ireland

Pande, R. K. (2010). Flash Flood Disasters in Uttarakhand. *Journal of Disaster Prevention and Management* 19(5): 565-570

Pugh,DT.(1987). *Tides,Surges and mean sea-level*: a handbook for engineers and scientist. Wiley, Chichester,472pp

Pugh,DT.(2004). *Changing Sea Levels Effect of Tides,weather and climate*. Cambridge University Press,280pp

Prasita, V. Dj and Kisnarti (2013). *Methods of Tidal Approach for Determination of Sea Level Rise in Surabaya Waters. Department of Oceanography, Faculty of Engineering and Marine Science, Hang Tuah University*.

Prasita, V. Dj. and E. A. Kisnarti, (2013). Prediction of Sea Level Rise Impacts on the Coastal Areas of Surabaya using GIS. *The International Journal of Engineering and Science Volume 2, Issue 7, Version 5 July 2013*. Page 01-09.

Republic of Indonesia. (2007). Law Number 26 Year 2007 About Spatial Planning. Jakarta

Republic of Indonesia. (2003). Land Use Control Guidelines In Flood Prone areas. Jakarta: Directorate General of Spatial Planning

Republic of Indonesia. (2005). *Guide Introduction Characteristics Disaster and mitigation efforts*. Jakarta: Directorate General Spatial Planning

Republic of Indonesia. (2007). Guide Manual Flood Disaster. Jakarta: Daily Implementing Bakornas PB.
Republic of Indonesia. (2007). Law Number 24 Year 2007 about Disaster. Jakarta

Rosenzweig, C., Major, D.C., Demong, K., Stanton, C., Horton, R. and Stults, M.: (2006), „Managing climate change risks in New York City‟s water system: assessment and adaptation planning,‟ *Mitigation and Adaptation Strategies for Global Change* 12, 1391-1409.

Smit, B. and Wandel, J.: (2006), „Adaptation, adaptive capacity and vulnerability,‟ *Global Environmental Change* 16, 282-292.

Saaty, T. L. (1993), *Decision Making for Leader* : The Analytical Hierarchy Process for Decisions in Complex World. Pittsburgh : University of Pittsburgh.
Smith, J.B. (1996). Development of Adaptation Measures for Water Resources. *Water Resources Development* 12(2)

Surabaya Municipality. (2013). Spatial Planning of Surabaya City 2013. Surabaya
Suryanta, J. (2012). *A Simple Method to Map Flood hazard*: Kolokium Hasil Litbang Sumberdaya Air.

Therivel, R. (2004). Strategic Environmental Assessment in Action. Earthscan. London

TU, T. (2009). *Adaptation to Flood Risk in Coastal Urban Area under Rapid Urbanization and Climate Change in Ho Chi Minh City, Vietnam*. Asian Institute of Technology

Turner et al., (2004). A Framework for Vulnerability Analysis in Sustainability Science. *Proceedings of the National Academy of Sciences of the United States of America* 100, 8074-8079.

The National Academies. (2010).Sea level Rise and Coastal Disaster. *The National Academies Press: Washington.D.C*

UNDP (2008) „*Fighting Climate Change*: Human Solidarity in a Divided World‟, Human Development Report 2007/2008, United Nations Development Programme, http://hdr.undp.org/en/reports/global/hdr2007-8/.

UNDP-Indonesia. (2007). Kerangka Kerja Pengurangan Risiko Bencana, Rencana Aksi (*Framework for Disaster Risk Reduction Action Plan*) Provinsi Nangroe Aceh Darusalam. Jakarta

United Nations/International Strategy for Disaster Reduction (UN/ISDR) (2004), Living with Risk: A Global Review of Disaster Reduction Initatives, 1, Geneva: United Nations

APPENDIX A:

LIST OF QUESTIONS FOR DETERMINING CURRENT ADAPTATION MEASURE

With Regards,

This questionnaire aims to assess current adaptation measures. Later, in the study of these criteria will be used to determine criteria to reach objectives of this research. I hope you provide answers to some questions. Then, I would like to say thank you for your time and cooperation.

Ariyaningsih
Urban Environmental Management
Asian Institute of Technology

Identity of Respondent

Name :

Position :

1. Can every individual do something to ADAPT to flood risk?
2. What have you done ALREADY to adapt to climate change?
3. What is the adaptation measure in this area?
4. Is there any change in attitudes or awareness after implementation of adaptation?
5. What did YOU learn about ways to adapt to CC?
6. Have you already planned to do any of these things in the FUTURE ie next 5 years to adapt to climate change?
7. How did you get a warning?

Please indicate whether you agree, disagree or don't know with regards to following statements.

Questions	Agree	Disagree	Don't Know
1. Every individual can do something to ADAPT to climate change			
2. The central/local government ARE doing things to help us to ADAPT to CC locally. If "agree" please give			

Questions	Agree	Disagree	Don't Know
Examples: ……………………………………………………………..			
3. The central/local government has ALREADY CONSULTED us to enable us to identify our areas of concern about CC on our island. If "agree" please give examples : ……………………………………………………………..			

15. Do you have anything you would like to add about any adaptation issues?

APPENDIX B
SCORING QUESTIONAIRE TO SELECT THE ADAPTATION MEASURE

With Regards,

The scoring questionnaire will be used to help researcher to choose current adaptation measure that deserve to evaluate. Please give the rank from 1 to 9 in this table below. I would like to say thank you for your kindly help and attention.

Ariyaningsih
Urban Environmental Management
Asian Institute of Technology

Please fill the rank coloum with number 1 to 9 for making prioritize. Numner 1 means that adaptation measure is definitely important and number 9 means that adaptation measure is definitely not important to evaluate.

No	Adaptation Measure	Rank
1.	Build Long Storage and box culvert in coastal area	
2.	Mangrove Conservation Area	
3.	Enhance Soft Skill of Community (preparedness and entrepeneurship)	
4.	Restoration and Protect River and Canal	
5.	Modify Floor (Adding number of Floor)	
6.	Built Small Embankment in front House	
7.	Eletave the House	
8.	Making artificial embankment of bamboo in pond	
9.	Maintenance mangrove in pond	

APPENDIX C:
DELPHI QUESTIONAIRE
EVALUATING CLIMATE CHANGE ADAPTATION USING CRITERIA FOR MEASURING THE SUCCESS OF ADAPTATION MEASURES IN COASTAL URBAN DEVELOPMENT CONTEXT

With Regards,

This questionnaire aims to determine the criteria to evaluate climate change adaptation. Later, in the study of these criteria will be used to formulate successful adaptation to reach objectives of this research.

With this, please willingness of you to be the respondents in this study. I hope you to provide answers to some questions in the questionnaire and its reasons. Previously, I would like to thank for your cooperation so that this research can be successful.

Researcher
Ariyaningsih
St115874
Urban Environmental Management
Asian Institute of Technology

Table 1 Organization of Criteria

No	Criteria	Group of member
1	Effectiveness	• Policy, planning, priorities and political commitment • Integration with development policies and planning • Integration with emergency response and recovery • Institutional mechanism, capacities and structures
2	Flexibility	• Hazard/risk level • Scientific and technical capacities and innovation
3	Equity	• Impact • Environmental and natural resources • Livelihood • Culture, attitudes, education

4	Efficiency	• Financial instrument • Cost recovery for adaptation
5	Sustainability	• Public awareness, knowledge, skill • Information management and sharing • Learning and research

Questionnaire

I. RESPONDENT PROFILE

Name :

Gender :

Position :

II. QUESTIONNAIRE DATA

Are these criteria appropriate to climate adaptation of evaluation?

No	Criterion of Evaluation	Sub Criterion of Evalution	Answer		Reason
			Yes	No	
1	Effectiveness	Enhancing policy, planning for adaptation measure			
		Legal and regulatory			
		Integration with development policies and planning			
		Institutional mechanism, capacities and structures			
2	Flexibility	Hazards risk			
		Scientific and technical capacities and innovation			
3	Inequality	Impact data			
		Environmental and natural resources			
		livelihood			
		Culture, attitudes, education			
4	Efficiency	Financial instruments			
		Cost recovery for adaptation			
5	Sustainability	Public awareness, knowledge, skill			

No	Criterion of Evaluation	Sub Criterion of Evalution	Answer		Reason
			Yes	No	
		Information management and sharing			
		Learning and research			

Do you have any new sub-criterion that important to evaluate the adaptation measure?

………………………………………………………………………………………………
……………………

APPENDIX D
QUESTIONAIRE FOR AHP (WEIGHTING)

Sincerely Mr. / Ms:

This questionnaire aims to determine the criterion and sub-criterion. In this analysis, we try to "Weighting criteria and sub-criteria that used in evaluation of adaptation measure". This questionnaire aims to weighting criteria and sub-criteria by order of importance. Weighting sub-criterion will divided into 5 categories.

Score	Note
1	Same important
2	Between 1-3
3	A little bit important
4	Between 3-5
5	More important

I hope the willingness of Mr./Mrs. for answering this questionnaire in accordance with your experience. Thank you very much for your availability.

With Respect,

Ariyaningsih

Identity

Name :

Inatitution :

Position :

I. Weighting Main Criterion

Effectiveness	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Flexibility	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Inequality	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Efficiency	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Sustainability

Sustainability	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency

II. Weighting Sub-Criterion

- Effectiveness

SC1	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3
	5	4	3	2	1	2	3	4	5	SC4

SC2	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3

SC3	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC4

SC4	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3

- Flexibility

SC5	5	4	3	2	1	2	3	4	5	SC6

- Inequality

SC7	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC9
	5	4	3	2	1	2	3	4	5	SC10

SC8	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC9
	5	4	3	2	1	2	3	4	5	SC10

SC9	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC10

SC10	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC9

- Efficiency

SC11	5	4	3	2	1	2	3	4	5	SC12
	5	4	3	2	1	2	3	4	5	SC13

SC12	5	4	3	2	1	2	3	4	5	SC11
	5	4	3	2	1	2	3	4	5	SC13

SC13	5	4	3	2	1	2	3	4	5	SC11
	5	4	3	2	1	2	3	4	5	SC12

- Sustainability

SC14	5	4	3	2	1	2	3	4	5	SC15
	5	4	3	2	1	2	3	4	5	SC16

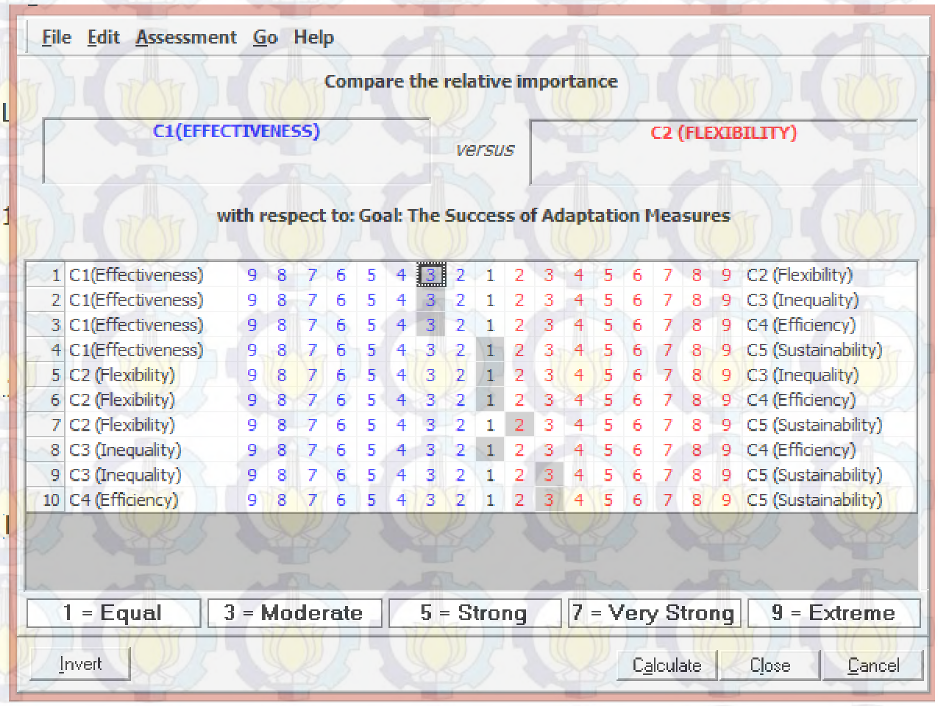
SC15	5	4	3	2	1	2	3	4	5	SC14
	5	4	3	2	1	2	3	4	5	SC16

SC16	5	4	3	2	1	2	3	4	5	SC14
	5	4	3	2	1	2	3	4	5	SC15

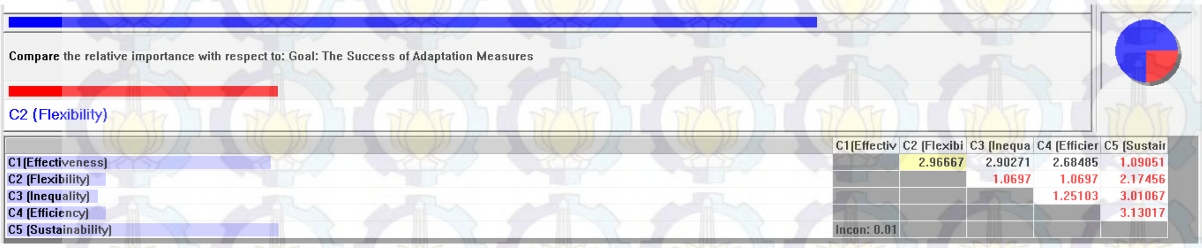
APPENDIX D.1

AHP QUESTIONAIRE RESULTS (MAIN CRITERION COMBINED)

A. Questionaire input



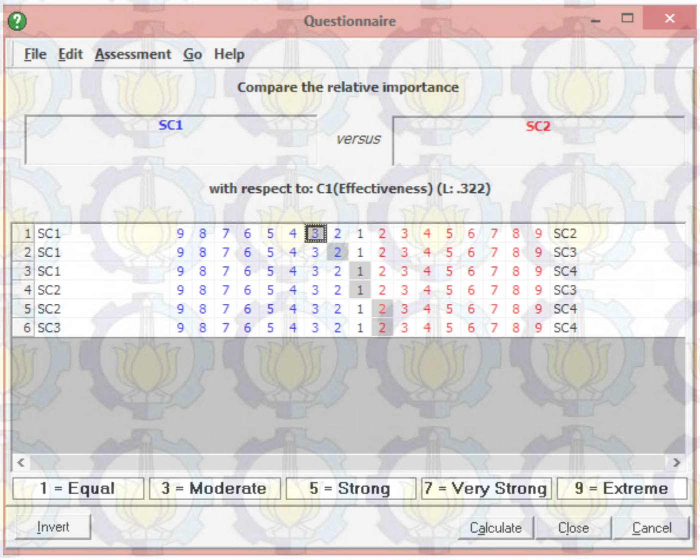
B. Pairwise Individual



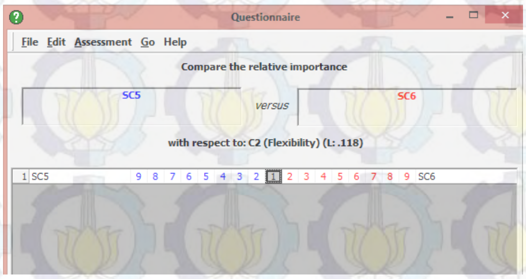
APPENDIX D.2

AHP QUESTIONAIRE RESULTS (SUB CRITERION)

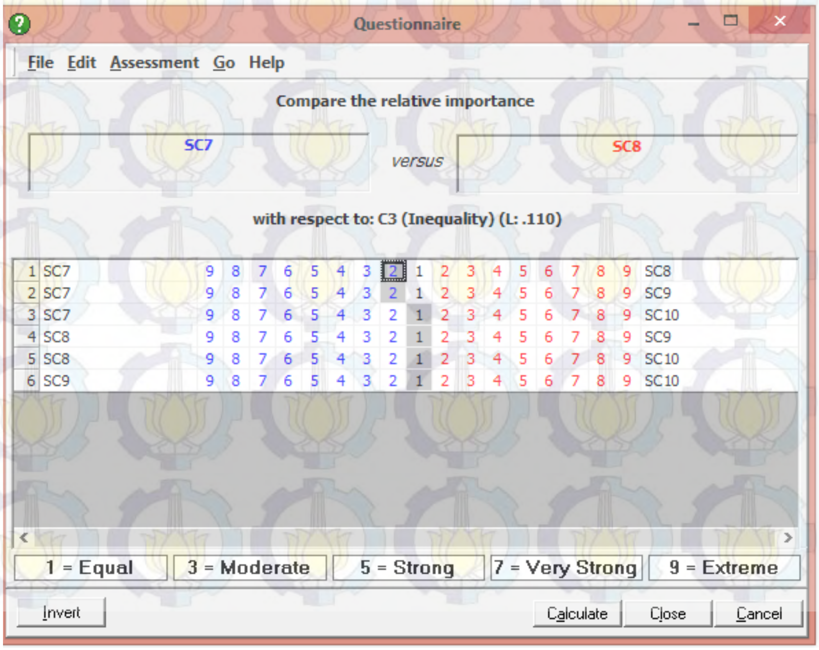
- Effectiveness



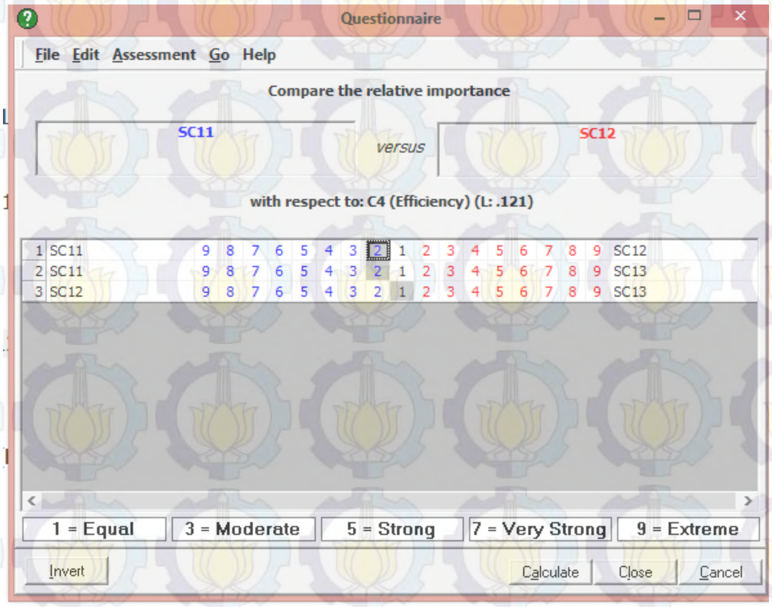
- Flexibility



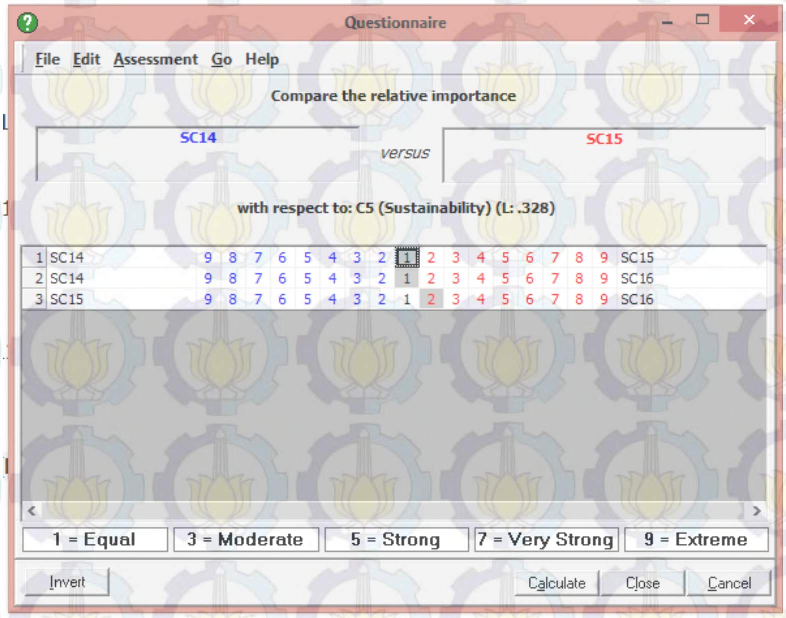
- Inequality



- Efficiency



- Sustainability



APPENDIX E

EVALUATION QUESTIONAIRE FOR LOCAL GOVERNMENT

Dear participants,

The feedback from this questionnaire will be very useful to us in improving the quality of adaptation measure. Thank you very much for your cooperation.

With Respect,

Ariyaningsih

No	Criteria	Definitely disagree (1)	Mostly disagree (2)	Neutral (3)	Mostly agree (4)	Definitely agree (5)
1.	Effectiveness					
	Policy, planning, priorities and political commitment are appropriate with existing adaptation measure					
	Legal and regulatory systems is good					
	Good Integration with development policies and planning					
	Good Integration with emergency response and recovery					
	Institutional mechanism, capacities and structures					
2.	Flexibility					
	Existing adaptation is relevant with hazard/risk happen in area					
	Scientific and technical capacities and innovation are available to address the hazards					
3.	Equity					
	Updated impact data is used to make adaptation measure					
	Environmental and natural resources is advantageous to adaptation measure					
4.	Efficiency					
	Financial instruments do efficiency by government to get maximum adaptation					
	There are cost recovery for adaptation measure					
	Monitoring and Operation Cost is appropriate to target					
5.	Sustainability					
	Public awareness, knowledge, skill are					

No	Criteria	Definitely disagree (1)	Mostly disagree (2)	Neutral (3)	Mostly agree (4)	Definitely agree (5)
	maintenance to get sustainable adaptation					
	Information management and sharing is doing well					
	Learning and research is built					

APPENDIX F: DATA INPUT FOR SCORING ANALYSIS

Mangrove

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	4	5	5	2	4	3	4	1	1	1	4	4	3	3	3	3
City Department of Spatial Planning	3	5	4	1	2	2	2	3	3	2	2	2	2	4	4	4
Regional Disaster Management	5	5	5	4	4	2	3	3	3	3	1	2	2	4	4	4
Academician	4	4	2	3	4	3	3	3	2	1	2	1	1	3	3	3
Agency for Environmental Management	3	5	3	2	2	3	2	2	4	2	4	3	2	4	3	4
Head of Krembangan	5	4	5	4	2	4	4	4	4	1	3	4	4	1	1	1
Head of Pabean Cantikan	3	3	3	1	4	4	3	3	4	4	2	3	2	2	3	3
Head of Kenjeran	4	3	2	1	1	1	2	3	3	3	3	2	2	2	2	2

Elevating Floor

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	3	3	2	2	2	1	3	3	3	3	2	2	3	3	4	4
City Department of	3	2	2	3	5	5	3	3	3	3	2	3	3	2	2	2

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Spatial Planning																
Regional Disaster Management	3	3	3	4	4	3	2	2	2	2	5	3	4	4	4	2
Academician	3	3	3	2	4	5	3	3	4	4	3	3	3	4	3	3
Agency for Environmental Management	4	4	4	5	2	4	3	3	3	3	2	2	3	4	2	4
Head of Krembangan	3	3	3	2	4	2	2	3	3	3	3	2	2	4	4	5
Head of Pabean Cantikan	3	2	3	4	4	4	2	4	4	4	3	3	2	4	3	3
Head of Kenjeran	3	3	3	1	4	2	3	3	3	3	2	2	2	4	2	4

Enhance soft skill

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	3	4	3	1	4	1	3	5	5	1	1	1	2	3	3	3
City Department of Spatial Planning	3	2	2	2	2	4	2	2	2	2	2	2	5	4	4	3
Regional Disaster Management	3	3	3	1	2	1	1	4	2	1	4	4	4	3	3	3
Academician	3	3	3	1	3	3	4	4	4	4	2	2	4	4	4	3
Agency for	4	4	4	4	4	5	3	4	4	4	4	4	2	3	3	3

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Environmental Management																
Head of Krembangan	3	3	3	2	2	2	3	3	3	1	4	3	4	4	4	4
Head of Pabean Cantikan	2	2	2	2	2	2	3	3	3	1	2	2	2	4	4	3
Head of Kenjeran	4	4	4	2	1	1	4	4	4	3	2	2	3	3	4	4

APPENDIX G : PICTURES DURING INTERVIEW AND SURVEY

A. Interview stakeholder's pictures

City Planning Agency (Bappeko)

Departement of Public Works – Devision Spatial Plannibg

Regional Disaster Management

Agency of Environmental Management

B. Field Observations

Mangrove in Wonorejo

Road condition in Kenjeran

Fishery housing in Krembangan

Fishery housing in Kali Kandangan

Coastal Environmental Condition

Bozem in Krembangan

Building density in Sukolilo Districts

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BIOGRAPHY

The author was born in Kediri, October 19th, 1989. She has been finished her study in elementary school in SDN Doko I (2002), junior high school in SMPN 1 Kediri (2005), senior high school in SMAN 1 Kediri (2008). She also got bachelor degree in engineering from Urban and Regional Planning Departement, FTSP-ITS (2012) with her final project about telecommuting topic. She continued her master degree in Architecture Departement, FTSP-ITS by double degree program between Sepuluh Nopember Institute of Technology (ITS) and Asian Institute of Techology (AIT) Thailand. She chosed her field of study in Urban Environmental Management during her study in AIT. Her thesis was about adaptation to climate change in Surabaya City. She finished her master degree in science under the excellent guidance of Dr. Vilas Nitivattananon as her advisor, Dr. Ir. Rimadewi Supriharjo, MIP as co-advisor, Dr. Bonaventure H.W Hadikusumo and Dr. Clemens Grunbuhel as her commitees. She interests in climate change, urban transportation, urban and regional development for reseacrh. She can be contacted by email in aiira.aya@gmail.com.

CHAPTER 1
INTRODUCTION

This chapter contains introduction which belongs exploration inhow to climate change related to flood in coastal area, what is adapatation. In addition, characteristics of Surabaya are explained in this chapter. Research objectiveand then scope and limitations are identified in this section.

1.1 Background

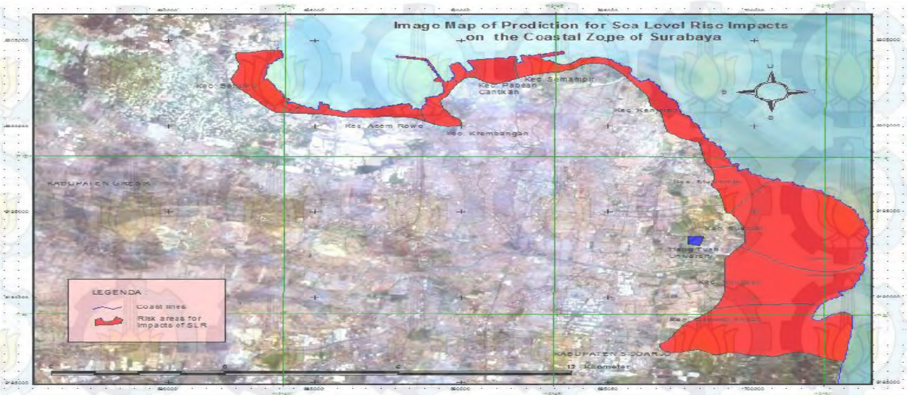
Urbanization or urban growth shows to the concentration of the human populations into separatedareas. It can be caused land use changes for commercial, industrial, transportation and residential purposes. This includes the densely populated centers, as well as adjacent suburban fringes or periurban and can be measured in various ways.

Concentration of the activities in urban areas like working, education, and entertainment make urban management complex. Hazard in urban areas depend on climate and non-climate factors of the cities. For example, one city can face one hazard like earthquake, while other cities face flood, or maybe some cities face more than one hazard at the same time. As a result, hazard can be made by man-made factors, natural factors, or combination of both factors.\

Floods risk is among the most powerful disasterin the world. People have lived and died because of floods, s a prominent role for floods within history, religions, and legends (Costa & Connor, 2004).Flood is a big problem in Indonesia, where most of its major cities are located in coastal areas. Indonesia’s capital city, Jakarta, was repeatedly suffers from flood risk and there is a big possibility that other cities in Indonesia also facing the same problem. Another major city in Indonesia facing the same problem as Jakarta is Surabaya, the capital of East Java Province, which have similar characteristics with Jakarta. Surabaya is located in low-lying land in coastal area, and surrounded by extensive land use conversion that can increase the discharge of the rivers that entering the city.

Surabaya city is the center of East Java and one of the coastal cities in Indonesia which has delta system of coastal morphology and it also has a characteristic of low land so that area has vulnerability to flood (Pamungkas, 2006). Topography of Surabaya is a low land with the height about 1-6 meters below sea level (Masterplan of Surabaya, 2013). That condition makes coastal area in Surabaya has flood potential.

In addition, Surabaya is a coastal city will be affected by SLR or sea level rise and SLT can impact directly on the ten sub-districts, namely: Benowo, Asem Rowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, Mulyorejo, Sukolilo, Rungkut and Gunung Anyar. These sub-districts will be affected because they are directly in contact with the sea Prasita (2013). Risk areas to the effects of sea level rise in the satellite images can be seen in Figure 1.1. Floods will occur mainly at high tide. Type in the tidal waters of Surabaya is a mixed semi-diurnal, which means in a day there is twice high tide and twice low tide but different in height and time. Then, coastal land use that will be affected is mostly mangrove conservation area, residential, tourist areas of Kenjeran, ports, and salt ponds.



Source: Prasita, 2013

Figure 1.1 Map of satellite image and impact risk areas of sea level rise

Flood’s effect will damage some aspects with the heavy destruction in aspects following: population aspect (victim who died), injured, float off, lost, and got disease, etc), economic aspect (loss of livelihood, traditional market malfunction, damage and loss of property, livestock and disruption of the community's economy), infrastructure aspect (damage of houses, bridges, roads, office buildings, public facilities, the installation of electricity, water and communications networks), environmental aspect (damage of ecosystem, tourism, land farming, water, and irrigation) (Departement of Disaster Management, 2007).

1.2 Rationale of Study

Indonesia is the one of most prone areas to various types of hazards, especially to floods. The record maintained by Centre for the Research on the Epidemiology of Disaster, has identifiedthree hundred and ninty main disasters in that country. There are about 135 flood risk occurred. In addition, in every year several areas of Surabaya, especially in the squatters and slums, suffers from a flood risk and affected many poor people. Then, Surabaya has a highly rainfall, with yearly average rainfall around 141.1 mm. The rainfall above 200 mm happens in February, March, April, November, and December (Ferita 2006).

There are conflicts between risk management, climate change adaptation and urban development in coastal area of Surabaya. That can be shown from big number of flood victims in that area (Immadudina, 2013). Adaptation that government done is not appropriate, this is because adaptation applied in there is only based on sudden-onset hazards, not long term strategies. Mismatches between government adaptation measures on the one hand and non-government or individual adaptation measures in urban areas on the other are important issues that have often been overlooked. It can be shown from that Department of Highways and Drainage has made an effort to reduce flooding in Surabaya. This can be seen in the preparation of the Master Drainage Plan Surabaya. The master plan applies the concept of operation of the house pump and a shelter boezem wastewater from the primary pipeline before the water was discharged into the sea. From the data, it turns out that the masterplan can not be applied to the fullest because there are only 33 stations out of a total of 66 stations by the Department of Highways (Departement of Disaster Management, 2007).

Then, like Greivingvet.al (2006) mentions that one studies the role of spatial planning in natural hazard risk management in several European countries found some very interesting conclusions are summed role of spatial planning in the management of major hazards such poor used to, such as limiting development in hazard-prone areas. Later than that, in many cases, the multi-hazard Approache there because there are so many organizations that deal with different types of hazards to work independently. They found a lack of coordinated activities between the stakeholders involved as well.

Adaptation measure is an issue which relevant at many levels such as local (region or city level), national (country level) and international levels (such as South Asia levelIt is very possible and important to identify the effectiveness in addressing adaptation measures were quite successful both in independent scale and in its scalar context (Adger et al, 2004). However, the success of a plan of adaptation depends on how such measures meet all the objectives of the adaptation program, and how the adaptation plan can affect the ability of others to fulfill its purpose. Then, a successful action for some individuals, organizations or government level may not be concluded as a successful adaptation by others. Then arguably, size adaptation success depends on scale application of the criteria used to evaluate it on any such scale.

1.3 Problem Statement

The increase in population and urbanization, the concentration of people in urban areas, land use conversion or change of land use has been made to convert openspace that have ecological functions. In addition, high population can put pressure on the development does not consider about the environment, such as changes in land use in conservation areas, changing green space for housing.

In addition, the high level of awareness and the various levels of concern about climate change coincided with a very limited knowledge in many countries (the European Commission's Directorate-General Communication, 2008; Downing, 2008; Dunlap 1998; Leiserowitz, 2010; Moser, 2008; Newport, 2010). However, studies of vulnerability to climate change are now generally considered to measure adaptation. Meanwhile, they go beyond to explain the adaptation measures that might be possible. Then, there is little research on the process of decision-making for adaptation measures, conditions that limit or stimulate adaptation strategies, and the role of non-climatic factors. Also, there are serious limitations in the curent evaluation of adaptation options. In addition, debate and discussion on the interpretation of adaptation measures and related terms that include resilience, adaptive capacity, and vulnerability of the base throughout the literature. However, yet relatively little research has focused on what constitutes a successful climate adaptation or empirical understanding how successful adaptation of maladaptations. According to the above causes gaps perceptive understanding or definition of success and failure in climate change adaptation mesures.

1.4 Research Questions

The questions in this research are:

1. What are characteristics of coastal development plan in Surabaya and their relationshipwithclimate risk andadaptation?
2. What are the criteria to evaluate climate adaptation measures?
3. How are the performance ofpast and on-going adaptation strategies?

1.5 Research Objectives

The main objectiveis to evaluateflood risk adaptation in the context of climate change using criteria for measuring the success of flood adaptation measures in coastal urban development context. To reach the main objective, the specific objectives are:

1. To assess past and on-going of flood adaptation strategies in term of development context in coastal city of Surabaya
2. Todetermine criteria of evaluating climate change adaptation in relation to coastal urban development
3. To evaluate performance of past and on-going adaptation measures and
4. To recommend how to enhance adaptation measures

1.6 Scope and Limitations

The scope in this research is focused in stakeholders' perception in past and on going adaptation measure in flood risk. Area of this study is focused in coastal area of Surabaya, has vulnerability of coastal flood. Then, this study will integrate current adaptation and urban development planning for sustainable development in order to make successful adaptation.

The Limitations: In this research, the vulnerability area of flood risk is described briefly and only focus on adaptation measure. Then, only local adaptation strategies are analyzed in this study. The selected adaptation measures are only considered on regional level and household level.

