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ADAPTATION STRATEGY OF THE BAJO FISHERMEN TOWARDS CLIMATE CHANGE

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Abstract

Climate change currently becomes the concern of policymakers and academics because the impact is already extensive. The Bajo People Community, located in Wakatobi, Southeast Sulawesi is a coastal community with a significant portion of its population living as fishermen. The people and fishermen in the Bajo people also felt the impact of climate change on the coastal and marine environment. The effect on the environment is very influential on the economic and social community of the Bajo People. This study aims to define the alternative to propose adaptation strategy to deal with climate change for fishermen. The benefit of this study is to provide input for planners, policymakers, and practitioners related to fisheries in the territory of Indonesia. Climate change adaptation is necessary to maintain the quality of life of fishers and to achieve the stability of available resources. This study used a literature study and Analytical Hierarchy Process (AHP) as its method to find the alternative strategy in order to face climate change. The plan proposed in this research are three, namely increasing knowledge and information about climate change, resource management, and livelihood diversification. The result of this research is that Bajo Fishermen need an appropriate adaptation strategy to mitigate the situation towards climate change issues, which is necessary to prevent the disruption of economic and social activities, focusing on the cognitive, practical and structured aspects that base on cultural values, norms, and customs of the Bajo people. This study found four useful variables to be used as coping strategies for climate change, which are social, ecological, economic and political alternatives. The four variables are strengthening the surveillance of epidemic disease, developing fish gear technology, improving proper water treatment management, and creating awareness of climate change for the fishermen community.

Keywords: Adaptation, Climate Change, Fishermen, Coastal Communities, Bajo People, Indonesia

I. INTRODUCTION

Climate change occurs on a count of hours primarily caused by greenhouse gas (CO2) emissions in the atmosphere (Hui, 2013) and it is becoming a hot topic these days. Climate change has increased global temperatures by about 0.6-0.76ºC since the mid-1800s and is expected to rise to 5.8ºC in the 2100s. In addition to temperatures, sedimentation is also estimated to increase by about 0.5-1% for most of the northern highlands (Hui, Tian, & Luo, 2012).

The Intergovernmental Panel on Climate Change (IPCC) (2014) explained that the climate change is a global or regional climate change that occurs due to human activities that change the global atmospheric composition, and the different natural climate conditions during the period. Climate change characterized by changes in temperature and rainfall, sea level rise and extreme climatic events. The causes and effects of climate change occur between the earth system and the human system (IPCC, 2007). Climate change mostly caused by anthropogenic human activities that produce greenhouse gas emissions that trigger climate change process on earth. But at the same time, humans are also the object of climate change impacts so that they experience vulnerability.

Climate change has been shown to be related to changes in ecological occurrence and distribution

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of plants and animals (IPCC, 2014). It is estimated that in the coming century, it is highly probable that global surface temperatures will exceed the pre-installed industry average of 1.5°C, the intensity of precipitation will increase, the incidence of rainfall and more massive droughts, and the global drylands extended (IPCC, 2014). These changes will affect human and natural systems and the human population will feel adverse effects in the developing tropical and subtropical countries (Costello et al., 2009). The impacts of climate change occur in various regions from local to global, with slow to extreme levels. This impact enters into human and ecological interactions that make an impact on both systems directly and indirectly.

Global climate change affects the physical and biological conditions of the environment, affecting biodiversity, both directly and indirectly (Ogawa-Onishi & Berry, 2013). Climate change also affects environmental damage including damage to coastal and marine ecosystems due to unpredictable climate and weather. Climate change changes in frequency and increased wind rate, make coastal areas more susceptible to sea level rise, seawater temperature rise and increased wave height. Besides, the increased concentration of carbon dioxide (CO2) causes the ocean to absorb more gas and become more acidic (Zikra, Suntoyo, & Lukijanto, 2015).

