

Climate Change Impact on Fisheries Sector in West Coast of Malaysia: Adaptive Strategy and Measures to Mitigate the Environmental Issues

S. Z. B. Zolkaply¹, L. Alam¹, L. F. Rahman¹, M. A. Bari¹, S. A. Halim¹, M. Mokhtar¹

¹Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), Bangi 43600, Selangor D.E., Malaysia

¹lubna@ukm.edu.my

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Abstract

The main source of fish production resides in fisheries, which eventually contributes to increase in Malaysia's economy. Among the 13 states of Malaysia, Selangor is recorded as a huge landing for marine fish, which is the third-largest in number for the West Coast of Peninsular Malaysia. As a result, the livelihood of Selangor rural community especially the fisheries has partly contributed to the income of these communities. However, these fisheries required to be maintained properly for sustainable fisheries development. Moreover, the problems need to be identified that are faced by this coastal area fisheries community, where the liabilities are allied with environmental and social features. Thus. This study aims to conduct an in-depth interview with focus group discussion (FGD) session to collect data and determine the problem arises in this community in Selangor of the west coast of Peninsular Malaysia due to climate change. Finally, this FGD studies local communities observations on adaptive strategy and measures to alleviate the adverse effects of climate change such as floods, salinity intrusion, coastal erosion, and sea-level rise. Consequently, this FGD session output will help the local government to take into consideration the increment of the fishermen incentives and subsidies. As a result, this will in turn help fishermen to develop the socioeconomic situation of these targeted groups.

Keywords: Climate Change, Fisheries, Focus Group, Adaptation, Flood, Fishermen

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1. Introduction

Fish industry and aquaculture is the most important source of healthy food habit, nutrition, income source, and livelihoods for millions of people in the world. Due to the rapid growth of aquaculture, world's per capita fish supply is reached to a record of 20 kg in 2014

by providing half of the all fishes consumed by a human [1]. In addition, this consumption is becoming a successful sector in the state of the fish stock market due to proper management of fisheries. Globally, 3 billion people rely on fish due to their main source of income and this sector assure livelihood of 12 % of world's population, which created economic benefits of

US \$ 2.9 trillion per year [2]. Moreover, the fish market becomes one of the most-traded food possessions in the world and exporting more than half of the fishes by value-creating in developing countries like Malaysia. According to recent reports, international organizations, fish industries and representatives, a global population is expected to increase by 9.7 billion by 2050 with proper food security and adequate nutrition [3-4].

Fisheries are the main contributor to fish production and economy of Malaysia. It contributes 1.47 % of the Gross Domestic Product (GDP) and become a major producer of protein for the population of this country [5-6]. The landing of marine fish in Selangor in 2017 recorded 125, 517 tonnes which are the third-largest in number for the West Coast of Peninsular Malaysia [7]. This large number of fish landing has partly supported the livelihood and generated income for the rural community, particularly fisheries community in Selangor.

The fisheries community population in Selangor is distributed along the coast from Sepang to Sabak Bernam. The well-being of fishermen is dependent on income, government assistance, expenses, savings, homeownership, land, vehicles, facilities, fishing equipment's, health and education [5]. Coastal shoreline communities of Malaysia particularly in Selangor are highly dependent on fishing. Most of the angler has a limited economic option except for fisheries. The health of the fisheries along the coast of Selangor has always been sensitive to environmental changes. The environmental changes are caused by both environmentally and socially. Therefore, it is important to identify the problems faced by coastal fisheries community to reduce the vulnerabilities associated with environmental and social attributes [8-10].

The aim of this study is to understand the views and perceptions of the fishermen on climate change and to identify their opinions on adaptive strategy and measures to mitigate the negative impacts of climate change such as floods, salinity intrusion, coastal erosion, and sea-level rise on fisheries sector of Malaysia.

2. Methods

This study is conducted in the coastal shoreline of Selangor from Tanjung Sepat to Sabak Bernam. The map of the study area is shown in Figure 1.

