# Assessment of Adaptive Capacity on Coral Reef Conservation in Weh Islands, Indonesia

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ABSTRACT

Adaptation strategies to cope with climate change become increasingly desirable to be implemented in the small island's community. Small islands with its limitation are ever more vulnerable. The high dependency of its natural resources requires an integrated management among aspects such as social, political and intellectual. These three aspects are also prominent capital to enhance local adaptive capacity, which could be assessed and evaluated through the Adaptive Capacity Wheel.

In this Thesis, Weh Island is chosen as a case study to assess adaptive capacity related to coral reef conservation, which perceived as adaptation strategy. Coral reef ecosystem plays crucial role to the tourism sector in Weh Island. Located on the western territory of Indonesia, this island is where the remarkable underwater scenery of Indonesia starts from. However, climate change is indicated by coral bleaching in the late 1998. Years after, the community together with the local government and Environmental NGOs are doing conservation program.

The adaptive capacity related to the conservation program is evaluated and assessed by applying the adaptive capacity wheel (ACW). In-depth interviews were conducted with stakeholders. From the three main elements of the ACW, social capital has the highest score followed by intellectual capital, while political capital has the lowest score. The existence of Panglima Laot as a customary board contributes positively to the enhancement of social capital. Overall, it is found that the coral reef conservation program has positively improves local participation and awareness of climate change. To sum up, several points of recommendation are suggested. Promoting fair governance and raising knowledge of climate change are highly recommended.

Keywords: *climate change, adaptation, adaptive capacity wheel, coral reef conservation, social capital, Small Island.*

# PREFACE

Climate change is happened and dangerously affected coastal ecosystems. Coral reefs ecosystem is among valuable ecosystem along coastal area that most affected by climate change. However, the main threat to coral reefs ecosystem is not by the natural pressure but anthropogenic pressure. Especially to Small Island's community, degradation of coral reefs ecosystems is crucial, as their livelihood is highly dependent on ecological value served by coral reefs ecosystem. Therefore, coral reef conservation is fundamental as an adaptation strategy to reduce vulnerability as well as to enhance resilience of the Small Island's community. The assessment of adaptive capacity on coral reef conservation program in Weh Islands is the main idea of this thesis. Indeed, this thesis is not solely aimed to fulfill the requirement of the Master Degree but also dedicated as part of my contribution to my country Indonesia and more specifically to my hometown Aceh.

On this special occasion I would like to acknowledge that this thesis would not have been possible without support of many people and institutions. First of all I would like to express my greatest grateful to God Almighty that made everything is possible. I also would like to express my gratitude to my thesis supervisors: Prof. Johan Woltjer (RUG) and Dr. Thomas Klenke (CvO UO) for their valuable remarks, comments and supports. In addition, more specifically I would like to thankful and appreciate the Aceh Government which granted me a scholarship to pursue my study in two different countries (Germany and the Netherlands). Special honor also I would like to address to DAAD who granted me field research funding through DevSus Program in Oldenburg University. Special thanks to all my friends, both in Groningen and Oldenburg, respectively my colleagues of DAAD Aceh Scholarship Holders who tirelessly encourage and share memorable moments during our study.

Finally the whole journey of this master degree is come to the end, and my honorable mentions goes to my family: to my beloved mom, my brothers and my sisters who support and believe in me that I can continue my study abroad, that was a big dream come true. Thank you for everything! Alhamdulillahirabbil'aalamiin.

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## ABBREVIATION LIST

ACW : Adaptive Capacity Wheel

$CO_2$ : Carbon di Oxide

ENSO : El Niño Southern Oscillation

| | |
|---|---|
| FFI | : Flora & Fauna International |
| GHG | : Green House Gases |
| IPCC | : Intergovernmental Panel on Climate Change |
| IUCN | : International Union for Conservation of Nature |
| MPAs | : Marine Protected Areas |
| NGOs | : Non Governmental Organizations |
| ODC | : Ocean Diving Club |
| RuG | : Rijksuniversität Groningen |
| SCUBA | : Self Contained Underwater Breathing Apparatus |
| SIDS | : Small Islands Developing Countries |
| TEK | : Traditional Ecological Knowledge |
| UNDP | : United Nations Development Program |
| UNEP | : United Nations Environment Program |
| UNFCCC | : United Nations Framework Convention on Climate Change |
| UNSYAH | : Universitas Syiahkuala (Syiahkuala University) |
| WCS | : Wildlife Conservation Society |
| WMO | : World Maritime Organization |

# CHAPTER 1

# INTRODUCTION

## 1.1. Background

Climate change is a global problem, threatened all countries across the globe. Despite its global effect, however, climate variability is obviously evident in a range of temporal and local scales (Tol, 2005). The global trend of climate impact on coastal area shows that coastal ecosystem becomes more vulnerable. High vulnerability is due to various elements that embedded in the dynamic of the coastal area. Sea level rise and the increasing sea surface temperature are the main threat to coastal ecosystem (Case, 2007).

Indonesia, the world's largest archipelagic country, is facing a serious problem. Coastal ecosystem consists of coral reefs, mangrove, and other important ecosystems, is seriously threatened. Degradation of coastal ecosystem is caused by many factors, in which humanity is contributing. The combination of anthropogenic and natural phenomena is influenced negatively and put coastal area under pressure. Environmental degradation lead by the increasing of population and infrastructure along a coastal area has exacerbated the natural climate impact (Nicholls, 1995). Sea level rise and ocean acidification are also among the crucial issue of climate change which harmful to coral reef ecosystem (Mimura, 1999). That is crucial, since coral reef is the most prominent ecosystem along a coastal area.

Rivaled by tropical rain forests on the land, coral reefs are owing to their diversity also well known as one of the most valuable ecosystems on the planet. In fact, scattered mostly around the equator line, Indonesia has an extensively diverse range of coral reefs. This fact ensures that the coral reefs of Indonesia are elevated in importance as a source of livelihood not only for Indonesian society, but also for the world.

The coral reef ecosystem is vitally essential to the whole processes of coastal ecosystems. It may be seen for its numerous ecological, economic, aesthetic, and cultural functions. In Indonesia, coral reef ecosystem is a central issue when it comes to marine tourism. This leisure business sector put their capital on various famous diving spots spread all over the area, especially around

the small islands. From an ecological perspective, coral reefs also have a significant role in protecting the coastlines from abrasion. Moreover, coral reefs are a lifeline for many coastal organisms.

However, nowadays coral reefs in Indonesia are threatened due to irresponsible activities of stakeholders. Various anthropogenic treatments which conducted in a non-sustainable manner, have led to an alarming degradation of both the quality and the quantity of coral reefs. Unavoidable, natural phenomenon led by climate change also becomes the main reason to adapt. El Nino events in 1998 in the Indian Ocean (including Indonesia, Thailand, Cambodia, and Malaysia) caused widespread coral bleaching due to increased sea surface temperature in which coral reef unable to cope with (Obura, 2004).

The diversity of Indonesian marine waters is extremely rich, placing Indonesia second only to Australia to the largest area of coral reefs in the world. Most relevantly, Indonesia is at the center of the world's coral triangle, a region with rich of tropical marine biodiversity. Weh Islands belong to the Aceh province in the northernmost of Sumatera Island. It represents the western most part of the Indonesian underwater paradise, stretching some 4,000 km to the Eastern part of Sumatera Island. Coral reef ecosystem is a main element of marine tourism in Weh Islands. However, climate impact on the coral reef ecosystem is factual and thus need for adaptation.

Adaptation strategy to cope with climate change is more effective than mitigation strategy. While mitigation is closely related to government task, adaptation is directly connected to the community as the main object who suffers from climate variability (Füssel, 2007). Quoting the IPCC Fourth Assessment Report 2007, "adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". If then adaptation is not taking place from now and on, coastal community will be more suffer in the future. A conservation program to decrease vulnerability of coral reef as well as to increase its resilience should be promoted by local community with the support of local university and the government.

There is no doubt that adaptation to climate change is urgent and should be put in a priority. Integrated management as well as sustainable approach should be promoted. Therefore, the

combination of different aspects in formulating adaptation policy is crucial. In this research, implementation of adaptation strategy is measured by assessing adaptive capacity elements which consists of intellectual, social, and political capital; respectively in a coastal community.

Particularly, it is obvious that adaptation strategy is highly depending on adaptive capacity. However, unfortunately, not like developed country which has substantial adaptive capacity and technology for mitigation, developing country like Indonesia, however, still has to deal with other priorities such as poverty and local economic growth than to cope with climate change. Zooming in the practical example of how does adaptation strategy being implemented at the local level, Weh Islands in Aceh Province is chosen. Coral reef conservation is perceived as an adaptive strategy to cope with climate issue related to coral reefs.

There are several conservation policies in Indonesia. Some of them are using technical approach such as coral transplantation, coral recruitment, and Biorock technique. Conservation program focus on technical approach aims to speed up the recovery of threatened coral. However, there is also a conservation policy which focuses on legal approach. The implementation of MPAs is a famous example. This approach aims to protect the respective coastal area from overfishing which indirectly conserve the coastal ecosystem. In this research, those two kinds of conservation program are elaborated. Coral transplantation is categorized to species-based conservation. On the other hand, MPAs is considered as area-based conservation.

The intention of this research is mainly focused on the adaptive capacity assessment in Weh Islands. As part of element in the adaptive capacity, institutional here is not defined as an institution but rather in a broad meaning. Gupta et al (2010) argued that institutions in the current dynamic social culture have to support social actors to encounter uncertainties through planned actions within institutions. Institutional capital is not only dealing with organizational skill but also enhancing social behavior (Pedersen et al, 2005). With a focus on adaptability to cope with climate variability and uncertainty, adaptive capacity is assessed through categorization of six elements namely variety, learning capacity, room for autonomous change, leadership, resources, and fair governance (Gupta et al, 2010). These six elements are categorized into three main elements, namely intellectual, social, and political capital. In this case, political capital has the

same interpretation to institutional capital as it closely related to the institution and the behavior of the policy maker to implement and succeed the conservation program.

As a final point, coral reef ecosystems in Weh Islands have to be well-protected. It is not only due to its valuable resources to the tourism sector but coral reefs are also playing important role to counter global warming. Moreover, some adaptation policies that already done and still going on are playing an important role and have to be retained. Coral reef conservation policy is playing a role as an adaptation policy in Weh Islands. Therefore, it is interesting and important to measure the effectiveness and the implementation of the conservation policy through implementing the Adaptive Capacity Wheel (ACW). The ACW is a valuable tool to assess how such conservation policy helps to improve adaptive capacity of the community in order to cope and anticipate further climate change phenomena.

### 1.2. Problem Statement

The coral reef ecosystem has a significant role in the coastal area. However, it is one of among prominent ecosystem along the coastal area which becomes more vulnerable to the change of climate variability. To cope with climate change, there are two basic strategies namely adaptation and mitigation. The differences between those two strategies are mainly in the actor's involvement. Mitigation strategy is strongly initiated by the national government; on the other hand adaptation strategy is more sectoral and run by the local community. Adaptation strategy is also proved to be more effective when local actors get involved actively (Füssel, 2007).

Adaptation to climate change is not only about technical measures but also community involvement (Füssel, 2007). Local community is the most affected actor and directly suffers from the change of climate variability. Thus, they tend to act actively to adapt. In a coastal community, it is clear that they have no choice but to conserve their natural resources. For coastal community, especially in small islands, the natural resources along the coastal area are their main income to support their life (Mimura et al, 2007). Conserving the natural resources means everything for the community.

It is fair to say that, for example, coral reef conservation, as part of adaptation strategy, is highly dependent on community participation. Many small islands all over the world perceived coral reef ecosystem as their main assets with regard to economic income. Small islands with their limited resources are highly dependent on the tourism sector (Nurse et al, 2009), in which the beauty of coral reef is the most notable capital for marine tourism. However, the impact of climate change, in this case is coral bleaching, is currently threatening this vital sector. Adaptive capacity ranges from intellectual, social, and political capital (Khakee, 2002) and it is regarded as a key element to succeed the implementation of adaptation strategy. Thus, it is necessary to assess the adaptive capacity of coral reef conservation in Weh Islands.

### 1.3. Research Objectives

The main objective of this research is to assess the adaptive capacity of coral reef conservation in Weh Islands, Indonesia. In a simple word, the assessment attempts to know the effectiveness of current coral reef conservation. Furthermore, this research is focusing on a small island issue, taking Weh Islands in Indonesia as a case study. In a wider context, the adaptive capacity of coastal communities, more specifically on the small island, is to some extent different with the community on the mainland. Those differences are intriguing to explore and elaborate to add perspective about adaptive capacity in Small Island's community. Moreover, coral reef conservation could also be analogous to other environmental protection program to cope with climate issues. Thus, coral reef conservation in this case is respected as adaptation strategy.

This research is done by taking field data collection in some areas in Weh Islands. The island is located on the most western territory of Indonesia. Elements of the adaptive capacity are ranging from intellectual, social, and political capital. Each of those three main elements consists of two derived criteria. The derived criteria are adopted from the adaptive capacity wheel. To get insight and opinion from the stakeholders, list of questions based on those sub-criteria are formulated and asked. All those elements have influenced the implementation of coral reef conservation and evaluation could be made by doing the assessment. Evaluation has also benefited to improve the implementation and to succeed the program.

### 1.4. Research Questions

The main question of this research is: **to what extent the implementation of coral reef conservation program has influenced the adaptive capacity of the community in Weh Islands?** Furthermore, in order to elaborate main question, some related research questions are emerged as followed:

- How is recent coral reef condition in Weh Islands?
- What kind of conservation policies that has been and will be implemented in Weh Islands?

### 1.5. Research Significance

This research means to elaborate and to evaluate the implementation of coral reef conservation in Weh Islands. It will contribute towards the development of adaptive capacity theory respectively with regard Small Island and environmental protection program. Community involvement along the coastal area is the focus of this research. Coral reef conservation is considered similar to other environmental protection program to face climate change challenge. In a wider scope, this research also attempts to give perspective and additional element to existing adaptive capacity wheel by adjusting developing countries perspective and/or condition in small islands all over the world.

### 1.6. Research Scope

The scope of this research is limited to coral reef conservation in Weh Islands. In addition, general condition and challenge faced by coral reef ecosystem along the coastal area of Weh Islands are elaborated. Furthermore, coral reef conservation program, which has been done and still ongoing, is used as an object of the adaptive capacity assessment. The assessment is based on three main elements which are intellectual, social, and political capital.

Table.1 Data resources

| Research objectives | Data required | Methodology |
|---|---|---|
| Identify impacts of climate change to coral reef ecosystem | Technical report, environmental assessment, scientific literature | Literature review, observation |
| Analyze adaptive capacity of coral reef conservation | Official document, scientific literature, perception | Interview, qualitative and quantitative analysis, literature review, document analysis |
| Identify the main stakeholders | Official documents, scientific literature | Document analysis, interview |
| Conclusion and Recommendations | Scientific literature | Literature review |

### 1.7. Research Methodology

This research will mainly be based on literature review and direct observation. Moreover, most of the analysis in this research is a qualitative analysis, respectively through conducting some interviews to collect information and perception. The interviews were conducted on May 2012 during the field research to Weh Islands. It was conducted in informal condition through a discussion. The stakeholders who were interviewed are the most relevant actors. They are perceived as representatives of each category from the element that will be assessed. These stakeholders are: FFI; Panglima Laot (a customary board); dive operator; Unsyah - ODC; and The Marine and Fisheries Agency of Aceh Province. Main data for this assessment is based on the interview. All stakeholders were asked the open question with no limited time. There is no limited sort of question, meaning that every stakeholder has its own perception regarding all elements.

Qualitative method is used to know the real condition that happens in the field. Through in-depth interviews, it is used to find problem, perception, and further question that will lead to analyze and to compare perception among actors. On the other hand, quantitative method is used to

assess and present the degree of adaptive capacity of each sub-criterion. This method is formulating the effectiveness, problem, and degree of participation in which influencing the implementation of coral reef conservation in Weh Islands.

With the intention of gaining insight on the climate change impacts on coral reefs ecosystem, literature review is conducted through collecting technical report and scientific literature. Scientific literature with a keyword of climate change, small islands, adaptive capacity theory and coral reef conservation is collected and reviewed. Those literatures are used to have a theoretical basis. Most of the literature is accessed freely from RuG Library links, the rest is from the local university library as well as technical reports from the official agency (e.g. Marine and Fisheries Affairs of Aceh Province and FFI). The condition of coral reefs was rechecked by doing joined underwater survey with the FFI team.

In addition, both qualitative and quantitative assessments are needed to assess an adaptive capacity. This research is guided by research protocol methodology which consists of five steps (Gupta et al, 2010), which are preparing for research, collecting the data, analyzing, interpreting and finally presenting the data.

In preparing for research as the first step, understanding the criteria used in the assessment are the most important thing. Formulating critical question in line with the main research question is needed in order to guide in-depth interview, which is useful to collect personal perspective and experience of the stakeholder. Practical observation is also simultaneously done appropriately during field research. The observation is focusing on social behavior related to the issue.

The second step is collecting the data through several methods. Data is collected mainly from interviews based on each criterion. A literature review and policy document analysis is done to complete and confirm the assessment. In-depth interview is a main element of qualitative research (Mack, N., *et al.,* 2005). List of questions related to each assessment criterion is prepared before the interview. The interviewees are selected based on their role related to conservation program. Interview data consists of voice recordings than typing into transcripts. Furthermore, scientific literature, for example, technical report on coral reef status is reviewed to assess recent condition of coral reef ecosystem in the respective area. The official policy

document is also evaluated to confirm institutional aspects of the program. Finally, the third step is analyzing the data through Adaptive Capacity Wheel method. Scoring each sub-criterion is formulated and translated into figures.

### 1.8. Thesis Structure

This research consists of five chapters. The first chapter is the introduction. It consists of background, problem statement, research objectives; research questions; research significance; research scope; research methodology; research design and thesis structure. From this chapter, the reader is expected to have first impression and general information about the thesis.

