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The adaptation towards climate change impacts among islanders in Malaysia

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HIGHLIGHTS

- The study focuses on adaptation aspects namely awareness, dependency and structure.
- Islanders were found to be highly aware of the rising temperature.
- Some concerns on their restricted ability to diversify income generating activities.
- The agencies supported the islanders by generating job opportunities.

GRAPHICAL ABSTRACT

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ABSTRACT

The climate change phenomenon has been occurring in every part of the world, including Malaysia. In particular, changes such as rising temperature, sea level rise, and unstable rain pattern are proven to affect the socio-economic routine of the community. Hence, it is necessary to learn how to adapt to it, especially those who heavily rely on nature stability. The present study examined the adaptation towards climate change among islanders in Malaysia. In addition, the current research was performed quantitatively using a developed questionnaire as the main data collection tool. In this case, a total of 400 islanders were selected as the respondents through a multi-stage sampling technique. The results revealed that the respondents recorded a moderate to high mean score for adaptation aspects namely awareness, dependency and structure. Accordingly, a number of recommendations that were highlighted can be utilized as a basis to develop community adaptation policy that is in line with the islanders' need, ability, and interests.

1. Introduction

The earth climate is worsening and climate changes have been taking place on such a massive scale. The increasing amount of carbon dioxide and other heat-trapping gases in the atmosphere have warmed the Earth, thus resulting in severe events such as rising sea level, melting snow and ice, higher occurrence of extreme heat events, fires, and drought as well as increasing number of extreme storms, unstable rainfall, and floods. Regarding this issue, a considerable amount of research forecasted that there would be constant changes of the climate which would pose severe effects on the forests, agriculture, freshwater supplies, coastlines, and other natural resources that are vital to the socio-economic routines of human beings.

In a report by Intergovernmental Panel on Climate Change (IPCC) (2018), the earth is getting warmer and global warming is likely to reach 1.5 °C between 2030 and 2052 if it continues to

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increase at the current rate. In a more specific finding stated by IPCC in their 2014 report, half of Asia's population including the islanders are living in low lying coastal zones and flood plains which are at risks of climate change impacts (Hijioka et al., 2014). Within the context of South East Asia (SEA) countries (including Malaysia), the temperature has risen at the rate of 0.14 °C to 0.20 °C per decade since the 1960s which consequently led to a rising number of hot days and warm nights, and a decline in cooler weather while the pattern of southwest monsoon season has changed and it decreases the total rainfall and the frequency of wet days and comparatively, during the northeast monsoon, total rainfall, the frequency of extreme rainfall events, and rainfall intensity have increased at the Peninsular Malaysia (Hijioka et al., 2014). Furthermore, the same report by IPCC also predicted future increases in precipitation extremes related to the monsoon are very likely in the SEA region. What has been reported by IPCC has been in line with several local studies who looked into several climate change effects on the environment such as rising temperature (Tang, 2019; Kwan et al., 2013), sea level rise (Jeofry and Rozainah, 2013; Md. Din et al., 2019; Abdul Hamid et al., 2018), extreme waves (Muzathik et al., 2010) and unstable monsoon pattern (Suhaila et al., 2010; Loo et al., 2015).

According to United Nations Framework Convention on Climate Change (2013), island areas are extremely vulnerable to climate change because it is highly influenced by the large ocean-atmosphere interactions which include trade winds, El Niño, and the monsoons. Apart from that, tropical cyclones and hurricanes are also important components of the climate considering that they could lead to sea-level rise. Understandably, these impacts pose formidable challenges to the islanders who tend to heavily rely on nature stability in conducting their socio-economic routines.

Accordingly, adaptation towards climate change is seen as an effective effort in response to these impacts based on its definition by the National Policy on Climate Change which is described as follows:

"Actions taken to help communities and ecosystems cope with actual or expected impacts of climate change".

More importantly, it should be understood that all community groups are not focused on similar adaptation strategies. Accordingly, a diverse and stronger adaptation strategy is expected to be practised by those who are dependent on environmental stability. For example, the highland farmers are more focused on landslide risks, which encourages them to adapt to the warming temperature (Sahharon et al., 2017). Meanwhile, Shaffril et al. (2017) stated that small-scale fishermen have to pay more attention to extreme winds and waves due to the need to reduce the risks associated with their fishing routine and at the same time embraces new technologies that can possibly double their catches. Consequently, this diversity eventually turns community adaptation into a distinctive aspect that is geared towards the need to conduct future works with the aim of producing a specific understanding of the adaptation towards climate change among multi-community groups.

