Environmental challenges on aquaculture rearing in Malaysia: The views of brackish-water cage entrepreneurs in Malaysia

[2]Khairuddin Idris, [1]Azmariana Azman, [1]Jeffrey Lawrence D'Silva, [3]Norsida Man and [1]Hayrol Azril Mohamed Shaffril

[1]Institute for Social Science Studies, Universiti Putra Malaysia, Malaysia
[2]Faculty of Education, Universiti Putra Malaysia
[3]Faculty of Agriculture, Universiti Putra Malaysia
majudesa.desa2@gmail.com or kidin@putra.upm.edu.my

Abstract: The main aim of this study is to investigate the environmental challenges' – changing climate and natural disasters affect on aquaculture activities in Malaysia. Four in depth interviews have been conducted with five brackish-water cage entrepreneurs from four different locations in Peninsular Malaysia. Based on the findings of this study, four main environmental challenges have been identified to post formidable challenges on aquaculture activities in Malaysia, namely temperature rise, heavy rainfall, flood and water current. Further analyses have shown that these four environmental challenges have affected the socio-economic routines of the brackish-water cage entrepreneurs. A number of discussions and recommendations have been highlighted and hopefully they can assist the relevant parties in constructing a better strategy to face the future environmental challenges.

[Khairuddin Idris, Azmariana Azman, Jeffrey Lawrence, D'Silva, Norsida Man and Hayrol Azril Mohamed Shaffril. **Environmental challenges on aquaculture rearing in Malaysia: The views of brackish-water cage entrepreneurs in Malaysia.** *Life Sci J* 2014; 11(7):509-513] (ISSN: 1097-8135). http://www.lifesciencesite.com. 67

Keywords: environmental challenge, aquaculture industry, fisheries development

1. Introduction

Aquaculture sector in Malaysia has continuously attracting interest among local people. Furthermore, this sector is positively contributes to the economic growth. In 2011, the average annual growth for freshwater aquaculture production was 14.9 per cent whilst 19.5 per cent for brackish water/marine aquaculture. Malaysia is ranked 17th in the world and 11th in Asia for fish capture production in 2010 (Dept. of Statistics Malaysia, 2012). Furthermore, Table 1 has demonstrated the productivity of aquaculture from 2006 to 2012. Malaysia government also encourages people to promote large scale aquaculture cage farming through EPP4 program. Nevertheless, albeit mounting of interest and persistent encouragement by the government, environmental problems are one of the major issues that obstruct the sustainable growth of aquaculture sector (Ahmad Faiz et. al., 2010; Hambal, et. al., 1994). Although environmental challenge posts a formidable challenge on the aquaculture industry, less has been understood with such challenge which drives the need for more studies to be conducted. However, up to this date, scholars seem to place less interest on such issues and this study tries to fill the gap by conducting a study relating to the environmental challenges faced by brackish caged water caged entrepreneurs (BCE) in running their aquaculture activities. This study is vital and need to be done to provide understanding of aquaculture vulnerability to climate change that able to recommend for prioritizing adaptive strategies (FAO, 2008).

Table 1: Aquaculture productivity in Malaysia

Year	Productivity (million)
2012	0.634
2011	0.527
2010	0.581
2009	0.472
2008	0.354
2007	0.269
2006	0.212

1.1 The effects of changing climate on the environment and aquaculture productivity.

The climate in Malaysia has already changed and expected to be worsening in the future (Intergovernmental Panel on Climate Change, 2007). The obvious climate changes in Malaysia are the rising temperature (Kwan et al., 2011; Wai et al., 2005) and an unstable rainfall pattern (Wan Azli, 2010 and National Hydraulic Research Institute of Malaysia, 2006). Such changes have been experienced by the local communities and they admitted that they can affect their socio-economic routines (Abu Samah et al., 2011; Shaffril et al., 2013). Temperature rise can affect aquaculture activities in temperate zones as such increases could surpass the normal temperature range of organisms currently cultured (2WE Associates Consulting Ltd,

