



TECHNOLOGY TRANSFER: A CASE STUDY OF BRUNEI
DARUSSALAM AQUACULTURE FIRMS

BY

MS. SHIFA SHAKIRAH BINTI HAJI MUHAMAD

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ARTS (ASIA PACIFIC STUDIES)
THAMMASAT INSTITUTE OF AREA STUDIES
THAMMASAT UNIVERSITY
ACADEMIC YEAR 2019
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THESIS

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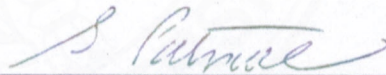
TECHNOLOGY TRANSFER: A CASE STUDY OF BRUNEI DARUSSALAM
AQUACULTURE FIRMS

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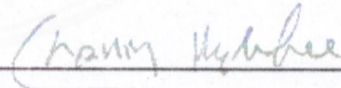
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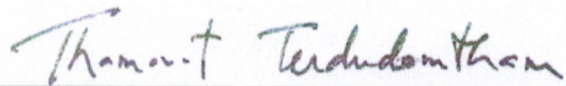
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ABSTRACT

This paper aims to answer the enigma on the inability of local firms to receive and diffuse the technology transfer from Foreign Direct Investment (FDI) and Joint Venture (JV) companies. To examine such issues, the process of technology transfer across Brunei Aquaculture Firms is therefore studied. The importance of the study remains on the ground condition of being under-researched. While numerous literature has discussed technology transfer, minor research exists on 'how' technology is transferred especially in aquaculture, let alone be in Brunei Darussalam. This qualitative research, therefore, investigates the process whether it is intra-firm, interfirm, licensing or/and international technology transfer and the problems that hinder the process through case studies to the local firms, JV and FDI firms in Brunei aquaculture sector. For a thorough understanding of the issue, an explanation of the development and current situation of aquaculture technology are also discussed. Following the results, recommendations and suggestions are put forward for future improvement, management, and development.

Keywords: Technology Transfer, Intra-firm, Licensing, Interfirm, International Technology Transfer, Foreign Direct Investment, Joint Ventures, Aquaculture

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Ms. Shifa Shakirah Muhamad

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LIST OF ABBREVIATIONS

Symbols/Abbreviations	Terms
BA	Barramundi Asia
BCC	Business Corporate Contract
BRI	China's Belt and Road Initiatives
CEO	Chief Executive Officer
DOF	Department of Fisheries
EU	European Union
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GSC	Global Supply Chain
HDPE	High Density Polyethylene Pipe
HNTEC	Higher National Technical Education Certificate
HP	Horse Power
IBTE	Institute of Brunei Technical Education
JV	Joint Venture
MNCs	Multi-National Corporations
MoU	Memorandum of Understanding
MTU	Mobile Technical Unit
NM	Nautical Miles
NTEC	National Technical Education Certificate
R&D	Research and Development
RAS	Recirculating Aquaculture System
SEAFDEC	Southeast Asian Fisheries Development Center
TOT	Transfer of Technology
UBD	Universiti Brunei Darussalam
UMS	Universiti Malaysia Sabah
US	United States
UTB	Universiti Teknologi Brunei

CHAPTER 1

INTRODUCTION

1.1 Background of the research

Brunei Darussalam, also known as the '*unexpected treasure*' is a country located in Southeast Asia, on the island of Borneo, rich with an abundant supply of natural resources. Among all resources, its maritime economic activity of offshore hydrocarbons is prioritized, which made-up 90 percent of Brunei exports in the year 2018 (DHL, 2019; Syazana, 2013; Trading Economics, 2019). However, the overspecialization of the long-term source of wealth has backfired as it has created Brunei to be under the curse of 'Dutch disease'. This curse has led Brunei to be in its fourth-term recession leading to 9.3 percent of the unemployment rate as of 2017, and specialization on unsustainable economic resources of the hydrocarbon industry has worsened the conditions (OECD, 2014; Rasidah Abu Bakar, 2019).

Thus, the government is seeking ways to have a 'Sustainable and dynamic' economy which aquaculture is made to be among the priority clusters. Due to the specialization on hydrocarbon, Brunei's other treasure or resources are left pristine and under-utilized. Brunei, whose sea is six-time larger than the size of its land, has made aquaculture sector to be promising (Oxford Business Group, 2016).

However, as of the year 2018, aquaculture only made up the total minority production of Brunei fisheries (Refer to Figure 1.1) and to have position among the Global Supply Chain (GSC) with goal of 269,377 metric tons of production is set to achieved by the year 2035 (Mariani Sabtu, 2018), needs a 17 percent of annual growth production. High sustainable productivity is the key towards such goal, which utilization of advanced technology in aquaculture is the answer.

Nonetheless, over-specialization on hydrocarbons is to be blamed for other technological advancements aside from hydrocarbons was under-developed, and due to its comparative advantage on aquaculture technological capability, the aquaculture sector could not progress as much due to the lacking of advanced technology for higher productivity. Therefore, Brunei has set its strategy by

emphasizing on attracting Foreign Direct Investment (FDI) and transfer of technologies (TOT) or technology transfer as the mechanism or key for Brunei economic growth (Mariani Sabtu, 2018)

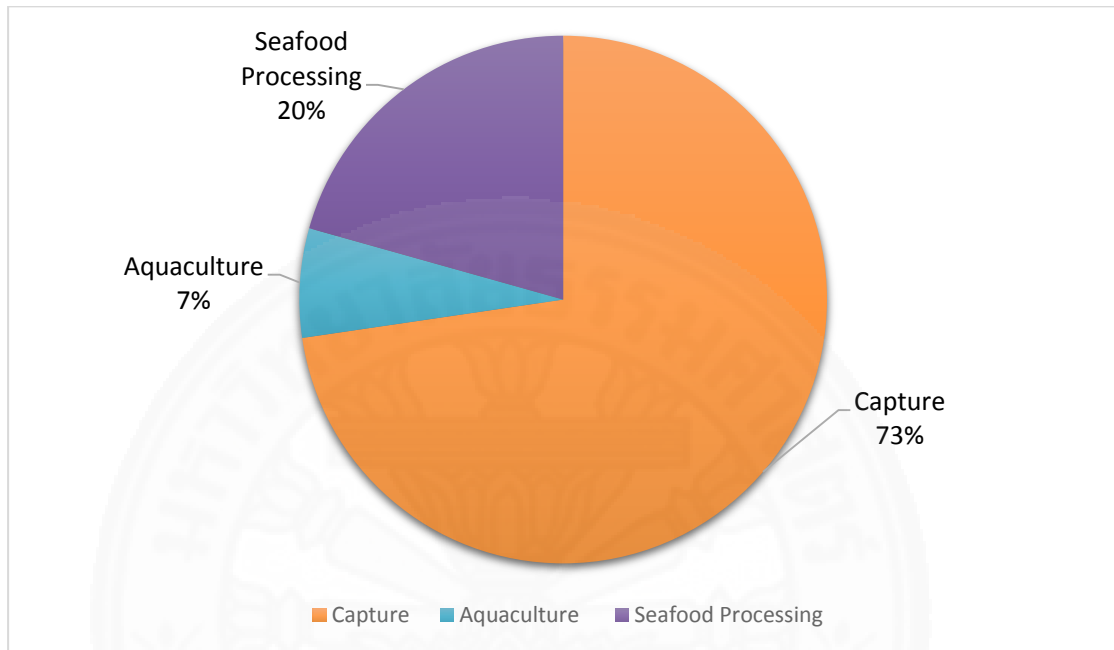


Figure 1.1 Brunei fisheries production categorization in year 2018

Source: Department of Fisheries(2019)

Despite the slow growth of FDI and Joint Ventures (JV) in recent years (Sofian Radzuan, 2016), Brunei has managed to attract FDI and JV especially in the aquaculture sector (DOF, 2019). Nonetheless, to achieve Brunei aspiration to be among the GSC, high productivity is necessary, FDI, JV activities and TOT is seemed to be its only hope and driver for achieving such goals. However, to generate high productivity, it necessary for firms to adapt and shift to modern technologies. Nonetheless, local firms hold the largest share of firms operation in Brunei aquaculture (Refer to Figure 1.1), and the condition of wide application and utilization of conventional farming still persists among the local firms operation even though there is a growing number of incoming JV and FDI to the country.

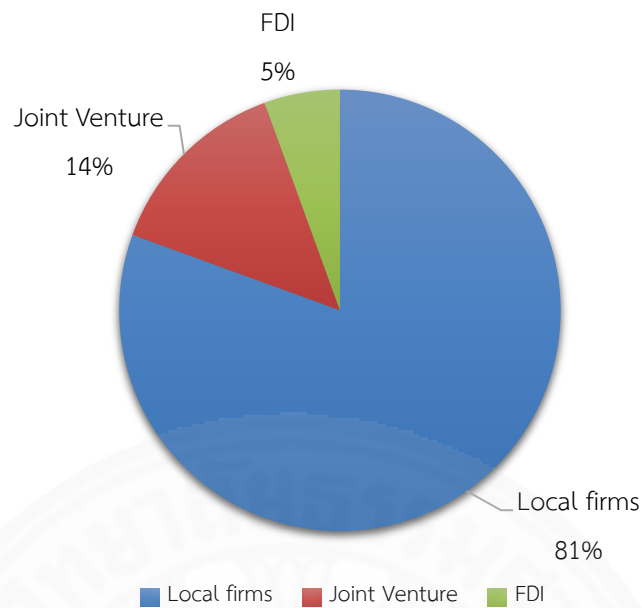


Figure 1.2 Aquaculture Firms operation in Brunei

Source: Department of Fisheries (2019)

Driven by these key strategies, it is found to be engaging to explore the process of the transaction of technology transfer across Brunei Aquaculture Firms along with the factors that might influence the transferring process to the local firms.

1.2 Problem Statement

Lacking readiness in technologies and know-how is identified to be the main issue faced by the local firms in Brunei. Thus, to tackle this issue, a bottom-up approach to how TOT is transferred to firms is studied. The process of technology transfer of intra-firm, licensing, interfirm, and international technology transfer are among the process discussed in the context of this research.

1.3 Research Objectives

The research aims to understand the enigma behind the inability of local firms to infuse the technology transferred. Thus, to support such objective, the

process of technology transfer across Brunei Aquaculture Firms of FDI, JV, and local firms and the factors that might hinder the transfer is also being assessed.

1.4 Research Questions

Therefore, to accomplish such objective, these questions are raised to have a better understanding of the issue.

Main Research Question

1. What are the factors that challenge the ability of local firms to receive and diffuse technology transfer from FDI and JV firms?

Sub Research Questions

1) What are the development and the current situation of aquaculture technology utilized in Brunei?

2) How TOT is transferred across Brunei Aquaculture Firms?

3) What are the problems encountered by firms when transferring technology?

4) What are other possible approaches to facilitate the TOT to the local firms?

1.5 Thesis Statement

Thesis statement offered in this research is; Readiness of the local firms and Brunei overall, to receive and diffuse the technology transfer are the important factor that can deter the use of advanced technology across Brunei aquaculture local firms, while Joint Venture is the mechanism for firms to acquire advanced technology easily.

1.6 Scope and Limitations of the Study

Due to the time constraint of this research, some scopes and limitations are applied in this study. The particular scope of this research is only to study the firms and specific interest is set to answer the inability of local firms to receive and diffuse the technology and by that process of 'how' TOT is studied across Brunei Aquaculture Firms which includes local owned, JV and FDI firms. Identifying which process they opt when transferring the technology, either intra-firm, licensing or international technology transfer.

Nonetheless, some sets of limitations on access to primary sources is also included. In this context, it refers to access to the firms. Due to time constraints this study is only able to study only nine firms—four local firms, four JV firms, and one FDI firm. Further justification offered is due to privacy policies set by the companies that prevent further study on other firms.

1.7 Structure of the Thesis

As a guideline and framework of this thesis, a tentative outline of the thesis chapter will be included in this section. Chapter 1 covered the background of the research; the importance of the study and objective is put forward to in this chapter. Followed by Literature Review in Chapter 2, which works of literature reviewed are related to the field of research. This is to find out the gaps as this research in the existing body of knowledge and to shape the research question of this research. The Literature review has helped the author to obtain information not only about the related research study but also gives an idea of research methodology that can be used to fulfill the need of this research and also to shape the framework of this study.

As for Chapter 3, the outline of the Research Methodology is outlined in this section. This chapter discussed the procedures and techniques that are applied to carry out this study. Things discussed include the methods of data collection, data

analysis, research framework and also setting research scope and limitations as a direction and backbone that shapes this research.

However, for further comprehension of this study, Chapter 4 has provided an overview of the development of the Brunei aquaculture sector. The importance of technology transfer to firms is also addressed extensively in this chapter. The next section of Chapter 5 has analyzed the results of the finding from data obtained from fieldwork that have been transcribed to answer the research questions to meet the objective set for this research with the guidelines that have been discussed in Chapter 3.

Chapter 6, is the final concluding section of this research. This chapter has concluded the findings of the research and recommended strategies that could be taken into consideration for immediate and future implementations. This section also pinpoints the central issue or problem of this research which is useful for Brunei policymakers, DOF and entrepreneurs to grab the opportunity to receive and diffuse the technology transferred for wide application for other production purposes. By this, both downstream and upstream of the aquaculture sector will flourish.

CHAPTER 2

REVIEW OF LITERATURES

This section is allocated for discussion on the review of literature existed in the field of study related to technology transfer ranging from past pieces of literature to the recent literature reviewed internationally and specifically in Brunei. To begin, this section will first offer the definition or concept of technology transfer which discusses the definition defined by various literature to construct it for the context of this research. It is followed by the process of ‘channel’ or modes of technology transfer to a country; this section has covered the literatures about how to get access to technology transfer. The next section has discussed the kinds of literature about the role of policies to influence technology transfer. Fourth section review about the existing literature using the case study conducted in Viet Nam and Chile due to the prominent activity of technology transfer to both economies in their aquaculture industry. Lastly, a review of Brunei literature related to technology and technology transfer and finally addresses the gap in the literatures which would become the core cause of this research.

2.1 Concept of Technology Transfer

In defining ‘technology transfer’ due to numerous conceptual has been discussed from the different discipline it is difficult to crop up. Different definition has caught up in different works of literature according to the discipline of the discussions for example in political science, public policy, economics, sociology, marketing, management of technology and organizational management (Bozeman, 2000; Sazali, Rose Raduan Che, & Osman, 2012; Zhao & Reisman, 1992). Nonetheless, it is wise to examine the different pieces of literature of technology transfers that are suitable for this discipline of study.

As defined by Chungu and Mandara (1994), technology transfer refers to the flow of technology or movement of technology from one place to another,

which usually involves transferor and receiver; which the ability to comprehend the use of technology effectively will determine the success of the transfer. Nonetheless, to add to the missing definition, Kumar and et.al (1999) have highlighted the division of technology transfer—technology transfer from national R&D and universities to domestic industries and international technology transfers that involves transferring technology from one country to another. Which this have supported the definition given by Putranto et.al, 2003, he defined it using economic status wise of transfer of knowledge and technology from developed countries to developing countries, especially economies with the least technological development.

Therefore, to conclude the concept of technology transfer, it is a process of TOT from one place to another, be it firms to firms, or institutions to firms. With the condition, the provider has gained the upper hand in technological advancement to be transferred to recipient countries who mostly lack in technological readiness.

2.2 Technology Transfer Trend and Pattern

Technology transfer field of study is increasingly active to be researched, various literature have discussed it in terms of development of TOT, the importance of TOT, the trend of TOT, but few discussions on the ‘how’ to transfer technology especially on sectoral and or industrial field of study. Technological development plays a vital role in the development of the global economy, which Porter (1990) argues economic development and competitiveness are not specified by the abundance of natural resources but the technological innovation it has. Nonetheless, technological development is becoming expensive and with the pressure of the current market competition, it is impossible to be self-sufficient in such technological development which Lee (1997) stated *“not only by the amount of R&D invested to create technology but also by the capacity to pool and transfer the scientific and technological resources”*. Thus, from this, it has already emphasized the importance of technology transfer in one country.

Technology transfers are defined as the transfer of the firms’ ability to manufacture a product or process that involves a transferor and receiver (firms) in

another country (Baranson, 1978). While also to add, technology transfer is a package of not only transferring equipment or hard technology but also soft technology or knowledge: that includes the transaction of skills, management, marketing, customer services and organizational (soft technology) (Khan, 2011; Sofian Radzuan, 2016). While the literature of Sazali and et.al (2012) has further discussed the differences between soft and hard technology transfer.

Khan (2011) literature has contributed to the viewpoint of technology transfer from both developed and developing economies. Which developed countries tend to view, TOT it is just a transferring of instruments entering other economies market while another definition is more to the comparative advantage that can be achieved through sharing the cost of developing technology due to the lacking and expensive scientific resources of developing countries, making the cost of technology development sky-high.

While different from the viewpoint of firms in developing economies, their view tend to emphasize on the need to depend on technology transfer by as it is expensive to develop technology by themselves, which idolize the developed country as the superior, which can be seen where most developing countries firms are eager for Multi-National Corporations (MNCs) to transfer their technology. Which this supports the reasons of government in developing economies are vocal and active in encouraging FDI with the purpose to gain access to FDI's technology to develop their economy.

Nonetheless, it is also important to highlight the agency of technology transfer; technology transfer can be access and gain through, FDI, the joint venture (JV), license, agreements, export of technology and trade in capital goods. However, there is missing information about the 'how-to' transfer technology from which this was supported in the literature by Khan (2011).

In spite of that, literature made by Sofian (2016) has address the elements needed or can influence the process of transfer of technology; type of technology, the capability of the owner to transfer, the ability of recipients to absorb such technology and interaction (culture) between two parties. Even these

processes have been examined but the absence of literature about the procedure of transfer the technology is still in question and be the gap in this field of study.

2.3 Channel of Technology Transfer

As mentioned before, technology transfer can be access through the activity of FDI, joint venture (JV), licensing, agreements, export of technology and trade in capital goods and among all FDI has proven to be the most effective and crucial agency to accomplish transfer of technology to developing economies (Sofian Radzuan, 2016; UNCTAD, 2001). This statement made by UNCTAD (2001) and Sofian (201) are proven to be true, especially when States are aware of the importance of FDI as the driving force for the state development, States began to liberalize their economy system; being proactive in FDI promotion just to gain the technology from the foreign companies.

Diaconu (2014) have identified successful Southeast Asia's strategy by being the export platform with cheap currency exchange to attract FDI. Such a claim, can be proved by looking at the recent development, developing countries of Asia has regained its status as the largest share of FDI recipient region, which Asia has marked 33 percent in 2017 in the global share of FDI worldwide and Southeast Asia with about 11 percent growth worth \$134 billion in 2017 (UNCTAD, 2018). Pieces of the literature on pull and push factors of FDI have been widely and further discussed by Te Velde (2006); Barros, Caporale, and Damasio (2013).

