Promotion of Sustainable Aquaculture in Malaysia

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Abstract

Aquaculture has been identified as a priority sector in the development of Malaysia's economy. It receives a wide participation as a result of the progressive development in most parts of the country. From producing only about 7% of the national fish production in 1992, aquaculture has produced almost 13% to that of capture production in 2003, and expected to produce equal volume to the latter in the future. The aquaculture production leaped from less than 80,000 metric tonnes in 1992 to more than 427,000 metric tons in 2017 valued at MYR3 billion. Demand is expected to continue to grow with anticipated population growth. Aquaculture provides employment, business and investment opportunities in this country. As of 2017, there are over 18,000 aquafarmers in Malaysia, with a total farm size of more than 34,000 ha. Two key factors i.e. the physical and financial factors, have boosted the competitiveness of Malaysia's aquaculture industry. The National Key Economics Area (NKEA) has become a mechanism to allow big players to lead private sectors participate in this industry. This paper intends to explicate Malaysia's aquaculture potentials with a view to provide insight prospects for aquaculture growth.

Keywords: aquaculture, sustainable, fisheries, Malaysia

Introduction

World population is expanding from 7 billion in 2011 and estimated to reach 9 billion in 2050 (Teh, 2012). Therefore, growth in human population also means increase in food intake. Fish and fish products have become essential diet components for most of the world's population. Currently, world fish supply is predicted to increase to 187 million metric tons (mt) by 2030. Nonetheless, capture fisheries is observed to remain stagnant over the period of 2000-2030 and global aquaculture projection will progressively increase until it reaches the points where it equals production from captured fisheries by 2030 (World Bank, 2013).

Global aquaculture continues to grow faster than other major food production, contributed nearly 47% of the world's fish, with an average annual growth of 5.8% during the period 2000–2016 (FAO, 2018). Global farm food fish production was 32.4 million mt in 2000 up to 55.7 million mt in 2009 and 80 million mt tons in 2016 (Roslina and Amir, 2014; FAO, 2018). Asia-Pacific is the highest world aquaculture producer with 92.5%. The largest quantities are from China accounting for more than a third of global production (World Bank, 2013). The world population is estimated to reach 8 billion and 2.2 million metric tons of fish need to be produced to meet the demand for an annual per capita consumption of 29 kg (Rosita, 2017).

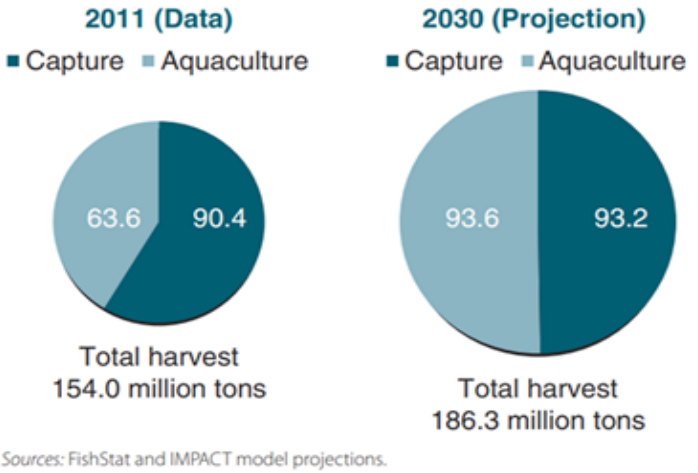

Figure 1. Aquaculture vs. capture fisheries from 2011 to 2030

Fish and fisheries products are popular sources of protein in Malaysia. The demand for fish is expected to increase from 1.3 million mt in 2010 to 1.9 million mt by 2020 (DOF, 2015b). In 2017, the total fishery production of the country has reached 1.93 million mt with a total value of MYR14.1 billion (DOF, 2019). Fisheries sector is composed of two major components, namely marine capture fisheries and aquaculture. They make vital contribution to Malaysia's food security and provide important livelihood opportunities and income for many subsistence fishing and farming families (Fisheries Research Institute [FRI], 2017a). Fish is presently the most inexpensive source of animal protein consumed by the commoners and it is a typical menu for Malaysians. According to the Food and Agriculture Organisation (FAO) Malaysia is among the top fish consuming nations in Asia (54.5 kg/year in 2010). The value goes higher in 2014 at 56.5 kg per capita higher than Thailand and China, but still below the levels in Japan and South Korea (Teh, 2012).