Mitigation and adaptation to climate change can interact with each other. This has become a discourse to be applied later. Despite the need for stronger supervision (IPCC, 2014). Berry et al. (2015) found that in the presence of complex problems can be overcome with adaptation and mitigation efforts in Europe. In addition to long political and bureaucratic issues that hinder the implementation of adaptation and mitigation policies, communication between the decision-makers and the people in need also does not work well. As such, the policy becomes useless.

Besides, governance and resource constraints hamper a more synergistic approach. Moser (2014) explains how communication is essential to be able to implement climate change adaptation and mitigation policies. In the United States, what the people do is not in line with the government policy. Community support is needed to improve ecosystem resilience that can produce success in both adaptation and mitigation efforts.

Adaptation is a response to stressors, in contrast to mitigation involving pre-empting challenges and taking steps towards the Impact of Climate Change to avoid threats such as reducing emissions or mitigating the impact of floods by building embankments (Scoones, 1998). There are many variations to describe the meaning of adaptation and mitigation itself. Adaptation according to this understanding is more directed to repressive activities, while mitigation can be done for preventive or punitive reasons.

In developing countries, the adaptation of the agricultural sector to the adverse effects of climate change is pioneered to protect the livelihoods of the poor (Dasgupta et al., 2014). Effective adaptation requires the involvement of multiple stakeholders, including NGOs, policymakers, researchers, social workers, communities, and farmers. Besides, climate change adaptation is location-specific mainly, and its effectiveness depends on local institutions and mediated socioeconomic arrangements and translates the impact of external interventions to facilitate adaptation to climate change (Morton, 2007).

Indonesia is one of the developing countries with densely populated populations in coastal areas. Indonesia is geographically located in 6°N-11°S and 95°E-141°E. Indonesia is also on the equator with a lot of potential marine wealth that can be utilized for the welfare of its inhabitants. The Geographical location makes most of the coastal community of Indonesia have a coastal culture because of its dependence on sea resources as life support. This enormous potential of marine resources becomes Indonesia's competitive advantage in the areas of tourism, marine transportation, maritime industry, offshore industry, fish cultivation, and resource extraction.

Therefore, it is also necessary to prepare for climate change. So far Indonesia has ratified the Kyoto protocol and enacted a law on this matter (UU 17/2004) which means that by law Indonesia has agreed to participate in reducing emissions and undertaking climate change mitigation efforts. Various policies in the form of presidential regulations and ministerial regulations are also emerging.

However, there is no policy that stipulates the impact on fishing that has been reduced due to climate change because there is still little research related to the fact that the decline in fishing due to climate change is possible. The condition of fish that migrate because of climate change that occurs in their habitat is something that can reduce fish stocks in a place. This can interfere with the livelihoods of coastal people.

Various groups of people dominate coastal life in Indonesia. One of the communities living on the coast and dependent on marine resources is the Bajo People located in Wakatobi Regency, Southeast Sulawesi. Bajo people still apply traditional ways to catch fish that are environmentally friendly and proven to be able to meet subsistence needs. Some communities of the Bajo people depend not only on fishing. Now they already have livelihood on land or

have a fixed location at sea to obtain resources. Bajo people not only catch fish but also cultivation. This can improve the economy to increase the income of the community. One of the most significant populations of the settled Bajo people is located in the Wakatobi Islands with a population of more than 10,000 inhabitants. Bajo People people who settled here have a low level of education and was taught to catch fish since childhood.

Nowadays, People in Bajo People are no longer living nomadically. They began to settle and have permanent residences and houses on stilts over the sea. However, the livelihoods of the Bajo People remain dependent on marine resources. About 70% of household income comes from fish (Cullen, 2007). In the Bajo community, there is a myth that the Gods created the marine environment for Bajo people. The same concept of dapu ma di laok means the sea of Bajo people. Which also means that the terrestrial environment is for people who live on land (Wianti, Dharmawan, Kinseng, & Wigna, 2012). Therefore, generally, Bajo people have the main livelihood of fishing or utilizing marine natural resources, while the terrestrial environment with all its potential gets less attention and is not even appropriately utilized.