However there are few elements or factors that can affect the transfer of technology; nature of technology; business ability to absorb the technology; capability to transfer and; willingness to transfer (Smith, 1995; Sofian Radzuan, 2016; UNCTAD, 2001). Nonetheless, most literature just stated the 'what' technology transferred and not the 'how' and this gap is supported by a thesis of Smith (1995).

Smith (1995) has raised the issue of the lacking of research made on the 'how' technology transferred especially dealing with specific industries. However, his work is centered towards technology transfer from National R&D and university of Aero-space plane program to such industry, nonetheless, this thesis is useful for this

research as it guarantees the feasibility of this research to be done. Smith's work has examined the process or the 'how' of technology transferred by using the four elements of technology transferred as stated above to shape the thesis and uses qualitative methodology with an in-depth interview for data collection.

However, all this literature either discussed technology transfer by FDI and national R&D; policies on encouraging technology transfer by promoting FDI incentives, but none on technology transfer to local firms. Therefore, it is found to be the clear gap in this school of thoughts or the field of study in technology transfer, firms and to aquaculture industry overall, moreover to Brunei as a whole. Thus this research needs to be carried out.

2.4 Public Policies Facilitates Technology Transfer

Policies are the essential component especially in governing certain organizations or in this context a sector or an industry. It is important because it is a guideline to solve underlying problems to achieve certain objectives and therefore it can be said, policies are important as it acts as the key towards success. Literature by Sung and Plein (1997) by establishing policies and strategies in technology transfers it can encourage the emergence of FDI, integration in the development process and alliances in trade.

This literature also further argue, state policies can control the path of technology transfer whether flourish or decline, which have indicated four important variables that able to influence the type of technology transfer—(1) *capacity of state to exercise control over domestic markets*, (2) *the capacity of a state to absorb new technologies*, (3) *the prerogatives of the state to obtain certain technologies*, and (4) *the nature of the technology itself*—(Sung & Plein, 1997). The reason for these four variables to influence technology transfer is to the ability of the transferor to pick “winning or losing” in such a situation. Nevertheless, the most important strategy is to establish policies on easing the TOT, that can be achieved through gearing up the policies on direct investment and licensing, depending on the respective country's strategy for development.

In somewhat the same vein, literature by Sofian Radzuan (2016) has discovered the components success of through the case study of Thailand and Norway. The literature has emphasized policies and government support as the most crucial components. The Kingdom of Thailand has proven its triumph in leading the electrical and electronics industry, and it is contributed by the prioritization on investment policies making Thailand attractive towards foreign investors, in fact among the Southeast Asia countries Thailand is one of the major recipients of FDI for the past two decennia (Mephokee, 2002 in Sofian, 2016). Furthermore, Thailand's government robust initiatives on promoting technology transfer, diffusion and innovation making Thailand be the ideal investment destination for electronics sectors. This success has resulted in the flourish of technology transfers by the FDI leading Thailand reserve itself a place in the GSC that exports to ASEAN, European Union, China, United States (US), Hong Kong and Japan.

While as for Norway, it is the same as Brunei where abundant natural resources of hydrocarbons are the backbone of the economy. However, in contrast with Brunei, Norway utilizes and exploits the hydrocarbon's income to invest in other industries (e.g. hi-tech industrial sector). Sofian (2016) has again highlighted the Norwegian economy's stability and strength is built on the *"openness and transparency with policies that support dynamic trade and investment"*. Norway is well known for having the highest quality of legal and regulatory framework worldwide. Also, it is worth to highlight, both case study of Thailand and Norway also emphasizes the development of investment on human capital to aid the investment in absorbing technology transferred from MNCs and further developing technological sector.

However, the gap of this literatures has pointed out the missing discussion on policies and the process of technology transferred especially to local. This literatures only examine the general facts and knowledge of the importance on the establishment of policies and make a recommendation for the overall transaction of technology transfer but not study on the process of transferring it and not to mention the scope of the aquaculture sector. Nevertheless, it is understood because the aims of this feasibility study are to discussed on the success factors for

Brunei to be technology-based industries with the procession of silica sands as part of the evidence that Brunei can manage to develop as technology-based industries. Thus, this research of 'how' technology transferred to Brunei Aquaculture Firms is important to be carried out.

2.5 Case Study of Viet Nam Technology Transfer-Aquaculture Technology

The Socialist Republic of Viet Nam started to liberalize their economies in 1986 by launching the Doi Moi reform that has transformed their political and economic system. Doi Moi has benefited the country, making Vietnam be one of the fastest-growing economies worldwide. The reason for such economic development is contributed by the activity of FDI, which the majority of it originated from the region of Asia (OECD, 2018). In terms of types of FDI settling in Viet Nam, it can be divided into three categories—JV, Business Corporate Contract (BCC) and 100 percent foreign-owned companies (Schaumburg-Muller, 2003).

Nonetheless, because of its success to transform the economy of Vietnam, numerous literatures have been done discussing about FDI in Viet Nam ranging from the history of FDI to Viet Nam that can be found in the literature of Wang (2012), Tran, (n.d), Thu, Wiboonchutikula, and Tubtimtong (2011); push and pull factors of FDI (Nguyen, 2011); Foreign Investment Policy (Tran, n.d); effects of FDI to Vietnam and also the problems faced by FDI in Vietnam (Tran, n.d).

Despite all the background and historical study of FDI in Vietnam, a thesis by Nguyen (2011) studied thoroughly. The author uses FDI's Absorptive Capacity theory to explain the phenomena and provide empirical evidence of FDI settlement, pattern, and trend in Vietnam. Aside from that, this literature also looks at the establishment of FDI under the constraints of comparative advantage to understand the situation. This literature is tremendously informative and thoroughly researched in explaining the push and pull factors of FDI in Vietnam, comprehend the reason for the establishment of FDI through comparative advantage and examine the necessary factors for the host countries to absorb the benefits of the FDI.

Regardless of countless discussion on background and history have been studied about FDI in Vietnam, the literature of Leproux and Brooks (2004) gave an overview about FDI in depth by using statistical data to make the analysis. This literature reveals the economies (countries), sectors and provinces that foreign economy had invested and settled in (1988 – 2003). This data shows the majority of the investments is originated from the region, with Singapore holds the major share of FDI in Vietnam. As for provinces, Ho Chi Minh city is home to the largest FDI activities, which factor of infrastructure came into the picture for Ho Chi Minh to be the preferred city by the foreign investors. While in terms of sector, heavy industry owned the biggest share of FDI commitments and in 2003 agriculture, forestry and fisheries only detained small part by seven percent of the total share of FDI commitments by sectors, nonetheless, these sectors accomplish steady development over the years.

Such development can be further proven by the national goal strategy of Vietnam export aim to reach US\$13 Billion by 2020 (Das, 2017), and such a goal is done by attracting FDI in the sector. By 2013, Vietnam has successfully attracted 70 foreign investments in the fishery industry, resulted in the growth of aquaculture export by 18 percent, which worth around US\$8 Billion in 2016 (Research and Market, 2019).

Aquaculture projects conducted are mainly focused on transferring of technology, such as American agricultural giant Cargill focused to develop aquaculture technology of fishing ponds, aside from that government also planned to make more efforts to increase FDI activity in aquaculture sector by establishing seafood center in Can Tho and fishing industry center in Kien Giang (Vietnam Briefing, 2013). However, such information and literature about activities of FDI in sectoral growth through technology transfer are not widely studied. This information can only be found in secondary sources of newspaper and webpage and thus it can be said that this field of study is under-researched and it is the gap in this field, mainly because there is the minimal number of technology transfer from FDI in the past 30 years (Vietnamnet, 2017).

2.6 Case Study of Chile Technology Transfer-Aquaculture Technology

Chile's economy used to largely rely on mining activity of copper exports however, current Chile holds one of the largest shares of seafood export worldwide. Being a non-native salmonids country, Chile manages to become the second worldwide producer of Atlantic Salmon. This success is contributed to the overwhelmed success of Chilean Government policies on attracting foreign investors of large firms. FDI has flooded into Chile's salmon industry by bringing new technologies, expanding productions, fostered vertical integration and automatically increase the firms' sizes and it was estimated \$300 million was invested in the aquaculture industry between 1989 and 2004.

The success of FDI flooding the economy had resulted in Chile to be the third world largest aquaculture industry, which represents 12 percent of global production and second-largest exporter of salmon after Norway (DHI, n.d.). In the year 2017, it was recorded that Chile has shown an increase over 19.6 percent in exports, making technology transfer worth to be mentioned.

The success factors to this are the government support by giving a prime concern in the fisheries and aquaculture sector as part of the national economic development. It was done by the government being proactive in its investment policies as the strategy to attract investments in the aquaculture sector. Literature by Ridler and Hishamunda (2001) has examined the investment policies that have made Chile attractive for investments; by allowing foreign investors to repatriate profits at any time and total capital after three years (Chocair, 1991). The government also gives special privileges by designing a debt-equity agreement to attract foreign investors to the growth of *salmoniculture* (salmon farming).

In terms of technology transferred, both hard and soft technology was transferred in Chile's aquaculture sector; both in terms of equipment and knowledge. However, only the process of soft technology transferred was examined in this literature; "Fundacion Chile" private investment on R&D, created in 1976 through an agreement between government of Chile and ITT Corporation from the United States to ease the facilitation of technological transfer for productivity and

exploitation of natural resources and Chile also developed their own local technological capabilities (Ibieta, Tapia, Venegas, Hausdorf, & Takle, 2012; Prado & Drew, 1999).

Nonetheless, this literature is equipped with information but it is believed more research can be done and discussed especially on the process of technology transferred to Chile's aquaculture industry, which due to the absence of such information specifically on the process to transfer technology, it is seen to be the gap of this literatures.

2.7 Brunei Technology Transfer-Trend and Pattern

Brunei as a case study and aquaculture Technology transfer is a field of study that can be said as under-researched as this research was never been done before. It is not actively being researched on, and the less transparency on the policy of investment and encouragement of technology transfer was not widely exposed to the public is identified to be one of the justifications to such issue (Sofian Radzuan, 2016). According to a report by ERIA and OECD (2014) have assessed that Brunei had scores 3.2 for technology and technology transfers making it scores just a little below the average of 3.5 among ASEAN and undoubtedly Singapore to hold the score with 5.6 (Refer to Figure 2.1).

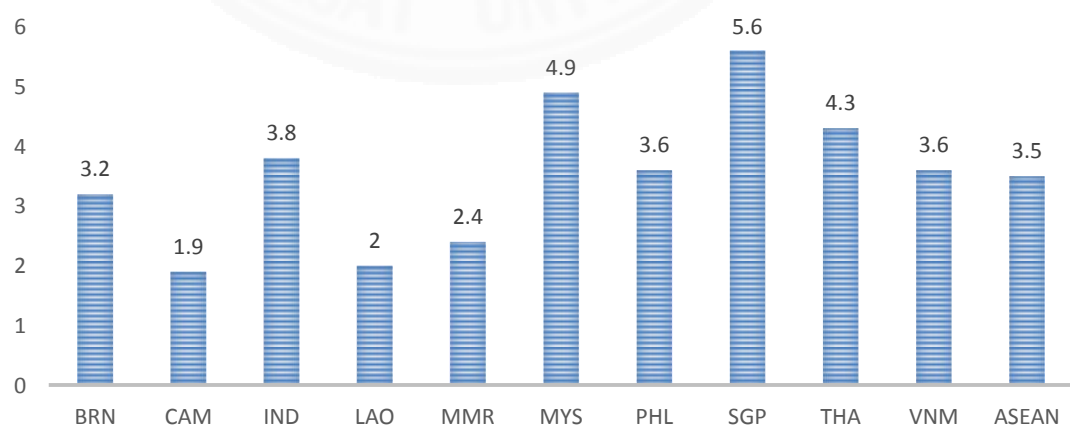


Figure 2.1 Overall Scores for Technology and Technology Transfer of ASEAN countries

Source: ERIA and OECD, (2014)

In this literature, it just reports the conditions and efforts of Brunei in developing its technology by establishing Anggrek Desa Technology Park to gear innovations as the integral components in development of technology. It also manages to analyze the strategy and scheme that attracts investors such as strengthening the Brunei patents system; giving incentive schemes such as grant scheme of the cost-sharing grant to support private sector R&D and infrastructure (e.g. laboratory) with the hope attract foreign firms to conduct R&D in Brunei. However, this literature fails to mention the process of technology transfer in Brunei which happens to be the gap of this literature.

Due to limited literature on this field of study, therefore both of the literatures are examined in this paper. Literature by Shabbir Hussain (1998) has discussed technology transfer with the case study of five Brunei-Japan JV firms. However, this literature has limited its direction of study and scope to only study the cultural aspects and role in the technology transfer. Which can be considered as part crucial that might influence the technology transfer matters for both transferor and recipients especially about the ability of absorption by the recipients and the willingness of donor to transfer due to the clash in culture. This research has suggested there are three types of technology transfer models across cultures; a success model, a partial success model, and a minimal success model. Which this investigation has shown Brunei is a success model, where technology transfer was absorbed in full by the recipients in Brunei by adapting the donor's culture as fully as possible. Shabbir Hussain's literature is good for the exposure of looking the capability of Brunei as recipients able to adapt to the culture of the technology transferred from Japan, however, it is believed that more can be done and the unavailability to address the type of technology transferred is found to be the gap in this literature.

Literature by Sofian Radzuan (2016) is about developing Brunei's economy towards Technology-Based industries, through the means of developing new technologies by investing in human capital and technology transfers through the channel of FDI. This research has provided government policies on how developing technology and technology transfer can be achieved in the context of Brunei

industries. However, it is found that this literature has discussed about the general solution on policies and not specific on certain industry which is the clear gap of this research, because it is believed that focusing on certain industry or sector helps to obtain information on the real issues and problems and tackle it using proper policies to attend the problem in the scope of one sector or industry.

2.8 Conclusion on Review of Literatures

With all the works of literature that have been discussed, there are massive gaps that needed to be addressed. Numerous literatures have been done regarding 'what' technology transfer but less on the 'process' of technology transfer. The process and policies of technology transfer are over-focused on the FDI but none talking about the process of technology transferred to local firms. Moreover, the aquaculture field of study is over-looked and especially Brunei, this field of study of Aquaculture Firms and 'how' to transfer technology is under-researched. Therefore, due to the clear gaps, it is a reason for this research to be done.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter serves the purpose to put forward the methodologies applied in doing this research, particularly to investigate the procedure to transfer technology to Brunei Aquaculture Firms which have been discussed in the objective section. This research has applied a qualitative method for both data collection and analyzation. To further explain the rationale of using such a method, the following sub-sections would explain and examine the reasons for the methods used.

3.1 Source of Data

To achieve the research objectives, this study has uses different types of data from various sources. To investigate the development of Brunei aquaculture and the current technology used, this research has used the secondary sources which were collected from the existing body of knowledge and studies of publications from newspapers, academic works of thesis and journals, research and working papers.

Secondly, to investigate the process of technology transfer the author has set the area to be studied that is the technology transfer via intra-firm, licensing and international technology transfer. Nonetheless, it is wise to also study the issues and challenges of technology transfer thus this research has to limit it into four factors as mentioned by Sofian Radzuan (2016) and Smith (1995). This investigation will rely heavily on primary data sources of government publications and qualitative methods of an in-depth interview with firm owners, experts in Brunei DOF, academics and investment. The rationale for the application of this method relies on the ground of the under-researched condition of this field.

It is also needed to highlight the importance to investigate the real problems, issues and challenges faced by firms in process of transferring technology, the author needs to experience it firsthand about the ground situation and those data can only be accessed through interview sessions.

Therefore, this study is extended across nine firms within two Brunei's districts only, namely Brunei Muara district and Tutong district. The rationale of this is because these two areas are the allocated zone set by the government for aquaculture activities.

To conclude, this research applies two kinds of qualitative data, from primary and secondary data sources. First, secondary data is applied to investigate the development of the Brunei aquaculture sector and the current situation of technologies used and it also requires primary data to support the lacking data. These data were collected from the government organization of Brunei DOF, books, research papers, working papers, academic journals, newspaper articles. Nonetheless, due to the situation of under-researched this field of study is and the lack of transparency on the process to transfer technology to firms, this study requires the use of primary data from Aquaculture Firms' owners, DOF Brunei, experts in investments and academics.

3.2 Data Analysis

3.1.1 Examining the Development of Brunei Aquaculture Technology and Aquaculture sector

To examine the development of Brunei aquaculture technology used and the aquaculture sector overall, secondary data and primary data of statistical data with the use of the descriptive method was used for analyzing such data. Primarily, this section investigated the development of the Brunei aquaculture sector overall into support the investigation to why this research of the process of technology transfer is important to be studied. It aims to further grasp and understanding of the development to support the second objective in analyzing the process of technology transfer to firms.

3.1.2 Analyzing the process of technology transfer to Brunei Aquaculture Firms

To investigate the process of technology transfer to the Brunei aquaculture sector, it can only be done by case study through firms. Data obtained

is in terms of statistics and qualitative data from the interview sessions, and is further analyzed to comprehend the situation and further acknowledge the factors that might affect the transfers by using the five factors that have been acknowledged in the previous section of Chapter 2 and this Chapter in the research framework for further understanding. It aims to answer the research question and as well to achieve the second objective of the process of technology transfer to firms.

3.3 Research Frameworks

This research is framed using the framework of Technology Transfer Analysis as the backbone of the research (Refer to Figure 3.1). Consisting three main variables of process, factors and firms' decision which these three is used to shape this research with main the aims to answer the following research questions and finally achieved the objectives of this research.

This process of technology transfer is shaped using the process of transfer and further discuss it using the case study as mentioned in the methodology section. This process compromises of four process, namely intra-firm, international technology transfer, licensing and interfirm technology transfer.

For the purpose of better understanding on this research, brief concepts of these process are offered. In the context of this research, Intra-firm, it is applied to subsidiary company established in foreign market which transfer the technology from their parent company in their home country to its subsidiary branch in foreign market. While as for international technology transfer, in this context it refers to local firms who transfer their technology or know-how via importation, whether it is in the form of equipment or laborer with no bondage with any firms and are independent while transferring such technology or know-how.

As for licensing, technology is transferred by local firms from other firms via license or agreement. Whereas, interfirm technology transfer is the transfer of technology or know-how from one firm to another firm which in this research, interfirm process on the technology and know-how from FDI and JV to the local firms is expected to occur.

