UNIVERSITI PUTRA MALAYSIA

COMPARATIVE STUDY ON SELECTED SPECIES OF AQUACULTURE PRODUCTION IN MALAYSIA UNDER DIFFERENT AGRO-FOOD INCENTIVE SCHEMES

SARA RAVAN RAMZANI

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By

SARA RAVAN RAMZANI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

November 2014

DEDICATION

This thesis is dedicated to my affectionate parents Ramzan Ravan Ramzani and beloved mother Nahid Roohbakhsh.

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairperson: Professor Mohd Mansor Ismail, PhD

Institute: Institute of Agricultural and Food Policy Studies

The aquaculture sector in Malaysia, like in most developing countries, plays an important role in the country's economic development, functioning as food suppliers, employment creations, export earnings and raw material suppliers for other industries. It is believed that the superior taste of prawns and fishes, their high nutritional value and exceptional market shares are the reasons for their quickly developing in aquatic crustacean farming. The recent interest and development in aquaculture mostly due to several factors such as the growing demand for fish protein, limitations in production of capture fisheries, high production rate per unit area of aquaculture operations, less dependency on fuel, economic viability of aquaculture enterprises, ability to supply quality seafood, especially fresh and live aquaculture products. Cost of production appears to be one of the major factors likely to affect the future expansion of brackish water and fresh water farming in Malaysia. High cost of production due to increased cost of local labor and high cost of non-tradable inputs will eventually limit expansion and deteriorate the competitiveness of efficiency in the market. High per capita consumption in 2012 (54kg/year) may not be sustainable for the industry especially towards the already depleting fish stocks, and increase domestic price and production cost in 2012. Aquaculture business in Malaysia involves many fish farmers and commercial companies, practicing several types of production systems. However, they almost exclusively use unimproved species and strains. It seems that currently available knowledge and experience in aquaculture systems management are not being fully exploited to achieve sustained yield and optimum fish performance. The main objective of this study is to measure the comparative advantage and analyses policy protection in aquaculture production. The specific objectives are to calculate Policy Analysis Matrix (PAM) indicators and to rank the competitiveness of the three selected species ((*Penaeus vannamei*, Grouper and Barramundi) under different Agro-food incentive schemes. The study employed secondary and primary data gathered among 226 farmers, which was collected in 2012.

The findings on the sustainability analysis of three main types of aquacultures productions namely brackish water species (*Penaeus vannamei*, Grouper and Barramundi) are discussed. This study provides a clear understanding on the current status of aquaculture in Malaysia and considers different aspects of government incentives for viable and sustainable aquaculture development. This research is in clouding of three sections. The first section discusses and provides the comparative analysis of the financial aspects of brackish water producers under different Agro-food incentives schemes. The financial analysis covers project evaluation criteria including, net present value (NPV), internal rate of return (IRR), and benefit cost ratio (BCR). The evaluation process was carried out using four different combinations of Agro-food incentives schemes: a) Base study and government incentives simulations, b) individually Pioneer status (PS), c) Investment Tax Allowance (ITA) and d) two combinations of PS and Accelerated Capital Allowance (ACA) and ITA and ACA. The results suggested that, in all brackish water farms, NPV after the ACA incentive showed a higher and positive value compared to individual PS and ITA. The Effect of Government Incentive on *Penaeus vannamei* and Grouper showed that IRR and NPV on ACA (based on PS) is 2% and 9%, respectively higher than ACA (based on ITA). Meanwhile in Barramundi ACA (based on ITA) was 8% higher than ACA (based on PS). This research concludes that in financial assessment, the aquaculture operators should choose to accept PS with ACA on *Penaeus vannamei* and Grouper, and choose ACA based on ITA on Barramundi, in order to maximize private profitability.

The second section discusses and provides the findings of Policy Analysis Matrix (PAM) that provide information on economic analysis. The evaluation and discussion also deals with policy interventions evaluated by Nominal Protection Coefficient of Output (NPCO) and Nominal Protection Coefficient of Input (NPCI), and Effective Protection Coefficient (EPC). Meanwhile, the discussion on comparative advantage used ratios namely Domestic Resource Cost (DRC) and Social Cost Benefit (SCB). The finding of this study illustrate the analysis of private profitability which shows that brackish water species generate profit. The government interventions on aquaculture productions in terms of tax have a negative impact on the competitiveness on the selected species. On economic assessment, the PAM analysis results indicated that the brackish water species are economically profitable and competitive. In other words, producers used their resources efficiently with DRC and SCB ratios less than one. The competitiveness of brackish water species was ranked according to the Domestic Resource Cost (DRC), Social Cost Benefit (SCB) and Effective Protection Coefficient

(EPC). The DRC, SCB and EPC indicates that Penaeus vannamei, have a high comparative advantage related to other species. Afterward Grouper is more comparative advantage and third is Barramundi. High comparative advantages in Penaeus vannamei is due to less input requirement and positive protected by government policy can be lead to lower production cost and increase the productivity. Section three presents the possible policy based simulations which highlight the effects of sensitivity analysis on financial and economic assessments. The result of sensitivity analysis showed that increase shadow exchange rate has great impact on comparative advantage. The level of competitiveness of brackish water production in Malaysia has improved when shadow price was used with government intervention devoted to subsidizing the brackish water factors of production.

Abstrak tesis ini telah dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KAJIAN PERBANDINGAN BAGI SISTEM PENGELUARAN SPESIES AKUAKULTUR TERPILIH BERDASARKAN SKIM INSENTIF MAKANAN-PERTANIAN YANG BERBEZA

Oleh

SARA RAVAN RAMZANI

November 2014

Pengurusi : Professor Mohd Mansor Ismail, PhD

Institut : Institut Kajian Dasar Makanan dan Pertanian

Sektor akuakultur di Malaysia adalah sama seperti kebanyakan negara membangun, ianya memainkan peranan penting dalam pembangunan ekonomi negara, berfungsi sebagai pembekal sumber makanan, mencipta peluang pekerjaan, hasil pendapatan negara daripada pengeksportan dan menjadi pembekal bahan mentah untuk industri lain. Adalah dipercayai bahawa rasa asli udang dan ikan yang yang tersendiri, mengandungi zat dan protein yang tinggi dan nilai pasaran yang luar biasa adalah penyumbang utama dalam mempercepatkan perkembangan di dalam perladangan krustasia akuatik. Dalam pendekatan dan pembangunan semasa di dalam sistem akuakultur sebahagian besarnya disebabkan oleh beberapa faktor seperti permintaan yang semakin meningkat bagi protein ikan, had batasan pengeluaran ikan daripada hasil tangkapan, kadar pengeluaran yang tinggi bagi satu unit kawasan operasi akuakultur, kurangnya kebergantungan kepada bahan api, daya maju ekonomi perusahaan akuakultur, berkemampuan membekalkan makanan laut yang berkualiti, terutama segar dan produk akuakultur secara langsung. Kos pengeluaran adalah sebagai salah satu faktor utama yang mungkin menjejaskan peluasan masa depan ternakan air payau dan ternakan air tawar di Malaysia. Kos pengeluaran yang tinggi disebabkan oleh peningkatan kos tenaga buruh tempatan dan kos yang tinggi bagi input yang tidak boleh diniagakan akan menghadkan perkembangan dan mengurangkan daya saing kecekapan di dalam pasaran. Penggunaan per kapita yang tinggi pada tahun 2012 (54kg/year) mungkin tidak mampan untuk industri ini terutamanya hala tuju industri sudah bermasalah dengan kekurangan stok ikan, dan peningkatan harga domestik, kos pengeluaran, dan mengurangkan input yang boleh diniagakan pada 2012. Perniagaan akuakultur di Malaysia membabitkan ramai

penternak ikan dan syarikat-syarikat komersial dengan mengamalkan beberapa jenis sistem pengeluaran. Walau bagaimanapun, mereka hampir secara eksklusif menggunakan jenis dan spesies yang tidak ditambahbaik. Ia menunjukkan seolah-olah bahawa informasi sedia ada dan pengalaman dalam pengurusan sistem akuakultur tidak dieksploitasi sepenuhnya untuk mencapai hasil yang mampan dan prestasi ikan yang optimum. Objektif utama kajian ini adalah untuk mengukur kelebihan perbandingan dan menganalisis dasar perlindungan dalam pengeluaran akuakultur. Objektif khusus adalah untuk mengira indikator Matriks Analisis polisi (PAM) dan untuk menentukan kedudukan daya saing bagi tiga spesies yang dipilih (*Penaeus Vannamei*, Kerapu dan Siakap) berdasarkan skim insentif makanan-pertanian yang berbeza . Kajian ini akan menggunakan data primer dan sekunder daripada kalangan 226 petani, dimana telah dikumpulkan pada tahun 2012.