Nevertheless, it is crucial to note that a number of studies have been conducted in the attempt to understand the adaptation ability towards climate change among specific community groups but not specifically on the islander such as by Sahharon et al. (2017) and Hamdan et al. (2014) on highland farmers, smallholders (Bedeke et al., 2019; Jellason et al., 2019), farmers (Davey et al., 2019; Chuang, 2019), urban community (Owusu et al., 2019) and mountain community (Yohannes et al., 2019). Meanwhile, local studies on islanders (e.g. Abdul Ghani et al., 2013; Nor Hizami et al., 2019; Ghani et al., 2016) have also been performed but they are more tourism-related in nature. This lacking of studies have led to the study's research questions related to the islanders' adaptation namely

1 – Are the islanders' aware on the occurring climate change as well as its impacts on the environment and their socio-economic routines?
2 – What are islanders' readiness to adapt to their economic orientation status in response to climate change?
3 – What are the existing and future supports provided by local institutions in assisting the adaptation process of the islanders?
4 – Is there any significant difference that might occur between the four islands studied with regard to their climate change adaptation

2. Review of literature

In their study, Shaffril et al. (2017) observed the adaptation strategies adopted by one of the important islander's groups – the small-scale fishermen. Their systematic review that was performed based on a total of 42 articles related to climate change managed to conclude that the challenges caused by climate change tend to affect their productivity, physical infrastructure, health, and social lives. Furthermore, the same study accentuated six adaptation strategies that are capable of strengthening the adaptation of small-scale fishermen. First, the insurance policies for fishermen need to be improved in order to reduce the risks associated with their fishing operation. Second, their social relationship needs to be strengthened because it is crucial during pre and post-disaster, followed by the need to manage climate change knowledge through knowledge and information sharing, pre and post-disaster courses as well as efforts from local universities to share their related research findings. Subsequently, Shaffril et al. (2017) explained the importance of alternative skills that are related to entrepreneurship and vocational as one of the methods to empower and rebuild communities following climate change impacts. The fifth strategy is to ensure that the community is involved in adaptation planning because it can assure that the plans are in line with the community's interest, need, and ability. Finally, efforts to enhance fishermen's access to credit were also discussed.

Other than that, Shaffril et al. (2015) conducted a study on the awareness of coastal community towards climate change. The quantitative study utilized the questionnaire as the main data collection tool which was distributed to a total of 210 respondents from three coastal areas in Peninsular Malaysia, namely Kedah, Johor, and Terengganu. The findings of their study claimed the importance of examining the awareness of the coastal community considering that climate change risks can be assessed based on human perceptions. This further demonstrates the role of social structures or conditions in determining the exposure of a system towards climate change. In this case, the coastal community is revealed to be highly aware of the rising temperature, coastal erosion, and condition at the sea (waves and winds). According to Shaffril et al. (2015), their awareness is influenced by factors of states as well as their profession.

In a study by Di Falco and Sharma-Khushal (2019), focus on the awareness drivers and effects of information on climate change adaptive behaviour in Fiji Island. In general, the study concluded that in order to strengthen community's adaptation towards climate change, it is important to consider the awareness antecedents of behaviour. Specifically, factors such as attitudes, subjective norms, and perceived behavioural control were found to significantly relate to the adaptation related behaviour. The influence of information on community's adaptation is crucial and the study also recommended holistic microloans approach can overcome negative environmental attitudes, intensify commu-

nity perceptions and able to inform of the risks and benefits of conservation and climate change adaptation behaviour.

In their study, Barrowman and Kumar (2018), conducted a climate change related study on Timor-Leste, one of the Small Island Developing States (SIDS). In their study, Barrowman and Kumar (2018) demonstrate the important of structure in any of community's adaptation related program and emphasize on the importance of any program to be suited with community's need, ability and interest. The study tried to identify the conceptual trends underpinning 32 donor-led adaptation programmes and the resulted findings reflect that donor-led adaptation programmes continue to conceptualise climate change vulnerability as an environmental related issue and not as a dynamic interactions between political, institutional, economic and social structures which eventually will limit the adaptation ability.

3. Present study

The current study offers its own uniqueness which makes it different from other existing studies that generally focused adaptation related to farmers, smallholders, highland farmers, urban community, tourism related and mountain people. (e.g. Bedeke et al., 2019; Jellason et al., 2019; Chuang, 2019; Owusu et al., 2019; Yohannes et al., 2019; Sahharon et al., 2017; Hamdan et al., 2014; Abdul Ghani et al., 2013; Nor Hizami et al., 2019; Ghani et al., 2016). This situation has resulted in scarce knowledge on adaptation towards the climate change of other specific groups such as the islanders The present study aims to understand the adaptation to climate change among islanders in Malaysia by focusing on a total of 400 islanders from four island areas, namely Langkawi, Tuba, Redang, and Tioman that are confirmed to be affected by climate change.

