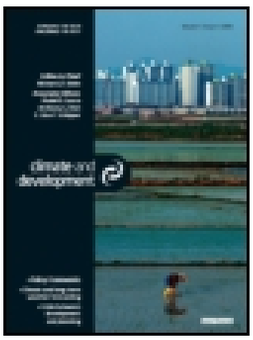

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climate and development

RESEARCH ARTICLE

Individual adaptive capacity of small-scale fishermen living in vulnerable areas towards the climate change in Malaysia

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The present study attempts to identify the individual adaptive capacity of small-scale fishermen living in coastal areas that are vulnerable to the climate change in Malaysia. This study is quantitative in nature and involves a total of 240 respondents from four areas in Malaysia. It can be concluded that small-scale fishermen in Malaysia have adaptive strength in two aspects: namely formal and informal networks; and environmental awareness, values and attitudes. Although the fishermen were found to record a high mean score for three other adaptive aspects – local environmental knowledge; attachment to job; and attachment to place – this actually demonstrates their adaptive weaknesses. Employability is another area of concern, as it emerged as the fishermen's weakest adaptive aspect. This study demonstrates the potential of alternative skills, managed retreat, accommodation and protection, information management, periodical assessment and access to credit to produce progressive adaptive capacity of small-scale fishermen in Malaysia.

Keywords: adaptive capacity; community development; fisheries development; environmental issues; rural development

Introduction

The fisheries industry in Malaysia is one of the main economic contributors to the nation as well as an effective problem solver for unemployment particularly in rural areas (Department of Fisheries Malaysia, 2013). Despite its tremendous contribution towards the economy and towards social well-being, however, due to its high reliance on weather stability, the fisheries industry is facing multi-faceted influences from the changing climate. Both – Malaysian and international scholars – have demonstrated the effects of climate change in Malaysia in terms of rising temperature (Intergovernmental Panel on Climate Change [IPCC], 2007; Kwan, Tanggang, & Juneng, 2011; Wai, Carmelengo, & Ahmad Khairi, 2005), rising sea level (Awang & Abdul Hamid, 2013; Ercan, Mohamad, & Kavvas, 2013; Sulaiman & Zainal Abidin, 2012), unstable rain patterns and thunderstorm (Wan Azli, 2010), strong wind and waves (Muzathik, Wan Nik, Samo, & Ibrahim, 2011; Razali, Sapuan, Ibrahim, Zaharim, & Sopian, 2010; Sapuan, Razali, & Ibrahim, 2011) and unstable northeast monsoon patterns (Kajikawa, Yasunari, Yoshida, & Fujinami, 2012; Suhaila, Deni, Wan Zin, & Jemain, 2010). These changes then have subsequently led to the occurrence of disastrous extreme events (Sulaiman & Zainal Abidin, 2012; Tanggang, 2007; Wan Azli, 2010; Zubaidi, 2010), which have damaged fishermen's properties (Abu Samah, Shaffril, D'Silva, & Uli, 2011; Tanggang, 2007) and negatively impinge their socio-economic aspects (Abu Samah et al., 2011; Shaffril, Abu Samah, D'Silva, & Yassin, 2013). Hence, in order to absorb these impacts, community adaptation is needed. Though the need for community adaptation is rising, little has been understood on their strengths in terms of adapting to such changes; much of the Malaysian climate-related research has focused on scientific areas (Awang & Abdul Hamid, 2013; IPCC, 2007; Kwan et al., 2011; Sulaiman & Zainal Abidin, 2012; Tanggang, 2007; Wai et al., 2005; Wan Azli, 2010; Zubaidi, 2010). Understandably, although there are some studies that looked onto community adaptation towards climate change in Malaysia such as by Shaffril et al. (2013), Alam, Siwar, Jaafar, Talib, and Osman Salleh (2013), Rakshit (2012) and D'Silva, Shaffril, Abu Samah, and Uli (2011), the number is still inadequate particularly one related to fishermen's adaptation to the changing climate.

In order to fill this gap, the present study attempts to identify the individual adaptive capacity towards the

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climate change among small-scale fishermen in Malaysia. The main focus of this study analysis is the fishermen as a person whom their socio-economic routines are under threats of the climate change. Conducting such a study is vital, as it produces a number of implications. First, information from this study will complement existing literature by providing new data regarding individual adaptive capacity towards climate change among small-scale fishermen in Malaysia. Second, constructing adaptation strategies is difficult as the nature and severity of impacts are likely to vary across industry sectors, information from this study can specifically assist concerned parties in developing concrete adaptation strategies that fit the needs, abilities and interests of the fishermen. Third, as socially focused climate-related studies are still lacking, the findings from this study will serve as a guide or basis for more detailed and in-depth studies to be conducted. Such implications can assist fishermen, who are expected to be strongly impacted by climate change due to their high reliance on the environment for their socio-economic routine (Badjeck, Allison, Ashley, & Nicholas, 2010).