CHAPTER II

LITERATURE REVIEW

As describe of Figure 2.1, this chapter explores the basic concepts of urban development in coastal cities, explores definition of climate change, Adaptation concepts, and Evaluation of Adaptation concepts. In this chapter also explores vulnerability of coastal cities under the climate change impacts. In climate change sub section, the relationship between flood risk and vulnerability area is identified. Then, in Adaptation section, tries to identify adaptation types and what is successful adaptation. So, after understanding successful climate adaptation, in next sub section tries to review evaluation of adaptation measure containing approach for evaluating, criteria, and evaluation process. Finally, urban development in Surabaya is reviewed before summary of knowledge gaps.

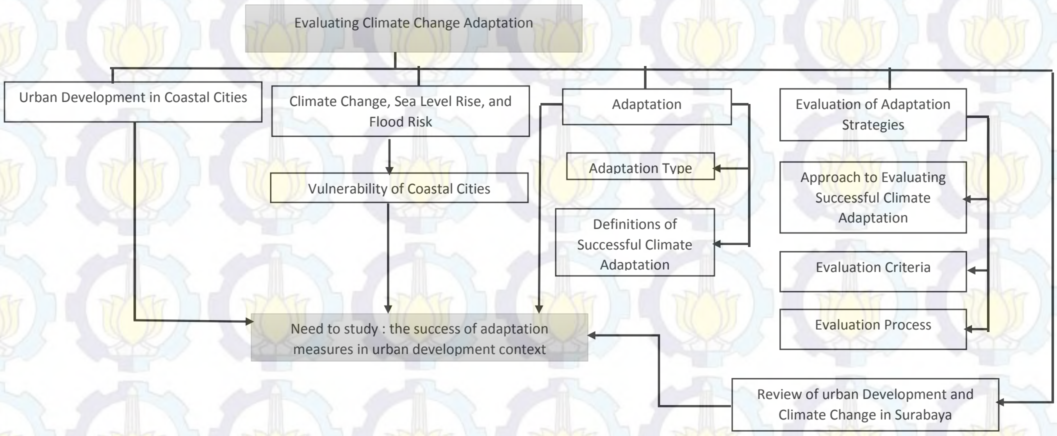


Figure 2.1 Literature Map

2.1 Urban Development in Coastal Cities

According to Nicholls (2004), many large cities in the world and capital in lowland or close to coastal areas or monitor, that's what makes the area potentially more vulnerable to SLR (sea level rise). In addition, coastal cities or beach usually has a large population and is the center of social and economic activities of national importance (Nordhaus, 2006) as the port for trade and services. Additionally, McGranahan et al (2006) have found that the settlements in the larger urban areas tend to be concentrated in the coastal areas with low elevation.

Planning is a system to support the development process to prove direction. Focusing on the scope and efficiency of the planning is the same as the integration plan, design patterns are classified into one type of Comprehensive or fragmented. According Kishiue et al (2005), the evaluation criteria used to test whether the pattern of urban planning can be considered comprehensive or not are as follows master plan, vision, scope, implementation and development agency leaders, planning tools, revision of the frequency plan.

Comprehensive pattern indicates the availability of vision and master plan/s which cover an entire area for its progress. The area is imageable as the all owing to good coordination among plans. Development of transportation infrastructure is incorporated into the plans as one of major growth factors rather than the answer to the demand. ―Fragmented” pattern denotes that vision and master plan/s are partially available in the area, but there is no means to make them integrated. The area which has several development directions and its image as a whole is vague. For the results, the development has been undertaken in that places without enough linkages among them and unexpected urban problems would be caused by losing the balance of the city aspects. Relationship of transportation infrastructure and urban development tends to be ‗mending‘ rather ‗guide-development‘. If the planning pattern of the city does not fall into the ―Comprehensive”, it is considered as ―Fragmented”. (Kishiue et al, 2005).

Fletcher & Smith (2007) said coastal zone is a growth area between sea and land, and possesses characteristics of both components. It receives influence from physical process and human activities, both from sea and land, with different scale of effects and functions (Tissier, et.al. 2004). The cooperation between human activities and physical process in the coastal zone determine characteristic of costal area and its environment. Most of coastal zones are located in alluvial plain or the delta region with the high concentrated population.

Coastal city as the part of urban areas with high human population more than one hundred thousand are living in vulnerable areas with have high risk of flood and other disaster and are influenced by hthe ydro-dynamically by an extensive body of surface salt or fresh water (Timmerman and White 1997). Thus, two-thirds of the world's large cities stood in areas that are vulnerable to global warming and sea level rise. Millions of people are vulnerable and at risk of flooding and intense storms. More than 180 countries have populations in the zone. And two thirds of those have urban areas of more than 5 million people and is under threat due to the 75% of people living in vulnerable areas in Asia at high risk for poorer nation. It can be known also that one-third of the world's 1,562 occurred flood disasters in Asia with half of the total around 120,000 human had been killed by floods risk living in that region.

The coastal environment is very significantt by economically and environmentally sensitive to several affecting factors, and physically vulnerable to several types of natural, man-made and man-enhanced hazards. As a Miliman and O‘Riordan said (2007), the development of coastal urban environment brought in more stakeholders which creates higher complexity in governance involvement of a wide range of stakeholders and interest groups are increasing and lead to more complex requirements in governance to guarantee physical and socio economic sustainability.

2.2 Climate Change, Sea Level Rise, and Flood Risk

Climate change can affect the coastal areas in different ways. Coastal areas are too sensitive to tidal and SLR (sea level rise), changes in the intensity and frequency of storms, warmer ocean temperatures, and then increases in precipitation. Then, improving atmospheric concentrations of CO_2 or arbon dioxide are causing the oceans to absorb more of the gas and more acidic. This rising of the acidity may have significant impacts on coastal and marine ecosystems. The impacts of climate change are likely to worsen many problems that coastal areas face. The coastal flooding, shoreline erosion and water pollution can affect the coastal ecosystems and coastal infrastructure (United States Environmental Protection Agency, 2012).

Sea Level Rise (SLR) is a series of processes tide. Tides are causing short-term rising sea levels and periodic (Sucia putri 2007). Effects due to rising sea levels to land referred to as the flood-tide, and Indonesian calls that ―rob" (Setiyono, 1994). SLR or sea level rise as the impact of human-driven climate change has significant implications to low-lying coastal areas and beyond. Small and Nicholls (2003) and McGranahan et al.(2007)mentioned the coastal are contains very valuable ecosystems and typically has higher human population densities than inland areas. Additionally it generates significant amounts of economic activity contributing to national wealth (Bijlsma et al., 1996; Sachs et al., 2001). In physical terms the biggest direct impacts of the sea-level rise include the inundation of low-lying areas, coastal wetland loss, shoreline erosion, saltwater intrusion, higher extreme water levels, and higher water tablesleading to coastal flooding (Leatherman and Nicholls, 1995). Nicholls et al. (2007) argued human-induced pressures on the coastal zone (such aswater abstraction, growing population, and the alteration of the hydrological regime that includes the damming of sediments) will exacerbate the effects of sea-level rise.

Increased human activity resulted in the increase in the quality and quantity of greenhouse gases in the atmosphere. This increase led to an increase in global temperatures. Global temperatures have increased by 0.6 ± 0.2 ° C since the last 19th century. As a result of global warming caused by humans, sea level gradually increased. Global sea level rise will reach a height of 9-88 cm by the year 2100 compared to 1990 (Church et al. 2001).

Flooding is a result of water overflowing river flow exceeds the capacity of carrying capacity of the river to overflow and flood plains or lower area surrounding (Yulaelawati, et al, 2008). Flooding can also be defined as a seasonal threat that occurs when water overflows from the existing channel and flood surrounding areas. Floods are the most frequent natural hazards occur and make the most losses, both human and economic terms. Ninety percent of natural disasters (excluding droughts) associated with flooding. The flood risk can cause the range of health impacts and risks such as injury and even death, contaminated drinking water, increased populations of the disease-carrying rodents and insects, hazardous material spills, moldy houses, and community displacement and disruption.

Type frequent flooding is a flash or shipment and tidal (General Guidelines for Disaster Management, 2007). A flooding is the situation in that water covers land with a specific time where it normally doesn‘t. Water usually comes from lakes, sea, rivers, sewers or canals, also be rainwater. Flood risk can be explained according to speed which called flash flood, the geography or the cause of flood risk. Manyl types of flood risk will be explored below together with severalhydrology aspects.

Yulaelawati and Shihab (2008) divided into three types of flood risk, three types following:

- River Floods

Rivers floods happen when rivers and streams cannot carry away all the extra water that falls as rain or comes from melting snow. The water rises in the rivers and streams and overflows onto normally dry land. Floods destroy farmland, wash away people's houses and drown people and animals. Towns and cities are flooded too.

- Coastal Flood

A flood starts when waves move inland on an undefended coast or overtop or breach the coastal defence works like dunes and dikes. The waves attack the shore time and again. When it is a sandy coast, each wave in a storm will take sand away. Eventually a dune may collapse that way.

Very characteristic of a coastal flood is that the water level drops and rises with the tide. At high tide the water may flow in and at low tide it may recede again. When a sea defence is breached, low tide is the time to repair the breach Coastal flooding can be caused by strong winds blowing waves onto the land.

Hurricanes and major storms produce most coastal floods. Very high tides and tsunamis also flood the coasts. In many countries, large groups of people live along the coasts and for these people coastal flooding can be very serious. Thousands of people have been drowned in coastal flooding in many parts of the world.

- Flash Floods

A flash flood is a quick flood caused by a sudden cloudburst or thunder storm. Huge amounts of water fall in a short time and in cities and towns the drains overflow and roads become flooded. Flash floods also happen in mountainous areas, where steep slopes cause the water to travel at high speeds. The rushing water erodes the soil, washing it away down the slopes. Flash floods often occur rapidly and with little warning.

Office of Public Works (2009) described many types of flood risk present different degrees and forms of its dangerous level to the people the environmentand, property due to the varying velocity, duration, depth, onset level and other risksthat associated with flood risk, as follows:

- Coastal Flood, this flood risk is caused by higher SLR (sea level rise) than normally SLR is, largely as theresult of the storm surges, as impact to overflowing onto the land. The coastal flooding is affected by the following three causes, which usually work in their combination:
  - High tidal level;
  - Storm surges that caused by low barometric pressure exacerbated
  - Winds (the highest surges can develop from hurricanes); and
  - Wave which is dependent on wind direction and wind speed, local topography and its exposure.
- Hinterland flooding, caused by drawn-out and, or the intense rainfall. Inland or hinterland flood risk might includes different types as follows :
  - Overland flow happens when the rainfall‘s amount exceeds infiltration capacity in the ground to absorb it. That can make inundation of water flows, make pond in natural basin and low-lying areas or behind the

obstructions. This happens as the fast response to make intense rainfall and eventually comes inpiped or drainage system.

- River flood risk occurs when water's capacity is exceeded or channel is restricted or blocked, and abundance the water spills out from channel onto nest low-lying areas or the floodplain. This situation may occur rapidly in the short rivers or for long time ago and some distances from where rain falls in the rivers with gentler gradient.
- Flood risk from the artificial drainage systems affects when water flowsand enters the system like urban storm of water drainage system, and exceeds its discharge capacity, finallysystem becomes blocked, and can't discharge due to the high level of water in receiving watercourse. This condition mostly happens as fast response to the intense rainfall. Work together with the overland flow, and it is often known as the pluvial flooding.

According to several research above, it can be concluded flood risk occurs because climate change factors and non-climate change factors and based on the theories of the type of flooding, the type of flooding that are being studied can be categorized as coastal flooding.

2.2.1 Urban Flood Management

Flood management in the urban areas is a complex decision-making process. Its main purpose is to define and implement all measures that can reduce the risk from flooding which human, natural and economic resources are subjected (Oliveri and Santoro 2000). In urban areas, objects that can be exposed to flood hazard are more various and have more complicated relationship each other compared to another type of land use, i.e., rural or agricultural.

Urban flood problem seems to be difficult to handle in developing countries. The reason for this is that firstly, developing countries have small, vulnerable economies and are common to be severely damaged when flood disaster strikes. Secondly, limited amount of resources to cope with flood hazard, particularly to investigate and evaluate possible strategies made government in developing countries often underestimate the existing flood hazard (Hansson, Danielson et al. 2008). Quality of human resources also limits the possible measures that can be implemented by government to protect the residents and their belongings in urban areas.

There are two main aspects in urban flood management; structural mitigation and non-structural measures. Structural mitigation measures are an effort to modify the characteristics of a flood (i.e., the volume and timing of flood waters, their extent and location, their velocity and depth), so that damage or susceptibility to people and properties can be reduced.

Non-structural measures are an effort to manage flood hazard by applying actions and regulations that can either reduce flood hazard, or to minimize the impact of flood in case disaster is unavoidable. (e.g. real-time forecasting and alert systems, information and training campaigns, tax adjustments, flood insurance programs).

2.2.2 Vulnerability of Coastal Cities

IPCC (2007) or usually it is called Intergovernmental Panel on Climate Change describes the vulnerability of climate change as degree to whichsocio-economic, biological, and the geophysical systems are affected and incapable to face withimpacts of the climate change.The different knowledges such aseconomics, anthropology, psychology, and also engineering use vulnerability term. Just in the human–environment relationships, vulnerability term has ordinary meaning, although contradict. The areas of geography and human ecology have particularly conceptualized the vulnerability to the climate variability (Adger 2006).

Since the early 1980s, the concept of vulnerability has been examined across a wide range of disciplines. Marandola and Hogan (2006) and Adger (2006) state that the study of vulnerability has been assessed in the disciplines of demography, geography, human ecology, economics, anthropology and psychology. The topic has also been approached from both natural science perspectives (such as engineering and natural processes) and social science perspectives (Roberts, Nadim & Kalsnes, 2009).

The multidisciplinary approach to the vulnerability concept leads to a multi interpretation of the concept and interchangeable meaning with other key concepts in DRM such as resilience and adaptation. Although there have been different interpretations of some of its basic terminology, Cutter (1996) and Adger (2006) argue that the varieties of interpretations indicate the importanceof the concept across the disciplines. In addition, Cutter et al. (2008) also illustrate the connections between vulnerability, resilience and adaptation indicating that a variety of meanings and relationships are used. However, greater definitional clarity is needed to progress research in areas such as vulnerability assessment (Cannon, 2008; Ionescu et al., 2009), a key concern of this research. It is essential especially for the purpose of modelling which builds the linkages between the three key concepts of DRM.

Adger (2006) said there are two major areas in vulnerability research that acted as the basis for the ideas which eventually led to the current research on physical vulnerability and the social systems in the holistic manner make analyzation in vulnerability as lack of the entitlements to resources and analyzing vulnerability to natural disasters. Several vulnerability studies consider on entitlements literature regarding the access to resources, on the political economy in exploring factors leading to the vulnerability, and O'Brien (2005) mentioned that on social capital as the means of claiming entitlements and pursuing coping mechanisms.

Even though vulnerability research has been conducted since the 1980s, there are still different understandings of how this concept should be defined. Kates (1985) highlights the literal meaning of the word as ―the capacity to be wounded". Dow (1992) emphasises the importance of the term ‗capacity' as part of his definition of vulnerability and this emphasis is echoed in more recent vulnerability research (e.g. Wisner, Blaikie, Cannon, & Davis, 2008; Armas, 2008; Pitilakis, Alexoudi, Argyroudis, Monge, & Martin, 2006; Villagran de

Leon, 2006; Dwyer et al., 2004; Downing, Butterfield, Cohen, Moss, Rahman, Sokana, & Stephen, 2001; Adger & Kelly, 1999).

The concept of vulnerability is multi-layered as the responses of individuals, groups of individuals and social networks to hazards must be considered. Adger and Kelly (1999) suggest that the vulnerability level reflects the state or situation of the individuals, groups or communities affected by a disaster. Dwyer et al. (2004) and Villagran de Leon (2006) suggest an even broader range of research subject matter for vulnerability studies drawing on the terminology of ―human communities". In fact, vulnerability research has been limited to partial or individual appraisal (e.g. Armas, 2008; Odeh, 2002). Even with this support for research into vulnerability assessment to extend beyond individuals to larger groups, the fact is that most has been limited to partial or individual appraisal.

2.3 Climate Adaptation Strategies

Human life on earth will certainly interact and adapt to natural conditions occur. Man with knowledge can provide a change to the "natural conditions", and vice versa, can form knowledge of human nature. Conditions dynamic nature makes humans are required to adapt adjust. Adaptation according Soemarwoto (1991), namely the ability of living creatures to adapt to their environment can be divided into a number of ways through 1. The process of physiological, morphological adaptation is Cultural or behavioral adaptation including the application of technology and social institutions, especially for living things. Holahan (1982) in a diagram was depicting the relationship between environmental conditions, psychological and behavioral phenomena.

Adaptation in the context adjust to the changes of the environment can be "adjusted" to the dwelling (a modified form of home or relocation of residence), livelihood or employment, and other forms of adaptation. In this study, adaptation is divided into two major parts shelter adaptation and adaptation activities.

Adaptation of residence is the desire to remain at its current location or plan to move the location of residence because of flooding disturbance. The adaptation in the form of activities, for example evacuate or remain in residence at the time of the flood, and other forms of activities in the context of adjusting to flooding were found in the field.

There are many factors in adaptation such as safety improvement or the protection of economic well-being. It can be done in many ways, by market exchanges Smit et al (2000) said, by extension of the social networks as Adger (2003) mentioned, or through actions of the organisations or individual to achieve their own collective goals or individual one. It can be initiated by individual to their own benefit. It can be set up of the actions by public and governments for protecting their citizens.

Many studies have focus at the city including the earlier work on the mega politan cities, for example Nicholls (1995), Klein et al (2003), and the city specific analysis of Kirkshen et al (2006) in New York, Ng and Mendelsohn in Singapore, the London Climate Change Partnership in London (LCCP, 2002), Sherbinin (2006) for Mumbai, Rio de Janeiro, Shanghai, TERI (1996) in Mumbai, and OECD (2004) in Alexandria.

Most of analyses, don‘t undertake quantitative for impact assessments, indeed such the efforts are now being undertaken in London city alone as mentioned by Hall etal. (2005). Those vulnerable cities in East and South Asia and even Africa havestarted with specific SLR impact assessments. In addition, Bigio (2003) considered cities such as Jakarta, Indonesia, then Egypt, Banjul, Bangkok, Thailand, also Tianjin, China as likely to be particularly affected though the quantitative analysis to inform adaptation decisions has not yet been undertaken. The parallel OECD study finds to face this actual gap.

2.3.1 Adaptation Types

Adaptation strategy contains a wide variety of interventions which reflects the multi-faceted nature. A typology is included below which excludes consideration of scale, and also encompasses both process type activities, in relation to building adaptive capacity and also direct interventions which deliver adaptation actions, such as the physical infrastructure. Many adaptation measures may cover severalits aspects.

In general, adaptation is an attempt to adjust to the environment. In the analysis of adaptation to the environment (environmental changes such as floods), the theme of the relationship between humans and the environment are becoming emphasis is behavior (behavior) of man (Yunus, 2010). More Yunus (2010), reveals itself based human behavior with among other things perceptions, preferences, and actions determine something and something created by a variety of factors. As stated Yunus (2010), human thinking in the earth's surface does not happen by itself, but due to the influence that comes from him (internal factors) as well as the influence that comes from outside himself.

Hardesty (1977) argued about the adaptations that: "Adaptation is the process through which beneficial relationships are established and maintained between an organism and its environment", that is, adaptation is the process of the establishment and maintenance of mutually beneficial relationships between organisms and their environment. Meanwhile, the ecologists culture (cultural ecologists) (Alland, 1975; Harris, 1968; Moran, 1982) defined, that adaptation is an adaptation strategy used by humans for life to respond to changes in environmental and social.

In the study of human adaptability to the environment, the ecosystem is the whole situation, where adaptability takes place or happen. Because human population scattered in various parts of the world, the context is very different adaptability. A population in a particular ecosystem adapts to the environmental conditions in ways that spesifi k. When a population or community began to adjust to a new environment, a process of change will begin and may take a long time to be able to adjust (Moran 1982). Sahlins (1968) emphasizes that the adaptation process is dynamic, because the environment and the human population continues and always changing. Smit et al., (1999) in her study of climate change, defines adaptation as an adjustment in the system of socio-economic-ecological response to conditions of climate and its impact. Smit and

Wandel (2006) also stated that human adaptation to global change is a process and the result of a system, to cope with and adapt to changes, stress, hazards, risks, and opportunities. In climate change adaptation are two roles that as part of the impact assessment with the keyword: (1) adaptation is done, and (2) the policy response to the keywords adaptation recommendations. Framework in mendefi niskan adaptation is the question: (1) adaptation to what?; (2) Who or what is to adapt ?; and (3) how the ongoing adaptation ?. This means that adaptation is the process of adaptation and adapted conditions.

Sunil (2011) defines adaptation to environmental uncertainty and disaster as handling the impacts that can not be avoided in a changing environment. Adaptations include adjustment in attitude towards the uncertain conditions. Adaptation is strongly influenced by socio-economic and ecological conditions specified. In the environmental changes that occur in coastal areas, the concept of adaptation refers to the strategy: (1) protection of the land area of the ocean, so that land use can be continued; (2) The property is adapting to its environment; and (3) avoid or migration strategy is to leave the coastal areas to safer areas.

A. Maladaptation

There has been so much attention which is focused on effectiveness of adaptation measures in decreasing climate change vulnerability, and so the potential impacts of climate change, it is hardly appreciated if done unwell; the adaptation interventions can exacerbate climate change‘s effects. This is called maladaptation. IPCC (2001) describes the maladaptation as ―any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli an adaptation that does not succeed in reducing vulnerability, but increases it instead”

Maladaptation is a condition in which an individual is unable to adapt to the environment, resulting in a gap between potential has with the environment. Maladaptation can happen to someone if they experienced any problems or obstacles are too heavy, giving rise to feelings of anxiety, helplessness, unhappy and similar symptoms.

More pragmatic identification of the maladaptation is any kind of the action that may involve one or mabe more of the following:

- Inefficient use of resources compared to other options (e.g. unnecessarily displacingdevelopment funds away from other concerns)
- Ineffective, for example relying on scenarios of future climatic risks that are not subsequentlyrealised and actions that have no other benefits)
- Inequitable reductions in vulnerability (or shifting vulnerability from one group toanother)
- Inflexible investments or decisions that may reduce the possibility for futureadaptation.

Refers to actions which tried to avoid or decrease climate change‘s vulnerability but end up encoureging it in other systems, sectors or social groups (Barnett and O'Neill 2010). Barnett (2011) said that maladaptation doesn‘t just refer to the unsuccessful adaptation measures (impliying that the action didn‘t have the desired impacts, but to actions that may have had the desired impactt but also produced unintended effects or consequences. The types of maladaptation described in the literature are summarised in Table 2.2.

It is significant therefore for considering these issues when the indicators are being conceptualized, particularly for the long-term and even short periods. While not actually specific to adaptation of climate change, these evaluations should also include whether the processes of change and the pathways to ‗success‘, are likely to show linearity or may indeed suffer periods of stagnation or reversal as a necessary step in the route towards long-term success. In other hands, the maladaptation means iinitial progress towards sthe uccess may lead to long-term increases in climate change‘s vulnerability.

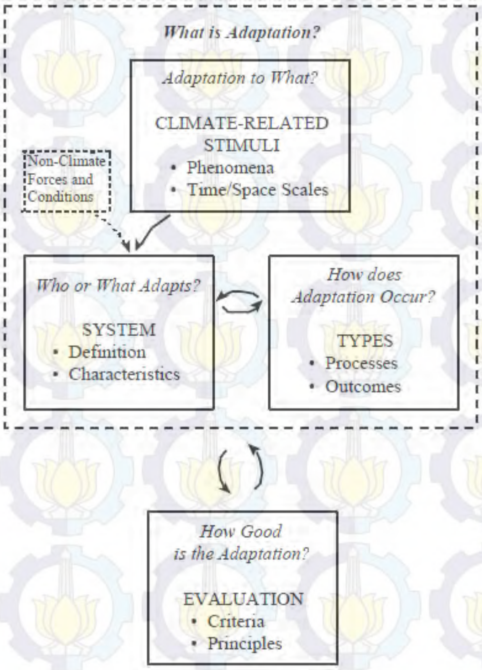


Figure 2.2 Adaptation to climate change and variability (Smit et al., 2000).

2.3.2 Definitions of Successful Climate Adaptation

Some papers in the climate change adaptation literature try to get a definition of successful adaptation. In a report for the Pew Center on Global Climate Change, Easterling et al (2004) offered the following definition:

"Successful adaptation is defined as one that follows a climate change causing adverse impacts and maintains a system at approximately the same level of welfare or services as was provided before the change in climate. If the adaptation can completely offset the loss from climate change, it is successful. Although less straightforward, adaptation also should be considered successful if it maintains services or welfare with a small or minimal loss")

Easterling proposedaudience was likely decision-makers, rather than the adaptation measure scholars. That is one of the first attempts for defining the term. The exploration of definition opens door to the development of the metrics that might have action for evaluating and characterizing the adaptation success. As an example, continued the economic vitality of the community, the ability of the area residents for maintainingcertain living standards, and provision of the clean water and other services, all of which can be calculated given sufficient data. The meaning does not, provide much guidance in the understanding how to measure the adaptation measures at different level or spatial scale or how to accommodate it for the effectst of changes such as in-migration or-migration. In addition, it poses the significant challenge, pushing empirical researchers to develop the methods to prove the degree to which prevention of related climate change which losses might be attributed and direct to success of the adaptation measures or may be the result of others.

Adger et al. (2005) focused more closely on various aspects of the concept of successful adaptation and set out a number of characteristics to paint a more holistic picture of success. They began with a simple definition: *"In the broadest terms, the success of an adaptation strategy or adaptation decision depends on how that action meets the objectives of adaptation, and how it affects the ability of others to meet their adaptation goals*" (p. 78). Understanding that means there is the possibility of a success essentially depends on the goals contained in the plan or program for adaptation, mungkinyang makes it more difficult to draw an overall experience and lessons learned from many cases. Adger and his colleagues put forward the need to evaluate the success rate of adaptation planning decisions that clearly impact on other objectives, provisions may help ensure a justice system that exists, but probably will cause the bar to the achievement of success.

Table 2.1 Six Types of Maladaptation

Maladaptation Type	**Description**
Increasing emissions	Adaptation is maladaptive if actions end up contributing toclimate change – for example, the increased use of energy intensive air conditioners in response to the health impacts of heat waves.
Disproportionate burden on others	Adaptation actions are maladaptive if, in meeting the needs ofone sector or group, they increase the vulnerability of thosemost at risk, such as minority groups or low-income households. Alternatively, the consequences of a maladaptive action could be shifted to another sector or group.
High opportunity costs	Approaches may be maladaptive if their economic, social, orenvironmental costs are

Maladaptation Type	Description
	higher relative to alternative actions.
Reducing incentiveto adapt	If adaptation actions reduce incentives to adapt – for example,by encouraging unnecessary dependence on others,stimulating rent-seeking behaviour or penalising early actors –then such actions are maladaptive.
Path dependency	Large infrastructural developments commit capital andinstitutions to trajectories that are difficult to change in thefuture, thus decreasing flexibility to respond to unforeseen changes in climatic, environmental, economic and socialconditions.
Increasing existing stressors	Adding further stress to already degraded ecosystems reduces their adaptive capacity to deal with climate change impacts. Forexample, actions like promoting plantations for carbons equestration may lead to reduced water availability downstream. which may place further stress on already degraded water ecosystems

Source: Barnett and O'Neill (2010).

To complete it, Adger propose that in assessing adaptation strategies in a spatial and temporal scale, it can use the general principles of policy appraisal (equity, effectiveness, efficiency, and legitimacy) to systematically evaluate specific decisions. While these criteria are useful to ensure that adaptation decisions are made under the principles of good governance, not sure how they help define the success of applications for adaptation to climate change in particular.

There is a lack of opinion and consensus about what is success in adaptation plans, ranging from large level (global) and it has an effect on the level below. In the end, successful adaptations seen in a very long period of time can even multi-decade based on the achievement of development objectives are sensitive to climate change. However, the assessment of long-term success does require monitoring and evaluation study to extend over a longer period than the ones associated with the projects and programs of a lifetime.

2.4 Evaluation of Adaptation Strategies

Evaluation for adaptation program has received a lot of attention recently. One is summarized by Tol et al. (1998), this is related to the cost estimates include the cost of the damage and the cost of benefits, adaptation is taken "self" rather than in response to the initiative of the government, and often a reaction to climate stimuli. The resulting cost estimates are very important in the "base case" (a reference or scenarios do-what) to evaluate both options and mitigation and adaptation policies. The second body of work deals with adaptation evaluative planned, mainly anticipatory, performed or directly influenced by the government as part of their policy response to climate change. This method is intended to evaluate the feasibility or utility or acceptance of potential adaptation measures or strategies. Carter et al., (1994) gives some very general measures for the evaluation. Smith and Lenhart (1996) proposed a net benefit and implementability as the main criteria for a more detailed set of proposed procedures for evaluating "anticipatory adaptation policies". Toll (1996) argues that the management options are evaluated in relation to the economic viability, environmental sustainability, public acceptance and behavioral flexibility. Titus (1990), Goklany (1995), Fankhauser (1997) and Klein and Tol (1997) describe a variety of principles and methods that have been proposed to identify, evaluate and recommend adaptation measures.\

2.4.1Approach to Evaluating Successful Climate Adaptation

Leurs et al. (2003) have developed a way to integrate related damage threshold, sensitivity, exposure, and the capacity of adaptation to indicate a result of vulnerability to harvest wheat in the Yaqui Valley of Mexico City. Then O'Brien et al. (2004) calculate the index for a climate and exposure to export competition and adaptive capacity in the agricultural sector in India and the countries that can produce a map showing which areas have some of the stress by making the area a significant vulnerability. O'Brien (2006) also examined the kerentanandalam aspects of agriculture in the country of Norway. This study potentially significant and relevant for policy makers, even though they are likely to be most effective when it is considered as a routine part of the planning and decision making in public (Smit and Wandel, 2006).

Empirical studies and evaluation of an example of a climate adaptation plan modern classified actually provide complementary to the type of vulnerability research that has been described. Evaluate the success of the adaptations made by the community with the most recent or current changes potentially fruitful evidence for the design of future adaptation strategies. Knowing when and how adaptation actions have been successfully able to help calibrate the use of resources and the design of strategies intended to address climate change in the future. For example, practitioners are trying to devise a plan can adapt their efforts on the model of the previous cases of success and continue to evaluate the relevant metrics as part of an adaptive management scheme intended to enhance adaptation efforts.

It is important, however, to carefully consider the contextual nature of challenges such as climate adaptation. Adaptation strategies and limits of these strategies can only be understood in the context of the analyzed system (Adger et al., 2009). So in order to provide the most useful research to inform future adaptation in modern society, researchers should examine adaptation in the context of the very recently. This implies the need to start by understanding the goals and objectives of modern societies and communities are trying to adapt.

Effective evaluation of the first successful adaptation efforts will identify potential adaptation purposes, then define the climate impacts associated with temporal and spatial scales encompassing appropriate and examine broad metric shows the effect on the original purpose. For example, winter tourism dependent region experiencing warmer winters may seek to maintain the overall level of economic output for the support of its citizens. Researchers may look to see if the output of the economy remain level or increase over that period. The next logical step would be to investigate the regional context to identify whether the policy, social response, cultural, and others can explain how certain communities adapted successfully to avoid serious economic decline and whether such adaptation, examined over several spatial and temporal scales, provide universal benefits or interfere with the achievement of social objectives.

Rather than using a conceptual approach, Preston et al (2009) developed a set of evaluation criteria for judging existing adaptation plans. Their examination of adaptation guidelines and planning documents focused largely on the inclusion of various procedural aspects of what they believed to be robust adaptation guidelines. Their review found numerous deficiencies in virtually every plan examined, but as they acknowledged, was limited only to what was proposed on paper and did not evaluate the success of any actual adaptation actions.

Doria et al (2009) used a variant of the ***Delphi technique*** to elicit expert opinions on a consensus definition of the concept. After three iterations with a panel dominated by welfare economists, they settled on a final definition: ―Succœssful‘ adaptation is any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social, and environmental sustainability". Of the 18 experts involved, 83.4 percent either agreed or completely agreed with that definition, although members of the same group tended to believe that expert elicitation was not well suited for defining subjective concepts like successful adaptation.Doria et al final definition. Focusing on risk reduction, instead of maintaining well-being, as was the case with Easterling et al. (2004) and Adger et al. (2005), which may make it more difficult to identify appropriate evaluation metrics. From the perspective of empirical research, however, the biggest drawback may be the inclusion of the term "sustainability," the authors intentionally undefined.

Taken together, the various definitions point towards the need to compare several types of results to various predetermined level, but differ in focus in both the risk / vulnerability and continued provision of various services. Moreover, this approach is very varied in scope, with some implications for the development of metrics that are relatively simple but warn others to take heed of the impact on many levels.

2.4.2 Evaluation Criteria of Climate Adaptation

Neil et al (2004) said that Adaptation to climate change, therefore, can be evaluated through generic principles of policy appraisal seeking to promote equitable, effective, efficient and legitimate action harmonious with wider sustainability. The criteria of evaluate adaptation are efficiency, effectiveness, equity and legitimacy are contested and context specific, and are based on competing values (Adger et al., 2003a).

- *Effectiveness in adaptation*

Effectiveness relates to the capacity of an adaptation action to achieve its expressed objectives. The effectiveness of adaptation can sometimes be directly measured, for example, the number of houses removedfrom high hazardlocat ions can be counted, but more often the effectiveness of an adaptation measure is more elusive: effectiveness depends on the sequence and interaction of adaptations over time.

- *Efficiency in adaptation*

Adapting to climate change entails costs, but should also yield significant benefits. At the scale of the individual organisation the costs will be those of implementation, including transaction costs and the costs of inaccurate prediction and the benefits, those of reduced impacts or enhanced opportunities.

- Equity and legitimacy in adaptation

The success of an adaptation action can be argued to depend not only on its effectiveness in meeting defined goals, but also on issues of equity and perceived legitimacy of action. It is important to note here that present-day adaptations to the risks from climate change are imposedon present-day society as a result of previous actions in perturbing the climate system. Equitable adaptations can be evaluated from the perspective of outcome (i.e. who wins andloses from the adaptation) as well as who decides on the adaptation to take.

Equity andlegi results timacy decisions both essential for endurance and finally perceivedsuccess adaptation. Equity is important for instrumental reasons: equitable development destructive potential welfare gains in the future and the development of less legitimacy have little opportunity for full implementation. Equity and legitimacy is also a goal in themselves (Low and Glee kids, 1998) in a fair public action defines both our relationship with nature worldandis component of long-term sustainability. In addition, equity defines the relationship of how individuals relate to and respect other parts of the community, local and global.

