



Adapting towards climate change impacts: Strategies for small-scale fishermen in Malaysia



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ABSTRACT

As with the global scenario, a number of climate change 'symptoms' are being detected in Malaysia. Local scholars have looked into the problems of rising temperature, rising sea level, extreme rainfall and extreme winds, which are causing coastal and mangrove erosion and degradation of marine resources. In turn, these issues are affecting the small-scale fishermen who rely heavily on weather stability to conduct their social and economic routines. This paper analyses six adaptation strategies, namely, reducing the risks associated with fishing routines, strengthening social relationships, managing fishermen's climate change knowledge, facilitating the community's learning of alternative skills, involving fishermen in climate change adaptation planning, and enhancing fishermen's access to credit. These suggestions are hoped to provide basis for concerned parties to develop adaptation strategies that are in line with small-scale fishermen's needs, abilities and interests.

1. Introduction

1.1. Research background

Climate change is a global phenomenon that affects the natural environment. In a report by the Intergovernmental Panel on Climate Change IPCC [9], global temperature is predicted to rise from 0.85 to 1.06 °C over a period of 132 years (1880–2012) in both land and ocean areas, while the global sea level rose by 3.2 mm per year between 1993 and 2010. A number of climate change 'symptoms' have been detected in Malaysia. Kwan et al. [11] concluded that five areas in Malaysia – namely Setiawan, Malacca, Bintulu, Miri and Kota Kinabalu – have recorded a more than 90% increase in the number of warm nights, while Tanggang et al. [35] predicted a significant temperature increase in Malaysia of between 3 and 5 °C by the end of the 21st century.

A number of studies conducted by local and international researchers have monitored the current condition of the climate in Malaysia. Wai et al. [38] revealed that over a 50-year period (1951–2000), several areas in Malaysia recorded an increase in temperature of between 1.75 and 2.69 °C, while the IPCC (2007) predicted that the temperature in Malaysia will have increased by between 0.6 and 4.5 °C by 2060. According to Kwan et al. [11], a number of areas located close to the sea, which are home to many fishermen, have been identified as facing significant changes in temperature. Areas such as Kota Bharu, Kuala Terengganu, Kuantan, Mersing and Setiawan, for example, are

facing 45.3–67.21% of increase in warmer days and between 45.8–90.81% of increase in warmer nights.

According to Wan Azli [39], since the 1980s the number of days of extreme rainfall events has exceeded the 90th percentile of total rainfall at a number of meteorological stations. Razali et al. [26] confirmed that over a long-term period there is a risk of extreme wind speeds in areas such as Alor Star, Kuantan, Mersing and Kota Bharu. A study by Zubaidi [42] identified a 1.25 mm/year rise in the sea level in Malaysia from 1988 to 2006. Findings by Md. Din and Mohd Omar [12] should solicit more concern, as they identified three places in Malaysia that have recorded a sea level increase of more than 3 mm per year from 1993 to 2008, namely in Sandakan (3.45 mm/year), Chendering (3.20 mm/year) and Kukup (3.02 mm/year).

All of these 'symptoms' are found to significantly affect the natural environment. The rising sea level, for example, results in extreme waves, which have been identified as one of the major contributors to coastal erosion and the destruction of mangrove forests in Malaysia [15]. Food and Agriculture Organization of the United Nation (FAO) [8] have shown that mangrove forest destruction in Malaysia is occurring at a rate of 0.8% per year, while out of 4809 km of coastal areas in Malaysia, it has been found that 29.1% are experiencing critical erosion [15]. Due to an increase in extreme waves, the extent of critical erosion in Malaysia increased from 156 to 233 km in a 14-years period (1986–2000) [15].

The impacts of climate change on marine resources is also im-

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portant. Ottersen et al. [22], claimed that reduction in fish quantities due to warmer temperatures could affect fish migration patterns, egg incubation time and spawning. van der Lingen et al. [37], on the other hand, confirmed that the incidence of harmful algal blooms resulting from dinoflagellates, which negatively impact fish species such as sardines, may be increasing as a consequence of climate change. Baker et al. [4] concluded that coral reef bleaching and mortality caused by climate-induced ocean warming might lead to the extinction of certain marine species.

As the environmental impacts of climate change are significant, the above issues are expected to result in profound impacts on the social and economic well-being of small-scale fishermen. Jafar-Sidik et al. [10] found that rainfall, temperature, wind and the Southern Oscillation Index correlated with fishermen's productivity. They further claimed that during the north-east monsoon, fishermen record 20% drops in their catch. Other issues include a reduction of fishing days, damage to fishermen's productive and non-productive assets, exposure to health problems, and decreased food supply [2,32,41,7].

For decades, climate change has been viewed as a phenomenon that will continue to worsen, and has been proven to cause rising temperatures and sea levels, unstable rain patterns, and extreme waves and winds [26,39,42,12]. The link between these changes and coastal and mangrove erosion has been recorded [8,15], while the impacts on the quality and quantity of several marine species have been noted [23,37,4]. Such findings have enabled better mitigation and conservation strategies to be formulated, whereby plans can be put in place to delay and reduce the impacts.