The current research focuses on the following three community adaptation aspects towards climate change namely (1) awareness which refers to their awareness on the occurring climate change as well as its impacts on the environment and their socio-economic routines, (2) dependency related to the islanders' readiness to adapt to their economic orientation status in response to climate change, and (3) structure that represents existing and future supports provided by local institutions in assisting the islanders. Accordingly, these three adaptation aspects are included in the present study based on the fact that they are three important elements that need to be measured in community adaptation (Di Falco and Sharma-Khushal (2019); Barrowman and Kumar, 2018; Shaffril et al., 2015, 2017; Marshall et al., 2010; IPCC, 2007).

4. Methodology

4.1. Participants

This subsection summarizes the background characteristics of the respondents in the present study. The demographic data showed that slightly half of the respondents are male (50.5%), while the remaining 49.5% are female. Other than that, the mean for their age is 41.12 years old whereby most of them are categorised in the age range of 26 to 50 years old. In addition, more than one-third of the respondents are upper secondary school certificate holders, while only 14.5% of them received education at the tertiary level. Meanwhile, a huge majority of the respondents are married (71.0%). In the aspect of their occupation, 23.5% of the respondents are involved in entrepreneurship, 17.3% of working in tourism-related activities, and another 12.3% are fishermen. Regarding their income aspect, the mean score for average income per month is RM1268.13 whereby 47.8% of the respondents are categorised in the income group between RM751 to RM1, 500. However, only 64 of the respondents have a part-time job that generates an additional income of RM648.91. On a more important note, most of the respondents (40.0%) have four to five household members, while another 28.5% of them have six or more household members. Finally, most of the respondents can be considered as senior villagers based on the mean score of 33.33 years for the duration of staying in the area.

4.2. Procedures

In the case of the present study, four islands, namely Langkawi, Tuba, Redang, and Tioman were selected considering that these areas have been scientifically confirmed to be affected by the climate change elements.. In Redang (situated in Kuala Terengganu district) is detected to experience 62.01 more warmer nights and 51.92% warmer days (Kwan et al., 2013) while Suhaila et al. (2010) claimed that the east coast region of Peninsular Malaysia (where Redang is situated) is experiencing unstable monsoon season. In Mersing (where Tioman is situated), Kwan et al. (2013) confirmed 45.85% warm night changes and 45.30% day night changes while Muzathik et al. (2010) recorded and predicted more extreme waves at the South China Sea region (where Redang and Tioman situated) whereby the total wave energy over an average year was 17.69 MWh/m and the average monthly wave power ranged from 0.15 to 6.49 kW/m. Jeofry and Rozainah (2013) in their study regarding sea level rise, have detected 0.24 cm/year of sea level rise in Tioman and predicted situation to be worsening in 2100 (22.26 cm/year). In Langkawi and Tuba, Jeofry and Rozainah (2013) have recorded sea level rise of 0.18 cm per year while in 2019, the Malaysian Meteorology Department have reported Langkawi to be in the alert level with the temperature reaching between 35 °C and 37 °C (The Sun, 2019) (Table 1).

In addition, a multi-stage cluster sampling was performed for the current research. The first stage of the sampling involved the selection of a village that represents the island and the selected villages in this study include Pulau Tuba Village (represents Tuba Island), Tekek Village (Tioman Island), Redang Baru Village (Redang Island), and Penarak Village (Langkawi Island). Subsequently, a total of 100 islanders from each village were selected as the respondents at the second stage of the sampling. However, it should be noted that the village leaders or the area administrator were first contacted by the research team prior to the actual data collection. The purpose of conducting this procedure was to seek their permission to perform the data collection process at their places.. The main criteria for selecting the respondents is they must be permanent residents of the village and their age must be at least 18 years and above. To ensure that all the respondents fulfil the requirement, screening process was done during the selection process by the researchers, enumerators and assisted by village leaders or areas administrators. If the selected respondents refused to be surveyed, the team will opt for another potential respondent. The data collection process took place at the places of interests

Table 1
Detected climate change elements.

Area	Detected climate change elements
Langkawi	Sea level rise (Jeofry and Rozainah, 2013) Temperature rise (Malaysian Metereology Department, 2019).
Tuba	Sea level rise (Jeofry and Rozainah, 2013) Temperature rise (Malaysian Metereology Department, 2019).
Redang	Warmer days and nights (Kwan et al., 2013), unstable monsoon pattern (Suhaila et al., 2010) Extreme waves (Muzathik et al., 2010)
Tioman	Warmer days and nights (Kwan et al., 2013), Sea level rise (Jeofry and Rozainah, 2013) Extreme waves (Muzathik et al., 2010)

of the respondents such as *wakaf*, coffee stall, public hall, and their home, which was assisted by trained and experienced enumerators. In particular, the main data collection technique adopted in the present study was the survey and the enumerators took between 20 and 25 min to read the questions in Malay to the respondents and then provide them with the response options.