2000). Furthermore, temperature rise is also linked to stress and increases vulnerability towards disease infections (2WE Associates Consulting Ltd, 2000). Such impacts can be dealt with potential positive impacts resulted from climate change – for example, greater growth and production in tropical and subtropical zones. Nevertheless, it is impossible for positive impacts to occur without some potential negative impacts resulted from other climatic change elements (e.g. increased eutrophication in inland waters). For inland waters, the changing climate will impinge the evaporation and precipitation cycles that more serious and occur more rapidly compared to salt water aquaculture activities (2WE Associates Consulting Ltd, 2000).

For the aquaculture industry, increased extreme events (e.g. hurricanes, storm) would result in more damage and additional losses, both costly to operations. They have impact on aquaculture stock and damage to aquaculture facilities and fishing gear. Due to such extreme events, there is a need for aquaculture entrepreneurs to design a better and firm cage moorings, pond walls, jetties, etc (World Fish Center, 2007). To have these are critical particularly to those who conduct their aquaculture activities at the east coast region of Peninsular Malaysia which is facing extreme events – resulted from the northeast monsoon that occur between November and February of the following year (Idris et al., 2013). As the changing climate is expected to worsen in the future, being selective on farm location has been discussed as one of the effective adaptation strategies. Nevertheless, another alternative - the greater availability of phytoplankton and zooplankton through eutrophication have been found to assist farmers – particularly those who run in finfish aquaculture that is predominantly based on the species feeding low in the food chain, facing the impacts of climate variability. Climate change can produce direct effects on physiology and behavior and alter growth, reproductive capacity, mortality and distribution of the reared fish. Such change also has been found to produce indirect effects and reduce the productivity, structure and composition of the marine ecosystems on which fish depend for food.

Changes in rainfall on the other hand will result in changes in water availability ranging from droughts and shortages to floods which then will result in lower water quality. Salinization of groundwater supplies and the movement of saline water further upstream in rivers resulted by rising sea levels on the other hand can affect inland freshwater aquaculture (IPCC, 2007). Heavy rain also may cause sewage or agricultural fertilizers that contain algal blooms flows to the river and this can reduce levels of dissolved oxygen and 'fish kills' (Bell et al., 2010). Bell et al. (2010) further stated that extreme rainfall patterns will cause losing fish from cages during floods, invasion of cages by alien species and destruction to cages via infilling and breaching of walls and expand the area suitable for rain-fed pond aquaculture.

Albeit it's direct impact on the environment, the changing climate has been proven to post indirect impacts to the socio-economic aspects of BCE. Ahmad Faiz et al. (2010), Westlund et al. (2007), Heltberg (2009) and Kelly and Adger (1999) have emphasized that the changing climate will delay the harvesting process, reduce productivity, damage to the cages, reduce the physical yields of crops and animals, loss financial and physical capitals which then lead to poverty, thrashing in common property rights and inefficiency in joint action and investment affects.

2. Material and Methods

This study used a qualitative method. A total of five in-depth interviews were conducted at four places namely Pekan Pahang, Sg. Linggi, Negeri Sembilan, Kuala Muda, Kedah and Kuala Besut, Terengganu. Five BCEs who run aquaculture activities involved in the in-depth interview. All of the BCEs were male and have been involved in aquaculture activities between 2 and 20 years. For the purpose of confidentiality, all the respondents were labeled with specific label instead of their real name. R1 and R2 were the respondents from Kuala Besut, R3 was respondent from Kuala Muda and R4 was from Kuala Linggi while R5 was from Pekan. On average, per discussion took almost one hour. The FGDs start with introducing themselves and basic background about them and their products. Later on their conversations become deeper into the issue discussed. The key questions were prepared related to the environmental challenges faced by BCE and these questions were also served as an interview protocol for the study. Data gained were later transcribed verbatim and analyzed using thematic analysis.