Current scenario of aquaculture industry in Malaysia

Malaysia's aquaculture began in the 1920s, starting with the polyculture of Chinese carps in ex-mining pools, followed by shrimp farming using trapping ponds in the middle of 1930s, and then culture of blood cockles in mud flats in early 1940s (Teh, 2012; Rosita, 2017). Cage aquaculture started in the early 1970s with the semi-intensive culture of shrimp, and the sector has significantly expanded in recent years (Kechik, 1995). Presently, Malaysia's aquaculture includes marine, brackish water, and freshwater aquaculture.

The aquaculture industry in Malaysia is still small compared to its neighbouring countries such as Thailand, Indonesia, Philippines and Viet Nam (Roslina and Amir, 2014). However, Malaysia also supplies aquaculture products to other countries through exports. Malaysia's major export products are freshwater fish

(tilapia and catfish) shrimps (*Penaeus* spp.), marine finfish (groupers, snappers and seabass), molluscs (cockles, mussels, and oysters) and seaweed (**Figure 2**).

Since 2003, the Government of Malaysia has implemented many programs to boost the potential of this industry. The government has committed an enormous allocation of physical and financial services to various aquaculture projects, particularly Aquaculture Industrial Zone (AIZ) projects. Basically AIZ are designated zones for both lands and water bodies which are granted by the state government for commercial scale aquaculture projects. The establishment of AIZ has transformed the aquaculture sector into a more technological activity driven by high market contribution in order to increase national food production and resolve the shortfall in captured fish production. In that particular year, aquaculture production reached 196,874 mt valued at over MYR10 billion, and contributed about 13% of the total fisheries production. Brackishwater aquaculture, with a total volume of 144,189 mt and covering an area of 17,357 ha, represented almost 70% of aquaculture production in terms of both quantity and value (DOF, 2003).

Since then, aquaculture has been acknowledged as a strategic industry that can accomplish the local demand for high value protein resources as well as demand for fish products for trade purposes. This has facilitated the government to reach its goals in the Ninth Malaysia Plan for food production growth of 33.4% or 1.8 million mt for fisheries and reached 103% self-sufficiency level by 2010 (Teh, 2012). The aquaculture industry benefited the country at both domestic and international levels by reaching the target for fish production and also recognized private sector technical and research capabilities for economic growth (Rosita, 2017).

The importance of aquaculture production in Malaysia's economic growth continued to be highlighted in the National Agro-Food Policy (NAFP 2011-2020) as the main focus in boosting the competitiveness of Malaysia's agriculture sector. The NAFP, which was launched in 2011, is the current policy by the Malaysian government in agriculture. Overall, the centre stage in NAFP is maximizing aquaculture contribution to food security and to national income and export earnings as well as maximizing income of aquaculture producers (Othman *et al*., 2017).

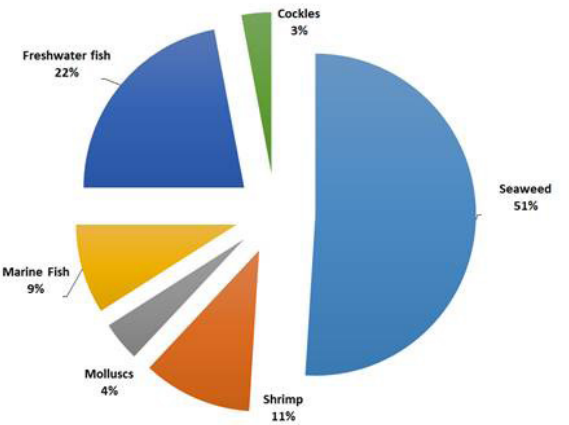

Figure 2. Aquaculture production in Malaysia in 2015 (Othman *et al*., 2017)

Earlier during the Third National Agricultural Policy (NAP3 1998-2010), a prospective development plan for aquaculture beyond 2010 was projected with a production target of 508,000 mt annually. Under NAFP, the target was further pushed to 790,000 mt, with an annual projection growth of 8.6% (Baki *et al*., 2012), as shown in **Figure 3**.