4.3. Measures

The questionnaire consisted of a total of 40 questions included in the questionnaire and further divided into four sub-sections, namely demographic, awareness, dependency, and structure.

In the case of the present study, the statements were developed based on the operational definition of each variable; however, statements from existing studies that indirectly fit the operational definition of each variable and were in line with the objectives of the current research were also considered where applicable. Apart from that, it should be noted that several workshops on instrument development were held among the team members to further strengthen the wording of the statements. Next, the instrument was presented to two community development experts for the process of validation. The experts then provided several comments, particularly in terms of the wording of the statements, measurement scale, and wording of the statements. Accordingly, three statements in the dependency section were excluded from the questionnaire based on their comments. Most importantly, to examine the instrument's reliability, a pilot study was conducted among 30 islanders at Pangkor Island and the resulted Cronbach alpha value was between 0.763 and 0.852.

4.3.1. Awareness

Awareness was measured based on 7 statements related to their awareness of the occurring climate change as well as its impacts on the environment and their socio-economic routines. In this case, the example of the statements included in the questionnaire are '*The temperature in your area is getting hotter*' and '*The weather on the island is unpredictable*'. The measurement scale utilized in the questionnaire was in the range of strongly disagree (1) to strongly agree (5), while the Cronbach alpha value for this section was 0.838.

4.3.2. Dependency

This section was measured using six statements related to the islanders' readiness to adapt to their economic orientation status in response to climate change. Example statements included in the questionnaire are 'I like to learn new skills - not related to fisheries/tourism (e.g. entrepreneurship, vocational)' and 'I can diverse my income-generating activities'. Similar to the previous section, the measurement scale used was ranging from strongly disagree (1) to strongly agree (5). In addition, the resulted Cronbach alpha value for this section was 0.763.

4.3.3. Structure

Structure was measured using nine statements related to existing and future supports provided by local institutions in assisting the adaptation process of the islanders. The example of the statements included in the questionnaire are 'Usually, the decisions made by the government agencies are in line with the needs and interests of islanders' and 'The government agencies in this area disseminate weather information to the islanders'. Furthermore, the measurement scale employed in the questionnaire was in the range of strongly disagree (1) to strongly agree (5). Other than that, the Cronbach alpha value for this section was 0.838.

4.3.4. Demographics

This section covered the background information of the respondents. A total of 14 statements included in this section covering several aspects which include their age, gender, income, educational achievement, number of households, and occupation.

4.4. Data analytic strategy

The collected data for the present study were analysed using SPSS. In the case of the current research, descriptive statistics such as frequency, percentage, mean score, standard deviation and inferential analysis namely ANOVA were carried out considering that the main objective of this study was to examine the adaptation of the islanders to climate change impacts. Moreover, it is crucial to note that the researchers categorised the resulted mean score of each of the adaptation aspect based on the range of score calculation, whereby,

$$\frac{\text{The maximum mean score } (5.0) - \text{the minimum mean score } (1.0)}{\text{The intended number of categories } (3)}$$

Accordingly, such calculation resulted in the score range of 1.33 for each category whereby the low category was based on the mean score of 1.00 to 2.33, the moderate category had a mean score of 2.34 to 3.67, and the high category had a mean score ranging from 3.68 to 5.00.

5. Results

Based on the performed analysis, a total of four statements in the awareness aspect recorded a high level of agreement (mean score between 3.68 and 5.00), while another three statements obtained a moderate level of agreement (mean score between 2.34 and 3.67). In this case, the respondents were found to be highly aware of the rising temperature and most of them agreed that their area is getting hotter. In addition, the respondents also expressed their agreement on the unpredictability of the current weather by stating that it is difficult to 'read' the patterns of the weather nowadays. Other than that, the respondents confirmed the uncertainty of the rainy seasons at their place based on their disagreement to the statement of 'the rain falls frequently in this area' which recorded the lowest mean score (M = 2.63). Moreover, the respondents also expressed their agreement to reduce marine resources in their area (Table 2).

In this section, only one statement within the scope of dependency managed to record a high mean score, while another six statements recorded only a moderate level mean score. In this case, the islanders are observed to be strong in this aspect because they tend to encourage their wife or son to work as one of the methods that can help them to increase their household income. Nevertheless, there are some concerns considering their restricted ability to diversify their income generating activities because the statement only managed to obtain a moderate mean score. Furthermore, the findings revealed that not all respondents are capable of seeking other jobs due to their limited academic qualification based on

Table 2:
Statements measuring awareness aspect.