The second and third chapters are elaborated theoretical framework and adaptive theory related to the coastal community. Central issues of this research such as climate change, small islands, coral reef conservation and adaptive capacity theory are added. Second chapter provides a basis to explain a case study in the third chapter. The third chapter consists of information about climate impact to coral reef ecosystem in Weh Islands. General information about Weh Islands is provided, together with a general condition of coral reef ecosystem and its recent conservation program.

The fourth chapter is the main focus on this research. It consists of the assessment of adaptive capacity on coral reef conservation in Weh Islands. This chapter explains the adaptive capacity based on three main criteria (intellectual, social, and political capital). Finally, fifth chapter gives a conclusion in which some research questions are answered.

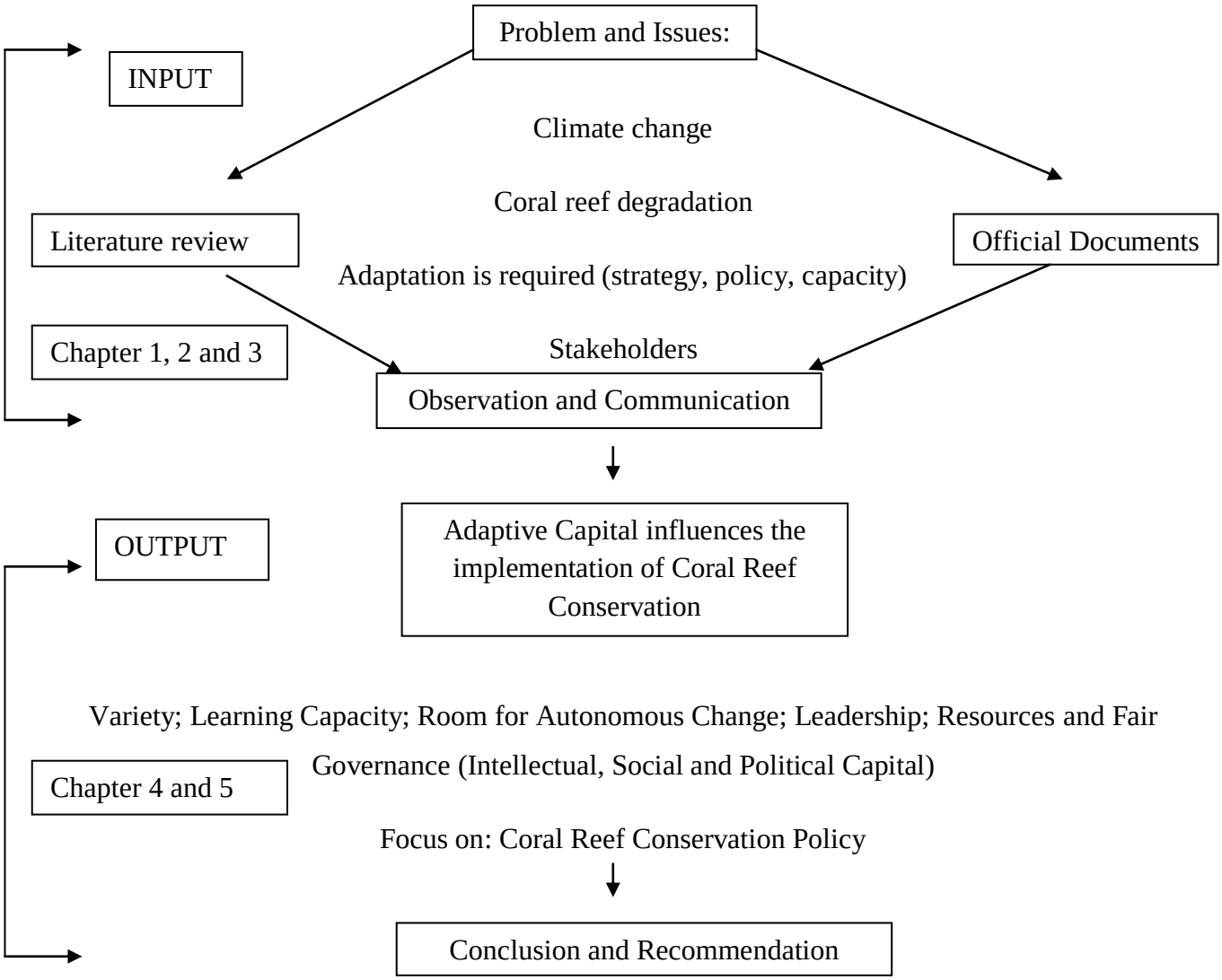



Figure 1. Research outline

# CHAPTER 2

# THEORETICAL FRAMEWORK

This chapter examines the theoretical basis of all related issues in adaptive capacity, respectively in small islands and coastal community. The first section discussed climate change knowledge especially related to small islands. The intention of explaining about climate change and small islands are to provide background with regard specific issue in terms of vulnerability and resilience of the community in small islands. The next section will elaborate about adaptation to climate change, differ it from mitigation strategy. As coral reef conservation is the central issue of this research, impact of climate change to coral reef ecosystem is explained. Furthermore, after knowing the impact of climate change on coral reef ecosystem, conservation program as a section of adaptation strategy is discussed. Finally, the last section of this chapter is discussed about adaptive theory. The discussion emphasizes on some elements of adaptive capacity namely intellectual capital, social capital, and political capital.

## 2.1. Climate Change and Small Islands

Climate change phenomena has been one of the most controversial and pertinent topics of the last decade. Climate is changing continuously. There is a evidence of rapid change of weather pattern across the globe. It becomes hotter when summer and cooler in winter. The global temperature has increased and predicted to continue, some models already showed the future change. In its assessment report, IPCC (2001) told us about the prediction of increased global air temperature with the range of 1,4 to 5,8 °C until the next century. The implication of increasing temperature is global; it will alter the weather patterns which lead to some extreme weather events (Mimura et al, 2007). Although the prediction is for worldwide, in fact, the impacts are expected differently across the region (Mimura et al, 2007). The impact of climate change to developed countries is different when it compares to developing countries. Moreover, not to forget other category, small islands which are still in the developing phase are also affected negatively.

Small Islands are, based on Beller et al (2004) cited in Calado et al (2007), defined as those islands with approximately or maximum square of 10.000 $km^2$ and have about 5.000.000 or fewer inhabitants. However, in local context of Indonesia, based on the Ministerial Decree No. 41/2000, Ministry of Marine and Fisheries Affairs of Republic of Indonesia define Small Islands slightly different in the numbers of inhabitants. In Indonesia, population on a small island has to less than 500,000 inhabitants. They are, still, the most vulnerable place on earth where climate change impact is dreadful. The impact is not only directly affected their smallness or limited area physically but also socially and most obviously economically.

Many small islands have just limited alternatives of strategy and resources to cope with climate change. There are numbers of climate impacts that already threatened small islands and many more are predicted to threaten their existence. However, they are suffered mostly from the rising of sea level and increasing sea surface temperature (Mimura et al, 2007) in which affected their coastal ecosystems. Thus, vulnerability of small islands is higher, if compares to other region.

Vulnerability is among the words that become a hot topic when talked about climate. The IPCC Fourth Assessment Report stated that vulnerability is *"a degree to which a system is susceptible to and unable to deal with. In terms of climate change respectively, vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity"* (Mimura et al, 2007). Based on the definition explained, there are some key words refer to vulnerability; susceptibility, exposure, and adaptive capacity (Pelling & Uitto, 2001). Those words are more crucial in the way of stakeholders create a policy as section of activity to dealing with the climate change effect.

In terms of vulnerability, they are the most at risk, respectively due to the raising of global sea level. Sea level rise accompanied by strong storm surge is most damaging effects of climate change. Storm patterns are strongly connected to local weather patterns. According to IPCC Report, the warm periods of El-Nino could increase the periods of drought in Small Island. Moreover, with the increasing of sea levels, the storm surges are promised to be more harmful.

There is a positive correlation between vulnerability and resilience (Hughes et al, 2005). Higher resilience is always decreased vulnerability and vice verse. While vulnerability has a close

relation to risk, resilience is closely connected to a capacity in facing the vulnerability and getting back to stable condition (Hansen, 2003). In comparison to the mainland, unfortunately, resilience of many small islands is lower.

Indeed, there are trade-offs between small islands and the developed countries on the mainland. In fact, when industrial countries are promoting to decrease GHG to tackle global warming, the developing countries and SIDS are already affected. It should be understood that climate change is a global problem which needs a global solution. Thus, understanding and defining solution together is crucial in order to, at least, delaying impacts of the changing climate.

Climate change has multiple interpretations. It depends on the focus and the field where we are focusing on. However, there is a prominent definition prepared by the UNFCCC which stated that climate change refers to any change in terms of weather pattern that observed over temporal scale, in which human activity is influenced directly or indirectly (IPCC, 2007). This definition, however, is quite general. In a specific case, climate change could define differently. For example, in case of small islands, climate change is commonly perceived as the major threat for not only physical appearance due to several extreme climate events but indirectly also affecting the viability of a human being. Interestingly, people who live on small islands are somehow less responsible for what they suffered. They just have a little contribution to the changing of weather patterns in comparison to other people. Nevertheless, they suffered most and thus become a global issue to be concerned (Mimura et al, 2007).

Small islands are identical with marine tourism. Many small islands are blessed with incredibly beautiful landscape and underwater scenery as their capital to attract tourist. However, tourism sector as a substantial revenue earner and generates significant employment in small islands, is expected to be influenced drastically. Sea level rise that accelerated erosion is for instance. Inundation and flooding will mainly decrease the attractiveness of Small Island.

When discussed marine tourism sector, undoubtedly, coral reef ecosystem is the most valuable asset of small islands. Unfortunately, several anomalies of weather led by climate change already caused degradation on coral reef ecosystem. Global warming is not only evident on the mainland, but ocean also getting warmer. Increasing sea surface temperature could

simultaneously lead other anomaly in the ocean (Mimura et al, 2007). Changing pattern of nutrient transfer, turbidity, and ocean acidification are likely threatened coastal ecosystems, especially coral reef which has only limited capacity to tolerance rapid change (Hughes et al, 2005). Degradation of coral reef ecosystem could make a significant loss of the tourism sector in small islands. That makes small islands become the saddest place to live on earth.

### 2.2. Adaptation to Climate Change

Adaptation is a key component of an effective strategy to address climate change (Tol, 2005). Quoting the IPCC Assessment Report (2007*), "adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"*.

There are different types of adaptation: proactive adaptation, spontaneous or autonomous adaptation, and planned adaptation (Mimura et al, 2007). Because of the far-ranging impacts of climate change, adaptation must be an integral component of an effective strategy to address climate change together with mitigation. Mitigation and adaptation are strongly connected to each other, because the more mitigation is done, the less adaptation need to be done (Tol, 2005). However, even if sustainable efforts are undertaken to reduce the climate change, it will still be unavoidable, thus the adaptation strategy is certainly needed in order to, at least, reduce the vulnerability.

Adaptation strategy depends on adaptive capacity. That means enhancing adaptive capacity is necessary to succeed adaptation program (Smit et al, 2001 in Tol, 2005). Adaptive capacity will be discussed later in the next section.

From the previous section, it is obvious that small islands are negatively affected by climate change. IPCC Assessment Report (2007) stated that there are at least four factors why adaptation strategy is prominent on small islands. Interesting that, all of those factors are connected to each other, those are:

- Exposure, which means the sensitivity of the community to be affected to climate variability (Marshall et al, 2009);

- Adaptive capacity, which range to all aspects related to adaptation strategy such as financial, intellectual, social, political, and technical capacity (Adger et al, 2005).
- Adaptation strategy is not a priority of a small islands development plan. The reason is because there are other aspects are much more urgent such as economic development.
- Weather is always uncertain and that makes the adaptation strategy becomes harder to be decided.

Those interrelated factors are dependent and support each others. Exposure's degree of the community is strongly related to the adaptive capacity. Community with higher adaptive capacity has a lesser sensitivity and higher resilience (Adger et al, 2005). However, uncertainty of climate impacts is a determinant factor which makes both resilience and exposure cannot be predicted, but it is possible to be prepared.

Dealing with uncertainty is never been easy. The only thing that is possible about climate is just by forecast. That is why uncertainty is considered as the main obstacle in formulating adaptation strategy. However, some scholars are already suggested that to solve the problem we have to focus on the other factors which are connected to the uncertainty, for example, focus on enhancing adaptive capacity and resilience which leads to reduce vulnerability. Barnett (2001) in IPCC Assessment Report 2007 stated that focusing on the improvement of social adaptive capacity is crucial (Mimura et al, 2007). Other scholar (Marshall et al, 2009) has recommended keeping traditional or local knowledge as it has already proved to be more effective when local community has its own tradition. Floating house made by wood along coastal is one of the examples (Wongbusarakum & Loper, 2011).

Climate change to some extent closely related to political interest (Marshall et al, 2009). It is not only talking about technical measures, but beyond that, socio-political aspects are also crucial. Formulating a national adaptation plan is indeed political. For small islands, formulating tourism policy is a famous example. However, policy is just in a conceptual framework. Indeed, technical application should be realized to support the strategy. For example, conservation policy is highly dependent on infrastructure. Conserving coral reef ecosystems need technical expert.

Naturally, a natural ecosystem like coral reefs has its adaptability (Obura, 2004). People just have to support it by formulating a policy. Marine Protected Areas is significant to mention as it is already proved to give a room for coral reefs to recover from unusual weather pattern (Hyrenbach et al, 2000). Furthermore, those kinds of policy are usually in small's island community done at the local level and are in the traditional way (Mimura et al, 2007).

The coastal area is vital on small islands and believes as the most threatened area due to climate change on small islands. There are some adaptation concepts provided by IPCC Assessment Report 2007 related to coastal adaptation. While, at the past time, people tend to use a technical approach to safe the coastal zone, nowadays the paradigm has shifted to be more opportunist. However, protection is indeed still perceived as the main concept, while there are two other concepts emerge (see picture below), namely accommodate and retreat (Nicholls et al, 2007).

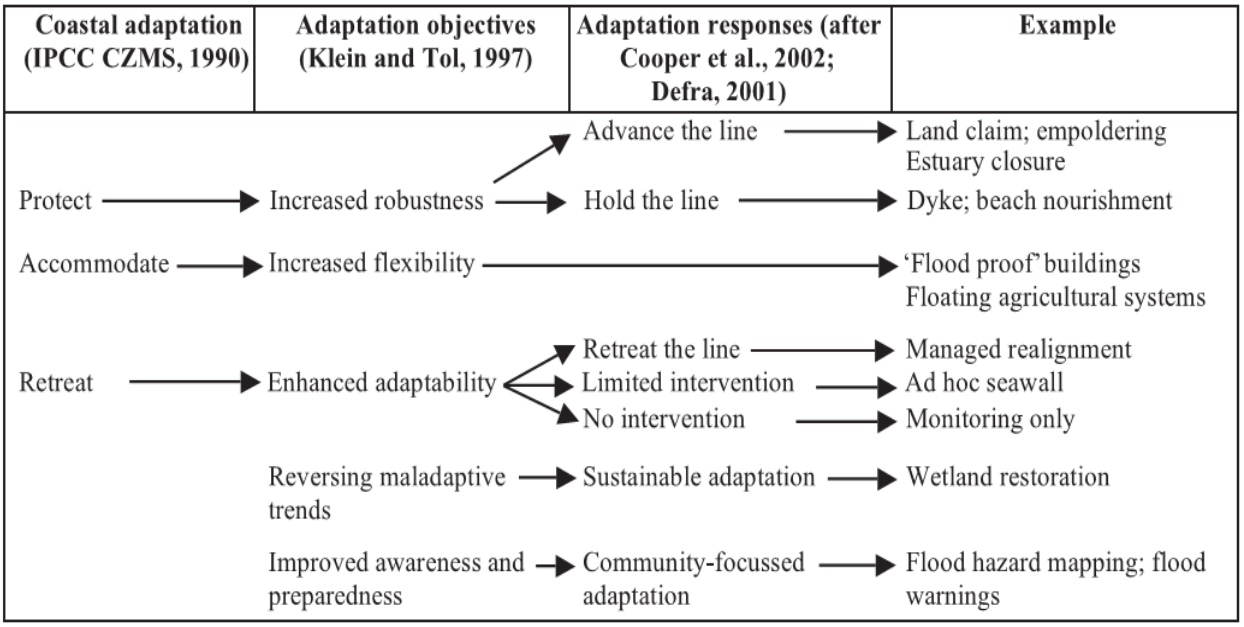



Figure 2. Evolution of Planned Coastal Adaptation Practices (Mimura et al, 2007)

Small Islands have limited adaptive capacity, mostly because of economic reason. Many small islands all over the world still have to meet their economic needs, whereas infrastructures, technology, and human capital are still insufficient (Mimura et al, 2007). Timor Leste is an example of how economic reason hinders adaptation plan and decrease resilience of the community (Mimura et al, 2007). As a young nation in Southeast Asia, Timor Leste still

develops its country, but, at the same time they have to face climate change challenges. Nonetheless, adaptation strategy is in fact, formulated in this country through some policies and institutions that have a specific task related to climate change.

### 2.3. Degradation of Coral Reef Ecosystem

Indonesia is the largest archipelagic country in the world. Blessed with thousand small islands, Indonesia has extremely beautiful of underwater scenery. However, Indonesia has to face a challenge every time since located on disaster-prone area. Tsunami led by a tectonic earthquake along West Indian Ocean in 2004 was a famous example on how dreadful is the effect of natural disasters to coastal ecosystems. In addition to natural disaster, climate change is exacerbated coastal ecosystem from recovery. Global rising of sea surface temperature accompanied by El-Nino events in 1998 was caused wide range of bleaching corals in Indian Ocean waters (Cesar et al, 2000).