This study has several limitations. First, the analysis is based on the answers provided by 240 fishermen from four different locations. Understandably, a bigger sample size and inclusion of other fishing areas may give broader spectrum on the issues studied. Second, although a number of adaptation-measurement tools have been developed by several established agencies, this study relies primarily on the individual adaptive capacity framework developed by International Union for Conservation of Nature (IUCN).

Small-scale fishermen in Malaysia

Although there are no official statistics on the number of fishermen according to their catchment zone, studies conducted by Shaffril et al. (2013), Omar, Shaffril, Bolong, D'Silva, and Hassan (2012) and Ramli, Omar, Bolong, D'Silva, and Shaffril (2013) have consistently confirmed that more than 60% of registered fishermen in Malaysia are conducting their fishing operations within the Zone A catchment areas. Zone A fishermen, who are also known as small-scale fishermen or coastal fishermen, are characterized by several traits such as operating within 0.1–5.0 nautical miles of shore, using smaller vessels (fibre or traditional boats, locally called *Sampan*), being equipped with basic communication tools (mobile phone), and conducting their fishing operations at subsistence level (Omar et al., 2012; Omar, Shaffril, Bolong, & D'Silva, 2013; Ramli et al., 2013; Shaffril et al., 2013). With regard to their demographic characteristics, the majority of small-scale fishermen in Malaysia are male, aged over 40, have more than 15 years' experience, conduct their fishing operation for 20 days or more a month, and rely solely on fishing as the main money-making activity (Abu Samah et al., 2011; Bolong, Omar, Shaffril, D'Silva, & Abu Hassan, 2013; Ramli et al., 2013; Shaffril, Omar, Bolong, & D'Silva, 2012).

Climate change in Malaysia

Studies across the globe (Badjeck et al., 2010; Chini et al., 2010; IPCC, 2007; Trenberth, 2011) have proven that climate change has shifted the world's weather, and this can also be seen in Malaysia. Several studies have focused on the continuous weather changes in Malaysia. A study conducted by Kwan et al. (2011), for example, confirmed that places such Kota Bharu, Bayan Lepas and Malacca are facing between 50.2% to 73.97% more warm days and 66.0% to 95.4% more warm nights while a study conducted by Kitada, Kobayashi, Kurata, and Ho (2006) confirmed an increase of 1.1°C in the last three decades in Johor, while Wai et al. (2005) detected an increase of between 1.75°C and 2.69°C over the last 40 years in places such as Kota Bharu, Mersing and Kuantan.

Several other studies have considered the rising sea level in Malaysia (Awang & Abdul Hamid, 2013; Ercan et al., 2013; Sulaiman & Zainal Abidin, 2012). Awang and Abdul Hamid (2013), for example, have observed at the sea level rise (based on satellite altimetry data from 1993 to 2010) at the Pulau Pinang-Perak Border Sea (6.45 mm/year), Tumpat sea (5.70 mm/year) and Malacca Strait (3.68 mm/year). Ercan et al. (2013), on the other hand, predicted a sea-level rise in Peninsular Malaysia coastlines with a mean between 0.066 and 0.141 m in 2040, and the scenario is expected to worsen in 2100, when the increase is expected to be between 0.253 and 0.517 m. Comparatively, such findings are almost in line with international studies by Bindoff et al. (2007) who concluded that the global mean sea level rise rate to be 1.8 ± 0.5 mm/year for the period of 1961–2003, and 1.7 ± 0.5 mm/year over the twentieth century while Cazenave and Nerem (2004) on the other hand had concluded the rate of sea level rise as 3.1 ± 0.7 mm/year, based on satellite altimetry observations for the period of 1993–2003.

Wind speed is another weather component that is affected by the changing climate. Razali et al. (2010), for example, has concluded that in 100 years return period, high extreme wind speed are predicted at areas such as Alor Star (22.07 m/s), Kota Bharu (22.58 m/s), Mersing (22.04 m/s) and Kuantan (20.27 m/s). Another study by Sapuan et al. (2011) confirmed that over a period of 50 years, places such as Alor Star (19.53 m/s), Kota Bharu (19.98 m/s), Ipoh (21.41 m/s), Subang (19.64 m/s) and Mersing (19.65 m/s) may be hit by extreme winds. Changes in wave strength have also been recorded, including a number of extreme wave occurrences in Malaysia (Muzathik et al., 2011). A number of studies have looked at the shifting northeast monsoon in Malaysia; for instance, Kajikawa et al. (2012) confirmed a significant increase in mean precipitation of 8% and an extension to the

monsoon period, while Suhaila et al. (2010) reported a significant increase in rainfall intensity and extreme weather occurrences across Peninsular Malaysia during the northeast monsoon. Rainfall pattern is another area of concern in relation to the changing climate in Malaysia. A study by Raja Hasyib, Ibrahim, and Abdul Rahman (2011), for example, looked at uncertainty regarding the pattern, density, duration and magnitude of rainfall in Malaysia. A study by Wan Azli (2010) accentuated the unusual frequency of rainfall and significant changes in the number of thunderstorms in Malaysia. Furthermore, Subramaniam, Kwok, and Wan Azli (2011) demonstrated that nearly a period of 30 years (1981–2010), areas such as Alor Star and Kota Bharu have experienced significant changes in terms of rainfall patterns.