Statements	Mean score
The temperature in your area is getting hotter	**4.34**
The weather in the island is unpredictable	**4.28**
There are not much rainfall in this area	**2.63**
The rainy season is uncertain	**4.15**
The changing climate reduces the marine sources in this area	**3.98**
The changing climate cause coral reefs to extinct in this area	**2.97**
The coastal erosion is getting worse in this area	**3.31**

Table 3:
Statements measuring dependency aspect.

Statements	Mean score
I like to learn new skills	**3.29**
I like to learn new skills - not related to what I'm doing now	**3.48**
I can get another job (other than my current job) that suit with my education level	**2.93**
I can diverse my income generating activities	**3.06**
I don't have problems to learn new technologies	**3.58**
I encourage my wife/son to work as it can help me to increase our household income	**3.73**

Table 4
Statements measuring structure aspect.

Statements	Mean Score
The government agencies in this area disseminate weather information to the islanders.	**2.96**
The government agencies advice the islanders regarding the adverse impacts of climate change on this area.	**2.96**
There are many other job opportunities (related to fishery activities) offered by related agencies	**3.23**
There are many other job opportunities (not related to fishery activities) offered by the related agencies	**3.49**
In the event of natural disasters, the reliefs will be distributed equally to the islanders	**3.28**
Government agencies offer loans for islanders to repair infrastructures damaged by the bad weathers	**2.85**
In this area there are many associations that can assist the islanders to diversify their economic resources	**2.95**
The community development plan related to islanders' preparation towards climate change has been done by government agencies.	**3.20**
Usually, the decisions made by the government agencies are in line with the needs and interests of islanders.	**3.27**

Table 5
Comparison analysis between four islands studied.

	Mean score	F	p
Structure		0.272	0.846
Langkawi	3.06		
Tuba	3.11		
Tioman	3.15		
Redang	3.10		
Awareness		1.917	0.126
Langkawi	3.58		
Tuba	3.50		
Tioman	3.42		
Redang	3.41		
Dependency		4.751	0.003
Langkawi	3.28		
Tuba	3.45		
Tioman	3.58		
Redang	3.13		

the lowest mean score shown by the statement related to this issue (Table 3).

All of the statements in terms of agencies support recorded a moderate level of mean score. In this case, the respondents were seen to be best supported by the agencies in terms of the generation of job opportunities (not related to fishery activities), equal distribution of natural disaster relief, and the ability of the government to produce decisions that are in line with the needs and interests of the islanders. Nevertheless, some improvements are still deemed necessary, especially related to the loans offered to the islanders in repairing the infrastructures that were damaged due to the bad weathers (Table 4).

Further analysis was performed using ANOVA and it aims to identify any significant difference that might occur between the four islands studied with regard to their climate change adaptation. In term of their awareness, based on F = 1.917, p = .126, there is no significance difference detected between the four islands studied and this is similar with regard to their structure based on F = 0.272, p = .846. Nevertheless, in terms of their dependency, there is a significance difference identified based on F = 4.751, p 0.003 and further analysis using Post Hoc Test confirmed the significant difference is detected between Redang with Tioman and Tuba (Table 5).

6. Discussion

Regarding this matter, it is important to note that the need for the adaptation among islanders is mounting considering the worsening climate change. Within the scope of this study, the adaptation of the islanders to climate change was measured based on three aspects, namely awareness, dependency, and structure.

The study's findings have provided answers to the first research question – Are the islanders' aware of the occurring climate change as well as its impacts on the environment and their socio-economic routines? Most of the islanders were aware of the occurring climate change. They further mentioned that the most obvious changes are the rising temperature. In their study, Kwan et al. (2013) managed to record an increase between 45.85% to 62.01% for a number of the hotter night for areas such as Langkawi (Pulau Langkawi and Pulau Tuba), Mersing (Pulau Tioman), and Kuala Terengganu (Pulau Redang). Another issue that caught the attention of the islanders was the difficulties to predict the weather because the patterns of the climate have significantly changed. In this case, it should be noted that indigenous weather predicting technique (e.g. observing the cloud patterns) is no longer relevant these days. Apart from that, uncertain rainy season is another obvious change that needs to be faced by the islanders based on the lowest mean score recorded by the statement of 'There is not much rainfall in this area'. The finding is in line with the studies conducted by Wan Azli (2010) and Subramaniam et al. (2011) who managed to confirm the inconsistencies of the rainy seasons in Peninsular Malaysia. It is important to understand that the islanders of some groups are concerned about the drying season at their places. Specifically, a hotter day and drying season will pose adverse effects on the health of fishermen despite the fact that they are able to carry out their fishing operation smoothly without having to worry about rain. Therefore, it is good for the islanders to have moderate to high awareness level because it helps them to constantly be prepared in order to strengthen their readiness against the worsening climate change.