Hasil analisis kelestarian bagi tiga jenis pengeluaran akuakultur utama atau lebih dikenali sebagai spesies air payau iaitu (Penaeus Vannamei, Kerapu dan Siakap) akan dibincangkan. Kajian ini memberi pemahaman yang jelas mengenai status semasa akuakultur di Malaysia dan melihat aspek alternatif insentif oleh kerajaan adalah supaya pembangunan akuakultur berdaya maju dan mampan. Kajian ini dibahagikan kepada tiga bahagian. Bahagian pertama membincangkan dan menyediakan analisis perbandingan aspek-aspek kewangan air tawar dan pengeluar air payau berdasarkan skim insentif makanan-pertanian yang berbeza. Analisis kewangan merangkumi projek kriteria penilaian termasuklah nilai kini bersih (NPV), kadar pulangan dalaman (IRR), dan nisbah faedah kos (BCR). Proses penilaian telah dijalankan dengan menggunakan empat kombinasi skim insentif makanan-pertanian: a) Kajian dasar dan insentif kerajaan diantara status Perintis (PS), b) Elaun Cukai Pelaburan (ITA) c) kombinasi PS dan Elaun Modal Dipercepatkan (ACA) dan d) ITA dan ACA. Keputusan mencadangkan bahawa dalam semua ladang air payau, NPV selepas insentif ACA menunjukkan nilai yang lebih tinggi dan positif berbanding dengan PS individu dan ITA. Kesan insentif kerajaan pada Penaeus Vannamei dan Kerapu menunjukkan bahawa IRR dan NPV pada ACA (berdasarkan PS) adalah 2% dan 9%, masing-masing lebih tinggi daripada ACA (berdasarkan ITA). Sementara itu di Barramundi ACA (berdasarkan ITA) adalah 8% lebih tinggi daripada ACA (berdasarkan PS). Keputusan di air tawar menunjukkan bahawa ACA (berdasarkan ITA) pada tilapia dan keli adalah 8% dan 6% lebih tinggi daripada ACA (berdasarkan PS). Kajian ini menyimpulkan bahawa dalam penilaian kewangan, pengendali akuakultur perlu memilih untuk menerima PS dengan ACA bagi Penaeus Vannamei dan Kerapu, dan memilih ACA berdasarkan ITA bagi Siakap, tilapia dan keli untuk memaksimumkan keuntungan peribadi

Bahagian kedua membincangkan dan menunjukkan hasil PAM dimana ia menunjukkan maklumat mengenai analisis ekonomi. Keuntungan sosial di PAM mencerminkan perbezaan antara hasil pada harga sempadan dan faktor kos domestik dan harga input boleh diniagakan pada nilai sosial. Penilaian dan perbincangan juga melibatkan campur tangan dasar dinilai oleh (NPCO (NPCI), dan (EPC). Sementara itu, perbincangan kelebihan menggunakan nisbah iaitu (DRC) dan (SCB). Hasil kajian ini menunjukkan analisis keuntungan peribadi yang menunjukkan bahawa spesies air payau menjana keuntungan. Campur tangan kerajaan dalam pengeluaran akuakultur dari segi cukai mempunyai kesan negatif terhadap daya saing kepada spesies yang dipilih. Manakala dari sudut penilaian ekonomi, keputusan analisis PAM menunjukkan bahawa spesies air payau adalah dari segi ekonominya menguntungkan dan berdaya saing. Dalam erti kata lain, pengeluar menggunakan sumber dengan cekap dengan DRC dan SCB nisbah kurang daripada satu. Daya saing spesies air payau di rangkingkan mengikut DRC, SCB dan EPC. DRC, SCB dan EPC menunjukkan bahawa Penaeus Vannamei, mempunyai kelebihan perbandingan yang tinggi berbanding dengan spesies lain. Manakala rangking seterusnya adalah Kerapu dan yang berada di rangking terakhir atau ketiga adalah Barramundi. Kelebihan perbandingan Penaeus Vannamei tinggi adalah disebabkan oleh keperluan input yang sedikit dan positif dilindungi oleh dasar kerajaan boleh membawa kepada mengurangkan kos pengeluaran dan meningkatkan produktiviti. Bahagian ketiga pula membentangkan simulasi keberangkalian berasaskan dasar yang menekankan kesan analisis kepekaan kepada penilaian kewangan dan ekonomi. Hasil analisis sensitiviti menunjukkan bahawa kadar pertukaran peningkatan bayangan mempunyai kesan yang besar pada kadar kelebihan. Tahap daya saing produksi ikan air payau dan air tawar di Malaysia telah bertambah baik apabila harga bayangan telah digunakan dengan campur tangan kerajaan yang menumpukan kepada memberi subsidi kepada faktor pengeluaran air payau dan air tawar.

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This thesis was submitted to the senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory committee were as follows:

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LIST OF ABBREVIATIONS

BCO	Benefit Cost Ratio
CVP	Cost volume Profit
DOF	Department of Fishery
DOS	Department of Statistic
DRC	Domestic Resource Cost
EP	Economic Profitability
EPC	Economic Protection Coefficient
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization
FOB	Free on Board
FP	Financial Profitability
GNPC	Gross Nominal Protection Coefficient
IO	Industrial Organization
MARR	Minimum Attractive Rate of Return
MOA	Ministry of Agriculture
MR	Malaysian Ringgit
NEB	Net Economic Benefit
NPC	Nominal Protection Coefficient
NPCI	Nominal Protection Coefficient of Input
NPCO	Nominal Protection Coefficient of output

OER	Official Exchange Rate
PAM	Policy Analysis Matrix
PC	Profitability Coefficient
PP	Producer Profitability
PSC	Producer Subsidy Equivalent
SCB	Social Cost Benefit
SER	Shadow Exchange Rate
SRP	Subsidy Ratio to Producer
UNDP	United Nations Development Programe
USD	United States Dollar
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

Farming of aquatic animals and plants is called aquaculture, and it includes activities from the spread of aquatic organisms with human supervision to the application of minimally one phase of life of aquatic organism before crop with the intention of raising the amount of production for gaining money or any social advantage (Chandrasoma, 2011). According to FAO (2011), Asian countries produce a great deal of aquaculture products at about 66.4 percent, with China alone making up almost 10 percent of fish production and export in the year 2009. Aquaculture is currently known as a practical activity that extensively takes the attention of commercial investors.

Fish and prawn with their great tastes and their being highly nutritious and their excellent marketing potential make significant products in aquatic farming (Saad *et al*, 2011). Besides, much of the river and costal fishing is greatly related to the ecological processes which take place in freshwater systems (FAO, 2011). The most recent progress in aquaculture is mainly because of increasing request for fish protein; limited production of fisheries; high production density of aquaculture operation areas; being less dependent on petroleum; commercial practicality of aquaculture investments; capability of supplying high quality sea food; and specifically live and fresh products (Esmaeili, 2008). Many of the production is done by small-scale careers, with extremely high levels of engaging in both catching and husbandry activities and treating and advertising. Food security of local food is also threatened by inland fishing (FAO, 2011).