Furthermore, destructive fishing practice is the main threat to Indonesian coastal ecosystems since a a long time ago (Edinger et al, 1998). Fish bombing, using cyanide and destructive fishing gears are some practices that harmed the coastal ecosystems. For example, most of the ornamental fishermen in Indonesia use bombs and poisons to catch ornamental fish. This irresponsible activity is not only killing off particular schools of fish, but also groups of corals. However, destructive fishing is currently controllable through several laws and policy. Destructive fishing is both directly and indirectly degrade coastal ecosystems, specifically coral reefs. However, that kind of anthropogenic disturbance is easier to reduce and prevent in comparison to natural disturbance such as climate change and natural disasters.

The effect of natural disturbance leads by disasters is not only dangerous for stability coastal systems, but more importantly also affected badly to economic revenue, especially with regard to small island community. For example, after the massive Tsunami hit the western part of the Indian Ocean (along west Aceh coasts), satellite imagery showed that 97,250 ha of coral reefs habitat was destroyed (UNEP, 2005 cited in Campbell et al, 2007).

Small islands are also suffering from the increasing of storm events. Extreme storm events lead abrasion and threatened coastal community. However, storm event is in indirect way degrading coastal ecosystems, as it is mostly affects the physical infrastructure along the coastal area.

Coral reefs have a narrow range of tolerance in environmental condition (Ammar, 2009). That is why coral reefs ecosystems are fragile and vulnerable to climate change. By definition, corals are animals. They consist of many corals that were formed by colonies of calcium carbonate secreted by spongy bodied animals called coral polyps. Solitary polyp has a tube-shaped body with a mouth which is surrounded by tentacles (King, 1993). These polyps have symbiotic relationship with *zooxanthellae*, giving the coral its color – the most attractive part of any coral reef ecosystem.

Indonesia is also among one of the nations that counts itself as one of the 'Coral Triangle' countries, the other are Malaysia, Philippines, Timor Leste, Papua New Guinea and the Solomon Islands. This fact ensures that the coral reefs of Indonesia are elevated in importance as a source of livelihood not only for Indonesian society, but also for the world.

The coral reef ecosystem is vitally essential to the whole processes of coastal ecosystems. It may be seen for its numerous ecological, economic, aesthetic, and cultural functions. In Indonesia, the coral reef ecosystem is a central issue when it comes to marine tourism with various famous dive spots spread all over the region, especially around the small islands. From an ecological perspective, coral reefs also have a significant role in protecting the coastlines from abrasion. Moreover, coral reefs are a lifeline for many coastal organisms. However, nowadays coral reefs in Indonesia are threatened due to irresponsible activities of stakeholders. Various anthropogenic treatments, conducted in a non-sustainable manner, have led to an alarming degradation of both the quality and the quantity of coral reefs.

Notwithstanding their appearance as massive rocks, coral reefs are, in fact, terribly fragile by both natural and anthropogenic pressures. Anthropogenic disturbances on corals are believed to be the main factor in the decline of corals. Pressure from rapid population growth in coastal zones has brought many reef ecosystems to the brink of collapse. Chemical pollution from household waste has significantly contaminated the waters and strongly contributed to

sedimentation. Coral mining, where corals are collected for house building, together with lime production as well as the ornamental coral trade, mostly occurs in traditional fishing villages in Indonesia.

Indonesian waters are getting warmer because of climate change and are projected to continue to warm at an accelerated rate over the next few decades. Global warming, indicated by ENSO in 1997-1998, has triggered the largest coral bleaching in history (WMO, 2010). The increasing of sea surface temperature is tremendously hazardous to corals which are highly sensitive to changes in temperature. Marine biodiversity is also severely depleted because of the rising surface sea temperatures (WMO, 2010) which could lead serious consequences for the marine ecosystems in general.

Green House Gasses are stimulated high concentration of $CO_2$ emissions and cold affect coral reefs in twofold (WMO, 2010). Firstly, when air temperature is increasing, this event leads to the increasing of sea surface temperature simultaneously. If the surface temperature is not stable in a short time, this could trigger coral bleaching events and lead to mass mortalities. Secondly, high concentration of $CO_2$ emissions has also induced ocean acidification, a condition where the ocean becomes more acid and poisoned living organisms. Acid condition could inhibit the reproduction and stop the growth rate of corals. In such condition, if it stays longer then coral reef ecosystems will be truly degraded and under pressured.

A direct link exists between the decline of coral reefs and the loss of economic opportunities, eventually leading to an increase in poverty. Loss of natural breakwaters that protect the coastlines from storm surges is highly expected from a decline in coral reefs. Furthermore, coral reefs have the potential to attract tourists, particularly for diving, which is one of the central attractions of marine tourism in Indonesia.

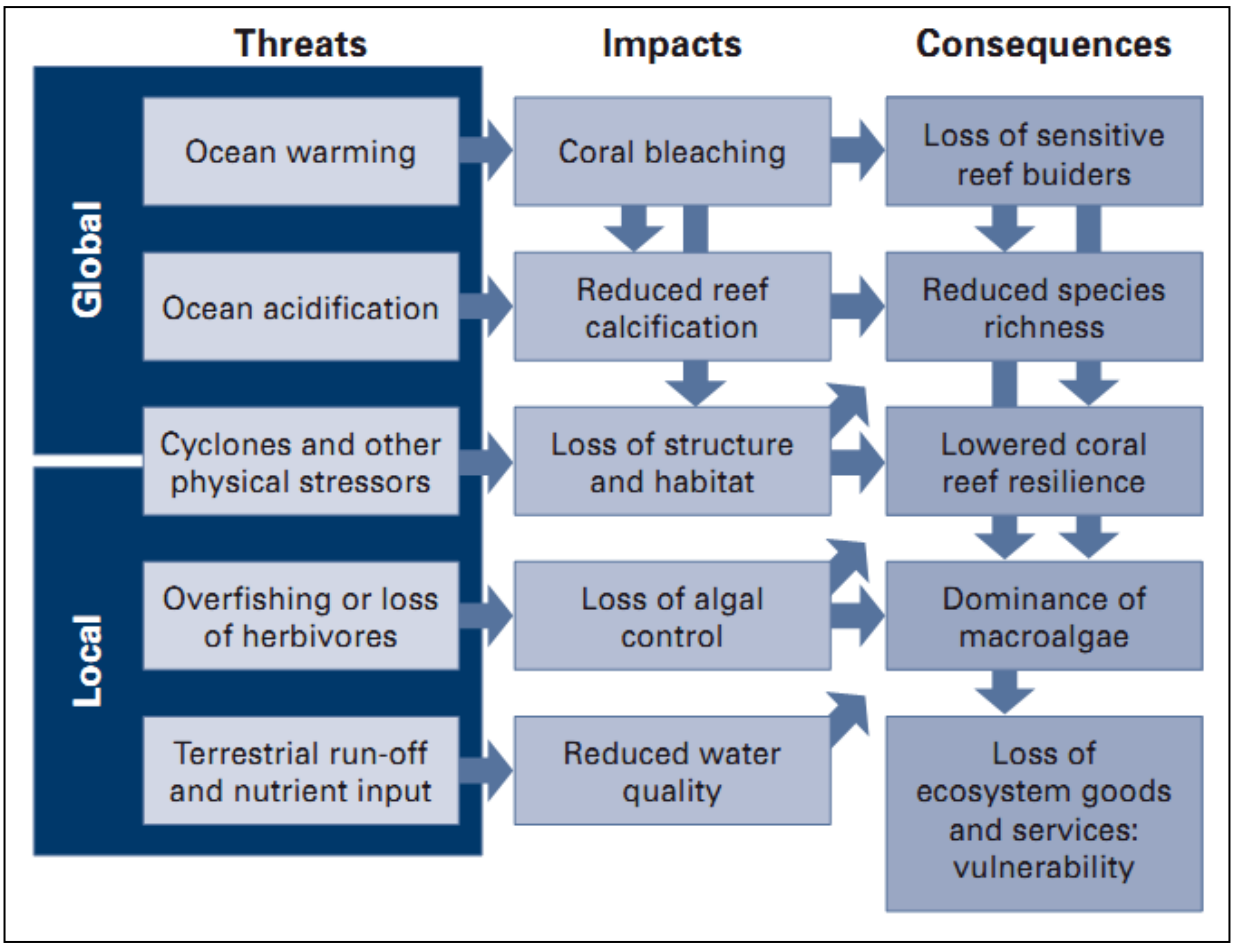



Figure 3. Threats, impacts, and consequences of climate change (WMO, 2010)

### 2.4. Coral Reef Conservation

Conservation is presumed has a same meaning with protection. In fact, there is a practical difference between conservation and protection. To conserve is not only aims to protect, but has a wider meaning. For example, in case of coral reef ecosystems, conserving corals is not only about how to protect corals from disturbance but also simultaneously to exploit the resources fairly. Conservation in this case is believed as a win-win solution to adapt to climate change.

Coral reefs conservation could be perceived as part of adaptation strategy for several reasons. The main reason is, for example, although a coral reefs conservation program is initiated usually at the national level however the implementation of the program is highly depending on stakeholders at the local level (Tol, 2005). Another reason is that because the coral reefs

conservation program could enhance adaptability of coastal community. The successful conservation program gives direct benefit to the community. Thus, as coral reefs have a crucial role in the livelihood of coastal community, by doing conservation program resilience of coastal community could be enhanced (Füssel, 2007).

However, McClanahan et al (2008) argued that contemporary environmental program does not empower adaptive capacity. They also suggested hybrid management in which taking into account local knowledge and concurrently to combine a traditional approach with a modern approach. Other authors, Cinner & Aswani (2007) stated that local knowledge should be considered as decisive element to increase the effectiveness of any conservation program. They argued that make use of local knowledge could lead higher acceptance, which consequently, contributes more effective results in the implementation of the conservation program. It is done through working together with the local people.

Customary management, although is quite traditional, gives a benefit of enhancing the conservation value at the local level (Cinner & Aswani, 2007). In practice, this kind of management has strong effectiveness as it is culturally embedded and already applied over generations (Cinner & Aswani, 2007). There are many examples and evidences where customary management even becomes more effective in comparing to modern approaches, especially on small islands community. Temporary closure of specific coastal areas due to religious celebration in Papua New Guinea is one of those examples (Polunin, 1984 *cited in* Cinner & Aswani, 2007). In that case, the tradition gives time to coastal ecosystems to recover in which benefits indirectly to the community. It is also benefiting for the government by utilizing local value, law enforcement would be more effective recover (McClanahan et al, 2006). It is simply because there is trust and higher sense of belonging to obey the regulation.

There are six types of customary management, which interestingly, to some extent are also found in current conservation practice. However, current conservation practice is in some places has a higher advantage in compared to the traditional approach (Cinner & Aswani, 2007). For instance, in spatial area approach, this is one of the types of customary management; flexible closure time in such Marine Protected Area in Western fisheries management gives opportunities to the fishermen to go fishing (Agardy et al, 2003). While in traditional closure time is fixed and totally

not allows fishermen to enter the respective area. Six types of customary management are based on: (1) spatial areas; (2) time; (3) gear or harvesting technology; (4) effort (through the number of participants); (5) types of species that can be harvested, and; (6) the number of fish harvested (Cinner & Aswani, 2007).

| Types of customary management | Description | Analog in modern fisheries management techniques | Differences to modern fisheries management | Examples |
|---|---|---|---|---|
| Spatial | Areas closed to fishing. These can be temporary (i.e. closed for several months to provide supplies of fish for a feast) or permanent (where spirits reside) | Marine protected areas, temporary fisheries closures | Often temporary and almost always harvested. Maybe reactive to events (e.g. death in village, declining catch) | Polunin (1984) and McClanahan et al. (1997) |
| Temporal | Restricting fishing/ harvesting activities during specific days, week, months, etc. Often short in duration (e.g. Sabbath), species-specific (e.g. trochus), and around a specified event (e.g. spawning aggregation) | Closed seasons | Dates may be highly flexible and reactive to events (e.g. price fluctuations for commercial species, spawning aggregations) rather than set dates. | Johannes (1978) and Thornburn (2001) |
| Gear | Prohibiting/restricting certain harvesting technologies or techniques | Gear prohibitions | Maybe inherited rights to use certain gears. Often exclude non-owners | Johannes (1991) and Cinner et al. (2005) |
| Effort | Limiting who can harvest certain species, use certain gears, fish certain areas, etc. | Permitting | Often based on initiation rights, lineage, class, or gender | Mantjoro (1996) and Veitayaki (2002) |
| Species | Prohibiting the consumption of certain species. Often lineage-related dietary restrictions. | Species-specific bans | Often the species may be caught or killed, but not eaten. | Carrier (1987) and Hickey (2006) |
| Catch | Restricting the quantity of a harvest. Often social norms that stress the avoidance of waste. Very rare. | Total allowable catch, quotas | Quotas not set *a priori* | Johannes (1981) and Tuelieres (1992) |

Figure 4. Types of customary management (Cinner & Aswani, 2007)

Those six types of customary management are commonly applied in the small islands community, although in some places are just partly or mixed to be adopted. With regard to coral reefs conservation, spatial-based, and species-based management are discussed in this section. MPA is commonly adopted in small islands (McClanahan et al, 2006). In addition, technical approach to conserve coral species by doing transplantation is also easily found along the coastal area in small islands.

MPA has indirectly contributed to coral reefs conservation. Definition of MPAs cited from IUCN (1999) is "*any area of intertidal or sub tidal terrain, together with its overlying waters*

*and associate flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or the entire enclosed environment*." (Pomeroy, Parks & Watson, 2004). The aim of the MPAs is mainly to protect the whole natural resources, especially fish, through regulation (legally binding). However, the implementation of MPAs is to some extent conserving coral reefs which at the same time giving more time to coral reefs to recover (McClanahan et al, 2006).

MPAs give multiple benefits, not only from ecological value but also from economic and social perspectives. The more effective the implementation of MPAs is the more benefits to the community. The effectiveness is measured from several indicators. For example from an ecological point of view, MPAs is successfully implemented if coastal ecosystems could supply their ecological services optimally which consequently enhancing resilience to external disturbance. In addition, specifically on small islands, practice of MPAs is combining with customary management has higher efficiency. The efficiency is strongly influenced by reason of internal motivations and sense of belonging among small islands community (McClanahan et al, 2006).

Technically, the effectiveness of MPAs could be assessed from three main aspects. The criteria are mainly due to the benefits of MPAs from biophysical, socio-economic and governance aspects. All those aspects are interrelated and the effectiveness relies on each other. For example, the direct benefit between ecological services provides by well-managed MPAs to the community can be considered in financial as well as social terms (Pomeroy, Parks & Watson, 2004). Therefore, there is a link that well-managed MPAs could enhance adaptability of the community.

In Indonesia, MPAs is mentioned implicitly on the regulation. It is a regulation of the Ministry of Marine and Fisheries Affairs of Republic of Indonesia No. 30/2010 about management plan and zoning of the aquatic conservation area. MPAs in Indonesia are typically formed in some zoning area. The zoning areas are ranging from core zone, open zone, and buffer zone. However, although there is regulation that ruled the MPAs, law enforcement is still an issue in Indonesia. In some area, MPA is not giving benefits to the community and open to destruction.

In addition to spatial-based conservation, in most cases, species-based conservation is one of the most applied conservation approaches in coral reefs ecosystem. Coral transplantation is frequently found along the coastal area. This technique is not only easy to apply but also cheap enough and not requires coral experts to guide the practice. Even common people who do not have a scientific background could do the technique. However, the success of this conservation approach is not relying on the transplantation practice, but on the monitoring phase after the transplantation is done (Kerby, 2008).

Coral transplantation is just an alternative of conservation approach which has both advantages and disadvantages. However, despite several disadvantages, this conservation approach seems to be the most favorite. It can be seen from relatively bunch of a scientific paper related to coral transplantation (Abelson, 2006). There are some strong reasons to do coral transplantation, especially related to adaptability of coastal community. First and foremost is because coral transplantation can quickly increase coral cover and diversity (Oren & Benayahu, 1997). Moreover, the involvement of coastal community is prominent as they can join to do transplantation even though they do not have a scientific background related to coral reefs (Edwards & Clark, 1998).

Despite of advantages of coral transplantation, however, this conservation still has a disadvantage. Coral transplantation has a higher risk as it is fragile and susceptible to extreme wave; transplantation also lead to higher mortality rates and influences the dynamic of coral colonies in respective areas. In contrast, coral transplantation has also potential benefits such as improving aesthetic value, respectively in the tourism area (Edwards & Clark, 1998).

There is always a risk of failure in every conservation program. With regard to adaptability of coastal community, the key factor to promote a successful coral transplantation program relies on the role of the community itself. Involving the community on coral transplantation is crucial because they are playing an important role in the monitoring phase.

## 2.5. Adaptive Capacity Theory

Adaptation and adaptive capacity are interrelated. These two elements are depending on each other. The higher adaptive capacity of the community, the higher is chances of adaptation strategy become successful (Wostl, 2009). Moreover, there are some terminologies that have close relation with adaptive capacity such as exposure, sensitivity, resilience, vulnerability and coping capacity (Smit & Wandel, 2006). Therefore, understanding all aspects related is necessary to be discussed.

Adaptive capacity has many definitions. It is different due to its focus of the central issue; it is context-dependent (Smit & Wandel, 2006). For example, adaptive capacity from a governance perspective would be slightly different from an environmental perspective and adaptive capacity elements in developing country context are different with elements in developed countries context. However, there are similarities or common idea that embedded in all of those definitions. Many scholars agreed to mention either implicitly or explicitly about social capital, knowledge or learning capacity and governance.

On the Technical Paper 7 (UNDP), adaptive capacity is mentioned and has a strong relation to a system that established to cope with specific climate impact (Brooks & Adger, 2004). In more general terms, Armitage (2005) defined adaptive capacity as the ability of socio-ecological system reacts to any change or disturbance from outside. In addition, Walker et al (2002) added element of resilience and learning capacity to solve the problem and develop alternatives to cope with external challenges. Likewise, Olsson et al (2004) illustrated adaptive capacity as an aspect of respective systems to deal with change (cited in Armitage, 2005).

