

## The Impact of Climate Change on Small-Scale Fishermen in Malaysia

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**Abstract:** This study aims to conceptually discuss the impacts of climate change on small-scale fishermen in Malaysia. Based on the document analyses made, it was concluded that Malaysia is also experiencing the impacts of climate change similar to other countries in the world. This impact of climate change has brought negative implications towards several community groups and the small-scale fishermen are one of them. Climate change is found to have increased several risks associated with fishing activities, affect their productivity, health and damage to the public facilities. A number of adaptation strategies were recommended and it is hope to assist the related parties in constructing the best adaptation strategies to overcome the rising climate change in Malaysia.

**Key words:** Climate change, adaptation, community development, environmental management, Malaysia

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### INTRODUCTION

Climate change is defined as the warming of the climate system due to human activities which are also called anthropogenic global warming. According to Rattanawan and coauthors global warming is a factor of climate change that is produced from carbon dioxide (CO<sub>2</sub>). Global warming is mainly caused by the greenhouse effect. The greenhouse gas is able to trap heat from the sun and reflect it back to earth, causing the rise of global temperatures. The obscurity of climate change is an increase in the temperature of within the atmosphere and the oceans. Correspondingly, it can have negative implications towards the world's weather pattern and possibly create mother nature disasters such as global warming phenomenons such as Madden Julian Oscillation (MJO), El Nino/La Nina-Southern Oscillation and Indian Ocean Dipole (IOD).

This problem of global warming can cause several problems such as sea level rise, extreme meteorological events and distresses in rainfall, further consequences was known to effect the human health and the ecosystem quality. Furthermore, causes of climate change such as biotic processes, variations in solar radiation received by the earth, plate tectonic movement and volcanic eruptions. In most developed and developing

countries, the climate change effect may vary and affect the humans and the ecosystem (Wolfson and Schneider, 2002).

According to Onur and Tezer (2015), climate change is a major factor that causes new vulnerabilities within the ecosystem disposition through events such as floods, heat waves and drought brought on by the rising in temperatures and changes in precipitation. The impact of climate change can trigger changes in temperature, precipitation, vulnerabilities in the hydrological cycle, food chain and land coverland use. The climate and spatial planning have a strong relationship as a presented effect on the human development and urban morphology (Zhao *et al.*, 2011). Douvere and Ehler (2009) define today's many permanent and temporal developments of the uses of ocean resources which development uses in the ocean was impacting on the ecology and the marine ecosystem. It is obvious that human activities can produce pollution discharges. Additionally, in prediction the global surface temperature and sea levels are expected to increase from 1.8-4°C and rise about 18-59 cm, respectively by the year 2100. In these cases, the impacts of climate change can be summarised as increase in continental average temperature, extreme weather events such as cyclones and tornados, changes in precipitation levels; severe heat waves and a proliferation of natural hazards such as droughts, floods and the spread of

diseases (Wolfson and Schneider, 2002). Further more, Polasky *et al.* (2011) claimed that climate changes can contribute to the carbon absorption in controlling the water quality, the quantity of water flow and biodiversity.

In Peninsular Malaysia, the surface temperature in the south offshore area was recorded to have a low temperature and the lowest recorded value was 28°C and most of the offshore areas were comparatively cooler. On the other hand, the temperature in the North offshore area of Peninsular Malaysia was slightly higher with up to 1-2°C differences compared to the south (Akhir, 2012). Normally, when the temperature presented lowest salinity are presented higher. On the other hand, if climate change occur, the temperature and salinity are presented higher and lower respectively. Further more, frequent precipitation on land could lead to flooding and a strong current will flow from the river to the sea (Fu *et al.*, 2015), in turn it will exhibit a lower salinity because more fresh water would enter the coastal areas.

Previously, it was mentioned that climate change have effect on the ocean temperature. Distribution of cool water can produce a more efficient current flow. According to Akhir (2012), the strong advection from the Northern region to the South China Sea has distributed cool water with the southward flowing current into the southern region. The current can distribute the juvenile to coastal areas which coastal areas is a best productivity area. Normally, the juvenile can scatter and depend at the coastal area with good salinity, temperature, turbidity and current (Dalla, 1986). Furthermore, increasing ocean temperatures caused by the climate change may increase the incidence of fish-borne disease outbreaks such as ciguatera and the availability of fish turn. According to Campbell and Quentin (2014), they have predicted in coming decades, the climate change will greatly affect the distribution and the wealth of oceanic fish resources. On the other hand, climate change can effect the quality and the diversity of coral reefs and intertidal habitats since, they are supported by coastal fisheries.