The Modernization of fisheries policy in the fishing community conducted by the government, in fact, has an impact on various aspects of Bajo people fishermen's life. The use of each type of facility has consequences or effects namely on the work pattern, social structure and the level of welfare of fishermen (Hamzah, 2009). Bajo fishermen who inhabit almost all coastal areas and small islands in Southeast Sulawesi are the main actors managing resources in the Wakatobi National Park (Wianti, Suriana, Ola, & Tadjuddah, 2018). Most of them are traditional fishermen, and depend almost entirely on fisheries resources, especially Kapota Reef, Kaledupa Reef, and Karomaho Reef with types of fishing gear such as trolling lines, primary fishing rods, squid fishing rods, catching with arrows/spears, and fishing with use the network (Wianti et al., 2012). Dependence on natural resources makes the fishermen in the Bajo people vulnerable when there is uncertainty on the catch, especially in the West wind season. Low education makes the Bajo people have no alternative but to become fishermen. Vulnerability experienced by Bajo fishermen households can ultimately lead to the emergence of illegal fisheries that damage the environment (Wianti et al., 2018).

Climate change can affect the welfare of fishers because it can limit the fishing routine by small fishermen thereby decreasing the level of productivity (Shaffril, Abu Samah, & D'Silva, 2017). An adaptation strategy for fishermen is needed to face climate change. One of the adaptation strategies that can be done is improving management and the environment by paying attention to fish stocks to be durable (Brander, 2010). Therefore, a climate change adaptation strategy is needed to reduce the impact experienced by the Bajo Fishermen. This research will describe the effect of climate changes on Bajo fishermen and analyze the vital variable to make an adaptation strategy using Analytical Hierarchy Process (AHP).

II. Method

The research uses literature studies by accessing related journals and the Analytical Hierarchy Process (AHP) as the method to define the adaptation strategy alternatives to deal with climate change for fishermen. Analytical Hierarchy Process (AHP) method was initiated by Thomas L. Saaty to help the decision maker in setting the obligations and determine the best preference (T. L. Saaty, 1988). The AHP is a multi-criteria decision-making

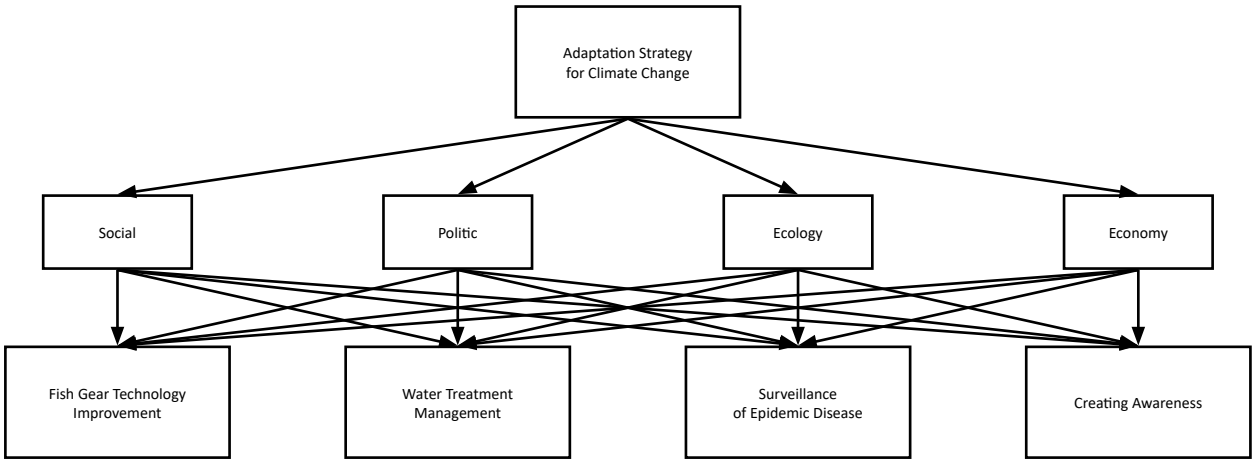

Figure 1. The Levels of Hierarchy

Table 1.
Scale Definition in AHP Method

Intensity of Importance	Definition
1	The importance scale of criteria/alternative A and B are equal
3	The importance of criteria/ alternative A is moderate than B
5	The importance of criteria/ alternative A is stronger than B
7	The importance of criteria/ alternative A is very stronger or demonstrated than B
9	The criteria/alternative A is extremely important than B
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*.