In this study different methods and techniques were used to generate data from both primary and secondary sources. Secondary data on fisheries sector were obtained through the department of fisheries, Malaysia. Participatory methods, including survey through questionnaire and focus group discussions at the fishermen community were used. A total of 206 respondents were surveyed during June 2017 at the oil declaration center (Pusat isytihar minyak) for active fishermen at the Selangor area. Representatives in the focus group discussion are randomly selected based on target villages that are potentially affected by climate change and sea-level rise. The participants represented the main economic activities in their villages.

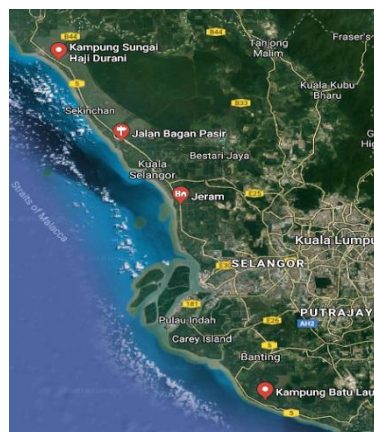


Figure 1: Map of the study area

Four FGD's are conducted between 20 and 21st October 2018 in four different locations of the study area (Table 1) involving ordinary fishers, farmers, breeders and village

community. The meeting place for these focus group discussions held in a community hall located in each study area.

Table 1: Date, location, meeting place and number of participants during the focus group discussion (FGD)

Group	Date	Location	Meeting place	No. of Participants
1	20/10/2018	Sungai Besar	Kg. Nelayan Haji Dorani Community Hall	18
2	20/10/2018	Tanjung Karang	Kg. Bagan Pasir Community Hall	14
3	21/10/2018	Kuala Selangor	Kg. Jeram MPKK (JKKK) Community Hall	18
4	21/10/2018	Tanjung Sepat	Kg. Batu Laut Community Hall	18

3. Results and Discussion

All the collected data has been analyzed to find out the trend of fish landing, licensed fishing gears, and fishermen involved in fishing in Selangor, which is shown in Figure 2. From Figure 2 it is clear that, the trend of fish landing is decreased sharply from 2006 to 2007. From 2007 to 2010 this trend is showing increment while decrees again in 2011. In addition, this decrement is continued from 2012 until 2016. However, this fish-landing trend is increasing again since 2017. A similar trend is observed in

the case of a number of licensed fishing gear. Typically, influences of climate inconsistency in the ocean namely sea-level rise, humidity, and average temperature variation directly affect on fish landing pattern, move-in current arrangements of livelihood and the controlling measures and eventually access to fish. However, this result shows that, it is in a steady state from 2009 until 2017. On the other hand, from 2006 to 2008 the total number of anglers working on licensed fishing vessels is in steady-state. Nevertheless, this number has been in a raising state from 2008 until 2017.

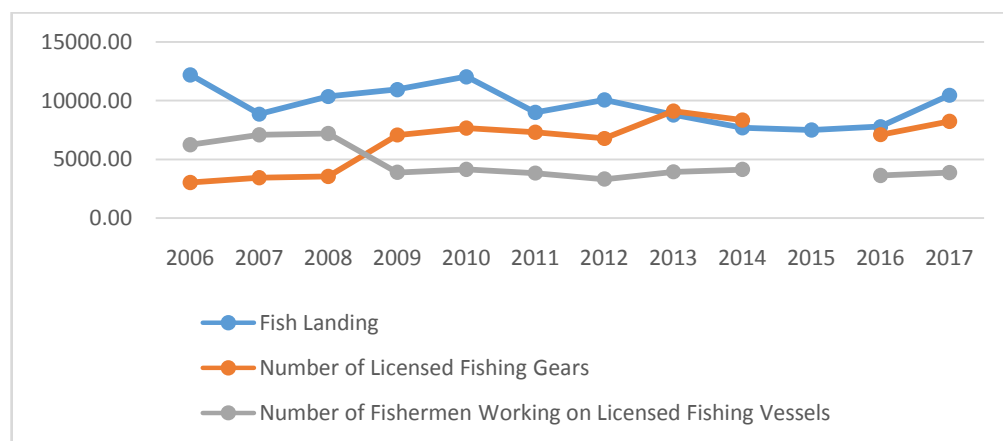


Figure 2: The trend of fish landing, licensed fishing gears, and anglers in Selangor

