Adaptation Towards Climate Change among Small Scale Fishermen: A Comparison Between the East Coast and West Coast Fishermen in Peninsular Malaysia

[1,2]Asnarulkhadi Abu Samah, [1]Mas Ernawati Hamdan, [3]Bahaman Abu Samah,
[3]Azimi Hamzah and [1]Hayrol Azril Mohamed Shaffril
[1]Institute for Social Science Studies, [2]Faculty of Human Ecology,
[3]Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Abstract: This study aims to compare the adaptation ability between the East and the West coast small scale fishermen in Peninsular Malaysia. This study is quantitative in nature whereby via a multi-stage cluster sampling, a total of 200 small scale fishermen had been selected as the respondents. The resulted analysis had confirmed that the adaptation ability are different between the East and the West coast small scale fishermen in Malaysia. Having this study offer responsible agencies opportunities to understand the adaptive ability of the fishermen, especially with regard to practice ability without putting aside their cognition and the structure abilities.

Key words: Community development, adaptation ability, fisheries industry development, environment, management

INTRODUCTION

The small scale fishermen in Malaysia: Fisheries sector is one of the important contributors to Gross Domestic Product (GDP) for Malaysia. In 2012 for example a total of RM7.98 billion (by that time it was roughly equal to USD2.3 billion) was generated. Furthermore, the industry is an effective solution for unemployment, particularly in rural areas and able to provide consistent protein supply for the Malaysian population (Omar *et al.*, 2012). Fisheries industry in Malaysia is divided into four categories, namely marine capture fisheries, inland fisheries, aquaculture and recreational fisheries sub-sector. The marine capture fisheries are further sub-divided into coastal fisheries (inshore) and the offshore sub-sector. Although, there is no official statistic on the coastal fishermen, also known as the small scale fishermen, nevertheless, local studies done by Omar *et al.* (2012), Ramli *et al.* (2013) and Osman *et al.* (2014) had consistently proven that the small scale fishermen in Malaysia are constructing >65% of the overall fishermen population in Malaysia. Within the scope of this study, the small scale fishermen are classified as those who operate their fishing routine for not >5.0 nautical miles from shore, the small size of the vessel (21 feet or less in length), lower boat engine capacity (<40 horse power), using fishing gears include drift/gill nets, hook and line,

traps, fishing stakes, bag nets, lift nets and barrier nets and a huge majority of them rely on basic technology tools such as mobile phone.

The impacts of climate change on the small scale fishermen in Malaysia: Similar to other countries, Malaysia is also subjected to frequent weather disturbance that negatively affect the biophysical, social and economic attribute. Having this situation should create concern among the community as this sector has for many years played an important role in the Malaysian economy. Climate change phenomena such as increased sea temperature, rising of sea-level, affected ocean pH, rainfall and ocean circulation are obviously affecting and threatening the ocean ecosystems (Halpern *et al.*, 2008; Schmidhuber and Tubiello, 2007). Understandably, these phenomena are lessening the quality and the quantity of the marine flora and fauna which eventually reducing the productivity of fishermen. Brown *et al.* (2010) in his study claimed that the climate change is producing negative impacts on ocean organisms, the composition of marine communities and ecosystem function. Previous studies have looked onto the impacts of rising or decreasing temperature (caused by the climate change) can result in local species extinctions and also to colonization by species previously absent in those areas (Cheung *et al.*, 2009; Vinagre *et al.*, 2011) which will most likely affect the

Corresponding Author: Asnarulkhadi Abu Samah, Institute for Social Science Studies, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

quantity and the quality of their potential catches. Consequently, having these impacts is affecting the socio-economic aspects of the small scale fishermen. Reduced quality and quantity of the marine sources means less catches for the fishermen-less catches means less money for them (Gamito *et al.*, 2013; Sumaila *et al.*, 2011). Extreme weather resulted from the climate change on the other hand is increasing the risks associated with their fishing routine. These small scale fishermen are highly vulnerable towards these extreme events as they are only equipped with the smaller vessel, low engine capacity and basic communication tool. These eventually will result in some of them to delay or cancel their fishing trips. There are also challenges for the small scale fishermen to keep up with the industry and they need to be ready with the environmental changes.