Source: Saaty (1989)

approach and undertakes the quantitative criteria which lead to the improvement of the subjects (T. L. Saaty, 1988).

This study evaluates the three levels of hierarchy, consists of the objective as placed in the highest level, criteria in the middle level and strategy proposal for the third level. We set the variable for adaptation strategy as the object that will be assessed based on four criteria. The criteria consist of social, politics, ecology, and economy. Meanwhile, we choose four strategies to be evaluated, consist of improvement in fishing gear technology, water treatment management, surveillance of epidemic disease, and creating awareness of fishermen about climate change. Each assessment analyzed through the pairwise comparison concerning the criteria and strategies.

Furthermore, the AHP method used 1 to 9 scale to illustrate the importance level of criteria or alternatives. The details are described below.

The AHP verifies consistency ratios (CR) to measure the consistency of expert judgment compiled by paired comparisons of survey results.

A consistency ratios (CR) value must be equal to or less than 0.10 (T. L. Saaty, 1988).

III. Results and Discussion

A. The Impact of Climate Change on the Coastal Area

1) Degradation of the Coastal Area and Marine Ecosystem

Climate change has a negative impact on weather in coastal areas. Coastal areas become hotter and also having stronger winds with unstable temperatures. Increased temperatures greatly disturb the community and the fishermen too. Increased temperature causes drought in a coastal region. Yao-Dong et al. (2013) added that the increase in temperature also resulted in heat waves. Increased air pollution usually accompanies such heat waves.

Coastal communities, especially fishermen, have observed significant changes due to high-temperature rise. Increased temperatures lead to migration of fish and reduced fish catch. Some coastal ecosystems (coral reefs) are damaged, and their quality declines due to rising seawater temperatures (Yu, Jiang, Cheng, & Chen, 2004). The damage caused the fish to lose their homes, thus reducing fish catch for fishermen.

The decline in the quality of ecosystems due to climate change also causes changes in fishing locations and certainty of time to go to sea. Climate change also has a negative impact on the ecosystem of the postlarvae fishing site (Ahmed, Occhipinti-Ambrogi, & Muir, 2013). If the world population approach goes "as usual" then emissions in 2100 are likely to cause ocean surface temperatures to rise 2-4°C higher than the present, and water surface becoming more acidic and only isolated locations will support coral growth (Cao, Caldeira, & Jain, 2007).

2) Health Problems

The impacts of climate change have resulted in the deterioration of the health of fishermen and other communities. The heat causes many fishermen to fall ill. The declining health of fishermen resulted in an inhibition of sea activities (Muhammad et al., 2016). For them, health is the most important thing. Without a healthy and robust body, they will not be able to catch fish.

Research conducted by Yao-Dong et al. (2013) showing climate change can cause stronger heat waves. As a result, a new disease will appear and lead to death. Environmental conditions have a role associated with natural phenomena, especially disruption to health such as malaria, dengue, and water-borne diseases. The rise in temperature and rainfall will increase the mosquito population

(Tanner, Mitchell, Polack, & Guenther, 2009), especially in clean water conditions.

Besides, health problems can also come from within oneself. Fishermen who are under high stress due to reduced fish catch may also reduce their health. According to Radetzki (2010), stress experienced by humans can cause increased body temperature and dehydration.

3) Menace towards the Infrastructure

Indonesia is one of the countries with high vulnerability to climate change. The degradation in the qualities of coastal areas and small islands environment is a direct impact of climate change. This symptom is seen with the increase of tidal waves, floods, droughts, puddles in lace fields, and coastal abrasion. Although some scientists have touched on this issue, until now there has been little research focusing on fishing communities in the Bajo People, Wakatobi, Indonesia.