The impacts of these changes on the environment is disastrous, and include extreme events such as floods (Abdul Mohit & Sellu, 2013; Tanggang, 2007), coastal erosion (Mohd Ekhwan, 1997; Sulaiman & Zainal Abidin, 2012), drought (Dai, 2013; Prudhomme et al., 2013) and loss of mangrove forests (Dilmaghani, Danehkar, Jozi, & Arjomandi, 2011; Gilman, Ellison, Duke, & Field, 2009).

The impact of climate change on fishermen's socio-economic well-being

As climate change is producing more extreme wind, waves, rain and thunderstorms, it is also increasing risks associated with fishing operations. Small-scale fishermen who are primarily equipped with smaller vessels and basic communication devices (mobile phones) are vulnerable towards such extreme events, wherein the only course of action is to delay or cancel their fishing operation. Frequent occurrences of such extreme events limit their hours and days of fishing; less time to fish means reduced catches and, consequently, less money (Abu Samah et al., 2011; Shaffril et al., 2013).

The occurrence of such extreme events increases fishermen's risks while at the sea. A study by the World Resources Institute (2007) illustrated the significant increases in the number of deaths caused by extreme temperatures and wind. Within the scope of Malaysia, the Asian Tsunami in 2004 illustrated that extreme events can kill fishermen. Furthermore, fishermen have also experienced uncertainties in relation to current weather – patterns of waves, wind and rain can instantly change, which can endanger fishermen while they are out at sea (Abu Samah et al., 2011), and things can worsen during emergency situations as most of the small-scale fishermen are only equipped with mobile phones during their fishing operation (Omar et al., 2012).

Climate change can also affect fishermen's productive (e.g. vessels, nets, engine, geographical positioning system) and non-productive properties (e.g. house, motorcycle). A majority of fishermen in Malaysia settle near to coastal areas, whose most of their houses are built from wood while some of them are built from a combination of wood and concrete. Understandably, the ability of these types of houses to withstand extreme waves and wind is low (Mohd Ekhwan, 1997). Furthermore, fishermen's assets such as jetties, vessels and fishing tools are exposed to the destructive threats of extreme events

In addition to the impacts of climate change on fishermen's productive and non-productive properties, a number of studies have confirmed the impacts of climate change on human health. Climate change has been proven to affect those with heart diseases (Tsai & Liu, 2005), asthma (Munoz-Lopez, 2007; Sheffield, Knowlton, Carr, & Kinney, 2011), skin diseases (Llamas-Velasco & Garcia-Diez, 2010) and allergic (Barnes et al., 2013; Shea, Truckner, Weber, & Peden, 2008). Furthermore, the changing climate has been shown to cause mental stress within the community (Kucera & McDonald, 2010; Salagrama, 2012), while increasing the number of people infected by dengue (Banu, Hu, Guo, Hurst, & Tong, 2014; Campbell-Lendrom & Reithinger, 2002), malaria (Diouf et al., 2012; Tonnang, Kangalawe, & Yanda, 2010), diarrhoea (Chou et al., 2010; Moors, Singh, Siderius, Balakrishnan, & Mishra, 2013) and flu and fever (Abu Samah et al., 2011). In addition, as climate change is affecting the productivity of the fisheries industry (Ottersen, Kim, Huge, Polovina, & Stenseth, 2009), it has been confirmed that this scenario will affect the diets of people in Asia and Africa who rely heavily on marine catches for their protein supply (Allison et al., 2009; Ogutu-Ohwayo, Hecky, Cohen, & Kaufmann, 1997).

Abu Samah et al. (2011) confirmed that the climate change is affecting fishermen's social routine at a moderate level. Some social activities, particularly those related to gathering at *wakaf*[1] or coffee stalls, in the evening are still practiced by fishermen regardless of the weather. Abu Samah et al. (2011) further explained that climate change is one, though not the main, reason why fishermen are not spending their free time with their families, alongside factors such as a lack of time and job commitments. Small-scale fishermen in Malaysia have also expressed concerns about shortages to their marine catches for food resulting from decreasing marine sources (Shaffril et al., 2013).

The need for adaptation in response to climate change

As discussed above, the changing climate has been negatively affecting fishermen in Malaysia, thus they have a dire need to adapt in response to climate change. Adaptation to climate change can be understood as:

Actions taken to help communities and ecosystems cope with actual or expected impacts of climate change Ministry of Natural Resources and Environment Malaysia (2010).