Figure 3 shows the demographic profile of respondents of fishermen community during the survey of active fishermen community in Selangor area. According to race, maximum number 89 % of respondents were from Malay race, while only 3% are from Indian and 8 % were from the Chinese race. In terms of age group 28 % of the respondents were in the age range of 40-49 years. Conversely, only 8 % of respondents are young peoples who were in age

level 20-29 years. In addition, Figure 3 shows that, 61 % of participants belong to a family of 4-5 person, which is the majority in terms of occupation. Moreover, it is found from Figure 3 that, 52 % of participants are passed secondary school, 39 % are passed primary school, 8 % are still illiterate and only 1 % have passed the diploma course among these anglers community in Selangor.

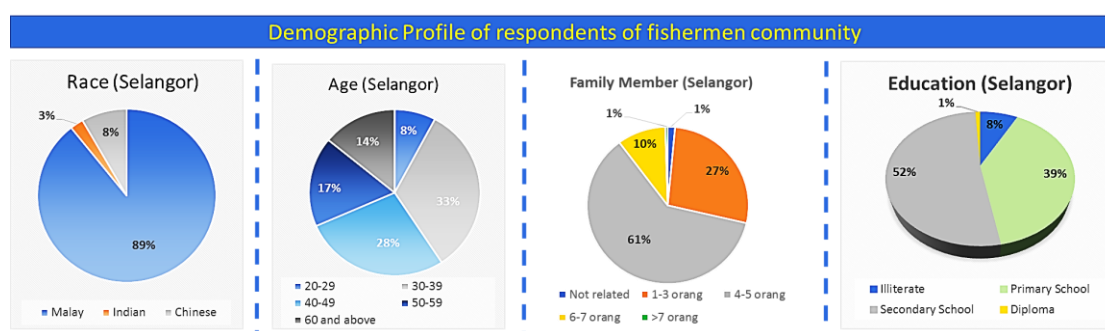


Figure 3: Graphical representation of the demographic profile of respondents of fishermen community in Selangor

According to the survey few parameters have been identified which are influencing the fisheries activities in Selangor, as shown in Table 2. It is clear from Table 2 that, 43% of respondents believe that marine sources are decreasing which affects the fisheries activity. On the other hand, participants believed that, 18% of fisheries activities are influenced due to

lack of knowledge and 10 % are affected only because of entrepreneur deficiency. In addition, 18 % affects the fisheries market activities as there is a lack of knowledge on sea technology among the villagers. However, illegal fishing is another factor which influenced about 33 % fisheries activity in Selangor.

Table 2: Summary of opinions on factors influencing fisheries activities in Selangor

Opinion on factors influencing fisheries activity	Selangor	
	Yes	No
Marine source decreasing	43%	57%
Incentive decreasing	7%	93%
Lack of knowledge on sea and technology	18%	82%
Lack of social mechanism (educationlevel/ low health)	4%	96%
Lack of management on fisheriesentrepreneur	10%	90%
Illegal fishing	33%	67%
Inefficient of fishery management	8%	92%
Lack of expert	5%	95%

Figure 4 shows the graphical representation of the occupation profile of respondents of four different villages namely, Kampung Sungai Haji Dorani, Bagan Pasir, Kampung Sungai Jeram and Kampung Batu Laut in Selangor during FGD. According to the occupation, maximum number 33 of the respondents are villagers, while 10 of them are a fisherman. On the other hand, only one of the respondents is

found from different occupation like community, security and development committee chairman (JKKKP), head of the fisherman, office assistant, restaurant owner and wife of a fisherman. Among the respondents only 4 of them are doing business and 6 of them are found farmers.