With regard to second research question related to islanders' readiness to adapt to their economic orientation status in response to climate change, it can be seen that reliance on the husband/father as a sole income generator is too risky for an islander family because it will be very difficult if their husband or father is no longer able to work. In response to this matter, the islanders who realized the risks of losing their income have put more efforts into expanding the number of income generators in their family. In particular, they will encourage their family members (wife, son, and daughter) to get a job. According to Shaffril et al. (2017), a higher number of income generators in a family can potentially strengthen their adaptation because a bigger household income is able to expedite the recovery process if any of their assets are hit by natural disaster. Nevertheless, it is important to note that the ability of the islanders can be weakened by two elements described as follows: (1) ability to get another job (other than their current job) that is suitable with their education level, and (2) ability to diversify their income generating activities. Nevertheless, their

willingness to embrace new technologies and learn new skills will be able to absorb these weaknesses. On a more important note, mastering new technology is an added advantage for any group. For example, the chances of fishermen to get more catches can be increased by learning to utilize advanced fisheries technologies such as GPS and echo sounder, while housewives who learn how to use new technologies such as the internet will further expand their virtual economic opportunities. In terms of learning a new skill, Shaffril et al. (2017) who studied the small-scale fishermen which are known to be one of the islanders' main group – managed to confirm their high attachment to their job. Nevertheless, they are still open to learning new skills provided that the new skills are in line with their need, ability, and interests.

The resulted analysis have offered answers to the third research question related to the existing and future supports provided by local institutions in assisting the adaptation process of the islanders. Within the current setting, the islanders agreed that there are numerous job opportunities (not related to fishery activities) offered by related agencies. In this case, it is not surprising for the four islands to be able to provide various job opportunities because all of these areas are tourist attractions in Malaysia. The offered economic diversity results in more job opportunities for the locals. Meanwhile, the adaptation of the islanders to climate change can be further strengthened through government relief provided during a natural disaster. Specifically, they claimed that the relief will be distributed equally which indicates that all victims will receive a similar amount of relief regardless of their demographic or political backgrounds. Hence, this is very promising because all the community will have equal chances to recover from the severity of climate change that tends to affect their lives. Nevertheless, the islanders also urged the government to offer loans for the post-disaster period because it will help to expedite their recovery process. Commonly, the community especially those who are poor will face the financial problem that delays their recovery process; hence, a large amount of money is needed for several purposes during post-disaster.

Comparison analysis performed has responded to the fourth research question and confirmed that there is no significant difference between the islanders in the four areas with regard to their awareness and structure which means that all of the islanders have an equal strength related to these two aspects. Nevertheless, a significant difference is detected with regard to their dependency with those in Redang island are identified to have a significantly weaker dependency ability compared to those in Tioman and Tuba. This finding suggests that there is much room for the related agencies or organizations to improve their plan on adaptation strategies at the community level especially at Redang. Their roles are very important, as Shaffril et al. (2017), Abu Samah et al. (2019a) and Abu Samah et al. (2019b) noted that without agencies that understands the needs, abilities and interests of the community, their adaptation plan has the potential to fail.

7. Recommendations

With reference to these results, islanders and related agencies can improve their plans to strengthen adaptation strategies either at the community or agency level because in the context of this research finding, they have been exposed to specific strengths and weaknesses and what they can do to further strengthen through the highlighted recommendations.

7.1. Knowledge management

Regarding this matter, the element of knowledge management must be strengthened to further enhance their awareness of climate change. First, higher learning institution can play their roles by sharing their research findings to the community. This situation creates a win-win situation for both whereby the researchers will be able to fulfil their research aim which is to benefit the community, while the community will obtain valuable information such climate change impacts to their socio-economic routines, climate change threats to their environment or climate change effects on their physical infrastructures. These information areable to enhance their awareness and readiness against the threats of climate change. In particular, potentials parties that are involved in the implementation of this suggestion is the public and private universities, specifically those that are located near to the island areas such as Universiti Malaysia Terengganu, Universiti Sultan Zainal Abidin, Universiti Malaysia Pahang, and Universiti Teknologi Mara (Kuala Terengganu Branch).

Second, the dissemination of climate changes information through trusted and influential individuals. In this case, concerned agencies such as Fisheries Development (LKIM) and Local Fishermen Association (PNK) should assign extension officers to brief the community leaders on any related climate change information, and then ask for their help to disseminate the information to the community. According to Hassan et al. (2011), most rural communities consider information obtained from their village leaders as reliable, while Shaffril et al. (2017) and Mazuki et al. (2013) stated that specific community groups such as the fishermen tend to believe information that comes from their skippers and jetty leaders as well as trusted information sources. Furthermore, bulletin board should be made available at the places of interests of the islanders such as *wakaf* (a small shelter that is usually located near the beach), coffee stall, mosque, and public hall instead of relying on community leaders. Therefore, this bulletin board will allow the concerned agencies or the universities to provide any valuable information related to climate change.