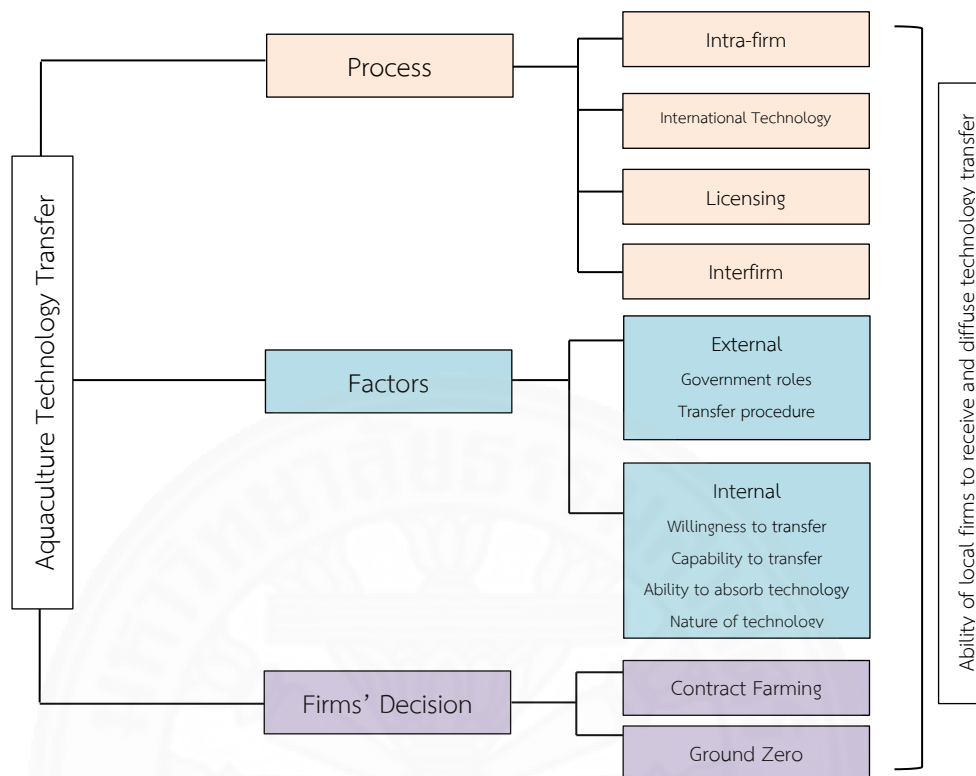


Figure 3.1 Research Framework

Source: Author's own framework based on the works of Smith (1995), Sofian (2016), and Plein and Sung (1997)

As for factors, it needs to be studied as one of the variables to fulfill the objective of this research. With this, it able to identify the problem that may influence the TOT with both external and internal factors listed. Four internal variables of; willingness to transfer; the ability of businesses to absorb the technology, the capability of the business to transfer and the nature of technology. This is modified and interpreted as a new framework, adopted from the literature of Plein and Sung (1997), Smith (1995), and Sofian Radzuan (2016).

External factors—government roles and transfer procedure and Internal factors—willingness of FDI and JV firms to transfer their technology; capabilities of local firms to transfer and receive technology from FDI and JV to local firms; ability of local firms to absorb technology transferred from FDI and JV and lastly; the nature

of the technology itself—do pose an influence especially to the local firms' decision when receiving technology, ability of Brunei to diffuse technology for a wider use of productions.

As a result, the author has come up with the firms' decision as it all come down came down to firms' decision whether to receive the technology and know-how from FDI and JV or refuse to do so. Which in the context of this research, access mechanisms to technology transfer of contract farming and ground zero were analyzed to finally understand why they have opted to such decisions.



CHAPTER 4

DEVELOPMENT & CURRENT SITUATION OF BRUNEI FISHERIES INDUSTRY – AQUACULTURE SECTOR

Background of aquaculture in Brunei Darussalam briefly is discussed by exploring the development and current situation of this industry. It is to support the analyzation of the importance of technology transfer to the Brunei aquaculture sector, which factors of government roles are also highlighted. The rationale and aim of this chapter to comprehend the situation by delivering background of the aquaculture sector overall, the importance of aquaculture sector, government roles in aquaculture sector, and emphasis the significance and necessity of technology transfer to occur across Aquaculture Firms in Brunei.

4.1 Geography of Brunei's Sea Features

Brunei Darussalam, with total size of 5,765 km located on the coastal area of Borneo island making the physical of Brunei sea's to extend to a total of 38,600 km of maritime territory within 200 nautical miles (nm) of Exclusive Economic Zone (EEZ) as stated in the United Nation Law The Sea (UNCLOS) (Syazana, 2013). With such claims, Brunei maritime is six times larger in size than of its land. Brunei coastline is approximately 160 kilometer (km) facing the South China Sea. Its waters consist of sandy beaches, mangroves, mudflats, and peat swamps.

With its vastness of maritime size and wealth in resources, thus making Brunei's maritime as the vital source of income to the country. However, the maritime wealth was contributed by the activity of the offshore oil and gas industry, which this minerals industry has contributed to 90 percent of Brunei's total exports in 2018 (Eijas Ariffin, 2018), (Refer to Figure 4.1).

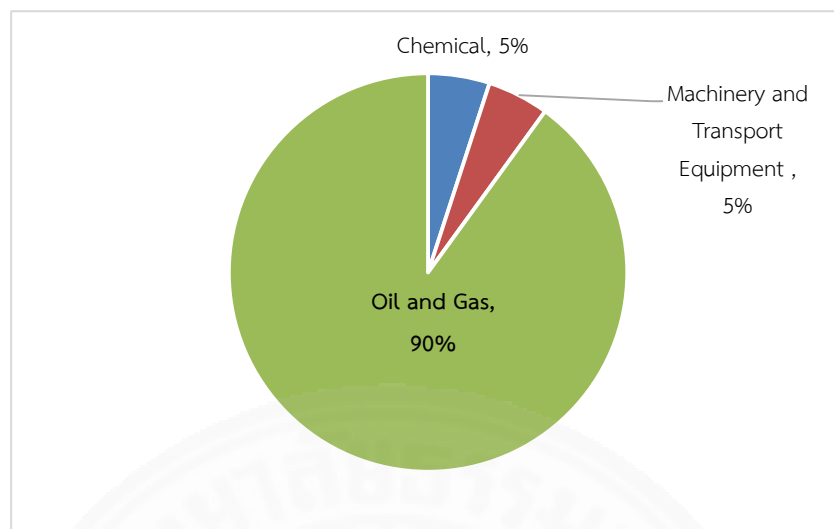


Figure 4.1 Brunei export activity in 2018

Source: Eijas Ariffin (2018) Brunei needs to move away from dependency on oil. *The Asean Post*. Retrieved from <https://theaseanpost.com/article/brunei-needs-move-away-dependency-oil>

Nevertheless, Brunei's sea can be explained through zonation as it is divided into four zones, with Zone 1 within the coastal area and Zone 4 being the farthest (Refer to Figure 4.2). The strategy for this zonation came into action was the strategy of DOF Brunei to prevent the activity of overfishing by only allowing only certain technology or fishing gear to operate in the specific zonation. As an effort to monitor, DOF Brunei have to determine operated vessels into color according to zonation (Refer to Figure 4.3)

In Zone 1, with zero to three nautical miles (nm), these areas is allocated for small scale fisheries or artisanal operation, only vessels with an outboard engine are permitted to operate in this zone. This zone targeted the small-scale fisheries that only use fishing rods, ring nets and trammel nets that would not operate excessive fish landing activity. Provided the existing research, it has proven that Zone 1 is overfished—by a 43% decrease in resources which to the increasing number of artisanal and recreational fisheries activity over the years (Khairul, 2017).

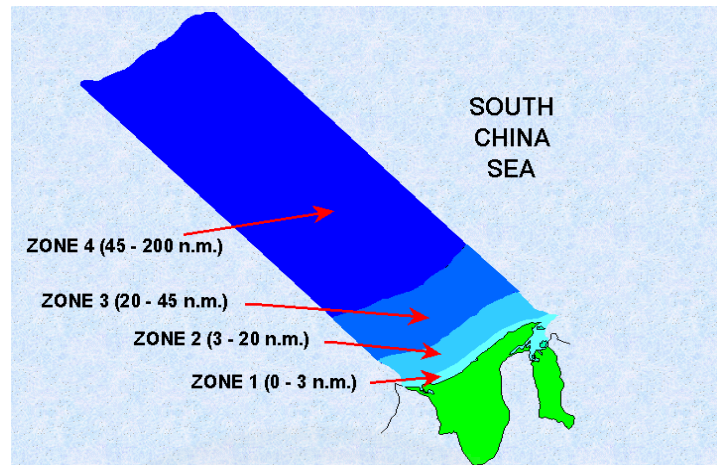


Figure 4.2 Map of Brunei sea zonation

Source: Department of Fisheries Brunei (n.d). Retrieved from <http://www.fisheries.gov.bn/SitePages/Investments.aspx>

Zone 1 0-3 nm	Zone 2 3-20 nm	Zone 3 20-45 nm	Zone 4 45-200 nm
Small Scale Fisheries (Outboard engine)	Vessel & Engine Specification Vessel: < 60 GT Color: Orange (Wheel house) Engine: < 350 HP	Vessel & Engine Specification Vessel: < 60 - 150 GT Color: Marine blue (Wheel house) Engine: < 351 - 600 HP	Vessel & Engine Specification Vessel: < 150 - 200 GT Color: Red (Wheel house) Engine: < 600 - 800 HP
	Longline, Trap & Handline Hooks: Max 1000 hooks/ vessel Max. long: 2km	Longline, Trap & Handline Hooks: Max 2000 hooks/ vessel Max. long: 4km	Purse Seine Net. Min. mesh size 3.0cm Max long: 800 meter Vessels: Catcher, Skip boat & Light boat
	Purse Seine Net. Min. mesh size 3.0cm Max long: 400 meter	Purse Seine Net. Min. mesh size 3.0cm Max long: 600 meter Vessels: Catcher, Skip boat & Light boat	Longline Tuna Hooks: Max 600-800 hooks/vessel Max 4km vessel
	Trawler Net: Code end mesh size 51mm	Trawler Net: Code end mesh size 51mm	Tuna Purse Seine Net: Min mesh size 7.62cm Max. length 800 meter

Figure 4.3 Brunei Fishing gear division by sea zonation

Source: Authors modification based on SEAFDEC (2016). Retrieved from <https://www.seafdec.or.th/neritic-tunas/country-profile.php>

Nonetheless, starting from Zone 2 extended to Zone 4, this area is targeted for commercial zones that use heavy and advanced technology. The depth

of the sea level is one of the justifications of such division. The specification of vessel and engine is specified according to zones. In Zone 2, with three to 20 nautical miles area vessel and engine is specified to only less than 60GT with the engine of 350 horsepower (HP) below, while in Zone 3, 60GT up to 150GT with 351HP to 600HP is allowed for operation.

In both Zone 2 and Zone 3, longline, trap and handline fishing gears, purse seine and trawlers are permitted to be operated in these two zones. However, in Zone 4, a deeper zone requires vessels with 150GT up to 200GT engines to operate in this area. Zone 4 allows the operation of purse seine, longline tuna and tuna purse seine due to the depth of the sea and the species of the fish.

4.2 Development of Brunei Fisheries Industry – Catching, Aquaculture and Processing activity

FAO defined fisheries industry activities undertake three main activities; catching, aquaculture and processing. Fisheries have always been part of the '*way of life for the Bruneian*' and it has evolved from self-sufficient oriented to become as one of the economic priority clusters for Brunei economic diversification (Sabihah Osman, Hadi Abdullah and Sabullah Haki, 1995; Yakub Othman, 2012; Sidhu, 1995). This part of the chapter examined in brief on the development of fishery industry in chronological method; development of fishery industry before independence (1923 – 1984) and; development of fishery industry after independence (1985 – 2018)

4.2.1 Development of Fishery before independence (1923 – 1984)

Before the discovery of oil in 1929, the fishery is part of Bruneian's tradition, culture and being one of the main sources of economic activity. Moreover, these claims can be further proven by *Kampong Ayer* or Water Village that used to be the settlement and capital area for Brunei.

Due to the living condition in Water Village, it is normal for the fishery to be one of the main activities for the source of income. Nonetheless, the situation of fishery activity was only self-sufficient oriented, this historical settlement

only able to survive until early period of British imperialism in Brunei. Such a condition has persisted until the advancement of the oil industry in the 1930s and further development of the gas industry in the 1970s. Nonetheless, the strategy of diversifying the economy has failed, which with the globalization, demand and advanced technology in oil and gas industry—government could not avoid but to have a specialization on the oil and gas industry, thus making the development of Brunei fishery industry to slow down.

However, according to Sidhu (1995) and Amaluddin and Raduan (1999), the act of such negligence on fishery and agriculture activity overall was the result of what O'Hara-Davies (2017) defined as '*Bruneian dreams*'. '*Bruneian dreams*' refer to a state where Bruneians desire and preference to work in the government sector, get married, own a house and have kids, preferably in that order. Nonetheless, these dreams have directed an impact on government aspirations to diversify the economy, this situation can be further proven by the declining number of fishermen by 46 percent (1921 - 1981) (Refer to Figure 4.4). The fact that '*Bruneian dreams*' exists in the community, therefore, can be the reason why the development of other industries was stagnant.

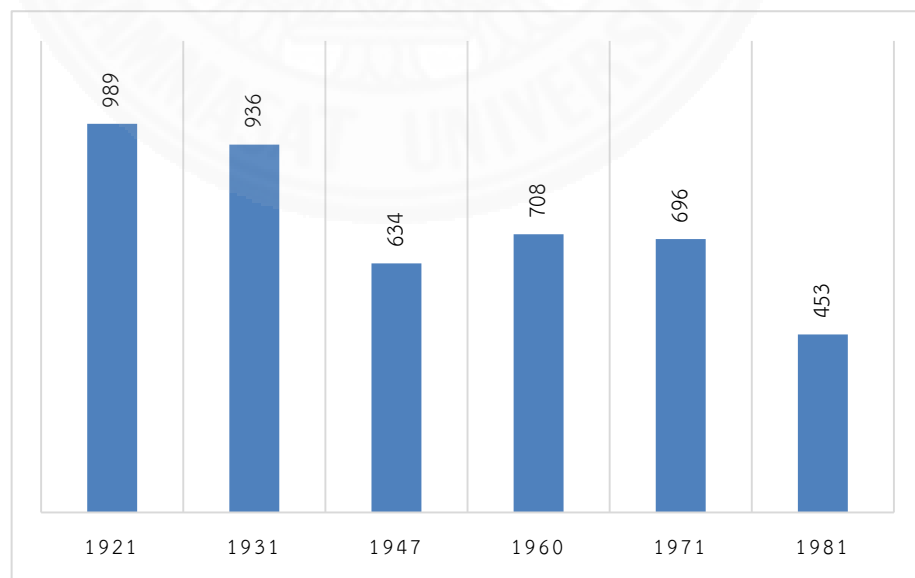


Figure 4.4 Number of fishermen before independence

Source: Department of Fisheries (2016)

Slow growth in the number of fishermen persisted with an only average growth of 4.3 percent from 1960 to 1985. However, the majority of this number were part-time fishermen (recreational) and minor involved as full-time fishermen. This artisanal and recreational fishery activity is unbeneficial in contributing to the growth and development of the fishery industry to diversify of the economy as 40 percent of the fish landed were unsold (Khairul Rijal, 2016).

Aquaculture rises into attention in the 1960s after there was a change in the government administration in 1959 and the beginning of focus to diversify the economy in 1975 from the third National Development Plan (1975 – 1979). In 1960s aquaculture activity concentrated in the Temburong District on the culture of freshwater fish and shrimp. In the late 1960s, the Department of Fisheries began implementing an in-land pond fish culture project with the allocation of 14 hectares of land in Sungai Jambu specifically for fish fry breeding culture that was imported from Sarawak, Malaysia (Sidhu, Jatswan, 1995). The fish fry was distributed to 87 ponds for culture, nonetheless, problems of the ineffective drainage system and unmaturing fish fry have resulted in unsatisfactory production, of only 49, 885 kilograms.

Nonetheless, the government continues with its strategy to diversify the economy, this was expressed in the Brunei NDP starting from the third NDP (1975-1979) with fishery as one of the priorities. Despite as mentioned by Barang in Sidhu (1995), it was acknowledged that past actions and efforts to diversify were unsuccessful.

4.2.2 Development of Fishery after independence (1984 - 2018)

Major changes and development can be seen in the fishery industry after Brunei gained independence in 1984. Such ground for delayed development can be explained through various factors and one of them was Brunei started self-governing in 1984 which only then fisheries industry was given a chance to develop (Khairul Rijal, 2015).

The fishery industry has evolved, from being self-sufficient oriented to commercial oriented. This can be proved by the increase of full-time fisherman by 76 percent and this is in line with the decrease of part-time fisherman with -10

percent (Refer to Figure 4.5). The growth is parallel with the increase of corporations involved in the fishery industry by 7.4 percent of average growth (1985 – 2015).

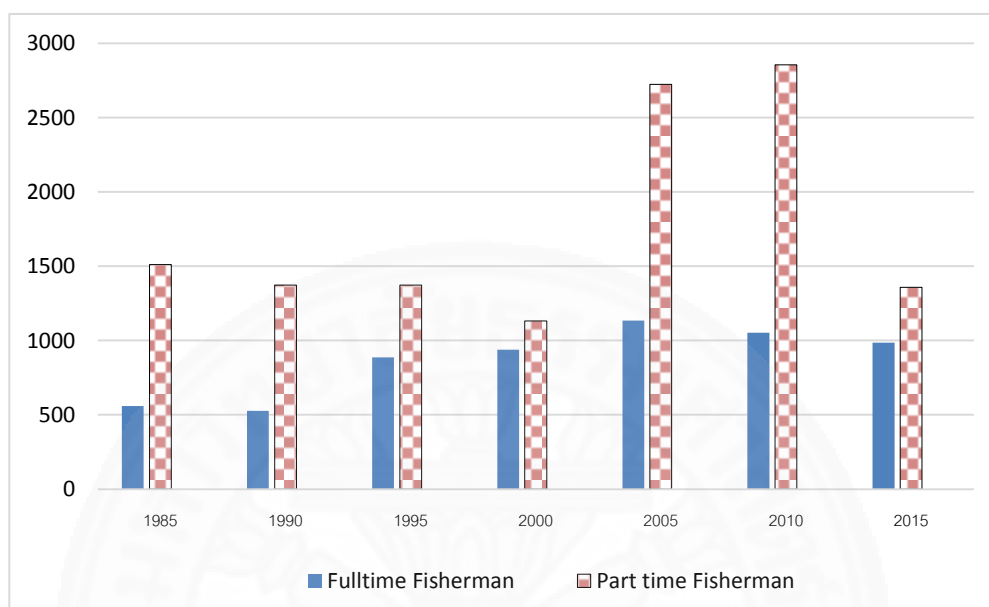


Figure 4.5 Status of fisherman activities

Source: Department of Fisheries (2016)

Such development is contributed by the incentives and encouragement by the government to form fishery-based activities that generate wealth and economy. The strategy developed is by focusing on making fishery activities as a source of national income by encouraging fishermen to explore and involved in aquaculture and processing for sustainability and value-added purposes. This strategy has resulted in drastic development which can be proven by the increase in export of fisheries with an average growth of 30 percent annually in the past 20 years of 1998 – 2018 (Refer to Figure 4.6).