4) Decreasing on Social-Economic Aspects

Several other climate change symptoms have been identified. In the future, the symptoms are expected to worsen and impact on small communities whose activities are highly dependent on weather stability (Shaffril et al., 2017). This resulted in decreased levels of income and welfare of the community. Brashares (2004) also said that the decline in fisherman income due to reduced fish production would encourage them to find alternative sources of income, one of them with a much risky fishing method which would burden the marine ecosystem. In addition to climate change, the poorly managed fisheries and tourism industry contributes to the damage that affects the economic decline of coastal communities (Caras & Pasternak, 2009).

Hussain & Badola (2008) argue that although there is no guarantee of a link between knowledge of the economic value of resources and the conservation and sustainable use of resources, this understanding can help them to become part of a productive economic system. Besides, this arrangement can be used in other sectors and provides opportunities for interest from marine ecosystems to become the livelihoods of local communities. The economic value of marine resources will decrease if degradation continues in coastal areas.

5) Impacts on the Water Source

According to Zhao et al. (2014), the adverse effects of climate change result in decreasing the number of regional water resources. Declining groundwater quality triggers an intrusion of seawater to the mainland, and sea level rise also contaminates the need for clean water and irrigation (UNDP Indonesia, 2007).

The increasing air temperatures due to global warming will speed up evaporation so that groundwater is reduced. Global warming also causes drought. This can change the flow of water and reduce the productivity of rivers (Conway, Allison, Felstead, & Goulden, 2005) so that waterways as one of the water resources also experience a reduction.

6) Custom and Value of Bajo People

The Bajo people is one of the communities that have an extreme attachment to the sea. Bajo in their long history are people who live nomadic in the sea (sea nomads) but then settle in the coastal area. Bajo people have traditional knowledge about when to go to sea and when to return. However, changes or shifts in seasonal patterns due to climate change have an impact on fishermen's knowledge of nature. If in the past they as peoples who always interacted with the sea knew nature, now they felt they could no longer predict nature. Changes in knowledge of Bajo fishermen about nature, especially about the season, affect their fishing activities because they are very dependent on nature. At present they have to work hard to determine when to go to the sea and where to catch fish. Bajo fishermen decide to go to the sea when the clouds are clear and the wind is calm, but not when the clouds are dark and the wind blows so that the ocean waves are big (Nurlaili, 2012).

In the Bajo People, there is a concept of calling themselves a Sama people and calls people outside their people to the Bagai People. If they are among Bajo peoples, they use the word "sama" as a reference term and to show their fellow groups. The term "sama" is in opposition to "bagai" which means other communities (various groups), outside the Bajo people, especially for mainland communities (Suryanegara, Suprajaka, & Nahib, 2015). Bajo peoples tend to be considered "negative," so they are sometimes harassed. Social status as an "isolated community" attached to the Bajo people so far.

So far, Bajo people were considered as static, they only live in the sea, lack of innovation, closed and unable to adapt physically geographically, socially and culturally with the population living on land. Consequently, the Bajo are less involved in the development process or enjoying the results of the development (Satriani, Juhaepa, & Upe, 2018). Therefore, a climate change adaptation strategy is needed that can blend in with customs and values believed by the Bajo people.

7) Determination of the Zoning of the Wakatobi National Park

Wakatobi National Park is managed by a zoning system. Wakatobi National Park zoning is stipulated by the Decree of the Director General of the Protection of Nature Conservation Forest (PHKA) No. SK. 149/IVKK/2007 dated July 23, 2007, consisting of: core zone (1,300 ha), marine utilization zone (36,450 ha), tourism zone (6,180 ha), local utilization zone (804,000 ha), general use zone (495,700 ha) and land special zones (46,370 ha) (Adimu, Boer, Yulianda, & Damar, 2018). Determination of zoning that does not involve the community results in incorrect zoning itself. Impact on the decline in fishermen's income due to the closed part of the fishing area of fishermen and the rights of fishermen to be limited to exploiting natural resources (Alauddin, Bauto, & Sarpin, 2016). Besides, Bajo People Culture which used to be sacred and obligatory is now changing. For the Bajo people, the culture is no longer a sacred thing that must be adhered to. Not because of the public distrust of their own culture, but the problem is the change in their catching area which is getting narrower.