Having these impact results in a dire need for a better adaptation among the small scale fishermen, hence, more studies need to be conducted to provide a depth understanding of what actually constructs climate adaptation among small scale fishermen. However, although there are abundance of climate change studies available such as by Sumaila *et al.* (2011), Vinagre *et al.* (2011), Alexander *et al.* (2006) and Tangang *et al.* (2007) nevertheless, many of them are focused on the scientific investigation and not on the social aspects specifically on the community such as small scale fishermen community. The lack of number in social studies has left a big gap to be fulfilled and this study aims to fill the existing gap by focusing on adaptation towards climate change among small scale fishermen in the West coast and the East coast of Peninsular Malaysia.

Adaptation towards climate change among small scale fishermen: The Intergovernmental Panel on Climate Change (IPCC) stated that "adaptation refers both to the process of adapting and to the condition of being adapted". The Malaysian National Policy of Climate Change which was initiated by Ministry of Natural Resources and Environment Malaysia (NRE) has defined adaption as actions taken to aid communities and ecosystems to cope with existing and projected impacts of climate change. Similar to other countries, several studies are predicting that resulted climate change impacts in Malaysia will worsen in the future (Alexander *et al.*, 2006; Tanggang *et al.*, 2007) where severe and frequent natural disasters might be occurred. Hence, adaptation towards climate change is one of the best way to cushion this phenomenon.

Generally, all groups of the community will be affected by the impacts of climate change, however, it is expected that those who rely on natural sources for their socio-economic routine are most affected. The farmers have been one of the affected groups drought in Malacca in 1991 for example, has caused RM7 million (by that time roughly equal to USD 2.3 million) in losses for local farmers while flood in Johor in the recent years were affected 7000 farmers and caused losses of agriculture products worth RM84 million (by that time roughly equal to USD 28 million) (Al-Amin *et al.*, 2011). Another group that is most affected by the climate change is the small scale fishermen as their reliance on marine resources is high and therefore their climate adaptation need to be strengthened. To identify the strengths and the weaknesses of the small scale fishermen regarding their climate adaptation, it needs to be measured and one of the effective measurement efforts it is by focusing on the three aspects of adaptation namely cognitive, practice and structure. The development of these three aspects is guided by the coastal community adaptation framework that was developed by the International Union for Conservation of Nature and Natural Resources.

The first aspects are cognitive that refers to the ability of small scale fishermen to adapt themselves to the changing-weather, are they aware (sensitive) or not on the occurring climate change and its impact on life. If they are aware, is this followed by their willingness to adapt to the changing weather manifested by physical environmental changes and changes in productivity. The second aspect is about practice. It focuses on the willingness to adapt to the changing environment by changing their economic activity from maritime sources of income to half of maritime or non-maritime environments local socio-economic. The main issue in this second aspect is their economic orientation status in response to climate change and the degree of willingness to change without dismantling the relationships and socio-cultural ties. After learning the cognitive aspect (process) and economic orientation (practice), the third aspect is on structure. This focuses on the supports given by the government and local institution, including the community based organization that able to equip the small scale fishermen at various stages of their skills and readiness against the resulted impacts of climate change.

Comparing the climate adaptation ability based on these three aspects will allow researchers to identify any gap that exists between the fishermen communities. This eventually will allow them to construct appropriate strategies to narrow it down and to be in line with the NPCC which to ensure that all groups of the community, regardless their socio-economic background, will have a better preparation and readiness in handling economic and social issues towards the worsening climate change in Malaysia.

MATERIALS AND METHODS

This is quantitative study which used a developed questionnaire as the main tool for collecting the data. The questionnaire was developed based on literature reviews in order to answer the research objectives. For each of the questions asked, the respondents were given a 5 point likert scale which gave them a choice of answers, including: strongly disagree, disagree, moderately agree, agree and strongly agree. Using a multi-stage simple random sampling technique, a total of 200 fishermen from the East and West coast region was chosen as respondents in this study. During the first stages of the sampling technique, states are grouped into two zones; the West and the East coast. Then a state was randomly selected from the zone. In this stage, the selected states were Pulau Pinang (represented West coast) and Terengganu (represented East coast). In the second stage of sampling, one fisheries district was selected to represent each zone. In this stage, the selected fisheries districts were Central Seberang Perai (Pulau Pinang) and Northern Kuala Terengganu (Terengganu). In the last stage of the sampling procedure, a simple random sampling was again employed to choose 100 respondents from each of the fisheries districts. The actual data collection took a month to be completed and was conducted during September 2015 and it was assisted by a number of trained and experienced enumerators. Survey was used as the main technique in collecting the data. The collected data then was analysed using SPSS Version 22 using related analyses such as frequency, percentage, mean score and independent t-test.

