

Benefits and Problems in Caged Rearing of Lates Calcarifer, Oreochromis Niloticus and Pangasius Sutchi: The Case of Entrepreneurs in Pekan, Pahang

Khairuddin Idris², Azmariana Azman¹, Jeffrey Lawrence D'Silva¹, Norsida Man² and Hayrol Azril Mohamed Shaffril¹

¹ Institute for Social Science Studies, Universiti Putra Malaysia, Malaysia

² Faculty of Education, Universiti Putra Malaysia, Malaysia

³ Faculty of Agriculture, Universiti Putra Malaysia, Malaysia

majudesa.desa2@gmail.com; kidin@putra.upm.edu.my

Abstract: As marine sources are consistently depleting, turning to aquaculture as an alternative source is seen as a vital step. However, little academic interest has been paid to aquaculture, particularly the social part of it. This study aims to identify the benefits and problems faced by entrepreneurs in Pekan Pahang who run caged aquaculture activities, particularly regarding three species: Lates calcarifer (sea bass), Oreochromis niloticus (red tilapia) and Pangasius sutchi (patin). To gain the required data, two Focus Group Discussions are conducted using a total of 12 respondents; five respondents in Tanjung Gosong and seven respondents in Pulau Keladi Village in Malaysia. In terms of the benefits of aquaculture activities, four main themes emerge, namely increasing their income, a sense of hard work, creatively solving problems and creating a norm of cooperation. In terms of problems faced by the entrepreneurs, four main themes emerge, namely relating to financial, environmental, seedling and diseases, and human and animal factors.

[Khairuddin Idris, Azmariana Azman, Jeffrey Lawrence D'Silva, Norsida Man and Hayrol Azril Mohamed Shaffril. **Benefits and Problems in Caged Rearing of Lates Calcarifer, Oreochromis Niloticus and Pangasius Sutchi: The Case of Entrepreneurs in Pekan, Pahang.** *Life Sci J* 2013; 10(3): 786-792]. (ISSN: 1097-8135). <http://www.lifesciencesite.com>.117

Keywords: Aquaculture entrepreneurs; social development; economic development

1. Introduction

Aquaculture is believed to have originated in China, where carp (*Cyprinus carpio*) was the first species reared. Cage culture probably began with fishermen who used cages to accrue fish for market. Gradually, they learned to nurse the fish in these cages to increase their size and improve their overall health. Southeast Asia began culturing fish at the end of the eighteenth century. Initially, the cages used were built of wood and bamboo and the kept fish were fed trash fish and food scraps. Eventually, technology changed the cages from wooden into high density polyethylene (HDPE), which could last longer in exposed areas with less maintenance cost.

In Malaysia, aquaculture became popular in 1990s, and caged aquaculture has evolved to become one of the most popular techniques used, especially within areas that have a sheltered coast or bay. Today, aquaculture in Malaysia has become well developed. In 2010, roughly RM3.6 billion was generated by this industry, whereby brackish-water aquaculture is the main type conducted. States such as Perak, Pahang, Selangor, P.Pinang and Johor are among the main producers of aquaculture products in Malaysia (Table 1). In addition, species such as seaweeds, cockles and sea bass are among the brackish-water species that are most produced in Malaysia, while freshwater catfish, *patin* and red tilapia are among the most popular

freshwater species (Table 2).

Table 1: Estimated income generated from aquaculture production by state in 2010

States	Income generated (RM million)
Perlis	7.8
Kedah	88.1
P.Pinang	474.8
Perak	811.1
Selangor	408.4
N.Sembilan	78.1
Malacca	71.9
Johor	468.4
Pahang	440.7
Terengganu	63.8
Kelantan	25.6
Sabah	188.3
Sarawak	449.4
Total	3,576.4

Department of Fisheries Malaysia (2010).