Successful adaptation that balances effectiveness, efficiency andequity through decision-making structures that promote learning andare perceived to be legitimate is an ideal from which much adaptation inevitably diverges.

OECD‘s Development Assistance Committee has agreed a standard set of international criteria to guide all evaluations of development assistance. These are: ***relevance, effectiveness, efficiency, impact and sustainability***.Table 2.3 sets out the five criteria of **Effectiveness**: Achieving objectives; **Flexibility**: How far can we adapt? **Equity**: Inequality dimensions to adaptation; **Efficiency**: Cost-effectiveness; and, **Sustainability**: The wider implications of adaptation. Frameworks for evaluating the success of climate change adaptation must recognize that CCAI occur at all scales, forcing reflection on what constitutes success at each level. Each of the following scales is relevant for developing adaptation evaluations:

- Globally and system-wide (e.g. effectiveness of global markets for risk transfer;adaptation in global commodity markets)
- Global finance delivery mechanisms (e.g. effectiveness of GEF adaptation funds orthe Adaptation Fund in promoting adaptation)
- National scales (e.g. efficacy of legislative and institutional arrangements)

- Across adaptation policies and programmes (e.g. implementation framework forNAPAs or programme-wide mechanisms like DFID/IDRC‘s Climate ChangeAdaptation in Africa programme)
- At the community-based project level (e.g. effectiveness of adaptation interventionson household vulnerability reduction)

Table 2.2 Factors in Determining the Success of Climate Change Adaptation

Measure	Description
Effectiveness: Achieving objectives	―An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including capacity building, information exchange and social learning. Complications arise when evaluations are extended to examine the impact of CCAI on poverty, as care must be taken that theachievement of adaptation objectives does not have a detrimental affect on level of poverty nor a negative longer-term impact onvulnerability. Therefore, all adaptation evaluations should include measures of the overall development impact the intervention has inaddition to any evaluation of how well it has achieved the objectives.” There is potential for conflict between funders and beneficiaries, and within different groups of beneficiaries which need to be addressed at the outset.
Flexibility: How far canwe adapt?	―Climate change is uncertain, due partly to an incomplete understanding of climate science, and partly to the fact that climate changewill impact upon a future world. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation. One response to this is to plan for the ‗worst case scenario‘. However, there are disadvantages to this approach, notleast because it is extremely expensive, and spending more money on adaptation (especially in relation to potential benefits in the farfuture) reduces resources available for pressing development needs now. Instead, there is a growing recognition that adaptationshould seek to avoid large up-front sunk costs, and focus instead on building capacity to improve current climate resilience, and on‗no regret‘ and ‗win-win‘ interventions, allowing for better

Measure	Description
	decisions downstream. Successful adaptation therefore has to be flexible,not least because of the potential range of climate changes projected under different emissions scenarios.”
Equity: Inequalitydimensions toadaptation	―Adaptation aims to reduce vulnerability to climate change shocks and stresses. However, vulnerability also depends on socioeconomicfactors, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups. With respect to equityand vulnerability, it is possible to consider: • Inequalities between sectors, e.g. ecosystems are particularly vulnerable to climate change because of low capacity to adapt. • Inequalities between regions, e.g. greater impacts from climate change in small island states compared to developed countries; • Inequalities within societies, e.g. cementing the voicelessness of excluded groups, or gender inequalities in access to educationor healthcare, lowering adaptive capacity. In some situations these interact. For example recent analyses in Africa, Asia and Latin America, for example, show thatmarginalised, primary resource-dependent livelihood groups are particularly vulnerable to climate change impacts if their naturalresource base is severely stressed or degraded by overuse or if their governance systems are not capable of responding effectively.” Adaptation interventions that are inequitable will undermine the potential for welfare gains in the future, and are unsustainable.
Efficiency: Costeffectiveness	―Efficiency or cost-effectiveness is typically used to compare the costs of alternative ways of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target. However, we note that cost-effectiveness only provides comparativeinformation between two or more options. It does not provide an analysis of whether an intervention is justified in itself. Secondly, inrelation to adaptation, it is unclear what level of ambition, in terms of reducing risk, to aim towards. This is particularly since communities have always dealt with climate variability and there will inevitably be residual risk in future. Successful adaptation will involve deciding on acceptable levels of risk (defined to some extent by communities, policy-makers and funders in a collaborative way) as a trade off with the resource invests needed to reduce this risk, and whether this should involve maintaining or improving on current levels of risk and

Measure	Description
	resilience accordingly.” ―Financial markets can directly internalise information on climate risks and help transfer adaptation and risk-reduction incentives to communities and individuals. The insurance sector- especially property, health and crop insurance- can efficiently spread risks and help reduce the financial hardships linked to extreme events. There are also opportunities for ‗regulatory‘ incentives on adaptation where there is a high or very high likelihood of specific patterns of climate change. In some sectors, e.g. housing in areas of high hurricane risk, insurance markets may drive such change. Also, public awareness of specific risks will drive market-based adaptation response. Adaptation is not then restricted to projects or programmes but is a function of governments using climate change science for designing incentives and regulations and markets driving technological change in both processes and outputs of production.”
Sustainability: Thewider implications of adaptation	―Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention‘s impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention.Thus there is potential overlap with the criteria of ‗Equity‘ (Social) and ‗Efficiency‘ (Economic), above (those adaptations which areequitable and efficient are more likely to be sustainable).― ―The characteristic of sustainability provides an opportunity to prioritise those adaptations, which offer ‗win-win‘ solutions – that isthose which offer ancillary benefits (social, economic, environmental) in the context of development, even if the anticipated climateimpacts were not to occur.Sustainable adaptation is likely to include strong elements of partnership-building, community engagement, education andawareness-raising, as well as focusing on interventions which are ‗mainstreamed‘ into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education).”

Source: OECD (2007)

Criteria for successful adaptation, like the ones set out above, will probably need to be tailored to reflect the challenges of evaluating adaptation at different scales.

2.4.3 Evaluation Process of Climate Adaptation

To predict the autonomous adaptation and provide inputs for policy adaptation, there is a need to improve knowledge of the processes involved in adaptation decisions. This knowledge includes information about the steps in the process, the reasons for the decision, the handling of uncertainty, the choice of the type of adaptation and time, conditions that stimulate or dampen adaptation, and the consequences or adaptation strategies or measures of performance (Burton, 1997; Rayner and Malone, 1998; Tol et al, 1998;. Basher, 1999;. Klein et al, 1999; Pittock, 1999;. Smit et al, 1999).

Decisions regarding the adaptation can be done in one of several scale, by private individuals, communities or local agencies, national governments, and international organizations organizasi. Where this adaptation consciously planned activities, either by public institutions or individuals, there is an interest in assessing the performance or the relative merits of the action and alternative strategies.

Then, in order to cut through the complexities involved in the evaluation of adaptation, we've compiled a pyramid diagram, to show the relevance, scale evaluation methods and indicators. What should not be done explicitly take into account the factors of success that we have previously identified - effectiveness, flexibility, equity, efficiency and sustainability - this needs to be fully explored by the evaluation method chosen and reflected in the indicator. The main point of the pyramid is to show the multi-scale nature of the effort required, and in particular the birth at the household level is an important, necessary starting at the international level. And through this integration, the peak of the business can be identified. The attached diagram is a first draft and can be developed further, and is used in a number of different situations.

This pyramid reflects the structure and financial development, but does not show how the ongoing knowledge of climate risks management and in particular an increase in the understanding of climate change will feed into this. This possibility will occur at all scales, with some interconnection. Measurement scientific dimensions of climate change impacts and adaptations assessment in relation to this, tend to have the most important at the local scale. It can also be framed to assess this dimension in particular, in relation to changes in the process, outcomes and behaviors. The use of well-established theory that changes in the community evaluation would seem to fit in here. Real need now is for climate change adaptation industry to engage with professionals who work in evaluating and developing a coherent strategy evaluation. Long-term benefits to the effectiveness of welfare Climate Adaptation may be large. Moreover, addressing this need for professional evaluation will expand the evidence base available to a political debate on the funding of adaptation. Finally, while developing a coherent framework for critical evaluation and effort should be put into developing this, as acquainting professionals on the evaluation of adaptation to climate change, will also be important to ensure that the framework is efficient and effective.

Then, to evaluate the completeness of adaptation planning is currently done by the developed countries, conduct an evaluation methodology that links theory with evaluation guidelines for adaptation planning is developed by a community of practitioners. One of the classical model for evaluation in various disciplines of policy is the use of Logic Frameworks. Logical Framework Analysis (LFA) has formed the basis for evaluation in development for decades as evidenced by the evaluation protocol for the United States Agency for International Development and the Australian Agency for International Development (USAID 1973; Rosenberg and Posner 1979; Cummings 1997; AusAID 2005). LFA approach combines the analysis of (a) the relationship between the goals and objectives of the program; (b) the activities that these objectives can be realized; (c) inputs and resources necessary to carry out these activities; and (d) the output arising from the implementation of the activities identified.

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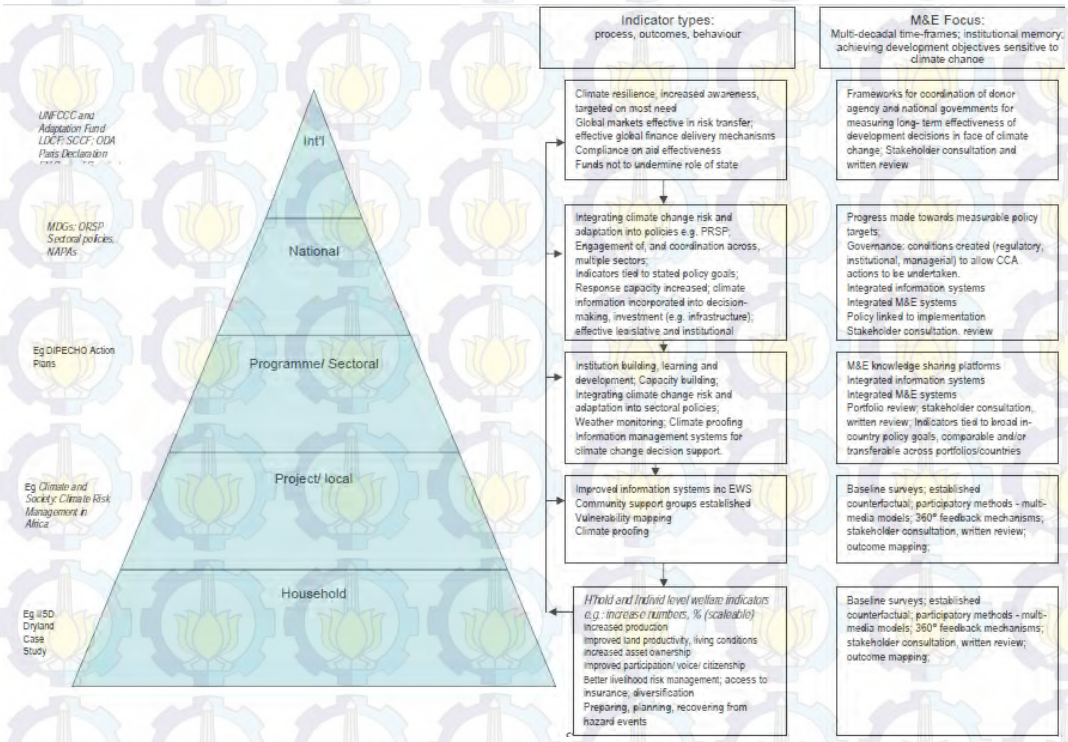

Figure 2.3 Pyramid of Adaptation Evaluation (source: IDS, 2008)

2.4.3.1 Tools and Methods for Evaluation of Adaptation Measures

The World Bank guide (2004) provides a useful summary of evaluation methods, and key points are extracted in Table 2.4 below.

2.5 Analytical Techniques

2.5.1 Multi-criteria analysis (MCA) and Analytic Hierarchical Process (AHP)

Multicriteria analysis was introduced since 1970 by Benjamin Franklin was a statesman United States (Jones et al., 2000). Franklin‘s findings of this assessment technique are the technique of choice is a study of double and usually conflicting (Azar, 2000). This multicriteria analysis approach was used with the flag (Flag Approach) to measure the sustainability of agricultural land use in Lesvos, Greece (Hermanides and Nijkkamp, 1997). The same is also used to select an alternative scenario development Buccoo Reef Marine Park using approaches regime (Regime Approach), (Brown et al., 2001). Intended using Regime method approach to assess rationally in choosing a unique multiple optionsare not real and can not be compared (Hinloopen et al., 1982).

Table 2.3 Methods and Key Features for Evaluation

Methods	**Key Features**
Performance Indicators	What can we use them for? • Setting performance targets and assessing progress toward achieving them. (withstakeholders) • Identifying problems via an early warning system to allow corrective action to betaken. • Indicating whether an in-depth evaluation or review is needed.
Logical FrameworkApproach	What can we use it for? • Improving quality of project and program designs—by requiring thespecification of clear objectives, the use of performance indicators, andassessment of risks. • Summarising design of complex activities. • Assisting the preparation of detailed operational plans. • Providing objective basis for activity review, monitoring, and evaluation.
Theory BasedEvaluation	Theory-based evaluation has similarities to the LogFrame approach but allows a much more in-depth understanding of the

Methods	Key Features
	workings of a program or activity—the ‗program theory‘ or ‗program logic.‘ In particular, it need not assume simple linear cause-and effectrelationships What can we use it for? • Mapping design of complex activities. • Improving planning and management.
Formal Surveys	What can we use them for? • Providing baseline data against which the performance of the strategy, program,or project can be compared. • Comparing different groups at a given point in time. • Comparing changes over time in the same group. • Comparing actual conditions with the targets established in a program or projectdesign. • Describing conditions in a particular community or group. • Providing a key input to a formal evaluation of the impact of a program orproject. • Assessing levels of poverty as basis for preparation of poverty reductionstrategies.
Rapid AppraisalMethods	What can we use them for? • Providing rapid information for management decision-making, especially at theproject or program level. • Providing qualitative understanding of complex socioeconomic changes, highlyinteractive social situations, or people‘s values, motivations, and reactions. • Providing context and interpretation for quantitative data collected by moreformal methods.
Participatory methods	What can we use them for? Learning about local conditions and local people‘s perspectives and priorities to design more responsive and sustainable interventions.

Methods	Key Features
	Identifying problems and trouble-shooting problems during implementation. Evaluating a project, program, or policy. Providing knowledge and skills to empower poor people.
Public ExpenditureTracking Surveys	Public expenditure tracking surveys (PETS) track the flow of public funds and determine the extent to which resources actually reach the target groups. What can we use them for? • Diagnosing problems in service delivery quantitatively. • Providing evidence on delays, _leakage,‘ and corruption.
Cost benefit and CostEffectiveness Analysis	Cost-benefit analysis measures both inputs and outputs in monetary terms. Costeffectiveness analysis estimates inputs in monetary terms and outcomes in non-monetary quantitative terms (such as improvements in student reading scores). What can we use them for? • Informing decisions about the most efficient allocation of resources. • Identifying projects that offer the highest rate of return on investment.
Impact Evaluation	What can we use it for? • Measuring outcomes and impacts of an activity and distinguishing these from theinfluence of other, external factors. • Helping to clarify whether costs for an activity are justified. • Informing decisions on whether to expand, modify or eliminate projects,programs or policies. • Drawing lessons for improving the design and management of future activities. • Comparing the effectiveness of alternative interventions. • Strengthening accountability for results.

Source: World Bank (2004)

Methods regime is one of the multicriteria assessment method based on the two data inputs, namely: (1) the matrix effect, and (2) a collection of weights that accompany the effects of its value. Impact matrix represents the values of the indicators are estimated for each scenario. The results of the research policy with the method of this regime are the ranking scenario, so it can choose which scenario is most desirable. As a final step will be a comprehensive assessment of the existing scenarios. Performance of various scenarios is compared, and then communicates with the decision makers.

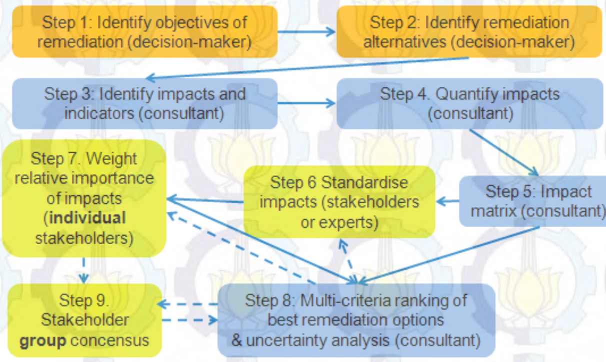

Figure 2.4 Steps and Roles in A Multi-Criteria Analysis

Analytical Hierarchy Process (AHP) is a method to solve a complex situation is not structured into several components in a hierarchical arrangement, by giving the subjective value of the relative importance of each variable, and specifies which variable has the highest priority in order to affect the outcome of the situation.

The decision making process is basically choosing a best alternative. As did the structuring issues, determination of alternatives, penenetapan possible value for the variable aleatori, settler value, preference requirements with respect to time, and specifications for the risk. However widening alternatives that can be set and the value assessment terperincinya possibilities, limitations that still surrounds is the basis of comparison in the form of a single criterion.

The main equipment Analytical Hierarchy Process (AHP) is to have a functional hierarchy with the main input of human perception. With hierarchy, a complex and unstructured problems can be solved in the group-group and organized into a hierarchical form.

2.5.2 Delphi Techniques

Delphi method is a modification of the technique brainwriting and surveys. In this method, the panel used in the movement of communication through several questionnaires contained in the article. Delphi technique was developed in the early 1950s to obtain an expert opinion. The object of this method is to obtain the most reliable consensus of an expert group. This technique is applied in various fields, for example for forecasting technology, public policy analysis, education innovation, program planning and others - others.

Delphi method was developed by Derlkey and associates at the Rand Corporation, California in the 1960s. Delphi method is a method of aligning a group communication process communication that is achieved effective process in getting the solution of complex problems.

Delphi approach has three distinct groups, namely: decision makers, staff, and the respondent. Decision makers will be responsible for the output of the Delphi study. Working groups consisting of five to nine members are composed of staff and decision makers, in charge of developing and analyzing all questionnaires, evaluation and data collection necessary to revise the questionnaire. The group is led by a coordinator staff who must have experience in the design and understand the Delphi method and recognize problem areas. The task of the staff coordinator is to control the staff in typing. Mailing questionnaires, split and process yield and schedule meeting belong here. Respondents are people who are experts in the matter, and those who agreed to answer the questionnaire.

2.6 Review of Urban Development and Climate Change in Surabaya

Albrechts (2006) said that spatial planning contains process of forming, allocation, harmonizing, and sizing the land or space for multifunction uses. That is the job usually implemented by the planning agency with the input from several disciplines (planners, transport analyst, geo-information specialist, and also economist. Based on the locations under the consideration, the spatial planning can be catagorized into national (country level), state (provincial level), district (regional level) and detailed spatial planning. Classification is based on extent of planning, how detail spatial plan is. The regional level provides guidelines on how area or space is zoned, controlled, and utilized but in general. The detailed spatial planning has legally binding status. It covers the whole area of city or little part of the city, and output map of spatial plan produced at large scale, with the scale around 1:500 to 1:5,000 or maybe larger. Many planning scenarios need few detailed information, and then very detailed is may not be required or even not available such as geological and hazards risk map usually not available in the large scale.

City spatial plan was done by private consultant who the close supervision from the governmental advisory team that consist officials people from different agencies. These agencies involved are Public Works, City Planning, Environment, Local Land Administration, Mining, Forestry, and Investment Coordinating Agency. At the fact of current city spatial plan form is the revision of previous spatial plan. Usually, it belongs of the evaluation on implementation and applicationof the previous spatial plan, the adjustment to current condition and a new development planning scenarios. The public participation was determined by inviting several communities and maybe business organisation for attending public meeting and FGD (focus group discussions). Finally, city spatial planning policy needs the approval and permits from local legislative or representative people and was accomplished as the local government regulation/policy.

In the district or city level, two types of city spatial plan were developed, that is RTRW (Rencana Tata Ruang Wilayah: General Spatial Plan) and RDTRK (Rencana Detil Tata Ruang Kota: Detailed City Spatial Plan). The latest RTRW and RDTRK are to be effectively implemented for 2010 to 2030. The development of them was based on Law 26/2007. However, there is a confusing situation in this case. Some government regulations required as a technical guideline were not yet issued. This includes government regulation on how spatial planning should be executed, how public participation be conducted and what are the map standard and specification. Therefore, provincial and district level government were forced to use new law but with old technical guidelines based on the previous law. With these circumstances, evaluated the RTRW 2010-2030, RDTRK 2000-2010 and RDTRTK 2010-2030 of the coastal city of Surabaya were evaluated. The following aspects were analyzed: how the spatial plan linked to the idea of disaster risk reduction, how the spatial plan address the issue of disaster risk reduction and how the spatial plan map represent disaster risk reduction effort.

The coastal area of Surabaya consists of 11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region
- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region.

Districts in Surabaya coastal area have 52, 6 km² of the total length of coast. The detail of length of coast follows:

Table 2.4 Length of Surabaya Coastal Area

No	**District**	**Area (km²)**	**Length of Coastal Area (km²)**
1	Benowo	23.73	3.9
2	Asemrowo	15.44	6.2
3	Krembangan	8.34	3.9
4	Pabean Cantikan	6.8	9.8
5	Semampir	8.76	3.4
6	Kenjeran	7.77	3.4
7	Bulak	6.72	7.0
8	Mulyorejo	14.21	2.8
9	Sukolilo	23.68	6.3

No	District	Area (km²)	Length of Coastal Area (km²)
10	Rungkut	21.08	4.4
11	Gunung Anyar	9.71	1.5
	Total	146.24	52.6

Source: Department of Agriculture, 2009

Flooding due to sea level rise potentially inundate coastal areas in Surabaya. Flooding occurs in 1st and 20th of every month but the height of the tide influenced the position of the earth, moon, and sun. Flooding due to sea level rise in coastal areas of Surabaya has a height of 0-1.5 meters. Flood elevation in each region is determined by the height of the topography due in accordance with the nature of the water that flows from high places to low places. In Surabaya, ebb and flow occur once time whitin one day. That is called diurnal tide which has tidal periode of 24 hours 50 minutes (BMKG Maritim Tanjung Perak, 2011). Flood due to sea level rise had been occurring in Krembangan on June, 2009 (Detik Surabaya, 2009). That flooding drown housings in Krembangan district with the height of 60 cm and duration of that is 4 hours. And then, on July 2010, flooding in Krembangan District had 20 cm height and the duration is 3 hours. Besides that, flooding occurred in Tanjung Perak Port Area in Februari 2010 with the sea level rise was 130 cm above mean sea level (Immadudina, 2011).

Because Surabaya has vulnerability to flood risk, the government has tried to make policy adaptation of urban and regional development to the SLR. Based on Firman at al (2008) on his study about Sea level Rise in java‘s North Coast Region: Implication for Urban Development Policy and planning which held in several cities named Jakarta, Semarang, and Surabaya, they identified existing adaptation strategy for three cities, as follows:

1. Rising awareness of decision makers that SLR will greatly affect urban and regional development in coastal regions.
2. Incorporating short-run and long-run impacts of SLR in the urban and regional development planning in coastal area
3. Formulating mitigation and adaptation policy at national and regional level

4. Developing inter local-government cooperation to deal with impacts of SLR
5. Improvinf the capacity of governmental institutions at all levels (national, regional, and local), including technical capacities.

In that report, also identified spatial planning for Jakarta, Semarang, and Surabaya Metropolitan Area as Adaptation Policy, which are:

1. Integrated urban and regional development at macro (Java), meso (metropolitan areas) and micro (cities) level, which take into considerantion vulnerabilities and risk of SLR and other potential national disasters.
2. Establishment of institutional governance for regional and urban development in Java North Coast Areas, ehich should involve inter-local government cooperation, to deal with impacts of SLR
3. Improvement of local government capacity in adaptation and mitigation, especially the local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang) and other related departements.

2.7 Summary

A lack of discussion of causal factors and relevant adaptations may influence the level of vulnerability at a future time. The vulnerability level will be affected not only by the causal factors but also by certain actions from stakeholders or adaptations. The gap emerges from vulnerability research results assessment particularly for determining vulnerability levels based on certain factors (e.g. Armas, 2008; Rygel et al. 2006; Odeh, 2002; Gabor & Griffith, 1980). The results of these assessments are often used inappropriately in deciding stakeholders' actions to reduce community vulnerability (Barnett et al., 2008). Therefore, there is an urgent need to integrate discussion of causal factors with the selection of stakeholders' actions in vulnerability assessment.

In addition, a major gap which important for this research is the lack of understanding of adaptation at individual and household levels, particularly those that are multi-local and that go beyond sedentary, productive activities, and of the underlying systems that may assist or directly enable adaptive capacity. Then, mismatches between governmental adaptation measures on the one hand and non-governmental or individual adaptation measures in urban areas on the other are important issues that have often been overlooked. No discussion exists on intermediary institutions that can facilitate flow of information, as well as enable or constrain adaptive measures.

Although researchers possess a long record of human adaptation to climate variability and other environmental changes (Adger et al., 2007), little of that record has been analyzed and synthesized in a manner conducive to providing lessons for efforts to adapt to future climate variability and change.

Then, vulnerability research is a weak correlation between vulnerability and other concepts within and beyond disaster risk management. To some degree, the relationship between policy and vulnerability analysis has received little focus as the majority of the existing research has stressed mapping and the level assessment results (e.g. Armas, 2008; Preston et al., 2008; Rygel et al., 2006; Brenkert & Malone, 2005; Odeh, 2002; Gabor & Griffith, 1980). Furthermore, Adger et al. (2004) state that the importance of adaptive capacity as a function of adaptation will influence future levels of vulnerability.

The adaptation itself is a part of public policies and planning systems. The quantitative approach in dynamic analysis could give a ranking system based on these comparisons. The rank will sort the future levels from the highest to the lowest. Therefore, the most effective adaptation can be distinguished from the lowest future vulnerability level after applying certain scenarios through the modelling process. The information on the most effective adaptation can finally enhance the quality of public policies and planning systems.

Adaptation requires largescale investment is likely to be episodic and staggered. It is likely to be triggered through extreme events that raise the consciousness of climate change within policy making and hence giving legitimacy to governmental action. This section is also arguedthat adaptation operates at different spatial and societal scales and that success or its sustainability needs to be evaluated against different criteria at these different levels. Elements of effectiveness, efficiency, equity and legitimacy are important in judging success. From this literature review, the criteria used to evaluation is identified. Here is the criterion, and then it will be explained to sub-criterion.

Table 2.5 Criterion and Sub Criterion Used in This Research

Measure	Description	Sub-Criteria
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including **capacity building, information exchange and social learning.**	• Enhancing policy, planning for adaptation measure • Legal and regulatory • Integration with development policies and planning • Institutional mechanism, capacities and structures
Flexibility: How far canwe adapt?	Climate change is uncertain, due partly to an incomplete **understanding of climate science**, and partly to the fact that climate changewill **impact upon a future world**. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation.	• Hazards risk • Scientific and technical capacities and innovation
Equity: Inequalitydimensions toadaptation	Adaptation aims to **reduce vulnerability** to climate change shocks and stresses. However, vulnerability also depends on **socioeconomicfactors**, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect	• Impact data • Environmental and natural resources • Livelihood • Culture, attitudes, education

Measure	Description	Sub-Criteria
	especially vulnerable groups	
Efficiency: Costeffectiveness	Efficiency or **cost-effectiveness** is typically used to compare the **costs of alternative ways** of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target.	• Financial instruments • Cost recovery for adaptation
Sustainability: Thewider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention‘s impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention. Sustainable adaptation is likely to include strong elements of **partnership-building, community engagement, education andawareness-raising**, as well as focusing on interventions which are _mainstreamed‘ into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education).	• Public awareness, knowledge, skill • Information management and sharing • Learning and research

CHAPTER III

METHODOLOGY

This study is based on exploring and describing the current situation of adaptation measure in Surabaya, Indonesia. Then, howurban development integrated to adaptation measure. This chapter tries to explore methods and framework which will be used in analysis.

3.1 Research Approach and Conceptual Framework

Based on vulnerability in coastal area related to adaptation measure which has been done there, the specific objective of this study is to get overall criteria that can be used in evaluation, then focus on communities that vulnerable on flood to know the successful of adaptation. After condition of adaptation is shown, then it can be integrated with urban development for recommend the possible adaptation based on vulnerable area. This is conceptual framework that used in this research:

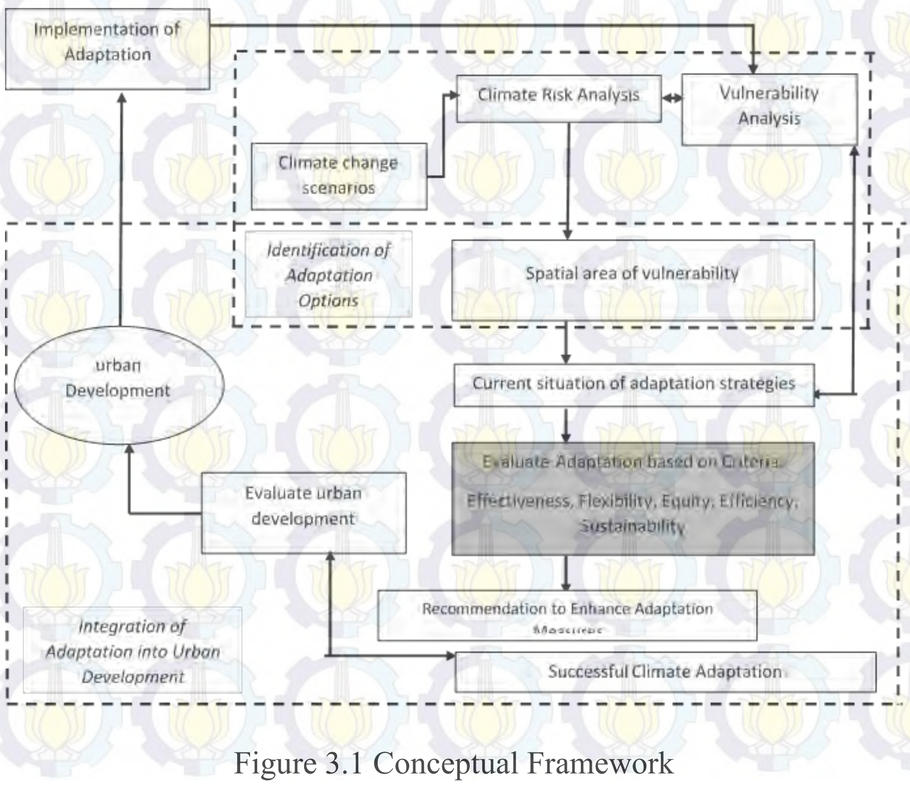

Figure 3.1 Conceptual Framework

A conceptual framework from this study is shown in Figure 3.1. It shows that determine adaptation strategies is needed to be thought after climate risk analysis. Identification of Adaptation starts with projections/scenarios for future development of climate parameters. Risk analysis considers the probability and impacts of harmful events such as floods, drought/water scarcity and etc. The impacts of these events are represented by vulnerability indices, determined using a vulnerability assessment that is conducted at the village and household levels. The combination of vulnerability and risk analyses allows for the identification of areas to be prioritized for adaptation actions (spatial area of vulnerability).

Based on vulnerability area and adaptation measure which is in urban development policy, current situation of adaptation will try to identify. From current situation of the adaptation, criteria for making adaptation successful will be shown. In addition, exploration of success criteria of adaptation will be done after evaluating urban development and analyzing current adaptation strategies. Final results will be synergized with and integrated into urban development and the successful practices of adaptation.

In addition, evaluation of adaptation measure plays two critical roles in ensuring effective adaptation: they support the long-term process of learning "what works" in adaptation and they provide a tool to manage the work in the context of the uncertainty surrounding climate change impacts. Integration of adaptation into urban development is a main objective in evaluation process above to strengthen connections between bottom-up and top-down information and decision making. Evaluation of adaptation is one of the weakest areas of adaptation practice. Of those evaluations carried out to date, most have been undertaken as part of ongoing implementation, whilst only a few have focused on evaluating interventions after completion. Given this panorama, there are increasing calls for an integrated evaluation framework for adaptation which is more closely aligned with development planning.

3.2 Methodology

Figure 3.2 shows the metholodology of study in five task conducted for evaluating adaptation measures in which primary and secondary data will be use to support In that figure explains about every task that have to through to get the successful adaptation measures. In Figure 3.2, there are several task that have to do it to achieve the main objective in Chapter 1. The main objective 1 is assessing current situation of adaptation strategies in term of development context in coastal city of Surabaya. Several task that have done in this study, namely:

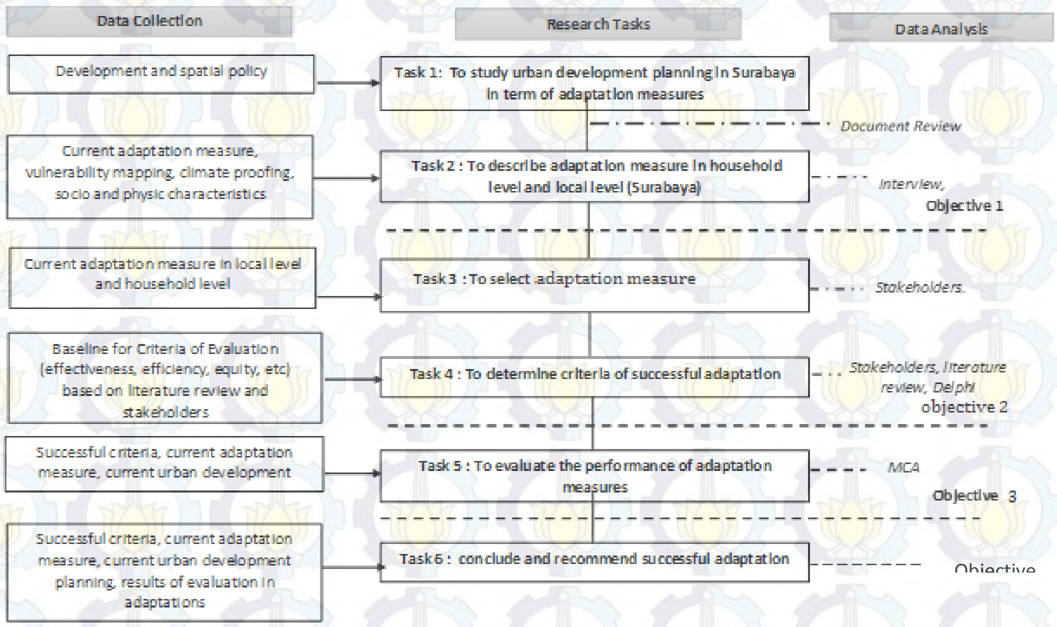

Figure 3.2 Methodological Framework

Task 1: to study urban development planningin term of characteristics and climate change in Surabaya

In this first task tried to get current and future condition of Surabaya's condition based on urban planning documents. This task have been done based on review of urban development planning document in Surabaya and its applications in that area including vulnerability and flood risks in Surabaya. This task is the first step to deal with flood problem, knowing the climate change characteristic to support adaptation measures is very important to know the effectiveness of the adaptation measure.