In addition, Adger (2003) identified adaptive capacity as, like others, the ability of systems to deal with perturbations and more specifically ability to enhance coping capacity. Furthermore, Folke et al (2003) formulated four main elements of adaptive capacity. Those elements are mentioned in the table below (cited in Armitage, 2005).

Table 2. Elements of adaptive capacity (Folke et al (2003) cited in Armitage, 2005

| Component | Sub-component |
|---|---|
| Learning to live with uncertainty and change | Learn from crises, expect the unexpected, evoke disturbance. |
| Nurture diversity for reorganization and renewal | Nurture ecological memory, sustain social memory, enhance socio-ecological memory |
| Combine different types of knowledge for learning | Combine experiential and experimental knowledge, integrate knowledge of structure and function, incorporate process knowledge into institutions, encourage complementarities of knowledge systems |
| Create opportunities for self-organization | Recognize relationship between diversity and disturbance, deal with cross-scale dynamics, match scales of ecosystems and governance, account for external drivers |

From all definitions describe above, there is no doubt that any adaptation to climate change strategy requires a capacity to learn and anticipate the uncertainty, called adaptive capacity. Dealing with uncertainty is always complex and requires constant capacity development. This development is believed as a main factor of improving adaptive capacity as it is related to coping capacity (Brooks & Adger, 2004).

Moreover, coping capacity is highly dependent on awareness of the range of actors to cope with vulnerability and uncertainty in order to enhance resilience. The relation between coping capacity and other factors (resilience, vulnerability, and exposure) is unique and interrelated. However, there is no doubt that coping capacity could enhance adaptive capacity when the exposure and sensitivity of any system are well defined which enable the system to anticipate and dealing with such vulnerability and simultaneously could enhance its resilience (Adger & Vincent, 2005).

Although adaptive capacity is context-dependent and dynamic, level of adaptive capacity is still can be measured. It can be reviewed from the individual up to community level in which can be used to assess adaptive capacity in the wider scale, for example, to national level **(**Marshall et al, 2009). Moreover, from a general perspective of adaptive capacity, all those elements could be reviewed from three main elements namely intellectual, social, and political capacity. Those three elements are rooted from the idea of institutional capacity developed by Healey who

identified knowledge, power relation, and ability to influence people as key factors to enhance institutional capacity (Khakee, 2002).

In this study, conservation policy is perceived as part of adaptation strategy that could enhance adaptive capacity of a small islands community. These three main elements are used to guide the assessment. The assumption is that, intellectual capital will ensure the conservation program could be run and enhancing social capital at the same time. Furthermore, social capital here is playing a role to succeed the conservation program while political capital is determined whether the conservation program is supported or not. These three elements are not dependent and influence each other.

The first element is intellectual capital which in general could be defined as all knowledge resources needed to help the decision making process. More specifically, intellectual capital also includes perspectives and opinion related to issues, make use of experience and openness to learn about new scientific things (Khakee, 2002). However, in this study, intellectual capital is interpreted as an ability of the stakeholders to learn and apply their knowledge to succeed the conservation program. This assumption is inspired by four criteria that are suggested by Khakee, (2002) as follow:

- Knowledge resources are used by the community to understand and solve the problem
- Learning is also about gaining a new perspective and uses it to improve the capacity
- By learning a new thing, several alternatives are emerged and transferred into action
- Respect and accept new ideas are useful to enhance adaptability.

Society is a subject who playing a role in any adaptation program. Their capability could support adaptability. Furthermore, related to adaptive capacity, the second element is social capital. As many authors suggested that social capital is crucial as like a bridge of intellectual and political capital (Folke et al, 2005). However, let us get closer to more general definition of social capital argued by Healey et al, 1997 (cited in Khakee, 2002). She defined social capital as collaboration among actors which aiming at supporting and optimizing all network resources to solve problems. Especially related to Local Agenda 21 issue where local actors are believed as key

success of any adaptation program, social capital has some criteria in which could be used as indicator (Khakee, 2002). The criteria are a number of stakeholders, networking, and power relations which glue another two criteria.

The last element is called political capital. Any adaptation strategy needs legal framework and political support which usually rules by the government. It is clear that government has a responsibility to enhance adaptability of their people. Political capital in this study is closely related to political will and support of the government officials to collaborate with other stakeholders (including citizen and private sectors) to formulate strategy collectively and transform the strategy into real implementation (Khakee, 2002). Indeed, trust and respect are crucial point to succeed the process. A good relationship among stakeholders is highly depending on leadership. In addition, a strong leader could bring the community to enhance their social capital as well as intellectual capital simultaneously.

Adaptive capacity would significantly improve when those three elements are well established in the society. However, when it comes to practice, there are many other sub-criteria that can be found to shape adaptive capacity assessment. The adaptive capacity wheel is one of methodology that can be used to assess adaptive capacity based on qualitative elaboration related to institution's role in enhancing adaptability (Gupta et al, 2010).

The sub-criteria which belong to adaptive capacity wheel are variety, learning capacity, room for autonomous change, leadership, resources, and fair governance. Those six sub-criteria belong to three main criteria namely intellectual capital (variety and learning capacity), social capital (room for autonomous change and leadership), and political capital (resources and fair governance).

The first sub-criterion is variety. Variety in this study includes several indicators such as variety of problem frames, multi actor; multi-level; multi-sector, and redundancy or duplication. Additionally, in original sources written by Gupta et al, 2010 variety defined broadly as recognition of diversity and openness of institutions to consider all options to formulate a long-term solution. However, in this study, variety is defined as part of the knowledge resources of the

community as by elaborating the indicator; it is useful to know their comprehension of the problem.

The second sub-criterion that belongs to intellectual capital is learning capacity. Four indicators of learning capacity are trust, single loop-learning and double loop-learning, institutional memory and discuss doubt. In this study, the reason why learning capacity is categorized to intellectual capacity is that, because learning capacity could be defined as capability of stakeholders to understand problems and accepting alternatives to solve problems. It is connected to what Gunderson and Holling (2002) suggested that learning is crucial because it can improve adaptability through flexibility and learn from past experience (cited in Gupta et al, 2010).

The third sub-criterion is room for autonomous change. It is defined as an ability of system to allow social intervention in order to balance social and ecological interest (Gupta et al, 2010). There are three indicators belong to this element namely continuous access to information, act according plan and capacity to improvise. Next sub-criterion that also belongs to social capital is resources. Resources have three main indicators that are unquestionably relevant in this element; there are authority, human resources, and financial resources. In addition, Gupta et al (2010) argued that there are more indicators that should take into account such as the legal framework and technological resources. However, in this study, this element is considered to assess how vital the role of stakeholders to succeed the conservation program is. Human resource is symbolized the quality of human capital to develop a strategy, while financial resources is needed to implement the strategy after an authority execute the decision.

In addition to variety, learning capacity, room for autonomous change and resources, there are two more sub-criteria namely leadership and fair governance. Leadership is obviously needed to guide the community. From a political point of view, leadership is the main factor in influencing stakeholders. It is not only beneficial to legitimate decision but also to inspire and motivate the community to get involved actively in order to succeed the program (Gupta et al, 2010). There are three indicators related to this element such as visionary, entrepreneurial, and collaborative. Those indicators are not independent and could support each other. Visionary of a leader is needed not only to utilize present opportunity but also to visualize future change (Young 1991 cited in Gupta et al, 2010). In addition, entrepreneurial leadership is required to reduce

dependency on government budget by gaining private funding creatively to succeed the program (Andersson and Mol, 2002 cited in Gupta et al, 2010). Finally, collaborative leadership is essential to manage coalition and accommodating interests among stakeholders (Folke et al, 2005).

The sixth sub-criterion is fair governance which is synonymous with good governance. There are four indicators related to fair governance namely legitimacy, equity, responsiveness, and accountability. It is commonly understood that the government has to avoid social injustice and promote good governance through accountability. The government is also needed to legitimize the decision and responsive to social change (Gupta et al, 2010). However, in this study, fair governance has close relation to the role of local government to succeed the program.

To conclude, there are several focal points that importance to mention as theoretical framework to this research. Those focal points are climate change issue in small islands and adaptive capacity theory. With regard to Small Island's community, climate change has degraded their quality of life through, for instance, the degradation of coral reefs ecosystem. To cope with the negative effect of climate change to the coastal ecosystem, in this case is coral reefs; the government has applied some adaptation policies. Thus, adaptive capacity theory is needed to paid more attention in order to understand and evaluate how far the effectiveness of the implementation of such adaptation policy. Indeed, climate change issue in small islands and adaptive capacity are the keywords for this thesis.

# CHAPTER 3

# CORAL REEFS ECOSYSTEM IN WEH ISLANDS

The central issue of this thesis is coral reef conservation policy and the adaptive capacity of Weh Island's community. Conservation policy is, in Weh Islands, identified to an adaptation strategy to cope with climate change. It is interesting to know how far is the contribution of the implementation of conservation policy to the development of adaptive capacity. The description of coral reefs condition as well as Weh Islands in general is essential to point out before the technical aspect of conservation policy and the stakeholders who are involved is discussed, and this chapter is aimed to describe the coral reefs ecosystem in Weh Islands. The intention is to explore coral condition and thus illustrate how urgent the conservation program is. The first section of this chapter is discussed about general description of Weh Islands. By providing a description of Weh Islands, it is useful for readers to know where exactly this research is done. Second section of this chapter is elaborated general condition of coral reefs ecosystem surrounded Weh Islands. The description data of coral reefs ecosystem are collected from some publications and monitoring report from ODC at University of Syiahkuala (local university in Aceh). Finally, the third section of this chapter is examined the conservation programs that have been done and also will be implemented in Weh Islands. However, the focus is about the current conservation program.

## 3.1. General Description of Weh Islands

Indonesia has thousand islands and famous as the world's largest archipelagic country. Weh Islands is one of them, located on the most western territory of Indonesia. In tourism tagline, Weh Islands is known as a place where the remarkable Indonesia starts from. The island offers not only extremely beautiful underwater scenery but also the warm smile of the community welcomed anybody who wants to enjoy beaches, forest, and historical building at the same time.

Geographically, Weh Islands which commonly mentioned as Sabang by locals is located at the most northwestern tip of Sumatera, one of the five big islands of Indonesia. Administratively, Weh Islands belong to Aceh Province. It has a direct border with Andaman Sea and Rep. India's

territory (Nicobar Islands) on the north, with Indian Ocean on the east, with Malacca Strait on the west and Banda Aceh (capital city of Aceh Province) on the south. Weh Island is surrounded by other four tiny islands including Klah, Seulako, Rubiah and Rondo. However, Weh Island itself is a small island due to its size and inhabitants. Together this entire island covers an area of 153 $km^2$ with inhabitants of about 35.000 people, mostly resided on the island of Weh. Among the smaller island, Rubiah is the most well known. Previously, Rubiah Island was the embarkation and quarantine place for the Muslims who are willing to perform Hajj to Mecca. Since then, the island has become famous above all of the beaches and coral reefs (Pemerintah Aceh, 2009).


Figure 5. Map of Weh Islands (google.com)

Weh Island, like other small island all over the world, is highly depending on the tourism sector (Edwards, 2004). Sabang as a City of Weh Island is not only famous for its people's hospitality and friendliness, but also its natural potentials that attract tourists to visit. Moreover, in order to promote Sabang as an international hub center for trading and industry activity at last Sabang in 2000 was reaffirmed by the Government as a Free Trade and Port Zone according to Act No. 37/2000.

Marine tourism is the main asset of economic revenue of this island. Weh Island has a marine national park. This park is not only famous for its marine tourism but also serving to help support research and education purposes. The following are marine tourism resorts in Weh Island (Pemerintah Aceh, 2009) that have been famous for both national and international tourists:

- Iboih Beach. Iboih is such potential and attractive beach, and has been quite popular for water sports among tourists like swimming, diving, and snorkeling while enjoying a variety of coral reefs. Various ornamental fish and coral fish are also available in the water like angel fish, surgeon fish, parrot fish and other types of fish that are seldom found in other places like napoleon fish. Along this beach, the protected forest with flora and fauna is also available with supporting infrastructures being developed to meet tourist's needs. Moreover, this beach is adjacent to Rubiah Island where the waters of about 2,600 Ha have been declared as a remarkable underwater nature reserve.

- Gapang Beach. Gapang is one the three most visited beaches on Weh Island. It is also famous with the Monument Zero Kilometer Pillar which is the mark of starting point of the territorial distance of Indonesia. Also, Gapang is one of considerable places to visit for diving, snorkeling, and fishing.

- Rubiah Island. Located approximately 23,5 km on the western part of Weh Island, Rubiah marine tourism park cover an area of 2,600 ha grown with various enchanting coral reefs and rare marine biota. Out of 15 kinds of marine biota that are protected by the Government, only 14 of them are found within Rubiah Island. This marine park is also famous for marine recreational activity such as diving, excursion ships, and fishing supported with enchanting coral ranges. The sea water is clear and clean with 10-15 meter visibility and an ideal habitat for diverse ornamental fish and coral reefs.

From the description of all marine tourism sites above, there is no doubt that coral reefs ecosystem plays a crucial role to support tourism sector. Therefore, coral reef conservation program in Weh Islands is not only useful to face the challenge of climate change in the future but also to mitigate immediately coastal ecosystem.

### 3.2. General Condition of Coral Reefs Ecosystem in Weh Islands

The coral reefs ecosystem is the most valuable asset of marine tourism in small islands. Good coverage of coral reefs is usually directly proportional to the increasing revenue from diving business. Unfortunately, nowadays coral reefs ecosystem is facing a serious challenge of climate change and makes marine tourism business on small islands under threatened. However, it is not only climate change (natural disturbance, including disaster such as Tsunami) caused a serious problem, but human pressure along the coastal area also contributes to the degradation.

There is little evidence of adverse impacts of Tsunami 2004 to the coral reefs ecosystem in Weh Islands. Surprisingly, evidence of how detrimental impact of El-Nino event in 1998 is quite obvious in some places. Recent survey of coral cover was run by researchers in February 2009 showed that coral reefs ecosystem in Weh Island is in fair condition with coral cover more than 40%. However, in some places the conditions are worse and just have coverage lower than 40%. Some of determinant factors are coral disease, destructive fishing practice, tsunami, and rapid rise in sea temperature in 1998; those factors are the main threat that caused the coral degradation (Baird et al, 2011).

The increasing of sea surface temperature is caused serious degradation to coral reefs ecosystem in Weh Islands. Although the event was happened a long time ago, in 1998, there are still some areas where corals could not recover and remain bleached (Gomez, Cruz & Villamor, 2001). At that time, coral bleaching was happened everywhere and called for worldwide concern. Since then, the evidence of climate change to coral reefs ecosystem turns out to be more obvious and raising more awareness. Many researchers are going to conduct surveys and monitoring.

Coral bleaching could be described in a simple way, although there is complicated scientific explanation behind it. Corals have limited tolerance to the rapid change of sea surface temperature. Bleaching literally means become pale. The color of the corals is because of symbiotic algae (*zooxanthelae*) with coral. Coral in this case could be considered similar to their home. Furthermore, when the temperature is getting warmer this symbiotic alga will escape from the coral and leave coral. That is why corals become pale. Actually the corals could recover soon if the sea surface temperature is stable and not keep rising (Gomez, Cruz & Villamor, 2001).

However, most of the case is the sea surface temperature remains warmer and makes corals could not be recovered.

Coral reefs condition in Weh Islands is in fair condition. It is not bad but also not good and could be improved through conservation program. Coral bleaching is found in some diving spots such as Gapang, Ujung Seurawan, Rubiah Island, Lhok Weng, etc (Ulfah, 2011). Bleached corals are not only giving negative impacts to diving business but also, more importantly, affect negatively to fish abundance. Fishing is vital for the small islands community from an economic perspective. Decreasing of their economic income in which highly depend on fishing activity could, consequently, trigger lack of capacity to adapt to climate change.

Interestingly, despite unavoidable natural disturbance, there is still a way to reduce impacts of coral bleaching. A different marine management style that applied in Weh Islands has different result in terms of condition of coral reefs ecosystem after being attacked by natural phenomenon. In her unpublished Master Thesis (Ulfah, 2011) stated that there is evidence of decreasing hard coral coverage up to 58, 65% in the open access area. In contrast, on an area where customary management is applied under control of Panglima Laot (Sea Commander) hard coral coverage has only decreased for about 17%.

It is proved that strict sanction form Panglima Laot is more effective which is indirectly diminished disturbance to coral reefs ecosystem. Coral reefs condition managed by Panglima Laot is on average 2-3 times better in comparison to other management which officially under government task (Campbell et al, 2007). Traditional management through Panglima Laot is widely accepted by the community. Direct election by the community to rule the Panglima Laot enhances trust and responsiveness among people in Weh Island (Siregar, 2002).

The role of Panglima Laot is to manage the respective marine area with customs and local agreement. Problems that emerged will be solved through informal court meetings based on the general agreement that already socialized. Every violation has its consequence and it is not limited to the cost of money but also social sanction, for example, gossiping, or even expelling from the island (Siregar, 2002).

In addition to the cause of coral degradation, impact from the Tsunami that happened in 2004 is also found in some areas. The most affected spot caused by the Tsunami is in Teluk Pelabuhan near to Rubiah Island. Damage of corals in that respective area is dramatically changed in comparison between before and after the Tsunami. Coverage of hard corals decreased up to 32% from good to fair category. However, in general, coral reefs condition is in fair condition. Tsunami damage is only little, which is believed because it was far away from the epicenter of the earthquake (Campbell et al, 2007).

In fact, degradation of coral reefs ecosystem in Weh Island is varied widely within the area. It is believed that the variation is related to human control or management. Despite natural disturbance, anthropogenic pressure such as destructive fishing practice is still perceived as the main cause of coral degradation in Weh Island (Hagan et al, 2007). One of the marine management types that applied in Weh Island is Marine Protected Areas (MPAs). In this case, MPAs is also identified as coral reefs conservation policy in addition to coral transplantation.