Adaptive capacity relates to the strength to react to challenges through learning, handling risks and impacts, developing new knowledge and formulating effective approaches (International Union for Conservation of Nature and Natural Resources, 2010). For fishermen, having a strong adaptive capacity is vital for several reasons. First, it will assist them to absorb negative climate-change impacts or manipulate opportunities that arise from the changing climate. Second, adaptive capacity can emerge as the main influence on what impacts eventually emerged. Third, adaptive capacity is also the construct of vulnerability most amenable to effect social systems, and this should be closely considered in any adaptation planning. The strength of individuals to cope and adapt can be affected by their characteristics and circumstances, and their ability to take advantage of other opportunities that become available.

Methodology

This is a quantitative study in which a developed questionnaire was employed to collect the required data. The instrument was based on the framework on individuals' adaptive capacity towards climate change developed by IUCN. The instruments included 16 aspects consisting of 90 questions. In addition, a total of 14 demographics questions were included (Table 1). For each of the questions regarding the adaptive capacity, the respondents were given an option of 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The instrument was strengthened via a series of instrument-development meetings, and then pre-tested at Kuala Kemaman village with 30 fishermen. The decision to determine whether or not the instrument is fit for the actual data collection is based on the Cronbach alpha value (CAV). The CAV refers to the measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. The resulting CAV for the study pre-test was .798, which exceeded the value of .700 recommended by Nunnally (1978).

Table 1. Number of questions included in the instrument.

Aspects	Number of questions
Demographics	14
Perception of risk	5
Ability to cope with change (financial and emotional flexibility)	5
Level of interest in adapting to change	6
Ability to plan, learn and reorganize	6
Attachment to occupation	6
Employability	6
Family characteristics	4
Attachment to place	6
Business size and approach	6
Financial status	6
Livelihood diversity	6
Local environmental knowledge	5
Environmental awareness, values and attitudes	6
Access to climate technology, information and expertise	5
Formal and informal networks	6
Perceptions of equity in accessing resources	6
Overall total	104

Based on previous research findings, four specific areas in Malaysia that are vulnerable towards climate change were selected (for the description of research sites, please refer to Table 2). For each area, purposive sampling was employed to select 60 respondents (60 respondents × 4 areas = 240 respondents); only small scale fishermen who are conducting their fishing operation within the range of 0.1–5.0 nautical miles of shore, using smaller vessels (fibre or traditional boats, locally called *Sampan*) and being equipped with basic communication tools (mobile phone), were selected as respondents. There are several reasons why purposive sampling fit as the best sampling technique. First, up to date, there is no formal statistic and lists on the small-scale fishermen in Malaysia (which fit the characteristics highlighted) and second, as there is no inferential statistics performed and only rely on descriptive statistics, it is suit to implement non-probability sampling technique such as purposive sampling.

A total of three months (October 2013 to December 2013) was needed to complete the data-collection process. The data collection took place at fishermen places of interests, such as jetties, coffee stalls and *wakaf*. In order to identify potential respondents, assistance from village leaders, jetty leaders and local fishermen was obtained. On average, each respondent took 20–35 min to complete the survey. The data were then analysed using descriptive analyses such as frequency, percentage, mean score and standard deviation, in order to obtain the general results of the study. In order to rank the mean score (low, moderate, high), the study has calculated the range of possible scores (in this case, 1–5) and divide by the number of categories to be established (in this case three – low, moderate and high). The resulted range which is 4 (5–1) is divided by three, resulting in the class of interval of 1.33. Based on this result, the first class (low) ranges between 1.00 and 2.33, second class (moderate) ranges between 2.34 and 3.67 and the third class (high) ranges between 3.68 and 5.00.

Results and discussion

Table 3 illustrates the demographic data of the respondents studied. All of the respondents were male, and this is in line with studies conducted by Shaffril et al. (2013), Abu Samah et al. (2011), Bolong et al. (2013) and Ramli et al. (2013), who confirmed the domination of males in the fishing

Table 2. Areas of study.

Areas	Vulnerability towards the changing climate
Sabak Village (Kelantan)	Coastal erosion (Sulaiman & Zainal Abidin, 2012) Temperature rise (Kwan et al., 2011; Wai et al., 2005) Sea level rise (Awang & Abdul Hamid, 2013) Unstable northeast monsoon pattern (Suhaila et al., 2010)
Tanjung Kling (Malacca)	Coastal erosion (Sulaiman & Zainal Abidin, 2012; Zubaidi, 2010) Temperature rise (Kwan et al., 2011)
Tanjung Piai Village (Johor) Teluk Tempoyak Village (Pulau Pinang)	Sea level rise (Sulaiman & Zainal Abidin, 2012) Sea level rise (Awang & Abdul Hamid, 2013) Temperature rise (Kwan et al., 2011)

industry in Malaysia. According to Gidarakou (1997), family commitments and the physical demands of the work has resulted in less involvement from females in agriculture-related activities. On average, the age of the respondents was 45.6 years old, which supports studies conducted by Shaffril et al. (2013) and Bolong et al. (2013), who claimed that the fisheries industry has inadequate backup from the younger generation. Omar et al. (2012) also stated that the younger generation have less interest in being fisherman, as they do not want to face the risks and challenges associated with fishing operations. The majority of the respondents possessed a lower level of education, with a small number possessing a tertiary level of education. The probable reason for this is the negative perception of agriculture-related activities as a second-class job, and not a main objective for those with higher education achievements (Man, 2008).