Task 2: To describe current adaptation measures

In this task used interview techniques to know the adaptation measure which have been done by local government and local people. In this task, also explain about characteristics and profile adaptation measures in that area. Observation and photograph also did in this task to support evidence of adaptation measure in term of flood riks. .Identify existing adaptations are needed to know what kind of adaptation strategies that already happened to deal with flood and also to know the impact of existing adaptation strategies if there are any impacts. In this task to get baseline information about existing adaptation strategies and plan adaptation strategies, interviewing expert (local government, NGO and local community)

Task 3: To select climate adaptation measures for evaluation

Through by people perception, the study is conducted to select and prioritize adaptation measure done in task 2.In this task, stakeholers are also used to help prioritizing the current adaptation measure. Scoring analysisis conducted to reach the goal of this task by stakeholders' perception.

Task 4: To determine criteria of successful adaptation

There are many criteria involves to evaluate adaptation measure. Hoewever, in this task found out criteria that are from resident perceptions and government perceptions. To conduct this task, Delphi analysis used with involved stakeholders.Criteria which are found in literature review will be crosschecked into stakeholders to get appropriate criteria that suitable in study area. The steps of Delphi analysis is explained on later section (section 3.5).

Task 5: To evaluate performance of current adaptation measures

After criteria found, in this task we used those criteria to evaluate current adaptation strategies. In this section selected different adaptation strategies by making list of adaptations strategies to deal with flood vulnerability that happened in selected area. The choosen adaptation strategy is based on stakeholder's perception. Then used scoring analysis (MCA) is in order to end up with effective and adaptation measures in developing adaptation strategies plan to deal with the problem of flood risk because of climate change and also deal with the vulnerable that happened in the selected area. Scoring analysis approach was a method to evaluate different type of adaptation strategies on wide of rage of attribute and to prioritize objectives while evaluating strategies. The performance of criteria assessed is effectiveness and benefits of each adaptation strategies. In this task, questionnaire (**see in appendices C and E**) of evaluation criteria will be distributed to stakeholders involved (list of stakeholders can be seen in later section).

Task 6 Conclude and Recommends for Enhancing Adaptation Measures

From all task above, integrating with results of evaluation and urban development, stakeholders, the study leads to conclude and recommend successful practices in adaptation. This study also recommended future research that can full fill the gap. In this task also recommend about futher studies which will not conducted in this study (knowledge gaps in this study) and also recommend to local government how to improve adaptation strategies become more successful in study areaa

3.3 Study Area

In Planning Document of Surabaya (Rencana Tata Ruang Wilayah Kota Surabaya), the city is devided to many areas. One of that area is coastal area which have special development such as Management of Coastal Areas and Small Islands (Pengelolaan Wilayah Pesisir dan Pulau-Pulau Kecil). The coastal area of Surabaya consists of 11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region

- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region

Districts in Surabaya coastal area have 52, 6 km² of the total length of coast. The detail of study area boundary is shown from Figure 3.3 below. Then, Based on previous study which is conducted by Prasita (2013), coastal village which is potentially affected directly by flood are shown in Table 3.1. From 32,639 Ha total area about 25,919 Ha or 80.72% of total area located in low land with –0.5 up to 5 m SHVP or 3 up to 8 m height. By this condition the area susceptible to inundate if one-meter increasing of sea level rise.

Table 3.1 Coastal Village Affected By Flood Risk

No	Distrricts	Vilage
1.	Benowo	Romo Kalisari
		Tambak Oso Wilangun
2.	Krembangan	Monokrembangan
		Perak Barat
3.	Pabean Cantikan	Perak Utara
		Perak Timur
4.	Kenjeran	Kedung Cowek
5.	Mulyorejo	Dukuh Suterojo
		Kalisari
		Kejawan Putih Tambak
6.	Sukolilo	Keputih
7.	Rungkut	Medokan Ayu
		Wonorejo
8.	Gunung Anyar	Gunung Anyar

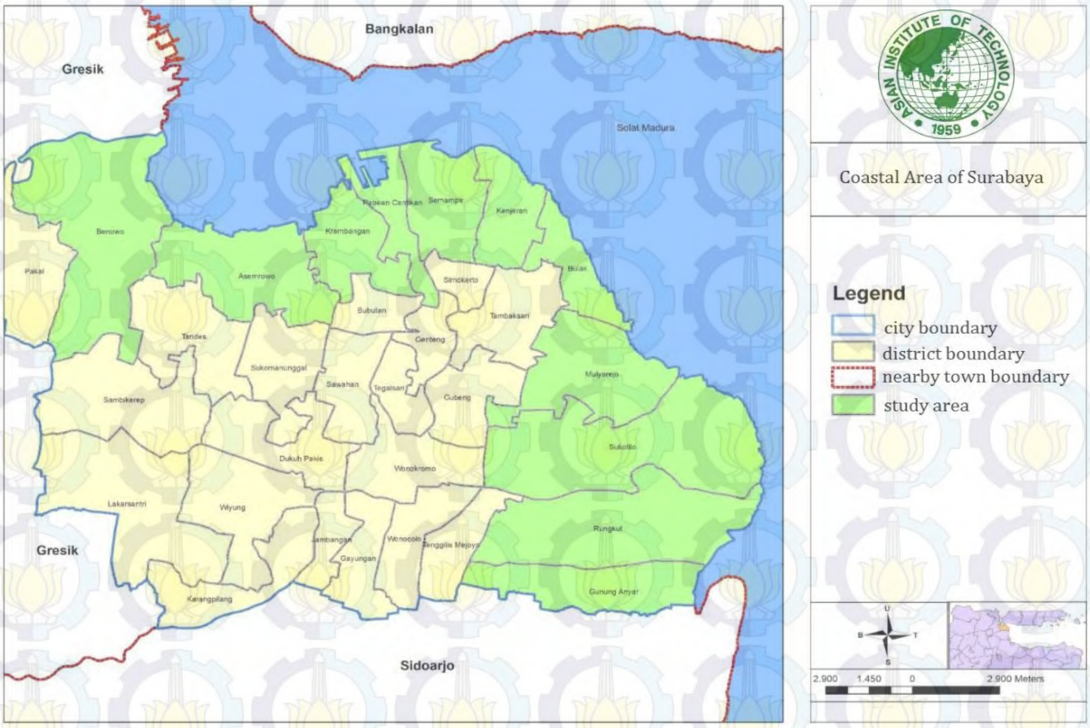

Figure 3.3 Coastal Areas in Surabaya

Source: City Planning Document of Surabaya (2013) with author's modification

However, Immadudina (2011) identified spatial area of vulnerability related to Sea Level Rise in coastal area of Surabaya. These area are Krembangan District, Pabean Cantikan, Semampir, and Kenjeran District. So, based on comparation of previous studies which are conducted by Prasita (2004) and Immadudina (2011), the selected areas to **distribute questionnaire to household** are shown in Table 3.2 below.

Table 3.2 Selected Areas

No	District	Village	Population (people)
1.	Krembangan	Monokrembangan	38.767
		Perak Barat	20.050
2.	Pabean Cantikan	Perak Utara	31.104
		Perak Timur	16.739
3.	Kenjeran	Kedung Cowek	11.388
	Total		118.048

Source: National Statistical Agency, 2013

Based on Firman at al (2008) on his study about Sea level Rise in java's North Coast Region: Implication for Urban Development Policy and planning which held in several cities named Jakarta, Semarang, and Surabaya, they identified existing adaptation strategy for three cities, as follows:

1. Rising awareness of decision makers that SLR will greatly affect urban and regional development in coastal regions.
2. Incorporating short-run and long-run impacts of SLR in the urban and regional development planning in coastal area
3. Formulating mitigation and adaptation policy at national and regional level
4. Developing inter local-government cooperation to deal with impacts of SLR
5. Improvinf the capacity of governmental institutions at all levels (national, regional, and local), including technical capacities.

In that report, also identified spatial planning for Jakarta, Semarang, and Surabaya Metropolitan Area as Adaptation Policy, which are:

1. Integrated urban and regional development at macro (Java), meso (metropolitan areas) and micro (cities) level, which take into considerantion vulnerabilities and risk of SLR and other potential national disasters.
2. Establishment of institutional governance for regional and urban development in Java North Coast Areas, ehich should involve inter-local government cooperation, to deal with impacts of SLR
3. Improvement of local government capacity in adaptation and mitigation, especially the local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang) and other related departements.

In the dry season, Head of Planning Urban Development (BAPPEKO) made concentration to face flood in Surabaya. Governments do the dredging of the river and made installation of pumps in whole area of Surabaya. Dredging of the river flow is also enhanced in the northern region that led to bosom or reservoirs in Morokrembangan, before the water is discharged into the sea. There are many bosoms in Surabaya including Morokrembangan, Kalidami, Bratang, Rungkut Industri, Wonorejo, Kedurus, dan Jurang Kuping. Generally, bosom is usually used by people to control and keep water (water storage). In addition to these functions also take advantage of the community as fish farming and irrigation fields.

To address flood riak in Surabaya, also improved maintenance of existing pumps in 68 units located in 21 different regions of the pump house in puddles in Surabaya. The pumps are expected to cope with and control flooding in the city. In addition, Surabaya City Government efforts to get help from the Netherlands in the form of a grant of 200 thousand Euros, or approximately USD 1.73 billion.

In addition, adaptation strategies to flood risk have been identified from Masterplan of Surabaya East Coastal Area (Pantai Timur Surabaya). In this area, government has made mangrove afforestation in East Area of Coastal Surabaya because this area is located in the end of the watershed

3.4 Data Collection Methods

Data will be used in this study is mixed data (qualitative and quantitative data). Qualitative data included stakeholder knowledge in determine criteria to evaluate adaptation measures. Quantities data included the information that includes number, such as the existing condition in this study area, such as: environmental, economic, social vulnerable that affected flood and climate factors (precipitation, temperature, river discharge, and sea tide) to describe vulnerable area. Table 3.3 shows data collection that will support in this study and describes techniques how to get these data. From table 3.3, the data can be divided into 2 these are primary and secondary data resources.

3.4.1 Primary Data Resources

The research is dependent on primary data collection, such as: field observation and photograph, in-depth interview and questionnaire with semi structured questionnaire interview with main stakeholder and local people.

- *Observation and photograph*

Observation will be conducted for documentation and knowing the existing environment spatially from study area.

- *Interview to stakeholders*

Interviews were conducted on-site and off-site research. Stakeholders are chosen by using a **purposive sampling or non-probability sample**. So this technique can determine the proper experts for this study sampled directly (related parties as a resource). Focused main stakeholder is semi structured interview. Interview in this study is used for determining criteria using Delphi Analysis and measuring the criteria regarding the successful of adaptation. The selected stakeholders are Town Planning Office, Department of Public Works of Water Management, Regional Disaster Management Agencies (BPBD), Ministry of Public Work, and Academician. For the list of stakeholders involved in this interview, see **Table 3.4**.

Stakeholders that have been selected to provide information from government offices as stakeholders is stakeholders who hold decision-making power in the future. Stakeholders that have been selected based on their expertise in this study or in connection with this research. In addition to interviews, questionnaires are used to obtain information that can cover a large area and is associated with this research.

Table 3.3 Data Collection Matrix

Research Question	**Key Body of Evidence**	**Data/Information**	**Source/s**	**Technique of Data gathering**
What are characteristics of urban development plan in Surabaya and their function and importance to the society in terms of	- Overall explanation of urban development - The situation of existing policy and plan	- Master Plan of City - Land use Map - Urban Planning Law - Climate change scenario in Surabaya - Flooding	- Departement of Ciy Planning Surabaya - Departement of Disasater Management	Document Review

Research Question	Key Body of Evidence	Data/Information	Source/s	Technique of Data gathering
adaptation measure?	of urban planning - Results of existing city development	maps - Land use maps		
What are the criteria to evaluate adaptation measure?	Identification of criteria in successful adaptation	- Data about current adaptation	• Local people • Departement of Ciy Planning Surabaya • Departement of Disasater Management	• Interview with stakeholders
How are the performance of current adaptation strategies in relation to urban development in Surabaya?	• Explananti on of government and local community adaptation • Explanation of past and on-going solution • Explanation of city development • Result of criteria of evaluation	- GIS Map - Adaptation by government and local people	• Key informants • Surabaya City Planning Departement • Disaster management Departement • Departement of Ciy Planning Surabaya • Departement of Disasater Management • Departement of Public Works	• Interview to stakeholders and head of districts

Table 3.4 List of Stakeholders

No	Stakeholders
1	Town Planning Agencies (Bappeko)
2	City Department of Spatial Planning (Dinas Tata Kota dan Tata Ruang)

3	Regional Disaster Management Agencies (BPBD)
4	Academician
5	Agency for Environmental Management (BLH)

This table below shows design of primary data which used in questionnaire to get performance of adaptation measure in Surabaya Coastal area. Primary data used as mention before, photograph is used to show the condition of Surabaya Coastal Area and questionnaire to evaluate adaptation measures in the study area.

Table 3.5 Primary Data Resources

No	**Data**	**Source**	**Agency**
1.	Baseline of charcteristics of coastal development plan	Stakeholders from government and local people	Departement of Public Works, local planning agencies (Bappeda), agency for environmental management (BLHD), city department of spatial planning (Dinas Tata Kota dan Tata Ruang), Departement of Marine.
2.	Baseline of adaptation measures • Current adaptation in household level • Current adaptation in local government		Local people
3	Baseline for Criteria of Evaluation (inequality dimensions) • Impact data • Environmental and natural resources • Livelihood data • Culture, attitudes, education (social data)		
4	Prioritized and scoring about evaluation criteria	Stakeholders from government and local people	Local people Local government

3.4.2 Secondary Data Resources

A secondary survey was also conducted to collect data related to government and non government publications. These data were especially significant for coverage of quantitative variables. Moreover, some of the data from both government and non-government publications can justify characteristics of the community.

Secondary Data Sources Secondary data is data that is collected through a text document and can document unpublished or published and can be obtained from the relevant agencies (government offices, and universities) and organizations (NGOs) such as: a report or document review. Secondary data can be obtained from other sources, including some reports, journals, books, documents and internet workshops. For this study, the use of secondary data sources from multiple reports / studies that local governments do, the journal in the same case but a different location, workshops and Internet documents can also be used as a reference to support this research

Table 3.6 Secondary Data Resources

No	Critical Information Set	Data Sources
1.	Baseline for urban development characteristic • Integrated Coastal Zone Management Document • RTRW (Rencana Tata Ruang Wilayah: General Spatial Plan) and RDTRK (Rencana Detil Tata Ruang Kota: Detailed City Spatial Plan) of Surabaya	• Bappeko • BPDB • Department of Public Works • Departement of City Planning • Departement of marine and Fishery
2.	Baseline for Adaptation Measure • Vulnerability Map • Vulnerable group who works in vulnerable sector • Climate proofing • Hazards event • Adaptation policy, project, etc	• BAPPEKO • BPBD • BMKG • Department of Public Works • Departement of marine and Fishery • Agency of National Land • Agency of National Statistic

From table 3.6 above, there are many data will be used in this research which are from secondary data. Baseline will be used are urban development baseline, adaptation baseline, and evaluation baseline. For urban development baseline will be found in local planning agency such as BAPPEKO and related agencies which are have role in Surabaya planning. Then, baseline for adaptation measures will be identified from Departement who works directly to adaptation measure like Departement of Public Works and Department of Marine. This is because of limitation of this research which concern adaptation in local and household level.

So, based on the stages of my research and sampling method, the data collection process included a Delphi Questionnaire, Semi-structured Telephone Interviews and a Secondary Survey. All three instruments of data collection accommodated both qualitative and quantitative data. Moreover, those three instruments also valued the explanation of relevant key persons whose input was a significant factor in defining the qualitative data. These explanations were critical because of the lack of systematic documentation of past floods.

3.5 Data Analysis Methods and Techniques

This reaserch uses Quantitative and Quantitative Methods. Quantitative includes scoring for for weighting criteria. In this research, weighting criteria is used to weighting factors that is used to get the appropriate adaptation to deal with the flood problem in Surabaya. Qualitative Methods is used to exploring adaptation criteria given by stakelokders using Delphi Analysis.

Analysis of data from interviews tends to focus either on the language (discourse or narrative analyses) or the content of interviews (King and Horrocks 2010). This analysis focused on the content. The major activity of data analysis involved categorising data based on themes and topics. Some of these were inductive, they became evident from interview responses, but most were deductive, organized by the nine adaptation options.Table 3.7 below shows summary of data analysis methods and techniques that will be used in this research.

Table 3.7 Data Analysis Techniques

No	Objectives	Task	Data	Analysis Techniques
1	To assess current situation of adaptation strategies in term of development context in coastal city of Surabaya	To study urban development planning in Surabaya in term of adaptation measures	Current situation of urban development planning	Descriptive (review documents)
		To describe adaptation measure in household level and local level (Surabaya)	Current situation of adaptation measure	Descriptive
2	To assess criteria of evaluating climate change adaptation in relation to coastal urban development	To select adaptation measure	Current situation of adaptation, Vulnerability Map	Descriptive, scoring
		To find out criteria of successful adaptation	Criteria based on literature review and stakeholders	Delphi
3	To evaluate the performance of adaptation measures	To evaluate the performance of adaptation measures	Successful criteria, current adaptation measure, current urban development planning	MCA (Multi Criteria Analysis), AHP,
4	To recommend adaptation measures	conclude and recommend successful adaptation	Successful criteria, current adaptation measure, current urban development planning, results of evaluation in adaptations	descriptive

From the table 3.4, this research will use specific methods to reach the aim of this research. The methods will explain below.

- **Decriptive analysis**

  This method is used to describe that already determined with the available existing data, so the data can be visualization in map. this method uses Microsoft excel with using percentage or graphic to describe the condition. In this descriptive analysis describes about urban development characteristics.

- **Delphi analysis**

In the Delphi Policy, I value the importance of avoiding face-to-faceinteractions among stakeholders as one of the main characteristics inachieving objective consensus. Consensus was confirmed by discussing onestakeholder’s opinions with others and/or clarifying their first round results withthose of the next round. In addition, avoiding stakeholders meeting face-tofaceminimised the bias from superior-subordinate relationships, prevented theneed for stakeholders to travel from distant locations and reduced the effect ofdiffering communication skills among key stakeholders. These advantageshave also been identified by Ley and Anderson, 1975; Mitchell, 1991; Bunting,2008; and Linstone and Turoff, 1975. These advantages are importantparticularly for my case study which has the potential bias based on theirrelationships, locations and communication skills among stakeholders.

Focusgroup discussion on this case study which need a face to face meeting will bepredicted to increase the bias among stakeholders.Furthermore, an iterative questionnaire in Delphi can increase the validity ofstakeholders’ responses. The iterative questionnaire (as in Franklin & Hart,2007; Briedenhann & Butts, 2006; Linstone & Turoff, 1975; Ley & Anderson,1975) gives two-fold benefits: 1) minimises misunderstanding betweenresearchers and stakeholders and 2) enhances stakeholders’ understandingof vulnerability and DRM. Since the current responses to DRM in my casestudy related mainly to the immediate response to emergency situations, therewas a pressing need to expand the understanding of stakeholders to includethe mitigation, preparedness, response and recovery stages (Shah AlamKhan, 2008; FEMA, 2006; and Atmanand, 2003).

Delphi analysis is used to strengthen the results of the criteria to evaluate the adaptation strategies. Respondents used are stakeholders who have selected to obtain fixation of the criteria of successful adaptation.

Interview of Delphi can be seen in **appendix B**. The stakeholders involved in Delphi Analysis can be seen at **table 3.4**. This is steps for Delphi Analysis in this research;

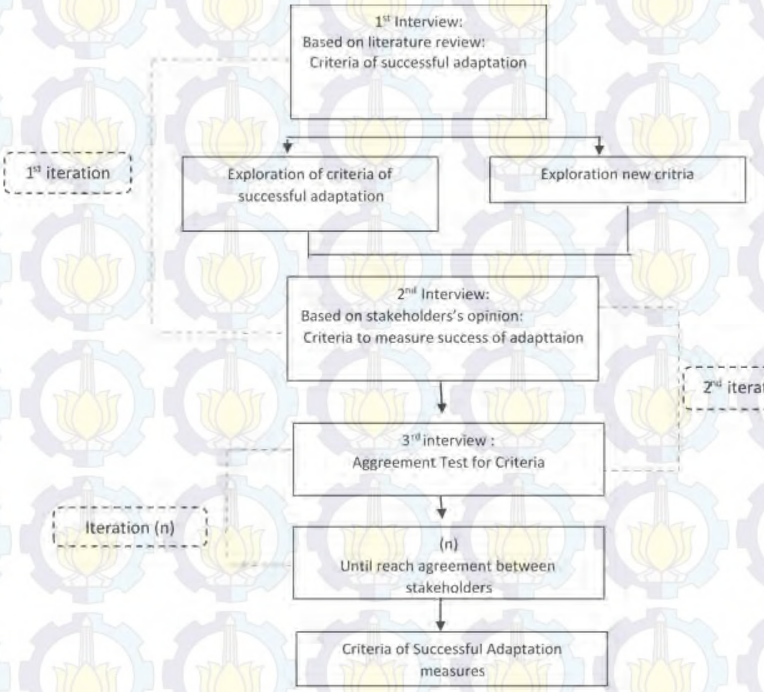

Figure 3.4 Steps in Delphi Analysis in this Study

1. Interview Stakeholders for Exploration Criteria for Evaluating Adaptation Measure. To conducted exploratory Criteria against stakeholders / key informant interviews. Based on objectives, the interview was conducted semi-structured interview technique.
2. Data Reduction and Display Results interview
   After finished with exploration of evaluation criteria by stakeholders, data reduction used to validation evaluation criteria.
3. Iteration Conclusion of Criteria Evaluation for Adaptation Measure
   Iteration is intended to ensure (cross check), whether criteria in accordance with the results of the interview summary meaning given by the respective stakeholders. From the identification of critria based on each stakeholder opinion, and then simplified, or grouped substantially. To other criteria(**see table 3.7**) that have not

mentioned by all stakeholders, will be cross check against the other respondents. So it can be formulated or inferred the criteria for measuring adaptation measures. This Figure below shows steps of Delphi analysis.

In the analysis stage of the Delphi Policy Technique, I used a qualitative approach rather than quantitative. I avoided relying only on quantificationbased analyses such as a Likert scale or tallying. While these methods may have increased the consistency of the analytical process, it may have also weakened its sensitivity to the variety of stakeholders' opinions and backgrounds, as aggregate values derived from a Likert scale do not allow for differing levels of competency among stakeholders. As Delphi is a qualitative based analysis, the competency of different stakeholders had to be valued proportionally.

- **Multi Criteria Analysis and AHP analysis for Evaluation**

Multi-criteria analysis is undertaken to make a comparativeassessment between projects or heterogeneous measures.In the evaluation field, multi-criteria analysis is usually an ex anteevaluation tool, and is particularly used for the examination of theintervention's strategic choices.In ex post evaluations, multi-criteria analysis can contribute to theevaluation of a programme or a policy through the appraisal of itsimpacts with regards to several criteria.In this analysis, stakeholders will be provided questionnaire based on previous analysis. Then, they must fill criteria of evaluation and after that MCA can be conducted to evaluate the selected adaptation strategies. This is the scoring scale to fill the questionnaire. AHP Questionaire can be seen at **Appendix C**.

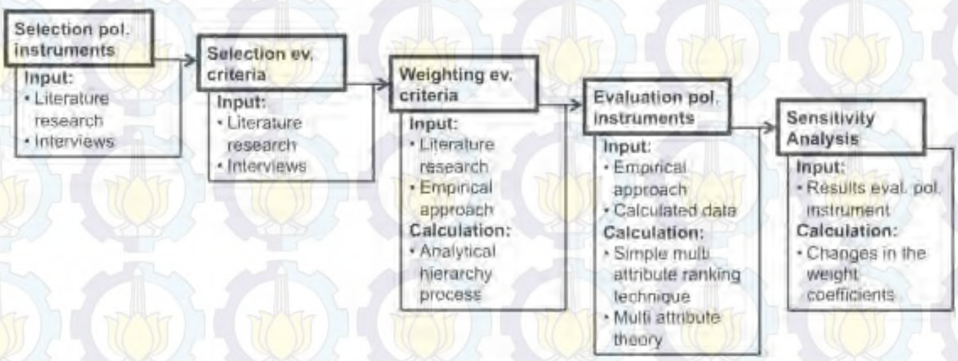

Figure 3.5 Steps in MCA

Level of importance of each criterion in this study was obtained from the interview process by seeking the perception of various stakeholders. Stakeholders were taken here is at the level of decision-making authority - the relevant agencies. The interview process is done by using a questionnaire in which stakeholders are asked to rank criteria - criteria, ranging from the most important criteria to the lowest interest rate. From these interviews, the survey results can be determined weight of each criterion then. The weighting process to get the weight or importance of each criterion is generally done with the following methodology:

- Make pairwise comparison matrix for each respondent to obtain criterion weights of each respondent
- Creating the average weight for all stakeholders.

The data input for MultiCriteria Analysis are Criteria from stakeholders combined with literature review and sub criteria. The value of these criteria os based on stakeholders's perception. So, Chiisen stakeholders gave their opinion to measure criteria. Scoring scale is used to help multi-criteria analysis. The scoring questionnaire can be seen at **Appendix E**. This table below shows criteria and how to measure criteria.

Table 3.9 Criteria for Evaluating in MCA

No	Main Criteria	Sub-Criteria	Value
1.	Effectiveness	Enhancing policy, planning for adaptation measure	Qualitative value 1 : Definitely disagree 2 : Mostly disagree 3 : Neutral 4 : mostly agree 5 : definitely agree
		Legal and regulatory	
		Integration with development policies and planning	
		Institutional mechanism, capacities and structures	
2	Flexibility	Hazards risk	
		Scientific and technical capacities and innovation	
3.	Inequality	Impact data	
		Environmental and natural resources	
		livelihood	
		Culture, attitudes, education	

No	Main Criteria	Sub-Criteria	Value
4.	Efficiency	Financial instruments	
		Cost recovery for adaptation	
5.	sustainability	Public awareness, knowledge, skill	
		Information management and sharing	
		Learning and research	

CHAPTER IV
OVERVIEW OF STUDY AREA, FLOOD RISK, AND ITS VULNERABILITY

4.1 Overview of Surabaya City

Surabaya city is a capital of East Java Province located on foreshore. Its main activities are manufacturing and trading with major air and seaport facilities. Surabaya also plays a role as a centre of development for eastern part of Indonesia.In geographical, the city of Surabaya is located in the south latitude and east longitude between 7°12 'to 7°21' south latitude and 112°36 ' to 127°54' east longitude. The total area of the city of Surabaya is 32 639 hectares which is divided into five regions maid mayor, 28 regions/districts and 163 villages.

In Regional context, Surabaya City plays a role as a center of development in East Java Province. Surabaya and its surrounding regencies formed a greater urban area known as "Gerbang Kertosusila" or GKS, which is an acronym for the regencies (Kabupaten) of Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo and Lamongan.

In the context of GKS, development of Surabaya City is a part of Surabaya Metropolitan Area (KMS), which plays a role as:

- Center of economic activities in East Java, Bali, and other Eastern Indonesia regions, with thepresence of Tanjung Perak Port as its main support.
- Center of regional development in East Java Province
- Urban Center for social-economic activities in "Gerbang Kertosusila" region.

Recent urban development has spread south from Surabaya to Sidoarjo, where both industrial and residential growths have been vigorous. To the west, Gresik is emerging as a major industrial centre as well, with significant residential development to be expected. The study is done in the districst that are located in the Coastal Zone of Surabaya. Coastal subdistrict in Surabaya has an area of 146.24 km².The coastal areas of Surabaya consist11 districts, covering Benowo, Asemrowo, Krembangan, Semampir, Pabean Cantikan, Kenjeran, District Bulak, Sukolilo, Mulyorejo, Rungkut and Gunung Anyar. Here are the administrative boundaries of the study area:

- North : Madura Strait and Madura Island
- East : Madura Strait
- West : Gresik Region
- South : District of Lakarsantri, Tandes, Suko Manunggal, Bubutan, Genteng, Simokerto, Tambaksari, Gubeng, Tenggeilis Mejoyo and Sidoarjo Region.

Then, Districts in Surabaya coastal area have 52,6 km² of the total length of coast. The detail of length of coast follows:

Table 4.1 Length of Surabaya Coastal Area

No	**District**	**Area (km²)**	**Length of Coastal Area (km²)**
1	Benowo	23.73	3.9
2	Asemrowo	15.44	6.2
3	Krembangan	8.34	3.9
4	Pabean Cantikan	6.8	9.8
5	Semampir	8.76	3.4
6	Kenjeran	7.77	3.4
7	Bulak	6.72	7.0
8	Mulyorejo	14.21	2.8
9	Sukolilo	23.68	6.3
10	Rungkut	21.08	4.4
11	Gunung Anyar	9.71	1.5
	Total	146.24	52.6

Source: Department of Agriculture, 2009

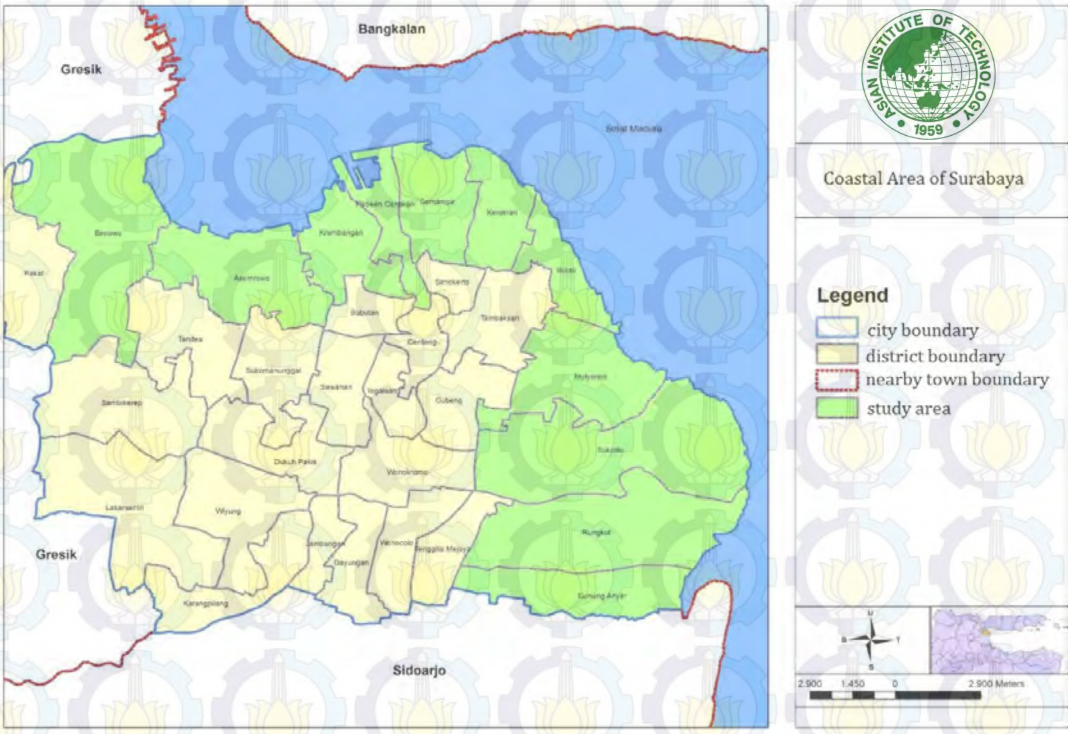

Figure 4.1 Study Area

4.1.1 Topography and Soil Type

Most of the areas in coastal Surabaya are low-lying lands. Topographic conditions in the study area vary in height 0-6 meters above sea level, except in the south with a height of 25-50 meters above sea level. The ground slope range are 0-2% in low-lying areas and 2 -15% sloping hilly areas (Spatial Plan of Surabaya 2009-2013).

The soil type in the study area consists of four types of hydro alluvial, alluvial gray, taupe alluvial and taupe gromosol. Almost the entire area of research has classified the land of fine-grained alluvial type with a depth of more than 0.9 m. Mainland alluvium (alluvial) contains gravel, gravel, clay, and fractions of local fossils. The spread of these rocks are in most towards the coast. This land is relatively impermeable because it produces a low water absorbing power.

From table 4.2, it can be seen that the existing topography in coastal areas are categorized as low / flat. Lowest elevation can be found in some villages and farms as Greges langon (district. Asemrowo), Hamlet Sutorejo (district. Mulyorejo) and Medokan Ayu (Rungkut). In regard to disaster mitigation, some villages which have become a lower elevation to be seen associated with susceptibility to both flooding due to high rainfall and runoff discharge and sea level rise.

Table 4.2 Topography Condition of Surabaya Coastal Area

No	District	Village	Elevation (mdpl)
1	Benowo	Tambak Oso Wilangon	2,28 -6,66
		Roomokalisari	2,29-4,28
2	Asemrowo	Kalianak	2,34 – 3,57
		Genting	3,02 – 4,68
		Asemrowo	2,15 – 4,75
		Greges	1,98 – 3,28
		Tambak Langon	1,99 – 3,03
3	Krembangan	Monokrembangan	2,19 – 7,28
		Perak barat	0,90 – 4,50
4	Pabean Cantikan	Perak Utara	0,90 – 4,52
5	Semampir	Ujung	2,61 – 4,72
6	Kenjeran	Tambakwedi	
		Bulakbanteng	2,49 – 4,30
7	Bulak	Bulak	2,09 – 3,04
		Kompleks Kenjeran	2,57 – 3,23
		Kedungcowek	2,41 – 5,48
		Kenjeran	2,08 – 3,52
		Sukolilo	2,28 – 6,12
8	Mulyorejo	Kejawan Putih	2,51 – 3,75
		Kalisari	2,51 – 4,22
		Dukuh Sutorejo	2,51 – 2,81
9	Sukolilo	Keputih	2,21 – 3,70
10	Rungkut	Medokan Ayu	2,28 – 3.12
		Wonorejo	2,30 – 4,52
11	Gunung Anyar	Gunung Anyar Tambak	2,39 - 3,36

Source : Office of Energy and Mineral Resources East Java, 2009

4.1.2 Total and Population Density

The total of population in Surabaya Coastal Area in year 2012 is 1.082.776 people. From the Figure 4.2 and table 4.2, the most crowded area is Semampir District with the total population is 205.439 people.