### 3.3. Coral Reefs Conservation Program in Weh Islands

Coral reefs are playing a crucial role in the tourism sector in Weh Islands. Degradation of coral reefs ecosystem can cause a serious problem. To cope with that problem several conservation programs are already implemented. MPAs and coral transplantation are two kinds of conservation policy that can be found in Weh Islands.

There are two MPAs which are indirectly conserving the coral reefs ecosystem. First is the MPAs under management of official government board and second is managed by Panglima Laot (customary board). It was in 1982 by official decree from Ministry of Agriculture Republic of Indonesia No. 928/Kpts/Um/2/1982 when Weh Island is agreed as Marine Natural Park with total protected area of 2.600 ha (including Rubiah Island and Seulako Island). Until now, this MPA is still exists but in lack of coordination. In addition, Panglima Laot has also their MPAs and proved to be more effective than MPAs managed by the government (Nasir et al, 2007).

Some strict regulations are applied in the MPAs. For example, it is not allowed for fishing with unfriendly fishing gear such as bombs, poisons, etc; and even in some areas it is totally forbidden

for fishing at all. By implementing the regulation, coastal ecosystems including coral reefs are indirectly benefit to recover from natural and anthropogenic pressures.

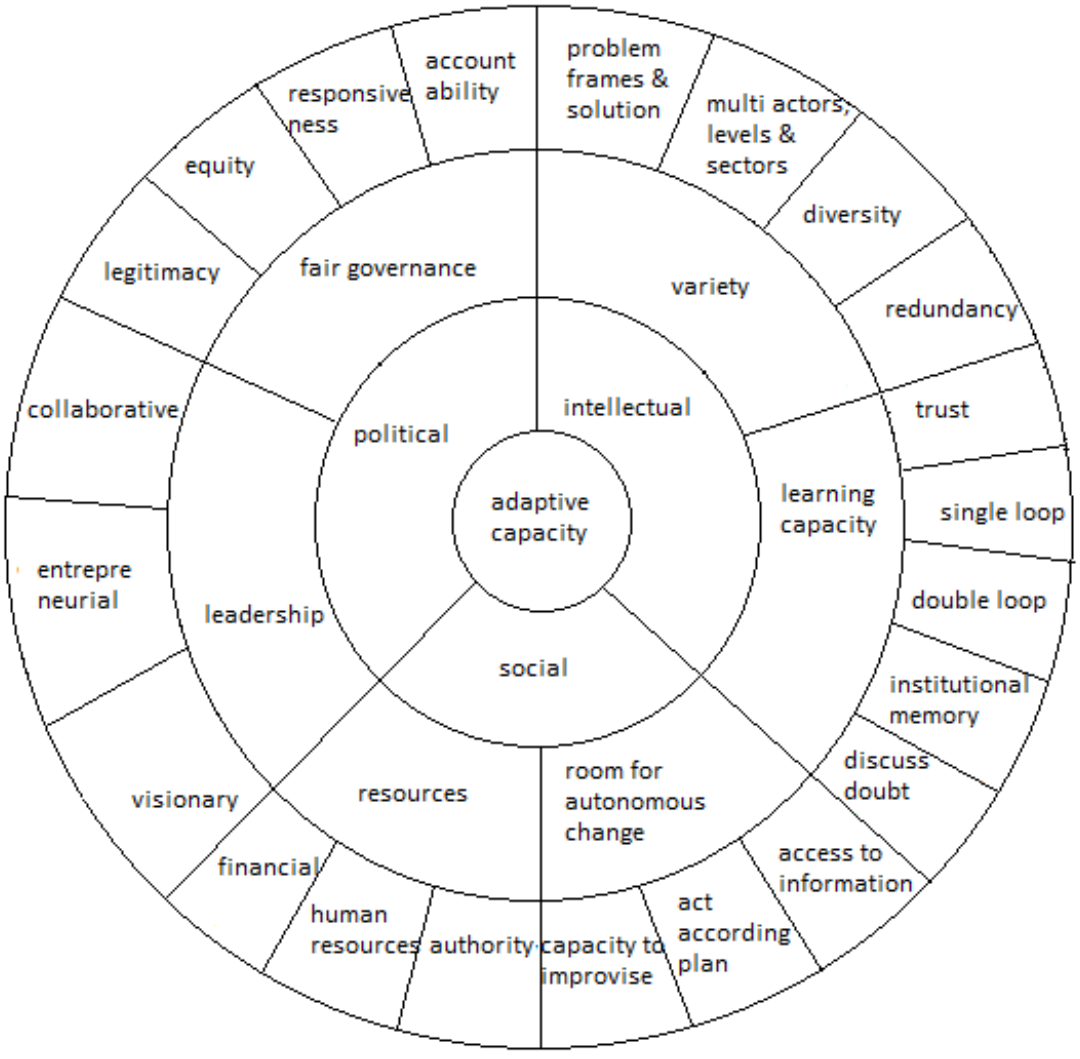
Besides MPAs, coral transplantation is also conducted on Weh Island. As already explained in chapter two, MPAs is perceived as a spatial/area-based conservation approach while coral transplantation is perceived as species-based conservation. The aim of coral transplantation is varied, but obviously in Weh Islands the community is doing the transplantation to conserve *Acropora. sp* (branching coral). ODC, a scientific diving club from the local university (University of Syiahkuala) is the main actor of coral transplantation in Weh Islands. They are doing the transplantation for not only the conservation purpose but also for their research as marine faculty's students. Some spots where coral transplantation have been implemented are Gapang, Teluk Pelabuhan and Ie Muele.

However, there is lack of a scientific paper reported the efficiency of this technique. Traditional coral transplantation that has been done in Weh Islands takes a long time to show the result. Therefore, monitoring activity that runs by local community becomes crucial. Moreover, monitoring could indirectly enhance social adaptive capacity as it requires social participation (Brooks & Adger, 2004).

# CHAPTER 4

## ASSESSMENT OF ADAPTIVE CAPACITY ON CORAL REEFS CONSERVATION IN WEH ISLANDS

In this chapter, assessment of adaptive capacity on coral reefs conservation policy in Weh Islands is elaborated based on Adaptive Capacity Wheel (ACW). The ACW method illustrates the degree of adaptive capacity through three main categories: intellectual, social, and political capacity (Khakee, 2002). The level of adaptive capacity is visualized in five different colors, range from the highest score to the lowest score (Gupta et al, 2010). In the end, the figure represented by the wheel is elaborated to explain the degree of adaptive capacity.



| Effect of institution on adaptive capacity | Score | Aggregate scores for dimensions and adaptive capacity as a whole |
|---|---|---|
| Positive effect | 2 | 1.01 to 2.00 |
| Slightly positive effect | 1 | 0.01 to 1.00 |
| Neutral or no effect | 0 | 0 |
| Slightly negative effect | -1 | -0.01 to -1.00 |
| Negative effect | -2 | -1.01 to -2.00 |

Figure 6. Adaptive capacity wheel and scoring scheme (Gupta et al, 2010)

Table 3. The color-scheme of the Adaptive Capacity Wheel (Gupta et al, 2010)

| Green | Light Green | Grey | Red | Dark Red | White |
|---|---|---|---|---|---|
| Institutional structure enhance adaptive capacity | The structure exists and could but is not (yet fully) applied to adaptation | Neutral score (positive nor negative effect expected) | Gap that needs to be filled to counteract negative effect on adaptive capacity | Institutional structure obstructs adaptive capacity for adaptation | Unknown (no information available to apply a score) |
| Score 2 | Score 1 | Score 0 | Score -1 | Score -2 | No score |

The assessment is divided into three main elements of adaptive capacity. The first element that is explained is intellectual capital, followed by social capital and finally political capital. This chapter is the central issue of the study, the intention of this chapter is to evaluate the implementation of coral reefs conservation and to what extent the conservation program contributes to the enhancement of local adaptive capacity. In addition, adaptive capacity wheel that used in this study is framed on Small Island's community perspective and in the context of developing countries.

### 4.1. Intellectual Capital

Any adaptation strategy needs knowledge and specifically in this study knowledge-related to conservation program is represented by intellectual capital. Moreover, intellectual capital in this

context is referred to a degree of the community's knowledge that shared and understood. Intellectual capital is respected as accumulation of experience, understanding, and scientific application which could enhance adaptability of the community (Khakee, 2010). It is assessed through two criteria based on adaptive capacity wheel. The criteria are variety and learning capacity. Furthermore, each criterion has derived sub-criterion which used to formulate a list of questions. Several informal interviews were taken to gain perspective and opinion of stakeholders.

Furthermore, in the next section the two main criteria and its sub-criterion are elaborated. Variety criteria has four sub-criterion which are variety of problem frames; multi actor, level and sector; diversity of solutions, and redundancy (duplication). Next to variety criteria, learning capacity criteria is explained based on its five sub-criterions namely trust; single-loop learning; double-loop learning; discuss doubts, and institutional memory. Tables are provided to summarize the discussion.

Table 4. Interpretation of Intellectual Capital in Adaptive Capacity Wheel

| Element | Criteria | Questions | Score | Remarks |
|---|---|---|---|---|
| Variety, Overall Score = ¼ (0,25) | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | -2 | The community does not really know about climate change, they do conserve the corals because of economic reason (especially tourism). Stakeholders who really know and aware about climate change issue are ODC and FFI (one of NGO there) |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | 2 | There are at least four main stakeholders with regard coral reef conservation in Sabang. Those are (1) NGO (FFI & WCS) who guides the community and gives consultation to the government; (2) Panglima Laot which is *"lembaga adat"* (customary institution) or could perceived as the representative of the community; (3) ODC (Ocean Diving Club) form Unsyah (local university) which get involved in conservation activity and (4) the government both local |

| | | | | |
|---|---|---|---|---|
| | | | | and national. |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | 1 | Until now, in Sabang there are two techniques of coral reef conservation namely MPA (Marine Protected Area) approach (area based conservation policy) and coral transplantation (species based conservation policy). |
| | Redundancy (duplication) | Is there any alternative of those techniques? | 0 | There is no need for new approach or alternative due to several reasons. First is because the old approach is still effective and the limited fund and human capital to apply new technique such as Biorock technique. |
| Score | | | 1 | |
| Element | Criteria | Questions | Score | Remarks |
| Learning capacity, Overall Score = 2/5 (0,40) | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | 2 | Yes, they are working cooperatively and know their role and task by themselves. However, it takes time to formulate and agreed upon one conservation policy. It is not the matter of cooperation but more the matter of procedure. Honestly, we enjoy working together with the community and we can see the initiative and food will from the government. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | 1 | Coral reef conservation policy somehow was the effect of other policy. It was started since 1970s when the first MPA policy was enacted. The main objective was to control fishing activity using unfriendly fishing gear. Until now, it is proved to be effective. Although the condition is changed and has to be improved. |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | -1 | No, there is no improvement. Just a little benefit from the rapid tourism development which improves the awareness of people about coral reef. |

| | | | | |
|---|---|---|---|---|
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | 1 | Yes, there ares both a formal and an informal forum to share information and invite the people to join the program. However, sometimes the invited participants are not going due to several reasons. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | -1 | There are no change in procedure, measurement, technique, and policy. In fact, the bureaucracy is getting complicated. |
| Score | | | 2 | |
| Intellectual Capital, Overall Score = [(0,25)+(0,40)]/2 = 0,325 | | | | |

### 4.1.1 Variety

Variety is closely linked to uncertainty (Klostermann et al, 2009). Indeed, knowledge is needed to understand climate change impact and alternative to solve the problem. Under variety criteria, Gupta et al (2010) suggested there are four derived sub-criterion which are variety of problem frames; multi actor, level and sector; diversity of solutions, and redundancy (duplication). In this study, all those four sub-criterion are asked through numbers of questions. From the interpretation of the answer, evaluation by giving a score to each sub-criterion is made. Interviews were recorded and the translation is described in words as a summary. Green color is indicated on the table which means variety of knowledge among stakeholders is not bad but could be improved (score of 0,25). Below is the elaboration of each sub-criterion.

Variety of problem frames

In this sub-criterion, the central focus of all questions is about the knowledge of climate change. The aim is to test the understanding of stakeholders about the benefit of coral reefs conservation program as adaptation strategy to cope with climate change. Interestingly, it is found that the community does not know about climate change problem even though they are actively getting involved in the conservation program. This lack of knowledge is confirmed in several interviews with Abdussalam (representative of Panglima Laot) and Alfarabi (one of diving operator). Abdussalam said that:

*"We are conserving and protecting coral reefs because the ecosystem has direct benefits for us, they provide abundant of fish and very useful for tourism activity. Yes, the climate is now a bit hotter than several years ago, but I do not know if there are impacts of hotter weather to coral reefs ecosystem."*

Alfarabi, when I asked about climate change impact was mentioned that he recognized about climate change from tourist. Coral bleaching is found when his guest went diving and told him that it was because of climate change.

*"I do not really know about climate change, but I have heard about that from my guests who went diving and saw coral bleaching. However, I do know why we should conserve corals."*

In its original paper written by Gupta et al (2010), variety of problem frames have something to do with institutional aspect, respectively an institution. However, in this study, coral reefs conservation is not regarded as an institution but in a wider scope as a product of institution. By definition, variety of problem frames refer to knowledge resources related to problems (Gupta et al, 2010). Unfortunately, based on interviews result, it is found that there is lack of knowledge about climate change in the community.

Having a wider range of knowledge to understand the problem and developing alternative to cope with the problem is crucial. However, sharing knowledge is more powerful and thus openness to a new idea and perspective is required. With regard coral reefs conservation program, community in Weh Islands is, indeed, still does not care about climate change. Fortunately, other stakeholders such as students from ODC and practitioners from FFI are well educated and willing to share their knowledge about the impact of climate change to coral reefs ecosystems to the community. Moreover, the local government has a role to provide information to raise awareness of the community by promoting community participation on the conservation program, which is already happened.

On the assessment, this sub-criterion is granted the lowest score (-2) and colored by dark red. It is obvious that the reason of conserving coral reefs ecosystem is to protect them from extreme climate events and reduce their vulnerability. Therefore, it is undesirable when the program could not enhance the awareness of the community about climate change. However, tourism

reason as mentioned earlier is also not proved to obstruct adaptive capacity in general. Apparently, a low score does not simply indicate the adaptive capacity is low (Klostermann et al, 2009), instead it means that the condition is not desirable and need improvement.

Multi actor, level and sector

There are many stakeholders who are concerned and getting involved in the conservation program. From several interviews, it is understood that initiative of the conservation program comes from NGOs. However, the role of the community through Panglima Laot is crucial. In addition, implementation of the conservation program, respectively coral transplantation is done in collaboration with students from the local university through ODC. Such collaboration has a significant impact on the implementation of coral reefs conservation program.

Joni, coordinator of the Marine Conservation program of FFI mentioned that there is no substantial conflict so far regarding the implementation of coral reefs conservation program.

"*We are working on the proposal based on recent condition and need of the community. After that, we discuss the proposal with the local government. If the local government has agreed to provide budget, then we call student from ODC to help me in practice."*

It is necessary to mention that beneficial collaboration will lift a chance to share knowledge and experience among stakeholders. Active participation among various stakeholders is believed could improve knowledge which leads to increasing legitimacy of any strategy or program (Siebenhüner, 2004). This knowledge basis benefits to guide any strategy or program to fulfill the sustainability principle. Therefore, based on perspective given by interviewees, this sub-criterion has the highest score (2).

Diversity of solutions

It has to admit that developing countries, specifically on the small island's community, there is limited human and natural resources available. In Weh Islands, there is no academic institution related to coral reefs conservation. However, interestingly, there is strong traditional knowledge applied in this island for a long time ago. Integration of current scientific approach and traditional knowledge is found in Weh Islands. For example, coral transplantation as modern

technique is indirectly monitored and protected by local wisdom managed by Panglima Laot, a traditional institution in Weh Islands.

Abdussalam, one of the local leaders represented Panglima Laot argued that area under their management is more effective than area which managed by the national government.

*"If you go diving in Iboih, you will see a better coral reefs condition in comparison to coral beauty in Ie Meulee. That is because we applied strict regulation and give sanction to anyone who violates common agreement."*

Nowadays, there are two kinds of coral reefs conservation program that can be found in Weh Islands. Those are MPAs and coral transplantation. It is possible, though, to add another technique of conservation. For example is Biorock Technology or the mineral accretion approach to speed up coral transplantation's growth rate. However, lack of financial resources is the main pitfall as this technology requires a lot of budget. Additionally, human resources are also still insufficient to put into practice other technique. The community in Weh Islands does not truly care about a new technique as long as their interest, for example fishing, is not disturbed. Discussion with Ferd who are one of ODC's students confirmed that perspective.

*"Indeed, coral transplantation is such traditional approach in the current development of coral reefs conservation technique. But, we cannot do the Biorock Technology in Weh Islands, there is no sufficient in electricity supply to establish the coral cage and also we do not have Biorock expert in Aceh."*

However, output of existing conservation program should be appreciated. It seems like another alternative is not urgently needed. Current monitoring and research about coral reefs ecosystems in Weh Islands shows that coral transplantation and MPA is sufficient to Weh Island's context. In addition, community driven management is applied and gives a room to integrate a traditional ecological wisdom with a modern approach of conservation (Nasir et al, 2007). Therefore, score one is given to this sub-criterion, indicating the current condition of coral reef conservation in Weh Islands contributes to adaptive capacity, but it could be improved and supported by other element that will be explained in the next section.

Redundancy (duplication)

Redundancy, in this context, refers to alternatives conservation program. It is seen as a back-up plan to support or avoid the inefficiency of the current program. Based on direct observation and interviews with stakeholders, they concluded that there is no need of new alternative. It is better, from discussion with Abdus Syakur (government official), to focus on the current conservation program as the process is still going on.