RESULTS AND DISCUSSION

Respondents' demographic data: Based on the analysis, 15% of the small scale fishermen were aged 30 and under, 39% were aged 31-50 while of the remaining 46% were aged 51 and above. Only 5% of the small scale fishermen had never been to school, 31.5% completed a primary school level of education as well as the number of small scale fishermen completed an upper secondary school level of education while 29.5% of the small scale fishermen possessed lower secondary level of education. The remaining 5% of the small scale fishermen achieved a tertiary level of education. The majority of the small scale fishermen were married (82%), 14% were single and only 4% divorced/widowed. In this study, the small scale fishermen were divided into three different categories:

- Full time fishermen
- Fishermen have side income related to fisheries
- Fishermen have side income non-related to fisheries

A total of 77, 4.5 and 18.5% of the total number of respondents were respectively recorded in three categories. The mean monthly income was RM890. Most of the small scale fishermen (35.5%) earn between RM701-1000 per month. The majority of the small scale fishermen' income generated from fisheries related activities, 60.5% of small scale fishermen had >76% of their income from fisheries. Based on the mean score recorded for experience as a fisherman (M = 24.3 years), it can be said that the majority of the small scale fishermen can be considered "senior" in terms of their experience level. A total of 32.0% of the small scale fishermen had 16-30 years' experience as a fisherman. On average, they spent 19 days a month out at sea. In addition, 97.5% of the small scale fishermen uses a fibre boat for fisheries activities (Table 1).

Adaptation towards climate change among small scale fishermen: Small scale fishermen's adaptation towards climate change were measured based on cognitive, practice and structure aspects. In this study, the overall mean score was categorized into three levels, namely low, moderate and high. The category was identified based on the range of score calculation; maximum mean score (5.00); minimum mean score (1.00)/number of categories (3) which then resulted in the range of 1.33. Hence, the resulted categories are low (1.00-2.33), moderate (2.34-3.67) and high (3.68-5.00). As depicted in Table 2, all the three elements were used to record a moderate overall mean score ranging from 3.12-3.44.

Comparisons between East and West coast small scale fishermen adaptation towards climate change: The analysis performed in Table 3 had shown that there is a significant difference in the cognitive aspect between East coast and West coast small scale fishermen based on the results presented for West coast small scale fishermen (M = 3.48, SD = 0.464) and the East coast small scale fishermen (M = 3.17, SD = 0.376; t (200) = 5.190, p = 0.0001).

Furthermore, a contrast result can be seen within the scope of practice as we can see the resulted analysis for the West coast small scale fishermen (M = 3.46, SD = 0.549) and the for the East coast small scale fishermen (M = 3.42, SD = 0.538; t (200) = 0.555, p = 0.579) had shown that there was no significant difference detected between these two groups.

Within the scope of the structure, based on the resulted analysis for the West coast small scale fishermen (M = 3.30; SD = 0.766) and for the East coast small scale fishermen (M = 2.94, SD = 0.766; t (200) = 3.020, p = 0.003), it confirmed that there is a significant difference between the two groups studied.

Table 1: Respondents' demographic data (n = 200)

Variables	Frequency	%	Mean
Age (years)			48.69
<30	30	15.0	
31-50	78	39.0	
>51	92	46.0	
Educational achievement			
Never been to school	10	5.0	
Primary school	63	31.5	
Lower secondary school	59	29.5	
Upper secondary school	63	31.5	
Tertiary level	5	2.5	
Marital status			
Single	28	14.0	
Married	164	82.0	
Divorced/Widowed	8	4.0	
Fishermen category			
Full time fishermen	154	77.0	
With side income (non-fisheries related)	37	18.5	
With side income (fisheries related)	9	4.5	
Income per month (from fisheries activity)			890.0
<RM500	57	28.5	
RM501-700	36	18.0	
RM701-1000	71	35.5	
>RM1001	36	18.0	
Percentage of income generated from fisheries related activities (%)	75.5		
<30	21	10.5	
31-50	47	23.5	
51-75	11	5.5	
>76	121	60.5	
Experience as a fisherman (years)			24.3
<5	24	12.0	
6-15	51	25.5	
16-30	64	32.0	
>31	61	30.5	
Days spent at the sea for fishing operation in a month (days)			18.9
<15	53	26.5	
16-20	105	52.5	
>21	42	21.0	
Vessel type			
Fibre boat	195	97.5	
Sampan	5	2.5	