The mean score recorded for income per month from their catch was RM 1023.50 (roughly equivalent to 340 USD). Being a fisherman seems to be the only income generator for the majority of the fishermen and their families. This can be proven based on several data: first, on average, it was found that 75.1% of their income is generated from their fishing operations; second, 90.2% of their catch is sold, while the rest is used for their own protein supply; third, only 32.5% have an alternative job, while not more than one-fifth of them (19.6%) have a wife who works to financially support them. Moreover, only slightly more than one third (34.6%) of fishermen have other household members working to financially support them.

The study also confirmed that most of the respondents have six or more household members. The mean score recorded for experience as a fishermen was 22.5 years; this is in line with studies conducted by Shaffril et al. (2013), Bolong et al. (2013), Ramli et al. (2013) and Omar et al. (2012), who proved that most fishermen in Malaysia are experienced. On average, the fishermen were found to spend almost 21 days per month on conducting their fishing operations; this scenario is not surprising, as in order to fulfil the requirements to be registered fishermen, they have to spend at least 120 days a year on their fishing operations. The majority of fishermen use a fibre boat, while some still rely on traditional boats (*sampan*). The main fishing tool used is nets.

Out of 16 adaptive aspects studied, five recorded a high mean score, namely attachment to occupation; attachment to place; local environmental knowledge; environmental awareness, values and attitudes; and formal and informal networks (Table 4). The high mean score for formal and informal networks depicts a strong social relationship among the fishermen. Shaffril et al. (2013) demonstrated the social-relationship strength of the fishing community with reference to the practice of providing mutual help (referred to by locals as *gotong-royong*), and evening gatherings at *wakaf* and coffee stalls. This strong social relationship profits the community before, during and after the occurrence of natural disasters, as it makes it possible to expedite vital processes such as transferring victims and properties to a safer place, and rebuilding settlement and public-infrastructure facilities. This will in turn save lives and properties during disasters.

The fishermen studied were found to record a high mean score on the aspects of environmental awareness, values and attitudes. Having such score depicts that the small scale fishermen are aware, valuing and possessing a positive attitude towards the environment. This is unsurprising, as most of the fishermen considered were experienced. Shaffril et al. (2013) have accentuated that experience educates fishermen on the importance of being aware of the changing climate and valuing the environment, and make them more informed about what can be done to delay the impacts of climate change. In another view, Marshall (2007) looked at the ability of resource-users who are environmentally educated and aware to act as the main supporters of resource-protection strategies.

Another aspect that recorded a high mean score is local environmental knowledge. Although fishermen possess extensive local environmental knowledge, relying on such knowledge is irrelevant lately due to unpredictable climate condition. Studies carried out by Omar et al. (2013) and Abu Samah et al. (2011) revealed that fishermen's indigenous predictions on weather are most of the time inaccurate as a result of volatile weather patterns. Consequently,

Table 3. Demographic data.

	Frequency	Percentage	Mean	SD
Gender				
Male	240	100.0		
Female	0	0		
Age			45.6	14.0
15–30	43	17.9		
31–45	73	30.5		
46–60	92	38.3		
61 years or above	32	13.3		
Level of education				
Never been to school	14	5.8		
Primary school	95	39.6		
Secondary school (lower level)	62	25.8		
Secondary school (upper level)	64	26.7		
Tertiary level	5	2.1		
Income per month (from fishing) (in Malaysia ringgit)			1023.5	769.0
500 or less	29	12.1		
501–750	64	26.7		
751–1000	89	37.1		
1000 or more	58	24.2		
Having alternative job				
Yes	78	32.5		
No	162	67.5		
Wife is employed				
Yes	47	19.6		
No	193	80.4		
Other household members are employed				
Yes	83	34.6		
No	157	65.4		
Percentage of monthly income from catch (%)			75.1	27.2
<25	11	4.6		
26–50	54	22.5		
51–75	43	17.9		
76–100	132	55.0		
Percentage of catch allocated to be sold			90.2	13.9
<25	9.6			
26–50	2.1			
51–75	2.1			
76–100	94.2			
Number in household				
1–3	66	27.5		
4–5	84	35.0		
6 or more	90	37.5		
Experience as a fisherman (years)			22.5	14.5
1–10	68	28.3		
11–20	63	26.3		
21–30	49	20.4		
31 or more	60	25.0		
Average days spent on fishing operation (days)			20.9	4.7
20 or less	135	56.3		
21–25	73	30.4		
26 or more	32	13.3		
Type of vessel				
Fibre boat	151	62.9		
Traditional boat (*sampan*)	53	22.1		
Big Boat	36	15.0		
Fishing tools				
Nets	161	67.1		
Hooks and lines	59	24.6		
Other	20	8.4		

Table 4. Individual adaptive capacity towards the changing climate among small-scale fishermen.