*"Two conservation programs which are running in Weh Islands (MPAs and coral transplantation) are still ongoing activity. Instead of regulating and budgeting for new alternatives I think, improving the implementation of these two programs should be our priority."*

Participation of the local community on the training regarding conservation program provided by NGOs is high. In a wider context, high participation could stimulate social learning in which simultaneously promotes the community to work on the program voluntarily although the resources (financial and human) are limited (Siebenhüner, 2004). Score zero is given with a reason that redundancy seems not urgently needed in the current situation.

### 4.1.2 Learning Capacity

Learning is a continuous process. The process is not only limited to learn from present action but also learn from experiences. Learning is not only about gaining new information but also to discover possible alternative. In this study, learning capacity refers to a degree of knowledge of stakeholders related to the conservation program which evaluated through some indicators. The indicators are trust, single and double loop learning, doubts, and institutional memory. From the table above, green color of learning capacity is indicating robust adaptive capacity. Below is the elaboration of the sub-criteria.

Trusts and Discuss doubts

Trust is an abstract factor. In this study, trust or degree of acceptance is investigated through several questions focuses on cooperation among stakeholders. Every stakeholder has their own

capability and role, and trust is seen as a bridge to make the conservation program succeeded. Moreover, trust is also could be traced from degree of participation and how they communicate. For example, does a community come to an informal meeting held by local government? Such question provides us hints regarding a curiosity of the community to gain new information and enhance their understanding.

*"Usually, on the weekend we have a gathering at the beach, talking informally about the progress of our program. We also invite all stakeholders (in this case Panglima Laot and NGOs) to our office to talk about the program."* (Interview with Abdus Syakur, government official)

However, it is obvious that the community is more interested in practical knowledge rather than discussing theory. People are helpful and enthusiastic doing coral transplantation or monitoring the protected area. Moreover, the existence of Panglima Laot as traditional institution is valuable in building trust within society. Through local leader, mobilizing the community is easier. It is commonly acknowledged that collaboration with local leader could lead higher acceptance among society in which simultaneously raises awareness of the community. So far, there is no conflict of interest that could fail the conservation program. All stakeholders are collaborating and supporting each other. Thus, the highest score (2) is given, indicating the current institutional arrangement is promoting adaptive capacity.

Furthermore, discussing doubts through discussion among stakeholders is happened couple of times. The discussion is held not only by inviting the representative of each stakeholder to a formal event, for example, workshop or meeting in the government's office, but also informally held by the community. Informal meeting usually happened after praying in *"Musholla"*, a simple building for praying. The way of this kind of meeting is more conducive than the formal one. People are sitting and talking each other, the atmosphere is warm and kinship.

*"We have an informal meeting and dinner together. During the meeting we do talk about technical things and agree upon procedure, we talk about anything!"* (Interview with Abdussalam, Panglima Laot Iboih).

Climate change is uncertain and the conservation program is aiming to anticipate further degradation. Uncertainty is related to doubt, so by doing a discussion, both formal and informal,

it is likely to establish solid understanding among stakeholders. Informal meeting is notable not only to legitimate political and technical procedure regarding the program but could also broaden knowledge among stakeholders (Siebenhüner, 2004). Thus, score one is fair for doubts criteria.

Single and double-loop learning

Single loop and double loop learning are interconnected. Single loop-learning describe the capability of stakeholders to run the conservation program and improve it through learning from past experience, while double loop learning means looking for alternatives to counter the future challenge (Gupta et al, 2010). From the questions that were asked during the interviews session, however, a bit contradiction relates related to these sub-criterion is found. The coral reefs conservation program was not a priority in the past.

*"MPAs were started in the 1970s when there were a lot of fishing boats coming to one area. They were catching fish excessively. Started since that time, awareness was starting to rise and started to think about the limited numbers of boat fishing. Indirectly, coastal ecosystems like coral reefs were also protected."*

Moreover, in the current situation, hybrid coastal management is not yet promoted. Whereas, hybrid management is suitable to the small island context and is already developed in the Cook Islands, Solomon Islands, Fiji, Samoa, and Vanuatu (Cinner & Aswani, 2007). There is lack of alternative solution and stakeholders tend to maintain old routines, therefore, score one and score minus one is given to each sub-criterion.

Institutional Memory

Institutional memory in this context means not to repeat past mistakes in the procedure. Questions to investigate if there is any change in procedure, technique, and regulation is asked. Current condition is changed from the past when society is not that dynamic like nowadays. In fact, the procedure has not really changed. It is even worse as the bureaucracy is getting complicated and takes a long procedure, for example a disbursement.

*"It takes quite a a long time to disburse a fund, we have to wait for the agreement from local parliament and if it is not agreed, then we have to wait for a next budgeting procedure starts."* (Interview with Abdus Syakur, government official).

In the end, overall score of intellectual capacity is just fair. Figure 0,325 means there is a contribution of knowledge to enhance adaptive capacity. However, it is indeed could be and should be improved. The condition of Weh Islands which is famous as a marine tourism destination makes all stakeholders more care about coral reefs. That is why the conservation program is accepted although it requires sufficient knowledge to improve the implementation of the program.

### 4.2. Social Capital

Social capital is defined in many descriptions. There is no doubt that social capital is the fundamental aspect of adaptive capacity. Society is the main actor of any adaptation strategy and in the coral reefs conservation program there is no exception. Enhancing social capital could simultaneously make society more resilient and increase coping capacity to reduce vulnerability (Folke et al, 2005).

More specifically in this study, social capital is evaluated through several sub-criteria under adaptive capacity wheel indicator. Room for autonomous change and resources are the main indicator of social capital. In addition to its derived sub-criteria, continuous access to information, act according plan, and capacity to improvise are contributing to the room for autonomous change criteria. Moreover, authority and human as well as financial resources are assessed under resources criteria.

An overall score of social capital based on those criteria is 0,50. It is still in the category of fair indicated by the green color. It shows that the conservation program is supported by the community and indirectly enhances community capacity. The table below describes the summary of the interpretation of social capital based on Adaptive Capacity Wheel.

Table 5. Interpretation of Social Capital in Adaptive Capacity Wheel

| Element | Criteria | Questions | Score | Remarks |
|---|---|---|---|---|
| Room for autonomous change, Overall Score = 1/3 (0,33) | Continuous access to information | Does the community recognize the conservation of coral reef? Aware about the climate change? And know how importance of coral reef? | 0 | The community knows about the importance of coral reef and its conservation program. However, the knowledge of the community has nothing to do with climate change issue. |
| | Act according plan | Have you trained to do the technique? | 2 | The community is getting actively involved in conservation program. They are doing the monitoring and applying the technique. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | -1 | There is both formal and informal meeting regarding conservation program. However, the old technique is not improved and the motivation of the community is not because of climate issue. |
| Score | | | 1 | |
| Element | Criteria | Questions | Score | Remarks |
| Resources, Overall Score = 2/3 (0,67) | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | 2 | There are both legal formal and customary basis that agreed among stakeholders. |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | 1 | Local university (Unsyah) through its diving club (ODC) is playing an important role on this program. Local government and the community are supported the NGO (FFI & WCS) as well as the ODC team during the implementation of this program. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial | -1 | The main reason of unimproved of the program is due to lack of financial support. Usually the funding is coming from NGOs or |

| | | | | |
|---|---|---|---|---|
| | | support, for example from private sector? Is the budget just enough or less? | | by making proposal to get funding from corporate or other resources. Besides having financial support from local government, there is also additional funding, voluntarily, from dive operator and tourism sector in Iboih. |
| Score | | | 2 | |
| Social Capital, Overall Score = [(0,33)+(0,67)]/2 = 0,50 | | | | |

### 4.2.1. Room for autonomous change

It is mentioned on IPCC Assessment Report II (2007) that adaptation strategy could be autonomous and planned. Autonomous adaptation characterized by short-term action and regarded also as coping capacity, while planned adaptation is more visualized and integrated to long-term application (Mimura et al, 2007). Moreover, in this study, room for autonomous change is perceived as part of a resilience system of society. Gupta et al (2010) suggested three sub-criteria to evaluate this criteria. Those sub-criteria provide sufficient information, ability to act according plan, and willingness to improve knowledge. From the previous table, this criterion is regarded with green color. However, one of the sub-criteria is indicated by red color. Below is the elaboration of the sub-criteria.

Continuous access to information and capacity to improvise

These two sub-criteria are not independent. Information is support the system to improve. From interviews, it is obviously recognized that there is valuable information available. However, the access is not supportive. For example, there is no socialization of a conservation program to the community. Trainings are usually organized just for chosen people and not openly recruited.

It is an interesting fact that the conservation program is not mainly triggered by climate issue. Information about climate change is insufficient. Besides, local community is obviously does not care about climate issue. Tourism issue is more interested for most of the stakeholders. Joni, one of coordinator program in FFI told me *"although coral bleaching is caused by extreme climate*

*event, conservation program is motivated not because of that reason, but more about the idea to fancy or keep the beauty of corals. That is of course for touristic interest."*

The capacity to improvise is hindered by the routines of the government official by just focusing on making regulation. It is even worse because the fact that the community has lack of information about the conservation program. Indeed, there are people who are expert in the field of coral reefs conservation. Though, they have difficulty to transfer their scientific basis into ordinary words. It is difficult to understand by the community where a fisherman is a majority.

Act according plan

The community is getting involved actively in the conservation program. They do also care about the continuity of the conservation program by doing a monitoring. Panglima Laot is ruling their area and also running the monitoring activity. Under this condition, the only threat to the program is a natural disturbance such as heavy rain and strong storm surges. While an anthropogenic disturbance such as destructive fishing practice and unfriendly tourist behavior is controllable. The highest score is given to this sub-criterion as all interviews indicated that all stakeholders are playing and coordinating their role and task properly.

### 4.2.2. Resources

Resources could be interpreted in many forms. Any supportive form to enhance efficiency could be regarded as resources. Additionally, specifically in the ACW, there are three resources that could be used to evaluate social capital in general. Those are authority (dealing with political and legal basis), human resources (related to knowledge and ability of the community), and financial resources (including the budget and access to technology) (Gupta et al, 2010). From the table before, it shows that resources are indicated by green color. However, it is based on the interpretation grasped from the interview. Although the fact is that there is still much improvement should be promoted.

Authority and human resources

In this study, authority deals with formal and political procedure, while human resource is about the capacity of the community to follow the procedure. Conservation of coral reefs in Weh Islands is not a single product from the local government. It has rooted from the national law. There are two Laws which could be considered as the legal basis of derived regulation regarding coral reefs conservation. First is Law No. 5/1990 about Conservation of Natural Resources and its Ecosystems and the second is Law No. 26/2007 about Spatial Planning. In addition, there is one government regulation No. 60/2007 specifically about Fisheries Conservation. Lastly, the very recent regulation enacted by the Ministry of Marine and Fisheries Affairs is Minister Decree No. 30/Men/2010 about Management and Zoning Plan of Waters Conservation Area.

It can be seen that the legal frameworks are sufficiently available. As one of the main factors of adaptive capacity, government authority has to empower social system (Tol, 2005). Furthermore, robust governance system is believed to enhance social resilience (Adger et al, 2005). However, robust governance system here does not only means providing good regulation but the enforcement of the regulation is also essential.

*"I think the legal framework with regard marine conservation in Indonesia is excellent. Especially to Sabang, the local government is very concern about marine ecosystems as their main tourism asset. However, law enforcement is quite weak and complicated. It takes quite a a long time to enact more specific regulation. Luckily, local wisdom is provided here and in some cases are more effective."* (Interview with Joni from FFI).

Good regulation will never give positive impact without strong human attitude. From interviews, it is identified that human resource in Weh Island regarding coral reefs conservation is fair. Indeed, there is room to improve. Nevertheless, the current situation is conducive. People understand what if the importance of conserving coral reefs. The collaboration among stakeholders is also run properly. Community capacity building is supported by the NGOs and ODC's student from the local university. Traditional knowledge is also well preserved in which enrich the adaptive capacity of the community, for example is Panglima Laot who use local wisdom to prohibit fishing in every Friday. Therefore, good score is given to both sub-criteria,

indicated by the green color. Unfortunately, it is not the case for other sub-criteria (financial resources).

Financial resources

Financial resource is always a case in the context of developing country, specifically for Small Island's government. The main funding of the conservation program comes from the local government's budget. However, it is still lack of money and the procedure of disbursement takes quite a a long time. Additional funding comes from the donation and sometimes is not with money. Many diving operators lend their SCUBA equipments that can be used.

The complicated budgeting procedure is always blamed as an excuse. It is a classic problem in the government system. The NGOs are pushing the local government to allocate more funds to the conservation program. A research grant from the local university is also used partially for conservation activity. In addition, Panglima Laot is in some cases also using their fine money to support the conservation program. This kind of uncertainty in funds could delay the conservation program.

### 4.3. Political Capital

Coral reefs conservation program is like another environmental protection policy that needs not only participation from the community and knowledge resources but also political commitment. Political capitals in this study refer to the capability and willingness of decision makers (especially government officials) to cooperate with other stakeholders in order to succeed the conservation program. In a simple word, this capital is showing the role of the governance system to support coral reefs conservation program.

Coral reefs are the most valuable asset for Small Island's community. There are many stressors that trigger the degradation of coral reefs ecosystem. The determinant of degradation factor is ranging not only from natural disturbance but also anthropogenic stress. Interestingly, poor governance system is also believed as part of this anthropogenic stress (Goldberg & Wilkinson, 2004 *cited in* Mimura et al, 2007). Poor governance system is supposed to be controllable by

enhancing, at least, two determinant factors suggested by Gupta et al (2010). These two factors that belong to political capital are leadership and fair governance.

Among other two capitals that discussed in this study, the political capital of stakeholders in term of coral reefs conservation program in Weh Islands is the lowest. The overall score for these sub-criteria is below zero, indicating from the red color. That means there is lack of leadership and fair governance practice should be more promoted. Below is a table shows the summary of the interpretation political capital in the ACW.

Table 6. Interpretation of Political Capital in Adaptive Capacity Wheel

| Element | Criteria | Questions | Score | Remarks |
|---|---|---|---|---|
| Leadership, Overall Score = -1/3 (-0,33) | Visionary | Does the procedure take a a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? | -2 | Yes, indeed, the procedure takes quite a long time. The main reason is due to formal and legal procedures that have to be fulfilled before the policy becoming legal. Our main partner is the community as we propose community based management and focus on initiative and awareness of the people to succeed the program. |
| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? | -1 | Budget is about 90% from the government and the rest comes from the community and NGOs. There is no funding support from private sector. |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | 2 | There are many stakeholders involved and they are cooperating fairly and have no serious conflict so far. |
| Score | | | -1 | |
| Fair Governance, Overall Score = 1/4 (0,25) | Legitimacy | Who is the local leader in the community? How important is he/she influence to | 2 | Panglima Laot is the main partner in practicing the conservation program, while the local government support with budget and provides legal framework. |

| | | | | |
|---|---|---|---|---|
| | | mobilize people to succeed the conservation program? Does the community know and get involved to this program? | | |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that "two ways dialogue" or just "command and control"? | 1 | Yes, there is an informal discussion about the program and it is not a "command and control" discussion. The local government is hearing opinion of the community. |
| | Responsiveness | What indicates the government's seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | 0 | The government is serious in this program. However, complicated and a long time procedure is still there. That makes the community less to contribute and become ignorance. |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, and planning procedure of the program? Do you think it is accountable | -2 | There is lack of accountability. The NGOs and ODC as well as the community do not care about the budget as long as the program could run properly. However, the budget transparency is checked by an official budget supervisor from the government (Badan Pemeriksa Keuangan Daerah/BPKD) |

| | | | | |
|---|---|---|---|---|
| | | and transparent? | | |
| Score | | | 1 | |
| Political Capital, Overall Score = [(-0,33)+(0,25)]/2 = -0,04 | | | | |

### 4.3.1. Leaderships

Any system is run by a leader. Talking about social systems, government is perceived as a leader who responsible to guide the society, thus leadership is crucial to influence positive change and to give a motivation to other stakeholders to participate (Gupta et al, 2010). Dealing with the dynamic of environmental processes and climate change issues, flexibility and innovation of a leader are required to adapt. In multi-level governance systems, a leader is playing a crucial role to build trust, coping with different interests, initiating collaboration, and implementing policy to other stakeholders (Folke et al, 2005).

There are three sub-criteria under leaderships in the ACW. Those are visionary, entrepreneurial, and collaborative. Ideally, a leader has to know about at least those three sub-criteria. The visionary has something to do with style of management while entrepreneurial is closely linked to innovation and flexibility to search additional funding with partnership scheme (Gupta et al, 2010). In addition, collaborative leadership is prominent to manage and to accommodate the interests of many stakeholders (Folke et al, 2005). Building network is a keyword of collaborative leadership.

Table 6 above shows that from three sub-criteria, collaborative leadership is the only sub-criteria that indicated by green color. The other two (visionary and entrepreneurial) is indicated by red and dark red color. Green color of collaborative leadership describes a solid networking among stakeholders in terms of coral reefs conservation program. It is not an easy task of local government to coordinate fairly with other stakeholders. As told by Abdus Syakur,

*"In this conservation program, we have to be careful with the community and especially to the NGOs because they are our main partner. As a government official, it is our task to initiate the program. However, sometimes the system is not run smoothly, respectively talking about budgeting. In fact, the community and NGOs do not care about the procedure. It is such a dilemma and of course we receive a lot of critics."*

There are many legal frameworks available that recommend conservation program. Community is waiting for a political will of the local government and the NGOs is monitoring seriousness of the local government to shape action. However, as acknowledged by Joni (Marine Conservation coordinator from FFI), the procedure is indeed complicated due to several reasons.