Table 2: Estimated aquaculture production from freshwater and brackish water culture systems by species, 2010

Species (Brackish water)	Productivity (tons)	Species (Freshwater)	Productivity (tons)
Sea bass	20,021.52	Javanese carp	903.28
Mangrove red snapper	12.17	Common carp	675.33
Grouper	4,569.63	Grass carp	872.99
Mangrove snapper	2,891.39	Big head carp	2,052.84
Hawaiian white shrimp	69,084.10	Giant freshwater prawn	619.22
Tiger prawn	18,118.51	Black tilapia	9,629.33
Mud crab	7.92	Red tilapia	29,013.94
Berried crab	4.02	River carp	975.77
Red tilapia	243.41	Freshwater catfish	63,206.24
Red snapper	4,956.29	Goby	8.87
Cockles	78,024.70	<i>Patin</i>	37,884.07
Mussels	10,529.06	Giant snakehead	2,503.67
Oyster	812.76	River catfish	1,655.88
Seaweeds	207,892.40	Others	5,397.21
Others	8,481.91		
Total	425,649.79	Total	126,384.70

Sources: Department of Fisheries Malaysia (2010).

In Pekan, aquaculture has been considered one of the main money-making activities for locals. From Kuala Pahang, a village in Pekan, the Pahang River flows to the South China Sea. Pahang River is the longest river in Peninsular Malaysia and one of the main places for aquaculture activities. Among the main species reared in cages along Pahang River are sea bass, red tilapia and river catfish (called *patin* by locals). Pahang, in which Pekan is one of the districts, has the highest number of aquaculture entrepreneurs; in 2010, a total of 1,738 entrepreneurs were recorded, of which a huge majority are Malay and a small portion are Cambodian migrants who are part of the UNCHR refugee program that took place during the Khmer Rouge regime era. Many of these migrants settled in villages such as Pulau Keladi, Sekukuh and Kemahang.

Caged aquaculture can be established in any suitable body of water, including lakes, ponds, mining pits, streams or rivers, providing these bodies have suitable water quality, access and legal authority. This flexibility makes it possible to utilize underused water resources to produce fish. Unlike pond aquaculture, cage farming requires less investment during the construction phase. Through cages, the aqua entrepreneurs can observe fish behavior, especially feeding behavior, which is critical to anticipate and avoid problems with stress and diseases, which often occur in cage culture. Cages are usually harvested by moving them into shallow water, crowding the fish into

a restricted area, and simply dipping the fish out of the cage. Alternatively, the cage can be lifted partially out of the water so that the fish are crowded into a smaller volume, and they can then be dipped out. This makes it possible to partially harvest fish from cages as needed for local niche markets or personal consumption. The confinement of fish to cages should not hinder other uses of the water resource, such as fishing, boating, swimming, irrigation or livestock watering. Contrarily, the disadvantages of caged aquaculture include the fact that the fish require a complete diet that provides all essential nutrition. Caged fish thus depend greatly on manufactured food rather than natural food. Furthermore, diseases are a common problem in cage culture, and can cause catastrophic losses. In addition, caged fish are often threatened by predators such as turtles, snakes, and fish-eating birds. Another problem with caged aquaculture relates to the fact that production is limited due to the stress associated with fish density, poor localized water quality, and threats of disease.

As marine sources are consistently declining, aquaculture is seen as one of the alternatives. Within the Malaysian context, aquaculture can be considered a new industry, which explains the lack of studies conducted to date. Though a large number of studies have been conducted in relation to aquaculture (Katranidis et al., 2003; El-Gayar, 2003; Bondad-Reantaso et al., 2005; Mazur and Curtis, 2006; Amberg and Hall, 2008; Schlag, 2010), less interest has been placed on the social aspects of the aquaculture industry, particularly the benefits and problems faced by the entrepreneurs in running the aquaculture industry. Understanding this area is indeed important, as, according to Schlag (2010), aquaculture requires a social science approach to anticipate and address future controversies in a timely and efficient manner. This leads the present study to its prime objective, which is to explore the profits and problems faced by aquaculture entrepreneurs, particularly those involve in caged rearing.