The threats of climate change have been studied by several scholars across the globe. Data regarding the impacts of climate change across the nation with diverse geographical background has been much discovered (Currie and Small, 2005; Meynecke *et al.*, 2006) nevertheless, a similar scenario cannot be seen within the Malaysian scope. Understandably, although there are some studies that have focused on the climate change occurrences within the Malaysian context (Akhir, 2012; Hanafiah *et al.*, 2011) yet, the number is not adequate. Making things worse, most of the available climate change studies would much focus on the hard science

part which left a huge gap to be filled by the social science related studies. To have more social science studies is deemed important as better understanding on the effects of climate change towards the socioeconomic routines of the people are needed as most of us is still relying on nature to sustain our lives.

## MATERIALS AND METHODS

**Links between climate variables and fisheries:** Many studies have been made to understand linkages between the biological processes, the physical and the chemical changes to the oceans ecosystem that influenced some of the marine life which may have impacts on the future of ocean biodiversity (Currie and Small, 2005; Meynecke *et al.*, 2006). There is a general consensus among climate change scientists that suggested this scenario will significantly affect the ocean ecosystems. They also projected the change in physical and biogeochemical ocean body will drive in such heat content and temperature, levels content of O<sub>2</sub> and CO<sub>2</sub>, acidification process and nutrients availability. According to Macfadyen and Allison, physical and chemical changes in the oceans such as the temperature rise, the heat content, the ocean circulation; the up-welling and the down-welling, the sea level rise and the ocean acidification will have an impact towards the marine ecosystems and fish population. Hence, climate change phenomena may affect the fisheries sector by dissuading the fishing related activities and the decline of valuable and commercial fish species due to fish migration, changes in the number of population and distribution, habitat and nursery changing and changes in the food chain. As a consequence, this situation may also affect the fisheries industries indirectly by affecting those who harvest of the fishery stocks or indirectly affecting the price of fishes in the market, especially those who depend on fishing for food and income.

Projected future changes are expected to affect the migration of fishes from the tropics and mid-latitudes to the area at high latitudes such as the Arctic and Southern Oceans. Climate change is presently causing displacements and movements of fish stocks due to projected future change in global temperature increase by 2°C in average (time frame between 2010 and 2050) and also because of an increase in ocean primary production of the phyto plankton as the base of food chain, the existing projection also suggests a decrease in ocean primary production (reduced nutrient supply) in the tropics and mid-latitudes. This situation is estimated to cause the largest loss in East Asia and Pacific for the fisheries into land value.

The scenario of the migration of fish and the shift of nutrient supply (plankton) towards a higher latitude will take by tens of kilometres per decade. However, some of the marine life is more tolerant towards the ecosystem change and less likely to migrate or shift to higher latitudes. The migration of fish are likely to move to cooler areas while leaving other marine lives that depend on these fishes as a food source which in turn will disrupt the existing food chain in the ocean ecosystem. Natural disasters caused by climate change such as flood, earthquake, storm and hurricane may affect the coastal ecosystems. For the example, heavy flooding would occur due to high density of rainfall in a short time. As a result, it can cause increases in water run-off which reduces the salinity along the coast, also can bring more nutrients in drainage water and sediment in the water. A significant reduction in salinity may lead to coral bleaching. In another part, run-off water from land will lead to excessive nutrient levels in water body and is a potential contributor to algal blooms.

According to Ellison (2008), the sea level rise will affect mangrove forests. It is expected that within 100 years, most of the world's mangrove would be seriously affected and damaged due to the rise in sea level. This is a catastrophe because the mangrove is a fortress to the tsunami and also a nursery for some juveniles of marine aquatic species. If this habitat is directly affected then it would threaten a number of aquatic species that depend on mangroves which can cause a dwindling to the species population and lead to extinction. This situation could affect the fisheries sector, especially for small boat fishermen who depend on the catch in the estuary and coastal zone.

In addition, the process of acidification due to excessive absorption of carbon dioxide by seawater will cause a decrease in the pH level of the ocean and make the sea more acidic, also the increase in sea temperatures will lead to the phenomenon of coral bleaching. The phenomenon of coral bleaching will have adverse effects on marine life and will affect the fisheries sector. The situation is very worrying because corals are the main habitat of several high-value species such as groupers and lobsters.

