COUNTRY REPORT

RECENT REPORT
ON COASTAL / MARINE AQUACULTURE
STATUS IN MALAYSIA

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1 Vision In Aquaculture

Malaysia is located in the heart of southeast Asia. Consisting of 127,000 sq.miles (330,200 sq. km). The country is divided into two main regions: Peninsular Malaysia, which lies south of Thailand, and East Malaysia, which can be found north of Indonesia on the island of Borneo. Although East Malaysia occupies the larger portion of Malaysia's total area, it is primarily comprised of undeveloped land and jungles. Hence about three quarter of its 23 million population stay in the Peninsular Malaysia.

Being surrounded by sea, Malaysia has a coastline of 4800 km. Within this the mangrove forest covered about 641,000 ha. A big portion are located in Sabah or 57 percent of the share, 26 percent in Sarawak and only 17 percent is in Peninsular Malaysia. Beyond the shore are over two hundred islands with warm clear waters and teeming marine life have delighted underwater adventures.

On climate side, average temperature is between 21 to 32 degree celcius. Humidity is high. Rain tends to occur between November to February on the east coast of Peninsular Malaysia, on the western Sarawak, and north-eastern Sabah. On the west coast of Peninsular Malaysia the rainy seasons is April to May and October to November. With its favorable climate supported by a vast resources Malaysia has a great potential for aquaculture development.

As to look forward to become a develop country status by the year 2020, Malaysia recognizes the significance of sustainable aquaculture as an integral part of efforts to develop its natural resources. On the way Malaysia is putting up effort to increase its aquaculture production. An area that is given attention is shrimp and marine finfish aquaculture industry. Various institutions and government agencies had been given the task to commercialize this sector, get involve in research, training and development. On the other hand, mindful of the rising labor shortage in Malaysia, the government policy

is to promote capital intensive large scale commercial shrimp aquaculture farms. We promote mechanization and automation whenever feasible. Farms are encouraged to operate on an integrated and self-sustaining basis. Fry and feed production, processing and packaging, as well as marketing, are built into these vertically integrated systems. In achieving these Malaysia as well encouraged partnership. The government also interested in attracting foreign capital and appropriate know-how whenever is available to develop this sector through environment friendly technologies. As a step to get closer to understand recent status of marine aquaculture in Malaysia some inputs are provided in this report.

2 Marine Aquaculture Products Demand, Trade and Market

2.1 An analysis on demand, trade and market trend local and international

Annually from 2002 to 2004 production of fish from marine sector in Malaysia were about 1.4 million metric tons value slightly more than RM 5 billion. The bulk of the production or closed to 90 percent of the contribution came from capture fisheries sector. At an average 10 percent of the share is product from aquaculture. This was amounted to about 1200 to 1400 metric tons which was valued between to RM 700-900 million annually during the last five years period (Table 2.0). Overall, brackish water aquaculture contributed on average 70 to 75 percent of the total aquaculture production. In term of quantity, big chunk or about 30-40 percent and 10-20 percent of marine aquaculture production were from cockle rearing and seaweed cultivation, respectively. Pond based production which is typically for shrimp aquaculture and cage system contributed at about 5 and 15 percent respectively in term of fish volume in marine aquaculture sector. Despite the low volume, products from this sector earned highest trading value in fishery product.

As a cheap source of animal protein fish is considered an important food item by local. Due to easy access to fish and fish products Malaysia is among the country with highest fish consumption in the world. Estimate put that on average per capita consumption was 49 kg per capita in year 2000. This was further increased to 53 kg per capita in the year 2005 and is expected to rise further to 56 kg percapita in the year 2010. The important of

fish as food is further reflected in expenditure of the household. On average this was about 20 percent of their food budget (8th Malaysian plan). With the increase in number of population of the country and increase in health consciousness among the people apparently current local production will not able to meet the goal of self sufficiency within these coming years. Basically, the self sufficiency was only 89 percent in year 2000. This was slightly increased to about 90 percent in year 2005 and expected to be slightly increase to 94.3 percent in 2010 if strategies and action plans put under NAP3 new policy thrust is achieved.

Table 2.0 : Fish production from marine landings and marine aquaculture in the year 2000 to 2004

Year	landing		aquaculture		total	
	Volume (mt)	Value (RM mill)	Volume (mt)	Value (RM mill)	Volume (mt)	Value (RM mill)
2000	1,285,696	4399.23	117,205.56	665.34	1,402,901.56	5,064.57
2001	1,231,289	4166.11	133,562.79	958.01	1,364,851.79	5,124.12
2002	1,272,078	4206.81	145,439.81	843.49	1,417,517.81	5,050.30
2003	1,283256	4013.62	146,926.82	931.09	1430182.82	4,944.71
2004	1,331645	4241.45	146,668.04	903.38	1478,313.04	5,144.83

The NAP3 (1998-2010) or Third National Agricultural Policy was formulated following financial crisis in the world and Asia in particular during the year 1997 which put pressure on food and country's food import bill. In the action plan government came out with strategies and implementing mechanisms to address agricultural development and economy as a whole (MOA, 1999). Virtually the potential and importance of fisheries was highlighted and was given a significant task and expectation following a moves into the 21st century fishery and to become a fully developed country in the year 2020. Beside the traditional role as food supply for the country the sector is trust to enhance food security thus need to increase it production and contribution. Secondly is to become an engine which has to contribute to national income and export earnings. Thirdly is to maximize income of the producers and poverty alleviation. The expectations and hope put on to fisheries sector were practically based on the basis that the sector of particular

aquaculture can produce food at cost competitive. Aside to that the country still has a vast suitable areas for the industry development. Last but not least was from the stand point of economic. Previous records of earnings indicated that the fisheries sector was a clear contributor to national economic (Table 2.1).