Nonetheless, the latest development made was on the moratorium in 2008. It is a strategy to have sustainable production of fisheries for export and as well to cater to the demand for Bruneians. This moratorium is proven to be a need to prevent further depletion and extinction of fish resources in Zone 1. Moreover, according to research done by Syazana (2013), demersal fish (deep sea)

fish were also on the verge of depleting. Thus, fishery activities have moved its focus from catching to aquaculture, it is obvious the target of DOF to reach production of 270,000 metric tons by the year 2020 can only be achieved through a sustainable activity which is aquaculture.

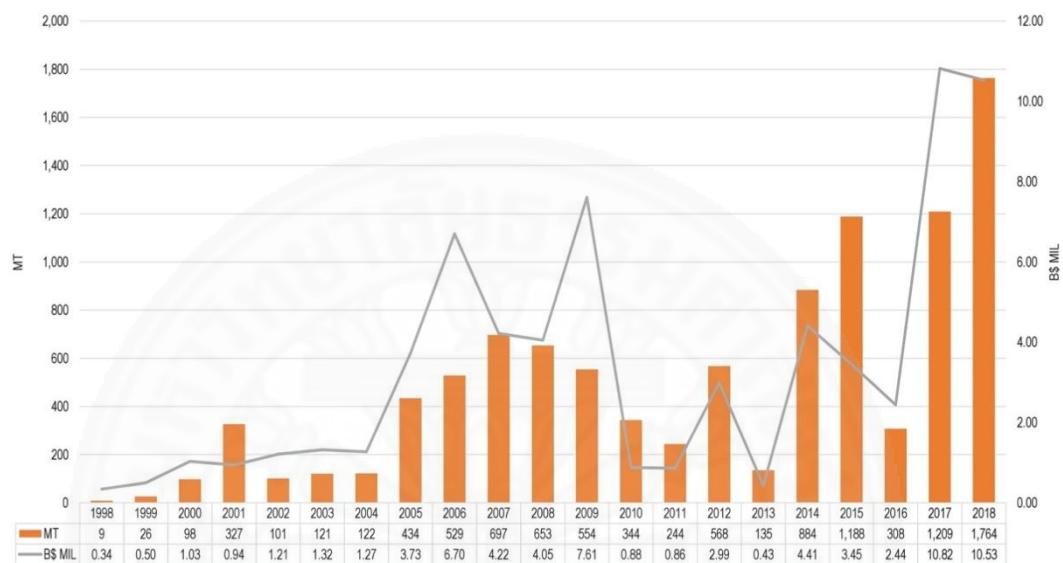


Figure 4.6 Brunei's Fisheries export activity (1998 – 2018)

Source: Department of Fisheries (2019)

As mentioned earlier, aquaculture has been practiced since the 1960s, however, due to inexperienced breeding fish fry, unskilled management of the fish farm and poor design of fish ponds, it has resulted in dissatisfying of production. Nonetheless, in the 1980s, the Department of Fisheries began to explore and give attention to the method of cage culture, and several other species like *Barramundi* or Asian Seabass, clams, crabs and freshwater fish were also introduced.

Cage culture was gaining more focus and popularity as it was easy to manage, less expensive yet effective to farm fish as it offers natural habitats and temperature making it favorable for fishes to live. Unlike ponds which are expensive to build, needing proper temperature, water quality, building cost, and drainage system must be well designed and usage of proper technology to achieve high productivity of production.

Development of aquaculture can be seen by the allocation of gazette areas for farming, a total of 19,317 was gazette for the aquaculture sector (Refer to Table 4.1). The gazetted area was allocated according to the suitable living condition of the species and culture in-land activity and freshwater culture (Refer to Figure 4.7) and for offshore culture (Refer to Figure 4.8)

Table 4.1

Brunei allocated area for culture sites

Culture Activity	Gazette Area (Hectare)
Shrimp Farm	689
Offshore Farm	18,202
Inshore Farm	289
Freshwater Farm	30.73
Hatchery	106.21
Total	19,317

Source: Department of Fisheries (2019)

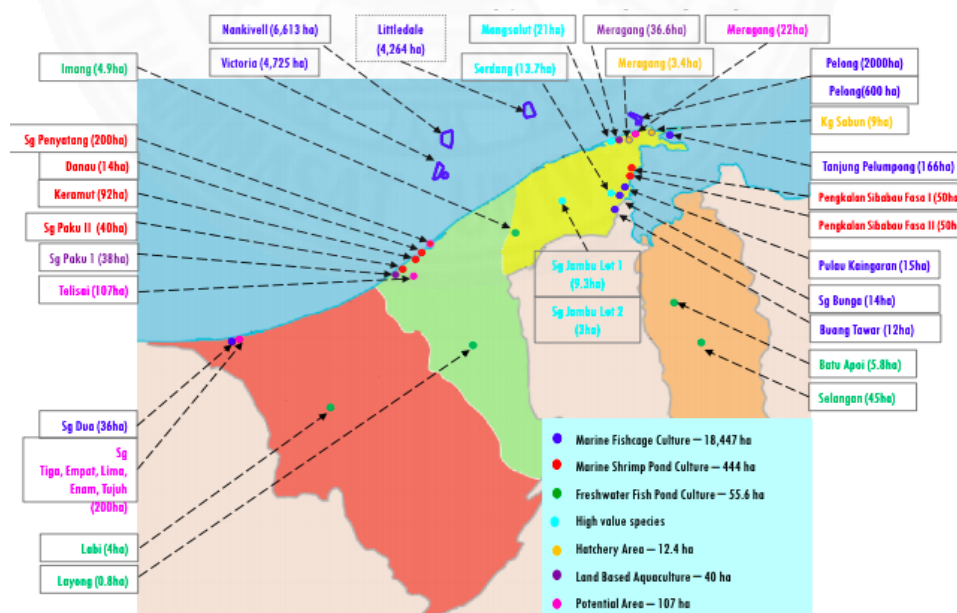


Figure 4.7 Gazette area allocated location for aquaculture operations

Source: Department of Fisheries (2016)

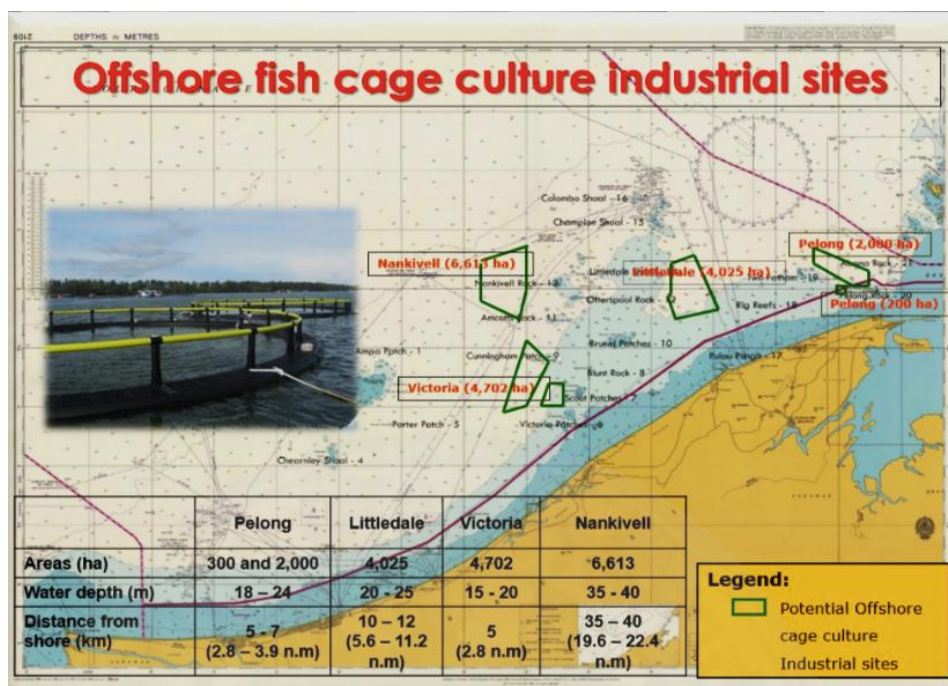


Figure 4.8 Gazette area allocated for offshore aquaculture sites

Source: Department of Fisheries (2016)

However, the development was not mushrooming as the people were not exposed to such practice. The government began its strategy by attracting FDI and encourage investors to undertake JV with local firms (Refer to Table 4.2). This activity of FDI and JV has helped technology transfer to the Brunei aquaculture industry.

Table 4.2

Types of aquaculture companies operation in Brunei

Types	Total Companies
Foreign Direct Investments	4
Public-Private Partnership	0
Joint Venture	10
Local Owned	58

Source: Department of Fisheries (2019)

4.3 Importance of Aquaculture Industry to Brunei's Economy

Aquaculture is the key to the entire development of Brunei fisheries that aquaculture was given attention to its development. Its sustainability is the answer to the uncertain and unsustainability of catching industry that has caused Brunei's sea resources to face depletion and extinction and the Brunei seafood processing industry can only survive and prosper with a sustainable supply of fish to be processed. Therefore, aquaculture is significant for the Brunei Fishery industry to developed and by being sustainable economic activity it, therefore, can combat the disease of Increasing inflation, high unemployment rate and slow GDP growth.

A compelling statement made by the King of Brunei that small market size is not to be the excuse for Brunei not to develop its other industries, and the strategy of aquaculture is to fulfill the economy than fulfilling the demand of the locals (Jabatan Penerangan, 2017). Moreover, with abundance and pristine resources of environment and sea, access to clean water and vast unexplored land makes aquaculture can be further developed.

Likewise, it is impossible for Brunei to just rely on catching industry as the maximum exploitation is only 21,300 metric ton per year and to achieve sustainable export activity Brunei's goals is to achieve 269, 377 metric ton per year by 2035 which aquaculture is expected to dominate the production of fisheries by 72.4% in 2035 (Khairul Rijal, 2016).

Besides, the development of the aquaculture sector is proven to be significant due to the oil industry has made fishery catching area limited. Hence, resources to be exploited is not to its full potential. Since 90 percent of Brunei's wealth is contributed by hydrocarbon, its safety is prioritized. Currently, nine offshore hydrocarbons is in operations with connecting pipelines between platforms (Refer to Figure 4.9). This has resulted in the respective agency in the hydrocarbon industry and the Government to announce a "buffer zone" surrounding the platforms and pipelines. Since 2000, the buffer zone of no-fishing area was set to 500 meters surrounding the oil platforms and implementation of a "no-take" area of 1 nautical mile from both sides of pipelines (Syazana, 2013). Thus, aquaculture proves

its importance, it will also make use of the abundance of Brunei resources and rise as the savior for diversifying the economy.

Moreover, with abundant resources and space, it is wise and important for aquaculture to be carried out. A total of 18,690 hectares of area was allocated for the activity of marine shrimp aquaculture; inshore aquaculture; offshore aquaculture and; freshwater aquaculture (Department of Fisheries, 2019). However, only two percent of the total allocated area was awarded as of the year 2016 with 296.9 hectares, and out of that only 42 percent was used for operations which were 124.5 hectares. Thus, with this opportunity and resources, it is important for Brunei to fully comprehend this wealth and operate aquaculture activities.

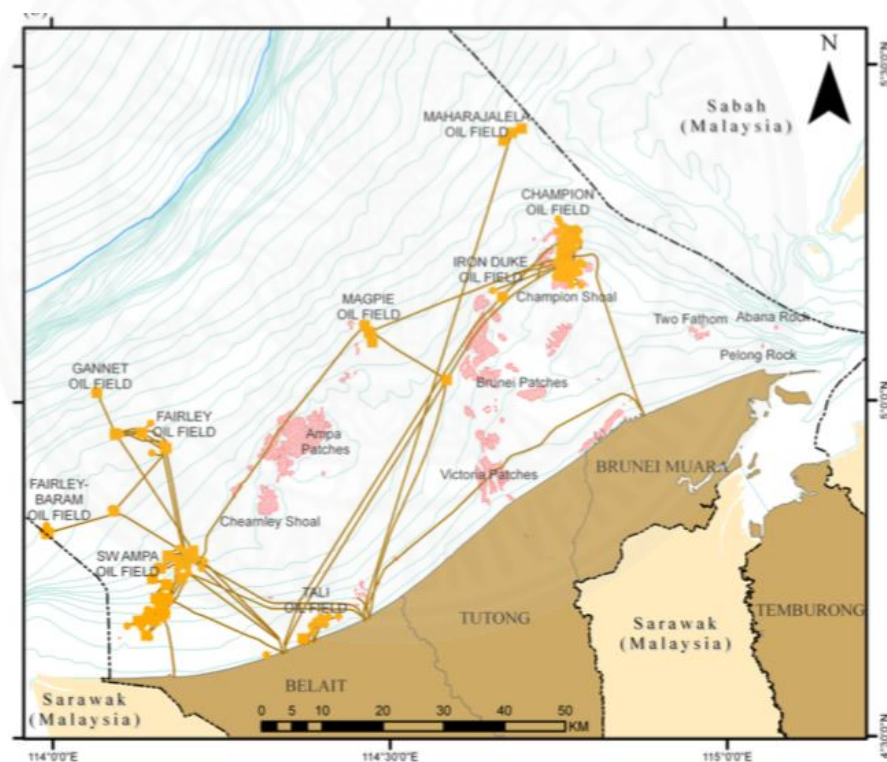


Figure 4.9 Map of Brunei hydrocarbon pipelines

Source: Syazana Ebil (2013)

4.4 Government roles in Aquaculture Industry

Being authoritarian, the government, therefore, plays a crucial role in determining the development path of every industry in Brunei including the aquaculture sector. For aquaculture development to thrive, the government needs to build a road of strategy and support for the entrepreneurs or firms to drive towards development. From the primary and secondary data gathered, a total of four assistance that was offered by DOF for the benefit of the entrepreneurs. Those five supports compromise government subsidies, technical assistance, providing technical advisory and monitoring support, offering support in facilities and license (Department of Fisheries, n.d.) and lastly encouraging technology transfer operation.

To begin, government subsidies for local firms offered by DOF are in the form of awarding farm sites (Zohrah, 1996). DOF is responsible in seeking suitable aquaculture location sites to be developed (Refer to Table 2 above for gazette aquaculture sites). According to Mariani in Azaraimy (2018), a total of 18,000 hectares of offshore aquaculture sites has been identified for aquaculture operation, however, only half were successfully awarded to local firms and some were leased to JV and FDI firms. The aquaculture sites are acquirable by applying to DOF's advertisement, published in the local newspapers (Refer to Figure 4.10 for the detailed process of application). Nonetheless, this process is found to be a hassle for new entrepreneurs because it requires eight months of the process for approval (Department of Fisheries, n.d.).

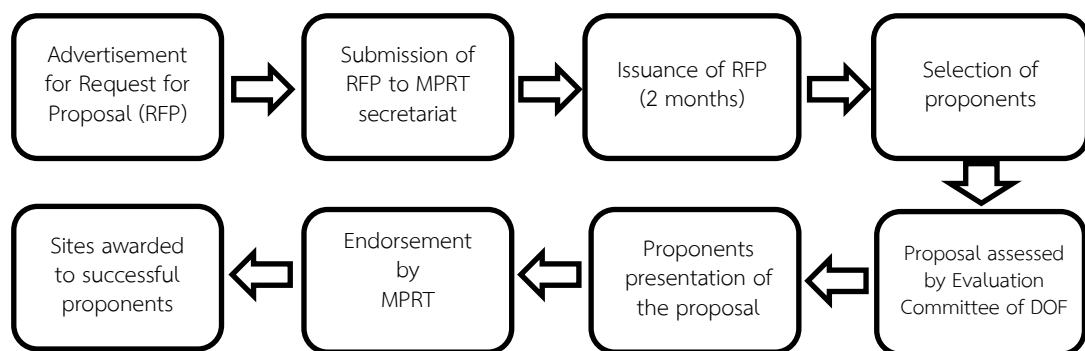


Figure 4.10 The Application process for aquaculture sites for local entrepreneurs

Source: Department of Fisheries (n.d), based on the Author's interpretation

Related to previous role, in term of DOF technical assistance includes ensuring the water quality for to ensure the quality production, doing survey to locate the suitable soil for in-land aquaculture operation and exploring of sites for fully utilization of aquaculture operation in Brunei, in-land, coastal and offshore operations and sites selection that is suitable for species to grow (Department of Fisheries, n.d.). According to an informant from DOF, things considered are temperature, type of water, the salinity of the water which these things can affect the growth of certain species.

Following the assistance of providing technical advisory and monitoring support, with the lacking readiness of local entrepreneurs in terms of know-how and skills in operating the aquaculture operation and business strategy (Kementerian Sumber-Sumber Utama dan Pelancongan, 2017), DOF step-in by providing workshops for local entrepreneur more proactive and progressive for the firms' development. According to Zohrah (1996) DOF undertakes weekly visits and has established the Mobile Technical Unit to monitor the progress of local operators. Furthermore, according to informant Azhar Aziz, Mobile Technical Unit (MTU) also provide emergency services for local operators, in case there is any complication on the fish's health. Nonetheless, to add, as reported by the informant from DOF, MTU is also responsible for reporting emergency cases such as destroyed farms caused by storms, and fish mortality due to diseases and other factors to the ministry, which under these circumstances, compensation is provided by the government for local firms to start over a new harvest.

Subsequent and related to points above, DOF also provides fast-track services to kick-start the progress of local firms' operation with support on facilities and licenses. This support service includes the supply of electricity to the firms mostly to firms operating in-land based aquaculture, in addition to that, portable water supply is also made available, while to settle things faster, DOF also assists in obtaining licenses for foreign workers (Department of Fisheries, n.d.).

Finally, yet importantly, government roles in technology transfer seen when MPRT acts as a bridge in delivering technology and know-how to local firms through encouraging technology transfer from FDI and JV. For every JV and FDI MOU

for operation, TOT is always emphasized by the ministry. There are a few outlines for procedures applied in monitoring the TOT to the aquaculture activities. The procedure they exert is to ensure the technology transferred is as follows (Department of Fisheries, 2019b):

1. Sustainable and supports environmental protection;
2. Fulfill the halal requirement of the fish feed and;
3. Support the implementation of Good Practices that ensure compliance on the basic requirement for safety, hygiene, and quality standard

From this, it has shown that there is missing on the specification of what technology to transfer, how to transfer and ways for local firms to receive it. Thus, as a result, JV and FDI companies mainly perform the transfer through contract farming.

4.5 Current Situation of Brunei Aquaculture Technology

As mentioned earlier, aquaculture is not a new practice in Brunei, and productivity is the key for Brunei to achieve 269,377 metric tons in 2035 (Department of Fisheries, 2016). The key to productivity is technology, however, have exposed to both conventional and modern technology that contributes to productivity. Which modern technology is largely transferred through the channels of FDI and JV.