Table 4.3Population in Surabaya Coastal Area in 2012

No	District	Population			Area (ha)	Population Density
		Male	Female	Total		
1	Benowo	27.586	27.324	54.910	2373,99	23,12984
2	Asemrowo	23.445	22.177	45.622	1544,1	29,54601
3	Krembangan	65.183	64.420	129.603	834,14	155,3732
4	Pabean Cantikan	46.556	46.056	92.612	679,55	136,2843
5	Semampir	103.414	102.025	205.439	876,75	234.3188
6	Kenjeran	76.722	75.189	151.911	777,01	195,5071

No	District	Population			Area (ha)	Population Density
		Male	Female	Total		
7	Bulak	20.981	20.761	41.742	672,52	62,06804
8	Mulyorejo	43.820	44.303	88.123	1421,28	62,00256
9	Sukolilo	55.700	55.568	111.268	2368,28	46,98262
10	Rungkut	54.048	53.906	107.954	2108,16	51,20769
11	Gunung Anyar	26.880	26.712	53.592	971,96	55,13807
	Total	544.335	538.441	1.082.776		

Source: Office of Population and Civil Registration Surabaya, 2013

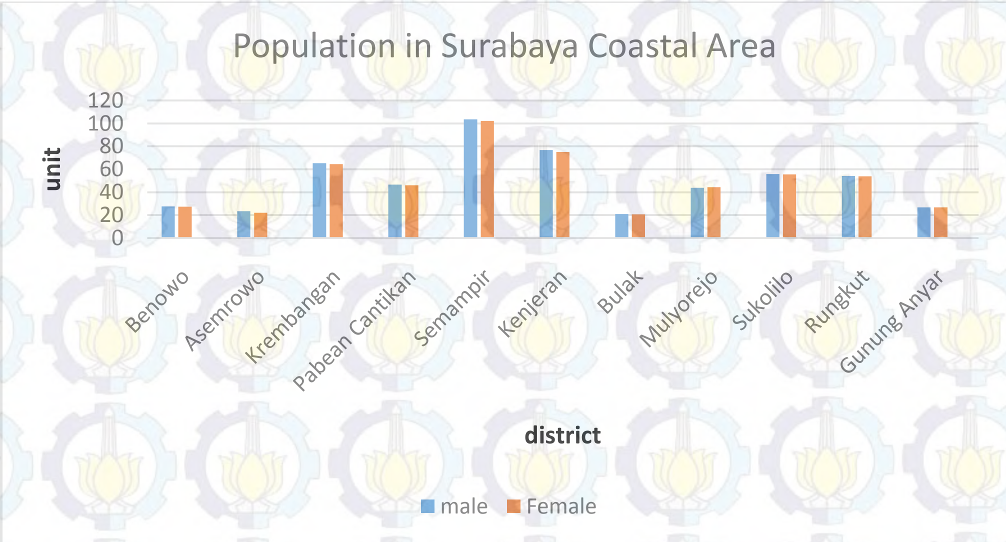

Figure 4.2 Populations in Surabaya Coastal Area

Source: Office of Population and Civil Registration Surabaya, 2013

4.1.3 Land Use

Land use in Surabaya City consists of both urban and rural activities. Urban land use consists of housing, commercial, industrial, offices and public service buildings, while rural activities consists of agricultural fields and fish ponds. The urban area is mainly in the central, southern and northern part of the city, but spreading to newly developing areas to the west and east of the city centre. Build up areas in Surabaya City in 2001 made up 63% of the whole city, while the rest are non-built-up areas such as agricultural, fishery, and vacant land. Fishery is a biggest component of non-built-up areas in Surabaya City.

There is a constant expansion of land in Surabaya City due to sedimentation process in the eastern coast regions and the presence of an island

(Galang Island) in the northern region of Surabaya. This expansion causes the morphologic form of eastern coast of Surabaya City constantly changed.

The majority of land use in Surabaya Coastal Area is water bodies that has area is 106041, 56 ha. Then housing as 47137,96 ha, and industry with the area is 15275,22 ha. From the table above, it can be concluded that the land use in Surabaya Coastal Area is dominated by water body since the main fuction is fisheries and have to rely on pond for their livelihood. Then, land use in Surabaya is used by housing with the total area is 47137, 96 hectare. In this study area, the housing can be divided into 2 types, namely formal settlements and informal settlements.

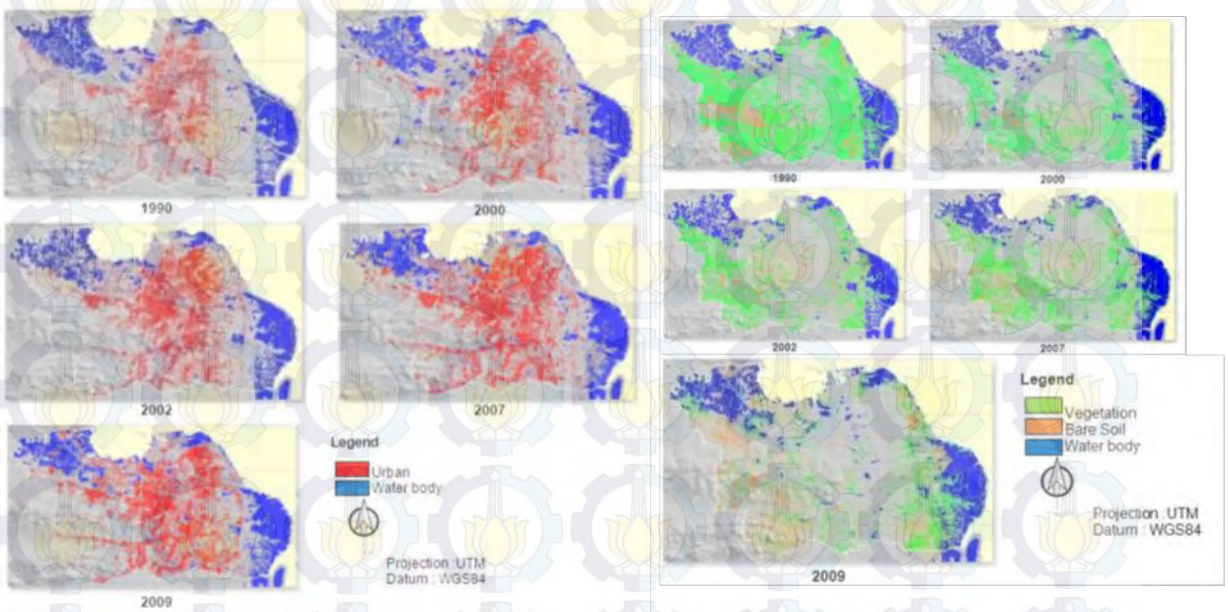

Figure 4.3 Land Use Changes in Surabaya

Table 4.4 Land Use in Surabaya Coastal Area

No	District	Public Facility	Industry	Trade and Service	Housing	Rice field	Pond	Wasteland	Military land	Port
1	Benowo	172,328	1156,18	3,02	2699,18	1114,25	19842,8	1356,38	-	-
2	Asemrowo	145,52	10453,94	174,86	1781,31	129,31	2280,24	389,95	-	-
3	Krembangan	240,24	234,93	618,45	3692,24	47,96	-	1219,02	2677,42	-
4	Pabean Cantikan	155,42	854,99	981,48	1725,85	72,6	-	-	148,47	1830
5	Semampir	22,67	758,67	-	3158,97	-	-	20,72	4536,64	-
6	Kenjeran	-	-	-	4717,74	102,6	557,8	-	-	-
7	Bulak	723,791	301,525	-	2278,58	327,38	50206	77,56	-	-
8	Mulyorejo	1268,7	33,80	375,87	8561,77	42,64	3574,94	1857,2	-	-
9	Sukolilo	1422,45	-	194,66	8018,74	2886,8	14917,8	1460,13	39,72	-
10	Rungkut	322,679	734,53	271,8	7175,12	743,36	11859	1922,17	-	-
11	Gunung Anyar	156,203	746,656	10,9	3328,46	3050,91	2802,56	2,7	-	-
	Total	4630	15275,22	2631,96	47137,96	11437,81	106041,14	8305,83	7402,25	1830

Source: Spatial Plan of Surabaya, 2013

4.1.4 Building Density and Road Conditions

The study area has 211.716 buildings with the building dnsity of 205,06 buildings/ha. The highest number of buildings is in districts Semampir which has 32 629 units and the lowest number of buildings is located in the District Bulak which the number is 7456 units. Then the highest density building is in the District are Semampir with the density is 37.22 units / ha and the lowest is in districts Benowo which has density building as 4.10 units / ha. The building density of Surabaya Coastal Area is showed at table below.

Table 4.5 Building Density in Coastal Area of Surabaya

No	District	Area	Total building	Building Density
1	Benowo	2373,99	10981	4,10
2	Asemrowo	1544,1	11319	7,33
3	Krembangan	834,14	27315	32,75
4	Pabean Cantikan	679,55	19515	28,72
5	Semampir	876,75	32629	37,22
6	Kenjeran	777,01	27513	36,01
7	Bulak	672,52	7456	11,00
8	Mulyorejo	1421,28	19698	13,86
9	Sukolilo	2368,28	18231	7,7
10	Rungkut	2108,16	24013	11,39
11	Gunung Anyar	971,96	13046	14,98
	Total	14627,74	211716	205,06

Source: City Planning Agency, 2010

However, the total of length road in Surabaya coastal area is 496,634 meter with the longest road is in Rungkut district which has length about 104.759 meter and the shortest road is in Asemrowo District which has 12.764 meter. Table below shows the length of road in Surabaya Coastal Area.

Table 4.6 Length of Road in Study Area

No	District	Road Length	Percentage of damaged road
1	Benowo	15.969	48,80%
2	Asemrowo	12.764	62,10%

No	District	Road Length	Percentage of damaged road
3	Krembangan	46.843	44,40%
4	Pabean Cantikan	31.955	30,48%
5	Semampir	27.284	31,65%
6	Kenjeran	30.717	38,15%
7	Bulak	16.567	43,46%
8	Mulyorejo	74.166	4,92%
9	Sukolilo	88.794	37,01%
10	Rungkut	104.759	1,70%
11	Gunung Anyar	46.816	32,30%
	Total	496,634	

Source: Ministry of Public Works, 2010

Figure 4.4 Building Densities in Monokrembangan District

4.1.5 Oceanography

4.1.5.1 Wind

Wind characteristics in the study area is influenced by the West and East monsoon season. Based on wind data obtained from the Port of Tanjung Perak Surabaya by BMKG, the wind in the region in November of the dominant wind direction is from the west then turns east in December to March and changed from the east in April. Then from May to October at the Port of Tanjung Perak wind direction is from the east.

4.1.5.2 Tidal

The study area consists coastal area and low-lying area effected by sea levek rise. Based on Meteorological and Geophysics Agency in Tanjung Perak

(BMKG), the tide condition in coastal area of Surabaya is devided by two zonings/sections that are northern section and eastern section. The zoning/section is based on the maximum height of the tides.

A. The tidal in Northern Section

Districts included in the northern section are Benowo, Asemrowo, Krembangan, Pabean Cantikan and Semampir District. The zone of northern tidal is lower than those of east coast in Surabaya. That is because the northern coastal zone of Surabaya is close to the island of Madura, which is indirectly reducing the height of sea waves. The maximum pairs in this region are only 150 cm of sea level on average. The cause of the low high tide in the north zone of the coastal Surabaya Madura Island in addition to the well caused due to a bottle neck region between the islands of Java and Madura islands resulting in waves and ocean currents of the open sea not to fully enter into the northern coastal zone of Surabaya. Based on data from the Meteorological and Geophysics Agency in Tanjung Perak (BMKG), high tidal began to commemorate the mainland or cause flooding due to sea level rise at a height ranging from 100 cm.

Table 4.7 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Northern Section)

No	Month	2007		2008		2009		2010	
		Min	max	min	max	min	max	min	max
1	January	40	130	40	120	50	130	50	130
2	February	50	120	60	120	60	120	60	110
3	March	70	100	60	100	50	110	50	100
4	April	50	110	60	110	50	120	40	130
5	May	40	130	50	120	50	140	40	130
6	June	50	130	50	130	40	140	60	140
7	July	50	130	40	130	40	130	40	130
8	August	50	110	50	120	60	110	60	120
9	September	70	100	70	100	50	90	60	100
10	October	50	120	60	110	50	110	50	120
11	November	50	130	60	130	40	130	50	130

No	Month	2007		2008		2009		2010	
		Min	**max**	**min**	**max**	**min**	**max**	**min**	**max**
12	December	50	140	50	140	50	140	40	130

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

B. The Tidal in Eastern Section

District that includes the eastern zone are Kenjeran districts, District Bulak, District Mulyorejo, District Sukolilo, the District and the District of Mount Newer Rungkut. Water tidal conditions in the eastern coastal zone of Surabaya are higher than in the northern coastal zone of Surabaya. Due to the location of the coastal zone, east of Surabaya is directly opposite to the open sea, the tide level of maximum height in this zone is 170 cm of sea level on average. Based on data from the Maritime BMG tide Tanjung Perak, coastal zone of the north began to inundate the land or cause flooding due to sea level rise on tidal height from 120 above sea level.

Table 4.8 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Eastern Section)

No	Month	2007		2008		2009		2010	
		min	**max**	**min**	**max**	**min**	**max**	**min**	**max**
1	January	50	150	60	150	60	160	60	150
2	February	60	130	70	130	60	140	80	130
3	March	70	130	80	120	60	130	60	130
4	April	60	150	60	140	60	150	60	140
5	May	60	160	50	160	70	160	60	150
6	June	60	160	60	160	80	160	50	160
7	July	50	150	60	160	80	170	40	150
8	August	60	130	60	160	70	150	60	140
9	September	70	130	60	120	80	130	70	120
10	October	70	150	60	160	80	150	70	140
11	November	60	160	60	160	70	170	70	150
12	December	60	160	60	160	80	170	80	160

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

Table 4.8 Maximum and Minimum Tidal in Surabaya Coastal Area in Centimeters (Eastern Section)

No	Month	2007		2008		2009		2010	
		min	max	min	max	min	max	min	max
1	January	50	150	60	150	60	160	60	150
2	February	60	130	70	130	60	140	80	130
3	March	70	130	80	120	60	130	60	130
4	April	60	150	60	140	60	150	60	140
5	May	60	160	50	160	70	160	60	150
6	June	60	160	60	160	80	160	50	160
7	July	50	150	60	160	80	170	40	150
8	August	60	130	60	160	70	150	60	140
9	September	70	130	60	120	80	130	70	120
10	October	70	150	60	160	80	150	70	140
11	November	60	160	60	160	70	170	70	150
12	December	60	160	60	160	80	170	80	160

Source: Meteorological and Geophysics Agency in Tanjung Perak (BMKG)

4.2 Climate Change Condition in Surabaya

4.2.1 Sea Level Rise

The rate of sea level rise is obtained based on the analysis of data from multi-mission satellite altimetry the Topex / Poseidon, Jason-1 and Jason-2 over a period of 19 years ie October 1992 to September 2011 the trend of sea level rise per year in the waters of Surabaya and surrounding areas generally ranged from 5.4 to 5.8 mm / year (AVISO, 2012).

Based on data from satellite altimetry, sea level rise (years 1992-2011) in the city of Surabaya is increasing about of 5.69 mm / year. While research has been conducted by Abdurrahchim (2002) that in the benchmark calculations using observations on the ground that the rate of sea level rise in the city of Surabaya is equal to 5.47 mm / year. So that there is little difference about 0.22 mm between the two calculations. This difference is relatively small.

Karsidi (2011) mentioned that the results of monitoring of sea level rise from satellite altimetry published by the French AVISO shows a consistency with the data of sea level rise from the observation station network operated by the National Tidal Bakosurtanal. Differences that may occur can be attributed to differences in methods of calculation of observation.

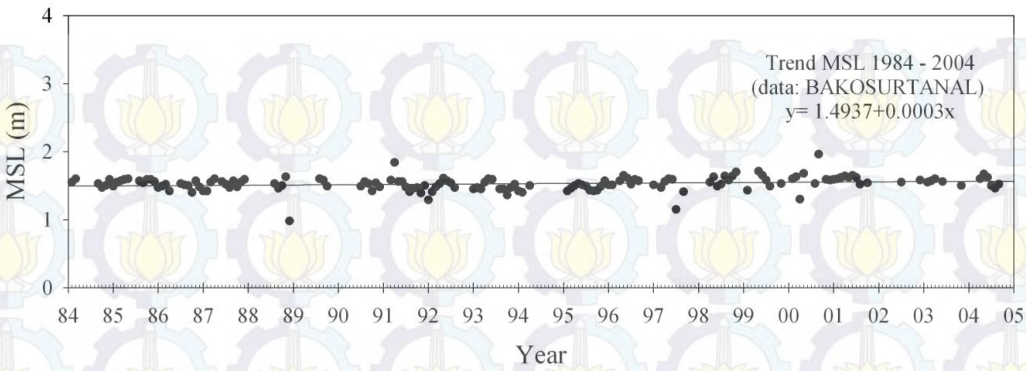

Figure 4.5 MSL Trend Year : 1984-2004

Source: Budiarto, 2011

4.2.2 Climatology Condition

4.2.2.1 Climate

As cities in the tropics, Surabaya has two distinct seasons: the rainy season and dry season. The rainy season usually starts from November to April and the dry season from July to October, while the May-June and October-November is a transition month of season changes.

Based on data from the Environment Agency, the climate in the study area is affected by a significant difference between wet and dry seasons. The rainy season lasts from November to April and the dry season lasts between May and October. Increase in high rainfall during the period of November to February, is caused by summer wind from North. The winds from the southeast bring colder air from Australia during the dry season. The average monthly temperatures are between 21°C in August to reach 34°C in April. In the rainy season the average humidity is 80% per month, while in the dry season down to 60%. The average annual rainfall at Tanjung Perak Rain Station of the year 1955 - 1998 is 1560 mm, average of 90% occurs during the rainy season. The highest monthly rainfall occurs in January, which is more than 300 mm, while the lowest 23 mm in August (Spatial Plan of Surabaya, 2013).

From the readings of precipitation at 10 stations managed by Meteorology and Geophysics Agency and the Department of Public Works-Water Resources Brantas Surabaya showed that maximum rainfall occurring during 1980-1990 are as follows:

Table 4.9 Maximum Rainfall 1980-1990

year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
avarage (mm)	105.37	97.47	101.61	107.90	109.80	97.74	90.70	89.30	101.38	79.40

Source: Department of Public Works-Water Resources Surabaya

4.2.3 Shorelines Changing

In a vulnerability analysis conducted by Sulma (2012), how quickly a part of the coastline has suffered abrasion (erosion) or accretion (addition) can be used as indicators of the vulnerability of the region where the region that experienced the most rapid abrasion will increase the level of vulnerability to sea level rise.

Table 4.10 Tidal Range and Shifts the Coastline Due To Differences in Tidal

No	Sampling Time		Tidal Height (m)	the shifting shoreline in Slope 0,2° (m)
	Date	Time		
1	05 October 1979	08:47 am	2,0	172
2	28 March 1989	09:08 am	1,7	86
3	17 August 2000	09:26 am	2,0	172
4	01 September 2011	09:29	1,5	-

Source: Sulma, 2012

Based on the analysis of shoreline change over a period of 32 years (1979-2011), it is known that the areas experiencing the greatest change in the form of accretion or advanced is the beach in the coastal village Kalisari, District Mulyorejo, Surabaya with shoreline change rate of 38.9 m / years. Other regions are also experiencing fairly rapid accretion is in the Village Keputih, Surabaya (estuary Keputih).

4.3 Flood Situation and Flood Vulnerbility in Surabaya Coastal Area

Major factors in the increase in severity of flooding in Surabaya are land development and increased urbanization. In addition, sea level rise has contributed to flood but it is not significantly contributed. However, the impact of proposed developments on drainage and flooding is not considered when building permits are issued. Developers are not required to provide adequate drainage for their developments or to bear the costs of improvements to the primary and secondary drainage systems which their development necessitates.

According to Surabaya Drainage Master plan Report (SDMP, 2000), due to an unusually heavy flood caused by La Nina, a detailed survey of flooding was carried out during the end of the 1998/99 wet season. Flooding caused by intense rainfall has been identified in 148 separate areas throughout Surabaya. The results of the survey showed that area affected by flooding in Surabaya City is up to 14.5% of the total area. Built-up areas include housing, commerce, industry, public facilities, roads etc. Within Surabaya city that were affected by 1999 flood is 15,826 ha or 22.7% of the total built-up areas in Surabaya City.

Flooding due to sea level rise has potentially effect on districts located in coastal area; those are Benowo, Asemrowo, Krembangan, Pabean Cantikan, Semampir, Kenjeran, Bulak, Mulyorejo, Sukolilo, Rungkut dan Gunung Anyar. The flood always occurs between first date of month and 20th every month but the height of tidal is affected by the position of the earth, moon and sun. If the tide along with high rainfall, it will increase the height of the flooding in the region. Flooding due to sea level rise in the coastal area of Surabaya has a height of between 0 - 1.5 m. Flood elevation in each region is determined by the height of the topography in the region due in accordance with the nature of the water that flows from high places to the lower place. In the study area, in one day occurred one time and one time ebb tide (BMKG Maritime Tanjung Perak 2011).

Table4.11 Flood Risk in Several Areas

No	Location	inundation heights	Source	Date
1.	400 houses and school in Krembangan districts	± 90 cm	Media Indonesia	27 May 2009
2.	Kalianak Road, Perak Port	± 1 meter	BMKG Maritim Perak	20 Feb 2010
3.	Villages and school in West Perak Sub District	± 30 cm	Media Indonesia	15 July 2010
4.	Housing in Krembangan District	± 60 cm	Television news	21 December 2010

No	Location	inundation heights	Source	Date
5.	Kalianak Road and Margomulyo Road	± 30 cm	Berita Jawa Timur	31 January 2011
6.	Bulak District and Krembangan District	± 30 cm	Immadudina	March 2011 and April 2011

Source: compilation of several resources, 2014

Source: compilation of several resources, 2014

Figure 4.6 Flood due to Sea Level Rise in North Coastal Area of Surabaya

Ascommunity's perception, the flood due to sea level rise, how the floods occur; on how high stagnation and duration of flood; and the impact of the flood are identified. These are the things that become the basis of community in assessing the risk of flood over their lives. In this case, people assume that flooding occurs as a common natural phenomenon (interview results, 2014).

According to their knowledge, the flood tide of sea water is the result of the interaction of waves and wind. They understand that the flooding would be even greater, when the waves during high tide driven by big wind. As a result, sea water flows to the land getting bigger and bigger, and stagnation becomes increasingly high. Although the time of stagnation and high of tidal can not be known with certainty by the community, there are some people who take advantage of the data from the port, to see the ocean tide height predictions for the anticipation of flooding. However there is also figure the heigh of tidal from Javanese calendar calculation, because it feels easy to understand, and they do not need to search for information to the port.

They no longer feel the flood due to sea level rise as one of the threats, but they considered it as matter limitations they face everyday. Although people think of flooding as a natural phenomenon and become part of the natural process that occurs due to the tide, but people feel the change of height of inundation. Based on interviews and field observations, as well as data from flooding due to sea level rise that occurred in the five villages have the following impacts:

1. In residential areas
   - Damage to the home such as walls, doors, and windows
   - Damage to household furnishings and transportation
   - Damage to the environment
   - The emergence of long puddle in the road environment and drainage
   - Trash were spread on homes that do not have sanitation
   - Itching disease and diarrhea due to polluted environment

2. In the Area of Ponds

Loss of fisherman because crop failure. It happen because of the loss of fish or shrimp when the flood came in and the level of water reaches the limit of pond dikes. Based on interviews, losses can reach 50% to 90%.

Then, based on Immadudina (2011), the process of determining the zone level analysis of flood vulnerability due to sea level rise in the coastal area of Surabaya taking a combination of four aspects, namely environmental, physical aspects, social aspects. To determine the level of vulnerability in the study area, there is map obtained from spatial patterns of vulnerability as a result of floods sea level rise based on the influence of environmental aspects, physical aspects, social aspects and economic aspects in the Coastal Zone of Surabaya. The highest levels of vulnerability are Krembangan Districts, pabean Cantikan Districts, and Kenjeran District, respectlively.

Coastal Area Surabaya proportion of potentially dangerous zone flooding due to sea level rise to the classification of very high danger zone has an area of 4889 acres, with extensive proporasi 33.4% of the total study area. While the zones with high hazard classification on the study region have an area of 2346 acres with a proportion of 16% of the total land area of research.

4.4 Overview of Disaster Risk Management in Indonesia in term of Adaptation Measures

Indonesian Disaster Risk Management, established in 1966. In 1979 it was revised by Presidential Decree No. 28 and renamed the National Coordination Board for Natural Disaster Management. In 1990 the need to include human-made disasters as subject matter for Indonesian DRM prompted changes to the board based on Presidential Decree No. 43. With those changes, the board changed its name to the National Coordination Board for Disaster Management. Further changes to the form of the DRM Board in Indonesia have occurred since then. In 2001, the board changed name again to the National Coordinating Board for Disaster Management and Internal Displaced People (Badan Koordinasi Nasional Penanggulangan Bencana dan Penanganan Pengungsi). This new board was based on Presidential Decree No. 3. It sat under the Ministry of Social Welfare.

Changes were again made in response to the extraordinary scale of the impact of the 2004 Aceh Tsunami. These changes were based on the ratification of the Government Rule No. 83 in 2005. The board was renamed the National Coordinating Board for Disaster Management (Badan Koordinasi Nasional Penanggulangan Bencana).

Even though there were changes to the form of DRM organisation in Indonesia from 1966 to 2005, the core characteristics of past management patterns were reactive actions from government in response to a disaster. A variety of different types of government organisations had similar functions in that they reactively coordinated other ministries or other government agencies in responding to disaster events.

They were ad hoc governmental agencies for handling disasters. The ad hoc nature meant that the agency had a role only in supporting other government agencies for particular events. This arrangement at the national level also became the pattern at the local levels (both provincial and municipal). Therefore, the coordination placed a greater focus on the emergency response rather than an integrated approach to disaster management.

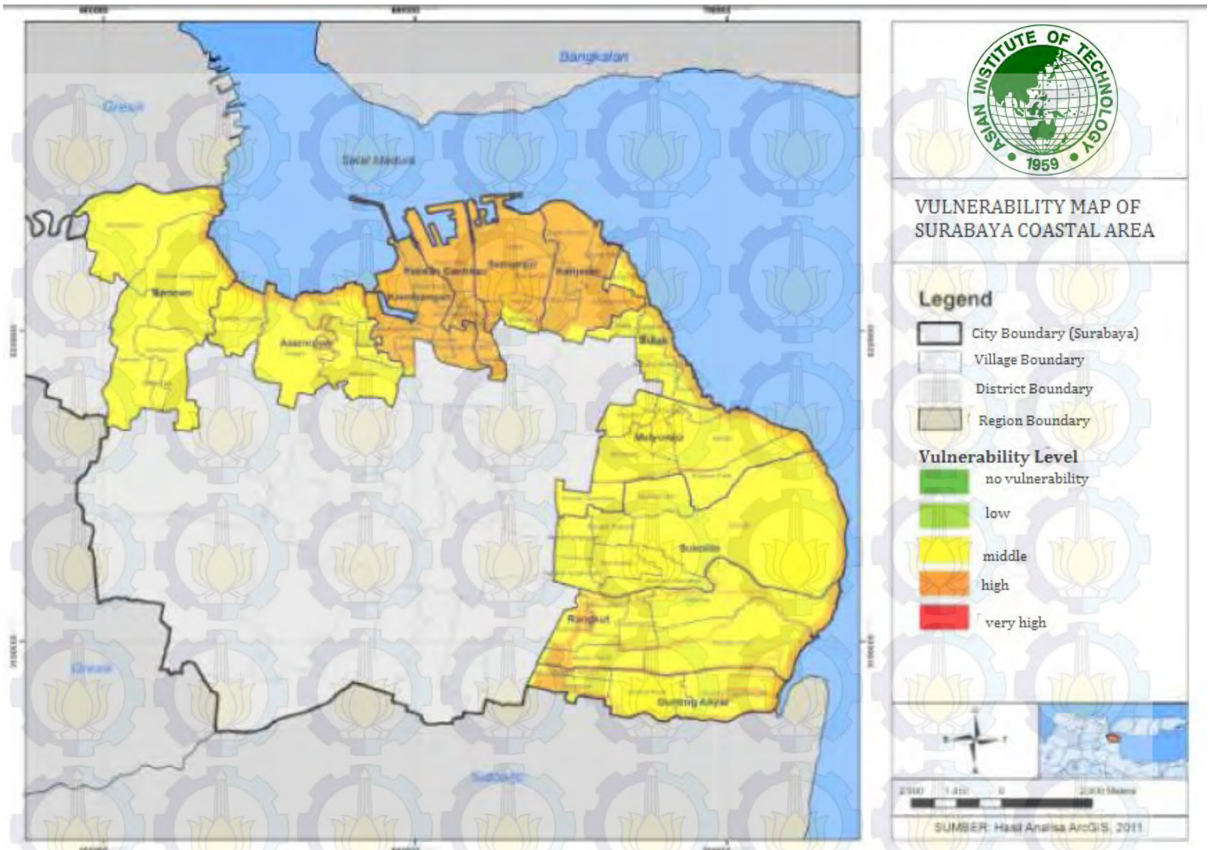

Figure 4.7 Vulnerability Map

Source: Immadudina (2011)

At the provincial level, in relation to Act No. 24 on Disaster Management in 2007, East Java Province had already established a Regional DisasterManagement Board (BPBD). The board is directly under the provincial governor of East Java Province. The existence of the board indicates that the provincial government has specific interests and concerns for DRM.

4.5 Summary of Findings

Major factors in the increase in severity of flooding in Surabaya are land development and increased urbanization. In addition, sea level rise has contributed to flood but it is not significantly contributed. As community's perception about flooding, how the floods occur; on how high stagnation and duration of flood; and the impact of the flood are identified. These are the things that become the basis of community in assessing the risk of flood over their lives. In this case, people assume that flooding occurs as a common natural phenomenon.

Although people think of flooding as a natural phenomenon and become part of the natural process that occurs due to the tide, but people feel the change of height of inundation. Then, the impacts of flooding in that area are :

- Damage to the home such as walls, doors, and windows
- Damage to household furnishings and transportation
- Damage to the environment
- The emergence of long puddle in the road environment and drainage
- Trash were spread on homes that do not have sanitation
- Itching disease and diarrhea due to polluted environment
- Loss of fisherman due to crop failure.

CHAPTER V
EVALUATING ADAPTATION MEASURES

Based on a synthesis of the literature on urban development in Surabaya, it broadly divided into 2 based programs implementing the program, the Government and non Government. On the side of government are the Village, the Central Government and other governments, non-government while such NGO. This identification serves to determine the public's perception of the program handling the problem of flooding, whether existing programs have helped to reduce the risk of flooding, or otherwise does not reduce the risk of flooding. According to document reviews of Coastal Zone Planning, General Spatial Plan, Detailed City Spatial Plan, and respondent's interview, the current adaptations has been identified.

5. 1 Past and On-Going Adaptation Measures Related To Urban Development

In Indonesia, disaster risk management including adaptation and mitigation has become a major concern, particularly after the Boxing Day 2004 Tsunami in Aceh Province. The substantial impacts of the tsunami prove that risk management was lacking. In response, national level regulations have been ratified such as the National Act 24/2007 on Disaster Management, the National Action Plan on Disaster Risk Reduction 2006-2009, and others. The purpose of the new regulations (ratified in 2008) is to develop clear requirements as to how disaster risk reduction should be delivered by both governmental and non-governmental organizations. Government Regulation No. 8 and 21 from 2008 describes the roles and responsibilities at the national board level for organizing disaster management. Other government regulations are in 2008 (no. 22 and 23) outline funding and other support systems, and the involvement of international organizations and NGOs.

Indonesia is also facing a new direction in its planning system due to the recent ratification of two major acts of parliament, namely the Planning Act no.

26/2007 and the Small Islands and Coastal Management Act no. 27/2007. Both of these Acts recognize disaster events as one of the most important issues requiring management. . According to document reviews of Coastal Zone Planning, General Spatial Plan, Detailed City Spatial Plan, and respondent's interview, the current adaptations has been identified as follows:

A. Build Long Storage and box culvert in coastal area

According to interview with governments, it can be known that Surabaya City Government is doing various projects for flood prevention and flood control. The famous projects are build long storage and box culvert in Surabaya coastal area such as Ahmad Yani Street, Rungkut Street. Based on interview with Myrna, Planning Staff in Town City Planning Agency, that project used more than 1,15 billion Rupiah. This long storage will launch from the water flow towards Kalimir Ketintang Road area, continues to Jagir, until finally into the sea. Thus, the presence of a variety of efforts to control and flood control in the city, undoubtedly puddles in the city of Surabaya will be reduced. According to the Spatial Plan City of East Coast development of new long storage will be implemented along the eastern side of the north east coast. Then for channel maintenance program will be implemented in Kali Kepiting, Kali Dami, Bokor Kali, Kali Wonorejo, and Kali Kenjeran.

B. Mangrove Conservation Area (Soft Protection)

One of adaptation strategy conducted by the government of Surabaya in East of Coastal Zone is the conservation of mangroves to cope with flooding due to sea level rise. Location mangrove is in around the village with different conditions. The mangroves are also on the outskirts of the pond as well as following sometimes small streams in the area of aquaculture. Locations of mangrove are also in along the Kali Wonokromo with different thicknesses.

Mangroves in the study area can be seen along of coastal area in Surabaya. The mangrove consist many species: Avicennia sp., Rhizophora sp, Sonneratia sp, and Bruguiera sp, Nypha sp, Hibiscus tiliaceus, Ficus sp. Based on data which got from Ecoton in 2002, the mangrove area in Surabaya coastal area is 3200 hectare. But, because of many activities around mangrove area so in 2008, its area is decreasing becoming 1180 ha.

Mangrove forest with the high density distribute near the sea in coastal area while the spread of mangroves in the area of aquaculture have lower density. The following table will explain the distribution of mangrove forest area.