3. Results

Aquaculture sector was seen as a potential sector that can contribute to Malaysia's economy. Due to that situation, there is an increasing trend of Malaysian who gets involve in aquaculture activities. Although aquaculture promise high investment return to those who success, it should be noted that aquaculture activities involve a lot of challenges particularly the one associated to environmental challenges – changing climate and natural disasters. Nowadays, aquaculture entrepreneurs across the global are talking about unstable climate such as temperature rise and extreme rainfall patterns and its

impacts on the aquaculture activities (De Silva et al., 2009) and the similar pattern can be seen within the scope of this study where the analyzed data have confirmed that environmental variability and natural disasters are producing significant negative impacts to their aquaculture activities.

3.1 Temperature rise

Temperature rise is among the most obvious climate changes in Malaysia (Kwan et al., 2011; Wai et al., 2005). Kwan et al. (2011) for example have confirmed that several places in west coast and east coast of Peninsular Malaysia recorded are facing 45.3% to 67.21% changes in terms of warmer days and from 45.8% to 90.81% in terms of warmer nights while another local study by Wai et al. (2005) in his study have recorded temperature rise between 1.75 °C and 2.69 °C in a number of meteorological stations. Rise in temperature has been found to affect the aquaculture productivity (2WE Associates Consulting Ltd, 2000) and findings of this study are in line with this as R3 has confirmed that temperature rise has impacts to the fishes, "*fish that lives in hot water can't stay longer, and it will die. Unless we put the seine deep in the water, they can swim. But if the seine just on the water surface, the fish will die with the hot climate".*

R2 has agreed with this and stated that

"Climate has big influence on fishes. If the climate keeps changing from hot to rain and then hot again, the fish will easily infected with scabies…

R5 has accentuated on the rising temperature on the level of oxygen available for their reared fish by stating

"Recently is dry season, we cannot give too much food because oxygen level in the water is low. But during monsoon season, we can give a lot of food. During that time, the water is cool and oxygen level is high."

Rise in temperature have been experienced by the local communities and they admitted that such changes are affecting their reared fish and findings of this study are in line with studies done by 2WE Associates Consulting Ltd (2000), Harwood et al. (1999) and Westlund et al. (2007) which confirmed that the rising temperature will cause significant loss to aquaculture productivity. R4 has confirmed this by stating

"We have to look at the situation first, if the hot weather occurs from five to six month with minimum amount of rain that can give impact on the productivity (of the reared fish). If not, it will be okay".

3.2 Heavy rainfall

The unstable rainfall pattern has already been experienced in Malaysia (Wan Azli, 2010; National Hydraulic Research Institute of Malaysia, 2006) and this has something to do with aquaculture activities. Drawing on information provided by the respondent, heavy rainfall pattern has a direct effect on their agriculture activities as such scenario will decrease the level of saltiness.

"Kerapu attribute are less compatible with brackish water. It more suits to sea, salt water. The big threat is flood. It happens from October until March" (R1).

He further stated that

"Previously, even the flood engulfs this area, the level oxygen will not decline, but nowadays things are different, it will affect the level of oxygen"

The heavy rainfall pattern also has indirect impacts on the aquaculture activities where the BCEs are facing the environmental threats produced by the pesticides that flow from the paddy farms each time. There are heavy rains at their places and this finding is not surprising as it is in line with a study done by Bell et al. (2010). R3 has confirmed this by explaining:

"If they use a lot of pesticides, sometimes the sea water also smell like paddy field poison.. yes, I smell the poison odor, it is pesticides from the paddy field"

It seems that R2 has expressed his agreement by accentuating on the impacts of paddy planting on their aquaculture activities. He further stated:

"when the plow paddy fields season, the sediment water will flow into the river. I quite concern about that"