Being engaged with FDI and JV, the aquaculture industry is exposed to various technology. Different technology and facilities used in this industry can be further divided by marine aquaculture that was conducted. Marine shrimp culture widely used new technology of Recirculating Aquaculture System (RAS) and High-density Polyethylene Cages Pond Liners (HDPE). While as for marine fish cage culture the usage of high-density polyethylene HDPE cages that is mostly transferred from Taiwan and China and the other is the usage of conventional farming that uses wooden cages.

While as for crab farming, usage of RAS technology was transferred from Thailand and Vertical Farming was also applied with the purpose to save the usage of large areas for crab farming. Nonetheless, despite the exposure gained from FDI

and JV, most of the aquaculture farmers are still using conventional technology to farm.

4.6 Importance of Technology Transfer to Aquaculture Sector

4.6.1 Knowledge Creation in Aquaculture Sector

To justify the importance of technology transfer to aquaculture, R&D and knowledge creation are analyzed. In general, Brunei R&D is relatively low compared to countries that are advanced in the aquaculture industry. Invention and innovation for suitable technology that suits the Brunei aquaculture environment are crucial for the development of aquaculture as well as to provide for higher production. Knowledge creation that is responsible for aquaculture development is the Institute of Brunei Technical Education (IBTE) of Agro-Technology and Applied Science Campus. the specific course of the National Technical Education Certificate (NTec) in aquaculture and Higher National Technical Education Certificate (HNTec) in Agrotechnology specialized in Aquatic Science is offered as part of the education system.

This course is equipped with the foundation of aquaculture skills by providing theoretical knowledge and skills for practical handling procedures and processes in aquaculture and fisheries. This course offers 12 months program, which nine months of duration spent in institution-based training while the other three months are industrial attachment (IBTE, 2019). NTec Aquaculture goals and vision are to provide the aquaculture industries for skilled junior aquaculture assistant; aquaculture farm operator; seafood operator; capture fisheries; aquarium fish shop operator; fishing gear shop; fish feed supplier and; fishmonger (IBTE, 2019).

This training, however, was not equipped to invent or design aquaculture technologies but just on how to operate it. From this, it can be concluded that the knowledge creation of Aquaculture NTec's goals is to provide labor forces that meet the demand of the industries. To support those claims, an informant, Ramlee Hamid, the Head of Department of Ntec in Aquaculture, the courses offered in this training program was shaped according to the demands and needs of the companies that

were involved in the aquaculture sector. This was to produce skilled students to be in the workforce and this contributes to higher productivity.

Nonetheless, this training program is recently developed with only five intakes for NTec in Aquaculture between the years 2015 and 2019 with a total of 106 students (Refer to Table 4.3). Also, IBTE offers students to pursue higher education of HNTec in Agrotechnology specialized in Aquatic Science, as of now there are already three intakes that enrolled starting from the year 2016. Currently, this program has trained 33 students with two graduated intakes of the class of 2016 and class of 2017 (Refer to Table 4.4).

IBTE NTec in Agrotechnology and Aquatic Science acquire their knowledge transfer from the companies involved in the aquaculture sector by doing working placements for experience and practical hands-on that only took three months. Apart from that, IBTE has been seeking formal agreement or Memorandum of Understanding (MoU) with University Malaysia Sabah (UMS) to exchange and transfer of knowledge and technology between the two institutions, however, the discussion is still in progress.

IBTE Ntec in Aquaculture has limited its student intake to only 20 students per year. The rationale of this was due to the unsolved problem of shortage of teaching staff. Some of the teaching staff were inviting experts, local Bruneian lecturers and some of the staff were employed from overseas. This problem has a direct impact on the productivity of aquaculture as it affects the production of skilled labor and personnel to meet the demand of the aquaculture sector itself.

To justify the significant of TOT to the industry is due to IBTE Ntec in Aquaculture and HNTec in Aquatic Science is the only knowledge creation of government agency available in Brunei to produce skilled labor and personnel to meet the job requirement in the aquaculture sector.

Table 4.3

NTec Aquaculture intakes (2015 – 2019)

NAME OF PROGRAMME	YEAR	DURATION OF STUDY	NUMBER OF STUDENTS ENROLLED
NTEC in Aquaculture (National Technical Education Certificate)	July 2015 – June 2016	1 Year	26
	July 2016 – June 2017		20
	July 2017 – June 2018		20
	July 2018 – June 2019		20
	July 2019 – June 2020		20

Source: IBTE Agro-Tech Campus (2019)

Table 4.4

HNTEC in Aquaculture intakes (2016 – 2018)

NAME OF PROGRAMME	YEAR	DURATION OF STUDY	NUMBER OF STUDENTS ENROLLED
HNTEC in Agrotechnology – Specialized in Aquatic Sciences (Higher National Technical Education Certificate)	July 2016 – June 2018	1 Year	16
	July 2017 – June 2019		10
	July 2018 – June 2020		7

Source: IBTE Agro-Tech Campus (2019)

4.6.2 Road to Global Supply Chain

As mentioned, the answer to end the curse of Dutch Disease is to focus away from oil and gas industry, which to develop aquaculture industry is the key to undo the curse. Thus, government have set 269,377 MT of production is needed for a stable export production for Brunei to position themselves in the GSC, which however needed 17 percent of annual growth to achieve the year 2035 goals (Department of Fisheries, 2016; Department of Fisheries, 2019).

Nonetheless, with Brunei current situation on the lacking of two important agencies that can invent and develop technology for high productivity, TOT therefore is proven to be essential for Brunei to locate themselves in the GSC.



CHAPTER 5

FINDING AND DISCUSSION

This chapter analyzes the results and findings of technology transfer across Aquaculture Firms in Brunei. Referring to the methodology section in Chapter 3, this chapter discusses the finding using the case study method. This research aims to investigate the current situation of technology used across Brunei Aquaculture Firms, as well as to investigate the process and problems of technology transfers to firms in the aquaculture industry. Qualitative analyzation is applied for the discussion on the findings based on the interview sessions with firm owners, academic experts, Department of Fisheries and Brunei government Investment officers.

5.1 Local Owned Companies

Research conducted to four local owned companies to study their aquaculture technologies and the process of technology transfer to their firms. The four companies involved in this research are Nur Az-Zahra Aquaculture, Berjaya Aquaculture, O.D.E Aquaculture and Agriculture and lastly to Qurashi Blue Ocean Enterprise. Data have been collected using the method mentioned previously in Chapter 3. Among these four local firms, the majority of them opted to transfer technology using International TOT and only one firm uses licensing TOT for its firm's operation.

5.1.1 Nur Az-Zahra Aquaculture

5.1.1.1 Firm's Background and Development

As a brief background of this case study on Az-Zahra Aquaculture, this company is fully owned by local Bruneian. Az-Zahra Aquaculture company previously known as *Perusahaan Azua dan Keluarga* (Azua and Family company) was rebranded as the current name, as it was bought off by the current owner Azhar in the year 2016 from the previous owner of Haji Sukor Hamid with USD30,000 of investment. Az-Zahra Aquaculture operates cage culture with two

branches of operation. The first branch is in Sungai Bunga River operated since 2013 and in 2018 they have started the second branch in Pelumpong Spit which one hectare was granted by the government but only able utilized 20 percent (0.2 acres) of the granted site (Refer to Appendix A and Appendix B).

Azhar, the owner is a Syariah graduate from Al-Azhar University in Cairo, instead of pursuing his plan to be a profession in Syariah court or religious teacher and taking consideration of Brunei's economy in its four-year term of the recession he decided to venture into aquaculture industry. The owner had little to no background on knowledge on aquaculture. Nonetheless, his investment of USD30,000 is paid off with the knowledge transferred from Preni, an Indonesian employee which is explained in the latter part of the section.

Since this company is rebranded, it has only operated for four years (2016 – 2019). As of 2019, Nur Az-Zahra Aquaculture culture five species of seabass, tilapia, hybrid grouper, white trevally, and golden snapper. As of May 2019, the average growth of Az-Zahra Aquaculture company production is nine percent annually since 2016 (Refer to Figure 5.1). According to the informant, such fluctuations in the productions are due to the experimenting on new species to culture and also due to the unpredictability of water quality especially the temperature and also the red tide that has exposed and endangered the life of the fishes.

As for marketing strategy, currently, Az-Zahra Aquaculture only manages to fulfill local demands due to the relatively small production in the past four years. They reach the customer using the medium of social media of Instagram, *Whatsapp*, and mobile number. Nonetheless, Az-Zahra Aquaculture became a supplier to high-end restaurants, and fine dining of Royal Brunei Catering and Hyatt Restaurant. Az-Zahra also supplies seafood products to seafood restaurants and buffet of *Pondok Sari Wangi* and Horizon Seafood Restaurant.

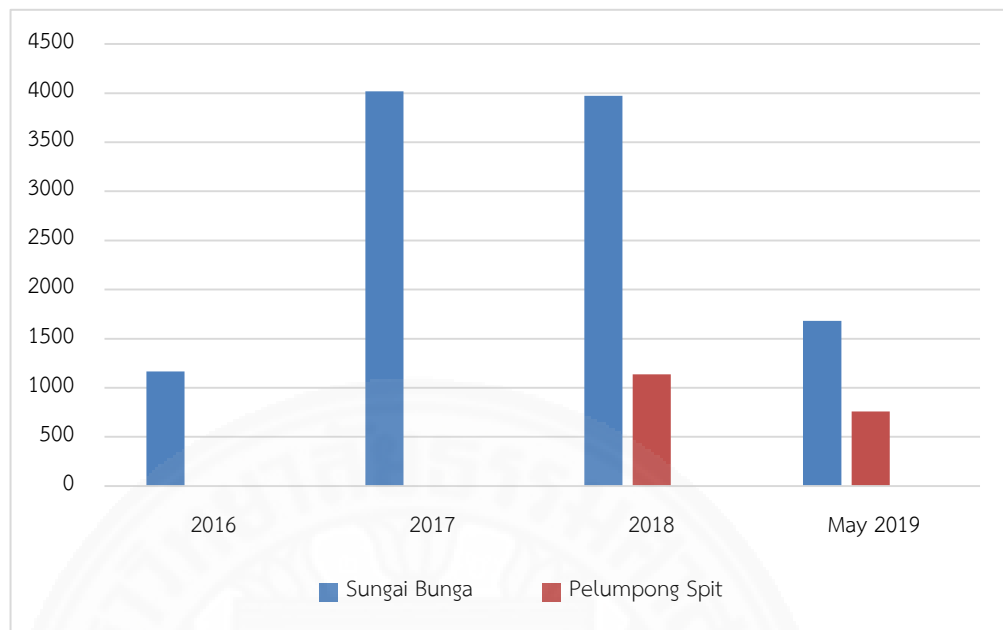


Figure 5.1 Nur Az-Zahra Aquaculture production data in Kilogram (kg)

Source: Department of Fisheries (2019)

5.1.1.2 Firm's Aquaculture Technology

Az-Zahra Aquaculture uses conventional floating wooden cages farming which is widely used across Aquaculture Firms operating in-shore farming. In terms of aquaculture technology used in both farms, Az-Zahra Aquaculture uses conventional floating cage farming. Compare to the rest of the other companies', Az-Zahra's farm owns the smallest floating cage size. For 24 cages in Pelumpong spit, the size of the cage is 3m (meter) x 5m x 2m each. While for 240 cages in Sungai Bunga River, the size ranges from 3m) x 3m x 2m; 2m x 4m x 2m; and 3m x 3m.

The cage technology uses water drums for cages to float, nets and resistant timber of *Kapur* or Camphor and *Selangan Batu* or better known as *Balao* in Thailand. The rationale of using these two kinds of timber because of its durability and strength up to 11 to 15 years of life-span. According to the informant, Azhar, cheap cost and easy to use and maintain is the main reason why this firm chooses to operate the conventional type of farming.

5.1.1.3 Process of Technology Transfer

As mentioned previously, the owner of this firm has little experience and knowledge to operate the aquaculture business. To gain access to technology, the company uses international technology transfer, where he employed three experienced Indonesian foreign workers. Therefore, the three workers just transfer their knowledge, experience, and skill within the firms, as mentioned by the informant, that experience and practice are the most crucial things in this business. Hence there is not a need to train the workers on how to use the technology and manage the farm.

According to an interview with Azhar, DOF also offers opportunity for entrepreneurs to be exposed to the usage of new cage technologies. Nonetheless, due to cheap cost and most importantly the comfortability for the worker, the firm decided to expand the business using the conventional method of farming rather than investing in more advanced technology due to its uncertainty, cost issues and unavailability of skilled workers to operate such advanced technology. One of the workers, Preni, is experienced in aquaculture and transferred his knowledge gained from his experiences to improve the performance of the farm, which includes knowledge on nutrition to infrastructure matters.

5.1.2 Berjaya Aquaculture

5.1.2.1 Firm's Background and Development

Standing on 0.18 acres of the owner's land, Berjaya Aquaculture is the first mud crab company that utilizes vertical farming techniques. This company established in 2018, with an investment with a total capital of USD73,000 from the owner's retirement fund. Vertical farming is innovation and evolution for crab farming species that intensive crab farming can be achieved. This is due to crab is cannibalism in nature which usually requires extensive space of land to operate. Currently, this company prioritizes farming mud crab species and as of August 2019, this company has reached a total production of 300kg and aiming for 1000kg per year of production in the future.

As a brief background of the CEO and founder of the company, Jamain was an engineer and his passion for technology is what inspires him

to apply new technology in Brunei aquaculture specifically in the farming of mud crab. As mentioned, being an expert in engineering the owner has a little background on how to manage aquaculture, nonetheless, the owner seeks for technology transfer abroad which elaborated and discussed in the latter part of this section.

5.1.2.2 Firm's Aquaculture Technology

Berjaya Aquaculture adopts and utilizes RAS technology vertical farming to culture mud crab (Refer to Figure 5.2 and Appendix C). The advantages of utilizing RAS in aquaculture overall, it can control the parameters that affects the quality and development of the crabs. With RAS vertical farming, not only it is intensive it also able to save the use of water, as water flows from each box from up to bottom thus water recirculates to the amount of water used (Refer to Appendix D). Water flows from water tanks, and in the case of Berjaya Aquaculture, it uses two types of water; seawater that is diverted from the sea and collected rainwater. The rationality of this is to provide fresh and quality crab as it controls the salinity of the water. As emphasized by the informant, Jamain, water quality is the most crucial factor in aquaculture business, and by using RAS, the company able to produce high quality and safe production of crab which issues of diseases, temperature and water quality can be handled.

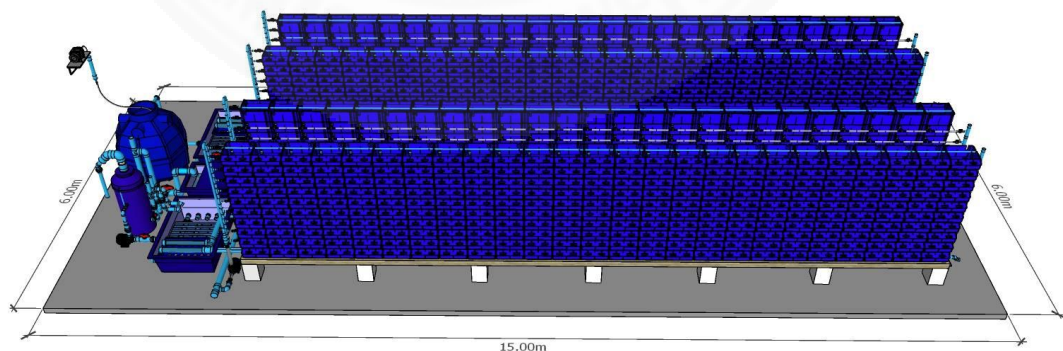


Figure 5.2 Berjaya Aquaculture's design of intensive RAS vertical crab farming

Source: AquaPlanet (2018)

5.1.2.3 Process of Technology Transfer to Firm

Licensing technology transferred is applied in the case of Berjaya Aquaculture in operating intensive vertical RAS crab aquaculture. Given the fact that the founder and workers have little knowledge of managing aquaculture, the owner and workers have sought technology transfer from various countries by having training abroad. The training took place in Kluang, Johor Bharu in Malaysia for the introduction of crab aquaculture and vertical farming using RAS technology; Neocrab Company in Kuching, Sarawak, Malaysia for transfer of knowledge in terms of hatchery and nursery of mud crab; Singapore and; Thailand. The technology of RAS and knowledge in both theoretical and the practical part are transferred to crab farming aquaculture in Brunei.

RAS technology equipment is transferred by Aqua Planets Thailand company to Berjaya Aquaculture via licensing. Aqua Planets is also the supplier for boxes and pipes, although Aqua Planet provides instant vertical aquaculture boxes ready to install since installing guide and process is confusing, it requires supplier's service to assemble and install the technology.

As for the process of exporting the supply of tanks, boxes, and pipes, the researcher able to organize an interview with the supplier side of Aqua Planets representative, Max. According to Max, problems of transferring the technology to Brunei and other customer is the installing of equipment. However, due to unavailability of guidance on assembling the technology, their service for installation and assembly of equipment is needed abroad. The informant also added, exporting of technology from Thailand to Brunei as well to other ASEAN country is less hassle compared to non-ASEAN countries, due to the Free Trade Agreement (FTA) that affect the price due to imposition of tax. Nonetheless, according to the informant of Berjaya Aquaculture, his company was taxed by the Brunei government by five percent due to the importation of machinery with the purpose of business which falls as dutiable goods.

According to the informant, access to knowledge and skills about RAS and crab farming in Brunei is difficult. Having the experience of the

importance of TOT, the owner took the opportunity and become the agent of technology and knowledge transferor to cater to the demand for RAS farming.

As of October 2019, Berjaya Aquaculture has successfully organized five two days training courses about vertical soft shell and mud farming with price ranging from USD145 to USD219. As part of the marketing strategy, Berjaya Aquaculture has offered packages by providing accommodation and transportation for overseas participants. According to the informant, Jamain, organizing training courses made up 50 percent off the total monthly revenue with the production of crab. He also added, that this training course is a success, and there is an increase in demand to offer more training classes. Thus, it can be said that transferring knowledge through this method is seen as more attractive towards the local entrepreneurs, as they are not bound to any contract. However, in terms problems in transferring technology, according to the informant the process and regulations is a hassle because it took a long time to be processed.

5.1.3 O.D.E Aquaculture and Agriculture

5.1.3.1 Firm's Background and Development

O.D.E Aquaculture and Agriculture is a family business wholly owned by a local, Azahari Chuchu. The owner's main idea is to supply fish to its restaurant, Aminah Arif. As a background, O.D.E Aquaculture has two aquaculture sites in Buang Tawar Village and Pelumpong Spit that practices conventional cage farming, which is explained in the latter part of this section. This company is managed by two local workers and eight foreign workers from Indonesia. Red snapper, barramundi, hybrid grouper, milkfish, tilapia, and pompano are among the species that are breed on this farm. According to the informant, some fish fry is bought from a local breeder and some are imported from Bali, Indonesia.