1.1 Aquaculture Industry Background in Malaysia

As stated by FAO (2012) and shown in table 1.1 and 1.2, Asian countries comprised 88.8 percent of world aquaculture production by quantity and 78.7 percent by value in the year 2008, whereas in the same year, Chines alone produced 62.3 percent of aquaculture products of the world by quantity and 51.4 percent by value.

Table 1.1. Aquaculture Production by Region: Quantity and Percentage of World Production

Countries		1970	1980	1990	2000	2009	2010
Africa	(tonnes) (%)	10,271 0.40	26,202 0.60	81,015 0.60	399,676 1.20	991,183 1.80	1,222,320 2.20
Sub-Saharan Africa	(tonnes) (%)	4,243 0.20	7,048 0.10	17,184 0.10	55,960 0.20	276,960 0.50	359,760 0.60
North Africa	(tonnes) (%)	6,028 0.20	19,154 0.40	63,831 0.50	343,986 1.10	714,277 1.30	928,530 1.60
Amercia	(tonnes) (%)	173,49 6.80	198,850 4.20	548,479 4.20	1,423,433 4.40	2,576,829 4.50	2,576,428 4.30
Caribbean	(tonnes) (%)	350 0.00	2,329 0.00	12,169 0.10	39,704 0.10	42,514 0.10	36,871 0.10
Latin America	(tonnes) (%)	869 0.00	24,590 0.50	179,367 1.40	799,234 2.50	1,835,888 3.30	1,883,134 3.10
North Amercia	(tonnes) (%)	172,27 6.70	171,931 3.70	356,943 2.70	584,495 1.80	634,427 1.10	656.423 1.10
Asia	(tonnes) (%)	1,799,1 70.10	3,552,38 75.50	10,801,35 82,60	28,422,18 87.70	49,538,01 88.90	53,301,15 89.00
Asia (excluding China and Near East)	(tonnes) (%)	1,034,7 40.30	2,222,67 32.70	4,278,355 32.70	6,843,429 21.10	14,522,86 26.10	16,288,88 27.20
China	(tonnes) (%)	764,38 29.80	1,316,27 28.00	6,482,402 49.60	21,522,09 66.40	34,779,87 62.40	36,734,21 61.40
Near East	(tonnes) (%)	18 0.00	13,434 0.30	40,599 0.30	56,665 0.20	235,286 0.40	278,061 0.50
Europe	(tonnes) (%)	575,59 22.40	916,183 19.50	1,601,524 12.20	2,050,958 6.30	2,499,042 4.50	2,523,179 4.20
European Union (27)	(tonnes) (%)	471,28 18.40	720,215 15.30	1,033,982 7.90	1,395,669 4.30	1,275,833 2.30	1,261,592 2.10
Non-European-Union countries	(tonnes) (%)	26,616 1.00	38,594 0.80	567,667 4.30	657,167 2.00	1,226,625 2.20	1,265,703 2.10
Oceania	(tonnes) (%)	8,241 0.30	12,224 0.30	42,005 0.30	121,482 0.40	173,283 0.30	183,516 0.30
World	(tonnes)	2,566,8	4,705,84	13,074,37	32,417,73	55,714,35	59,872,60

Source: FAO (2013)

Table 1.2. International Trade in Fishery Commodities by Principal Importers and Exporters

Country	Imports			Exports		
	2010	2011	2012	2010	2011	2012
USA	15,496,409	17,466,321	16,958,865	44,367,46	44,630,52	41,446,23
China	4,976 ,220	6,154,359	7,572,593	92,507,10	101,143,24	10,245,527
Japan	13, 258, 134	14, 891,698	17, 340,620	1,583, 110	1,945, 488	1,859,955
Malaysia	672,396	777,858	982,289	654,733	823,845	705,412
Thailand	1, 978,634	2, 137, 320	2, 717,030	6,235,867	7,149,828	8,141,815
Singapore	807,036	951,181	1,142,568	306,994	370,597	403,966
Indonesia	229,613	315,758	401,847	2,248,430	2,561,863	3,181,872
Australia	441,805	452,246	539,513	823,904	942,002	998,099

Source: FAO (2013)

In one other definition, aquaculture is defines as “the husbandry of aquatic organisms like fish, aquatic plants, crustaceans, and molluscs” (Fisheries *et al*, 2013). Farming is also meant to have some kind of involvement in the process of production to improve production, like consistent stocking, nourishing, and protecting from raiders. Husbandry also encompasses the possession of cultivated stock individually or corporately (Fisheries *et al*, 2013). According to FAO (2009), viable development is defined as the managing and saving of the natural resource base and the direction of institutional and technological change in such a way as to guarantee the achievement and satisfy continuously the human needs for the sake of generations now and in the future.

Conservation of water, land, and genetic resources of animal and plant are the results of maintainable development in the sectors of forestry, husbandry, and fisheries (Fisheries *et al*, 2013). Such development is environmentally non-damaging from environment point of view, exactly applicable, economically feasible and socially appropriate. As is shown in table 1.3, FAO announced aquaculture as one of the quickly developing universal sectors in producing food in the year 2011 (FAO, 2012).

In order to compare the expenditure with benefits, and decide on the alternative projects with a suitable profit, an economic analysis of agricultural projects is carried out. As is shown in table 1.3, investing on aquaculture products has a better return in comparison with the other products (Fisheries *et al*, 2013).

Table 1.3. Economic Comparison of Agricultural Commodity

Commodity	Income per Hectare/year (RM)
Tiger Prawn	60,000
Ornamental fish	24,000
Freshwater Fish	24,000
Vegetable	13,000
Tobacco	8,304
Palm Oil	4,000
Tiger Prawn	60,000
Ornamental fish	24,000

Source: FAO (2011)

According to Figis (2006), a new period of shrimp farming started when there was an improvement in the ponds in 1980s regarding the engineering problems. These difficulties which included facilities, processes, equipment, and the system requirement for growing and producing aquatic animals, were minimalized within that phase. The number of brackish water ponds in Malaysia was about 1,877 in 1993. As announced by FAO (2011), there was an increase in the quantity of production of farm-cultured shrimps, from 60 mt to 3, 0557 mt in the period of 1984 to 1991.

It is announced by FAO (2012) that the production decreased somewhat in the year 1992 to 2, 963, but again improved in 2 subsequent years. 30, 000 mt of whole shrimp were produced in the year 2003, including Penaeus monodon, and tiger shrimp, while some banana shrimp, the Indian white shrimp, P. indicus, and P. mergiensis were also cultivated. It is also indicated by FAO that a continuous progress is documented in the production of shrimp in the previous decade. It is claimed by Holthuis (1980) that there are at about 33 types of prawns with around 2500 species in the world. From this variety of prawns, almost 300 species are economically important for people.

In Malaysian context, there exist more than 20 sorts of prawns, involving king prawn, white prawn, black tiger prawn, white prawn, and sharp-rostrum prawn (MFO, 2009). The data collected from local resources, as stated in DOF (2012), show an annual landing of some 60, 000 tons of prawns with a rising weight every year. Also, according to FAO (2009) the relative amount of fish consumption in Malaysia with 19 percent is more than the world consumption level with about 15 percent during the period of 1980 to 2009 as shown in Table 1.4. It shows an above normal consumption of aquaculture products in Malaysia in comparison with world consumption (DOF, 2009).

Table 1.4. Key Agro Food Consumption in Malaysia, 2010.