Aspect	Elaboration on the adaptive aspects	Mean	SD
Perception of risk	Their perception of risks (resulted by the changing climate) that are associated with their fishing operation	3.46	0.73
Ability to cope with change	Their emotional and financial flexibility that enable them to cope with the impacts of the changing climate	3.55	0.70
Level of interest in adapting to change	Their level of interests in new things. Within the scope of this study, it focuses on their interest on new skills (fishery and non-fishery related) and knowledge on the changing climate	3.58	0.75
Ability to plan, learn and reorganize	This aspect demonstrate their strength to anticipate the future. Their ability to plan, learn and reorganize in the face of change is dependent on novelty, creativity, experimentation, learning and planning	3.64	0.77
Attachment to occupation	To assess how flexible resource users might be to an alternative livelihood or no longer being able to operate in their current occupation	4.64	0.54
Employability	Other job opportunities that available at their areas	2.56	1.08
Family characteristics	The ability of the immediate family members to cope with changes emotionally and financially	3.17	0.70
Attachment to place	The possibility of people to move from their township in order to take the advantage of the opportunities available elsewhere	4.80	0.41
Business size and approach	The level of small scale fishermen flexibility their resource use	3.09	0.68
Financial status	Their financial strength that are needed to cope with the change and to experiment with various options for the future	3.22	0.69
Livelihood diversity	The ability of the small scale fishermen to generating income from non-fishery-related activity and the climate sensitive resource	3.17	0.61
Local environmental knowledge	Their level of local environmental knowledge which includes the indigenous knowledge	3.91	0.78
Environmental awareness, values and attitudes	The level of support for conservation initiatives and changes of their fishing practices that can minimize the harms to the environment	4.21	0.60
Access to climate technology, information and expertise	To assess their accessibility and use of climate information	3.13	0.57
Formal and informal networks	The possibility of the small scale fishermen to move to other places in order to make the most of opportunities elsewhere	4.46	0.49
Perceptions of equity in accessing resources	To gauge level of satisfaction with perceived equity	3.38	0.64

fishermen expressed that instant changes in weather condition endanger them while they are at the sea. Furthermore, it is common practice for the fishermen to invest substantially in developing local environmental knowledge, and this can assist them in identifying subtle changes in resource conditions over time. Nevertheless, this investment denotes that fishermen will exhibit less interest to move and develop it again elsewhere (Cinner, 2005).

Despite the high mean score recorded in relation to attachment to place, the fishermen actually exhibited a weak adaptive capacity in this regard. This strong attachment can be caused by several factors, such as an identity shaped around the locality, a sense of belonging to specific areas, and the strong social relationships and networks that exist within it, or connections to ancestors (Gustafson, 2001; Stedman, 1999). A strong attachment to place can result in a number of problems, such as difficulties in persuading fishermen to move to a safer place, and conflicts arising among fishermen with respect to whether to leave their settlement when there is a need to do so (Shaffril et al., 2013).

The fishermen were also detected to record a high mean score on the aspect of attachment to occupation and this demonstrated a strong attachment of the fishermen to their fishing activities. Within the scope of this study, such strong attachment can be supported by four demographic facts – first, only 32.5% of respondents have an alternative job; second, 75.1% of their income comes from their fishing operation; third, 90.2% of their catch is solely for sale; and fourth, their average experience as fishermen is 22.5 years, which reveals their long involvement in fishing activities. A strong attachment to occupation entails difficulties for fishermen to become involved in other income-generating activities, and this can negatively impinge their financial aspects if bad weather in the future limits marine resources and days available for them to be at sea (Gonzalez & Benito, 2001).

Out of 11 aspects that recorded a moderate mean score, the score recorded in relation to employability was the lowest, which reveals that the fishermen had the weakest adaptive capacity in relation to this aspect. This should cause concern, as a lack in this respect will result in economic difficulties for the fishermen. A number of reasons can be associated with this scenario. First, most of the fishermen studied have a strong attachment to their daily routine as fishermen, and being involved in other areas of

income-generating activities may result in negative attitudes among them (Gonzalez & Benito, 2001). Second, as most of the fishermen have a strong attachment to place, most of them expressed reluctance to take opportunities available at other places (Gustafson, 2001; Shaffril et al., 2013; Stedman, 1999). Third, the demographic results of the study show that most of the fishermen are 'veterans' with a low level of education achievement, which may lead to difficulties for them in seeking new jobs (Shaffril et al., 2013). Fourth, Reed (1999) concluded that community living, and working in resource-independent environments, often result in limited experience in other occupations, which may result in less interest among fishermen to take advantage of other employment activities.

