

BACHELOR OF SCIENCE (SCIENCE MARINE)

2020

SUSTAINABLE

AQUACULTURE

MARINE COASTAL AND DELTA SUSTAINABILITY FOR MALAYSIA



MILLBROOK, DUNGUN



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*The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained



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Co-funded by the
Erasmus+ Programme
of the European Union

INTRODUCTION

Aquaculture is very important to us in a lot of aspects, such as the economy, generation of income (society), wildlife food, human food, and the improvement of our standard of living around the world. There are many organisms living under water, such as fish, plankton, algae, molluscs, crustaceans and other organisms. The most important aspect of aquaculture is they are one of human food sources so that we can get enough energy, nutrients for our body and keep our body in a stable state for physical activities.



Figure 1.1 : Millbrook farm captured by Yasmin at Dungun, Terengganu

For the **environmental** impact, aquaculture should not create significant disruption to the ecosystem, or cause the loss of biodiversity or substantial pollution impact. For the **economic** benefit, aquaculture must be a viable business with good long-term prospects. Last but not least, for contribute to local **society** is aquaculture must be socially responsible and contribute to community well-being. Sustainable aquaculture could be a dynamic concept and also the sustainability of an aquaculture system will vary with species, location, societal norms and also the state of data and technology.

Sustainable aquaculture is the production of marine animals, including fish, molluscs, crustaceans and aquatic animals. Sustainability is the ability to thrive on a continuous basis that is capable of sustaining its habitat in the long term. In short, sustainable aquaculture means that the production of aquatic species for commercial purposes has an environmental impact, contributes to local society and can bring economic benefits.

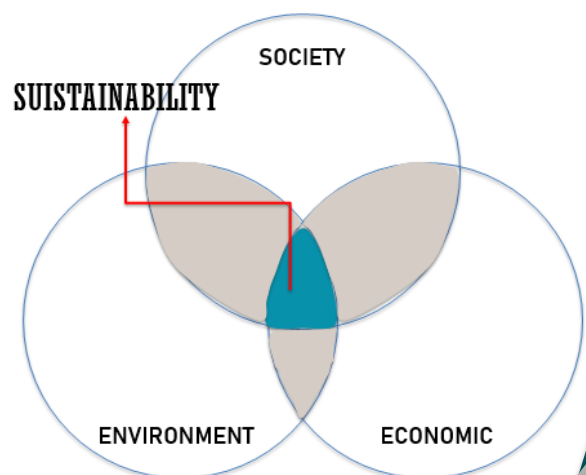


Figure 1.2 : Sustainable basic Venn

PRODUCTION FISHERIES AT MALAYSIA

Importance of aquaculture are aquaculture contributes about 20 percent of the full catch in Malaysia. Not only that, aquaculture fisheries are currently a really important agricultural sub-sector as a complement to the marine fisheries sector in Malaysia. Among the importance of aquaculture is that it supplies protein sources. From the Sources of the Fisheries Department, in 2007 alone, aquaculture contributed approximately 729.47 metric tones of protein supply to the country.

Additionally, aquaculture can avoid the extinction of marine life. Intensive marine fishing activities have caused some marine life to become extinct. Therefore, with the aquaculture sector, endangered marine species is preserved like grouper, tiger prawns and sea bass. Not only that, aquaculture also reduces the destruction and disruption of ecosystems. Does not involve the employment of kit that may disrupt and destroy habitat. For instance, fishermen now rarely use nets during fishing and that may destroy corals. Therefore, the aquaculture sector is extremely important to make sure an eternal supply of protein in Malaysia.