7.2. Early warning systems

Although the islanders' recorded a good score on adaptation strategies related to awareness, nevertheless, considering that the climate change is prediected to worsen in the future (Kwan et al., 2013; Jeofry and Rozainah, 2013), to constantly strengthen and improve this adaptation strategy is a must. An early warning system is one of the techniques that can enhance the awareness of climate change in the community. Within the scope of this study, two types of early warning systems are suggested, first is related to technology usage (mobile phone, potential of fisher friend development, internet – online information) and second is related to traditional way of warning systems – usage of different colors of flag. Nowadays, it is undeniable that mobile and smartphone have been regarded as common technologies; hence, it is possible to develop a messaging system that is able to inform the islanders on any approaching climate change threats. Most importantly, this system will be able to strengthen the readiness of the islanders and prevent them from taking any risks. A similar system via a technology known as Fisher Friend has been implemented in India which had been successfully proven to reduce the risks associated with any marine activities, and at the same time, enhance the awareness of community on any threats from the Mother Nature (Shaffril et al., 2017). The Bangladesh Department of Disaster Management on the other hand have developed two mobile-network-based warning systems to the community in order to disseminate any nature's threat quicker to them. The first system known as Cell Broadcasting System used to send warnings on extreme weathers to a targeted community while the second one known as the Interactive Voice Response where via the systems the community residents to a recorded warning message by calling a number (Roy et al., 2015).- Omar et al. (2013) further added that among important information that are needed by the community

in the early warning systems are extreme winds, extreme waves and seasonal monsoon pattern. Nonetheless, the existence of such technologies and information would be a waste if the islander refused to embrace it, they had to learn and express their interest in order to be in line with the advancement and to profit from the advantages offered by the early warning systems.

Next, it is extremely necessary to encourage islanders to seek online information. In most cases, this would be difficult to implement especially among older individuals in the community; hence, it is more appropriate to focus on the younger group – the youth as the main target group in implementing this suggestion. Moreover, this group is usually associated with their ability to utilize the internet; hence, they should be exposed to related websites such as http://publicinfobanjir.water.gov.my/ and http://infokemarau.water.gov.my/drought_front.cfm to obtain relevant updates on any possibility of severe climate change events. Therefore, it will be their responsibilities to disseminate information that is obtained from the websites to other household members.

Nevertheless, it should be understood that the implementation of the traditional warning system is still relevant up to the present time considering that not all islanders will prefer the new method of the early warning system. Understandably, the flag systems can be implemented in the island areas. Regarding this matter, Chendering Jetty (located at Kuala Terengganu) is still implementing the traditional warning system using certain flag colors that represent a certain level of wind speed. For example, the red colour indicates a strong wind which warns the fishermen to cancel or delay their fishing operation. Hence, the utilisation of a similar system then will update the islanders on the current climate situation. Therefore, the flag system can be placed at several places of interests such as *wakaf*, coffee stall, mosque, and public hall. As the older group are expected to be familiar with this conventional system, the younger group need to take proactive roles in learning the meaning of certain flag colors and this would be a great addition to their current knowledge. Other than that, another old method of warning the community of natural threats is using a siren system.

7.3. Learning alternative skills

On another note, as the islanders' ability to diversify their skills is one the concerns, to create alternative ways instead of only relying on their current income-generating is important.. Specifically, a number of alternative skills can be learned by the islanders as well as their household members. First, they are recommended to learn international languages such as English, French, Germany, Cantonese, Mandarin, and others which will enable them to be a part of the tourism industry. In this case, the Ministry of Tourism is the best agency to implement this suggestion; however, other agencies such as universities can play their effective roles by assigning experts from the Languages Department.

Meanwhile, periodical training and workshops on vocational related skills can be conducted for the islanders youth. Motorcycle, mobile phone, and smartphone repair are among the potential skills that should be learned by the youth because these skills will provide a large amount of money-making opportunity. Therefore, professionals from the industries or any related organizations such as Industrial Training Institute (ILP) and Polytechnic College can share their expertise to interested community.

Furthermore, entrepreneurship activities are another type of alternative for the islanders regardless of their age. The islanders should take chance to involve in entrepreneurship activities especially one related to tourism as it is expected to increase their income. In this case, older individuals who commonly refuse to engage in new methods of conducting activities will find entrepreneurship activities to be suitable for them (Shaffril et al., 2017). Furthermore, the youth and housewives group can be exposed to the best techniques for conducting online businesses. Regarding this matter, it is undeniable that interested islanders will be faced with the lack of capitals and entrepreneurship knowledge; hence, local agencies such as SME Corps and MARA should offer several initiatives that can overcome the mentioned problems. Moreover, Malaysia Digital Economy Corporation (MDEC) has been actively conducting Youcanduit program - a digital campaign to raise additional income for Malaysians through eRezeki and eUsahawan digital initiatives which offers training and courses that would guide interested groups or individual on the best method to conduct online business.