Table 2: Adaptation towards climate change among small scale fishermen

Variables	Frequency	%	Mean score
Cognitive			
Low (1.00-2.33)	2	1.0	3.32
Moderate (2.34-3.67)	158	79.0	
High (3.68-5.00)	40	20.0	
Practice			
Low (1.00-2.33)	1	0.5	3.44
Moderate (2.34-3.67)	128	64.0	
High (3.68-5.00)	71	35.5	
Structure			
Low (1.00-2.33)	36	18.0	3.12
Moderate (2.34-3.67)	115	57.5	
High (3.68-5.00)	49	24.5	

In this study, the cognitive aspect was measured based on small scale fishermen' sensitivity and awareness about climate change and its impact on the environment

Table 3: Comparisons between East and West coasts small scale fishermen adaptation towards climate change

Variables	Mean score	SD	t-values	p-values
Cognitive			5.190	0.0001*
West coast	3.48	0.464		
East coast	3.17	0.376		
Practice			0.555	0.579
West coast	3.46	0.549		
East coast	3.42	0.538		
Structure			3.020	0.003*
West coast	3.30	0.766		
East coast	2.94	0.928		

*p<0.005

and socio-economic routine. Based on the results of the study, in general, the cognitive aspect of the respondents is at a moderate level (M = 3.32). However, further analyses performed using Independent t-test has demonstrated that the small-scale fishermen on the East coast (M = 3.17) were less aware and sensitive to the climate change compared to smaller scale fishermen in the West coast (M = 3.48). Having this result is quite surprising as the small scale fishermen in the East coast are expected to be more sensitive compared to their counterpart on the West coast as most of the extreme events and the monsoon season are frequently recorded on the East coast. Such scenario might be driven by a number of causes. First, weaknesses of the information management systems whereby, according to Shaffril *et al.* (2013) lack of related climate change information by the concern parties disseminated to the small scale fishermen might cause less awareness among them. Secondly, Abu Samah has explained that as most of the small scale fishermen are immune to the climate change whereby due daily interaction with the weather, most of them have become used to it and consider any change that occur as a common phenomenon.

Based on the results depicted, the overall mean score for practices aspect is at a moderate level (M = 3.44). Result analysis shown that there is no significant difference in the practices aspect between East and West coast small scale fishermen. Although, there is no significant difference recorded, it should be noted that the moderate mean score recorded for this aspect denotes that there is still a gap to be filled. This aspect should be further strengthened. The related alternative skills and occupation needs to be introduced to small scale fishermen community as one of their preparation towards climate change as adaptation ability as suggested by Badjeck *et al.* (2010).

Just like the two aspects mentioned above, structure aspect has been at a moderate level with an overall mean score M = 3.12. T-test analysis shows that there is a significance difference in the structure aspect between the East coast and West coast small scale fishermen. This

result indicates the available opportunity for the agencies to provide more climate adaptation supports to the small scale fishermen, especially to those in the East coast areas.

CONCLUSION

Adaptation abilities are different among small scale fishermen community though they are exposed more or less to the phenomenon of climate change. This study had shown that despite the same category of fishermen, their ability to adapt are not the same. The small scale fishermen in the west coast of Peninsular Malaysia had a better adaptation ability with regard to cognitive and structure. However, there was no significant difference detected in adaptation ability related to practice. This indicates that there are more avenues to safeguard the interest of small scale fishermen, especially with regards to economic orientation for both areas East and West coasts. Besides that, both public and private fisheries extension and advisory services have a major role to play in providing small scale fishermen with information, technologies and education on how to adapt to climate change particularly in the East coast region. Extension services can assist the small scale fishermen to deal with the issues of climate in several ways, including retooling by introducing new skills to develop a new ability for a new type of occupation or diversifying their capabilities to accommodate new challenges in the fishing industry. This could further help to confront for greater climate variability and uncertainty, create contingency measures to deal with rapidly increasing risk and reduce the effects of climate change by providing advice on how to deal with droughts, floods and so forth. Collaborative efforts between relevant agencies and fishermen communities is crucial. The supporting agencies such as Department of Fisheries, the National Fishermen Association and Fisheries Development Authority of Malaysia can take the lead in providing new inputs in terms of skills and information pertaining to climate change, according to the fishermen level of sensitivity and awareness, hence, the provided input is well matched with the needs of the beneficiaries (the small scale fishermen). Understandably, matching the right inputs from the agencies and the needs of the beneficiaries could help to lessen the impacts of climate change to the small scale fishermen communities in the East and West coasts.

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