Climate change is also causing unpredictable weather conditions (e.g., storms and heavy rains) with a change in frequency and a high density is the factor that affects the fishing activities. According to Badjeck *et al.* (2010), these factors can threaten the safety of fishermen at sea. Therefore, no doubt that climate change could affect fishery activities, especially for small-scale fishermen who depend on small boats when fishing, which do not have a complete security equipments.

## RESULTS AND DISCUSSION

**Influence of climate change on the socioeconomic of small-scale fisheries:** Climate change can have an impact not only on the terrestrial ecosystems and the oceans but also affect the socioeconomic dimensions of the fishermen community. Extreme weather changes can cause big waves and changes in the frequency and density of rainwater can cause flood and coastal erosions which may disrupt the daily activities of fishermen community. The damage of infrastructures such as roads, jetty, homes, vessel and fishing tools due to the extreme weather caused by climate change will bring difficulties for the fishermen to operate their fishing activities. Omar and Quah stated that climate change can bring negative effects on the fisheries which can decrease the income of fishermen due to big waves and strong winds. Unpredictable weather is not suitable for fishing operations and can threaten the security of the small-scale fishermen.

Besides that, climate change may also affect the health of fishermen. In De Schryver *et al.* (2009) and Hanafiah *et al.* (2013) studies, they developed an endpoint characterization factors for climate change impacts on human health and the ecosystems. According to the IPCC, uncertainty of rain falls and the heat can be associated to human health problems such as fever, cold and cough. This situation could affect the fishermen's daily activities because they are very dependent on their health when operating fishing activities, if they get sick, the frequency of going to the sea will decrease and it directly affect their income.

**Adaptation strategies for climate change among the small-scale fishermen:** Every living organism has a resilience and adaptability to adapt towards environmental stress. According to the IPCC, adaptation in the context of global warming refers to the ability of wildlife to recover or change their lives or their environment system as a response to climate change adaptation measures which would reduce the negative impact brought by climate change. Significant challenges are faced by the fishermen due to climate shifts within the ecosystems, particularly in communities with a lower adaptive capacity. Coupled with the increases of severity and frequency of extreme events (e.g., heavy rain, storm and flood) will be exacerbated the situation then leads to the problem for livelihoods, health problem and damaging infrastructure (Haines *et al.*, 2006). Thus, the adaptation strategies formula should be a vital.

Since, the catastrophic of climate change becomes unpredictable, the capability to understand the community or individual adaptation to these changes is a critical necessity (Pereira *et al.*, 2010). According to IUCN,

the ability to adapt is the key to whether a person is capable or not to adjust to any changes in weather variables. In this context, the fishermen who have a good adaptation is expected to have a high resistance to the effects of climate change that occurred around them (Wiseman *et al.*, 2009). In confronting this environmental crisis, some steps should be planned and implemented in order to be a catalyst for the process of adaptation of fishermen communities' toward climate changes that happening around them. The strategies can include strengthening the knowledge and information related to climate change among fishermen such as El Nino and La Nina, hurricane, frequency of rain and others who related to the disaster of Mother Nature. All these efforts are to urge the communities towards being more prepared for future crisis of global warming, thus help to reduce the risk of climate change (Badjeck *et al.*, 2009).

Due to the distribution shift in fish and invertebrate species, the expansion of sustainable marine aquaculture can be an alternative for further strategies on climate change adaptation for fishermen community development. Besides providing a source of income, the fishermen do not have to find other jobs and still remain in fishery activities which is already a part of their lives. Mangrove replanting and the artificial reef are both strategies for restoring fish habitat due to mangrove damaging and degradation of corals (coral bleaching) caused by climate changes. Besides, to increase the number of fish in the area, artificial reef also provide a playground, a nursery and a house for some of vertebrate and invertebrate species (fish, lobster and other marine live) (Harris, 2009). Therefore, the local government or related agencies must play a part and held responsible in restoring the ecosystem for fish habitats by expanding the mangrove replanting programme and the numbers of artificial reefs in strategic are a around the coasts because this action cannot be done by fishermen community themselves.

### CONCLUSION

Extreme weather disturbances around the globe including Malaysia such as frequent heavy rains resulting the flooding, long drought, stronger and more frequent of typhoons and sea level rise is part of the phenomena associated with climate change. These changes are expected to have an impact broadly across the lands, the ocean ecosystems and the economies. These phenomenas increases the pressure on all livelihoods and food supply chains including within the fisheries sector. The small-scale fishermen in this region are very vulnerable as they are dependent on the fishing activities using a small vessel and traditional fishing tools for food and income. In that case, the adaptation strategies are

urgently needed in response to threats to food and livelihood provision of small-scale fishermen due to climatic uncertainty.

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