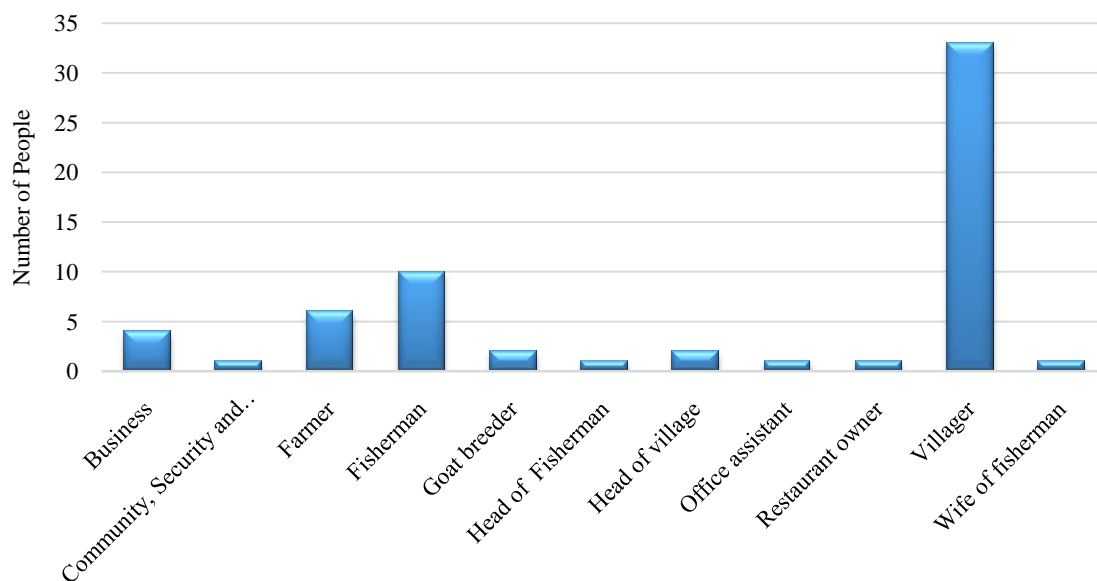


Figure 4: The occupation profile of respondents of four different villages in Selangor

The development of questions for focus group discussions is divided into two sections, which are the social vulnerabilities and livelihoods and the impact of environmental factors on fishing activities. 20 questions have

been asked to the ordinary fishers and village communities. Table 3 shows the questions that have been asked and an overall summary of responses of the participants.

Table 3: Summary of Questions (1-11) and fisher's responses on social vulnerabilities and livelihoods during the focus group discussion (FGD)

Question Number	FGD. Question	Social vulnerabilities and livelihoods
1	What is the main economic activity in this area?	Fishery, carpenter, food entrepreneur, homestay entrepreneur, farmers, goat breeders, fish breeders and factory industry
2	What is your opinion about the facilities and infrastructure in this area?	i. Safety issue arises due to the highway project, systematic management of drainage system to avoid flood during sea-level rise. ii. To build new revetment that has high resistant from coastal erosion to replace the existing bund revetment. iii. To build new barrage to improve the efficiency of water flow and to avoid flood incidence during sea-level rise.

		iv. To have the internet center to get more information about climate and other related environmental.
3	What is your opinion about climate change particularly sea-level rise?	i. Deforestation of mangrove and drainage blockage that cause coastal erosion, salinity intrusion and flood. ii. Mangrove will reduce the water quality, reduce species diversity, destroy fish and crustaceans nursery habitat, which depends on mangroves for numerous good and services [3].
4	What are the factors of sea-level rise?	iii. Destruction of mangrove areas and aquaculture areas due to strong wave.
5	What are the impacts of the climate change phenomenon in this area (impacts on fisheries community, angler, fishery resources, agriculture, and others)?	iv. The bund revetment is weakly function due to strong wave v. The water flooded the farm which resulted in crop damages, food shortage and lack of income of farmers. vi. The contaminated water arises from pesticide and factory caused small fish and cultured shell to die. vii. The Department of Irrigation and Drainage (JPS) can improve its service to overcome drainage blockage. viii. To quickly open the barrage when sea-level rise and heavy rain happen to avoid a serious flood. ix. To change the barrage into a new one to make sure it works at an optimum condition.
6	Are you aware of environmental issues such as flood, erosion, sea-level rise and any disaster that happen recently?	i. Erosion and pollution such as heavy deforestation, pollution from factory and rubbish. ii. The poisonous chemical substance on crops that can affect the villager's economic activities
7	Based on your experience, what is the obvious climate change event that happened five years ago? Please state the impacts on angler and community such as damage to the house, infrastructure, fishing boat, fishing nets and others.	i. The incidence of flood and sea-level rise affected the housing area and damage the infrastructure ii. Poor drainage system due to blockage sea level rise during the rainy season iii. Salinity intrusions are associated with a tidal wave and embankment breaching cause farmers and breeders experiencing salinity intrusion in cultivated land to produce crops and farm fish iv. Fish distribution changes due to water current, which reduces the fish, catch to decrease. v. Losing and damage to boats and fishing facilities.
8	What is your source of information on climate?	i. Internet (Whatsapp), television (Meteorology Department), radio and community ii. Informed by stages from the state level, district level, village leader and community
9	What is your preparation to face any disaster and is it effective?	i. Stopped fishing during an extreme climate event ii. Visited the houses that mostly affected and get their contact number iii. Will move to a nearby area that is safe or builds a new house that is higher than before iv. Will raise the red flag if the weather is critical as a warning sign for them to stop their fishing activity. v. A special team named "Rakan fish" and "SUKUN" is formed to monitor any issues regarding climate and invasion at the sea
10	What are the initiatives or methods to improve awareness of the community towards the conservation and preservation of the environment?	i. Organizing a program to educate people about environmental conservation and preservation, cleaning the beach program, create a program that will allow people in the villages to communicate with each other despite differences in race, religion, and political belief. ii. The enforcement and management effort should be done towards farmers and people who always throw palm oil waste and rubbish into the drain to avoid drainage blockage in the future.