Despite these successes, an important gap that remains in this growing body of research is the somewhat limited understanding of the social aspects of climate change. Although several climate change studies have been conducted, most of these are predominantly scientific in nature [12,26,39,42,15,23,37,4]. This points to a deficiency in climate change studies, especially those related to social aspects, which results in planned programmes not aligning with target groups' needs, abilities and interests.

Against this backdrop, this paper provides a conceptual explanation for one of the central social issues of climate change – potential adaptation strategies towards climate change among small-scale fishermen in Malaysia, highlighting potential adaptation strategies that are germane to their needs, abilities and interests.

1.2. Methodology

The initial step in developing an adaptation strategy was to analyse related papers and try to connect any identified relationships between climate change and its impacts on the socio-economic aspects of small-scale fishermen. Within this process, relevant articles were sought from search engines including Science Direct (<http://www.sciencedirect.com/>), Taylor & Francis (<http://www.tandfonline.com/>), Sage Publications (<http://www.sagepub.com/home.nav>) and Emerald Publishing (<http://www.emeraldinsight.com/>). Keywords, such as 'community adaptation towards climate change', 'climate change impacts on the environment', 'climate change impacts on fish productivity' and 'climate change impacts on the socio-economic activity of fishermen' were used in this process. These efforts resulted in identification of 163 articles; however, only 42 remained after the second stage of the screening process. A total of 33% of the articles were related to small-scale fishery and commercial fishery studies, while the remainder were linked to climate change in general. Most of the selected articles focused on climate change issues in Malaysia, while a small number of articles touched on climate change in other Asian and European countries, and Australia. A total of six articles were identified as the main references in developing the adaptation strategies, while the remaining articles provide supportive information for the present article (Table 1). The relationships identified allowed us to suggest six adaptation strategies that fit Malaysian small-scale fishermen's needs,

abilities and interests.

Following this introduction, the paper focuses on the socio-economic aspects impacted by climate change, and the context of study – that is, small-scale fishermen and the impacts of climate change on their productivity, physical infrastructure, health and social aspects. Six adaptation strategies are then recommended; namely, reducing the risks associated with fishing routines, strengthening social relationships, managing fishermen's climate change knowledge, facilitating the community's learning of alternative skills, involving fishermen in climate change adaptation planning, and enhancing fishermen's access to credit. These recommendations are believed to be appropriate for small-scale fishermen's needs, abilities and interests.

2. Impacts of the changing environment on the socio-economic aspects of small-scale fishermen

2.1. Small-scale fishermen in Malaysia

Although there is no official record of the number of small-scale fishermen in Malaysia, previous local studies (e.g., [25,28,20]) have consistently found that small-scale fishermen constitute more than 65% of the overall fishing population. Small-scale fishermen have several characteristics in common: they operate their fishing routine using smaller vessels (22 feet and smaller) and less than five nautical miles from shore; they are generally older than 40; they have a lower level of educational achievement (Malaysia Certificate Education or lower); they earn between RM 500–1000 per month (roughly equal to USD 166–333); they use nets, fishing rods or *rawai* (a traditional catching tool) as their fishing gears; and they operate their fishing trip for between five and nine hours.

2.2. The impacts of climate change on small-scale fishermen's productivity

Climate change is expected to have negative impacts on marine resources and productivity [22,37,4]. In the Malaysian context, Shaffril et al. [27] confirmed that climate change impacts have reduced the number of fishing days. During the north-east monsoon, operating days can be reduced by up to 90% in a month. A local study by Omar and Quah [21] concluded that the changing climate results in a 32% reduction in fishermen's catches. Omar and Quah [21] further confirmed that small-scale fishermen (in their context, in the East Coast region of Peninsular Malaysia) recorded a total of RM 429.25 (roughly USD 143) of income per month during the north-east monsoon, compared to RM 563 (roughly USD 188) per month during the normal season. Fishermen with greater occupational mobility, especially related to tourism activities, are also affected by climate change. During the north-east monsoon, boat rental services to Redang and Perhentian in Terengganu must be temporarily suspended due to extreme wind and waves, while demand for boat rentals by anglers significantly decreases during the same period. Those who alternatively rely on agriculture are also facing climate change threats. During the 2015 flood disaster, for example, a total of 11 ha of agricultural land in Kelantan was destroyed, resulting in a loss of RM 35 million (roughly equal to USD 8.5 million) in the paddy industry, RM 2.1 million (roughly equal to USD 0.46 million) in the fruit industry and RM 2.02 million (roughly equal to USD 0.44 million) in the vegetable industry [36].

2.3. Impacts on fishermen's physical infrastructure

Climate change impacts damage Malaysian fishermen's physical infrastructure. The 2004 tsunami, for example, demonstrated how badly a natural disaster can affect fishermen in Malaysia. During the disaster, a total of 5200 fishermen (most of whom were small-scale fishermen) from states such as Perlis, Kedah, Perak and P. Pinang, lost their vessels and fishing gear, which is estimated to have cost around

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