2. Material and Methods

This study is qualitative in nature. A total of two Focus Group Discussions (FGD) were conducted with two groups of entrepreneurs who run caged aquaculture-rearing activities. One of the FGDs was conducted with five entrepreneurs in Tanjung Gosong Village, whereby sea bass (*Lates calcarifer*) and red tilapia (*Oreochromis niloticus*) are the main species reared. The second FGD was conducted among Cambodian migrants who have settled in Pulau Keladi Village. A total of seven entrepreneurs were involved in the second FGD; the main species reared by this group is *patin* (*Pangasius sutchi*). All of the respondents have experience of between two and 20

years in aquaculture activities. For the purpose of secrecy, all the respondents were labeled with specific label instead of their real name. Respondents in Tanjung Gosong were named as respondents A, D, F, G and K while respondents in Pulau Keladi Village were named as respondents 1, 2, 3, 4, 5, 6 and 7.

The number of respondents was determined according to the quality of the data and findings required, as is the case in most qualitative methodologies. The researchers continued to conduct interviews until they believed they had reached saturation. This is understood as the moment when a researcher has gained a full understanding of the experience, which will not be altered through further discussion with participants (Laverty, 2003).

The first FGD took one hour and 21 minutes to complete, while the second took one hour and 16 minutes. The researchers began the FGD subtly, with a conversation intended to understand the backgrounds of the participants, and later progressed into deeper discussion concerning the relevant issues. The FGD was guided by the interview protocol, and was designed to keep to a standard interview procedure and maintain the flow of conversation. The questions included within the interview protocol were mainly created to fit the purposes determined, which were to explore the benefits and problems in conducting aquaculture activities. The questions served as a guide, allowing respondents freedom and flexibility in their answers. Questions relating to problems faced consumed the longest amount of time for both FGDs. The data obtained were later transcribed verbatim, and analyzed using thematic analysis.

3. Results

3.1 Benefits

Aquaculture in Malaysia is known to be a vital alternative for marine sources, and concerned parties have recognized the great potential it has to satisfy customer demand while assisting entrepreneurs to enhance their socio-economic development (DOF, 2010). The data gained in the present study are in line with this, as analyses have revealed four main themes relating to the benefits of conducting caged aquaculture among entrepreneurs, namely increased income, a sense of hard work, creatively solving problems, and creating a norm of cooperation.

3.1.1 Increased income

A study conducted by Food Agriculture Organization (FAO) (2006) confirmed that aquaculture can strengthen the socio-economic aspects of a community, particularly by increasing income, providing additional and alternative forms of employment, and developing rural areas (FAO 2006). Another study by Weeks (1992), Katranidis et al. (2003), Piumsombun et al. (2005) demonstrates the

strength of aquaculture in terms of increasing the levels of economic opportunity and diversity within communities, particularly those in remote and rural areas. The findings of the present study seem to be in tandem with these, as they suggest that communities are able to increase their income via aquaculture activities through the creation of more reasonable market prices and an ability to meet demand. In the case of respondents in Pulau Keladi Village, for example, a kilo of harvested fish can be sold for RM20. Regarding the income generated from harvested fish, Respondent 4 stated that there are persistent demand on their fish which positively impinge their income "*sometimes they want one kilogram and [...] sometimes, they want 100 kilos*". Respondent 1 similarly stated: "*it depends on time, if it is in the middle of the year (June or July), customers even ask us to prepare 100 kilograms of harvested [fish]*".

3.1.2 Sense of hard work

In the case of respondents in Pulau Keladi Village, holding migrant status has hindered them from receiving any assistance or subsidy from the government. Although this hindrance seems to pose a great challenge to them, particularly in the earlier stages of life as aquaculture entrepreneurs, it actually contributes to developing a sense of hard work among them. For example, Respondent 5 stated that financial limitations have, in the past, restricted the fishermen from buying seedlings; they have overcome this by netting seedlings from the river by themselves, which consumed a lot of time and energy.

Previously, I didn't buy the seedlings, I caught the seedlings by myself in the river which in that time was a lot, I managed to caught half a tin of seedlings each time I went for netting.

3.1.3 Creatively solving problems

Problems faced by the respondents have taught them how to rely on available alternatives. Such alternatives are often derived from their shared experiences. For example, as the pellet price keeps increasing, Respondent D explained how he reduces the consumption of pellets:

I feed the fish [twice] a day, sometimes I just feed them once [...] a day to reduce the pellet consumption and it seems ok for the fish. I need to try such alternatives to reduce the cost.