The aquaculture sector is recognized as one of the important drivers of economic activities under the Malaysia National Key Economics Area (NKEA). Sixteen agro-food Entry Point Projects (EPP) of the NKEA are listed under aquaculture. The government has allocated MYR18.9 billion for the 16 EPPs, where 70% sharing are from private sector (local and foreign) and the balance are supported by the government. These projects receive prioritized government support and focuses on transforming a traditional small-scale, production based sector into large scale business industry. The EPPs and Business Opportunities (BO) are driving the growth of the private sector while allowing them to get involved and offer opportunities for investment. Under BOs, the related program helps to create opportunities for aquaculture in terms of future growth such as branding and marketing. On the other hand, the EPP program aims to establish growth in food production. Here, three sectors for aquaculture have been identified namely ornamental fish farming, feed mills and export centres.

Currently, under the EPPs, DoFM has engaged with commercial-scale seaweed farming in the east coast of Sabah, integrated shrimp aquaculture zones and integrated cage culture with different goals. The aim of seaweed farming is to create high-yield commercial scale business by clustering farms under mini-estate initiative. The production of seaweed is projected to rise from 20,000 tons dry weight in 2010 to 150,000 tons dry weight by 2020 (Othman *et al*., 2017). Meanwhile, the EPP on shrimp sector seeks to increase production of fully export premium quality shrimp to all major markets. This can only be achieved by zoning the affected areas in integrated way and fully equipped with infrastructures and facilities such as hatcheries, processing plant, feed mill, grow-out pond areas and driven by anchor company. Target for cage farming is to increase production of high-value commercial fish species such as seabass, groupers, snappers and tilapia. It is projected that the fish production from this project will increase to 28% of the

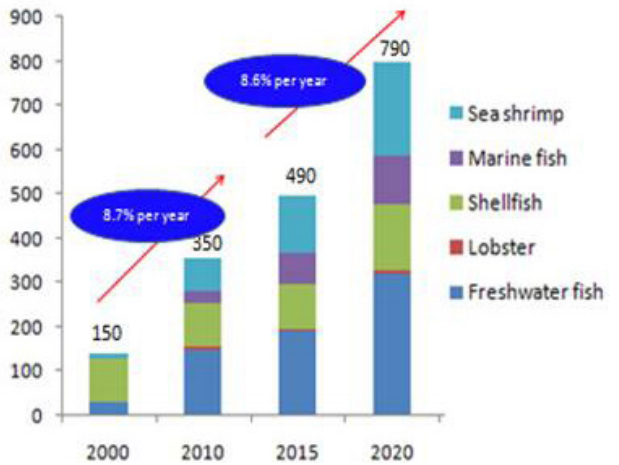

Figure 3. Target aquaculture production 2000-2020 ('000 mt)

total volume of the aquaculture production (Othman *et al*., 2017).

In 1992, this sector employed nearly 18,000 people who were mostly involved in freshwater farming. The total pond area was 8,360 ha and a total of 426,846 m^2 of cage were used (Kechik, 1995). Since then these numbers have grown rapidly. In 2013, there were about 1,966 brackishwater cages and 84 brackishwater pond entrepreneurs located in Malaysia. The total land used for the brackishwater aquaculture projects was 2,861,069 m^2 for cages and 6,903 ha for ponds (Rosita, 2017).

In 2017, aquaculture production in Malaysia has contributed food-fish of 427 millions mt valued at MYR3.041 billion (**Figure 4**). There were 18,378 aquafarmers in Malaysia, mainly in the freshwater sector, with the total farm size of 34,300 ha (DOF, 2017). In terms of percentage share of gross domestic product (GDP) in the national agriculture sector, the aquaculture sector consistently contributed significantly from 6.7% in 2010 to 8.9% in 2016 (DOS, 2016).