*"We think the local government is just fair. They are trying to accommodate and hear our interests. Regarding bureaucratic procedure, it is understandable if budgeting and enacting regulation is quite complicated. Decentralization is somehow contra-productive and makes the procedure even complicated. The capacity of the government officials is also a problem, there are just a few numbers of a government official who understand the importance of coral reefs conservation, most of them are just doing a business as usual, just because it is their job."*

Sabang's city government could be perceived as the leader of any conservation program in Weh Islands. The local government has marine and fisheries agency and assigned a specific task to deal with coral reefs conservation. It is acknowledged by Abdus Syakur that it takes quite a long time to agree upon specific marine protected area. For example, in Teluk Dalam waters, the initiative was started since three years ago and until now the discussion in the local parliament is not clear. Some pitfalls are because the local regulation has not overlapping with national regulation, while in that respective area, there is a national agency which responsible to manage the waters. However, unfortunately, local people under Panglima Laot decide to manage their waters by themselves and not under the management of the national agency. It shows that there is a conflict of interest and local government is rather failed to manage it.

However, there is no substantial conflict among stakeholders until now. The implementation of coral reefs conservation is also acceptable. It seems like the collaborative leadership that run by the local government is a balance. Although there is some delay in formal procedure, alternatives are independently searched by other stakeholders without too complaining to the local government. The overall score of the leadership sub-criteria is indicated by red color. That means there is room for improvement, especially with regard visionary and entrepreneurial aspect.

### 4.3.2. Fair governance

Fair governance has a strong point on four factors namely legitimacy, equity, responsiveness, and accountability (Gupta et al, 2010). Decision makers (local government) have to be legitimate and acceptable by the community. It is also notable that other stakeholders respond and even better support the political decision of the local government. However, in a developing country's context, accountability is still an issue. Lack of budget transparencies and low level of trustworthiness from the society is obstructing fair governance campaign. In fact, adaptive capacity will be higher if there is fair governance and solid leadership in the political realm (Wostl, 2009).

Previous table shows that in overall score of fair governance criteria is quite good; indeed, there is room for improvement especially in accountability criteria. Below is the elaboration of derived sub-criteria:

Legitimacy and equity

Climate change adaptation is not independent of the political realm (Folke et al, 2005). Any policy that has a close relationship with a common interest has to be legitimate and equitable. That is simply because it influences social systems. For example, coral reefs are a main tourism asset for such small islands like Weh Islands. There is no doubt that any policy regarding coral reefs becomes public interest and, therefore, has to be accepted by all stakeholders and equitably informed.

There is a tendency that the society is being skeptical to the local government. It is understandable due to numbers of negative attitude or mentality of persons in government officials such as corruption, opportunist, and laziness. This perception is concluded from the interview with Abdussalam from Panglima Laot Iboih.

*"I know the local government has number of money to realize the conservation program, but sometimes budgeting and making good policy is indeed complicated. Each party, of course, has their own interest. For example, the local parliament which has a power for disbursement sometimes delays the process. It is just simply because conservation program is not their*

*priority. The awareness of government to put a conservation program as the most priority program is far from desirable condition. That is a pity."*

One of the fundamental elements of legitimacy is a scientific basis. The scientific legitimacy in the coral reefs conservation program is supported by some monitoring and researches done by the local university, respectively ODC's students. Furthermore, Panglima Laot as an independent social organization contributes positively and helps the local government in shaping the action. It is crucial as adaptive capacity is highly depending on the solidity of stakeholders at the root-level where usually conflicts are started. The combination of independent social organization and local government promotes adaptive capacity in the way of diminishing conflicts (Brooks & Adger, 2004). Panglima Laot is legitimate and acceptable legally by all stakeholders. They coordinate the conservation program together with local government. It can be seen that legitimacy and equity is not a critical issue in the implementation of coral reefs conservation program in Weh Islands. The green color is indicating these sub-criteria on the ACW.

Accountability and responsiveness

The politician is not paying much attention to the conservation program. On the other hand, initiative and response from other parties like the NGOs and the local university should be appreciated. It should not be forgotten that in managing natural resources, high participation is believed as the main factor (Wostl, 2009). In fact, responsiveness of many parties to the conservation program is not improved. Zero point is given indicating this sub-criterion in a grey color.

Furthermore, an accountability criterion is even worst. There is obvious that transparency of not only budgeting but also a process of guiding regulation is still far from desirable condition. As acknowledged by Abdus Syakur that *"the local government is indeed not report the budgeting as well as the progress of any discussion related to conservation program to other stakeholders."*

*"There is no obligation to let them know how the budgeting and the process are running. If they want to know, then they can come to us and ask it. Moreover, there is already a mechanism within the government system related to accountability and transparency. Therefore, I think other stakeholders should not worry about that and trust us."*

Lowest score is given to accountability criteria as there is a demand from other stakeholders to the local government is more transparent. As Joni has said:

*"The local government has to respect our effort and let us know transparently about the budget and also the progress of our proposal. Collaborative effort is beneficial for each other and I think the local government is already knows about it. Despite its lack of transparency, we as a NGO will keep monitoring and rebuking them if there is an indication of corruption or other violation."*

Low awareness of political leader about conservation program is still being a main reason of why political capital, in this study, just gaining a low score and indicating with red color.

### 4.4. Adaptive Capacity Wheel and proposed additional criteria

It is not easy to assess adaptive capacity of coral reefs conservation policy with the ACW. In the original paper developed by Gupta et al, (2010), the ACW is designed to assess the kind of institution in physical entity and under the frame of developed country perspective. Some sub-criteria are found to not actually clear and connect to the specific study like coral reefs conservation in Weh Islands.

The ACW shows that there are still many crucial factors that have to be improved, although, in overall, the score is good (indicated by green color). It has to be acknowledged that political capital is still an issue. Leadership factor is not in desirable condition and has to seriously develop. The local government has a responsibility to motivate all stakeholders to act collectively, minimize conflicts, and solve problems. It is crucial since adaptive capacity depends on social stability and strong leadership is needed to achieve such condition (Brooks & Adger, 2004). The picture below shows the whole score of the ACW regarding the assessment of coral reefs conservation policy. Further explanation of criteria is followed.

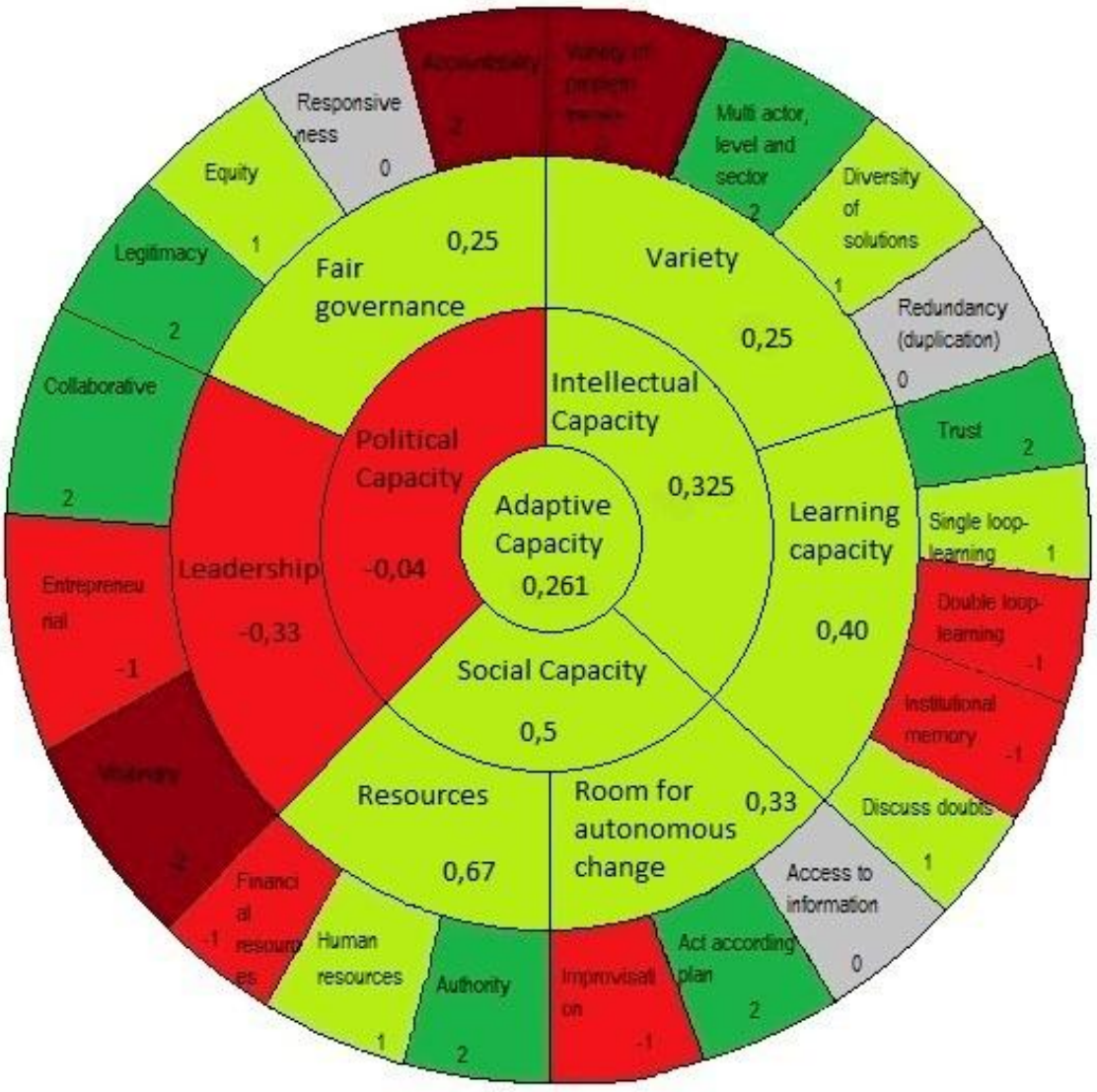



Figure 7. The Adaptive Capacity Wheel of Coral Reefs Conservation Program in Weh Islands

On the other hand, social and intellectual capital seems to contribute to adaptive capacity. The coral reefs ecosystem is widely understood by the community as the main asset of their livelihood. That is why the awareness of stakeholders is high and they are working together even though have to deal with limited fund and technology. The existence of NGOs and ODC are helping the community to enhance their knowledge which simultaneously could enhance adaptability (Khakee, 2002). From social capital point of view, the existence of customary board, in this case is Panglima Laot, is proved to significantly enhance community participation. Building a network and maintain a harmony among stakeholders is never been easy. Though,

Panglima Laot contributes to some extent by bridging the formal and informal procedures as well as mobilizing the community together with other stakeholders to succeed the conservation program. Indeed, social capital is contributing significantly to enhance adaptive capacity in Weh Islands.

Despite all criteria proposed in the ACW, there are some additional criteria that could be suggested. Respectively in this case, adaptive capacity assessment through the ACW is framed within Small Island and developing country context. Moreover, coral reefs conservation program in which perceived as part of adaptation strategy has the same implementation to other environmental protection program.

At least, there are two additional criteria to strengthen the ACW in the context of environmental protection program within developing country and more specifically to small islands community. Those suggested factors are using local ecological knowledge and self-management. Using local ecological knowledge could be added in social capital element while self-management is likely to be a part of fair governance.

Local ecological knowledge refers to terminology proposed by Berkes et al (2000) who used traditional ecological knowledge (TEK). He defined TEK as "*a cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment."* (Drew, 2005). In areas where there are lack of scientific research conducted and remoteness due to poor accessibility like small islands, using local knowledge become prominent. Local people are believed to have more traditional knowledge than researchers from outside (Heyman et al, 2001 cited in Drew, 2005).

Adaptive capacity put emphasize on local capacity building (Folke et al, 2005). Indeed, by taking into account local ecological knowledge that means indirectly to develop local participation and acknowledge the community's belief. Integrating local ecological knowledge with a management plan could enhance the community's sense of belonging and promote effectiveness and efficiency of any conservation program. Moreover, there are already many

studies explained about integration of local knowledge and scientific research in managing common natural resources.

In addition, self-management is another crucial factor that has to be emphasized and promoted. In this specific context, self-management refers to the ability of the community to solve problems using their resources. Again, customary board like Panglima Laot is an excellent example of how small island's community collectively anticipates problems. Folke et al (2005) argued that self-management should be also promoted by the local government through implementing flexibility of formal institutions and equity in the social dimension.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

## 5.1. Conclusion

This chapter is aimed to conclude the study by answering research questions. The conclusion is explained through answering research questions that asked in the first chapter with the link to the analysis in the previous chapters. The research questions are as follow:

- How is recent coral reef condition in Weh Islands?

Recent condition of coral reefs in Weh Islands is in fair condition. It is not bad but could be improved through conservation program. There are two main threats to coral reefs ecosystem. Those are unfriendly fishing practices and the rising sea surface temperature which lead to coral bleaching. Additionally, couple times of natural disaster like what happened in Tsunami 2004 that has caused degradation to coral reefs ecosystem. The most affected spot caused by the Tsunami is in Teluk Pelabuhan near to Rubiah Island. Damage of corals in that respective area is dramatically changed in comparison between before and after the Tsunami. Coverage of hard corals decreased up to 32% from good to fair category (Campbell et al, 2007). However, based on the last survey to observe Tsunami impact that was conducted on February 2009 showed that there is little evidence of Tsunami.

On the other hand, coral bleaching due to the rising of sea surface temperature in the late 1998 is still remained (Gomez, Cruz & Villamor, 2001) and need conservation. Coral bleaching is found in some diving spots such as Gapang, Ujung Seurawan, Rubiah Island, Lhok Weng, etc (Ulfah, 2011). In fact, degradation of coral reefs ecosystem in Weh Island is varied widely within the area. It is believed that the variation is related to human control or management. Despite natural disturbance, anthropogenic pressure such as destructive fishing practice is still perceived as the main cause of coral degradation in Weh Island (Hagan et al, 2007).

- What kind of conservation policies that has been and will be implemented in Weh Islands?

There are two kinds of coral reefs conservation program in Weh Islands. Those are Marine Protected Areas (MPAs) and coral transplantation. Since, in this case, any conservation program is perceived as adaptation strategy, therefore, these two kinds of conservation program are assessed with Adaptive Capacity Wheel.

There are two MPAs which are indirectly conserving the coral reefs ecosystem. First is the MPAs under management of official government board and second is managed by Panglima Laot. Besides MPAs, coral transplantation is also conducted on Weh Island. As already explained in chapter two, MPAs is perceived as spatial/area-based conservation approach while coral transplantation is perceived as species-based conservation.

- To what extent the implementation of coral reef conservation program has influenced the adaptive capacity of the community in Weh Islands?

This is the last research question and also the main focus of this study. The ACW is aimed to help stakeholders to assess how specific adaptation strategy contributes to enhance adaptive capacity of society through some elements (Gupta et al, 2010). From the ACW presented on the previous chapter, it is clear that coral reefs conservation program contributes positively to the adaptive capacity of society. However, it is intriguing to comment on the fact that the conservation program is not actually rooted on concerns about climate change issue. Nevertheless, coral reefs conservation program in Weh Islands has a positive influence on adaptability.

To conclude, there are two main colors that indicate the adaptive capacity which shown in figure 7 (page. 61). From three elements, two elements (intellectual and social) are indicated by green color and one element (political capital) is indicated by red color. Generally, that means the local government has to improve its capacity to support and response the conservation policy. It also means that the fair governance principal has to put into practice, literally. On the other hand, the green color of both intellectual and social capital is already indicated an improvement of the adaptive capacity among stakeholders. However, some improvement has to be encouraged, especially to share knowledge in order to raise awareness of the community to climate change issue. Conservation policy is proved to be one of successful adaptation policy in Weh Islands,

the figure shown us that this policy contributes positively to the adaptive capacity, especially to the social and intellectual capital. The existence of local customary board (in this case is Panglima Laot) is indicated that society cares about coral reefs ecosystem. In addition, the active contribution from local university (in this case is ODC) has to be highly appreciated to improve local knowledge and anxiety of the community. It would be even better if the local government being more transparent about accountability and has a good leaderships to manage and accommodate all stakeholder's interest.

### 5.2. Recommendation

In this sub-section, two kinds of recommendations are delivered. The recommendations are suggested to the coral reefs conservation's stakeholders and to the academician with regard future research.

The recommendations for the stakeholders consist of several points:

- It is found during the field research that the community in Weh Islands is unaware about the climate change issue. They do more care about the tourism issue rather than climate change issue, whereas climate change, in fact, is influencing the tourism sector in Weh Islands. Coral reefs as the main asset of the tourism sector in Weh Islands are an opportunity to raise awareness of the community about climate change issue. It could be done through sharing knowledge and doing the conservation activity together with the community. It is highly recommended to the local government to promote the climate change issue. Using local media such as radio should be encouraged. The young generation should be put on the priority. In addition, the NGO and ODC Unsyah could contribute through sharing their ideas, information, and knowledge by writing scientific article on the newspaper and/or making an informal public discussion.

- There are two kinds of coral reefs conservation program in Weh Islands. It is considerably recommended implementing Biorock Technology in some diving spots. Biorock technique is not only conserving coral reefs much faster, but the tourism sector is also advantaged from this technique. Biorock technique allows the creation of an

underwater coral's garden by designing colorful coral skeleton made by iron framework. It is an opportunity to attract private sector to invest in Weh Islands and simultaneously conserving the coral reefs.

- There is still lack of research about climate change effect on the coral reefs ecosystem, especially in Weh Islands. It is encouraged to the local university through the ODC to conduct more researches. It can be done together with the NGO in Weh Islands such as FFI and WCS. The local government is also encouraged to support research program by giving research fund.

In addition, the recommendations are also addressed to the academician with regard further research. The recommendation is formulated from author's experience during the field research. Several points that have to be considered are:

The main methodology that is used to assess adaptive capacity in this research is the ACW. In the original paper, the ACW is used in developed countries context and specifically assess the formal institution. However, in this research, the ACW is used differently by applying the methodology in a developing country and, particularly, to assess a policy (not a formal institution). It is found that there are several obstacles when using the ACW in this respective context. Adjustment of the ACW is made by combining three additional adaptive capacity elements (intellectual, social, and political). Therefore, it is notable for users to creatively explore the possibility and not only stick with the existing variable.