Nonetheless, with the success of O.D.E Aquaculture, from one hectare of land, the government has upgraded to four hectares for the company to expand, according to the informant as of July 2019, the company currently owned more than 1,400 cages (Refer to Appendix E). As a result, O.D.E Aquaculture experienced progressive development and production along with its investment in increasing the number of ponds and the size of the farm (Refer to Figure 5.3).

Nonetheless, it is worth highlighting the unpredictability of fish diseases and water quality of red tide that occurs without warning has resulted in the fluctuations of production between the years 2017 and 2018.

Regardless of that, for the marketing strategy of O.D.E Aquaculture, the large number of productions are being directed for domestic markets. Most of its fish caters to the O.D.E group's restaurant of Aminah Arif, also marketed to the Gadong fish market and Jerudong fish market. However, as for Pompano fish, it is farmed specifically for export purposes to cater to huge demand in the Hong Kong market.

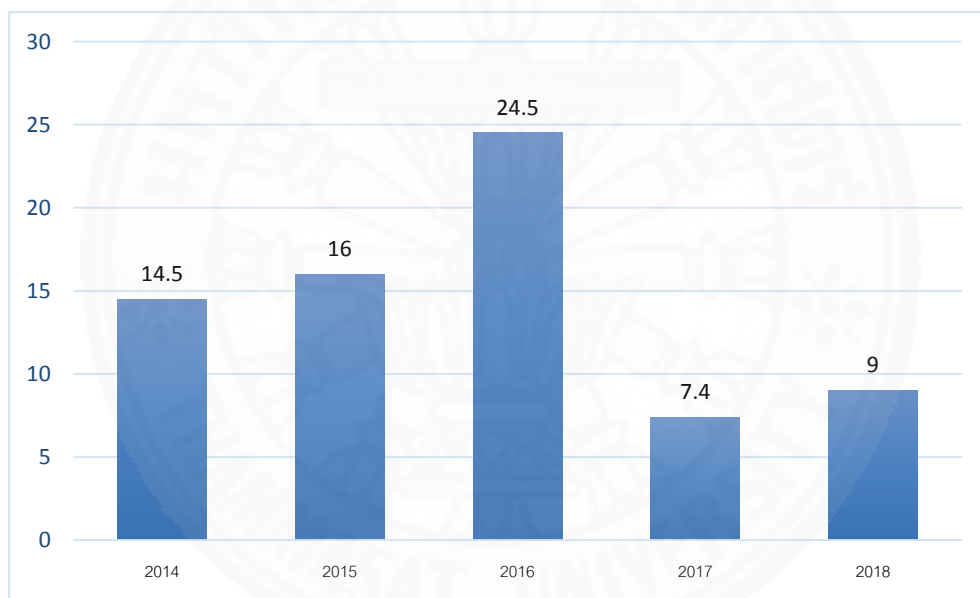


Figure 5.3 Production data of O.D.E Aquaculture and Agriculture in Metric Tons (MT) (2014 – 2018)

Source: Department of Fisheries (2019); Syahir Zaky (2017)

5.1.3.2 Firm's Aquaculture Technology

The extensive farming approach is the strategy used by O.D.E Aquaculture to develop and gained high quantity production. This can be proved by the expansion of space from one hectare to allocation of four-hectares by the

government as mentioned above. The main reason for this is conventional cages need large-scale space and more cages to be built for favorable production.

The factor of cost on building the technology and comfortability in usage became the crucial factor in this company to ensure less complication when operating. O.D.E Aquaculture farms standard size is 2m x 4m with 2m depth with the specified cage, each cage can hold up to 600 to 800 fishes depending on the species. Like any other conventional cage, the technology involves using water drums, nets and resistant timber of *Campor* and *Selangan Batu* for two main reasons, its durability and cheaper cost than other technology.

5.1.3.3 Process of Technology Transfer to Firm

The process of transferring technology which in this case is knowledge for this company is through international technology transfer. The means of gaining access to this technology and knowledge is made easy with the simple process to import foreign workers from abroad. However, in terms of technical equipment, the company just bought ready-made cages from a local seller.

The knowledge that is transferred to this company is their experience and practicality with operating the farm and maintaining the cages. Their experience working in the aquaculture field made them responsible for attending the farm which includes feeding, harvesting and observes the health of the fish.

When matters of adapting to acquire and utilize new advanced technologies in farming as a milestone development of the company are put forward, the informant emphasizes that the company will use the same technology and expand to fully utilize the space. The rationale behind this is due to the cheap factor of using conventional cage technology and the comfortability of the worker using the existing technology to ensure a high quantity of production and care of the fish.

Nonetheless, it is clear why the company decides to develop while sticking to the same conventional technology because acquiring new technology means investing more in the company and its workforce. Being widely used worldwide, conventional cage technology known for the benefit of being to offer straightforward operation, for this company, instead of allocating a big amount

of investment to train the workers, they opted for an easy and faster way of importing foreign workers from Indonesia.

5.1.4 Qurashi Blue Ocean Enterprise

5.1.4.1 Firm's Background and Development

Established since the year 2005, Qurashi Blue Ocean Enterprise is owned by two local Bruneians, Zalilah Razak and Omar Yaakub. This company operates cage culture in two aquaculture sites in Pulau Kaingaran and Pelumpong Spit. The strategy to expand their aquaculture operation is due to its vision of exports, and it is successful with adopting new technology for its Pelumpong Spit branch. This company offers seabass, pompano and hybrid grouper for the domestic market to the supermarket, Gadong fish market, Jerudong fish market, and to restaurants. While being a loyal supply to domestic demand, Qurashi Blue Ocean Enterprise also began to explore and supply species of Pompano to China market.

As for the company's development, Qurashi Blue Ocean Enterprise started with 0.2 hectare of aquaculture sites awarded from DOF in the year 2005, and due to its progressive development in production, Qurashi was awarded one hectare of aquaculture sites in the year 2017. According to DOF (2018), total recorded for Qurashi's production until the year 2017 reached 307.1 MT. The reason for this progress is due to the adaptation and utilization of different technology which is covered in the next part of this case study.

5.1.4.2 Firm's Aquaculture Technology

As of the year 2018, Qurashi Blue Ocean Enterprise owned a total of 74 cages in Pulau Kaingaran and 246 cages in Pelumpong (DOF, 2019) operating by two systems of aquaculture technology in their farming activity. They started with using conventional farming cages in Pulau Kaingaran and adopted on utilizing a different technology of HDPE open cages for their Pelumpong Spit (Refer to Appendix F) branch which was bought from a Chinese investor. The cages size ranging from 2m x 4m, 3m x 3m and 5m x 5m with at least four to six meters in depth.

The advantage of using conventional cage technology is the easy feature it offers, simple operation, inexpensive for construction and

maintenance and most importantly its practice is widely known among the foreign laborers which in the case of Qurashi Blue Ocean Enterprise, they import foreign labors from Indonesia.

However, different for HDPE cages operation in Pelumpong Spit, it requires skilled technicians to operate the farm. Therefore, Qurashi Blue Ocean Enterprise has to employ two Chinese skilled technicians from the company they acquired the HDPE technology from.

5.1.4.3 Process of Technology Transfer to Firms

International technology transfer occurred in Qurashi Blue Ocean Enterprise. This happened due to the import of skilled workers from China to operate HDPE open cages in the Pelumpong Spit branch and Indonesian technicians to manage the cage in the Pulau Kaingaran branch due to the utilization of conventional cage farming.

To argue, interfirm technology transfer can happen in this situation, but it did not, as the language barrier is the main issue to hinder such transfer to occur. Due to this, the process of transferring knowledge on the technical part and know-how is slow and heavily based on observation.

5.2 Joint Venture Companies

Research conducted on four JV companies namely, KR Apollo, Golden Corporation, Hiseaton Fisheries and Nur Nabai Aquaculture. As mentioned before, data collection was done for the purpose to investigate the aquaculture technologies operated and the modes of the process the firms used to transfer technology to their firms. From the data analyzed, all of these JV firms opted for intra-firm technology transfer to be transferred from their parent company for their subsidiary companies in Brunei.

5.2.1 KR Apollo

5.2.1.1 Firm's Background and Development

Established in 1972, Apollo Aquaculture Group currently became the leading producer of groupers and shrimps that provide confidence for Singapore's food security issue. The island is known for the problem of land scarcity, and this motivates Apollo Aquaculture Group to invest more than USD 14 million to internationalize through the entry mode of JV. This partnership is between Apollo Aquaculture Group of Singapore and local businessman, YAM Pengiran Kerma Raja Pg Haji Kamarulzaman which later named the JV company as KR Apollo. 12 hectares of land in Sungai Jambu, Tungku Village is allocated and awarded for the operation of this vertical farming business. Being known to use land efficiently, Singapore has amazed the industry by inventing technology in small space but able to contribute a high quantity of production.

KR Apollo became the first vertical land-based fish and prawn aquaculture that operates in-door. The business will be handled remotely from Singapore and local Bruneian will be employed to control on-site in case of any emergency (Khew, 2017). While the harvested production is to be exported back to Singapore to support Singapore's branch production, demand and also to strengthen Singapore's strategy of food security (Lyna, 2017; Brunei News Gazette, 2017).

Nonetheless, this firm is still in the process of development and they estimated to be able to produce more than 5000kg of yields per year—83 tons fish with utilizing four farms in a year and up to 3,240kg a year for shrimp which makes Apollo to be six times more productive compared to traditional farming output of only 15 tons a year for fish and 1,080kg a year for shrimp (Khew, 2017). More aquaculture technology used and the process of technology transfer is explained in the latter part of this section.

5.2.1.2 Firm's Aquaculture Technology

"The traditional method for fish farming has never changed. It's very tough work. But with technology, the possibilities are endless" quoted from the owner Mr. Ng, the CEO Executive of Apollo Aquaculture Singapore (Khew, 2017). Apollo Aquaculture has applied the use of the vertical land-based system of farming

by applying RAS technology. With the allocation of 12 hectares of land, KR Apollo starts by building four sets of vertical ponds with each pond have three levels (Refer to Figure 5.4).

Each vertical pond has three levels of tanks with Level 1 and Level 2 grows hybrid grouper or commonly known as pearl grouper by the Singaporean and coral trout, in which these two species have a huge demand in the Singapore market. These two tiers are designed to imitate the natural habitat of the species by building dark surroundings for these two tiers. Nonetheless, for the most top-level three, it is designed for farming white shrimp.

According to Apollo Aquaculture Group from The Straits Times in Khew, (2017), these tanks are equipped with advanced technology to monitor the farm with sensors, cameras, o-zone sterilizers, and bed bioreactor. Sensors are used to examine the water quality, salinity, oxygen levels and the temperature of the tank. While the camera is also installed to monitor the cultured fish and prawns to ensure their health status as for o-zone sterilizers since this farm opted for RAS in vertical farming, water is recycled and it is responsible to sterilize the water before it is released to the next tank. Also, this firm applied the use of a bed bioreactor that acts as a filter to reduce dirty substances from recycled water before being reuse to the other fish tank.

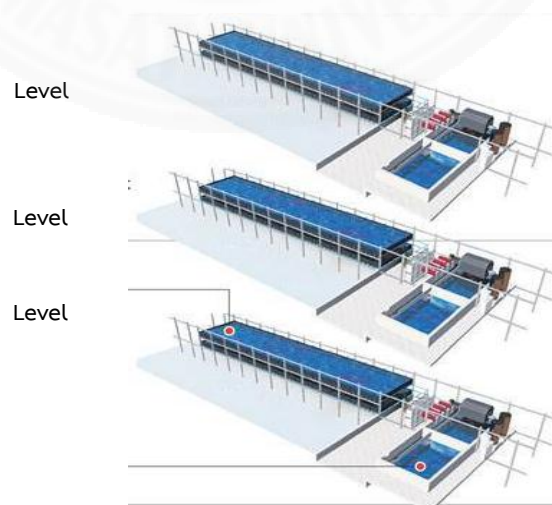


Figure 5.4 KR Apollo's design of RAS vertical land-based aquaculture technology

Source: Khew (2017)

5.2.1.3 Process of Technology Transfer to Firm

In this case study, since the vertical technology patent is owned by the parent company of Apollo Aquaculture Singapore, and by doing JV, the intra-firm transaction process occurred from the parent company in Singapore transferred its technology by duplicating the design of the farm and export the technologies to Brunei. Like any other firm that bringing in machinery for business purposes, KR Apollo was also taxed at five percent for entering the Brunei market.

Nonetheless, as mentioned before, since the handling process is done remotely from Singapore, the transfer of knowledge might be not as engaging as it should be, compared when it is done hands-on in the site itself. Nonetheless, according to Lyna (2017) in the future KR Apollo plans to transfer the technologies to Brunei local firms and to establish research and development to Brunei local species of the famous Blue Shrimp and '*macrobrachium*' (freshwater prawn). However, since the development of this company is still under progress and is targeted to be done by the year 2020, the process of transferring their technology to be utilized by the local firms is still unsure as it is beyond the researcher's capability of time to investigate about such matter.

5.2.2 Golden Corporation

5.2.2.1 Firm's Background and Development

A Foreign company from Taiwan established as Golden Corporation in 2002 as a courtesy invitation from a quasi-government corporate entity, Semaun Marine Resources. Semaun Marine Resources is a company that specializes in farming shrimp and Taiwan investor specializes in the seafood processing industry. Being partners, Golden Corporation became Brunei's leading seafood company producer that deals with whole value chain of aquaculture from hatchery, aquaculture feeds, farming of organic shrimp, investing in fishing vessels to exploit Yellowfin Tuna and Skipjacks in Brunei's Zone 4 of Brunei's sea that were undiscovered by local fisherman, and established three Multi-Purpose Seafood Processing Centre. Nonetheless, with the scope set in this research, it will only study on aquaculture. Therefore, only the aquaculture activity of this firm is studied.

As a brief background to this FDI company, more than USD 36 million was injected to develop 200-hectares land were lease for in-land shrimp farming activity located in Penyatang in the year 2017. According to the informant, over the years, the sites were expanded making a total of 459 hectares sites were leased for this FDI operation (Refer to Appendix G). With such a strategy, Brunei has successfully become the world's largest producer of Blue Shrimp.

Frozen organic blue shrimp is exported to cater to high demands in parts of Europe countries of United States, United Kingdom, parts of Asia of Japan, China, South Korea, Hong Kong, Malaysia, Viet Nam, The Philippines, Indonesia, Taiwan, and Australia. Between January 2017 and June 2018, it was reported Golden Corporation has exported 1,582 metric tons of frozen products that worth USD 6 million. Golden Corporation succeeds in offering job creation and have employed a total of 347 workers, which 59 percent (205 workers) were local Bruneians, and the other 142 are foreign workers.

For further development and success in the industry, Golden Corporation has established their R&D center to ensure quality and export criteria is met especially when exporting to European Union (EU) market that requires the exporter to meet certain criteria that have been set. Nonetheless, sustainable exports were possible with the use of advanced technology which is explained in the latter part of this case study.

5.2.2.2 Firm's Aquaculture Technology

In-land conventional farming (Refer to Appendix H) is utilized by Golden Corporation to culture the organic blue shrimp, located near Penyatang River and the South China Sea. This sites is named Penyatang Shrimp farm, which as mentioned earlier, a total of 459 hectares was used for this farming activity, which this area is further divided into five zones; namely Zone A, Zone B, Zone C, Zone D and Zone E.

Like any other conventional farm, Golden Corporation technology also involves excavation of land, canvas and water pump, except the water pump is bigger and was kept in a pump house. The water pump draws seawater to the farm for a quality taste of the blue shrimp. Nonetheless, this

company utilized proper filter technology for quality and safety measures of the water in terms of salinity and pH balance before being pumped to the shrimp farm.

5.2.2.3 Process of Technology Transfer to Firm

The process of Intra-firm technology transfer occurs in Golden Corporation from Taiwan to Brunei. It is transferred to Golden Corporation's organizational structure and its engineering team to manage the transfer of know-how to operate the equipment imported. Nonetheless, these transfers are mostly towards seafood processing activities, this is because as mentioned above, technologies used in farming shrimp are straightforward.

Nonetheless, having experience in the industry, Golden Corporation became the agent to transfer its knowledge and technologies to local farmers, and universities. The rationale is to contribute to the development of the company and the Brunei aquaculture sector overall. In the case of the initiatives of technology transferred to local farmers, Golden Corporation made an effort to encourage local farmers to farm blue shrimp through contract farming that is equipped with assistance and technical know-how under the supervision of Golden Corporation (Golden Corporation, 2015). Golden Corporation's strategy is to create supply chains for greater production of shrimp by buying back the farmed shrimp to add to the company's production. This is to ensure sustainability and quality shrimp stocks as Golden Corporation's main activity is Seafood Processing activity. Even so, these initiatives are still in the planning and have not been implemented.

However, in another attempt and effort to transfer technology and knowledge, it has involved in shaping the Brunei education system specifically in the IBTE Vocational Wasan School syllabus (Golden Corporation, 2016). Work placement or internship is included as part of the syllabus, as mentioned by informant, Ramli, that practical in IBTE aquaculture course is crucial for students to experience and understand the theoretical part that has been taught. Thus, Golden Corporation has done its part by offering the company as a work placement or internship place for students, and some graduate students were employed by the company according to their credibility and achievements. The rationality of this plan is to produce skilled students for the industry's workforce.

In addition to that, Golden Corporation also grants students with scholarships to Taiwan for four years degree courses that are taught in English. The courses are focus to study aquaculture practices and management, in which students are guaranteed a position in Golden Corporation company. In 2015, Golden Corporation has sent more than 10 students to Taiwan, expecting more technology transfer will take place for the company's development (Golden Corporation, 2015).

5.2.3 Hiseaton Fisheries Sdn. Bhd

5.2.3.1 Firm's Background and Development

Hiseaton Fisheries is a partnership between a subsidiary of Guangxi-Hai Shi Tong Co., Ltd based in Guangxi Province, China, and Brunei Government-linked company. It was established in the year 2016 as Hiseaton Fisheries Sdn. Bhd. The subsidiary company internationalizes its influence based on the advantage of ASEAN-China FTA and the invitation from the Brunei government. However, this is also a motivation of political-economic incentive as mentioned by Hiseaton (2019) this subsidiary is part of "*Guangxi Brunei Economic Corridor*" project as part of China's Belt and Road Initiatives (BRI) which is designed for transaction of knowledge and technology transfer through scientific and technological cooperation (Hiseaton, 2019).