Year	**1990**	**2008**	**Differences**
Consumption per person	**Kg**	**Kg**	**%**
Potato	3.2	6.4	100.0
Duck and Goose meat	2.1	4	90.5
Vegetables	26.1	49.2	88.5
Sugar crops	206.9	383.2	85.2
Wheat	32.6	57.6	76.7
Chicken meat	20.1	31.8	58.2
Maize	6.1	9.3	52.5
Sheep and Goat meat	0.6	0.9	50.0
Meat	35.3	47.6	34.8
Milk, fresh	32.9	43.5	32.2
Fish	48	57.3	19.4
Fruits	55.2	57.9	4.9
Eggs	14.1	12	-14.9
Rice	118.2	99.9	-15.5
Oil crops	133.9	90.4	-32.5

Source: DOF (2010)

There are varieties of shrimps living in the salty and marine waters of the world, with some rare species and some tiny sorts, or inedible species for humans. Penaeids, which belong to the family of Penaeidae, are the sort of shrimps raised in farm or caught by fishermen. Based on the statistics of FAO (2011), almost 90 percent of the shrimp produced globally comprised the western white shrimp or Penaeus vannamei, and giant tiger shrimp or Penaeus monodon in the year 2006. As documented by FAO (2011), it was considered essential to have a good control where a thorough argument and discussion zoomed on the practices of husbandry and farming in Malaysia. This farming has already been brackish water farming in Malaysia, and their relevant appraisal of dangers and advantages is necessary, as well (DOF, 2010). According to Hashim and Kathamuthu (2005), the states of Kedah, Sarawak, Johor, Perak, and Sabah as the major farming locations comprise 10 percent, 11 percent, 13 percent, and 42 percent of the shrimp farming areas. There are great potentials in the states of Selangor, Johor, Sarawak, and Sabah. From among the 36, 136 boats that had got license for fishing in the year 2004, 15, 651 vessels were small in size and had outboard engines, 2, 697 boats were not powered by engines, and the rest were inboard motorized. The number of fisheries in Malaysia equals around 89, 453 with Labuan 232 fishers, Sabah 29, 845, Sarawak 13, 206, and Peninsular Malaysia 55, 170 fishers. According to DOF (2009), these fishers use different methods to catch fish in fishing areas, as 29,499 of them use drift-gill nets, 25, 018 fishers use trawlers, 16, 425 work with purse seines, and 8, 258 of them apply hooks and lines. The majority of 94 brackish water hatcheries in Malaysia are placed in Peninsular Malaysia, Sabah, and Sarawak. Due to the accessibility of aquaculture products from nearby countries, the local marketers in Malaysia have to offer half the established price for white shrimp from fisheries. As a result, the local fisheries are commercially affected and do not make a good profit (DOF, 2009).

It was expected by Hashim and Kathamuthu (2005) that the production of Penaeus monodon will rise to 150, 000 mt by the year 2010 from just 30, 000 mt in 2005 including 30, 000 ha of brackish water ponds. Based on the statistics from FAO (2011), in the year 2006, the western white shrimp or Penaeus vannamei, and the giant tiger shrimp or Penaeus monodon comprised around 90 percent of the production of shrimp on farms globally.

It is documented by FAO (2011) that the fish as a commercially important product is raised in the countries like Malaysia, Indonesia, Thailand, Australia, India, Vietnam, Poland, Israel, and United States. The annual production of fish in Malaysia is around 2,000,000 tons, of which around 75 percent is collected by the marine sector. While the fish stock is decreasing in the world, wild captured fish as a very nourishing food is not likely to satisfy the global needs (DOF, 2012). One other source of marine food, which is extensively farmed for so many years in Asia, Africa, North America, and Europe, is catfish. As stated by Baker (1988) and FAO (2011), people have different views about the taste and flavor of catfish. Some think of it as an excellent aquaculture product, but some others do not consider it as a tasty food complaining about its being too watery and tasteless (Cai *et al*, 2009).

During the 1980s, there began a significant expansion of shrimp aquaculture continued up to now representing an industry with multi-billion income annually. Rosenberry (2003) refers to the shrimp production in the year 2002 claiming that at about 1.6 million metric tons of shrimp were globally produced then, and it was expected that the production would rise at a rate of 12 up to 15 percent annually in the following years. Though the main aquaculture supply in the world has been from brackish water farming with 70 percent, virus-related diseases have extensively caused main economic loss afflicting the industry over the previous years. Unstable prices, shortage of good seed supply, feed accessibility, and disease are among the main problems of Grouper fish, Penaeus vannamei, and Barramundi in Malaysia (FAO, 2012). Farmed carnivores such as salmon are more dependent on fish oil and fish meal than barramundis comprising 20 – 30 percent fish oil, and 30 – 40 percent fish meal, but barramundis are 25 – 35 percent or 5 – 15 percent respectively dependent on fishmeal and fish oil (Boonyaratpalin 1998; Tucker *et al*. 2002; Williams *et al*. 2003a; Glencross, 2006).

As documented by FAO (2012), whereas there has recently been a substantial development in catfish industry, due to the high expenses of current fish feed and high death rate of fish, further progress is delayed in this industry. In order that aquaculture make more contribution to the chain of human food, it is essential to find a solution to these problems. It is also argued by FAO (2012) that the main fish-producing Asian countries like Malaysia, Indonesia, Philippines, and Bangladesh are taking much of the produced fish to the domestic markets.

Governments are further encouraging the consumption of Grouper. For instance, The Philippines' Bureau of Agricultural Research (BAR) has recently funded a project in cooperation with the Bureau of Aquatic Resources and Fisheries attempting to improve, advertise, and make a better quality for Grouper products (FAO, 2012). In Malaysian context, because of the high level of demand for Grouper, the production of it is diverted just to the domestic market in order to satisfy the needs of the people of the country. According to DOF (2012), the interest to use fish among Malaysian has recently been growing as the economic conditions have improved and the people want to choose from various kinds of fish.

Lates Calcarifer, which is known as Seabass in Asian countries and Barramundi in Australia, is extensively sent to the Indo-West Pacific area from the Persian Gulf to China, Papua Guinea, Taiwan, and Northern Australia (DEEDI, 2010). According to FAO (2011), Australians were the first farmers of these species in the 1970s in Thailand, quickly reached much of Southeastern part of Asia. The following are the qualities that cause barramundi to be a perfect option for aquaculture:

- It is a fairly strong species that bears being in a crowd and possesses extensive physical endurance.
- The high fertility of female fish makes a lot of material available for producing seed.
- It is following some easy steps to produce seed by hatchery.
- Barramundis are quickly produced, getting to a size at about 350 g up to 3 kg in a period of six months to a couple of years.

Nowadays, the production of barramundi is all through Southeast Asia, usually from the small farms of coastline cage (Cabanas, 2009; FAO, 2012). Mathew (2009) declares that in these farms, a combination of species, together with barramundi, groupers (Family Serranidae), and snappers or Family Lutjanidae are cultivated. Barramundi live in freshwater, lakes, estuaries, coastal waters, and brackish and marine environments. It is claimed in FAO (2011) that barramundis are adaptable marauders; shellfishes and fish prevail in the adults' diets. Barramundi are very productive; one female with 120 cm TL can yield 30 to 40 million eggs. Therefore, just few brood stocks are needed to deliver sufficient numbers of larvae for extensive producing of hatchery (Mathew, 2009).