As there is growing public unease regarding the health of the aquaculture fish and the methods used to rear them (Amberg and Hall, 2008; Fernandez-Polanco and Luna, 2012; Bergjford, 2009), what have been practiced by entrepreneurs in Pekan shall relieve them. The respondents have relied on their creativity to cure infected diseases by relying on more environmental friendly methods. For instance, based on

their indigenous knowledge, Daun Kapal Terbang, or plane leaves, can be used as a medicine and antibiotic for tilapia. As Respondent G stated:

The leaves [are] good for tilapia, [they] can act as medicine and antibiotic. We can blend [them] together with onion and then with the pellets [...] and it seems that our tilapia can cope with such blended food.

3.1.4 Norm of cooperation

It seems that a norm of cooperation has emerged from the aquaculture activities. As aquaculture involves a number of activities that require the efforts of more than one person, cooperation between the entrepreneurs seems to benefit all of them. Respondent G, for example, clarified how they guard their fish cages:

We don't have any shift[s], the rotation for guarding the block[s] happened by itself, here we have four blocks of cages, people from other block[s] will cover other blocks if their colleagues are yet to arrive. Here there is no specific time for guarding.

Experience is a part of knowledge, and hugely fuels how people conduct their practices (Baynes et al. 2011). Experiences should, without doubt, be shared and disseminated among the entrepreneurs as it can contribute towards the development of both the industry and the entrepreneurs. A good level of cooperation among the entrepreneurs has resulted in this knowledge- and experience-sharing and -exchanging among the new and senior entrepreneurs, as confirmed by Respondent K:

Based on our own experience and information from experienced entrepreneurs, we ask them [for] some information with regard to the best practices and they have no problem to share it with us.

3.2 Problems

In any socio-economic activities conducted, a number of problems inevitably arise, and the communities involved should be ready for them. The problems faced tend to vary in the sense that different groups of communities face different challenges in relation to their activities. In the case of aquaculture entrepreneurs in Pekan, four themes emerged regarding the problems faced in running their aquaculture activities, namely those relating to financial, environmental, seedlings and disease, and human and animal factors. Each of the themes also contains their own sub-themes.

3.2.1 Financial

Financial aspects can be considered the backbone of any economic activities. To intensify their production, entrepreneurs require wider access to additional financial resources, as it assists them to cope with financial issues such as unstable pellet price, and a less commercial and competitive market. In line with

this, the financial category emerging in this study contains a total of four sub-themes: unstable pellet prices, competition from other entrepreneurs, less commercial market, and non-systematic financial records.

3.2.1.1 Unstable pellet price.

Issues relating to pellets are long-standing among the local entrepreneurs, as they have no control over price and pellet producers increase the price from time to time. This scenario increases the production cost and poses difficulties for the entrepreneurs, as outlined by Respondent D: *"The most obvious [problem] is the pellet price and this problem [is] yet to be solved as there is no control [over] it"*.

Respondent F accentuated the role of the government in providing pellet subsidies as one way in which to ease this burden.

[For] paddy farmers, half of their fertilizer [is] subsidized by [the] government, for us, we need the pellet subsidy. If [the government cannot] afford to give us [a] full subsidy, [they should] just give us half of it, it is enough for us.

3.2.1.2 Competition from other entrepreneurs.

It is natural for the business world to face fierce competition in the market. Such competition should, however, be handled carefully, as a study by FAO (2006) confirmed that social conflicts can potentially emerged from such competition. Moreover, as the numbers of aquaculture entrepreneurs are consistently increasing in Malaysia, entrepreneurs in Pekan are expected to face problems in marketing their goods. As the entrepreneurs explained:

The [...] market nowadays is very competitive; our main rival is [producers of] pond fish. Pond fish entrepreneurs typically harvest their fish in a large volume which enables the dealer to buy at a lower price (Respondent K).

Some dealers in Kuantan (place near to Pekan) request stock from P.Pinang, [and] add [s] competition in the local market (Respondent G).

3.2.1.3 Less commercial market.

Most of the respondents interviewed have yet to become commercial aquaculture entrepreneurs, as most of them have inadequate capital to increase the scale of their aquaculture business. As Respondent G stated:

[On average] we are not achieving [the] status [of a commercial business]. Each of us still possess [less than] 30 [cages, and] some of us [...] have less than 20 cages, so we [haven't] achieve[d] the commercial status yet.