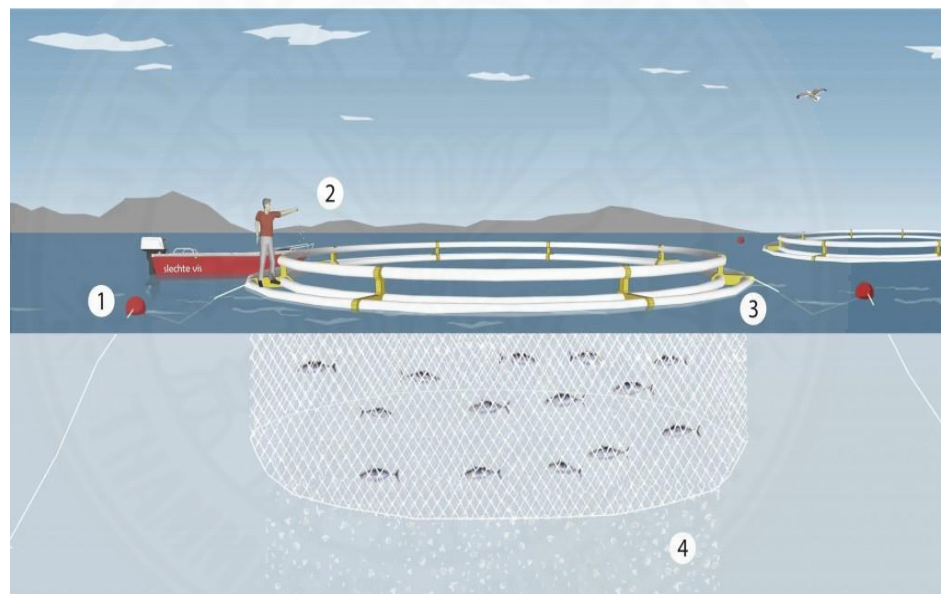
For a brief introduction and development, Hiseaton Fisheries runs three fisheries activity of hatching, aquaculture and seafood processing, where 22 hectares of land were awarded for hatching base, 2000 hectare of a sea area for culturing activity and two hectares for seafood processing base (Hiseaton, 2019). It is a fact that Hiseaton is the first large-scale deep-sea aquaculture company in Brunei which the rationale of 2000 hectares of sea area awarded is explained in the firm's aquaculture technology part of this case study.

Following the introduction, Hiseaton Fisheries cultured species that are in high demand. Species of Cobia, Pompano, Barramundi (Seabass) and Grouper were cultured to cater to the domestic market and international market of China and Canada. However, product exportation was done under the branding name of the parent company Guangxi-Hai Shi Tong. According to Mariani (2018), Hiseaton Fisheries have exported 2.5 Metric Tons of frozen Pompano to Canada in

July to August 2018, that worth USD 0.075 million. In addition to their marketing strategy aside from exports, Hiseaton also provides an online platform for China customer, nonetheless, Hiseaton also joined international expos for international exposure – 14th China-ASEAN Expo held in Nanning, Guangxi, China (Hiseaton, 2019).

5.2.3.2 Firm's Aquaculture Technology

According to an informant, Hiseaton Fisheries owns 133 HDPE open cages or what Hiseaton Fisheries called as 'net box'. HDPE cage is anchored to the sea floor, buoyant tubes surrounding the cages is responsible for making the open cage to float (Refer to Figure 5.5).



1. The cage is moored to the ocean floor 2. Fishmeal based feeds are added to the cages 3. Buoyant tubes keep the cages afloat 4. Fish faeces and waste fall through the cages

Figure 5.5 Operation of an open cage aquaculture system using HDPE technology

Source: GoodFishBadFish (n.d)

Compare to typical net boxes around the world, Hiseaton Fisheries's design is much bigger, with a size of 500-meter distance and 12m in depth (Refer to Appendix I). Thus, with the size of the net box, it is unambiguous to the reasons of 2000 hectare of sea area allocated by the government for its operation (Hiseaton, 2019). Nonetheless, the reason for having such a big design for this net

box is to ensure a high quality of fish by having big spaces, the net box will allow the flow of water conversion for self-purification.

5.2.3.3 Process of Technology Transfer to Firm

Intra-firm technology transfer process occurs in Hiseaton Fisheries Brunei, transferred from parent company to its subsidiary company in Brunei. According to the informant, three major things were transferred—equipment, know-how (knowledge) and management. As part of the management, the organizational structure is affected by changes, which Managing Director MS. Wei Cheng Yu was placed to the subsidiary company in Brunei. The rationale of placing MS. Wei Cheng Yu as the managing director is due to the duplication of the Hiseaton business model called ‘China Model’ extracted from the parent company itself and it has proven a success (Hiseaton, 2019). The intra-firm transfer also occurs in transferring equipment, engineers, experts and exchanging knowledge and research to the subsidiary company in Brunei.

Part of the goal of the ‘Guangxi Brunei Economic Corridor’ project is to transfer technology and knowledge of ‘know-how’ to locals. For initiatives to achieve such goals, they initiated contract farming with local companies, by implementing the same business strategy of ‘China Model’ which is well accepted in Brunei. As a result, 30 local farmers have cooperated with Hiseaton—among the knowledge and technology transferred were technical training, recovery of fish and processing activity, furthermore, Hiseaton also responsible for supplying fish seedlings (Hiseaton, 2019). As a result, the company not only is a success in the farming of fish, high productivity and fewer diseases on fish by utilizing the Chinese technology, but also able to provide high-quality fishes that have met the international standard for exports within just six to eight months of farming under the supervision of Hiseaton Fisheries.

Aside from that, as informed by informant, Ramli, Head of Department of Agrotechnology and aquatic science, Hiseaton Fisheries also contributes to shaping the IBTE syllabus. It was done by informing the important issues to be added to the syllabus. Hiseaton Fisheries also offer the company as a place for doing a practical internship or work placement to gain experience.

5.2.4 Nur Nabai Aquaculture

5.2.4.1 Firm's Background and Development

Established by the end year of 2016 as a JV company partnership between Fisherod Enterprise from Brunei and PT Sumatera Budidaya Marine from Indonesia, it has successfully made Nur Nabai experience fast development in Brunei aquaculture industry. Within just 10 months in operation, Nur Nabai already exported three metric tons of live hybrid grouper to Hong Kong. The key factor of success is explained in the latter part of this case study.

As a brief background and development of this JV company, a total of 19 hectares was allocated by the government for its operation as of the year 2018. This company's main production is hybrid grouper and is marketed for export purposes to Hong Kong and the People's Republic of China. It was reported a total of 141.95 metric tons of live fish hybrid grouper worth USD1.56 million were successfully exported to Hong Kong from June 2017 until November 2018 (Mariani, 2018) (Refer to Figure 5.6).

Nur Nabai owns two aquaculture sites; in Sungai Paku and Pelumpong Spit; 13 hectares are allocated in Sungai Paku for land aquaculture sites for hatcheries, nurseries, and stocks of groupers; while other six hectares are allocated in Pelumpong Spit for fish farm using the conventional cage.

As mentioned by the informant, Rudi, its strategy of developing hatcheries and nurseries, other than to have a stable supply for the company, Nur Nabai aims to be the largest producer of hybrid grouper and directed several contract farming with local fish farmers by supplying hybrid grouper fry and buy back the mature fish to be exported.

While in terms of the workforce, Nur Nabai has employed 25 employees, which majority of it by 72 percent (18 people) are foreign workers and the rest of seven workers are local Bruneians. More discussion on company's technology used and process of technology transferred is discussed in the latter part section of this case study.

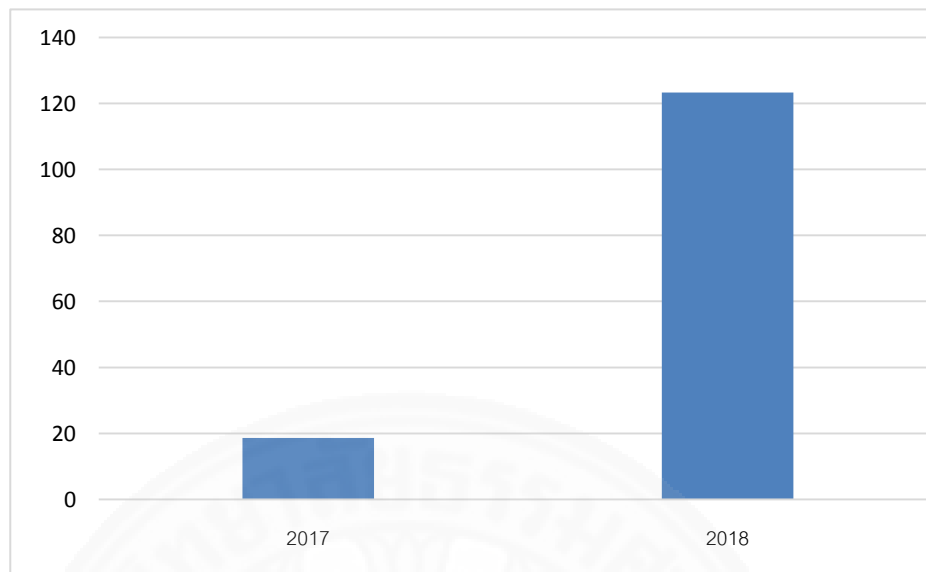


Figure 5.6 Nur Nabai production data in Metric tons (2017 – 2018)

Source: Mariani (2019); Majlis Ilmu (2018)

5.2.4.2 Firm's Aquaculture Technology

Nur Nabai operate by using conventional cage technology system. The rationale for utilizing this technology is due to the well-established skills and experienced workers when operating the farm. Like other conventional cage, water drums, timber, and nets are used, with each cage size of 4m x 6m with at least two meters depths (Refer to Appendix J).

Nonetheless, the problem with conventional cage technology it doesn't have a proper place to keep the matured fish. Since Nur Nabai products are live grouper, the fish needed to be moved for the new batch of fry to be farmed. In the case of Nur Nabai, they moved the matured fish to a 13 hectares sites in Sungai Paku in-land conventional farm. Technology use water pumped to fill in the pond with seawater to ensure high quality and consistent supply of grouper ready for export (Refer to Appendix K)

5.2.4.3 Process of Technology Transfer to Firm

The process of technology transfer to Nur Nabai is through the process of intra-firm technology transfer from Indonesia to Brunei. As mentioned above, within just 10 months Nur Nabai has succeeded in exporting its first product

to Hong Kong. The factor of this success is none other than the transfer technology and knowledge by a partner company of PT Sumatera Budidaya Marine by allocating an expert in Nur Nabai organization and management to ease the operation of the company which is proven by the progressive development it has gone through. For the case of Nur Nabai, an agreement is reached through the placement of Mr. Michael Cheong to be the manager and settled in Nur Nabai.

Other than that, by establishing JV, Nur Nabai able to use the influence of PT Sumatera Budidaya Marine that is already well established in Hong Kong Market. Making them be on the fast-track when exporting to the Hong Kong within just 10 months of establishment. As emphasized by the informant, CEO of Nur Nabai, Haji Rudi, the company is fortunate to have Michael Cheong as the manager because he is well experienced in handling the company to develop. Thus it is worth highlighting the importance of transfer to company organization as shown by the development as the case of Nur Nabai company.

5.3 Foreign Direct Investment

As mentioned in previous chapter 4, Brunei Darussalam allows 100 percent of foreign ownership business to be established in Brunei. However, Barramundi Asia is the only subsidiary company that is fully owned by the Barramundi Asia group. Identical to previous case studies, it has studied the background, technology utilized and process of technology transfer to the firm in Brunei.

5.3.1 Barramundi Asia

5.3.1.1 Firm's Background and Development

Brunei's friendly business environment strategy of allowing 100 percent foreign own company to set up in Brunei has resulted in a total investment of USD235 million is to be injected by one of the largest Barramundi farming company, Barramundi Asia (BA). This company is originated from Singapore which already internationalizes to Australia and now to Brunei for the main purpose

production to high-quality seabass, as mentioned by one of the BA's Boards of Director, Andrew Kwan in Biz Brunei (2019) Brunei's pristine water territories makes it makes it suitable for breeding high-quality seabass.

In May 2019, it is a milestone for BA and Government of Brunei who has signed two agreements for the approval of BA's operation in Brunei and the lease agreements for both offshore and land sites operation. For offshore aquaculture sites, around 6,613 hectares of Nankivell offshore deep-sea sites were leased for its operation and another 25 hectares for land sites in Meragang were awarded on lease for hatchery and nursery purposes. This investment is expected to be fully operational by the year 2032 with expected production to reach total of 36,000 MT by the year 2032 to be exported back to Singapore, Australia and European countries.

5.3.1.2 Firm's Aquaculture Technology

BA utilizes advanced aquaculture technology in farming its Barramundi or seabass. Open cage deep-sea technology is adopted from salmon farming in Norway (Refer to Appendix L) to ensure its quality and health. This open cage works like the typical cages available in Brunei, but BA's aquaculture system took it to another level, it's cages is computerized. It is equipped with high technology such as cameras installed underwater to watch over the fish health inside the cage (Refer to Appendix M) and machine feeder technology (Azaraimy, 2018).

5.3.1.3 Process of Technology Transfer to Firm

For the BA subsidiary in Brunei, its technology transfer is made via the intra-firm transfer process. It is transferred from the parent company in Singapore and export it to Brunei for both equipment and skills (e.g. engineers and operators for operating the machinery). BA also ensures that this investment will be a benefit to Brunei and its aquaculture industry, as mentioned by General Manager of BA, Eva Lim in Rasidah (2019), it is guaranteed to be job creations for the locals and promising on allowing the transaction transfer of new technologies and practices of know-how. Nonetheless, since this investment is still in the progress of developing and further information about the process technology transfer to other firms is still left undiscovered.

5.4 Key Findings of the Case Study

5.4.1 Different process of TOT to firms

To describe the method on the TOT to Aquaculture Firms of JV, FDI, and local firms in Brunei can be divided into four fragments (Refer to Figure 5.7). The process TOT across Brunei Aquaculture Firms can be done via Intra-firm, licensing, international technology transfer, and interfirm. However, it is worth highlighting that only three—intra-firm TOT, licensing TOT and International TOT are utilized in operation across Brunei Aquaculture Firms.

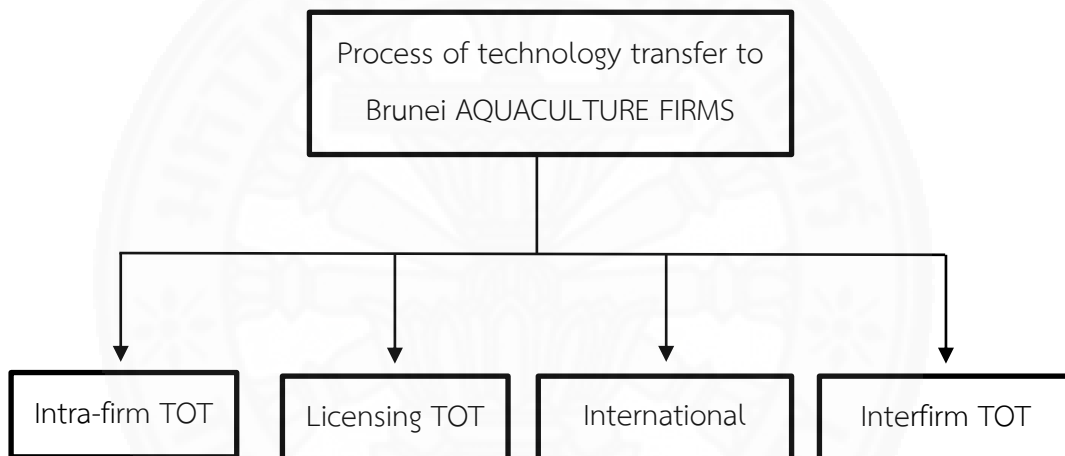


Figure 5.7 TOT process that can be applied to Brunei aquaculture industry

Source: Author's analysis based on analysis from data collection

From the data gathered, it is intelligible that the process pattern of TOT is different between FDI, JV compare to the local firms. Transcendency of FDI and JV has led them to be more successful and superior in terms of technologies and know-how. This is because FDI and JV company is well established which they inclined to transfer the existing technology via intra-firm TOT customarily transferred from the parent company. This superiority in terms of technologies and know-how has spontaneously made them be the provider of technologies that the industry expected interfirm technology transfer to take place and technology spillover effect to occur. While in contrast with local firms, being the novice in the industry, they

inclined to be the recipients of technology with the means of obtaining licensing TOT and international TOT.

Nonetheless, by JV and FDI entering the Brunei aquaculture industry, technology transfer via interfirm is expected to happen. In this case, the local firms do have a choice to access technology from FDI and JV via interfirm technology transfer through contract farming. However, regrettably, it was not the case of TOT of JV and FDI to Brunei local firms. To support this argument can be proven by one case study discussed earlier—that the locals are more incline to receive the technology and know-how via training as it is more intensive exposure, practical, and acceptable due to the ‘no-bound’ to contracts and regulations. Due to this condition, the government has changed the focus audience of contract farming to be received by the youth which they expected diffusion of technology to occur. Nonetheless, more discussion on the absent of interfirm TOT of JV and FDI to Brunei local firms is justified in the latter part of this section.

5.4.2 Access Mechanisms to technology transfer: Local firm’s refusal

Lacking readiness of the local firms in regards to infrastructural and skills has resulted in them to seek for means to transfer technologies for their firm’s operation. For the process of technology transfer in the case of Brunei Aquaculture Firms, it can be established that there are two transfer mechanisms of technology that can be categorized into contract farming and ground zero (Refer to Figure 5.8).

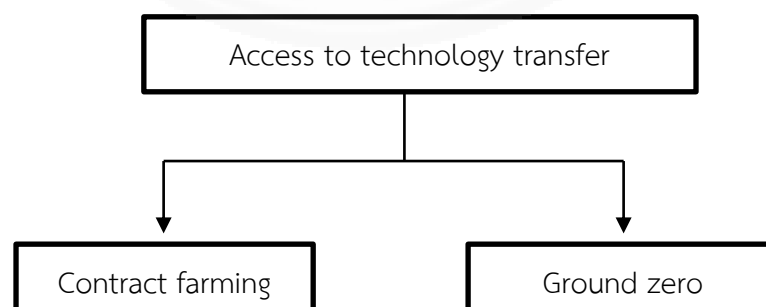


Figure 5.8 Access mechanism of technology transfer for local firms

Source: Author’s analysis based on analysis from data collection

Firstly, the mechanism of contract farming in this context refers to the local entrepreneur to have gained access to FDI and JV technologies and know-how. It is gained through an agreement signed between both providers (FDI and JV) and the recipients (local farmers). For this mechanism, local entrepreneurs have gained access to the supply of fish fry from the FDI and JV hatchery, technical support, knowledge, guidance to solve problems especially in dealing with fish diseases and are equipped with the business model set by the JV and FDI companies. The production is bought back an agreed price set by JV and FDI companies, the bought back production is an assurance to support their company production.

While, in contrast to contract farming, ground zero in the context of this research refers to local fish farmers who start their firms from the ground. With no technologies and know-how readiness to operate their firms. From the data that have been gathered, it is found that ground zero is a trend for local firms' operation in which they are inclined to take the benefit of licensing TOT and International TOT. The rationality of local firms' decision is examined in the next part of this section.

5.4.3 The Rationality of Firm's Decision: Contract Farming vs Ground Zero

The cornerstone that hinders local firms to receive the technology transfer and get spillover effect to the industry from FDI and JV can be further divided into two factors. These factors are categorized into external and internal factors as indicated in Chapter 3. This being said, it is identified that these factors do contribute to the local firm's decision for deciding to operate their firm from ground zero instead of clinging on the FDI and JV with a contract farming approach.