11	What is the best method to improve the knowledge of people in your community about sea-level rise?	<ul style="list-style-type: none"> i. To create awareness about sea-level rise and climate change impacts ii. To guide them about preparation to face the incidence of sea-level rise and climate change iii. To build understanding about the exact definition of sea-level rise iv. Television and radio are also important to attract people to improve their understanding of the sea-level rise and climate change impact
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Table 4: Summary of Questions (12-20) and fisher's responses on the impact of environmental factors on fishing activities during the focus group discussion (FGD)

Question Number	FGD. Question	Environmental factors and livelihoods of fishing communities
12	In your opinion, is climate change and environment influence the fish catch (species, size and quantity)? Can you compare the fish production with 10 years ago?	<ul style="list-style-type: none"> i. The fishing trip and the number of fishing days increased, so fish production is declining ii. Fish captured and species diversity is decreasing and the size becomes smaller as compared to the past iii. Fish species that obviously showed declining in number are mackerel, red snapper and prawn iv. Types of boat and net, fishing technic, an increasing number of boat and fisherman, time and area of fishing affected the fish production in all villages due to lack of enforcement in protecting illegal nets v. Fishers who use small fiberglass and aluminum boats (Zone A) encounter problem with larger fishing boats (Zone B) that destroy their fishing nets and occupy their targeted fishing areas. vi. Chinese fisherman are using the larger boat (Zone B) while Malay fisherman only depending on a small boat (Zone A) for fishing
13	In your opinion, what is the factor that contributes to the species that is captured in this area (Example: environment, climate change, fishing gear, fishing technic or others)?	<ul style="list-style-type: none"> i. The harpoon nets and trawling nets resulted in a decreasing number of small fish ii. In Kampung Jeram, fisherman tends to get more fish during Southwest monsoon season (dry season) as compared to the wet season because, during the wet season, polluted water from factory enters the sea through the river. As a result, the fish habitat was degraded and the fish mortality rate was increased.
14	Is there any variation on species captured by angler as compared with 5 to 10 years ago? Can you give examples of species that undergo such variation?	<ul style="list-style-type: none"> i. No response
15	What is the factor that influences the disappearing or extinction of fish species?	<ul style="list-style-type: none"> i. Pesticides from crops polluted the aquaculture area during rainy season due to sea-level rise and continuous rain that caused the polluted water to enter the aquaculture area (seabass and shells)
16	If any disaster happened caused by sea-level rise, will you move to another place? Is the new place near to the sea?	<ul style="list-style-type: none"> i. Some of them think they would leave their house but many did not think they would leave their house and the local community as they still believe that their land is safe from any disaster and such prediction will never happen ii. Participants from Bagan Pasir believe that moving for a while is the best solution to continue their life until the situation is safe. However, they still looking for areas that are near to the sea to continue their fishing activities iii. Kampung Jeram and Kampung Batu Laut, they will find a new place for fishing and livelihood which is in the range of their operation district only. If they no longer could rely on the fishing profession, they will move away from the coast and resettle elsewhere