Table 5.1 Mangrove Area in Surabaya Coastal Area

No.	Villages	Area of Mangrove (Ha)
I.	Mulyorejo Districts	
	Dukuh Sutorejo Village	1,81
	Kalisari Village	71,95
	Kejawan Putih Tambak Village	40,71
	Total Mulyorejo District	114,47
II.	Sukolilo District	
	Keputih Village	146,71
	Total Sukolilo District	146,71
III.	Rungkut District	
	Wonorejo Village	7,88
	Medokan Ayu Village	55,79
	Total Rungkut District	63,67
IV.	Gunung Anyar District	
	Gunung Anyar Tambak	20,21
	Total District Gunung Anyar	20,21
Total		345,06

Source : Town City Planning Agency and Citra Landsat, 2011

Mangrove forest area located along the coast of the east coast when conditions are dwindling with the development or manufacture of new coastal land around the pond, so the presence of mangroves are increasingly threatened, needed socialization to the community fish farmers to know where the boundaries are defined as the area of pond area or areas designated as protected areas for the development of mangrove protected area.


Figure 5.1 Mangrove condition in Surabaya Coastal Area


Figure 5.2 Mangrove Conditions and Open Area for Ponds

The Surabaya government had discussion with public about the conversion of mangrove to pond and public told them their inspiration. Recommendations or suggestions from the public related to the problems above include :

a. Rezoning of protected areas and mangrove protected area boundaries.
b. Development of residential areas will be restricted territory in accordance with the limits of protected areas so that the direction of development of residential areas not led to the conversion of land from the fishery ponds function towards the settlement function.
c. Enhance Soft Skill, Entrepreneurship, and Preparedness for Local People

The government has done a fishing community empowerment with the framework of Community-Based Fishing System Management. Government programs that have been conducted have not been getting the maximum results due to the lack of community involvement in the development process. The development process consists of planning, implementation, monitoring, and evaluation. This development approach for using a top-down approach has shifted into a bottom-up approach. In community development, bottom-up approach is the starting point. The community is involved from an early age, ranging from planning, implementation, and monitoring and evaluation program to be implemented. In the Community-Based Fishing System management, the community has given skill to improve their fishing skill and make added-value with their products. It can help them to be creative and face the flood risk if flood come, their livelihood can be saved.

In addition, disaster response training conducted by BPBD (Regional Disaster Management Agency). Community gathered to get emergency response training for disaster. Then, a risk map also disseminated to the public. Department of Education in collaboration BPBD designs a program with the theme of Disaster Management School. BPBD through of Emergency and Logistics put together a program that involves elements of structured education to disseminate disaster. In this activity, the participants were given a view of the concept of the program to the students in their respective areas. Activities conducted at Hotel Utami, Sidoarjo is also invited steering committee BPBDs E, ITS Centre for Disaster Studies, Surabaya University and Education Department officials in East Java.

C. Flushing or Clean the river and Built Bosom

Surabaya city government and local people jointly make efforts to prevent flooding, the start of building a culvert and ditch cleaning water in the villages. Not only that, Surabaya City Government is also making a mini bozem or rainwater catchment reservoirs. Now there are nine mini bozem built and operated which are in Dukuh Kupang Timur, Bundaran Satelit, Dukuh Kupang Barat, and Darmo Permai.

Figure 5.3 Flushing the River before (Left) and After (Right) in Greges Krembangan River

City Government also has six bozem ready to accommodate large size and infiltration of rainfall, which Bozem Morokrembangan with an area of 79.5 hectares, Kedurus with 37 hectares, Bratang with an area of 1.4 hectares, Kali Dami with an area of 2.7 hectares, Jurang Kuping with area of 3.7 hectares and Wonorejo with an area of8.5 hectares Wonorejo. Head of City Development Planning Agency (Bappeko) Surabaya Hendro Gunawan said that to minimize flooding, the local government also makes infiltration wells and build water channels and culverts. He said the construction of culverts at 21 locations there is also completed, of which at Sidotopo Wetan Street, Sukolilo, Kenjeran, Dukuh Kupang XX, and Saluran Balongsari Makam. For rehabilitation of clogged channels also conducted in 22 locations of which are in Pegirian, Medokan Ayu Downstream, Greges, Tanjungsari, Simorejo and Nambangan. There is also a water channel dredging in the channel, 12 of them is in line at Indragiri Road, Dr. Sutomo, Rungkut, Indragiri, Sriwijaya Street, and in some other places.

5. 2 Past and On-going Adaptation Measures based on Key Informants in Surabaya Coastal Area

The process of perception and attitude of the people to stand the coastal flood is the start for the adaptation to deal with the pressure of the impact of the coastal flood. In addition, adaptations which happen in study area is not only making modification to their shelter but also water supply and waste management, the community is also responding to the tidal flood take to protect themselves and their families.

The response is community's reaction when flood occurred. Actions from community are displaced or moved and or stay at home when the flood happen. However, the community response was also influenced by the condition of their home (old) that reflects society occupying and living in the area. Adaptation to flood risk is an adaptive strategy that is conducted and applied the changes people for life in a social environment. Adaptations which have done by the community in that area are following:

A. Restoration and Protect River and Canal

River and canal restoration in villages (kampoeng) is an initiative from head of communitie for their communities to clean the river and canal near their house for preventing the flood. This event is done by all of communities in the study area. Based on interview with Head of Krembangan, then, in Asemrowo and Medayu Utara, the communities joined together to cleaning the canal and culverts around their houses. Citizen participation was well received and award from Surabaya city government for its initiatives to help face flooding because without public support, it would be difficult to handle.

Figure 5.4 Artificial Ponds in Krembangan District

Aspirations of the people which ask for new canal are followed. The advocacy to people for not throw garbage also aggressively implemented because the main cause of the breakdown of the channel so that the flood happen. For this achievement, Head of Krembangan District said, Surabaya is one example of a city where the meeting of political will and citizen participation has been successful in reducing flooding problems are often considered as impossible to overcome the city.

B. Adaptation Done at Commity's Housing

Adaptation in the community performed by making embankments, elevate the house and roof, raised floor, making the water channel around the house. The conditions for the people are considered a routine event and how to overcome them waiting for the puddle recede by itself. The most common action done on their home is a raised floor for those who can afford so that the floor is higher than the road, or they make a small embankment in front of their homes. Elevating the foundation of the house by each individual or create a dike on the front porch that can impede water into the house. This is done in accordance with the financial capability of each individual or household.

They also modify their houses from 2 to 4 floors. They were conscious of adding "space" vertically to avoid flooding. This is evidenced also by the placement of items such as televisions, refrigerators, coffee table, and other valuables placed at a higher level.

Figure 5.5 Small Embankments which is built in Front of House

In addition, in Krembangan where always routinely flooded 30 cm every month because of sea level rise also made small embankment. The most common action done on their home is a raised floor for those who can afford so that the floor is higher than the home environment, or they make a small embankment in front of their homes or on the front of the terrace.

C. Adaptation Done at Community's Pond

Adaptation to the ponds is done to reduce the impact and costs of coastal floods done by creating dikes, installing nets or waring around the ponds, elevation dikes, drainage ponds and pools liaison between planting and care mangroves around the coast and ponds. Planting mangroves also serve to reduce the impact of tidal flooding such as land loss and coastal erosion.

Make dike of bamboo filled by land along the edge of the road that limit coastal areas with embankments breached the settlement area. This activity is a non-governmental activities performed by involving some communities. Making artificial embankment of bamboo at the mouth of a canal to hold the sand in order not to fall and hold the sand of the sea into the channel when the flood tide came.

Figure 5.6 artificial embankment of bamboo

Based on explanation above, it can be concluded that current adaptation which is happen in study area following

1. Build Long Storage and box culvert in coastal area
2. Mangrove Conservation Area

3. Enhance Soft Skill of Community (preparedness and entrepeneurship)
4. Restoration and Protect River and Canal
5. Modify Floor (Adding number of Floor)
6. Built Small Embankment in front House
7. Elevate the House
8. Making artificial embankment of bamboo in pond
9. Maintenancemangrove in ponds

5. 3 Selected Adaptation Measures for Evaluation

After identified on-going and past adaptation measure in section 5.1 and 5.2, the selected adaptation measures has been done by scoring analysis. Stakeholders involved scoring adaptation strategies are Town Planning Agency, City Department of Spatial Planning, Regional Disaster Management Agencies, and Agency for Environmental Management (BLH), and Head of Districts from three districts (Krembangan, Pabean Cantikan, and Kenjeran). The result of scoring can be shown on the table below

Table 5.2 Scoring Results from Stakeholders.

No	Adaptation Measure	S1	S2	S3	S4	S5	S6	S7	Results
1.	Build Long Storage and box culvert in coastal area	3	1	6	6	9	9	4	38
2.	Mangrove Conservation Area	2	2	1	1	3	1	1	11
3.	Enhance Soft Skill of Community (preparedness and entrepeneurship)	1	6	3	2	4	3	3	22
4.	Restoration and Protect River and Canal	8	3	7	7	7	7	8	37
5.	Modify Floor (Adding number of Floor)	5	7	5	4	6	8	9	44
6.	Built Small Embankment in front House	6	8	4	8	5	6	7	44
7.	Eletave the House	4	4	2	3	1	2	2	18
8.	Making artificial embankment of	9	5	9	9	8	5	6	51

No	Adaptation Measure	S1	S2	S3	S4	S5	S6	S7	Results
	bamboo in pond								
9.	Maintenance mangrove in pond	7	9	8	5	2	4	5	40

Source: Analysis Result (2014)

Note:

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies

S4 : Agency for Environmental Management

S5 : Head of Krembangan

S6 : Head of Pabean Catikan

S7 : Head of Kenjeran

According to stakeholder's perception above, the first, second and third priorities are mangrove conservation area, elevate floor's housing, and enhance soft skill of community, respectively. This three adaptation measures will be evaluated in the next section of this chapter.

5.4 Evaluation Process of Adaptation Measures

Criteria from literature review (**chapter 2**) need to be crosschecked to stakeholders to get the appropriate criteria for evaluation. Before distributed to stakeholders, the criteria has been explored to get sub-criteria by descriptive analysis from literature review. Then, the stakeholders would check the cub-criteria to get evaluation sub-criteria. Here is each criterion and its explanation.

Table 5.3 Exploration of Evaluation Criteria

Measure	Description	Sub-Criteria
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptivecapacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively	• Enhancing policy, planning for adaptation measure • Legal and regulatory

Measure	Description	Sub-Criteria
	straightforward,providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptationoutcomes, it also relates to the adaptation process, including **capacity building, information exchange and social learning.**	• Integration with development policies and planning • Institutional mechanism, capacities and structures
Flexibility: How far canwe adapt?	Climate change is uncertain, due partly to an incomplete **understanding of climate science**, and partly to the fact that climate changewill **impact upon a future world**. The large uncertainty around climate change means that it is likely we will either do too much, or toolittle, adaptation.	• Hazards risk • Scientific and technical capacities and innovation
Equity: Inequalitydimensions toadaptation	Adaptation aims to **reduce vulnerability** to climate change shocks and stresses. However, vulnerability also depends on **socioeconomicfactors**, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation canreinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups	• Impact data • Environmental and natural resources • Livelihood • Culture, attitudes, education
Efficiency: Costeffectiveness	Efficiency or **cost-effectiveness** is typically used to compare the **costs of alternative ways** of producing the same or similar results, i.e.to assess the least-cost path to reaching a given target.	• Financial instruments • Cost recovery for adaptation
Sustainability: Thewider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention's impact. It considers thelonger-term viability of the intervention (e.g. how far are the benefits of an activity	• Public awareness, knowledge, skill • Information management and sharing

Measure	Description	Sub-Criteria
	likely to continue after donor funding has beenused up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention. Sustainable adaptation is likely to include strong elements of **partnership-building, community engagement, education andawareness-raising**, as well as focusing on interventions which are 'mainstreamed' into existing development processes andmechanisms, and cutting across key sectors (water management, agriculture, health and education).	• Learning and research

Source: Analysis Result (2014)

5.4.1 Determining Evaluation Criteria Using Delphi Analysis

Identification of criteria for the evaluation is done based on the study of literature and has been crosschecked with stakeholders to determine the existing condition in the evaluation. The Delphi Questionnaire can be seen at **Aappendix C**. There are many steps done in the determination of the evaluation criteria, namely

I. Phase I

At this stage of the research is conducted (exploration) the opinion of the respondents about the evaluation criteria. The method used to obtain these criteria is through semi-structured interviews as mention in chapter 3 (methodology section). Respondents as expert (see **section 4.4**) may add criteria to offer and there is also the possibility of reducing the existing factors. The results are as follows:

Table5.4 Results of Stakeholders' Perspective in Delphi Phase 1

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	S2	S3	S4	S5
1	Effectiveness	Enhancing policy, planning for adaptation measure	A	A	A	A	A
		Legal and regulatory	A	A	A	A	A
		Integration with development policies and planning	A	A	A	A	A

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	**S2**	S3	**S4**	**S5**
		Institutional mechanism, capacities and structures	A	A	A	A	A
2	Flexibility	Hazards risk	A	A	A	A	A
		Scientific and technical capacities and innovation	D	D	A	D	D
3	Inequality	Impact data	D	A	A	A	A
		Environmental and natural resources	A	A	A	A	A
		livelihood	A	A	A	A	A
		Culture, attitudes, education	A	A	A	A	D
4	Efficiency	Financial instruments	A	A	A	A	A
		Cost recovery for adaptation	A	A	A	A	A
5	Sustainability	Public awareness, knowledge, skill	A	A	A	A	A
		Information management and sharing	A	A	A	A	A
		Learning and research	A	A	A	A	A

Source: Analysis Results, 2014

Note:

A : Agree

D : Disagree

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies – Disaster Expert

S4 : Academician

S5 : Agency for Environmental Management

From the exploration results of Delphi Phase 1 obtained the opinion of the respondents about the influence on the evaluation criteria of adaptation measure. For more details, here is a description of the exploration of the respondents:

Table 5.5 Exploration Result of Stakeholders Perspective in Delphi Phase 1

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
1	Enhancing policy, planning for adaptation measure	Adaptation must be in accordance with RPJMD (Planning Policy) and in evaluating the adaptation must be in accordance with the targets that set out in the policy and vision of the adaptation project	
2	Legal and	Legality is needed in the evaluation of	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
	regulatory	adaptation because during this time many NGOs and people who walk on their own. To support the success of adaptation then there should be legalized so that the government can also help realize the adaptation program if there are constraints	
3	Integration with development policies and planning	Adaptation program involving many parties who are affected. In this case the government and the public should be able to integrate in terms of adaptation strategies to achieve upon the success. An example is the reclamation project is a program of the government but if the people around are not willing to accept the government should integrate it with local people. There are some things that need to be right on target and not a lot of conflict.	
4	Institutional mechanism, capacities and structures	Evaluation of the mechanism is very important in evaluating the success of an adaptation project. Because the organizational structure is closely related to human resources. And institutions in Indonesia that specifically deal with the CC does not exist, therefore there must be translated into capacity building programs of disaster	
5	Hazards risk	In evaluating adaptation strategies urgently need to know the risk in advance, priority areas to determine the level of risk of climate change. Successful adaptation therefore has to	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		be flexible, not least because of the potential range of climate changes projected under different emissions scenarios.	
6	Scientific and technical capacities and innovation	Every country need to develop the capacity to produce and use science Due to the uncertain and dynamic nature of climate change impacts.	Many researchers have done already. The amount of research is not a barometer of success of an adaptation strategy. This is because the implementation of the research that is less because bad mechanism. Institution is supposed to be responsive to implement existing research
7	Impact data	these data are required to support climate change adaptation needs. However as the impacts of climate change vary by location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.	The availability of impact data is difficult because of lack of facilities. The important thing is human resources. Pro public rogram will make the successful adaptation
8	Environmental and natural resources	Availability of natural resources is very influential to measure adaptation. For example, the government can use natural resources without damaging the existing programs to support the adaptation. For example, mangrove. With maintenance of the mangrove, the government can obtain a lot of benefits that hold seawater ashore and can create new skills to the community in supporting the mangrove tourism.	
9	livelihood	it can be used to measure the level of	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		success. Because residents get new opportunities, then the affected communities can feel the success of the adaptation program	
10	Culture, attitudes, education	A change in attitude of society to cope with floods is a reflection of the success of adaptation projects	Not too important for evaluation. Because programs that have so far followed the customs of the people and the training has not been entirely successful behavior change
11	Financial instruments	Financial instrument is very important, here we can find out whether the money that was spent for the appropriate adaptation project	
12	Cost recovery for adaptation	The project has not been successful adaptation must be considered on performance cost-recovery and get the better target to benefit.	
13	Public awareness, knowledge, skill	To be successful, climate change adaptation strategies may require skills and knowledge of local people. It is challenge for government to increase skill sets to effectively use climate change data.	
14	Information management and sharing	providing information including information needed to identify adaptation and measure the adaptation is successful or not. It can show their sustainability to adaptation measures.	
15	Learning and research	This is important because the actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable. The existence of learning and research will determine the	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		sustainability of adaptation projects	
New Sub-Criteria		**Maintenance and Operation Cost**:to evaluate adaptation measure should consider about maintenance and operation cost too because it shows the efficiency of funding which government spent.	

Source: Interview Results, 2014

II. Phase II

According to the results of the first phase, there is an additional sub criterion in the evaluation from the opinion of the respondents. Additional criterion is the efficiency of the M & O costs. So, 16 sub-criteria will be processed at the interview phase II. Phase II is the first iteration. This iteration is to reduce the sub-criteria necessary to obtain the agreement of the respondents about criteria affecting the evaluation of adaptation measures in Surabaya. The results of the first iteration can be seen in the following table.

Table 5.6 Results of Stakeholders' Perspective in Delphi Phase 1I

No	Criterion of Evaluation	Sub Criterion of Evalution	Stakeholders				
			S1	**S2**	**S3**	**S4**	**S5**
1	Effectiveness	Enhancing policy, planning for adaptation measure	A	A	A	A	A
		Legal and regulatory	A	A	A	A	A
		Integration with development policies and planning	A	A	A	A	A
		Institutional mechanism, capacities and structures	A	A	A	A	A
2	Flexibility	Hazards risk	A	A	A	A	A
		Scientific and technical capacities and innovation	A	A	A	D	A
3	Inequality	Impact data	D	A	A	A	A
		Environmental and natural resources	A	A	A	A	A
		livelihood	A	A	A	A	A
		Culture, attitudes, education	A	A	A	A	D
4	Efficiency	Financial instruments	A	A	A	A	A
		Cost recovery for adaptation	A	A	A	A	A
		Maintenance and Operation Cost	A	A	A	A	A
5	Sustainability	Public awareness, knowledge, skill	A	A	A	A	A
		Information management and sharing	A	A	A	A	A
		Learning and research	A	A	A	A	A

Source: Interview Results, 2014

Note:

A : Agree

D : Disagree

S1 : Town Planning Agency

S2 : City Department of Spatial Planning

S3 : Regional Disaster Management Agencies – Disaster Expert

S4 : Academician

S5 : Agency for Environmental Management

From the results of interviews Delphi phase II obtained the opinion of the respondent about the sub-criterion of evaluating adaptation measures.

Table 5.7 Exploration Result of Stakeholders Perspective in Delphi Phase II

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
1	Enhancing policy, planning for adaptation measure	Adaptation must be in accordance with RPJMD (Planning Policy) and in evaluating the adaptation must be in accordance with the targets that set out in the policy and vision of the adaptation project	
2	Legal and regulatory	Legality is needed in the evaluation of adaptation because during this time many NGOs and people who walk on their own. To support the success of adaptation then there should be legalized so that the government can also help realize the adaptation program if there are constraints	
3	Integration with development policies and planning	Adaptation program involving many parties who are affected. In this case the government and the public should be able to integrate in terms of adaptation strategies to achieve upon the success. An example is the reclamation project is a program of the government but if the people around are not willing to accept	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		the government should integrate it with local people. There are some things that need to be right on target and not a lot of conflict.	
4	Institutional mechanism, capacities and structures	Evaluation of the mechanism is very important in evaluating the success of an adaptation project. Because the organizational structure is closely related to human resources. And institutions in Indonesia that specifically deal with the CC does not exist, therefore there must be translated into capacity building programs of disaster	
5	Hazards risk	In evaluating adaptation strategies urgently need to know the risk in advance, priority areas to determine the level of risk of climate change. Successful adaptation therefore has to be flexible, not least because of the potential range of climate changes projected under different emissions scenarios.	
6	Scientific and technical capacities and innovation	Every country need to develop the capacity to produce and use science due to the uncertain and dynamic nature of climate change impacts.	Research is already a lot. The amount of research is not a barometer of success of an adaptation strategy. This is because the implementation of the research that is less because less mechanism. Institution is supposed to be responsive to implement existing research
7	Impact data	the data needed to support climate change adaptation needs. However as the impacts of climate change vary by	It doesn't matter for impact data availability because the data can not be found because of lack of

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
		location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.	facilities. The important thing is human resources. Pro public rogram will make the successful adaptation
8	Environmental and natural resources	Availability of natural resources is very influential to measure adaptation. For example, the government can use natural resources without damaging the existing programs to support the adaptation. For example, mangrove. With maintenance of the mangrove, the government can obtain a lot of benefits that hold seawater ashore and can create new skills to the community in supporting the mangrove tourism.	
9	livelihood	Livelihood so can be used to measure the level of success. Because residents get new opportunities, then the affected communities can feel the success of the adaptation program	
10	Culture, attitudes, education	A change in attitude of society to cope with floods is a reflection of the success of adaptation projects	Not too important for evaluation. Because programs that have so far followed the customs of the people and the training has not been entirely successful behavior change
11	Financial instruments	Financial instrument is very important, here we can find out whether the money that was spent for the appropriate adaptation project	
12	Cost recovery for adaptation	The project has not been successful adaptation must be considered on performance cost-recovery and get the better target to benefit.	

No	Sub-Criterion	Reason of Agreement	Reason of Disagreement
13	Maintenance and Operation Cost	Evaluate adaptation measure should consider about maintenance and operation cost too because it shows the efficiency of funding which government spent. Cost-effective can be seen from the M&O Cost too	
14	Public awareness, knowledge, skill	To be successful, climate change adaptation strategies may require skills and knowledge of local people. It is challenge for government to increase skill sets to effectively use climate change data.	
15	Information management and sharing	providing information including information needed to identify adaptation and measure the adaptation is successful or not. It can show their sustainability to adaptation measures.	
16	Learning and research	This is important because the actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable. The existence of learning and research will determine the sustainability of adaptation projects	

Source: Interview Results, 2014

III. Phase III

From the results of interviews Delphi Phase II there are several sub criteria has agreed to be the criteria that will be used to evaluate adaptation strategies. Sub-criteria are scientific and technical capacities, impact data, social criterion (culture, attitudes, education). The sub criteria that have not reached a consensus and not agreed upon by all respondents, conducted more interviews processing phase III. As the sub-criteria to achieve a consensus and agreed together.

Table 5.8 Results of Stakeholders' Perspective in Delphi Phase III

No	Sub-Criterion Will Be Used in Evaluation	Stakeholders				
		S1	S2	S3	S4	S5
1	Is scientific and technical capacities important and innovation can be used in evaluation to adaptation measure?	A	A	A	A	A
2	Is impact data important and can be used in evaluation to adaptation measure?	A	A	A	A	A
3	Is culture, attitudes, education and can be used in evaluation to adaptation measure?	A	A	A	A	A

Source: Interview Result, 2014

Note: A : Agree
D : Disagree
S1 : Town Planning Agency
S2 : City Department of Spatial Planning
S3 : Regional Disaster Management Agencies – Disaster Expert
S4 : Academician
S5 : Agency for Environmental Management

From the interview Delphi Phase III consensus obtained from the respondents regarding the adaptation criteria. For more details, here is a description of the exploration results of the respondents:

1. **Sub Criteria : scientific and technical capacities**

   They agreed because every country need to develop the capacity to produce and use science due to the uncertain and dynamic nature of climate change impacts. The actual research is non static and adaptive to the scientific phenomena that occur and research should be applicable to make adaptation measure success.

2. **Sub Criteria : availability of impact data**

   The data needed to support climate change adaptation needs. However as the impacts of climate change vary by location. Impact data can shows the scenarios, facilitating the exchange of experiences in and providing training and technical assistance on the use of data.

3. **Sub Criteria : culture, attitudes, education**

   A change in attitude of society to cope with floods is a reflection of the success of adaptation projects

Based on the analysis Delphi to get consensus on the cub-criteria to evaluating of adaptation measures, then the exact sub-criteria following:

1. Enhancing policy, planning for adaptation measure
2. Legal and regulatory
3. Integration with development policies and planning
4. Institutional mechanism, capacities and structures
5. Hazards risk
6. Scientific and technical capacities and innovation
7. Impact data
8. Environmental and natural resources
9. Livelihood
10. Culture, attitudes, education
11. Financial instruments
12. Cost recovery for adaptation
13. Maintenance and Operation Cost
14. Public awareness, knowledge, skill
15. Information management and sharing
16. Learning and research

5.4.2 Evaluate Performance of Flood Risk Adaptation in The Context of Climate Change

According to analysis result in **section 5.3**, the selected adaptation measures are mangrove conservation area, elevate floor house, and enhance soft skill of community. To evaluate this adaptation measure, it has been used criteria from earlier section (**section 5.4.1**) which has been crosschecked by stakeholders. Then, questionnaire had been distributed to stakeholders who involved. The stakeholders involved is same as with stakeholders in Delphi Analysis, four people from local government, one academician, and there representative of District Head (Krembangan, Pabean Cantikan, and Kenjeran). The detailed of stakeholders is showed below:

- Government

Government as policy makers and decision makers in adaptation is the most important stakeholders. In this study, the respondents from government to evaluate adaptation strategies are Town Planning Agency of Surabaya (Bappeko), Department of Public Works - City Department of Spatial Planning, Agency for Environmental Management

- Representative of Local People

Respondents who used to represent the community comes from the district head who reside in flood prone areas namely Head of Krembangan District, Head of Pabean Cantikan District, and Head of Kenjeran District.

- Academician

Academics will be represented by a lecturer of urban and regional planning in one of university in Surabaya. In consideration, the problem of flooding adaptation is one of the objects of study in this study program. Opinions and judgments of those who understand the science of waste management is what is expected to be input in the study.

- Practitioners

The practitioners include operators or parties who were involved directly in the project adaptation, at least in the scale communal or residential, directly. The opinions and judgments of experienced composting activities, is one of the considerations in making this data. In this case, people from disaster expert in Regional Disaster Management Agencies were chosen.

5.4.2.1 Analytic Hierarchy Process Analysis

The process of assessing the success of adaptation in this study was done by a multi-criteria using AHP method. . In using AHP, the decomposition needs to be done to identify problems with the criteria and sub-criteria used. The main criteria in assessing the success of adaptation strategies are obtained in the previous Deplhi analysis whichhas been adjusted. Table of criteria and sub-criteria used to evaluate the success of adaptation strategies is showed below.

Table 5.9 Criteria and Sub-Criteria for Evaluating Adaptation Measure

No	Main Criteria	Criterion Code	Sub-Criteria	Sub Criterion Code
1.	Effectiveness	C1	Enhancing policy, planning	SC1
			Legal and regulatory	SC2
			Integration with development policies and planning	SC3
			Institutional mechanism, capacities and	SC4

No	Main Criteria	Criterion Code	Sub-Criteria	Sub Criterion Code
			structures	
2	Flexibility	C2	Hazards risk	SC5
			Scientific and technical capacities and innovation	SC6
3.	Inequality	C3	Impact data for flooding	SC7
			Environmental and natural resources	SC8
			Livelihood to people surrounding	SC9
			Culture, attitudes, education conditions	SC10
4.	Efficiency	C4	Financial instruments	SC11
			Cost recovery for adaptation	SC12
			Maintenance and Operation Cost	SC13
5.	sustainability	C5	Public awareness, knowledge, skill to people surrounding	SC14
			Information management and sharing	SC15
			Learning and research related to enhancing adaptation measure	SC16

This multi-criteria analysis makes the analytic hierarchy process, with the main objective (goal) are in the top position, followed by the main criteria, sub-criteria, and alternatives issues. Hierarchy of research that has been compiled (Figure below) is the basis for the preparation of the questionnaire and data processing.

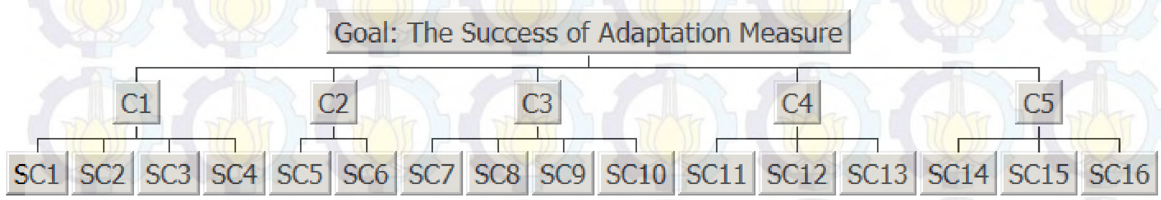

Figure 5.7 Hierarchies of Criteria and Sub Criteria on AHP Analysis

Assessment procedure in AHP pair wise comparison refers to the assessment scores that have been developed by Thomas L Saaty, as shows in Figure 5.8. In determining priority of criteria and sub-criteria analysis techniques is used AHP (Analythical Hierarchie Process) with individual pairwaise (of Expert Choice software 11).

Degree of importance	Definition
1	Equal importance (no preference)
2	Intermediate between 1 and 3
3	Moderately more important
4	Intermediate between 3 and 5
5	Strongly more important
6	Intermediate between 5 and 7
7	Very strongly important
8	Intermediate between 7 and 9
9	Extremely strongly more important
1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9	Reciprocals of 2, 3, 4, 5, 6, 7, 8, and 9

Figure 5.8 Aassessment Scores of AHP

AHP technique to compare the level of interest among criteria and sub-criteria based on the expert opinion. The results of the questionnaire input from the respondents can be seen in **Appendix D.**

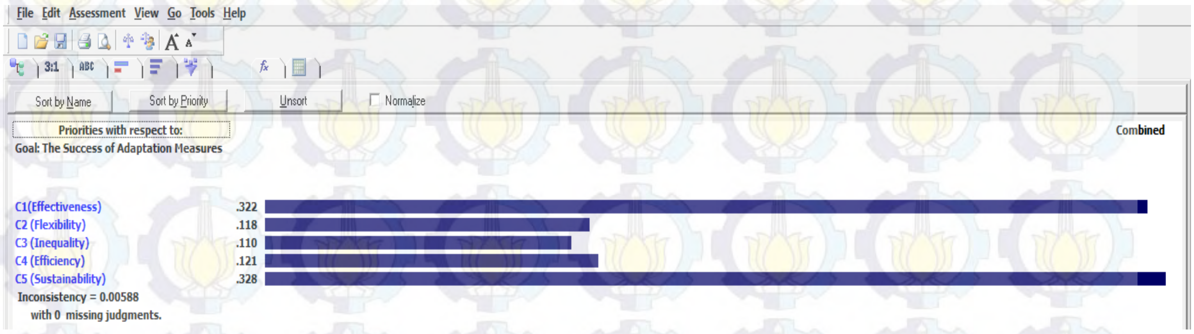

Figure 5.9 Weighting Criteria from Expert Choice Results

From the analysis obtained the weight of each criteria and sub-criteria as follows:

A. Effectiveness Criterion Weighting

Based on the analysis results obtained AHP weight values for each sub-criterion of effectiveness criterion are Enhancing policy, planning (0.385), Legal and regulatory (0.167), Integration with development policies and planning (0.147), and Institutional mechanism, capacities and structures (0.3) with a value of 0.00023 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.000233, sub criteria of the effectiveness is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

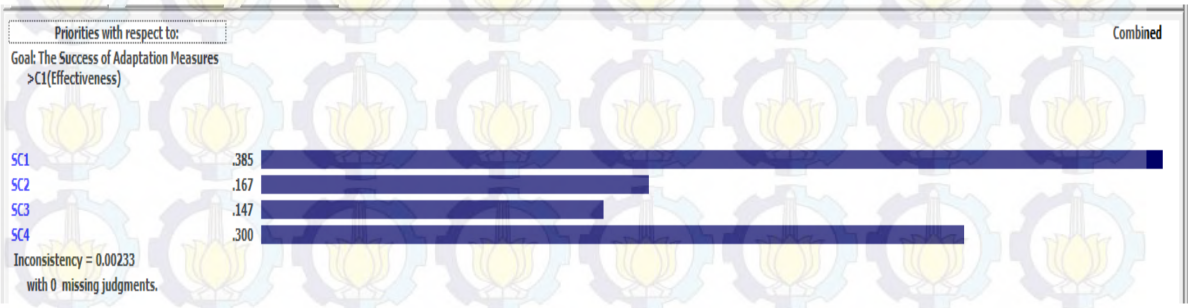

Figure 5.10 Outputof AHP for Effectiveness Criteria

B. Flexibility Criterion Weighting

Based on AHP result, the criteria consist of many sub-criteria. These are hazard risk (0.547) and scientific and technical capacities and innovation (0.453) with the inconsistency is 0.00. That means the criteria is valid can be used for evaluation. Output from Expert Choice for Flexibility is shown in figure below:

Figure 5.11 Output of AHP for Flexibility Criteria

C. Inequality Criterion Weighting

Based on AHP result, the inequality criteria consist of many sub-criteria. These are impact data for flooding (0.363), availability of environmental and natural resources(0.176), livelihood to people surrounding (0.221), and culture, attitudes, education conditions (0.240) with the inconsistency is 0.00. That means the criteria is valid can be used for evaluation. Output from Expert Choice for Inequalityis shown in Figure 5.12:

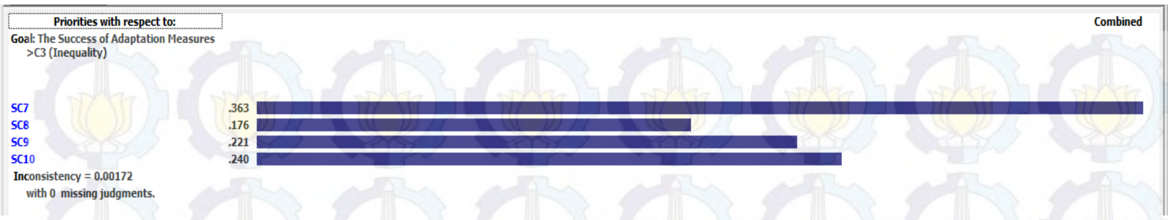

Figure 5.12 Output of AHP for inequality Criteria

D. Efficiency Criterion Weighting

Based on the analysis results obtained AHP weight values for each sub-criterion of efficiency criterion are financial instruments (0.537), cost recovery for adaptation (0.23), and maintenance and Operation Cost (0.323) with a value of 0.000208 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.000208, sub criteria of the efficiency is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

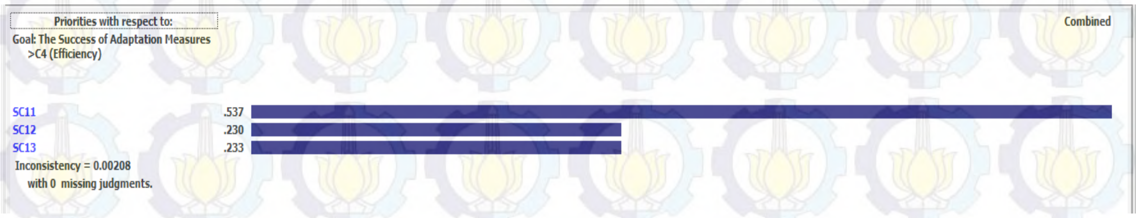

Figure 5.13 Output of AHP for Efficiency Criteria

E. Sustainability Criterion Weighting

According to the analysis results obtained AHP weight values for each sub-criterion of sustainability criterion are public awareness, knowledge, skill to people surrounding (0.336), Information management and sharing (0.258), and Learning and research related to enhancing adaptation measure (0.407) with a value of 0.00095 which if inconsistency value <0.1 then it is considered valid criteria. Thus, the inconsistency value 0.00095, sub criteria of the sustainability is considered valid and it can be used for the evaluation adaptation measure in coastal city of Surabaya. The output processed using Expert Choice AHP 11 can be seen in figure below.