7.4. To strengthen infrastructure facilities

The government via several agencies can play proactive roles to further strengthen the infrastructure related facilities. For example, municipals can build a relief centre with complete facilities in order to accommodate victims during severe climate change events. In most cases, victims within the current scope are usually transferred to a temporary relief centre (usually at school or public hall) with inadequate and unsuitable facilities to accommodate the victims. Such condition can cause discomfort, stress and spread of disease among the victims. Furthermore, re-settlement programme should be implemented at the areas that are highly vulnerable to extreme impacts such as coastal erosion. A successful re-settlement programme in Pengkalan Atap Village in Kuala Besut Terengganu, by the state government which involved 161 villagers from 41 families, can be a good example and should be copied in other affected islanders areas. The related agencies should also discouraged construction of new building near to the shore to reduce the vulnerability to the climate change impacts such as coastal erosion, extreme winds and extreme waves. Consequently, such action is expected to minimize the risks related to property damage, injury or even worse, loss of life. On another note, most of the houses near to the shore are fully built by wood and such materials are fragile and not able to stand the extreme weather (Mohd Ekhwan, 2006). Hence, the related agencies should take initiatives to improve the islanders' house structure by reconstructing their house with cement brick or stronger fortresses or wave barriers around settlement areas.

7.5. To empower the extension officer

On another note, there is still an ample amount of time to empower the extension officers. This group play an important role in promoting a better climate change adaptation that require efforts to change the islanders' behaviour, strategies and socio-economic practices. The islanders need to be supported to better comprehend the climate change impacts and to prepare against its by having a stronger adaptation. Within this scope,

The extension officers should be empowered their roles to encourage the islanders to adopt new technologies and to diverse their sources of incomes, organizing open days and study groups (related to climate change impacts) with the islanders, technology demonstration, information sharing, managing natural resources, as well as informing the media about climate change challenges faced by the islanders. In addition, the extension officers should be part of the islanders by meeting them at their places of interests, asking about their problems, and providing the best solution that is in line with their need, ability, and interests.

7.6. Post disaster financial relief

Apart from that, financial relief should be given to the community during the post-disaster period because it is believed to expedite their recovery process. Extreme events can cause damage to prop-

erty (e.g. house, vessel, fishing gear, jetty) and the poor will face difficulties in getting resources to recover from the damages. Some of them opt to temporarily discontinue their fishing activities while some opt to stay at the relief center or relatives house until they have sufficient funds to recover from the damages,; hence, a large sum of money is needed for several purposes during post-disaster. A number of related agencies offer such assistances such as legal microcredit institution, NGO, related government and private agencies that aims to eradicate poverty. Two things need to be considered prior to providing the islander with financial relief. First, the financial relief should involve zero to minimal interest and second, Ahmad Faiz et al. (2010) noted that efforts aimed for the community should involve less bureaucracy to ensure that their acceptance can be obtained. In other words, the need to fulfil too many forms will keep them away from any government programs. Ignoring these two possibly force the islanders deeper into poverty trap. The Islander might opt on the easier and less bureaucracy loans process from the illegal lenders, taking advances from the wholesalers or even make desperate sales to sell their belongings.

8. Conclusion

Climate change poses several effects on the environment which refers to common phenomena such as rising temperature, unstable rain pattern, and extreme wind and waves. It is important to note that these changes do not only affect the environment but has also been confirmed to affect several community groups and one of them is the islanders. The purpose of the present study was to examine the adaptation to climate change impacts among the islanders in Malaysia because most of the existing studies only focused on the general community adaptation and tourism related. More importantly, the current research has successfully demonstrated the adaptation strength of the islanders, particularly in terms of their awareness, dependency, and structure. Specifically, the statements that were analysed in this study showed that some adaptation aspects illustrate a good adaptation strength, for example, the islanders seem to be stronger on their adaptation strategies such as been alert to the environment changes especially rising temperature, encouraging their family members (son and wife) to work to increase their household income and a having a greater access to other employment opportunities (other than fishery related). Weaknesses on several adaptation strategies however raised concerns especially one related to their ability to diversify their skills and access to financial loan. Finally, in order to further strengthen the islanders adaptation to climate change, they need a better knowledge management, effective early warning systems, learning alternative skills, strengthening infrastructure facilities, empowered extension officers and post disaster financial relief.. Nevertheless, These recommendations can only be implemented via proactive roles by the federal and the states governments.

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