Conclusion and recommendation

The climate change is foreseen to become more severe in the future. Among its victims are fishermen, who rely heavily on weather stability for the sustainability of their livelihood. At this stage, fishermen are facing great challenges at both social and economic levels from the climate change, and therefore a number of actions can be strategized at the individual level to minimize the impact and to manipulate advantages that emerge from the changes. It can be concluded that out of 16 aspects studied, small-scale fishermen in Malaysia only have an acceptable level of strength in two adaptation aspects – formal and informal networks, and environmental awareness, values and attitudes. This result reflects the possibility that more effort needs to be placed by concerned parties on assisting the fishermen to face the persisting impacts of the climate change. All of the 16 aspects recorded a varied level of strength, and each of the aspects has the potential to be strengthened further. A number of recommendations with regard to alternative skills, managed retreat, accommodation and protection, information management, periodical assessment and access to credit have been highlighted.

Enable fishermen to learn alternative skills

The provision of alternatives skills-training would enable fishermen to strengthen their adaptive aspects in relation to employability, financial status, livelihood diversity and family characteristics. Although fishermen are seen as being strongly attached to their jobs, they have also been found to be interested in learning new things (Shaffril et al., 2013). It is important to provide, as far as possible, training in alternative skills that are non-environment related, as other agriculture activities (farming and aquaculture activities) and several tourism activities are also impinged by the negative effects of the climate change.

Entrepreneurship and vocational income-generating activities are seen as potential alternative money-making activities for the fishermen. Becoming involved in entrepreneurship is seen as a wise step among fishermen, and, within the Malaysian context, new entrepreneurs are assisted by a number of agencies such as SME CORPS and Majlis Amanah Rakyat (MARA), particularly in relation to capital, technical and economic advice, and infrastructure facilities (e.g. stalls). Vocational skill is another potential alternative for fishermen – as most of the fishermen in Malaysia possess mobile phone (Omar et al., 2013; Ramli et al., 2013), and being experts on the technical aspects of mobile communication may offer great advantages to them. Typically, starting the above activities is obstructed by financial, knowledge and skills limitations; however, local agencies such as SME CORPS and MARA are currently offering financial assistance and skills courses to the interested fishermen. Assistances from these agencies are expected to expedite their learning process.

Furthermore, it is also important to provide alternative livelihood for the fishermen family members as it can be seen that almost 80% of their spouse are full time housewife while only 34.6% of their household members are working to financially support them. To integrate the fishermen family members' role in development by maximizing their economic potential through gainful employment is seen as critical determinant for improving the adaptive capacity of small scale fishing communities. Similar to the fishermen, it is recommended the male and female household members to be provided opportunities to engage with alternative job-related activities to entrepreneurship, vocational and non-environment related. Additionally, Malaysia Fishery Development Authority (LKIM) can intensify the role of Fishermen Wives Group (KUNITA) by allocating more financial allocation – having this, will enable them to conduct more activities that financially benefit the housewife and their family. Within the current context, KUNITA assists the housewife group to venture into small-scale businesses particularly based on marine and non-marine products such as fish balls and fishcakes, fish crackers, yellow noodle, tofu, traditional cakes, bean sprout and tailoring. Understandably, all these activities had been proven to enhance the socio-economic status of the fishermen family (Hafiza, Salfarina, Intan Hashimah, & Juliana, 2010; Salfarina, Hafiza, Intan Hashimah, & Juliana, 2014).

As their attachment to place is high which make adaptation strategy for resettlement might be difficult, such strong attachment would be a good motivating factor for them to learn other alternatives skills and knowledge such as shifting from the old ways of fishing to the modern one and diversifying their fishing techniques and gears. Eventually, having all these will help fishermen to stay in the vulnerable areas without a need for them to be transferred. To encourage fishermen to use modern technologies is expected to post less problem as Osman, Omar,

Bolong, D'Silva, and Shaffril (2014) study has confirmed a high level of fishermen readiness to use modern technologies such as GPS in their fishing routines as long as they are provided with financial assistance from the authority. Realistically, fishermen can be encouraged to diversify their fishing tools and techniques as Shaffril et al. (2013) has confirmed on their willingness to learn new things. To diversify fishing techniques and gears benefits the fishermen in various ways such as increasing their landing, double their income and lessen the risks associated with their fishing routine. Consequently, all of these according to Badjeck et al. (2010) can contribute success to fishermen adaptation efforts.

Managed retreat, accommodation and protection

This study confirmed on the vulnerability of the small scale fishermen to future climate change impacts such as sea level rise, strong wind and waves, unstable rain and monsoon patterns and sea level rise and this is worsened by the facts that they are strongly attached to their place as a weakness. In line with such findings, this study suggest to construct planned adaptation strategies such as managed retreat, accommodation and protection including structural and non-structural options will enhance their adaptive capacity. These strategies can be addressed through review and amendment of existing land use and coastal development plans, building codes and standards. Doubtless, having this can enhance the community adaptive capacity as their surroundings are built and planned to withstand the impacts of climate change. Understandably, to have this, constructing the areas development plan will require integrative works among the municipals, community leaders and more importantly, the community themselves.

Systematic information management

As adaptive aspects such as perception of risk, interest in adapting to change, the ability to plan, learn and organize, and access to climate technology, information and expertise is at a moderate level, systematic information management is needed to further strengthen fishermen's adaptive capacity.