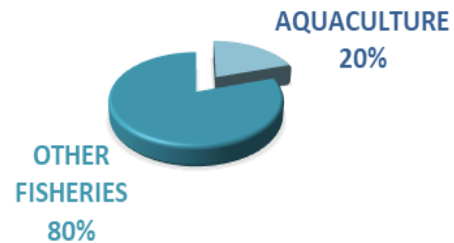


Figure 2 : Fisheries at Malaysia
Source: (Kepentingan Akuakultur, 2017)

Purposes of aquaculture are practiced for a variety of purposes, including food production and income generation. The bulk of the production of freshwater aquaculture (over 70%) comes from food-deficit countries with low incomes. Fish farming, even in the poorest countries, is rarely a subsistence activity. Thus, while farmers may consume a number of their products, they typically sell fish, allowing farmers to earn income by buying other goods and services. Additional aquaculture purposes are the use of land that is not suitable for agriculture, the use of inland water bodies such as shallow lakes, the recovery of saline soils, the increase in the supply of highly valued species and the improvement of the reliability of fish supplied on the marketplace.

There are many **type** of aquaculture. But in this eBook will explain shortly about the type of aquaculture in Malaysia.

Firstly is **fish farming**. Fish farming is raising fish in tanks commercially, usually for food stock business. In Malaysia usually fish farmer farming carp, tilapia and catfish.



Figure 3.1 : Fish Farming at Dungun, Terengganu captured by Yasmin.

Second is **mariculture**. Mariculture involved the use of seawater. The organisms bred such as prawns, some type of shellfish and seaweed. This bred can contribute to manufacturing in cosmetics and jewelry industries as they have collagen from seaweed and pearls from molluscs.



Figure 3.2 : Dr Tan breeding cockle (USM researcher)
Source: (SimYK, 2018)



Figure 3.3: Type of alga in the cultivative
Source: Algaeworldnews. (December 18,2014)

Third is **algae culture**. Alga culture is a little bit different because they used cultivation of algae. Algae are microbial organisms that share animal and plant features but like motile like other microbial and also contain chloroplast and make algae green.

Forth is **pond culture**. Pond culture is the farm that was redesigned from rows of single ponds to a bio-secure modular system lined with high-density polyethylene (HDPE) with reservoirs for water treatment. By adding paddlewheel, the number and position are standardized in line with stoking density and culture system for having dissolved oxygen at acceptable level in the pond.



Figure 3.4 : Pond Culture at Kuala Lumpur
Source: Global Aquaculture Advocate. (September 19,2018).

Fifth is **recirculating system** (RAS). RAS provide a constant and controlled environment for the fish, allowing for optimal and fully manageable production. The innovation at the research centre in Tanjung Demong, Terengganu, Malaysia successfully created a simple and cheap RAS called CENTS (cheap efficient nursery tank system) for small scale nursery operators but can easily adopted by the commercial scales hatcheries.



Figure 3.5 : Recirculating system
Source: Mahmud Ismail. (January 9, 2021).

Sixth is **open net and cage system** often found at offshore and in freshwater lakes. The fish are kept in a mesh cage. With high concentration of fish in the pens, waste, chemicals, parasites and diseases are often exchanging environment. This open cage also attracted the predator in the sea.



Figure 3.6 : Open net at Kukup, Johor
Source: (Amierah Amer, 2020)

There are many **ways** to managing sustainable aquaculture and one of them is to make advances in newer technologies. Researchers are encouraged to do research about technology that can develop new techniques and methods for sustainable food production. Research can be done in different aspects such as disease control, weed control and feeding. To supplement conventional approaches, science and technology will play a significant role in designing low-impact development processes.

Next **way** is to develop in innovative fields of alternative energy. For example, the usage of wind turbines for shellfish and the usage of solar-powered heating and cooling systems, also wind powered water pumps. If the government encourages the researchers to research this, it will have a positive impact towards the image of aquaculture.