Increasingly desperate, they are conducting prohibited fishing activities by stealth. The crisis in accessing resources causes Bajo households to be good at utilizing other livelihoods to survive the crisis and not fall into conditions of chronic poverty.

B. Adaptation Strategy

The assessment of the AHP method is made based on expert judgment. The judgment made by analyzing the interview result and compared to the relevant works of literature. Furthermore, the judgment quantification process is aided by Superdecision software. Superdecision as a software helping calculation of relative weights of objective and corresponding criteria and also consistency ratios of the matrices. After synthesizing the judgments from the experts, the further step is to decide the best preference for the strategy proposed.

Table 2 described the pairing comparison between objectives and criteria. The assessment showed that the social factor becomes the highest importance criteria (0.539) to propose the adaptation strategy to climate change. This is because the social criteria of the Bajo people community need to be taken into consideration in recommending strategy in adapting, social criteria need to be looked at thoroughly and evenly. Regional ecological and economic criteria have a lower level of importance based on analysis, with 0.295 and 0.111 respectively. Last priority of adaptation strategy is made by the criteria of politic (0.056). The result of the comparison is valid because the CR value is 0.089.

In this case, political criteria also become an essential part of proposing strategies. The roles and participation of various stakeholders in the Bajo people also need to be included to make decisions about the strategy that will be prepared.

Table 3 and 4 presented the pairwise comparison between criteria and alternative. The variables for highest-ranked weights on social and politic criteria remain the same. The consecutive variables are strengthening on surveillance of epidemic disease (0.608 and 0.588), improving the fish gear technology (0.204 and 0.205), developing water treatment management (0.125 and 0.137), and creating awareness of the fishermen community placed as the lowest ranked by 0.062 and 0.070. CR value for the result of the matrix shown as a valid assessment since those are smaller than 0.10. This is because the strategy of strengthening existing epidemic disease surveillance requires prevention and treatment as the main alternative to adapt for the Bajo people, while fish equipment technology is also important to improve because climate change can directly affect fishing. Water treatment for the community also needs to be enhanced through adjustments so that it can also increase public awareness in the future to survive climate change. This also indicates that in the strategy a variety of reforms are needed that are appropriate for the situation of the Bajo people in proposing

Table 2.
Pairwise Comparison Criteria Related to Objective

Criteria	Social	Politic	Ecology	Economy	Normal	Ranks
Social	1	7	3	5	0.539	1
Politic	0.143	1	0.200	0.333	0.056	4
Ecology	0.333	5	1	5	0.295	2
Economy	0.200	3	0.200	1	0.111	3
Consistency Ratio			**0.089**			

Table 3.
Pairwise Comparison Matrix Between Criteria (Social and Politic) to the Alternatives

	Social					Politic				
	FGT	**WTM**	**SED**	**CA**	**Normal**	**FGT**	**WTM**	**SED**	**CA**	**Normal**
FGT	1	3	0.20	3	0.204	1	2	0.20	4	0.205
WTM	0.33	1	0.20	3	0.125	0.5	1	0.20	3	0.137
SED	5	5	1	7	0.608	5	5	1	5	0.588
CA	0.33	0.33	0.33	1	0.062	0.25	0.33	0.20	1	0.070
CR			**0.088**					**0.092**		
Ranking	**2**	**3**	**1**	**4**		**2**	**3**	**1**	**4**	

Table 4.
Pairwise Comparison Matrix Between Criteria (Ecology and Economy) to the Alternatives