The external factor compromises government roles and the transfer procedure of taxation. Both of these drivers have led to local firms disregarding the use of high-advanced technology in their farming operations. To begin, the government plays an important role in determining the technology adoption decision of the local firms. To prove this, granting a large quota of aquaculture sites for sea-cages aquaculture operation and assistance especially for conventional farming has made the local firms to fully utilize the space awarded and

utilizing the benefits of operating it. This can be proved by the extensive utilization of conventional farming across the local firms. However, a more obvious justification for this is the cost which is clarified in the internal factor below. Another factor is, by firms having to operate their firms from ground zero, the firms are allowed to have the ‘privilege’ of having access to fast track in obtaining foreign workers’ license.

Supplementary to this factor, the transfer procedure of taxation plays an important role in the local firm’s decision of ground zero operation. The imposition of taxes is applied to the importation of all machinery related to business purposes. In a certain sense, taxation is conceived as an extra burden of cost to the local firms. This is proven by the case of Berjaya Aquaculture on the importation of machinery from Thailand. Five percent of the tariff was charged by the Government as part of the import requirement. Nonetheless, it is worth to acknowledged, such tariff is contributed by the ASEAN FTA between Brunei and Thailand, which has been highlighted by the exporter of Berjaya Aquaculture as mentioned above. Needless to say, this taxation is considered relatively low because ASEAN FTA has lifted the barriers of import between the signatory’s member. Thus, this has become one of the major concerns of the local firms to opt for licensing and contract farming, but operating using ground zero option specifically for firms using conventional farming.

Deviate to the internal factors, the corresponding factors pointed out to the willingness to transfer, absorption of technology, the capability to transfer and the nature of technology, as elaborated in previous Chapter 3. These four internal components are drivers of the firm’s rationality to favor the ground zero operation. Willingness to transfer focus on the compliance of JV and FDI in sharing their technology and know-how. Initially, the process of technology transfer from JV and FDI is found to be confined within just the company, transpired because the transfer only occurred in the approach of contract farming. Therefore, contract farming appears to be the fundamental issue that triggered the local firms to operate their firms from ground zero. The fact is, they believe contract farming made them be bound to strict commitments set by the FDI and JV companies. Local firms perceived the situation as if they are merely being ‘used’ as channels by FDI and JV companies to secure their production output, instead of receiving and transfusion the

technology and know-how to the firms. Thus, it is a sufficient ground to said the extent of willingness to transfer is 'anchored' by the means only transferring the technologies and know-how through the method of contract farming.

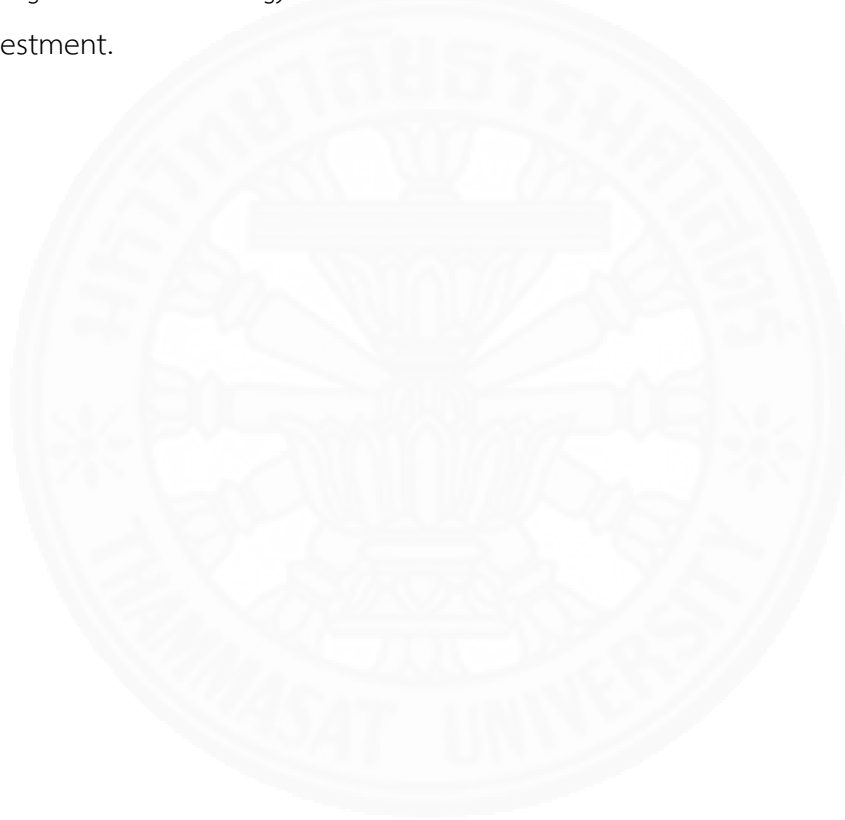
Other justification laid on the ground of local firms' capability to transfer. In the context of this research, those capabilities remain on the concern of insufficient capital investment and human capital. Discussion about the cost of investment capital has been emphasized heavily by the local firm owners, which cost appears to be the barrier for them to adapt to new technologies. Uncertainty on the return of investment is identified to be the source of the persistence of conventional farming techniques. To support such a claim, debate about cost does not solely focus on the equipment itself, but also on the cost of know-how of the workforce in operating the technology. They believed, in the consequence of utilizing high-advanced technology, of the demand of workforce to fit the operation to avoid the situation of job mismatch for high productivity. Nonetheless, this point is relevant and proved a stable foundation with further discussion of the third driver on the absorption of technology.

That being the case, the third driver on the absorption of technology also determined the popularity of ground zero options within the local firms. The local firms' concern when adopting new technology is the ability for them to absorb the knowledge and skills. From the data gathered, it is concluded that absorption is one of the main issues being raised by owners when considering to adopt new technologies.

The final factor of ground zero being a preferred option for the local firms' is the nature of the technology itself. Feasibility to transfer the technology is raised as an issue. The local firms' owner has emphasized convenience as part of the advantage and benefit of using conventional farming for it's firm's operation in building it. The fact is, ground zero enables them to develop custom conventional technology to fit their comfort. Moreover, the nature of conventional technology is less-hassle since most of the resources can be obtained in Brunei itself. Unlike the transfer of technology which in this case from contract farming, the

unfamiliarity and the hassle of import process on the technology are identified to be unappealing for the local firm owners.

Thus, to conclude these three points, this local firms' condition does not mean they are not capable of transferring technology and absorbing new technology, but they refuse to such changes due to their uncertainty about the change. This brings the issue to the ground of that ground zero option is cheaper, wiser and able to give assurance to the local firms, contrary to the condition of investing in new technology and know-how with no assurance that it will be a return of investment.



CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Summary

Previous chapters have discussed the development of the aquaculture industry and background to Brunei aquaculture technologies. This is to justify the importance of technology transfer to Brunei aquaculture development and the case study was done across Brunei Aquaculture Firms to examine the process of TOT to the Brunei Aquaculture Firms. Qualitative research is applied and content analysis from the face-to-face interview with a total of nine firm owners—local firm owners, JV, and FDI; experts, and government officials is conducted.

The development of Brunei fisheries is proven to be more leaning towards catching and seafood processing sector, while aquaculture that supposedly to act as the backbone of fisheries industry overall is proven to be stagnant. This remain on the justification on the persistence on the utilization of conventional farming operation among the local firms. Lacking of readiness in the technological and know-how and the absence on the development, receive and even diffuse of new technologies in the sector.

Importance of TOT to Brunei Aquaculture Firms is therefore studied. It has pointed to the minimized exposure on knowledge creation & R&D aquaculture and fisheries related. The lacking of prioritization on the promotion of investment on R&D is found to be responsible for such matters. This research proceeds with the case study to investigate the process of technology transfer to Brunei Aquaculture Firms. Furthermore, it also explores the reasons that challenge the ability of local firms to receive and diffuse technology transfer from FDI and JV. This is guided by the internal and external factors which both of these factors do exert a significant effect on the inability of local firms to receive and diffuse the technology from JV and FDI. External factors—Government roles, and taxation. While internal factors, consists of—willingness of JV and FDI to transfer, capability of local firms to transfer, ability of local firms to transfer, and nature of the technology. Thus, as a concluding section to

the key finding discussion, this section is separated into two—technology transfer and technology adaption.

6.1.1 Technology transfer

As emphasize thus far, there are three technology transfer occurred across Brunei Aquaculture Firms. However, with the presence of FDI and JV firms, interfirm TOT is expected to take place for technology spillover effect to happened. Nonetheless, that is not the case for Brunei aquaculture sector, interfirm (firm to firm) did not happened. The three technology transfer are intra-firm, licensing and international technology transfer.

The reasons on the absence of interfirm is due to the lacking of technological and know-how readiness in advanced and modern technology. Due to the lack of knowledge and exposure on other technology, hesitancy exists within the local firms. Other than that, external factor of government roles on supporting the local firms has somehow made the local firms to be ‘comfortable’ in using conventional farming operation which is why there is a widespread of conventional farming among the local firms’ operation. External factor of taxation is also seen to be the ‘hassle’. This hassle has become the reason to the persistence of local firms on opting for ground zero operation with the process of international technology transfer. These two external factors have somehow related to the internal factors which is discussed at the next part of this section.

6.1.2 Technology adaption and diffusion

Internal factors of the willingness of JV and FDI to transfer, capability of local firms to transfer, ability of local firms to transfer, and nature of the technology are proven to create hesitancy within the local firms. Hesitancy has emerged as the main culprit influencing most of the local firms’ decision to disregard and refuse to accept the TOT from JV and FDI. The refusal has resulted in the absent of interfirm technology transfer from JV and FDI to the local firms.

Nonetheless, it is worth to highlight that, this matter is not to be wholly blamed on the local firms, but matters of willingness to transfer also need to be questioned. Based on the findings of this research, it has been found that the only FDI and JV company means to transfer of technologies and know-how is via contract farming. Main analysis has pointed out to contract farming is seen as the

barrier for the local firms in receiving and diffusing the technologies from JV and FDI. Merely being 'used' is the reason the local firms' refusal to receive such technology transferred from FDI and JV. However, it is noteworthy to highlight that the local firms are inclined to receive interfirm TOT through training and workshops, as they are not bound to anything unlike interfirm from JV and FDI through contract farming. Factor of capability and ability to receive the transfer technology from FDI and JV is assessed. Cost and adaption level is the main concern when shifting from conventional farming to advanced technology. Hesitancy on the return of investment is questioned by the local firms' owners. Conventional farming is found to be cheaper, and wiser to be applied and utilized compare to the use of advanced technologies. While the final factor on the nature of technologies has further justified the reasons for local firms to opt for ground zero of conventional farming operation. Nature of technologies of conventional farming has become the wiser choice for local firms' owner to persist with their decision to continue on utilizing conventional farming techniques.

Thus, based on the findings of this research, the author has come up with a rather strong claim of 'oversight of technology transfer' that can be put forward as the local firms fail to receive and diffuse the technology from JV and FDI for wide application on production purposes. Which this is not wholly to be blamed on the local firms, but the agency that supposedly responsible to support the receiving and diffusing process to occur is still weak and almost missing in action. While exposure on the new technologies is crucial to assure the local firm for adaption process to occur for higher productivity.

6.2 Policy recommendations

To formulate a strategy, it is wise to reemphasize the main problem of this research. The main finding and problem as to why the local firms are not able to receive and diffuse the technology remain on the ground of hesitancy. This hesitancy exists due to the uncertainty of the locals in the return of investment on the "unfamiliar" use of technology. Thus, to provide assurance and exposure to the TOT

to be well-received by local firms, there are few recommendations and policies proposed to ensure the success and diffusion of the technology transfer. Matters focused is on the government role, strategies on knowledge creation, R&D advancement and influencing the mindset of Bruneians on the importance of technology transfer as well as the local firms on the benefits of modern technology.

Government involvements are the key to determining the pathway of technology transfer to flourish and that is integral for Brunei aquaculture development. Therefore, to improve the current situation of TOT to Brunei Aquaculture Firms, it is substantial for the government has comprehensive requirements and regulations to guarantee the JV and FDI TOT to be conducted. The government needs to provide specific details on what to transfer such as equipment to transfer, knowledge and skills on handling the operation, business management and operation, engineering skills, and others. By being specific, it can assure the maximization of the TOT opportunity can be achieved.

Secondly, given the fact that technology transfer is inclined to be well accepted via training and workshop compare to contract farming, thus for local firms to be well exposed for application and utilization of intensive modern technology, it is a wise strategy to implement policies that encourages training and workshop to put into practice. This training not only acts as a theoretical and practical base for entrepreneurs to be exposed and also it is encouraged for training also offers the road or way for local entrepreneurs on how to transfer or obtain such technology, either by licensing or others. By this, it can be seen as 'less hassle' towards the local firm owners to shift and adapt to new intensive technologies and assurance is expected to build up as success cases are proven.

Thirdly, it is significant for the government to initiate policies that encourage the success of technology transfer. Therefore, a recommendation on the establishment of an independent agency of the Technology Transfer Agency is proposed. This independent agency will correlate with the government for policy and laws related. This agency will be responsible to facilitate and supervise the TOT process. The agency is expected to act as a bridge in ensuring the transfer of new technology whether from the universities and large firms (FDI and JV) to the local firms. Through this agency, technology transfer can be diffused, resulting in more

innovation and new technologies will be invented which localization can be achieved to cater and fit the local firms' needs.

Fourth, progressiveness in promoting and emphasizing on the R&D investment need to be achieved. The government needs to be proactive not only in attracting business but also be specific to favor of and attract the R&D investment, especially in fisheries and aquaculture. The ground for this is, R&D is unquestionably the foundation in the development of technology and generates stable human capital development that able to provide the high-skilled workforce for the industry's production.

Finally and importantly, as an integral system to support the industry overall, strategy in knowledge creation needs to be improved. Short-term and long-term strategy recommendation is put forward for immediate and future implementation. For short-term strategy, the existing vocational institution, IBTE, need to boost their roles. Not only offering skills on the procedure of aquaculture operation but also to encourage invention and innovation in aquaculture technology. This can be done by having an exchange in knowledge transfer between the universities in the region through the MoU. As for long-term strategy, it is recommended for the expansion of knowledge creation to be established. Expansion of knowledge creation on fisheries and aquaculture is crucial for the development of the industry both in upstream and downstream development. Universiti Brunei Darussalam and Universiti Teknologi Brunei, both are well-known institutions that are required to live up to their role. This can be done by opening up new courses and faculties, specifically in fisheries and aquaculture. Through this, it can encourage innovation and most importantly the success of technology transfer is guaranteed to serve its purpose to the receiving countries as the receiving country can diffuse the technology for wide application for production purposes.

As a final remark, technology transfer is a promising prospect for the development Brunei aquaculture industry, if technology transfer is fully utilized. Nonetheless, currently, it is still missing its backbone of 'recipient's assurance', R&D and knowledge creation, to be able to receive, diffuse the technology transfer for further innovation and invention for wide application towards production purposes.

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APPENDICES

APPENDIX A
NUR AZ-ZAHRA AQUACULTURE SITES



Aerial view of Nur Az-Zahra Aquaculture sites in Pelumpong Spit

Source: Azhar (2019)

APPENDIX B

NUR AZ-ZAHRA CONVENTIONAL AQUACULTURE SITES



View of Nur Az-Zahra Conventional cages in Pelumpong Spit

Source: Azhar (2019)

APPENDIX C

BERJAYA AQUACULTURE RAS TECHNOLOGY



Vertical farming of Berjaya Aquaculture utilizing RAS technology transferred from Thailand.

Source: Fieldwork, August 2019



Flow of water to the boxes using RAS technology of Berjaya Aquaculture Vertical Crab farm.

Source: Fieldwork, August 2019

APPENDIX D

O.D.E AQUACULTURE CONVENTIONAL TECHNOLOGY OPERATION



Conventional farming cages for O.D.E Aquaculture operation

Source: Fieldwork, August 2019

APPENDIX E

QURASHI BLUE OCEAN ENTERPRISE AQUACULTURE TECHNOLOGY



Usage of HDPE Technology in Qurashi Blue Ocean Enterprise Aquaculture operation.

Source: Fieldwork, August 2019

APPENDIX F
GOLDEN CORPORATION PENYATANG SHRIMP FARM



459 hectare of Golden Corporation Penyatang shrimp farming sites.

Source: Golden Corporation, n.d.

APPENDIX G

GOLDEN CORPORATION INLAND AQUACULTURE TECHNOLOGY



In-land conventional shrimp farming practices and technology

Source: Golden Corporation, n.d

APPENDIX H

HISEATON AQUACULTURE TECHNOLOGY



Hiseaton Fisheries utilization of HDPE open cages in Brunei deep sea for its aquaculture operation

Source: Hiseaton Fisheries, n.d.

APPENDIX I

NUR NABAI CONVENTIONAL AQUACULTURE TECHNOLOGY



Nur Nabai Sdn. Bhd. applied conventional cage system technology for the aquaculture operation.

Source: Nur Nabai, 2019

APPENDIX J
NUR NABAI INLAND AQUACULTURE SITES



Nur Nabai Sdn. Bhd.'s in-land aquaculture holding area in 13 hectares Sungai Paku sites

Source: Nur Nabai, 2019

APPENDIX K

BARRAMUNDI ASIA HDPE TECHNOLOGY



Barramundi Asia deep-sea open cages system inspired by Salmon aquaculture technology system in Norway

Source: Barramundi Asia, n.d

APPENDIX L

BARRAMUNDI ASIA AQUACULTURE TECHNOLOGY INSIDE THE CAGE



Picture captured using the camera installed inside the cage to monitor the seabass condition inside the cage

Sources: Barramundi Asia, n.d

List of Interview Questions – Firms owner

Background information

Gender ☐ Male ☐ Female

Name: _____

Age: _____ Company: _____

Date interview: _____ Place of interview: _____

Aquaculture activity: Freshwater / off-shore culture / shrimp culture / technology-based culture – in land culture / others: _____

1. Explain briefly about the company from its development until the current operation
2. Who and many workforce are there in this company?
3. Do this company receive any privileges and support from the government – explain
4. Explain briefly the type of aquaculture technologies used in this company
5. Are there any specific reasons for this company to operate using this technology - Why?
6. What and how are technology transferred to this company – explain
7. What are the challenges and benefits of using this technology to the firm?
8. What are the concern of the company when operating this technologies?
9. What are the future strategies and plans for the development of this company?

BIOGRAPHY

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Publications

Shifa Shakirah, (2017) *Perkembangan Satu Kampung Satu Produk di Negara Brunei Darussalam*. Latihan Ilmiah bagi memenuhi Sarjana Muda Sastera Major dalam Pengajian Brunei, Akademi Pengajian Brunei, Universiti Brunei Darussalam.