The aquaculture industries do have some issues and challenges. Among the common issues faced by these industries are lack of local workforce. Malaysia's aquaculture industry depends on 7,850 registered foreign workers (Othman *et al*., 2017). Other than that, small-scale farmers in Malaysia are burdened with high cost of farm operations, especially since 60-70% of cost are attributed to commercial fish feeds. In addition, lack of good quality of fry and broodstocks, emerging of new fish diseases such as Tilapia Lake Virus (TiLV) and Early Mortality Syndrome (EMS) / Enterocytozoan Hepatopenaei (EHP), and export barriers imposed by developed countries such as America gives a great pressure and challenge to farmers. The issue on quality and safety of fisheries products varies from one importing country to another and it changes from time to time. In facing these issues, the local entrepreneurs need to be more sensitive and further explore new markets to ensure that the excessive volume of fisheries products in domestic market could be exported profitably. At the same time, the products need to be produced in a cost-effective manner, realizing that the local production cost is getting higher compared to top competitors such as China, Indonesia, Viet Nam and Thailand. These issues and challenges, however, could be managed successfully with the effective communication and up to date information (Sharihan *et al*., 2018).

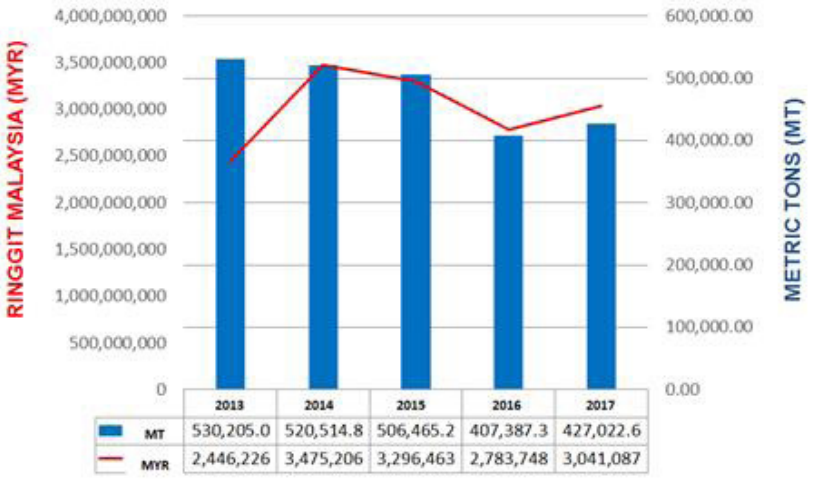

Figure 4. Malaysia aquaculture production (2013-2017)

Way forward: Aquaculture as a new frontier in food production in Malaysia

The Department of Fisheries Malaysia (DoFM has taken serious effort to achieve the Key Performance Indicator (KPI) for aquaculture sectors. To initiate the overall production, three sectors of aquaculture implementations were identified. They are (i) NKEA aquaculture project implementation and set to produce 33% of the required volume; (ii) development of new aquaculture areas which will produce 27% of the production; and (iii) increase productivity from the current operation hence to produce 40% of the total fish production (**Figure 5**).

Since aquaculture has been recognized by the Malaysian government as one of the priority under the NKEA focus, it suits as an alternative to improve the living standards of rural population. The NKEA has become a mechanism to allow big players to lead private sectors participate in this industry, helping to enhance national economic activities by creating many job opportunities, producing high value fish and fish products, and creating aquaculture chain productions from hatcheries to marketing level. In total, NKEA projects have created jobs for 2,872 people, invested approximately MYR410 million in 36 EPP. In 2018, about 23,602.74 mt of fish and fishery products were recorded with sales of MYR660.87 million (DOF, 2019).

Malaysia is the first country in Asia to embrace and implement Good Aquaculture Practice. It was launched as myGAP on 28 August 2013. myGAP is a comprehensive certification scheme for agricultural, aquaculture and livestock sectors. DoFM has produced documentation and guidelines on Good Aquaculture Practice – Aquaculture Farm (GAqP) for each aquaculture system. It is a very inclusive guideline that covers all the critical criteria of food safety and environmental concerns. GAqP is a scheme for aquaculture farm while General Guidelines and MS 2467:2012 Code of Practice used for seaweed cultivation. Compliance of myGAP will not only benefit farmers to produce fresh and best quality fish but the most important aspect is customers trust and rights to have safe and reliable food to consume. In addition, it will also increase Malaysia agricultural products competitiveness at the international level. There are still more rooms for MyGAP direction to achieve such as increase number of farms with MyGAP certification to encourage sufficient production of quality and safe agricultural products for domestic consumption and international markets, increase customer's awareness and demand for quality and safe agricultural products with MyGAP logo, and benchmark with international GAP certification scheme such as the ASEAN GAP and Global GAP. To date, about 70% of farmers in Malaysia has been certified with MyGAP that make them eligible to export their products to Singapore, Korea, Australia, America and European