3.2.1.4 Non-systematic financial record.

It seems that aquaculture entrepreneurs in Pekan still rely on traditional methods with regards to keeping financial records. Only a few of them have started to use advanced technology such as computers; and this situation is in line with findings by Shaffril et al. (2009), who accentuated the lack of ICT knowledge, skills and compatibility, which results in people refusing to use ICT in their daily tasks or routines. As Respondent G stated: “*We have [to keep] record[s], but we only [keep] written record[s], only [a] few of us use computer[s]*”.

3.2.2 Environmental

The environment is threatened by two main sources: natural disasters and humans themselves. As one of the main dependents on natural sources, any changes to the environment pose great challenges for the entrepreneurs. Within the scope of Pekan, the sub-themes that emerged under the environmental theme are pollution, natural disasters and clean water supply.

3.2.2.1 Pollution.

The aquaculture entrepreneurs have expressed their concern on the pollution caused by the community to the river; the main place they conduct their economic activities. Respondent G accentuated on this by saying “*there are people who [pollute] the river, I mean they throw away [trash], they throw it in the river, in the sea*”. Respondent 3 also stressed concerns regarding logging activities: “*logging activities have caused problem[s] to our fish*”.

3.2.2.3 Natural disasters.

As the world’s climate continues to change, entrepreneurs are predicted to face great challenges. According to Badjeck et al. (2009), the changing climate is expected to threaten aquaculture activities in the sense that such conditions will result in the sea level rising, which will cause salt water to intrude into downstream areas. This scenario will increase the salinity of the water, making it unsuitable for brackish-water species. Similarly, frequent rain is also expected to threaten aquaculture activities, as it can potentially reduce the salinity of the water in downstream areas, again making it unsuitable for brackish-water species. In case of Pekan, frequent rain and floods were mentioned by a number of respondents as the main threats they have to face.

During the flood season, water from upstream [has] intruded [upon] areas which are more suitable for brackish species such as sea bass and tilapia, our fish cannot cope with that kind of water (Respondent K).

Frequent rain can cause death for the fish (Respondent 6).

During [floods] we have to transfer our

cages [...] lots of our fish [die] (Respondent 1).

3.2.2.4 Clean water supply.

A clean water supply is important as it can serve as an alternative treatment for infected fish. Using clean water as a remedy is also more environmental friendly, and lower cost. Unfortunately, accessing clean water poses challenges for the entrepreneurs, as their cages are located far away from the main sources of clean water. As Respondent K stated:

Supposedly we use the clean water [to treat infected fish], but here we have [a] problem [with] supply, previously some of us [brought] clean water from [our] home[s] to the cages but not anymore [...] it consumes too much [of] our energy.

Another respondent stated that as there is no clean water supply at the cages, it poses problems not only for fish treatments but also on equipment. As Respondent G clarified:

If we use the water jet [to clean the nets], as there [is] no clean water supply, we just use the water from the river, unlike typical river water, downstream river has more [salt which] damages the water jet.

3.2.3 Seedlings and disease

Selecting quality seedlings is the most important part of any aquaculture activities as it hugely impacts productivity. Disease is another threat in this industry, and failing to provide early treatment for diseased fish leads to greater problems for the entrepreneurs in the future. Seedlings and disease were frequently raised by the respondents as one of their main problems, and thus low-quality seedlings and disease were identified as sub-themes within this category.

3.3.3.1 Low-quality seedlings.

Low-quality seedlings seem to pose problems for the entrepreneurs. A number of seedling-related issues are raised by El-Gayar (2003): the first relates to the ability to supply seedlings of an appropriate size. Appropriate seedling size is vital as it enables the farm to produce bigger fish, which return more money. The second issue is the ability to produce mono-sex fry, and the third issue is the ability to supply species that suit the salinity levels of the available water. It is likely that these issues might also affect the entrepreneurs in Pekan, as a number of them highlighted seedling quality as an issue in their aquaculture activities.

Most of the seedling[s] provided to us [are] low quality [...] if they provide us with 10 seedlings, only five will survive, in some cases only three or two will survive (Respondent D).