3.3 Flood

Flood is one of the common natural disasters in Malaysia, usually resulted from heavy rain that occurs during the end of each year. For the respondents, normally, they already prepared with the flood calamity. R1 told *"we always get ready (against flood) because we are familiar with the situation, if the fish are big enough we will harvest it early, but the fingerlings face problems as it cannot stand with the flood and all of them will die."* While R2 added *"in this area the main factor is natural disaster like flood, factors such as fish disease is normal and we still can handle it"*

Bell et al. (2010) and Ahmad Faiz et al. (2010) have clarified the impacts of heavy rain on the level of oxygen and the damage it can do on the cages. In line with findings of Bell et al. (2010) and Ahmad Faiz et al. (2010), the respondents were placing their concern on the post effects of the flood – reduced level of oxygen, as R1 stated *"before this we are less concern on the post effect of the flood, but*

now, when the flood recedes, the oxygen become null. The fish inside and outside the cage were died". In addition, the respondents also raised their concern on the damages done to their cages as R2 stated *"During the rainfall season, my friend called me and asked about my cage, I said it still ok, but when I woke up in the morning and my cage has gone".*

Another post effect of the flood is the waste from the upper stream. R4 has confirmed this by clarifying *"before this, there is a minimum amount of waste, but recently, there will be a lot of wastes coming from the upper stream after the flood, as this happens, it pollutes the river and it affects the fish".*

3.4 Water currents

Bell et al. (2010) have confirmed the effects of heavy rain on water current and the similar view can be gained among the respondents of this study. R3 has experienced this and stated

"…When the water flow faster than usual, the seine will lift out. That's the problem. They push out sediment water under the sea. Dirty water that the reason why the fish died."

He further added

"fish can be tired. When the water speeds too much, the fish just locked away in the corner. It will be the problems for the fish. Sometimes, the water smells bad. When the storm strike, the sediment will lift up and the fish will die…"

While R3 accentuated on the impacts of the water current on the fish, R5, on the other hand has clarified the impacts of unstable water current on the cages.

"…when the speed of water currents increase, the rope cage was broken and the cage was torn. It will trespass other cages. The burden will increase and all the cages will break."

4. Conclusion and Recommendations

It can be concluded that the BCE have admitted that the environmental challenges have posted negative impacts on their aquaculture activities. Unstable temperatures, heavy rainfall, water current and natural disaster such as flood were seen as the main environmental challenges faced by the entrepreneurs. To further strengthen their preparation and readiness against such challenges, knowledge management process should be strengthened between concern parties and BCEs particularly for those who are affected by the northeast monsoon season. One of the effective ways of doing this is by strengthening the extension process where information sources such as printed media, electronic media and fisheries officers can be used to disseminate the information germane to the impacts of changing climate and natural disasters on their aquaculture activities. Furthermore, the BCEs should be trained with proactive and reactive actions as that will assist them to make earlier preparation against any unstable climates or natural disasters and this in turn will protect their aquaculture activities from the impacts of climate variability and one of the possible ways to do this is by conducting series of related courses and seminars.

Acknowledgements:

Foundation item: Fundamental Research Grant Scheme (FRGS) (Project Code: 05-12-10-1021FR). Authors are grateful to the Ministry of Higher Education (currently known as Ministry of Education) for funding this study.

Corresponding Author:
Khairuddin Idris
Faculty of Education
Universiti Putra Malaysia
43400 Serdang
Selangor Darul Ehsan
E-mail: majudesa.desa2@gmail.com
or kidin@putra.upm.edu.my