17	Is there any difference in fish price during monsoon and non-monsoon season? Why?	<ul style="list-style-type: none"> i. During monsoon, the price of fish increase if fish production is low ii. As Chinese are using larger fishing boat belonging to the B fishing license category that permits them to work far from its base and operating using the trawling net to get fish during fishing
18	Let say, if there is any bad disaster happen in this area; do they (angler) need to change their job? Please give your opinion.	<ul style="list-style-type: none"> i. All fisherman will quit their job if find another alternative except for fisherman from Bagan Pasir who still wanted to become a fisherman as most of the fisherman in Bagan Pasir are Chinese and they are operating in Zone B using a larger boat ii. Will focus on maintenance work such as mending nets iii. Need to have financing and needed a big capital to continue their fishing activity to buy new boat and nets
20	What is your hope in order to improve the fisheries sector and socioeconomic in this area.	<ul style="list-style-type: none"> i. The government will maintain the incentives and subsidies that they received previously and trying to improve the existing effort to help fisherman to improve their socio-economy ii. In Bagan Pasir, the main hope is that the government can provide a fund to finance a new revetment project to replace an existing bund revetment that can easily damage by climate change iii. In Kampung Jeram and Kampung Batu Laut, anglers are suggested to establish a committee to improve fisheries resources, which will help the Fisheries Department and LKIM in many ways. iv. The government could introduce many activities for them to gain extra income.

From Table 3 and Table 4 it is illustrated that, the vulnerabilities of a coastal community in Selangor are caused by both environmental and social factors. The participants responded to the questions given and decided that the key factors that cause disaster and damages in their villages are human activities and changes in climate. It is important to reduce the problem by creating awareness among people about environmental issues and to practice good behavior to reduce the risk of disaster. For example, people should stop the drainage blockage by throwing rubbish at the right place and farmers should not use poisonous chemicals to avoid water pollution. Thus, the impacts of climate change can be reduced. In addition, several recommendations are obtained during the focus group discussion. A continuous effort is needed by conducting and organizing attractive programs that can educate people about environmental conservation and preservation, cleaning the beach program, a strong enforcement should be applied towards farmers or villagers that cause environmental

pollution and drainage blockage and gain cooperation from villagers and related agency to solve environmental and social issues in the villages. For fishermen, three main recommendations are identified such as providing financial counsellors for angler to solve financial issues, increasing facilities at the fishing port to help them to gain income and conducting strong and continuous enforcement to solve the issues at their fishing areas such as illegal fishing boat and nets, disturbance from foreign angler and overexploitation of fisheries resources. Some fishermen suggested making a schedule for fishing activities to avoid the extinction or declining of fisheries resources such as six months fishing and six months rest to let the small fish grow bigger. Therefore, it is hoped that this focus group discussion has provided a comprehensive approach for the management of coastal areas and taking into account mitigation measures to solve the problems in the coastal areas of Selangor.

4. Conclusion

In this research, the survey and FGD were conducted among fisheries community in Selangor regarding adverse effects of climate change on fisheries sustainability. Most of them mentioned that the price of fish is depending on monsoon. During monsoon, the price of fish increases if fish production is low. All fishers mentioned that they would quit their job if they have opportunities to find another alternative except for fishermen from Bagan Pasir who still wanted to remain in their same occupation as fishermen. As the bund revetment can easily damage by climate change, so the respondents in Bagan Pasir concerned about the government fund to finance a new revetment project for installing a new one. Most of the fishermen were satisfied with a government effort to ease the burden of fishing operation through affordable insurance protection (Etika Insurance). However, some of them are hoping for free insurance. The villagers requested the enforcement agency to conduct their duty as wise as possible and keep on monitoring and managing the wrongdoing in the village and at the sea. They also hoped that the government will maintain the incentives and subsidies that they received previously and trying to improve the existing effort to help fishermen to improve their socioeconomic status.

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