More than 60% of the seedlings died after certain stages (Respondent G).

Seedlings [have] a number of grades [...] some of the dealer[s] provide us with [the lowest] grade of seedlings which in turn pos[e] a great risk to us. We need quality seedlings to produce quality fish as [...] quality fish will increase our income (Respondent K).

3.3.3.2 Disease.

Disease can be considered one of the prime threats in aquaculture activities, and may negatively impinge on the socio-economic development of the entrepreneurs (Bondad-Reantaso et al., 2005). Reared fish can be vulnerable to diseases via 1) the introduction of exotic diseases; 2) sudden changes in the pattern of existing endemic diseases; or 3) the appearance of previously unrecognized diseases (Wei, 2002). Respondent A highlighted scale protrusion as one of the common diseases: *“Typically it is [...] scale protrusion [...] we can detect the infected fish”*. Respondent A added: *“we [use] plane leaves to cure the disease”*.

3.2.4 Human and animal factors

As their aquaculture activities are located near rivers, it is not surprising that the entrepreneurs are facing threats from animals. Fish are the main diet for predators such as monitor lizards and otters, which can be found in large numbers in river areas. Another main threat is criminals who steal the fish, especially during harvest season.

Furthermore, aquaculture entrepreneurs have to deal with losses through theft. The stealing of live fish from cages typically becomes more serious as the harvest season approaches. Respondent F stated: *“usually [thefts happen] during harvest season or during festive seasons, that’s their target”*. The other respondents also accentuated these problems:

The most dangerous [threat] is [thieves], for us that is the main predator and the second one is the original predator; the animal (Respondent K).

Monitor lizards can steal the fish; there are also otters and thieves (Respondent G).

If we are not [on guard] the monitor lizards will steal some of the fish (Respondent 6).

4. Discussions

The findings confirm that caged aquaculture entrepreneurs in Pekan gain a number of benefits from their activities such as increasing their income, obtaining a sense of hard work, creatively solving problems and creating a norm of cooperation. Uniquely, in addition to the benefits in terms of enhancing their income, aquaculture activity is also seen as a tool that intensifies their social bonding and relationships. A number of problems have been highlighted; entrepreneurs should be taught the best methods to

overcome these problems, as failure to do so at the earliest stages might prevent them from gaining the maximum profits from their activities.

One of the best ways to solve financial problems is by widening the entrepreneurs’ access to financial sources. In Malaysia, specific agriculture banking institutes such as Agro Bank are willing to provide loans with minimum interest levels to aquaculture entrepreneurs. Entrepreneurs should be informed of these financing opportunities; furthermore, loan processes should avoid high amounts of bureaucracy, as this has been proven to pose problems to the aquaculture entrepreneurs (Ahmad Faiz et al. 2010). Entrepreneurs and concerned parties can cooperate to overcome pollution problems, and early reports from the entrepreneurs allow concerned parties to take early preventive actions. Pekan, which is located in the East Coast Region of Malaysia, is one of the areas that is affected by monsoons. Though natural disasters such as floods are unavoidable, information, forecasts and warnings from the meteorological department can be used by the entrepreneurs to strengthen their preparation against natural threats. In addition to early warnings on natural disasters disseminated by traditional mass media such as television, radio and newspapers, aquaculture entrepreneurs should also be exposed to early warning systems provided in websites such as that belonging to the Malaysia Meteorological Department (http://www.met.gov.my/index.php?option=com_weat_heropenwaters&Itemid=909), and the Department of Irrigation and Drainage Malaysia (<http://infokemarau.water.gov.my/> and <http://infobanjir.water.gov.my/realtime.cfm>).

Courses, seminars and training are needed with regard to seedling quality, and aquaculture entrepreneurs should be given the opportunity to attend these events. One of the things that should be included in these training opportunities is how to identify the head, the body and the tail of the seedling. This technique is vital so as to avoid high death rates of the seedlings, which can impact the entrepreneurs’ income during the harvesting season. In addition, courses and seminars can inform the entrepreneurs about proactive (prevention) actions and reactive actions (taken for the infected fish) for diseases, which in turn will inform them about what should be done and what should be avoided if their fish are infected with any diseases. Threats from predators and thieves can be reduced by conducting rotation guarding among the entrepreneurs. This strategy will ensure that their cages are monitored at all times. Furthermore, placing CCTV at strategic places could be an effective way in which to guard the cages.