It was expected that in the year 2010, the production of brackish water species would be reduced by about 13 percent over the year 2009. According to FAO (2012), the increasing local request would result in local market interest to take in more and more amount of brackish water species. Simultaneously, the export of this aquaculture product was estimated to be good in the year 2010. Despite the bad climate in China during the ten first months of 2010, the export of brackish water species extended to 250 thousand tons which is 24 percent more than the year before. Among the exported products, frozen fillet was in the first place with 144439 tons. Much of export belonged to Mexico and the USA as the major markets in this period. FAO (2012) announced that the low level of production in 2010 caused an increase in the price. The decline in production was partially because of wintry weather and a bacterial infection. There was a 7.2 percent increase in the price of frozen fish to USD 3.53 per kilogram in the same period. Larger amounts of brackish water species were also exported to some African countries like Cameroon, Congo, Angola, and Zambia. The zone of fillet product was expanded to the western countries like Germany, Poland, Ukraine, and Canada. It is claimed by FAO (2012) that the countries like Russia have reduced their imports of fish in an effort to compensate for the lack of it and support its production. It was also anticipated in the conference of Info fish 2010 in Kuala Lumpur, as indicated by FAO (2012), that producing Barramundi in the world would get to 3.7 million tons by the end of the year 2010. While in China, Barramundi production was estimated not to make a big difference by remaining between1.1 to 1.2 million tons, this amount was probable to increase in the other countries. The world production of aquaculture will be in a rise in the future, as there has so far been a steady increase over years. According to Franz (2011), in 2008, the level of capture production was less than aquaculture production at about 755362 tons, and Barramundi production in the world was 2.8 million tons, however; after some 2 years, due to an increase in the world request, the prices in the world market increased. It is also said by DOF (2012) that due to the weakening of US dollar against the other currencies, much more production is taken in by the domestic markets in main producing countries. It is anticipated by FAO (2010) that the production of value-added brackish water species in the processed form will raise in Malaysia though there are increasing costs of production, labor, and processing in there. Warm weather creates an ideal condition for the production of brackish water species, which ends in low prices of it in grocers (Morris, 1993; FAO, 2012).

There has recently been made a significant progress in fish production, but the growth is now delayed because of high mortality rate, poor growth, and high expenditure of current fish feeds. In order to be more involved in satisfying human nutritional needs, a way should be found to solve these problems.

1.1.1 Status of *Penaeus vannamei* in Aquaculture in Malaysian Economy

According to Lucas and Southgate (2003), it is important to pay a lot of attention to the feeding habits of different types of aquaculture, especially in warm-water poly-culture, where a mixture of types of fish exist, each inhabiting a varied ecological place. It is also claimed by Mathew (2009) that in aquaculture, fish are usually supplied with supplementary feeds. He believes that manure can function as a source of food for some sorts of fish by adding the food accessible in the pond from food organisms. Supplementary food can also be formed from an extensive kinds of by-products of agriculture. At feeding time, these ponds may be supplied with higher rates. As some fish like common carp are feeding in the bottom of water, stocking them avoids sediments to be formed and nourishment to be wasted. DOF (2012) believes that some sort of low-level feeders may also be very selective in their nourishing, like filter feeders that have need of specific planktons of special form. Predatory sorts of fish are mostly used in intense aquaculture, but demand higher prices in the fish market, and are considered a good export product attracting extensive investment (FAO 2012; De Silva and Hasan, 2007). Before beginning aquaculture and choosing the sort of fish, it is essential to find the best product market and consider the market value of that product (FAO, 2012; Subasinghe *et al*, 2009). While choosing among some fish of the same feeding place, economic value and turnover of the species should be taken into account. There is a direct relationship between the fish production and demand in the market. It means that, as stated by Seyednezhadfahim *et al*. (2013), the better organization of production could be done consistent with the market demand regarding size, quality, color, processing and preservation.

Market value for some species can also be of different types; some species can be traded as fingerlings in order to be replaced in the wild. De Silva and Hasan (2007) believes that in order to have a subsistent pisciculture, there is a need for sustainable culture for the domestic market. The link between density of population and the rate of aquaculture is one other significant issue. It is suggested in FAO (2012) that in African countries, where transportation is expensive and under-developed, it is important to think of domestic market potential. Also, FAO (2012) claims that the significance of domestic markets belongs both to commercial and subsistent fish farming.

In the year 2000, a foreigner in Malaysia wanted to make an official application for replacing Penaeus vannamei with Penaeus monodon. After a careful consideration of the application by the Department of Fisheries Malaysia or DOF, the proposal was officially rejected. There was also made an announcement on May 2000 by DOF to alert the public. At the same time, the import of brood stock from foreign countries was banned even those pathogen resistant or pathogen free ones. Due to this ban in Malaysia, the production of P. vannamei post larvae was also not allowed by shrimp hatcheries. Based on the statistics from DOF (2009), in order to prevent the spread of TSV and other viruses in Malaysia, the Malaysian government prohibited unlimitedly the import of Penaeus vannamei effective from June 2003, although the implantation of this prohibition was after the import of Penaeus vannamei into Malaysia from Thailand and Taiwan in the period of 2001 – 2002 (FAO, 2012).

In some distant places in Sabah and Peninsular Malaysia, some illegal fish farming is observed. At the same time, culturing of Penaeus vannamei is not allowed in Sarawak, and fishing requires obtaining a license from the government. So, for the sake of preserving their farms and keeping their licenses, they have to follow the regulations. According to DOF (2012), there is also a great attempt by the government to make the farmers register their farms with DOF. Farming activities are monitored through this action, and practical, longer term legislation is ensured in order to set the import of unknown species under control and minimize disease transmission.

1.1.2 Status of Grouper Fish in Aquaculture in Malaysian Economy

The application of aquaculture in full cycle form for several grouper species is getting much more common through Asia. Groupers are farmed at a variety of forms in any of the countries of Southeast Asia like Malaysia, Hong Kong, Indonesia, Taiwan, Vietnam, and Philippines (FAO, 2012). Full-cycle farming comprises only 10 to 15 percent of total marketing, whereas a rising amount of its culturing is expected in the future. The major producing countries in this field are Thailand, Indonesia, Taiwan, China, and Australia (FAO, 2012).

As claimed by DOF (2012), in Malaysian context, fish farmers who are involved in marine culture are more than 2000. A vast area in the river mouths of the eastern coastal area of Peninsular Malaysia and the neighboring areas are presently recognized as having the potential for grouper fishing. At the same time, the areas next to the main offshore reef islands are found to have more potential. The mainland coastal areas vertical to P. Tioman, P. Redang, and Pulau Perhentian are also described as having ideal conditions for grouper farming (DOF, 2012).The commonly farmed species in these areas are brown-spotted groupers, which are known as E. malabaricus and E. suillus, and maybe E. tauvina. Besides, some sort of snappers and siganids are cultured, as well. It is stated in FAO (2012) that at the end of the season in March and April, there are also cultured some Bleeker, and E. bleekeri.

Hashim and Kathamuthu (2005) stated that the share of groupers from the total marine finfish of Malaysian aquaculture products is more than 30 percent by value and 16 percent by weight. They also claim that fish seed in Malaysia is mainly imported from Thailand and Taiwan, and only about 15 percent of it is locally collected or produced by private or state hatcheries. The typical grow out systems for groupers are net cages, and the main sites for growing them are in Sarawak, Sabah, especially Sandakan and Tuaran. It is documented by Sadovy (2000) that two kinds of culturing of groupers as ‘real’ and ‘system’ are done in Sabah. Growing the wild-caught, fingerlings, mainly E. malabaricus and E. coioides, is called real culturing, but when small groupers or large captive juvenile are fed in net cages, system culturing occurs. There are two main limitations in the trade of groupers. One is poor quality of seeds because of the way they are caught and handled, and the other is the problems in supplying them. Besides, as is claimed by Nguyen and Hambrey *et al*. (2000), there is a need for replacing trash fish with one other more economical specie.

The grouper is a popular marine food fish of high market value in Southeast Asia. Groupers have been farmed in net cages in coastal water for a longtime. The species which have been reared in tropical countries are estuarine grouper, Epinephelus malabaricus, black spotted grouper, E. salmoides and brown spotted grouper, E. tauvina. Some countries, like Indonesia, Singapore and Malaysia have attempted to rear leopard grouper, Plectropomus leopardus (FAO, 2012). As a popular marine fish, grouper has a good trade in much of the world like Indonesia, Kuwait, Malaysia, Taiwan, Thailand, the Philippines, Japan, Hong Kong, China, and Mexico (FAO, 2011). Their habitat are coral reefs and stony environment. Majority of groupers belong to the genus *Epinephelus* (Brais, 1987). The grouper is characterized by an oblong body usually with spots and blotches and having a very large mouth (Brais, 1987). A highly carnivorous organism, it feeds on fish, crustaceans and cephalopods. Some species of grouper such as estuarine grouper, *E. malabaricus,* black spotted grouper, *E. salmoides,* brown spotted grouper *E. tauvina*, red grouper *E. morio* and red spotted grouper *E. tauvina,* red grouper *E morio* and red spotted grouper *E. akaara* have been found to be suitable for intensive cage culture in coastal water (Chen *et al*, 1977, Kohno *et al*, 1988, Brais, 1987; Tookwinas and Charearnrid, 1988 and FAO, 2013).