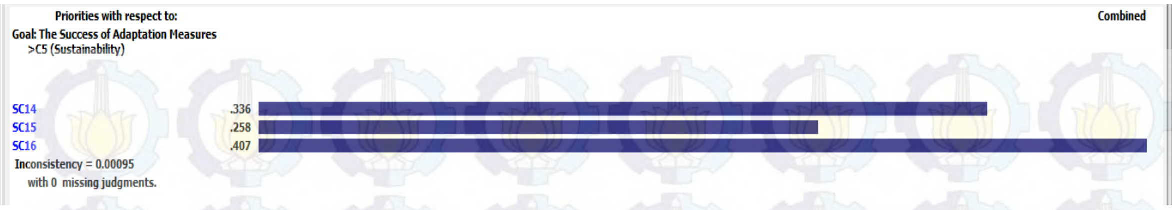

Figure 5.14 Output of AHP for Sustainability Criteria

As for the result of a combination of all criteria and sub criteria weighting shows as follows:

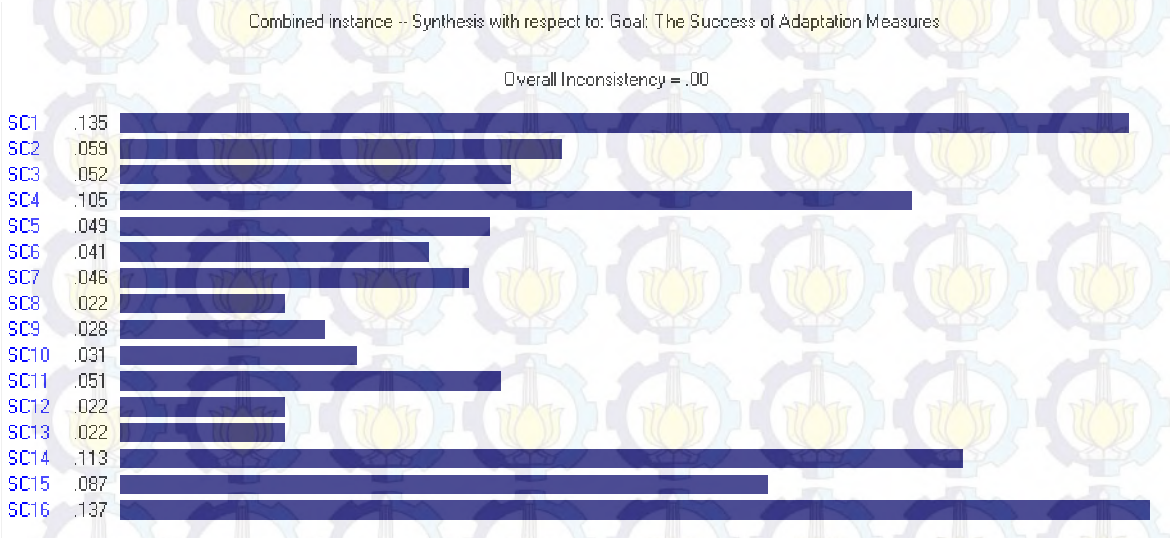

Figure 5.15 Weighting Sub-Criteria from Expert Choice Result

5.4.2.2 Ranking Method Using Scoring

This hierarchy below shows each criterion and sub-criterion with the weight. This weighting will be calculated with scoring in the later section to know the successful of criteria based on stakeholders's perception. To get the score or value, scoring scale is used to help in this multicriteria analysis. In ranking method, every criterion consideration is ranked in order of the stakeholders' preference. To generate for each evaluation unit, each criterion was weighted according to the estimated significance for evaluating adaptation measure.

Basically, the evaluation of adaptation measures is to compare the performance indicators of the achievement of targets set by the researcher. In this section will be made a remedy worksheets provide an assessment and evaluation of the adaptation measure. But to give a score to each sub-criterion, the determination of value is done in accordance with the adaptation measures that will be evaluated (see **appendix E** for evaluation questionnaire). Each adaptation measure has a value and the class individually.

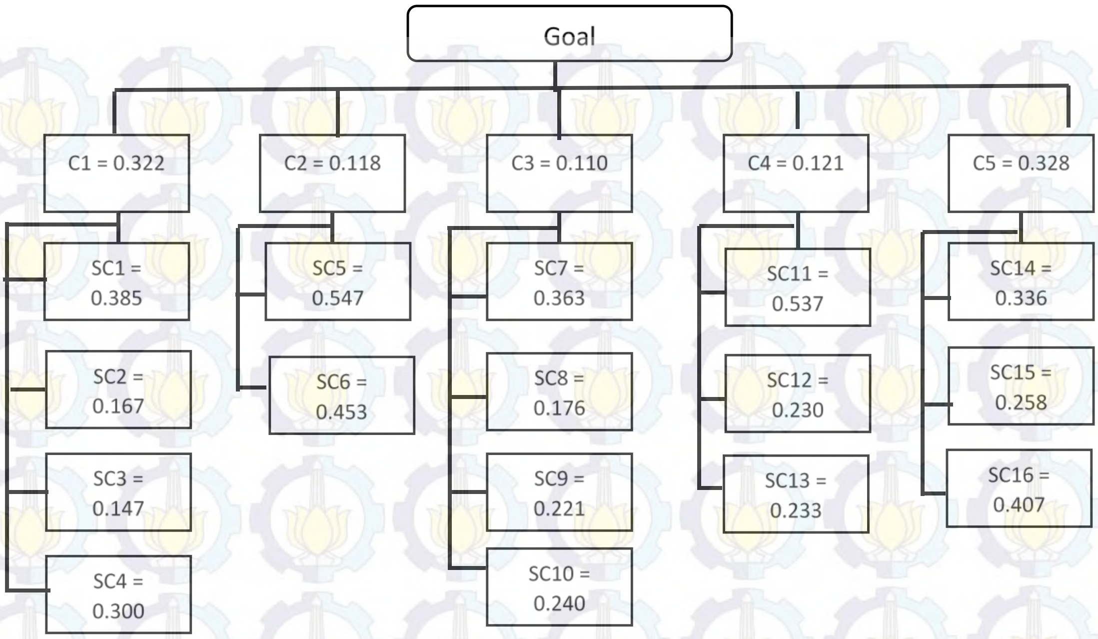

Figure 5.16 Combined Weighting of Criteria and Sub-Criteria

In the scoring scale, a number of questions are formulated and answered by selected stakeholders (see the **appendix F**). The number of questions is 16, according to the number of sub-criteria. In every response is given by value. With a purposive sampling, the sample size is eight people. Then the maximum value for the question is 16 x 8 = 128 and the minimum is 8 final score was obtained by summing the numbers for each answer. The amount or maximum rating for the 16 questions is 8 x 16 = 128 points and the minimum is 16 points. So scores ranged 16 - 128 of this amount will be multiplied by the weight and will obtain the level of success of a program against goals and targets have been achieved. From the results of the distribution of questionnaires to the stakeholders' perceptions of the obtained results of analysis of the sub-criteria as follows:

Table 5.10Value and Weighting for Three Adaptation Measures

No	**Sub-Criteria**	**Value**			**Weighting**
		Mangrove	**Elevate Floor**	**Enhance Skill**	
1.	Enhancing policy, planning	0.775	0.625	0.625	0.385
2.	Legal and regulatory	0.85	0.575	0.625	0.167
3.	Integration with development policies and planning	0.725	0.575	0.6	0.147
4.	Institutional mechanism, capacities and structures	0.45	0.575	0.375	0.300
5.	Hazards risk	0.575	0.725	0.5	0.547

No	Sub-Criteria	Value			Weighting
		Mangrove	Elevate Floor	Enhance Skill	
6.	Scientific and technical capacities and innovation	0.55	0.65	0.475	0.453
7.	Impact data for flooding	0.575	0.525	0.575	0.363
8.	Environmental and natural resources	0.55	0.6	0.725	0.176
9.	Livelihood to people surrounding	0.6	0.625	0.675	0.221
10.	Culture, attitudes, education conditions	0.425	0.625	0.425	0.240
11.	Financial instruments	0.525	0.55	0.525	0.537
12.	Cost recovery for adaptation	0.525	0.5	0.5	0.230
13.	Maintenance and Operation Cost	0.45	0.55	0.65	0.233
14.	Public awareness, knowledge, skill to people surrounding	0.575	0.725	0.7	0.336
15.	Information management and sharing	0.575	0.6	0.725	0.258
16.	Learning and research related to enhancing adaptation measure	0.6	0.675	0.65	0.407

Source: Analysis Result, 2014

Value will be used to calculate the percentage the success of adaptation measures. In the next sub-section, the value will be multiplied with weigh to get the percentage.

5.4.2.3 Calculation of Criterion Score

- Mangrove Conservation Area

Criterion score is obtained from multiplying the amount of weight by a score of adaptation measures in the same criteria. Here is the calculation of the score criteria.

Table 5.11Criterion Score for Mangrove Conservation Area

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.775	0.385	0.298	5.967
		Legal and regulatory	0.850	0.167	0.142	2.839
		Integration with development policies and planning	0.725	0.147	0.107	2.131
		Institutional mechanism, capacities and structures	0.450	0.300	0.135	2.7
2	Flexibility	Hazards risk	0.575	0.547	0.315	6.291
		Scientific and technical capacities and innovation	0.550	0.453	0.249	4.983
3.	Inequality	Impact data for flooding	0.575	0.363	0.209	4.174
		Environmental and natural resources	0.550	0.176	0.097	1.936
		Livelihood to people surrounding	0.600	0.221	0.133	2.652
		Culture, attitudes, education conditions	0.425	0.240	0.102	2.04

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
4.	Efficiency	Financial instruments	0.525	0.537	0.282	5.638
		Cost recovery for adaptation	0.525	0.230	0.121	2.415
		Maintenance and Operation Cost	0.45	0.233	0.105	2.097
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.575	0.336	0.193	3.864
		Information management and sharing	0.575	0.258	0.148	2.967
		Learning and research related to enhancing adaptation measure	0.6	0.407	0.244	4.884
Total						57.58

Source: Analysis Result, 2014

From table above, the mangrove conservation area has level of successful by **57.58%.** In addition, the graph below shows the proportion every criterion for mangrove conservation area. In that graph, there are two criteria which have same percentage by 19 % that are inequality and flexibility. However, the highest percentage is effectiveness criterion which has value as 20%.

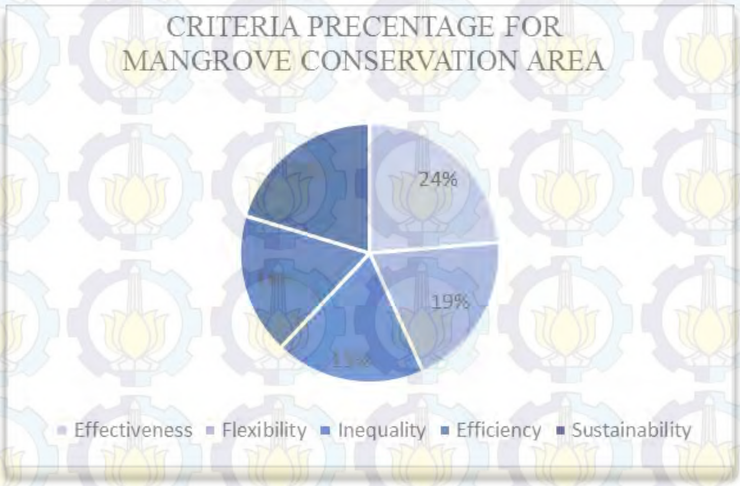

Figure5.17: Criteria Percentage of Mangrove Conservation Area

- Elevating Floor

To the adaptations made by this community, the criteria will also be given a score to get the right value to measure the success rate of this adaptation. Table 5.12 show the calculation of each criterion for elevating floor.

According to calculation provided in the table below, this adaptation measure occupied more percentage than previous adaptation (mangrove conservation area adaptation measure). This adaptation measures has around **61.62%** then the proportion of each criterion can be seen at graph below. In this adaptation measure, the sustainability and inequality have same percentage by 19%. In addition, effectiveness and efficiency also have same percentage by 22%.

Table 5.12 Criterion Score for Elevate Floor

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.625	0.385	0.241	4.812
		Legal and regulatory	0.575	0.167	0.096	1.920
		Integration with development policies and planning	0.575	0.147	0.084	1.690
		Institutional mechanism, capacities and structures	0.575	0.300	0.172	3.45
2	Flexibility	Hazards risk	0.725	0.547	0.396	7.931
		Scientific and technical capacities and innovation	0.65	0.453	0.294	5.889
3.	Inequality	Impact data for flooding	0.525	0.363	0.190575	3.8115
		Environmental and natural resources	0.6	0.176	0.1056	2.112
		Livelihood to people surrounding	0.625	0.221	0.138125	2.7625
		Culture, attitudes, education conditions	0.625	0.240	0.15	3
4.	Efficiency	Financial instruments	0.55	0.537	0.29535	5.907
		Cost recovery for adaptation	0.5	0.230	0.115	2.3
		Maintenance and Operation Cost	0.55	0.233	0.12815	2.563
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.725	0.336	0.2436	4.872
		Information management and sharing	0.6	0.258	0.1548	3.096
		Learning and research related to enhancing adaptation measure	0.675	0.407	0.274725	5.4945

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
Total						61.6125

Source: Analysis Result, 2014

- Enhance Soft Skill and Entrepreneurship to Local People

Criterion score is obtained from multiplying the amount of weight by a score of adaptation measures in the same criteria. Here are the score calculation criteria for adaptation strategies Enhance Soft Skills and Entrepreneurship to Local People. Table 5.13 shows criterion score for the third adaptation measure.

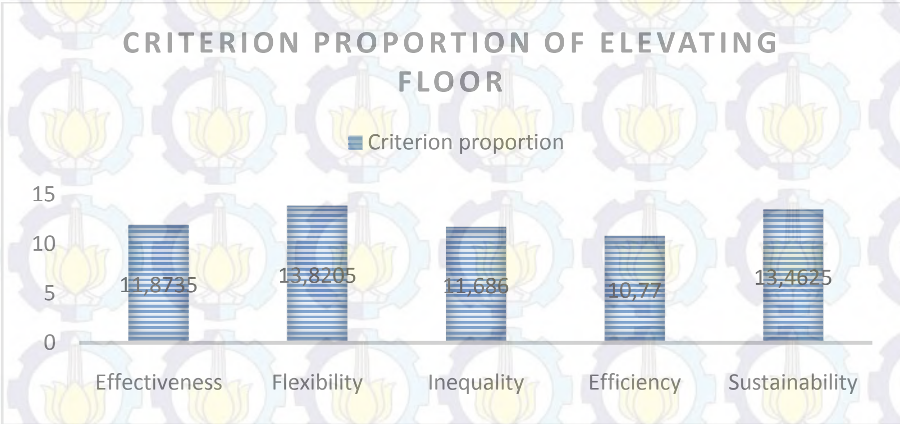

Figure 5.18: Criteria Percentage of Elevating Floor Adaptation Measure

Table 5.13 Criterion Score for Enhance Soft Skill and Entrepreneurship to Local People

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
1.	Effectiveness	Enhancing policy, planning	0.625	0.385	0.241	4.812
		Legal and regulatory	0.625	0.167	0.104	2.087
		Integration with development policies and planning	0.6	0.147	0.088	1.764
		Institutional mechanism, capacities and structures	0.375	0.300	0.112	2.25
2	Flexibility	Hazards risk	0.5	0.547	0.273	5.47
		Scientific and technical capacities and	0.475	0.453	0.215	4.303

No	Main Criteria	Sub-Criteria	Value	Weighting	V*W	Percentage (%)
		innovation				
3.	Inequality	Impact data for flooding	0.575	0.363	0.208	4.174
		Environmental and natural resources	0.725	0.176	0.127	2.552
		Livelihood to people surrounding	0.675	0.221	0.149	2.983
		Culture, attitudes, education conditions	0.425	0.240	0.102	2.04
4.	Efficiency	Financial instruments	0.525	0.537	0.281	5.638
		Cost recovery for adaptation	0.5	0.230	0.115	2.3
		Maintenance and Operation Cost	0.65	0.233	0.152	3.029
5.	sustainability	Public awareness, knowledge, skill to people surrounding	0.7	0.336	0.235	4.704
		Information management and sharing	0.725	0.258	0.187	3.741
		Learning and research related to enhancing adaptation measure	0.65	0.407	0.264	5.291
Total						57.141

Source: Analysis Result, 2014

From the table above, it can be seen that percentage of this adaptation measure is **57.141%.**The score of this adaptation is lower than the other but it is not much difference with first adaptation (mangrove conservation area. To know the proportion of each criterion, the graph below is showed.

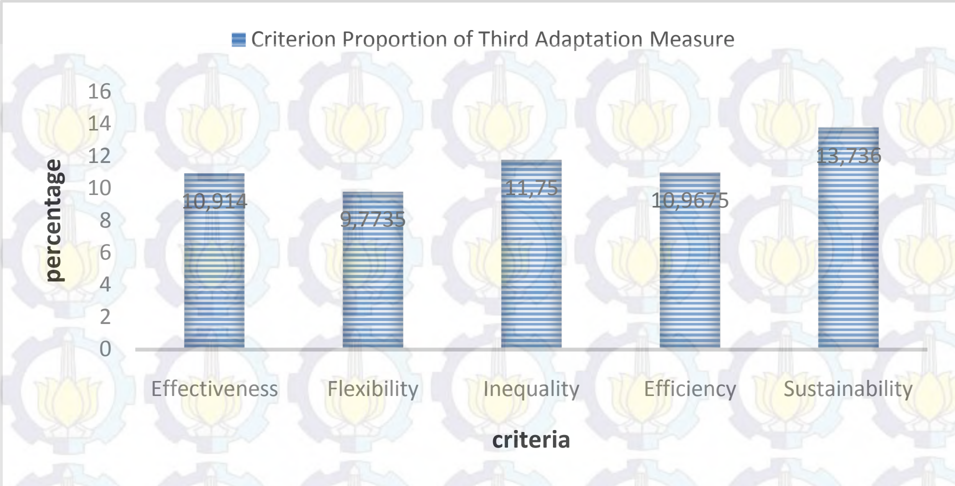

Figure 5.19: Criterion Proportion of Enhancing Skill and Entrepeneurship for Local People

Table 5.14 Level of Success for Three Adaptation Measure

No	Criteria	Adaptation Measure		
		Mangrove Conservation (%)	Elevating Floor (%)	Enhancing Soft Skill (%)
1.	Effevtiveness	13.63	11.87	10.91
2.	Flexibility	11.27	13.82	9.77
3.	Inequality	10.80	11.69	11.75
4.	Efficiency	10.15	10.77	10.97
5.	Sustainability	11.71	13.46	13.74
	Total	**57.58**	**61.61**	**57.14**

Source: Analysis Results, 2014

According to calculation above, it can be known that the most successful adaptation measure is elevating floor. This adaptation is adopted by communities who live in coastal area. Criterion of Sustainability is the highest score in this adaptation, and then followed by flexibility which has score with 13.8%.

Then to assess the success, a standard traffic light system is used. Traffic light system uses three colors: green with a threshold of more than 68% means that the achievement of the criteria already achieved, yellow color with a threshold of 52% to 68% means that the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats. The red color with a threshold of less than 52% which means that the achievement of an adaptation program actually below the target set and require immediate repair. The threshold is determined based on the characteristics of the overall criteria score. For this explanation, it can be concluded that three adaptation measure that choosen are in yellow color. Then, figure 5.20 shows the compilation each criteria for each adaptation measures. The sustainability criterion is the most successful criteria of adaptation measures although its score has bit differences with others. The second successful criterion is effectiveness, it means all of adaptation measures have been achieved the targets but the score of this criterion is in yellow threshold.

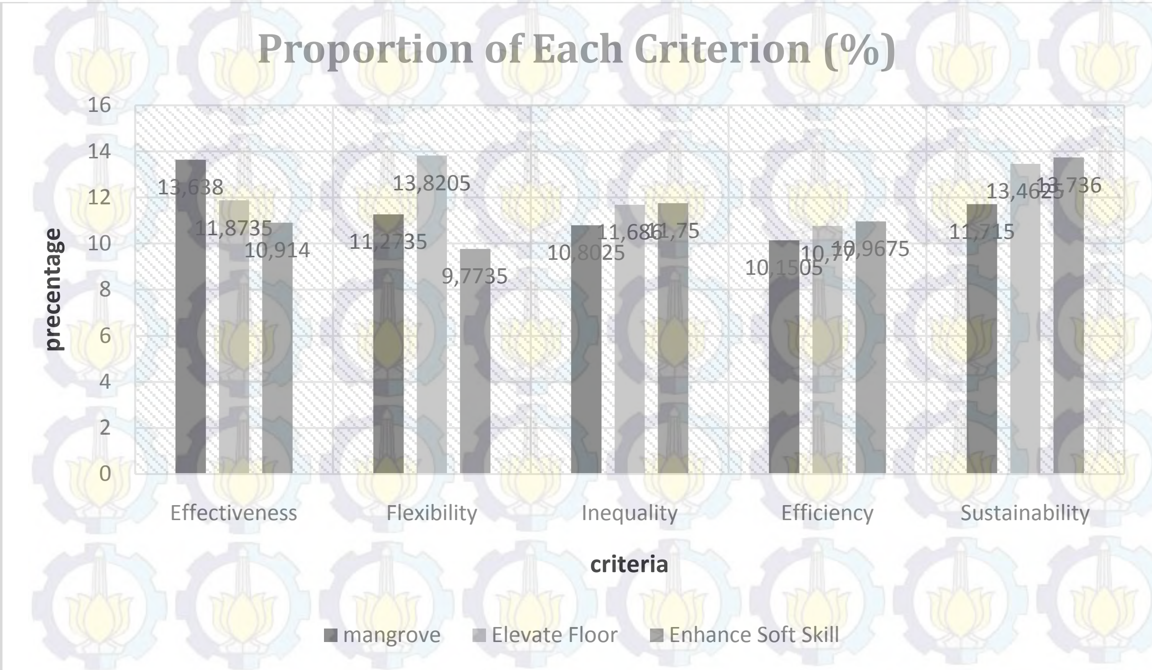

Figure 5.20 Proportion of Each Criterion

5.5 Recommendations to Enhance Adaptation Strategies Based Under the Current Situation

A key aim of this section is the development of recommendations to assess the successful of adaptations for reducing future vulnerability levels to flooding. Chapter 4 providesthe situation of flooding and chapter 5 provides an assessment of current adaptations under current conditions. Based on the assessment and evaluation results in early section, I concluded that all of criteria will make a significant contribution to enhancing the adaptation of disaster responses. However, future environmental conditionsalso need to be taken into account. In particular, extreme rainfall events arepredicted to increase under future climate change scenarios (Solomon et al.2007; Olsson, Gidhagen, & Kawamura 2011 and Mullan, Mortlock & Fealy2012).

In the early section, the results of successful criteria have been identified indicating that three of chosen adaptation measures is in yellow color, the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats. In this section, the recommendations will be identified how to enhance adaptation measure based on the type of adaptation measure. The three selected adaptation measures include household adaptation (elevated floor) and city level adaptation (mangrove conservation and enhance soft skill of the people). The recommendations to enhance adaptation measures at the city level are identified as follows:

1. Integrating adaptation application with the policy and actual condition of the area

   The effectiveness percentage is avarage in 12.14%. It is important for assessing the **effectiveness of adaptations** scenarios and should be used to inform international and national policy for disaster risk management related to adaptation measures and be made available at more regional and local scales for regions and communities that are particularly vulnerable to disasters. Strengthening the effectiveness criterion can be done with the procurement monitoring and evaluation of programs for adaptation. The evaluation is done ex-ante and e-post in order to create an integrated adaptation.

   In addition, to reach the integrated adaptation, the Municipal Government should cooperate with NGOs (local and non-local) in emergency situations. Current actions of NGOs are not normally integrated with government activities. In the case of a flood emergency, some coordination occurs, but is generally at a technical level such as in collecting and organizing disaster relief assistance, and conducting search and rescue activities. Both local and outside stakeholders, excluding the BPBD, support these coordination initiatives.

2. Enhancing Spatial Plan

   Enhancing spatial plan can also enhance the **effectiveness criterion** of adaptation. Enhancing spatial plan implementation can be significant recommendations for adaptation measure. The spatial plan implementation involves controlling land use. The land use control will regulate the mix of built-up areas and open space both in upstream areas and it will also prevent buildings and houses being located on risky land or in potentially inundated areas. The building code within the spatial plan will regulate the appropriate types of buildings for the area.

In addition, the spatial plan will also allocate appropriate infrastructure to support local community's livelihoods. As a result, the spatial plan can be used not only in the mitigation stage but also in the preparedness and response stages.

3. Reforestation and flood infrastructure redevelopment

   Reforestation remains effective in reducing the impact of floods on **all sub criteria in equality**. This is indicated by the most same values on every sub critrion in both comparisons. Therefore,reforestation is a sustainable approach for minimising the impact offloods for the near future.

   Reforestation can be done with converting non-forest land use types or replanting the forest. Reforestation will increase the amount of green open space as well as the density of trees. Both of these effects will increase the amount of rainfall infiltration to the soil. This increase in infiltration will reduce the run-off water which in turn reduces the amount of water in the plain and river. Consequently, there will be a reduction in the scale of inundation.

   Then, the adaptation of flood infrastructure redevelopment has consequences for the capacity of flood infrastructure. Infrastructure redevelopment will not reduce the amount of water but will manage the flowing water. The increase in embankment height will increase the river capacity while the increase in capacity of drainage system will increase weekly water discharge back to the river.

   The Infrastructure Redevelopment Adaptation was shown to be most effective adaptation by stakeholders under current conditions. However, under the climate change, it is shown to be no longer effective andcannot therefore be regarded as a sustainable approach. It will only help thevillagers in the short term but not in the longer term.

4. Providing research related to flood risk

   This recommendation has aim to develop researches related to flood risk which can improve proper handling of adaptation efforts and improving knowledge and awareness of disaster in this area too.

However, recommendations to enhance adaptation measures at household level should be applied to support the success adaptation measure at all. There are recommendations to enhance household-adaptation:

1. Promoting household income and creating other sources of income

Promoting income is proposed by creating alternative economic activities, particularly during floods and increasing productivity of current sources of income such as paddy and aquaculture. Promoting income will logically increase community's savings. With better savings, households will have better financial capacity. The increased savings are assumed will provide better capacity to the households in responding to coming floods. Therefore, this increased capacity is thought to decrease community vulnerability (Gaillard, Maceda, Stasiak, Le Berre, Espaldon, 2009; Fussel, 2012; Brauch, 2011).

For livelihood, the local community who has proffesion as farmer can combine their main source of income. For example, some paddy field farmers combine their rice field with aquaculture. When the local community have no savings, they will regularly catch fish in swamp areas to fulfil their daily needs.

Kenaf planting is one of the alternative sources of income particularly in the inundated swamp areas. Since the majority of people in the community rely on a day-to-day income source, the villagers often experience a shortage between income and expenditure, especially in emergency conditions. That means saving isn't feasible for the local community. Therefore, creating other sources of income will be expected to enhance community's economic stability.

2. Implementing insurance mechanism

The adaptation of Insurance can effectively enhance **the efficiency criterion** by reducing the **cost recovery sub-criterion**. This meansthat the adaptation can minimise the number of collapsed houses onlyduring floods. Moreover, insurance can also minimise the economic losses of middle and highincome families.

Insurance helps community by providing money for their houses after flood events. This mechanism will avoid community spending their savings on house repairs. Sometimes, the cost of house repairs makes them incapable of recovery. Furthermore, people may sell paddy fields to get money. An insurance mechanism has the added benefit of decreasing the need for government spending in assisting the victims. Major government assistance funds are spent on rehabilitation and reconstruction programs including reconstruction programs for low income people. Involving the low income people will decrease this government spending too. Consequently, the funds can be spent on other type's ofexpenses in disaster adaptation or mitigation.

However, a lack of understanding of the benefits of insurance is one major challenge. Insurance is still perceived as a luxury and new for most people especially the poor in developing countries (Feyen, Lester & Rocha, 2011; Radermarcher & Brinkmann, 2012). Consequently, there is a need to promote the idea of sharing the risk within the community. One approach to communicating the idea of insurance is to draw an analogy with the tradition of ‘lumbung padi’ whereby villagers collect some of the harvest from the paddy field for public storage. This long tradition in Indonesian villages makes the sharing of food feasible particularly in a famine situation. The other challenge is the unwillingness of the government to approach insurance companies and provide assistance to low income earners to pay premiums. Kousky & Kunreuther (2009), Kron (2009), Hofman (2007) and Atmanand (2003) provide examples of how governments can contribute to subsidizing villagers’ involvement in insurance for disasters.

The other effective economic adaptation is the Cash Transfer Program. This has a similar effect to theInsurance Adaptation, specifically in minimising the broken houses.The CashTransfer Program will effectively increase low income families’ savingswhich in turn minimises villagers’ dependency ongovernment assistance. Therefore, in the case of a shortage ofgovernment assistance, a low income family can still repair theircollapsed house with partial government assistance.

5.6 Summary of Findings

There are nine adaptation measures which were identified during the document review and interview with stakeholders. However, according to scoring analysis, the three selected adaptation measures which have high prioritizes are (i) mangrove conservation, (ii) elevating floor, and (iii) enhancing soft skill and entrepreneurship for local people.

Based on AHP and scoring analysis, the percentage of success for Conservation mangrove, elevating floor, and Enhancing soft skill are 57.57%, 61.61%, and 57.14% respectively. According to traffic light threshold, all adaptation measures that choosen is in yellow color. It means that the achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats.

According to analysis results, problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The integration among them is crucial due to the important role of the planning system and the planning profession in disaster management (Bosher, Dainty, Carrillo & Glass, 2007). The need for a planning instrument is also regarded by key scholars as more important than an emergency system for anticipating routine hazards rather than just responding to incidental hazards (Handmer & Dovers, 2007).

The interviews conducted as part of this study revealed that stakeholders place major importance on improving and redeveloping flood infrastructure to minimize flood impacts. Flood infrastructure redevelopment can be in the form of improving river embankments, improving drainage systems and building dams. Reforestation has not been a major concern since most of the stakeholders focus on reactive and segmented actions. Furthermore, because reforestation is required upstream of the village, this action may seem less under their control and is therefore not a focus of their attention.

By combining the strategies of each criterion, it can be concluded that strategies to enhance adaptation measures in study area are: (i) Integrating adaptation application with the policy and actual condition of the area, (ii) Enhancing Spatial Plan, (iii) Reforestation and flood infrastructure redevelopment, (iv) providing some research and its implementation, (v) Promoting household income and creating other sources of income, (vi) Implementing insurance mechanism.

However, these strategies are only effective in improving specific sub criteria, and theyare associated with increasing impacts in other sub criteria. For this reason they cannot be categorised as effective approachesin isolation, although they perform better when applied together with other adaptations.

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CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

In this part includes conclusions and recommendations regarding results of research. Conclusion part describes about the result of main objectives and specific objectives too, whilst for recommendation part explains the further directions of this research, such as: application of research result and limitation and further studies of this research.

6.1 Conclusions

While evaluation of adaptation measure has the potential to improve responses to floodevents and hence reduce their impacts on communities, current adaptation are limited and lack a strong predictive capacity. More sophisticated tools are needed to adequately represent the multiple dimensions of adaptation under the vulnerability and tosupport decision-making. This thesis has demonstrated that MCA has the potential to meet this need by evaluating flood in acommunity vulnerability usingthe Delphi Technique, secondary surveys and semi-structured interviews.

The main objective of this research is to evaluate climate change adaptation using criteria for measuring the success of coastal flood adaptation measures. According to the evaluation results, problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The achievement of adaptation measure is not achieved yet though the value is close to the target, so the parties concerned should be fastidiously with a variety of opportunities and threats.

To asses past and on-going adaptation measures, document review and interview had been done. There are nine adaptation measures which were identified during the document review and interview with stakeholders After knowing the adaptation that occurs in study area, three selected adaptation measures which have high prioritizes are (i) mangrove conservation, (ii) elevating floor, and (iii) enhancing soft skill and entrepreneurship for local people.

Surabaya government has spent big amount of money to do adaptation measure projects. In the adaptation process, they involve community from an early age, ranging from planning, implementation, and monitoring and evaluation program to be implemented.

To determine criteria of evaluation, literature review and Delphi Analysis have been conducted. Identification of criteria for the evaluation is done based on the study of literature and has been crosschecked with stakeholders to determine the existing condition in the evaluation. Criteria of effectiveness, efficiency, equity, flexibility and sustainability are said important in judging success. The sub-criteria that found in the literature is fifteen sub-criterion, but after conducted Delphi with three stages, agreement of stakeholders is found with one new sub-criterion (Maintenance and Operation Cost).

Evaluating the success of adaptation measures is done by MCA analysis. The result shows the percentage of success for conservation mangrove, elevating floor, and enhancing soft skill are 57.57%, 61.61%, and 57.14% respectively. According to traffic light threshold, all adaptation measures that chosen are in yellow color. It means that the achievement of adaptation measure is not achieved yet though the value is close to the target. Problems include the fact that adaptation is still in an early stage of development and is not integrated with the planning systems. The integration among them is crucial due to the important role of the planning system and the planning profession in adaptation measure under disaster risk management.