This study reflects perspectives that may differ from other studies. Nevertheless, such

differences can lead to a variety of perspectives that might assist the government and the aquaculture industry in becoming more prepared and equipped to generate a socially acceptable and sustainable industry. Considering and including all of these views in their planning is deemed crucial, as, according to Hugues-Dit-Ciles (2000), the values and needs of locals should be considered in aquaculture planning.

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;
kidin@putra.upm.edu.my.

References

- [1] 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.
- [2] Amberg S, Hall T. Communicating risks and benefits of aquaculture: A content analysis of US newsprint representations of farmed salmon. *Journal of the World Aquaculture Society* 2008; 39 (2): 143-57.
- [3] Badjeck M-C, Allison EH, Ashley SH, Nicholas KD. Impacts of climate variability and change on fishery based livelihood. *Marine Policy* 2009; 3: 375-83.
- [4] Baynes J, Herbohn J, Russell I. The influence of farmers' mental models on agroforestry extension program in the Philippines. *Small-scale Forestry* 2011; 103: 377-87.
- [5] Bergjford OJ. Risk perception and risk management in Norwegian aquaculture. *Journal of Risk Research*, 12 (1), 91-104.
- [6] Bondad-Reantaso M, Subasinghe RP, Arthur JR, Ogawa K, Chinabut S, Adlard R, Tan Z, Shariff M. Disease and health management in Asian aquaculture. *Veterinary Parasitology* 2005; 132: 249-72.
- [7] Department of Fisheries Malaysia (DOF). Estimated value and aquaculture production from all aquaculture system, 1998 –2007. Retrieved on 4 December 2012, from: <http://www.dof.gov.my/html/perangkaan/files/Carta%20utk%20laman%20web.pdf>. 2010.
- [8] El - Gayar OF. Aquaculture in Egypt and issues for sustainable development. *Aquaculture Economics & Management* 2003; 7 (1-2): 137-54.
- [9] Fernandez-Polanco J, Luna L. Factors affecting consumer' beliefs about aquaculture. *Aquaculture Economics and Management* 2012, 22-39.
- [10] Food Agriculture Organization (FAO). Retrieved on 5 December, 2012, from: <http://www.fao.org/docrep/009/a0874e/a0874e00.htm>. 2006.
- [11] Hugues-Dit-Ciles EK. Developing a sustainable community-based aquaculture plan for the lagoon of Cuyutlan through a public awareness and involvement process. *Coastal Management* 2000; 28 (4): 365-83.
- [12] Katranidis S, Nitsi E, Vakrou A. Social acceptability of aquaculture development in coastal areas: the case of two Greek Islands. *Coastal Management* 2003; 31 (1): 37-53.
- [13] Mazur NA, Curtis AL. Risk perceptions, aquaculture, and issues of trust: lessons from Australia. *Society & Natural Resources: An International Journal* 2006; 19 (9): 791-808.
- [14] Piumsombun S, Rab MA, Dey MM, Srichantuk, NN. The farming practices and economics of aquaculture in Thailand. *Aquaculture Economics and Management* 2005; 9 (1-2), 265-87.
- [15] Schlag AK. Aquaculture: an emerging issue for public concern. *Journal of Risk Research* 2010, 13 (7): 829-44.
- [16] Shaffril HAM, Hassan MS, Abu Samah B. Level of agro-based website surfing among Malaysian agricultural entrepreneurs: a case of Malaysia. *Journal of Agriculture and Social Science* 2009; 5 (3): 55-60.
- [17] Weeks P. Fish and people: Aquaculture and the social science. *Society & Natural Resources: An International Journal* 1992, 5 (4), 345-357.
- [18] Wei Q. Social and economic impacts of aquatic animal health problems in aquaculture in China, pp. 55–61. 2002. In: *Primary Aquatic Animal Health Care in Rural, Small-Scale, Aquaculture Development*. Technical Paper No. 406. Rome, Italy: FAO.

7/23/2013