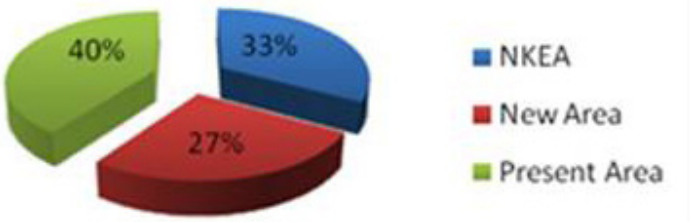

Figure 5. Source for aquaculture production

countries. At least 395 farms are expected to be MyGAP certified by 2020 (DOF, 2019).

DoFM has introduced a new concept of synergy farming in dedicated aquaculture zones called Aquaculture Industrial Zones (AIZ). In 2015, there were 56 AIZ sites with a total area of 24,388 ha (DOF, 2016). The overall projected AIZ production is 400,000 mt with a value of MYR5.8 billion, focusing on highly commercial species, such as tilapia, groupers, penaeid shrimps, mussels and seaweed (Baki *et al*., 2012).

One of the successful synergy farming is located in Tasik Temenggor, Perak, covering a water body of approximately 100 ha. The new strain of Genetically Improved Farmed Tilapia (GIFT) was used in this farm. The marketing chains are mainly for overseas such as America, Middle East countries and Singapore. As for mollusc culture, Malaysia has traditionally cultured green mussel (*Perna canaliculus*) using the longline method and it represents the second most important bivalve species after the blood cockle (*Tegillarca granosa*). Nowadays, Malaysia is using a new technology called mussel smart line farming that can produce approximately 10 mt per line with minimal workforce. This system has been introduced to 25 participants in Johor, and has generated income to this community up to MYR3.6 million (DOF, 2019).

In addition, a comprehensive plan named Aquaculture Project Implementation (API) with adoption of quick-win and high outcomes to drive viable and sustainable aquaculture activities has been implemented. Some of the strategies proposed in the API include upgrading existing entrepreneurs' projects and having engagement sessions with local agencies such as Muda Agricultural Development Authority (MADA) and Kemubu Agricultural Development Authority (KADA) to provide general release programs or restocking for species suitable for canals, paddy fields, mine sites or lakes. Private sectors interested in undertaking the program will be identified and assistance provided (MOA, 2019).

Cluster approach for several existing projects in the states has been implemented by focusing on one species such as the freshwater prawn project in Negeri Sembilan, the fish cage farming project in Pahang and the cockle project in Johor. Special teams have been established as management and technical advisors that comprise representatives from the Fisheries Research Institute (FRI), Aquaculture Development Center and the State Fisheries Office.

It is undeniable that technology and innovation had play an important role to aquaculture production in the world, as well as in Malaysia. DoFM has furnished the strategic plan and the key elements within the plan of action in order to enhance the productivity in aquaculture industry through research and development, technology and innovation. Some of the new technologies and innovation that have been introduced in aquaculture sectors are the production of Red Tilapia, blue Kelah fish and Recirculating Aquaculture System.

Tilapia has always been the favourite fish among locals in Malaysia. With red colour characteristic similar to marine fish, moderate market price, easy to breed and rear, it makes Red Tilapia one of the major species for aquaculture. Currently, tilapia hatchery operators have just bred fingerlings in mass production without having proper information on their origins, genetic background, growth performance and pedigree information and then sell directly to fish farmers. However, the aquaculture sector is facing lack of high-quality seedstock for production. Therefore, DoFM has taken initiative to

produce Red Tilapia with faster growth and resistance to diseases through genetic improvement program using selective breeding method (FRI, 2017b). The program has successfully developed selected strains that produced higher growth rate (2.8 g/day) and higher survival rates (78 %) compared to unimproved strain of Red Tilapia (Azhar *et al*., 2017). Thus, the improved strains are valuable genetic resources for aquaculture industry. Moreover, it could reduce the operational cost.