1.1.3 Status of Barramundi Fish in Aquaculture in Malaysian Economy

Malaysia has experienced a relative production rate of 20, 000 to 27, 000 tons of barramundi per year in the period of 1998 – 2010 (FAO, 2012). Some main producers of this product are Thailand with around 8, 000 tons per year since the year 2001, China, Malaysia, Indonesia, and Taiwan. There has been a fluctuation in the global average value of barramundi from the year 1994 up to now. In 1994, it was USD 3.80 per kilogram, but rose to USD 4.59 per kilogram in 1995, and decreased to USD 3.92 by the year 1997 (FAO, 1997). Ever since it has been about USD 3.7 per kilogram. The global average value of farmed barramundi base on the statistics from FAO (2010) was USD 3.80/kg in 1994 and rose to USD 4.59/kg in 1995 but had fallen to USD 3.92 by 1997 (FAO- NACA, 1997). Since then it has been around USD 3.7/kg excepting 2002, when it dropped noticeably to below USD 3.0 per kilogram.

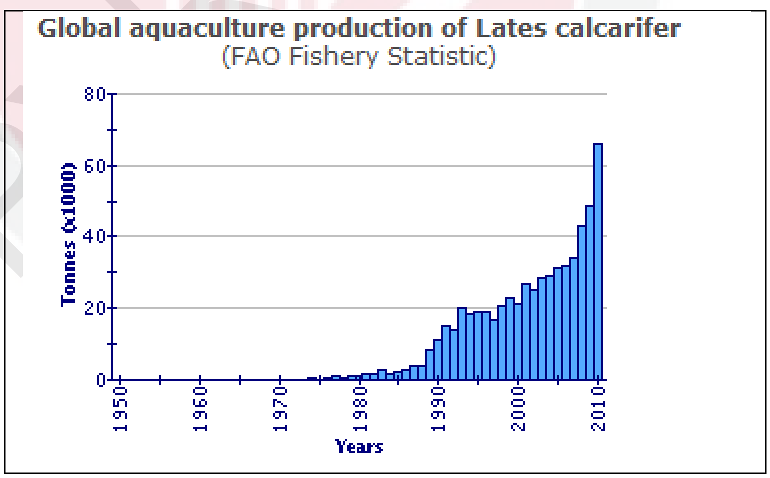

Figure 1.1. Global Status of Barramundi fish production

Generally, there has been made little attempt to develop value-added product for barramundi. A number of suppliers of barramundi in smoked form are in Australia. They sell live barramundi to the food centers which specialize in these live products, however; this is a fairly small amount of the whole market for barramundi. According to FAO

(2010), most of the produced barramundis in Australia are not put for export and consumed locally.

Producing barramundi as an aquaculture product started in 1960s (FAO, 2012). Some countries are presently producing barramundi, such as Thailand, Indonesia, Malaysia, Australia, Singapore, Taiwan, Brunei, Israel, and lately America. The global production of barramundi in the year 2004 was 29,856 tons, valued at USD 77,733,000 (FAO, 2012). According to Figis (2006), among these countries, Thailand with 14, 550 mt was the first producer of barramundi, afterwards Taiwan with 4, 985 mt, Indonesia with 4, 663 mt, Malaysia with 4, 001 mt, Australia with 1, 567 mt, Singapore with 77 mt, Brunei with 43 mt, and Israel with 15 mt were the global producers of this aquaculture product. Vietnam is also an unregistered producer of barramundi in the world, but China as a former producer has no more production of it (Figis, 2006). There was an increase by 15 folds in the production from 1985 to 2000, however; most of the produced barramundi had local consumption with just little export. As an example, The Australian consume 97 percent of their products locally, and only 3 percent goes for export (FAO, 2012). After all, there is expected to be a global increase in the production of barramundi, majorly in open systems like Indonesia, Singapore, Australia, and Taiwan, due to the global increase in profile of barramundi.

Feeding comprises about 40 percent of barramundi farming; therefore, according to FAO (2012), in order to reduce the costs of production and aid to make the industry more viable, through having less dependence on wild fish input, inquiry to find alternative feeds is now continuing. In order to find alternative ways for feeding fish, there have been some investigations in the department of primary industry of Queensland, Australia since 1993, and a significant development has been made in lowering the presence of fishmeal to below 15 percent (Williams *et al*, 2003a). A likely replacement for fishmeal is soybean in fish diets; though Boonyaratpalin *et al*. (1998) discovered that it is less edible for barramundi than classic diets based on fish. Some other problems about nutrition have been reported to affect the fish diets. Alternatively, some research has revealed that meat meal can make a well-liked feed for the consumption of barramundi (Williams *et al*. 2003b). A good solution for fish diet problem is the consumption of green mungbean or white cowpea as a replacement for 18 percent of fishmeal with no negative effect on the growth of barramundi (Eusebio and Coloso, 2000; Coloso *et al*, 2004; Williams *et al*, 2003c).

1.2 Malaysian Agriculture and Trade Policies

The 2011-2020 Agro-Food Policy is a continuation of the 1998-2010 Third National Agriculture Policy (NAP3) which aims to increase income and guarantee food supply in Malaysia. This policy also outlines some strategic direction to enhance the competitiveness of the value chain as well as to increase production sustainability. The Tenth Malaysia Plan (10th MP) comprises the Government Transformation Program and the New Economic Model aspirations which focus on high income, inclusiveness and sustainability (The Tenth Malaysia Plan 2011-2015, 2010).

The 10th MP has been formulated with the Agri-Food Policy in mind, with the objectives to;a) Ensure adequate food supply for the country and b) Increase the income of target groups. To achieve the objectives of the Agro - Food Policy, the following strategies have been designed (NAP, 2012; The Tenth Malaysia Plan 2011-2015, 2010).

1.2.1 Increase Production and Productivity

Production and productivity will be enhanced through optimized land productivity using appropriate technology, reduced production costs and improved production management by virtue of a centralized management. Identified production areas will be zoned as Permanent Food Production Park while integration of crops with field crops such as oil palm and rubber will be encouraged (The Tenth Malaysia Plan 2011-2015, 2010).

1.2.2 Increase Good Agricultural Practice

To improve the quality of agricultural products, the Agriculture Department will continue to implement a number of good agricultural practices such as the Malaysian Organic Scheme and Malaysia Good Farm Practice Scheme. Among the methods used is the use of beneficial microorganisms, integrated pest management and recycling of agricultural waste materials such as straws to make compost (The Tenth Malaysia Plan 2011-2015, 2010).

1.2.3 Strengthening of the Agro-Food Chain

The food supply chain system will be strengthened by the involvement of the Government, the private sector and entrepreneurs through cluster development to link production and market demands, increase value-added activities as well as grading and marketing. To expedite the implementation of supply chain systems, agro-food tracking system from farm to consumer (traceability) has been established to ensure Halal aspects (The Tenth Malaysia Plan 2011-2015, 2010).

1.2.4 Increase Productivity and Agriculture-based Production

Productivity and agriculture-based production will be enhanced through the adoption of good manufacturing practices, such as GMP and HACCP, Halal accreditation, improved packaging, labelling, promotion, marketing and branding and consumer taste fulfillment. Agriculture based industries will also be developed in clusters such as One District One

Industry Program (NEW ECONOMIC MODEL FOR MALAYSIA part 1, 2010).