Fishermen have the right to be informed on the causes and impacts of the changing climate, and several efforts can be made in this regard. First, courses or seminars can be provided, whereby the main content should focus on the proactive actions (before the occurrence of the natural disaster) and reactive actions (during the natural disaster) that can be practiced by the fishermen. Second, experience and knowledge on reacting to climate-related disasters should be shared between concerned parties and fishermen. To date, agencies such as Malaysia Civil Defense Department, Mercy Malaysia and AMAN Malaysia have high levels of knowledge and experience of facing climatic threats locally and internationally, and this should be shared and disseminated among fishermen. Third, Nursey-Bray (2011) demonstrated the need for universities to educate communities on the impacts and causes of the climate change; university members such as researchers can share their research findings with the community, while students from environment-related departments can inform and educate fishermen on the impacts and causes of the climate change through formal and informal events. Within the scope of Malaysia, universities such as Universiti Malaysia Pahang (Pekan Branch), Universiti Malaysia Terengganu, Universiti Sultan Zainal Abidin, Universiti Teknologi Mara (Dungun Branch) and several other universities can perform this role, as they are located near to coastal areas.

Moreover, as fishermen's reliance on weather stability is high, providing them with accurate weather information via sources such as television, radio and newspapers is seen as a positive step. The provision of such information sources among fishermen is vital, as these sources are considered more reliable and 'friendly' compared to advanced sources such as the internet (Omar et al., 2013). Moreover, information providers must be sensitive to the information needs of fishermen, as according to Omar et al. (2013) fishermen require more weather information during the northeast monsoon season, as the weather during this period is very dangerous and unpredictable, leading to increased risk.

In addition to this, it would be useful to promote the setting up community-based early warning systems that would complement existing government flood and disaster risk reduction mechanisms while at the same time empowering coastal communities for their own safety and well-being. Such strategy has been proven to be a success in several Southeast Asian countries such as Thailand, Philippines, Vietnam and Indonesia (International Federation of Red Cross and Red Crescent Societies, 2012; Thomalla, Mutusela, Naruchaikusol, Larsen, & Tepa, 2009) and such system has a great potential to be implemented at the Malaysian coastal areas. In general all of these community-based early systems are benefiting the community in four aspects namely, enhancing knowledge of the risks; enable to monitor, analyse and forecast the hazards; communicating or disseminating the alerts and warnings and strengthen the communities' capacities to respond to the warnings received.

Periodical assessment

This study suggests on the periodical assessment of fishermen readiness to diversify their technology skills and knowledge. As their attachment to place and attachment to occupation is high, it can be seen that any adaptation strategy of re-settlement might be difficult and rather than focusing on any re-settlement effort it is suggested that a more practical approach would be to allow this community to reside in their current location. However, there is a

pressing need to ensure that they are given additional technology skills and knowledge. This in turn will ensure that they will be able to sustain living in their current location and to withstand all the negative impacts resulted from the climate change.

Continuous assessment of the fishermen's readiness to transform their fisheries skills and knowledge is vital (Shaffril et al., 2013). Periodically assessment on this will help to overcome several problems: first, it will assist the relevant agencies in understanding the readiness of the community to diversify their fisheries skills and knowledge (e.g. using new technology, shifting fishing methods and gears). Such assessments can be conducted via several related instruments such as by Osman et al. (2014) which measure fishermen readiness to use GPS and other established instruments by agencies such as IUCN and Intergovernmental Panel on Climate Change. Second, these assessments will enable more participatory research to be conducted in relation to climate change. Malaysia is in dire need of climate-change-related research, as proven by Zakri (2011), who claimed that over a six-year period (2006–2011) only 303 indexed journals were produced by the Malaysian researchers.

Access to credit

Natural disasters can badly affect communities, particularly those who are financially weak; hence, one of the effective channels to overcome such problems is by offering financial relief to the affected communities. This is important, as communities' ability to cope with change (financial and emotional flexibility), financial status, and livelihood-diversity aspects only recorded a moderate mean score in the present study. Furthermore, in order to further strengthen fishermen's adaptive aspects with respect to business size and approach, and perceptions of equity in accessing resources, the provision of financial relief could transform interested fishermen from small-scale, subsistence fishermen to commercial fishermen. Commercial fishermen need bigger vessels and more advanced fisheries tools, and accessing these can only be made possible by providing substantial financial assistance from the relevant parties. Within the Malaysia scope, agencies such as Agro Bank, Fisheries Development Authority of Malaysia, Amanah Ikhtiar Malaysia and the National Association of Fishermen are ready to offer fishermen loans with zero or minimal interest. However, it is important to ensure minimal bureaucracy, as a failure to do this will lead to less interest among fishermen to apply for such loans (Ahmad Faiz, Khairuddin, Jegak, Hayrol Azril, & Jeffrey, 2010).

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Note

1. Small shelter, usually constructed near to coastal villages or fishermen jetty.

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