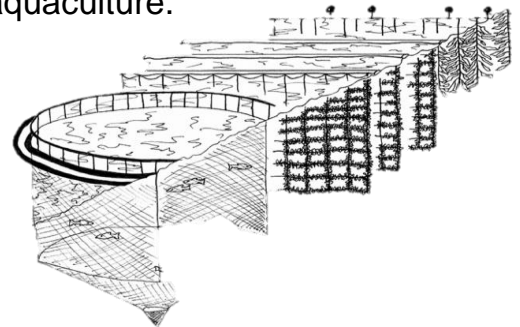


Figure 4 : Integrated multi-trophy aquaculture is the most efficient aquaculture.

Source: (Susan Løvstad Holdt & Maeve Edwards, 2014)

Benefit of aquaculture for the **economic** aspect is giving alternative food sources. Good sources of protein include fish and other seafood. Compared to other meat-producing animals, fish is also easier to keep as they are able to convert more feed into protein. Next, with this aquaculture, it can prevent the shortage of seafood stock and prevent the high demand of seafood because of the deficit stock. This causes the price of seafood stock to still maintain and not increase.



Figure 5
Source:(Oana, 2018)

Other than that, aquaculture of algae can be another alternative for fuel source. Algae generate lipids that can be burned as an alternative source of fuel if harvested. In addition, algae fuel is an energy source that is cleaner and farmable, which means it can give resources to the energy sector and create a more stable economy that can avoid the boom-bust nature of oil and replaces it with a more abundant fuel source.

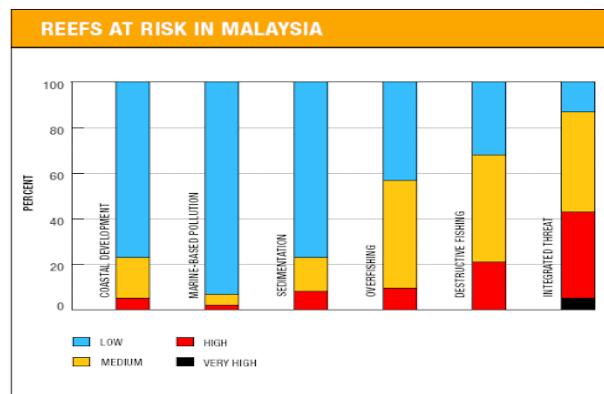


Figure 5.1 : Overfishing caused the reef broke too.
Source: (ReefBase : Global Database : Threats - Reefs At Risk - Southeast Asia, Malaysia, 2021)

Next, for the **environmental** aspect, aquaculture can reduce fishing pressure to the wild stock. Overfishing and unregulated exploitation, make the species in danger of being depleted. Hence, aquaculture help to rebuild wild populations. The option for less labour with more profits pushes fishermen to switch to fish farmers.

Other than that, aquaculture can give low impact to the environment because, for example, filter-feeding shellfish, such as oysters, are grown in situ, water quality can improve in ponds and lakes. It is also possible to farm fish and shellfish using methods that do not harm the environment. The Biosecurity systems, cameras and surveillance infrastructure, ensure that farms comply with environmentally safe activities and helps reduce the spread of diseases in the water.

Although, it also can prevent pollution with molluscs and seaweed because they like are filter feeders. Both these creatures, as carried in by the current, sift the water that flows through them and clean the water. This protects the rest of the sea from land contamination, especially from activities that disrupt the bed of the sea and raise dust.



Figure 6 : Mussels
Source: (Rashidah Ibrahim, 2018)

Next, for the **society** aspect, aquaculture provides more resources with less effort and cost. More efficient than cattle or chicken production, fish convert feed into body protein. It is much more efficient, which means that fish companies are producing more food for less feed. Such efficiency means that food is produced using less food and energy, hence the production process is cheaper as well. It saves resources and even allows for the production of more food, leading to secure reserves and less environmental stress.