1.2.5 Human Resource Development

To enhance the skills and expertise of officers, youths, entrepreneurs and businessmen, the Department of Agriculture has planned to implement several projects, namely human capital development (training, courses and seminars to officers), Certificate in Agriculture Training, Agriculture Technology Development Centre and Entrepreneur Coaching (NAP, 2012).

With the smaller provisions of the 10th MP compared to the 9TH MP, a priority should be given to departmental projects to achieve improvement in productivity, output and income of the target groups. A successful two (2) years implementation will be the indicator to the application of provisions in 2013 to 2015 ("TENTH MALAYSIA PLAN 2011-2015," 2010).

1. 3 Agricultural Policy Analysis based on PAM in Malaysia

1.3.1 National Agricultural Policy in Malaysia

Overall, the agriculture sector funded RM 42 million with a total of 9.5 percent of Malaysia's Gross Domestic Product in the year 2004. There was an outstripping in the development of manufacturing sector to agriculture sector in the period of 2000 to 2004. In Malaysian context, the manufacturing has always been the primary sector with high progress and a contribution of 31.4 percent to GDP. However, agriculture continues to be an important element of the economy of Malaysia. The two major bases of agriculture, rubber and oil palm keep on benefiting from developed productivity, and market demand for export which promoted greater export revenues in 2004. This raised the revenues of farmers engaged with the farming of these two crops to some extent. At the same time, the production of oil palm reached to 3, 600 tons, while raising the production of crude palm oil to 13.9 m tons in the year 2004. According to NAP (2012), the average price of 1, 706 per ton of crude palm oil in that year resulted in the export value of RM 20.1 million.

It is evident that currently agriculture sector is experiencing inadequacies due to operational deficiencies like lack of labor, land breakups, and growing expenses of inputs. As a result, efficiency, income, and productivity from small holdings linger plantations. It is observed that the policy of the state government to guarantee minimum price for structural and paddy deficiencies causes the prolonged inadequacies in paddy farming. Because of the involvement of the government in setting the price and supplying the products, organizational deficiencies have been established and are inflexible and difficult to change. Making any change is even getting more difficult now, since the subsidies paid to paddy farmers are used as means of gathering votes. It is also expected that investment and labor in agriculture will remain under control in a reaction to request for these selfsame inputs by quickly growing manufacturing sector in Malaysia. The final result is the lack of interest of investors in the agriculture sector leading ultimately to the withdrawal of capital from this sector (NAP, 2012).

1.4 Problem Statement

Major problems for brackish water species (*Penaeus vannamei*, Grouper fish, Barramundi) grow-out industry in Malaysia include access and fluctuating prices, lack of reliable seed supply, feed availability and disease outbreak (FAO, 2011). In order to increase the share and role of aquaculture in human food chain, it is essential to find solutions to these difficulties.

Domestics markets in aquaculture producing countries in Asia like Malaysia, Bangladesh, Philippines, and Indonesia are taking in much of the local products. This is being further encouraged by governments' promotion of aquaculture product consumption. Export was consistently higher indicates fishery sector might contribute to the food trade surplus (Table 1.5).

Table 1.5. International Trade in Fishery Commodities by Principal Importers and Exporters

Country	Imports (Tone)			Exports (Tone)		
	2010	**2011**	**2012**	**2010**	**2011**	**2012**
USA	15,496,409	17,466,321	16,958,865	44,367,46	44,630,52	41,446,23
China	4,976 ,220	6,154,359	7,572,593	92,507,10	101,143,24	10,245,527
Japan	13, 258, 134	14, 891,698	17, 340,620	1,583, 110	1,945, 488	1,859,955
Malaysia	**672,396**	**777,858**	**982,289**	**654,733**	**823,845**	**705,412**
Thailand	1, 978,634	2, 137, 320	2, 717,030	6,235,867	7,149,828	8,141,815
Singapore	807,036	951,181	1,142,568	306,994	370,597	403,966
Indonesia	229,613	315,758	401,847	2,248,430	2,561,863	3,181,872
Australia	441,805	452,246	539,513	823,904	942,002	998,099

Source: FAO (2012)

Recently, Malaysians have increasingly become interested in fish consumption as the economic conditions get better, and people search for new alternatives. Organic fish in the aquaculture of Eastern Asia has also a developing market as the customers are concerned about the existence of antibiotics and likelihood of genetically adapted fish in aquatic products. Based on the information from FAO (2012), richer consumers are ready to pay more so as to become reassured of organic quality of aquaculture products. One of the main issues affecting the upcoming growth of brackish water farming in Malaysian context is the high expenses of production (DOF, 2012). Some other difficulties will be related to the high cost of hiring local workers, and the export market which is competitive will cause some hitches. In order to continue being competitive, the sort of effective procedure for pond management should be applied that leads to decreased production cost and growing efficiency. The actions taken by management should include appropriate preparation of ponds, optimal stocking compactness, economical feeding system, and applying process to manage discharges. Taking these measures will result in being successful in improving efficiency and having a sustainable aquaculture in Malaysia (Akkaya, 2010; FAO, 2013).

To increase exports, government assistance is needed through new policy interventions. Existing policy interventions should be analyzed to evaluate current protections. High cost of production due to increase cost of local labor, high cost of non-tradable inputs will eventually limit expansion and deteriorate the competitiveness of export market (DOF, 2012). High per capita consumption in 2012 (56kg/year) may not be sustainable for the industry especially towards the already depleting fish stocks, and increase domestic price, production cost, and reduce tradable inputs in 2012 (Figure 1.2)(FAO, 2013). Studies have shown that between 1997and 2009 marine biomass in the country had fallen by as much as 50%. Reasons cited were environmental degradation as well as overfishing.

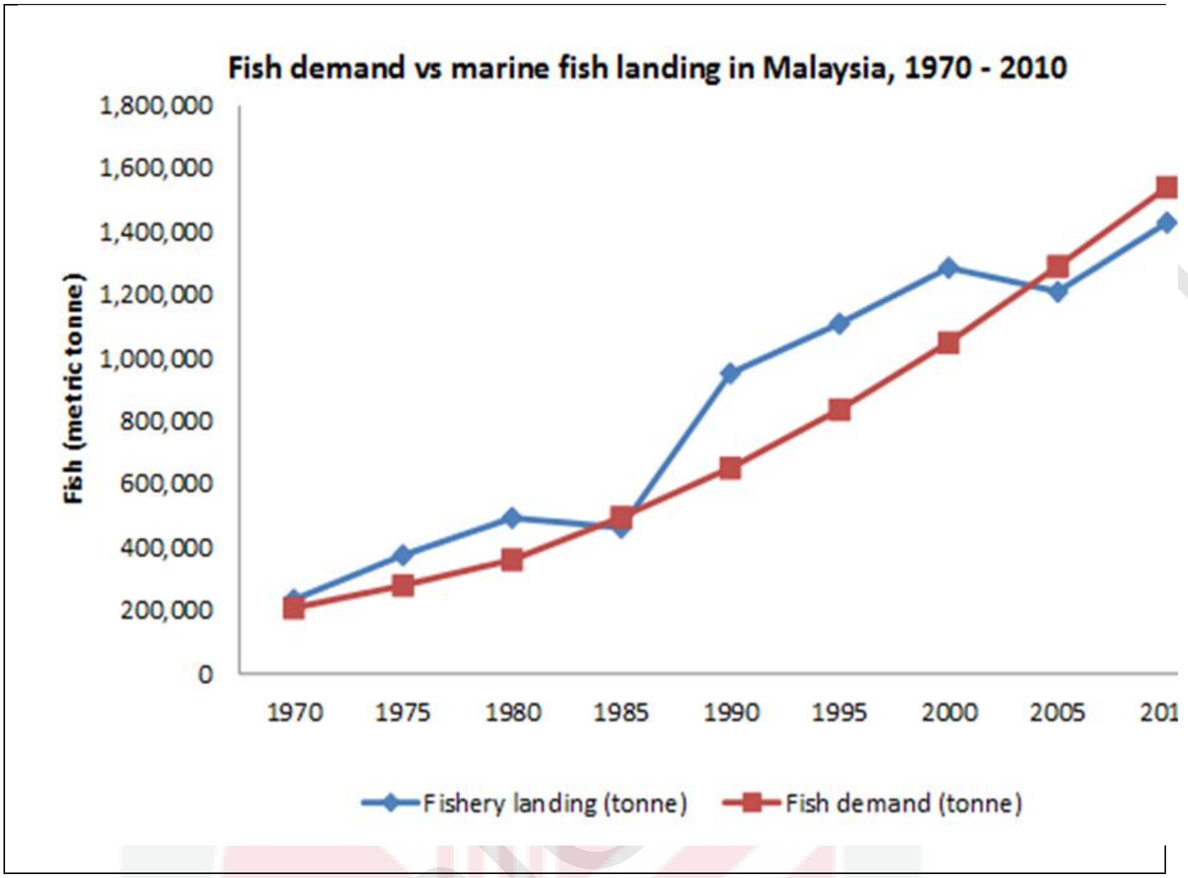

Figure 1.2. Fish demand against marine fish landing in Malaysia, (FAO, 2011)