Kelah fish (*Tor* sp.) is one of the most expensive fish in Malaysia where its price can fetch up to MYR1000/kg. According to DOF (2015a), the production of Kelah in 2015 was 24.76 mt and it dropped to 19 mt in the following year due to difficulties in obtaining seeds. Most hatchery operators collected Kelah seeds from its natural habitats. This method contradicts with the general practice and regulation of natural fisheries resource conservation. In this regard, the DoFM has implemented the development program for Kelah to produce potential and competitive new varieties that can compete with existing aquaculture species in Malaysia (FRI, 2017b). Among the benefits of the program are as follows:

- Increase the hatching rate from 50 % to 90% via a simple nursery system.
- Increase the incubation rate of eggs from one to four times a year through the provision of a formulated diet specifically for the matured bloodstocks.
- Improved the quality and quantity of eggs produced by each broodstock.

DoFM has successfully introduced an innovation called the Cheap Efficient Nursey Tank System (CENTS) which can produce more efficient and cheaper tank system to address problems of seedling. The system used continuous flow of water that connected the nursing tank to the pump from the improved water storage tank with the Recirculating Aquaculture System (RAS), making the CENT-RAS system a unique innovation by DoFM. The system offers cheaper, more efficient, economical, minimal time management and flexible features, and enables the salinity to be adjusted to the level required in order to minimize the usage of seawater. This system has resulted in higher production of marine fish by up to 90 % from 20 kg/tons to 64.4 kg/tons.

In terms of fish health management, DoFM has developed SirehMax, an innovation product from FRI, that could inhibit the growth of microbial culture (FRI, 2017b). It is capable of replacing antibiotics by increasing the marine life expectancy by more than 80 % with a much lower treatment cost of MYR0.40/kg food per treatment compared to MYR1.40 for antibiotic costs. SirehMax is not only effective in controlling marine fish diseases but is also designed to be user friendly and environmentally friendly.

In addition, DoFM has produced grouper hybrid via its spawning technology which has managed to increase the cycle of farming rate by reducing the breeding period from a year to just 10 months with a high survival rate of 76 %. This technology has also reduced its predatory features compared to tiger grouper. The sale price of this hybrid grouper eggs is around MYR6,000 to MYR10,000 per million eggs. While the price of 10–12 cm juveniles is between MYR5–MYR7 per individual.

The potentials of aquaculture can further be developed through the advancement in biotechnology as a means to enhance productivity via improved yield and quality of production. Potential benefits

include improving growth rate and cost effectiveness; increasing resistance to environment and pathogens; improving broodstock quality and control reproduction; and creating new and better products. The main challenges in the application of biotechnology in Malaysia are quoted as limited financial resources, lack of qualified personnel, less optimal structure for cutting edge research, and limited international collaboration.

Overall, aquaculture development in Malaysia continues to sustain due to its strategic location in the heart of Southeast of Asia. Blessed with abundant fisheries resources, good climate and generally safe or free from natural disasters, Malaysia offers the perfect ambience for aquaculture to grow steadily in the future and provide ample supply of raw materials for a wide range of seafood industries. With strong support from the government of Malaysia under the NAFP (2011-2020) and National Economic Transformation Programme as part of the government's strategy, aquaculture supply will continue to increase and will help to improve the balance of trade and expand Malaysia's export.

Conclusion

Aquaculture in Malaysia is the forefront of fish production for national food security. However, the growth rate of development is not significant. Good and efficient aquaculture practices in farm management will influence the potential growth of this sector and minimize farm production risks and vulnerability. At the farm level, all aspects of aquaculture farm management have direct bearing on the sustainable growth of this sector currently and in the future. While at the same time, ensure that aquaculture practices remain sustainable and safe. This will produce high quality aquaculture production including effective land use management as well as technical factors such as labour, feed management, harvesting, and marketing the products. Undeniably, technological assistance will help enhance the future growth of aquaculture. Thus, the creation and availability of low-cost and efficient aquaculture technology may help aquafarmers in enhancing their production. While big enterprises fund their own research for technology improvement, this is not applicable to more than 80% fish farmers in the country, which are small scale and family farm operators. Technology and innovation must be initiated and sourced by the government in order to improve the aquaculture sector. It is the objective of DoFM to manage the fisheries and aquaculture into an economic, profitable and sustainable industry in the long run and at the same time to protect and rehabilitate the marine habitats and ecosystems.

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