NKEA AKUAKULTUR			
	EPP#3 (Seaweed)	EPP#4 (i-Cage)	EPP#6 (i-Zaq)
JUMLAH PELABURAN	• RM 165 juta	• RM 243.613 juta	• RM 2.46 Billion
GNI	• RM 1.4 Billion (RM 1.1 B)	• RM 1.4 Billion (RM 1.1 B)	• RM 1.3 Billion (958.62 juta)
PELUANG PEKERJAAN	• 13,000 orang (1,608 orang)	• 10,100 orang (1,700 orang)	• 12,000 orang (3,535 orang)
PERUNTUKAN 2011-2015	• RM 100.87 juta (RM 61.625 juta)	• RM 142.835 juta (RM 48.53 juta)	• RM 299.194 juta (RM 183.798 juta)
BIL PROJEK DILULUSKAN	• 16 Projek (10 mini estet & 6 kluster)	• 9 Projek	• 15 Projek
KPI 2011-2015	• 119,500 t.m (108,335 t.m)	• 104,958 t.m (107,829 t.m)	• 97,500 t.m (69,480 t.m)
QUANTUM DILULUSKAN	• RM 56.38 juta	• RM 50.81 juta	• RM 628.6 juta
			

Figure 6.1 : Job opportunities
Source: Portal Rasmi Jabatan Perikanan Malaysia. (2013).

Other than that, aquaculture makes jobs market wider. In the market, aquaculture increases the number of possible jobs. It provides a market with both fresh products and creates job opportunities as labour is required to maintain the pools and harvest the cultivated organisms

In addition, aquaculture gives health benefits. The demand for seafood has increased worldwide because people have learned that seafood is healthier and helps combat diseases such as cardiovascular disease, cancer, Alzheimer's disease and many other major diseases. Seafood has now become part of ordinary diets.

There are some **disadvantages** of aquaculture despite the good intentions of cultivating fish for consumption and increasing the population of fish, it can also lead to an increase in the population of invasive species that are harmful to other marine species because they take away food supplies from fish in the wild and the closest example is crawfish farming. Crawfish eat almost all things include small fish and egg fish.



Figure 7 : CrawFish

Source: (rally, 2019)

For pond and fish farming, pumping groundwater to supply fresh water to livestock caused depletion and causing water shortage for coastal community. Not only that, aquaculture can give negative impact to environment because the usage of cage can reduce the dissolved oxygen in the water. Other than that, the waste of cage aquaculture increased the total of water nutrient and this will increase the turbidity of water. But all these disadvantages can be solved with following the sustainable step.



Figure 7.1 : Pumping Groundwater

Source: (Knudson, 2015)

All in all, although aquaculture may harm the environment, sustainability will make it possible for aquaculture to be managed in a manner that is safe and benefits all aspects, including the economic, environmental and social. Thus, we can still produce a large scale aquaculture product with the right procedure to prevent damage in the long term or in the short term. Together we must be vigilant to take care of the nature to ensure good future for the upcoming generations. Nature is the most priceless gift and nothing can substitute the nature if it is destroyed. So, let us together take a good care of our nature before it is gone forever.

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Special Thanks
University Malaysia Terengganu
Institute of Oceanography and Environment, INOS
Faculty of Science and Marine Environment, FSSM
MARE(Marine Coastal and Delta Sustainability for Southeast Asia) European Union Erasmus+

The Project First Year Student
Bachelor of Science(Marine Science),Year 2020
Course Fundamental of Marine Science(MMS3009)



"Without our coasts, these cultures may never have been the same."
-NUR FATIN ATIRAH BINTI MOHD RAWI-



"I hope we will all together hand in hand, do our best to contribute for the sustainable future."
-IRDIANI NATASHA BINTI SUFYAN-



"If the coastal are damaged, it will damage almost all life"
-WAN YASMIN HUMAIRAH BINTI WAN SAARI-



"Wildlife is really important for us."
-MOHAMMAD ALIFF BIN AZIZAN-



"If marine life is endangered, believe me that we cannot survive today."
-MUHAMMAD KHAIR HAFIZUDDIN BIN JUMAT-



"We know when we protect our ocean we're actually protecting our future."
-NUR KAMILAH MAHIRAH BINTI WAKHI ANUAR-