Lots of people in Malaysia have been engaged in aquaculture as fish farming in addition to the many commercial companies which are performing various types of producing systems. But they totally use unaltered species leading to almost inefficient production. It is because the current accessible knowledge and practical skills in managing aquaculture are not fully applied to obtain continuous profit and optimal fish functioning. In this study, the growth and use of genetically developed stocks which are more fruitful becomes.

In this research, the development and use of genetically improved stocks that are more productive becomes essential so as to more efficiently use the resources and increase demand by finding most attractive place in aquaculture industry are imperative for policy making and planning of the three most important species of the aquaculture sector. These cannot be found in any previous studies. The other problematic issue with aquaculture in Malaysia according to DOF (2012) is the shortage of professionals and scholars to direct and organize aquaculturists. Universiti Putra Malaysia and Universiti Sains Malaysia have been supporting the industry for many years to boost through supplying them with proper information so as to handle the industry and marine resources. Nevertheless, the professionals and information provided help to increase

technical feasibility but are not sufficient to improve economic feasibility when the number of aquaculturists in Malaysia is growing. To overcome this problem, this research can be effective and efficient since the economic analysis on five aquaculture species will be scrutinized to completely apply the normal conditions in the state to promote aquaculture industry. These factors appear to positively support the expansion of aquaculture sector. Therefore, this research study identified the questions as flows;
1) What are the main factors Malaysia should focus on brackish water farms? Is it the tradable input or non-tradable input price can affected more on productivity of aquaculture farms? And should there be any new agriculture policy to be pursued?
2) Does the aquaculture production in Malaysia have the comparative advantage and policy protection?

3) What is the level of comparative advantage of brackish water productions in Malaysia?

1.5 Objectives of the Study

This study is conducted in order to investigate into the factors responsible for improving aquaculture production in Malaysia. The general objective of this study is to evaluate and ascertain the factors affecting comparative advantage and policy measurements of five aquaculture species farming. The specific objectives are as follows;

i. To investigate factors of production that affect financial and economic profitability of aquaculture production.
ii. To measure and analyze the comparative advantage and policy protection indicators of aquaculture production.
iii. To rank the competitiveness of five selected species of aquaculture production under different Agro-food incentive schemes.

1.6 Significance of the Study

Malaysia has a high potential to develop fish farming to absorb a substantial fraction of its food trade deficit. The country has an adequate national infrastructure; there is a high demand for fish and its sale price is favorable. What is needed is a more dynamic approach to implement the available knowledge while exploring ways to ameliorate the performance of the industry. However, due to the population increase, decrease of protein products, and increase in the meat prices during the recent years, the demand for fish has increased. For this reason, the Ministry of Fisheries (MOF) has embarked on a policy to increase the aquaculture production of valuable species. The contribution of the fisheries sector to the national economy is largely positive. Significant progress could occur in national fisheries development, which could result in the consolidation of small industrial base, growing export receipts resulting to a positive trade balance. This would require significant efforts towards improving the management of fish production systems and supporting the development of aquaculture.

Initially presented to describe the benefits of global trade, relative advantage has become an influential concept extensively applied to address developmental subjects. In the issue of aquaculture development, it is important for policy makers to identify the comparative advantages of the country in aquaculture sector so as to develop appropriate policies to adopt these advantages into viable effectiveness. Information about comparative advantage is also important for individual aquaculturists to allocate to promising aquaculture activities and avoid unsustainable innovativeness.

There is a dire need to increase the output per hectare of aquaculture product as this seems to be the only way to increase production for now. Therefore, effective policy recommendations are necessary to reduce the cost of production. As such, the policy makers may find the following suggested policy recommendations worthwhile. The introduction of aquaculture production which will incorporate part of the cost of production should be considered by the government. Since the government is bent on finding ways of increasing production of aquaculture farms per hectare this might be a good way of encouraging the independent farms. This incentive will make them eager to use improved quality and it will also motivate them to try their best possible to increase production. To cap it all, the government needs to intervene now in aquaculture farms if an improvement is to be expected in the nearest future. No stone must be left unturned in pursuing the increase in production goal as Malaysia now has a great competitor in Indonesia which has expanded more and products at low cost.

Despite the considerable amount of literature dealing with the issues of comparative advantage was use Policy Analysis Matrix (PAM). Other indicators like Domestic Resource Cost (DRC), Effective Protection Coefficient (EPC), Nominal Protection Coefficient (NPC), Social Cost Benefit (SCB), on Policy Analysis Matrix (PAM) and Base Study (BS), Pioneer Study (PS), Intensive Tax Allowance (ITA) and Accelerate Capital Allowance (ACA) on government incentives were used in this research. There was little evidence in the literature that employed these indicators for Malaysian aquaculture farms. Brackish water farms are very important to Malaysians economy as it is a significant revenue source, and therefore, it is one of the main sectors of its economy. Therefore, the objective of this study to analyze the comparative advantage of brackish water species farms and to provide the government with policy options to increase the aquaculture production and continues with export on future. The outcomes of the analysis would be worthy to formulate suitable policy and government interventions according to the parameters such as DRC, NPC, EPC, NPV, IRR, BC, etc. Each indicator provides some understanding on a specific dimension of the comparative advantage.

The main contribution of this study lies on the usage of different tools and techniques to measure the comparative advantage and Agro-food incentive schemes using Policy Analysis Matrix (PAM) tool and other indicators as well as Domestic Resource Cost

(DRC), Effective Protection Coefficient (EPC), Nominal Protection Coefficient (NPC), Producer Subsidy Equivalent (PSE), Subsidy Ratio to Producer (SRP), on PAM analysis and Base Study (BS), Pioneer Study (PS), Intensive Tax Allowance (ITA) and Accelerate Capital Allowance (ACA) on government incentives were used in this research. These tools were never used in the past to measure comparative advantage under different Agro-food incentives schemes in Malaysia. Hence, this research in the first of its kind in understanding and measuring the brackish water farms on the point of comparative advantage and government incentives. The result of this research will be useful for policy makers, aquaculture farmers and traders. They may be guided by outcome of this study to design appropriate policy for further improvement in aquaculture sector.

1.7 Organization of the Study

These researches are organized into seven chapters. Chapter 1, introduces the subject matter and its importance, the problems undertaken in the study; in other words, it provides an outline of the study. Chapter 2, provides the concepts and literature review of most recent and relevant studies relevant to productivity and efficiency growth its sources in the agriculture and aquaculture of several countries in the world. It also elaborates on the approach of the analysis adopted in the current study. Chapter 3, provides the theoretical framework and methods used to achieve the stated objectives. Chapter 4, provides Financial Assessment of Brackish water Species. Chapter 5, provides Economics Assessment of selected species and provides Explain on PAM and effect of government incentives on production. Chapter 6, provides conclusion and recommendation.

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