References

1. 2WE Associates Consulting Ltd. (2000). Aquaculture and climate change in Canada. Retrieved on on 29 November 2000, from: http://www.cics.uvic.ca/workshop/Aquaculture&climate-in-Cda.htm 2000.
2. Abu Samah B, Shaffril HAM, D'Silva J, Uli J. The negative environmental changes on the sea and its impact on the aspects of economic, social and health of the fishermen living in the East Coast Zone of Peninsular Malaysia. American Journal of Environmental Science, 2011; 7 (6), 534-541.
3. Ahmad Faiz AN, Khairuddin I, Shaffril HAM, D'Silva JL. Aquaculture industry potential and issues: a case from cage culture system entrepreneurs: suggestions for intensification of aquaculture industry. Journal of Social Science 2010; 6 (2): 206-11.
4. Bell J, Batty M, Ganachaud A, Gehrke P, Hobday A, Hoegh-Guldberg O, Johnson J, Le Borgne R, Lehodey P, Lough J, Pickering T, Pratchett M, Sheaves M, Waycott, M. Preliminary assessment of the effects of climate change on fisheries and aquaculture in the Pacific. In: Fisheries in the Economies of the Pacific Island Countries and Territories. Pacific Studies Series. Asian Development Bank, Manila, Philippines; 2010, pp. 451-469.

5. De Silva SS, Soto D. Climate change and aquaculture: potential impacts, adaptation and mitigation. In Cochrane K, De Young C, Soto D and Bahri T (eds). Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. FAO Fisheries and Aquaculture Technical Paper. No. 530. Rome. 2009.
6. FAO. Climate Change Adaptation and Mitigation in the Food and Agriculture Sector. Technical Background Document from the Expert Consultation held on March 5-7, 2008. In High-level Conference on Food Security: The Challenges of Climate Change and Bioenergy, June 3-5, 2008, Rome.
7. Hambal H, Mohd Akhir A, Saniah Y. Environmental Issues on Aquaculture Development in Malaysia. Working papers of the Fisheries Research Institute, Department of Fisheries, Malaysia. 1994.
8. Heltberg R, Siegel P B, Jorgensen SL. Addressing Human Vulnerability to Climate Change: Toward a 'no-regrets' Approach. Global Environmental Change 2009; 19(1): 89-99.
9. Idris K, Shaffril HAM, D'Silva JL, Man N. Identifying problems among Seabass brackish-water cage entrepreneurs in Malaysia. Asian Social Science 2013; 9 (9): 249-256.
10. Kwan MS, Tanggang FT, Juneng L. Projected changes of future climate extremes in Malaysia. Paper presented at National Symposium on Climate Change, 16-17 November 2011, Putrajaya, Malaysia.
11. Kelly PM, Adger WN. Theory and practice in assessing vulnerability to climate change and facilitating adaptation. Climatic Change 2000; 47(4): 325-352.
12. National Hydraulic Research Institute of Malaysia (NAHRIM). Study of the impact of climate change on the hydrologic regime and water resources of Peninsular Malaysia – Final Report. Ministry of Natural Resources and Environment, Malaysia. 2006.
13. Shaffril HAM, Abu Samah B, D'Silva JL, Yassin, SM. The process of social adaptation towards climate change among Malaysian fishermen. International Journal of Climate Change Strategies and Management 2013; 5 (1): 38-53.
14. Shariff M, Yusoff FM, Gopinath N. Aquaculture in Malaysia: Current Trends and Future Outlook. Paper presented at the Second International Seminar on Fisheries Science in Tropical Area, Tokyo, August 19-22, 1997, Japan.
15. Wai NM, Carmelengo A, Ahmad Khairi AW. A study of global warming in Malaysia. Technology 2005; 42: 1–10.
16. Wan Azli WH. Influence of climate change on Malaysia weather pattern. Paper presented at Malaysia Green Forum 2010 (MGF2010), 26–27 April, Putrajaya, Malaysia.
17. Westlund L, Poulain F, Bage H, van Anrooy, R. Disaster response and risk management in the fisheries sector. Food and Agriculture Organization of the United Nations, Rome. 2007.
18. World Fish Center. The threats to fisheries and aquaculture from climate change. Retrieved on 29 November 2013 from: http://www.worldfishcenter.org/resource_centre/ClimateChange2.pdf 2007.

5/4/2014