	Ecology					Economy				
	FGT	**WTM**	**SED**	**CA**	**Normal**	**FGT**	**WTM**	**SED**	**CA**	**Normal**
FGT	1	0.50	0.33	0.20	0.088	1	2	3	5	0.452
WTM	2	1	0.25	0.33	0.125	0.50	1	4	5	0.348
SED	3	4	1	3	0.489	0.33	0.25	1	2	0.127
CA	5	3	0.33	1	0.299	0.20	0.20	0.50	1	0.073
CR			**0.059**					**0.040**		
Ranking	**4**	**2**	**1**	**3**		**1**	**2**	**3**	**4**	

an approach. Finally, the strategy of raising public awareness has the lowest value but still taking part in social and political criteria so that increasing public awareness needs to be done holistically and functionally according to the social conditions of the community.

Furthermore, related to ecology and economy criteria, the result shows a slightly different rank. The adaptative strategy for ecology criteria determines that surveillance of epidemic disease becomes the preferred strategy to propose by 0.489. Meanwhile, creating awareness of the community be the second strategy to be strengthened (0.299), followed by the development of water treatment management (0.125) and fish gear technology (0.088). Related to economic criteria, strategy to develop fish gear technology becomes the most important alternative (by 0.452). Strategy to improve proper water treatment management (0.348), surveillance on epidemic disease (0.127) and to create awareness of the community (0.073) are the latest priority to propose. Epidemic disease surveillance is the main adaptation strategy to be recommended because it is closely related to the natural environment that changes and allows for increased disease due to climate change. Climatic change will indeed change the environment and need to raise public awareness of this, the increasing knowledge and understanding of the Bajo people will make people become accustomed and able to deal with climate change.

In contrast to ecology criteria, when understanding strategies with economic criteria developing fish equipment technology is an important alternative because development will not occur without economic support. Progress will be hampered when people's income to renew tools is not appropriate. However, when the development of fish equipment technology is done, this can also increase people's opinion because it will affect the catch. A supportive economy will also facilitate water treatment in the Bajo tribal so that the water management strategy obtains a second position in the proposed strategy related to economic criteria. The rest is followed easily to suggest an epidemic surveillance strategy.

The main advantage of the AHP is the ability to rank choices of strategies in the order of their

Table 5.
Pairwise Comparison Criteria Related to Objective

Strategy	Normal	Ranks
Fish Gear Technology Development	0.237	2
Water Treatment Management	0.184	3
Surveillance of Epidemic Disease	0.453	1
Creating Awareness	0.126	4

effectiveness. Table 5 showed the result of the rank choices of adaptative climate change strategies. Among four variables, the rank choices sequentially are strengthening the surveillance of epidemic disease, developing fish gear technology, improving proper water treatment management, and creating awareness the climate change for the fishermen community. Health is the most important thing for fishermen. Without a healthy and robust body, fishermen will not be able to catch fish, so they can reduce their catch, so by conducting health monitoring and prevention will be a good strategy to survive climate change. This will help fishermen to continue to carry out their activities without barriers to health problems. Followed with fish equipment that has been developed into more modern can also help fishermen face various changes in conditions when fishing and multiplying their catch. The water treatment strategy also becomes necessary because clean water will not cause disease in the body of the fisherman so that it also supports the health of fishermen. Finally, creating public awareness is also important as seen from the values obtained from each alternative analysis. Without creating awareness of the impact on the environment due to climate change, Bajo community would be left behind and unable to adapt to the conditions that are created due to climate change.

IPCC (2001) defines adaptation to climate change as an adaptation to nature and the human life system in response to climate change and its negative impacts or reducing opportunities to benefit. Such adjustments can be differentiated into several types of anticipatory and reactive adaptation, private and public adaptation, and planned adaptation and autonomy. Smit & Wandel (2006) explain that in some areas of science, adaptation is interpreted as a response to risks associated with environmental problems and human susceptibility or adaptive capacity. In the discussion of the changes in climate, the analysis of adaptation has a multifaceted goal. The adaptation approach takes into account the damage caused by long-term climate scenarios with or without the adjustment. Study of adaptation to climate change evolves following awareness of climate change itself. A key objective of climate change adaptation analysis is to estimate the degree of impact that climate change scenarios can be faced with mitigation (adaptation) or adaptation efforts. Adaptation aims to reduce the adverse effects of climate change or realize the positive impact of avoiding harm.