The three selected adaptation measures include household adaptation (elevated floor) and city level adaptation (mangrove conservation and enhance soft skill of the people) having different recommendations. For the city level, the need for a planning instrument is also regarded by key stakeholders as more important than an emergency system for anticipating routine hazards rather than just responding to incidental hazards such as integrating adaptation application with the policy and actual condition of the area, Enhancing Spatial Plan, and Reforestation and flood infrastructure redevelopment. Then, economic development such as promoting household income and creating other sources of income, implementing insurance mechanism are regarded as significant ways to reduce people vulnerability.

6.2 Recommendations

6.2.1 Applications of research results

According to the main results of this study, focusing attention on adaptation measures will be a key to reducing community vulnerability to flood in the case study presented. This study also presents about problems and condition of ongoing and past adaptation measure, it can used by government as consideration in decision-making and monitoring process to face flood risk and it will improve the capacity of decision-makers to minimize the impacts of future disasters. Then, the results of each criteria show in yellow indicators, it should be reviewed to know which adaptation measure is still integrated and good and which one is not good and doesn’t fit with actual condition of the study area. Then, the recommendation to enhance adaptation strategies can be adopted by area which have same characteristic with study area.

This study proposes a way of recommendations for adaptations under disaster risk management. Lack of integration that shows in this study’s results can be suggestion to decision-makers. This integration is important to provide decision support systems for disaster assistance both from governments and non-government organizations. This kind of decision support system is needed to increase the degree of effectiveness of the chosen adaptations in the future.

Because of people in this study area have enough awareness to flood (based on key informants), it can be sustainable modal to human empowerment and it can make easy for government to do human capital strategies such as training to save from flooding and other hazards.

6.2.2 Limitations of this research

This research only focuses on stakeholder’s perception including representative of local people to evaluate the criteria of adaptation measures. Then, only local adaptation strategies are analyzed in this study. It will be good to also evaluate the regional and national adaptation strategies.

Flood vulnerability mapping in this study is not enough to explain the extent of flood problems in urban area, because urban settlement has various object that can be influenced differently by flood. This study was tried to describe vulnerability of flooding generally, and due to some limitations, especially time constraints, vulnerability was based on assumptions, previous study, and local experiences, not by actual vulnerability.

Most of the criteria in this research are qualitative. Measuring qualitative criteria in a quantitative manner may produce other errors in the results. Therefore, value is used for every qualitative variable. The use of grounded theory in analyzing the stakeholders' opinions can also increase the confidence of the results. In addition, since there is no complete documentation of the impacts of past floods, the condition of flood risk impacts including damaged houses are established by considering available data together with key informants' responses.

6.2.3 Further studies

Recommendations for next studies are needed to explore about recommendation to improve adaptation strategies to deal with flood risk based on criteria results. In addition, this research conducted in coastal area of Surabaya, with some adjustments this analysis can be applied to other case studies or hazard types with different types of climate change hazard in other areas. Assessing other possible adaptations in a variety of cases will improve the concept and practice of vulnerability assessment and evaluation of adaptation measures.

Study about community's perception can be conducted to know in deep about how community face flooding and how they survive because the finding here shows community no longer feel the flood as one of the threats, but they considered it as a matter limitations they face every day. Research by quantitative criteria in the next study can improve the results and may produce less error.

REFERENCES

Adger, W.N., Arnell, N.W. and Tompkins, E.L.(2005). Successful adaptation to climate change across scales.*Global Environmental Change* 15, 77-86.

Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R.S., Smit, B. and Takahashi, K. (2007), *Assessment of adaptation practices, options, constraints, and capacity*, in Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds.), Climate Change 2007: Impacts, Adaptation and Vulnerability.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. and Wreford, A.: (2009), *Are there social limits to adaptation to climate change?*, Climatic Change 93, 335-354.

Albrechts, L. (2006). *Shifts in strategic spatial planning? Some evidence from Europe and Australia*. Environment and Planning A 38(6): 1149-1170.

Baker, E. J. (1977). *Public Attitudes toward Hazard Zone Controls*. Journal of the American Planning Association 43(4): 401 - 408.

Basuki, S., (2000), Rate and trend of land subsidence in the eastern part of Semarang (in Indonesian), *Media Teknik*, No. 3, 2000.

Bakornas PB. (2007). Guidelines for Flood Control 2007-2008. Jakarta.

Beach, D. (2002). Coastal Sprawl: *The Effects of Urban Design on Aquatic Ecosystems in the United States. Pew Oceans Commission*. http://www.pewtrusts.org/our_work_report_detail.aspx?id=30037.

Coburn et al, (1994), *Disaster Mitigation*, UNDP, Cambridge Architectural Research Limited

CCSP (2009). Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region . A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Titus, J.G. (Coordinating Lead Author), K.E Anderson, D.R. Cahoon, D.B. Gesch, S.K. Gill, B.T. Gutierrez, E.R. Thieler, and S.J. Williams (Lead Authors). U.S. Environmental Protection Agency, Washington, DC, USA

Doria, M.d.F., Boyd, E., Tompkins, E.L. and Adger, W.N.: (2009), „Using expert elicitation to define successful adaptation to climate change,‟ *Environmental Science & Policy* 12, 810-819.

Dahuri, R (1966). Integrated Management of Coastal and Marine Resources.Jakarta: Pradnya Paramita, 2001

Fleischhauer, M., S. Greiving, (2005). Spatial Planning in the Focus of Hazard and Risk Assessment/Management in Europe. EURO-RIOB Conference, Wroclaw, 19-21 October 2005.

Fletcher, S., H.D. Smith (2007). “Geography and Coastal Management”, *Coastal Management* 35(4):419-427.

Greiving, S., M. Fleischhauer, et al., Eds. (2005). Report on the European scenario of technological and scientific standards reached in spatial planning versus natural risk management. Dortmund, ARMONIA Project, European Community.

Greiving, S., M. Fleischhauer, et al. (2006). "Management of natural hazards in Europe: The role of spatial planning in selected EU member states." *Journal of Environmental Planning and Management* 49(5): 739-757.Hyogo Framework for Action 2005–2015, 2005

Hsu, C and Brian A Sandford (2007). The Delphi Technique: Making Sense of Consensus. The Ohio State University and Oklahoma State University

IPCC.(2001). Climate Change 2001: Impacts, Adaptation & Vulnerability: *Contribution of Working Group II to the Third Assessment Report of the IPCC*. In J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken and K. S. White, eds. Cambridge, UK: Cambridge University Press. 1000 pp

IPCC Summary for Policymakers. (2007). The Physical Science Basis. Contribution of Working Group I to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press*

Jennings, T.L.: (2009), „Exploring the invisibility of local knowledge in decision-making: the Bostcastle Harbour flood disaster,‟ in Adger, W.N., Lorenzoni, I. and O'Brien, K. (eds.), *Adapting to Climate Change: Thresholds, Values, Governance, Cambridge University Press, Cambridge*, UK, pp. 240-254.

Pamungkas, A. (2006). Feasibility Assessment of Flood Disaster Mitigation Techniques in Indonesian Context. Surabaya

Kodoatie, R. J. (2005). *Introduction to Management Infrastructure*. Yogyakarta: Pustaka Pelajar

Kodoatie, R.J. (2008). *Integrated Water Resources Management*. Yogyakarta: ANDI.

Kodoatie, R. J. (2010). *Spatial Water*. Yogyakarta: ANDI: Pustaka Pelajar.

Nordhaus, W. D (2006). *The Economics of Hurricanes And Implications Of Global Warming*. Yale University. USA

McGranahan, G (2000). *The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones*. London. UK

Maskrey, A. (1998). Community Based Disaster Management, CBDM-2 Hand-out: ADPC

Meiviana, A., D.R. Sulistiowati dan M.H. Soejachmoen. 2004. *Earth is getting hotter*: Threat of Climate Change in Indonesia. Yayasan Pelangi. Jakarta.

O'Brien, K., Eriksen, S., Sygna, L. and Naess, L.O.: (2006), „*Questioning Complacency: Climate Change Impacts, Vulnerability, and Adaptation in Norway*,‟ Ambio 35, 50-56.

O'Brien, K., Lieichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L. and West, J.: (2004), „Mapping vulnerability to multiple stressors: climate change and globalization in India,‟ *Global Environmental Change* 14, 303-313.

Office of Public Work. (2009). *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. Ireland

Pande, R. K. (2010). Flash Flood Disasters in Uttarakhand. *Journal of Disaster Prevention and Management* 19(5): 565-570

Pugh,DT.(1987). *Tides,Surges and mean sea-level*: a handbook for engineers and scientist. Wiley, Chichester,472pp

Pugh,DT.(2004). *Changing Sea Levels Effect of Tides,weather and climate*. Cambridge University Press,280pp

Prasita, V. Dj and Kisnarti (2013). *Methods of Tidal Approach for Determination of Sea Level Rise in Surabaya Waters. Department of Oceanography, Faculty of Engineering and Marine Science, Hang Tuah University*.

Prasita, V. Dj. and E. A. Kisnarti, (2013). Prediction of Sea Level Rise Impacts on the Coastal Areas of Surabaya using GIS. *The International Journal of Engineering and Science Volume 2, Issue 7, Version 5 July 2013*. Page 01-09.

Republic of Indonesia. (2007). Law Number 26 Year 2007 About Spatial Planning. Jakarta

Republic of Indonesia. (2003). Land Use Control Guidelines In Flood Prone areas. Jakarta: Directorate General of Spatial Planning

Republic of Indonesia. (2005). *Guide Introduction Characteristics Disaster and mitigation efforts*. Jakarta: Directorate General Spatial Planning

Republic of Indonesia. (2007). Guide Manual Flood Disaster. Jakarta: Daily Implementing Bakornas PB.
Republic of Indonesia. (2007). Law Number 24 Year 2007 about Disaster. Jakarta

Rosenzweig, C., Major, D.C., Demong, K., Stanton, C., Horton, R. and Stults, M.: (2006), „Managing climate change risks in New York City‟s water system: assessment and adaptation planning,‟ *Mitigation and Adaptation Strategies for Global Change* 12, 1391-1409.

Smit, B. and Wandel, J.: (2006), „Adaptation, adaptive capacity and vulnerability,‟ *Global Environmental Change* 16, 282-292.

Saaty, T. L. (1993), *Decision Making for Leader* : The Analytical Hierarchy Process for Decisions in Complex World. Pittsburgh : University of Pittsburgh.
Smith, J.B. (1996). Development of Adaptation Measures for Water Resources. *Water Resources Development* 12(2)

Surabaya Municipality. (2013). Spatial Planning of Surabaya City 2013. Surabaya
Suryanta, J. (2012). *A Simple Method to Map Flood hazard*: Kolokium Hasil Litbang Sumberdaya Air.

Therivel, R. (2004). Strategic Environmental Assessment in Action. Earthscan. London

TU, T. (2009). *Adaptation to Flood Risk in Coastal Urban Area under Rapid Urbanization and Climate Change in Ho Chi Minh City, Vietnam*. Asian Institute of Technology

Turner et al., (2004). A Framework for Vulnerability Analysis in Sustainability Science. *Proceedings of the National Academy of Sciences of the United States of America* 100, 8074-8079.

The National Academies. (2010).Sea level Rise and Coastal Disaster. *The National Academies Press: Washington.D.C*

UNDP (2008) „*Fighting Climate Change*: Human Solidarity in a Divided World‟, Human Development Report 2007/2008, United Nations Development Programme, http://hdr.undp.org/en/reports/global/hdr2007-8/.

UNDP-Indonesia. (2007). Kerangka Kerja Pengurangan Risiko Bencana, Rencana Aksi (*Framework for Disaster Risk Reduction Action Plan*) Provinsi Nangroe Aceh Darusalam. Jakarta

United Nations/International Strategy for Disaster Reduction (UN/ISDR) (2004), Living with Risk: A Global Review of Disaster Reduction Initatives, 1, Geneva: United Nations

APPENDIX A:
LIST OF QUESTIONS FOR DETERMINING CURRENT ADAPTATION MEASURE

With Regards,

This questionnaire aims to assess current adaptation measures. Later, in the study of these criteria will be used to determine criteria to reach objectives of this research. I hope you provide answers to some questions. Then, I would like to say thank you for your time and cooperation.

Ariyaningsih
Urban Environmental Management
Asian Institute of Technology

Identity of Respondent

Name :

Position :

1. Can every individual do something to ADAPT to flood risk?
2. What have you done ALREADY to adapt to climate change?
3. What is the adaptation measure in this area?
4. Is there any change in attitudes or awareness after implementation of adaptation?
5. What did YOU learn about ways to adapt to CC?
6. Have you already planned to do any of these things in the FUTURE ie next 5 years to adapt to climate change?
7. How did you get a warning?

Please indicate whether you agree, disagree or don't know with regards to following statements.

Questions	Agree	Disagree	Don't Know
1. Every individual can do something to ADAPT to climate change			
2. The central/local government ARE doing things to help us to ADAPT to CC locally. If "agree" please give			

Questions	Agree	Disagree	Don't Know
Examples: …………………………………………………………………..			
3. The central/local government has ALREADY CONSULTED us to enable us to identify our areas of concern about CC on our island. If "agree" please give examples : …………………………………………………………………..			

15. Do you have anything you would like to add about any adaptation issues?

APPENDIX B
SCORING QUESTIONAIRE TO SELECT THE ADAPTATION MEASURE

With Regards,

The scoring questionnaire will be used to help researcher to choose current adaptation measure that deserve to evaluate. Please give the rank from 1 to 9 in this table below. I would like to say thank you for your kindly help and attention.

Ariyaningsih
Urban Environmental Management
Asian Institute of Technology

Please fill the rank coloum with number 1 to 9 for making prioritize. Numner 1 means that adaptation measure is definitely important and number 9 means that adaptation measure is definitely not important to evaluate.

No	Adaptation Measure	Rank
1.	Build Long Storage and box culvert in coastal area	
2.	Mangrove Conservation Area	
3.	Enhance Soft Skill of Community (preparedness and entrepeneurship)	
4.	Restoration and Protect River and Canal	
5.	Modify Floor (Adding number of Floor)	
6.	Built Small Embankment in front House	
7.	Eletave the House	
8.	Making artificial embankment of bamboo in pond	
9.	Maintenance mangrove in pond	

APPENDIX C:

DELPHI QUESTIONAIRE

EVALUATING CLIMATE CHANGE ADAPTATION USING CRITERIA FOR MEASURING THE SUCCESS OF ADAPTATION MEASURES IN COASTAL URBAN DEVELOPMENT CONTEXT

With Regards,

This questionnaire aims to determine the criteria to evaluate climate change adaptation. Later, in the study of these criteria will be used to formulate successful adaptation to reach objectives of this research.

With this, please willingness of you to be the respondents in this study. I hope you to provide answers to some questions in the questionnaire and its reasons. Previously, I would like to thank for your cooperation so that this research can be successful.

Researcher

Ariyaningsih

St115874

Urban Environmental Management

Asian Institute of Technology

Table 1 Organization of Criteria

No	Criteria	Group of member
1	Effectiveness	• Policy, planning, priorities and political commitment • Integration with development policies and planning • Integration with emergency response and recovery • Institutional mechanism, capacities and structures
2	Flexibility	• Hazard/risk level • Scientific and technical capacities and innovation
3	Equity	• Impact • Environmental and natural resources • Livelihood • Culture, attitudes, education

4	Efficiency	• Financial instrument • Cost recovery for adaptation
5	Sustainability	• Public awareness, knowledge, skill • Information management and sharing • Learning and research

Questionnaire

I. RESPONDENT PROFILE

Name :

Gender :

Position :

II. QUESTIONNAIRE DATA

Are these criteria appropriate to climate adaptation of evaluation?

No	**Criterion of Evaluation**	**Sub Criterion of Evalution**	**Answer**		**Reason**
			Yes	**No**	
1	Effectiveness	Enhancing policy, planning for adaptation measure			
		Legal and regulatory			
		Integration with development policies and planning			
		Institutional mechanism, capacities and structures			
2	Flexibility	Hazards risk			
		Scientific and technical capacities and innovation			
3	Inequality	Impact data			
		Environmental and natural resources			
		livelihood			
		Culture, attitudes, education			
4	Efficiency	Financial instruments			
		Cost recovery for adaptation			
5	Sustainability	Public awareness, knowledge, skill			

No	Criterion of Evaluation	Sub Criterion of Evalution	Answer		Reason
			Yes	No	
		Information management and sharing			
		Learning and research			

Do you have any new sub-criterion that important to evaluate the adaptation measure?

……………………………………………………………………………………………
………………………

APPENDIX D
QUESTIONAIRE FOR AHP (WEIGHTING)

Sincerely Mr. / Ms:

This questionnaire aims to determine the criterion and sub-criterion. In this analysis, we try to "Weighting criteria and sub-criteria that used in evaluation of adaptation measure". This questionnaire aims to weighting criteria and sub-criteria by order of importance. Weighting sub-criterion will divided into 5 categories.

Score	Note
1	Same important
2	Between 1-3
3	A little bit important
4	Between 3-5
5	More important

I hope the willingness of Mr./Mrs. for answering this questionnaire in accordance with your experience. Thank you very much for your availability.

With Respect,

Ariyaningsih

Identity

Name :

Inatitution :

Position :

I. Weighting Main Criterion

Effectiveness	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Flexibility	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Inequality	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Efficiency
	5	4	3	2	1	2	3	4	5	Sustainability

Efficiency	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Sustainability

Sustainability	5	4	3	2	1	2	3	4	5	Effectiveness
	5	4	3	2	1	2	3	4	5	Flexibility
	5	4	3	2	1	2	3	4	5	Inequality
	5	4	3	2	1	2	3	4	5	Efficiency

II. Weighting Sub-Criterion

- Effectiveness

SC1	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3
	5	4	3	2	1	2	3	4	5	SC4

SC2	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3

SC3	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC4

SC4	5	4	3	2	1	2	3	4	5	SC1
	5	4	3	2	1	2	3	4	5	SC2
	5	4	3	2	1	2	3	4	5	SC3

- Flexibility

SC5	5	4	3	2	1	2	3	4	5	SC6

- Inequality

SC7	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC9
	5	4	3	2	1	2	3	4	5	SC10

SC8	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC9
	5	4	3	2	1	2	3	4	5	SC10

SC9	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC10

SC10	5	4	3	2	1	2	3	4	5	SC7
	5	4	3	2	1	2	3	4	5	SC8
	5	4	3	2	1	2	3	4	5	SC9

- Efficiency

SC11	5	4	3	2	1	2	3	4	5	SC12
	5	4	3	2	1	2	3	4	5	SC13

SC12	5	4	3	2	1	2	3	4	5	SC11
	5	4	3	2	1	2	3	4	5	SC13

SC13	5	4	3	2	1	2	3	4	5	SC11
	5	4	3	2	1	2	3	4	5	SC12

- Sustainability

SC14	5	4	3	2	1	2	3	4	5	SC15
	5	4	3	2	1	2	3	4	5	SC16

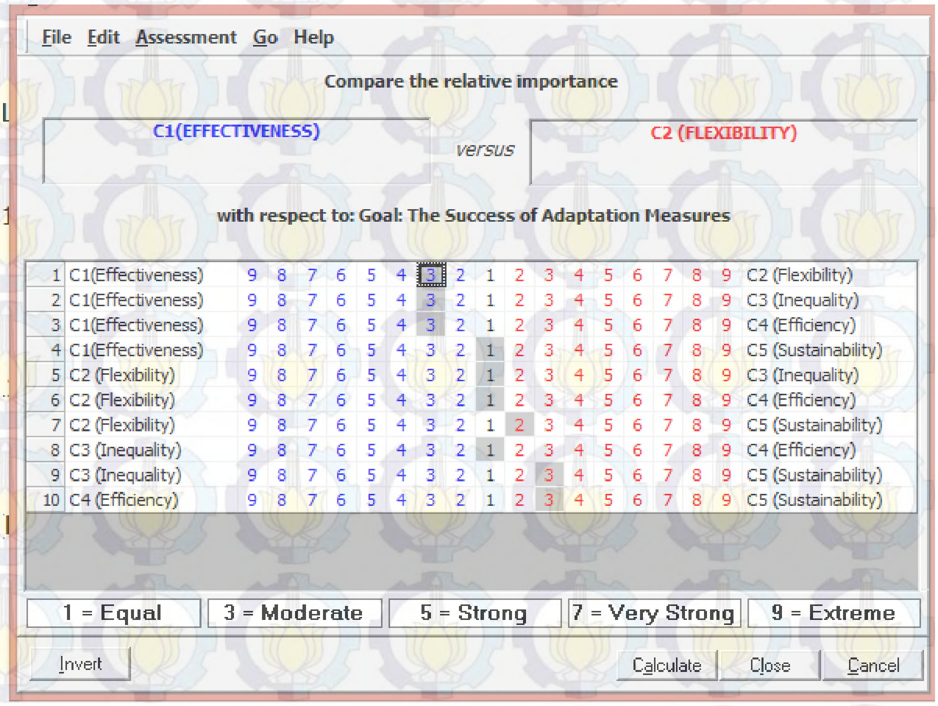
SC15	5	4	3	2	1	2	3	4	5	SC14
	5	4	3	2	1	2	3	4	5	SC16

SC16	5	4	3	2	1	2	3	4	5	SC14
	5	4	3	2	1	2	3	4	5	SC15

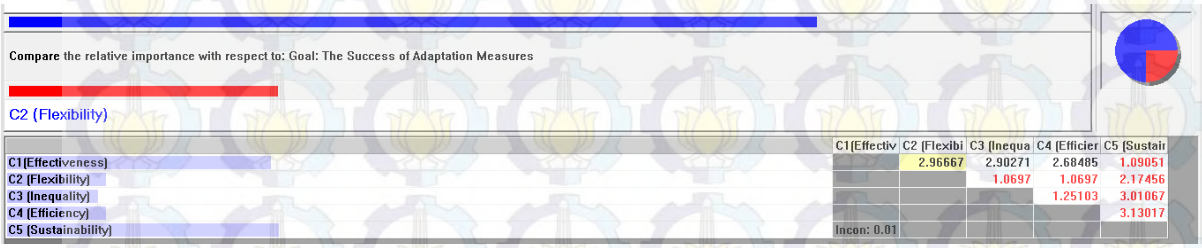
APPENDIX D.1

AHP QUESTIONAIRE RESULTS (MAIN CRITERION COMBINED)

A. Questionaire input



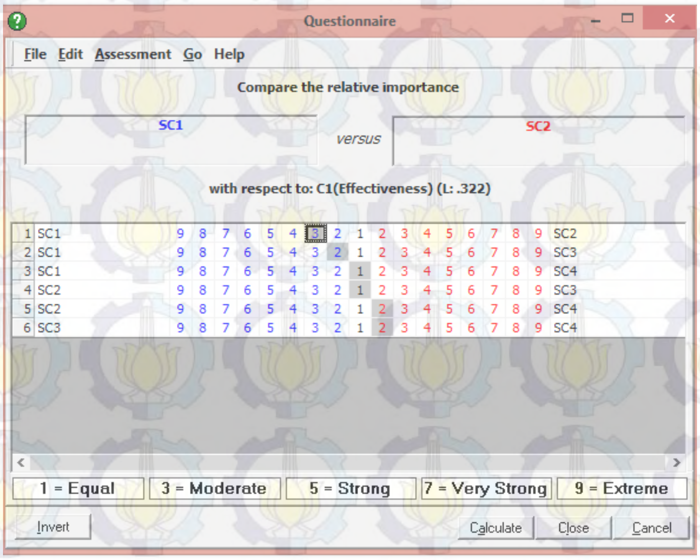
B. Pairwise Individual



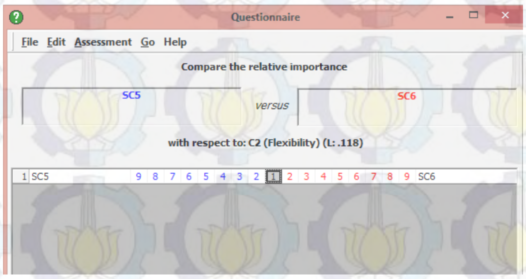
APPENDIX D.2

AHP QUESTIONAIRE RESULTS (SUB CRITERION)

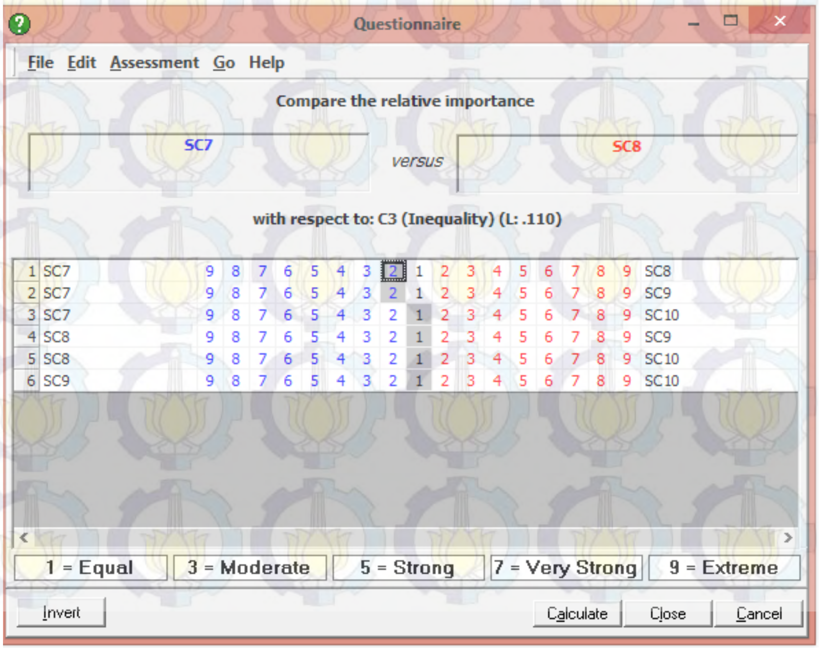
- Effectiveness



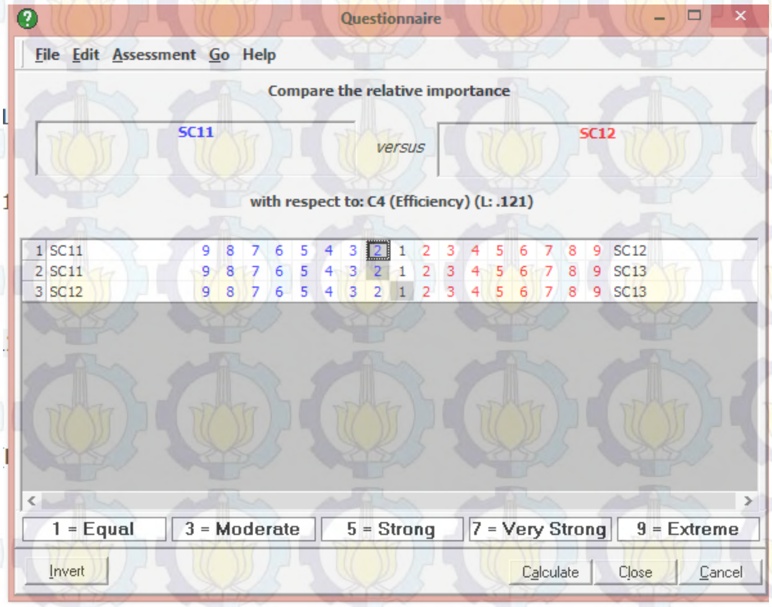
- Flexibility



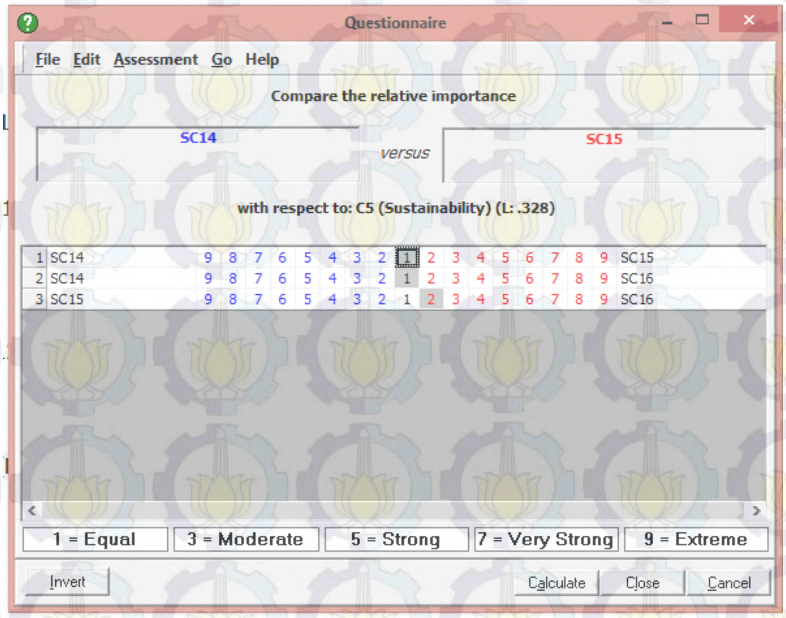
- Inequality



- Efficiency



- Sustainability



APPENDIX E

EVALUATION QUESTIONAIRE FOR LOCAL GOVERNMENT

Dear participants,

The feedback from this questionnaire will be very useful to us in improving the quality of adaptation measure. Thank you very much for your cooperation.

With Respect,

Ariyaningsih

No	Criteria	Definitely disagree (1)	Mostly disagree (2)	Neutral (3)	Mostly agree (4)	Definitely agree (5)
1.	Effectiveness					
	Policy, planning, priorities and political commitment are appropriate with existing adaptation measure					
	Legal and regulatory systems is good					
	Good Integration with development policies and planning					
	Good Integration with emergency response and recovery					
	Institutional mechanism, capacities and structures					
2.	Flexibility					
	Existing adaptation is relevant with hazard/risk happen in area					
	Scientific and technical capacities and innovation are available to address the hazards					
3.	Equity					
	Updated impact data is used to make adaptation measure					
	Environmental and natural resources is advantageous to adaptation measure					
4.	Efficiency					
	Financial instruments do efficiency by government to get maximum adaptation					
	There are cost recovery for adaptation measure					
	Monitoring and Operation Cost is appropriate to target					
5.	Sustainability					
	Public awareness, knowledge, skill are					

No	Criteria	Definitely disagree (1)	Mostly disagree (2)	Neutral (3)	Mostly agree (4)	Definitely agree (5)
	maintenance to get sustainable adaptation					
	Information management and sharing is doing well					
	Learning and research is built					

APPENDIX F: DATA INPUT FOR SCORING ANALYSIS

Mangrove

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	4	5	5	2	4	3	4	1	1	1	4	4	3	3	3	3
City Department of Spatial Planning	3	5	4	1	2	2	2	3	3	2	2	2	2	4	4	4
Regional Disaster Management	5	5	5	4	4	2	3	3	3	3	1	2	2	4	4	4
Academician	4	4	2	3	4	3	3	3	2	1	2	1	1	3	3	3
Agency for Environmental Management	3	5	3	2	2	3	2	2	4	2	4	3	2	4	3	4
Head of Krembangan	5	4	5	4	2	4	4	4	4	1	3	4	4	1	1	1
Head of Pabean Cantikan	3	3	3	1	4	4	3	3	4	4	2	3	2	2	3	3
Head of Kenjeran	4	3	2	1	1	1	2	3	3	3	3	2	2	2	2	2

Elevating Floor

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	3	3	2	2	2	1	3	3	3	3	2	2	3	3	4	4
City Department of	3	2	2	3	5	5	3	3	3	3	2	3	3	2	2	2

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Spatial Planning																
Regional Disaster Management	3	3	3	4	4	3	2	2	2	2	5	3	4	4	4	2
Academician	3	3	3	2	4	5	3	3	4	4	3	3	3	4	3	3
Agency for Environmental Management	4	4	4	5	2	4	3	3	3	3	2	2	3	4	2	4
Head of Krembangan	3	3	3	2	4	2	2	3	3	3	3	2	2	4	4	5
Head of Pabean Cantikan	3	2	3	4	4	4	2	4	4	4	3	3	2	4	3	3
Head of Kenjeran	3	3	3	1	4	2	3	3	3	3	2	2	2	4	2	4

Enhance soft skill

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Town Planning Agency	3	4	3	1	4	1	3	5	5	1	1	1	2	3	3	3
City Department of Spatial Planning	3	2	2	2	2	4	2	2	2	2	2	2	5	4	4	3
Regional Disaster Management	3	3	3	1	2	1	1	4	2	1	4	4	4	3	3	3
Academician	3	3	3	1	3	3	4	4	4	4	2	2	4	4	4	3
Agency for	4	4	4	4	4	5	3	4	4	4	4	4	2	3	3	3

Stakeholders	C1				C2		C3				C4			C5		
	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC13	SC14	SC15	SC16
Environmental Management																
Head of Krembangan	3	3	3	2	2	2	3	3	3	1	4	3	4	4	4	4
Head of Pabean Cantikan	2	2	2	2	2	2	3	3	3	1	2	2	2	4	4	3
Head of Kenjeran	4	4	4	2	1	1	4	4	4	3	2	2	3	3	4	4

APPENDIX G : PICTURES DURING INTERVIEW AND SURVEY

A. Interview stakeholder's pictures

City Planning Agency (Bappeko)

Departement of Public Works – Devision Spatial Plannibg

Regional Disaster Management

Agency of Environmental Management

B. Field Observations

Mangrove in Wonorejo

Road condition in Kenjeran

Fishery housing in Krembangan

Fishery housing in Kali Kandangan

Coastal Environmental Condition

Bozem in Krembangan

Building density in Sukolilo Districts

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BIOGRAPHY

The author was born in Kediri, October 19th, 1989. She has been finished her study in elementary school in SDN Doko I (2002), junior high school in SMPN 1 Kediri (2005), senior high school in SMAN 1 Kediri (2008). She also got bachelor degree in engineering from Urban and Regional Planning Departement, FTSP-ITS (2012) with her final project about telecommuting topic. She continued her master degree in Architecture Departement, FTSP-ITS by double degree program between Sepuluh Nopember Institute of Technology (ITS) and Asian Institute of Techology (AIT) Thailand. She chosed her field of study in Urban Environmental Management during her study in AIT. Her thesis was about adaptation to climate change in Surabaya City. She finished her master degree in science under the excellent guidance of Dr. Vilas Nitivattananon as her advisor, Dr. Ir. Rimadewi Supriharjo, MIP as co-advisor, Dr. Bonaventure H.W Hadikusumo and Dr. Clemens Grunbuhel as her commitees. She interests in climate change, urban transportation, urban and regional development for reseacrh. She can be contacted by email in aiira.aya@gmail.com.