There are two suggested variable to the ACW. Using local ecological knowledge could be added in social capital element while self-management is likely to be a part of fair governance (political capital). Local ecological knowledge helps the lack of scientific research and it is already proved to be more useful through several implementations by the Panglima Laot. Furthermore, self-management should be promoted as the local awareness is a crucial element of adaptive capacity. By promoting self-management, the local community is encouraged to solve problems using their existing resources. Those two variables are found notably urgent to be considered in the ACW methods, especially in the context of environmental protection on small islands.

Lastly, with regard to international literature context, there are some remarks that important to mention. The ACW is originally developed to assess and evaluate if institution contributes to the improvement of adaptive capacity of the community in order to cope with climate change issue (Gupta et al, 2010). The institution in its original paper refer to organization while in this thesis, institution refer to not only organizational context but also policy or strategy in political context. Therefore, it would be better if all dimensions on the ACW are also could flexibly be applied in the policy context, especially environmental policy. Knowing fact that most of environmental policy has strong connection to climate change issue, the improvement of the ACW is highly recommended. It could be done through improving the dimensions by taking into account the political context. Nevertheless, in this thesis the ACW is already proved to be flexible and could be used to assess any environmental policy, in this case is coral reef conservation policy.

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## APPENDIX

**Interview guideline:**

| Main criteria | Sub-criteria | Questions |
|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? |
| | Diversity of solutions | What kind of conservation technique/policy do you know? |
| | Redundancy (duplication) | Is there any alternative of those techniques? |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? |
| Room for autonomous change | Continuous access to information | Does the community recognize the conservation of coral reef? Aware about the climate change? And know how importance of coral reef? |
| | Act according plan | Have you trained to do the technique? |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? |
| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? |

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| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that "two ways dialogue" or just "command and control"? |
| | Responsiveness | What indicates the government's seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? |

**Transcript of Interviews:**

Data of interviewee:

Name : Joni

Institution : FFI (Flora & Fauna International)

Date of interview : 9th, 10th, 11th of May 2012

Short description : Joni is a team leader of Marine Conservation Program at FFI, an international Non-Governmental Organization from England. He has been working in Sabang since 2006 and get involved directly in ecosystem based tourism development, focusing on coral reef conservation program.

Contact : jonigapang@gmail.co.id

| Main criteria | Sub-criteria | Questions | Response |
|---|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | He knows about Climate Change and its effect on coral reef ecosystems, respectively along coastal area of Sabang. He mentioned about coral bleaching phenomena in 1999 and 2006 caused by El-Nino event. |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | There are at least four main stakeholders with regard coral reef conservation in Sabang. Those are (1) NGO (FFI & WCS) who guides the community and gives consultation to the government; (2) Panglima Laot which is "lembaga adat" (customary institution) or could perceived as the representative of the community; (3) ODC (Ocean Diving Club) form Unsyah (local university) which get involved in conservation activity and (4) the government both local and national. |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | Until now, in Sabang there are two techniques of coral reef conservation namely MPA (Marine Protected Area) approach (area based conservation policy) and coral transplantation (species based conservation policy). |
| | Redundancy (duplication) | Is there any alternative of those techniques? | There is no need for new approach or alternative due to several reasons. First is because the old approach is still effective and the limited fund and human capital to apply new technique such as Biorock technique. |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | Yes, we cooperate properly. However, it takes time to formulate and agreed upon one conservation policy. It is not the matter of cooperation but more the matter of procedure. Honestly, we enjoy working together with the community and we can see the initiative and food will from the government. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | Coral reef conservation policy somehow was the effect of other policy. It was started since 1970s when the first MPA policy was enacted. The main objective was to control fishing activity using unfriendly fishing gear. Until now, it is proved to be effective. Although the condition is changed and has to be improved. |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | No, there is no improvement. Just a little benefit from the rapid tourism development which improves the awareness of people about coral reef. |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | Yes, there is both a formal and an informal forum to share information and invite the people to join the program. However, sometimes the invited participants are not going due to several reasons. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | There is no change in procedure, measurement, technique and policy. In fact, the bureaucracy is getting complicated. |
| Room for | Continuous access to | Does the community recognize the conservation of coral reef? Aware | The community knows about the importance of coral reef and its conservation program. However, the knowledge of the community has |

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| autonomous change | information | about the climate change? And know how importance of coral reef? | nothing to do with climate change issue. |
| | Act according plan | Have you trained to do the technique? | We have trained the ODC members and the people who get involved in conservation program. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | As said before, there is both formal and informal meeting regarding conservation program. However, the old technique is not improved and the motivation of the community is not because of climate issue. |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? | Yes, indeed it takes very long time with complicated procedure. For example, just for one area of MPA, the process has been started since 2006 until now. |
| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? | No, there is no creative innovation. The budget is mainly from government but he is not sure the percentage. The community does also contribute on the budget but just very little. |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | There is no single group which is dominant on this conservation program. Every stakeholder has their own function and role and their working together properly. |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | There is SK and also customs which is agreed among the community (local wisdom). |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | Local university (Unsyah) through its diving club (ODC) is playing an important role on this program. Local government and the community are supported the NGO (FFI & WCS) as well as the ODC team during the implementation of this program. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? | The main reason of unimproved of the program is due to lack of financial support. |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? | There are some areas covered by MPA monitored by Panglima Laot (lembaga adat). Abdussalam is one of the leaders of Panglima Laot in Gapang (one of the area where coral reef conservation program is implemented). He has strong influence to mobilize people, in fact the approached used by Panglima Laot is proved to be more effective than the government does. Yes, the community knows and get involved. |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that "two ways dialogue" or just "command and control"? | Yes, there is an informal discussion about the program and it is not a "command and control" discussion. |
| | Responsiveness | What indicates the government's seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | The government is serious in this program. However, complicated and long time procedure is still there. That makes the community less to contribute and become ignorance. |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? | There is no accountability at all. We do not know where the budget goes to and other detail related to that. But, still until now, he thinks that the coral reef conservation program is efficient enough. He does not care about the budget as long as the program could run properly. |

Data of interviewee:

Name : Ferdi

Institution : ODC (Ocean Diving Club) Syiah Kuala University

Date of interview : 16th of May 2012

Short description : Ferdi is a chairman of ODC (Ocean Diving Club), the one and only diving club in Aceh, officially under the local university (Unsyah). Organizationally, this diving club is part of Marine and Fisheries Faculty at Syiah Kuala University. ODC has strong role in coral reef conservation program since its establishment in 2006. He has been lead the diving club since 2010 and get involved, practically, in coral reef conservation program such as monitoring and collecting scientific data.

Contact : ferdian_syah_89@yahoo.com

| Main criteria | Sub-criteria | Questions | Response |
|---|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | He knows about Climate Change and its effect on coral reef ecosystems, respectively along coastal area of Sabang and Aceh Besar. He mentioned about some subjects explained about climate change effect on coastal ecosystems. |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | ODC is the main practitioner in terms of coral reef conservation in Sabang. That means ODC team implemented the technique directly, under supervision of lectures from the university, senior students and staff of NGOs (WCS & FFI). Related to the community, in this case is Panglima Laot, ODC coordinates to them indirectly, meaning that the community knows and allows ODC team working on the program. The government has nothing to do with ODC. |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | Until now, in Sabang there are two techniques of coral reef conservation namely MPA (Marine Protected Area) approach (area based conservation policy) and coral transplantation (species based conservation policy). |
| | Redundancy (duplication) | Is there any alternative of those techniques? | There are different approaches from each stakeholder, for example WCS is focus on how to make use of local value/custom (social approach) while FFI is more focus on how to make use and enhance economic capacity of the community. |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | As ODC main partner is NGOs, as far as they know that coordination between WCS & FFI (two main environmental NGOs in Sabang) is fair and their trust each other. The fact that they have two different area to implementing the program and have different focus is confirmed the opinion. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | Since ODC was established, we get involved in coral reef conservation program in Sabang. However, due to several reasons such as limited human resources (student), lack of financial support and technical issue (accommodation, travel time, etc) the program is not effective enough. |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | No, there is no improvement. |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | Yes, there is an informal forum to share information and invite the people to join the program. However, sometimes the invited participants are not going due to several reasons. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | No response, not related |
| Room for | Continuous access to | Does the community recognize the conservation of coral reef? Aware | The community knows about the importance of coral reef and its conservation program. In fact, the community helps ODC teams during the |

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| autonomous change | information | about the climate change? And know how importance of coral reef? | field work. However, the knowledge of the community has nothing to do with climate change issue. |
| | Act according plan | Have you trained to do the technique? | We are well trained. ODC team consists of scientific diver and practitioners focus on coastal ecosystem protection.ODC is the one and only diving club in Aceh. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | The community through Panglima Laot does know about conservation program. ODC and local people working together to succeed the program. |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? | No response, not related |
| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? | No response, not related |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | In some cases, there is area where the role of Panglima Laot is very strong. For example is the MPA in Iboih waters where, interestingly, is also the MPA area managed by BKSDA (national government). |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | There is local wisdom in Sabang. Locally managed area run by Panglima Laot since long time ago is proved the information. |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | Yes, they are working together fairly. ODC could be perceived as the representative of the university. While there are two NGOs who are actively get involved to the program (WCS & FFI). In addition, Panglima Laot is the representative of the community while marine and fisheries agency is an official agency who responsible of marine affairs in Sabang. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? | As far as they know, usually the funding is coming from NGOs or by making proposal to get funding from corporate or other resources. |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? | Panglima Laot is directly chosen by the community. Thus, the legitimacy of Panglima Laot is strong enough. |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that “two ways dialogue” or just “command and control”? | No response, not related |
| | Responsiveness | What indicates the government’s seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | No response, not related |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? | No response, not related |

Data of interviewee:

Name : Abdussalam

Institution : Panglima Laot Iboih

Date of interview : 18th of May 2012

Short description : Abdussalam is a local leader of Panglima Laot in Iboih. He is responsible for area covered by MPA along Iboih's coast. He has mandated to be a leader.

Contact : +628136987324

| Main criteria | Sub-criteria | Questions | Response |
|---|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | He knows at all about Climate Change and its effect on coral reef ecosystems. |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | Main partner of Panglima Laot is ODC and NGOs (FFI & WCS). |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | He does not know about specific program of coral reef conservation. |
| | Redundancy (duplication) | Is there any alternative of those techniques? | There are different policies implemented in every single area managed by Panglima Laot. It depends on the area and fisherman condition in the respective area. |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | We have good relationship with the people/community and NGOs. However, local government is using and making us as the main player on the conservation program. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | He does not know about coral reef conservation program |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | No, there is no improvement. |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | Yes, there is an informal forum to share information and Panglima Laot is always invited. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | No response, not related |
| Room for autonomous change | Continuous access to information | Does the community recognize the conservation of coral reef? Aware about the climate change? And know how importance of coral reef? | No, there is no sufficient knowledge about climate change among the community. However, the community is aware of the importance of coral reef ecosystem. |
| | Act according plan | Have you trained to do the technique? | No, we just help the ODC team during their fieldwork. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | There is no specific about coral reef conservation program is informed and formulated. General thing is to limit unfriendly fishing gear which is indirectly safe the coral reef ecosystem. |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? | No response, not related |

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| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? | No response, not related |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | The successful of program is highly depending on permit which is given by Panglima Laot. |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | There is local wisdom in Sabang. Locally managed area run by Panglima Laot since long time ago is proved the information. |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | Student from the university is doing the coral transplantation program. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? | Besides having financial support from local government, there is also additional funding, voluntarily, from dive operator and tourism sector in Iboih. |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? | Panglima Laot is directly chosen by the community. Thus, the legitimacy of Panglima Laot is strong enough. |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that "two ways dialogue" or just "command and control"? | No response, not related |
| | Responsiveness | What indicates the government's seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | No response, not related |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? | No response, not related |

Data of interviewee:

Name : Alfarabi

Institution : Rubiah Tirta Dive Operator

Date of interview : 20th of May 2012

Short description : Rubiah Tirta is one of many dive operators in Sabang. This dive operator is not only providing diving service but also help the conservation program.

Contact : +6285260122332

| Main criteria | Sub-criteria | Questions | Response |
|---|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | He knows just a little about Climate Change and its effect on coral reef ecosystems. He mentioned about coral bleaching phenomenon. |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | We usually borrow the SCUBA equipments to the student from ODC. |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | There are some areas where coral transplantation is implemented. |
| | Redundancy (duplication) | Is there any alternative of those techniques? | No response, not related. |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | We are not that close to other stakeholder. If we are quite busy with the divers, we do not care about the program. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | He does not know about coral reef conservation program |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | No, there is no improvement. |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | No response, not related. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | No response, not related |
| Room for autonomous change | Continuous access to information | Does the community recognize the conservation of coral reef? Aware about the climate change? And know how importance of coral reef? | No, there is no sufficient knowledge about climate change among the community. However, the community is aware of the importance of coral reef ecosystem, mainly because of tourism reason. |
| | Act according plan | Have you trained to do the technique? | No response, not related. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | There is no specific about coral reef conservation program is informed and formulated. However, indeed, coral reef conservation program is useful for us in terms of tourism development. |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how long is the program being planned? | No response, not related |
| | Entrepreneurial | Is there any creative innovation to | No response, not related |

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| | | run the program? How about the budget? | |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | No response, not related. |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | No response, not related. |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | Student from the university is doing the coral transplantation program. FFI and WCS is giving information to the community and we do not see any contribution from local government. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? | No response, not related. |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? | No response, not related. |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that "two ways dialogue" or just "command and control"? | No response, not related |
| | Responsiveness | What indicates the government's seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | No response, not related |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? | No response, not related |

Data of interviewee:

Name : Abdus Syakur

Institution : Marine and Fisheries Agency of Aceh Province

Date of interview : 23th of May 2012

Short description : His job description is closely related to coral reef conservation program in Aceh Province, respectively in Sabang (capital of Weh Islands).

Contact : abdus_syakur@yahoo.com

| Main criteria | Sub-criteria | Questions | Response |
|---|---|---|---|
| Variety | Variety of problem frames | What do you know about climate change? What do you know about climate change effect to coral reef? | He knows about Climate Change and its effect on coral reef ecosystems. |
| | Multi actor, level and sector | Who are the stakeholders related to coral reef conservation program? | In formulating the policy, coordination between levels of government is done. The community is getting involved after the draft is finished in which NGOs giving their consultation on formulating and implementing the policy. |
| | Diversity of solutions | What kind of conservation technique/policy do you know? | Marine Protected Area |
| | Redundancy (duplication) | Is there any alternative of those techniques? | No response, not related. |
| Learning capacity | Trust | How is the relationship among stakeholders? Are the stakeholders cooperating properly? Or support each others? Do you have difficulties working together with other stakeholders? | Yes, I think our relationship is good. We support the implementation of the program by providing the budget and permit. |
| | Single loop-learning | Do you have experience before about coral reef conservation? How effective was the old technique? | Current policy is not quite change from the old one. However, I think the former policy is quite effective. |
| | Double loop-learning | Is there any improvement of coral reef conservation program? What kind of improvement? What are the challenges? | No, there is no improvement. |
| | Discuss doubts | Is there any public discussion about the program? Do you have formal/informal meeting to inform the community about the program? | We perform both formal and informal meeting to inform about the program. |
| | Institutional memory | Is there any change in procedure? Measurement? Technique? Policy? | The procedure takes time due to regulation and consultation to the Parliament in order to make it legally binding. |
| Room for autonomous change | Continuous access to information | Does the community recognize the conservation of coral reef? Aware about the climate change? And know how importance of coral reef? | No, the community does not aware about climate change issue. They are just think about tourism. |
| | Act according plan | Have you trained to do the technique? | No response, not related. |
| | Capacity to improvise | Have you ever informed about coral reef conservation program? Does the technical expert teach you about the conservation technique? Does everybody within the community know about conservation program? | We have experts who formulate and help other stakeholders to implement the program. |
| Leadership | Visionary | Does the procedure take a long time? Who is the main stakeholder in coral reef conservation? For how | Yes, indeed, the procedure takes quite long time. The main reason is due to formal and legal procedure that has to be fulfilled before the policy becoming legal. Our main partner is the community as we propose |

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| | | long is the program being planned? | community based management and focus on initiative and awareness of the people to succeed the program. |
| | Entrepreneurial | Is there any creative innovation to run the program? How about the budget? | Budget is about 90% from the government and the rest comes from the community and NGOs. There is no funding support from private sector. |
| | Collaborative | Who is the main stakeholder? Are they dominantly influence the successfulness of the program? | NGOs are our main partner. However, we focus to make use of the community as the main player. The conservation program so far is successful. |
| Resources | Authority | What is the legal basis of coral reef conservation? Is there any local wisdom related? | There are some regulation such as Law No. 5 about Nature Conservation and its Ecosystems, etc (see appendix) |
| | Human resources | What are the role of university, local NGO, local government and local leader in this program? Do they collaborate and support each other? | Student from the university is doing the coral transplantation program. FFI and WCS is giving information to the community and we do not see any contribution from local government. |
| | Financial resources | Do you have financial program to succeed this program? Is there any other financial support, for example from private sector? Is the budget just enough or less? | We have limited budget to this program and do not have any significant financial support from private sector. |
| Fair governance | Legitimacy | Who is the local leader in the community? How important is he/she influence to mobilize people to succeed the conservation program? Does the community know and get involved to this program? | As our main partner, Panglima Laot is legitimate. They have very good organization and directly chosen by the people. Their contribution to succeed the program is significant. |
| | Equity | Do you have a discussion about the program? What kind of discussion? Is that “two ways dialogue” or just “command and control”? | We hear the opinion from NGO and the community. |
| | Responsiveness | What indicates the government’s seriousness in addressing this issue? How does the community react to this program? Do they ignore it, or they pay attention to the program? | We provide sufficient budget to implement the program. The community is working together with us. |
| | Accountability | Do you think the program is efficient? How about the procedure, budget transparency, planning procedure of the program? Do you think it is accountable and transparent? | Well, there is no need or compulsory to show the cash flow to the public. However, the budget transparency is checked by an official budget supervisor from the government (Badan Pemeriksa Keuangan Daerah/BPKD) |