In facing climate change, the people of Bajo need to get the right strategy. The adaptation of fishers in confronting climate change should focus on the cognitive, practical and structured aspects (Abu Samah, Hamdan, Samah, Hamzah, & Shaffril, 2016). Knowledge and information on climate change such as the occurrence of La Nina and El Nino, rainfall and other things that can cause natural damage should be known to the public to be better prepared to face climate change (Muhammad et al., 2016).

Adaptation strategies for human health include strengthening surveillance of epidemic diseases in potential transmission areas, improving environmental and health education in coastal communities, participating in government interventions and conducting STBM (Community-Based Total Sanitation). Evaluating the potential health impacts of extreme climate change requires the understanding of both the vulnerability of the community and its ability to react to new conditions.

Meanwhile, to overcome the declining water resources, it is necessary to control the water resources and plan the future water management system taking into consideration the climate change that will occur. In addition to increasing knowledge and also information about climate change, it is also necessary to add expertise and information in managing existing resources. In this case, attention must be paid to local wisdom, social life patterns and behavioral tendencies that will change in every location or place of residence, including the Bajo People.

This process can be done to improve the community through collective action. Villagers can form groups to protect the environment and obtain assistance from non-governmental organizations (NGOs). It is important to strengthen conservation techniques in marine ecosystems, such as mangroves ecosystem, seagrasses, and coral reefs, and to repair a series of marine reserve areas (Yao-Dong et al., 2013). This will be a support for the Bajo People in the next adaptation process. This is one of the options to empower and rebuild the communities after a disaster occurs (Shaffril et al., 2017). People who have difficulties to do the marine activities will be able to diversify their livelihoods. Given education in resource management, communities

will find other jobs to increase their income when during the bad climate and weather.

The fishermen could do some other works to earn money for living, such as managing mangroves, seagrasses, etc. Wakatobi as open nature has excellent marine tourism potential. The management must be community-based so that coastal communities can be enabled to manage the attraction. Besides, fishermen can open a home-based lodging for the tourist as well as being a tour guide.

However, it should be emphasized that the new tour services must preserve the environment to remain in line with the principles of the Bajo People community. All these adaptation efforts must also receive the attention of the local government. Ahmed et al. (Ahmed et al., 2013) suggest the need for an integrated approach given the extreme vulnerability to the impacts of climate change on post-harvest communities. The availability of clean water should be the concern of the Bajo People. The adaptation effort taken is a desalination, which is processing the sea water into water that can meet the clean water needs of coastal communities. The role of local government should be more prominent as the institution that issued the policy also the stakeholders that involved in management, conservation, regulation and research (Burger et al., 2017).

IV. Conclusion

The occurrence of climate change happening in the world also having an impact on the coastal areas in Indonesia. The rise of sea level, the frequency, and intensity of wind speeds, changing and increasing wave heights and rising sea temperatures disrupt people who live in surrounding coastal areas, especially those working as fishermen, such as the Bajo People. Climate change leads to a reduction in fishing activities, endangering their lives, destroying physical infrastructure, degrading health quality and reducing food supplies.

An appropriate adaptation strategy to mitigate the situation towards climate change issues is necessary to prevent the disruption of economic and social activities, focusing on the cognitive, practical and structured aspects. This strategy should also be based on cultural values, norms, and customs of the Bajo people.

By using AHP, four effective variables were found to propose coping strategies for climate change with social, ecological, economic and political alternatives. The four variables are strengthening the surveillance of epidemic disease, developing fish gear technology, improving proper water treatment management, and creating awareness of climate change for the fishermen community.

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V. References

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