Table 2.1 : Food export and import bills in year 2004

Commodity	Exports (RM million)	Imports (RM million)	Trade ballance (RM million)
Livestocks	1005.2	2696.3	-1691.0
Fish products	2073.0	1935.0	137.9
Agricultural	4337.5	7778.4	-3440.9
Others	2513.8	4144.8	-1631.0
Total	9930.0	16554.5	-6625.0

Source : Ministry of agricultural Malaysia, 2004

2.2 The consumer trens, preferences, buying patterns

Longtime, majority of consumers in Malaysia prefer marine fish for the reason of taste at least despite a much lower market price of fish from fresh water origen. However, of late due to influx of foreign workers mainly from Indonesia and Bangladesh there seemed to be a steady demand for fish from fresh water side. On set to that, locals also start to show preference towards fresh water fish due to a better promotion by the government and dealer alike. As an indication, since year 2001 fish production from this sector showed a yearly increase of production of 8-12 percent. Most of fresh water supply come from aquaculture sector as Malaysia has little natural productive area. In year 2003 the landing from inland fisheries was only 0.27 percent of the total fish production (Table 2.2). Bulk of the fresh water fish from aquaculture sector constitute mainly the tilapia and African cat fish.

Generally marine fish contributed to more than 70 percent of the demand by local. Despite the volume, this constitute mainly those from lower grade species such as

mackerel, sardines, scad and tuna. Beside economic reason it is worth noting that eating habit and dining style of Malaysian especially the Malay ethnic group which is the majority is inclined towards small fish serving. The big or high value fish such as crustacean is normally served in restaurant and of high demand during festive season and ceremony especially among the Chinese community. Except cockle and mussel, fish from marine aquaculture sector generally do not really supply the need of ordinary people.

As a result to continuously high demand of small and lower grade fish species, Malaysia needs to import as a mean to ensure enough supply for its people. On average this were between 300,000-350,000 metric tons of fish and its products during the year of 1999 – 2002. The import bills that came with the expenditures were between RM 1000-1300 million (Fig. 2.1). The increased in volume came to about 406,000 metric tons on the year 2004 (Table 2.2) with import bill of RM 1,935 million. Great portion of the imported fisheries commodities were from neighboring and traditional countries such as Thailand, Indonesia, Singapore as well as China (Table 2.3).

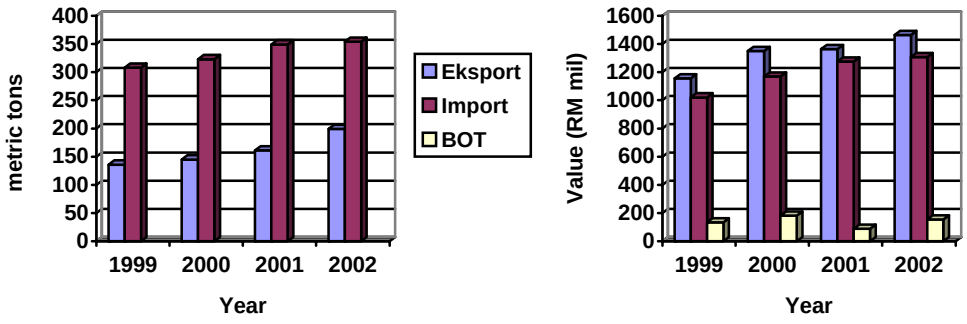

Fig. 2.1 : Quantity, value and effect to BOT in import and export of fishery commodities.

As source of income, Malaysia export most of its high value fish to foreign market. Among the commodities are shrimp, high grade fish and mollusk (Table 2.3). The bulk of these commodities were sent to United States followed by Singapore , Japan, EU and China. During the period of 1999-2002 the amount of the products were between 130,000

– 190,000 mt The earning that the country gained from export of these high valu efishes during the same period were between RM 1,100 – 1,400 million. Subsequently this was more than 238,000 metric tons and value at RM 2,072 million in the year 2004. Apparently, the trading brought in positive gained to the country by as much as RM 90-182 million during the year 1999-2004 (Table 2.2, 2.3).

Table 2.2 : Main commodities export and import of fisheries commodity, Malaysia-2004

Commodity	Exports		Imports	
	Volume (mt)	Value (RM 10^6)	Volume (mt)	Value (RM 10^6)
Live fish	8332	74,941	4502	24,792
Fish- fresh, chilled or frozen	79,836	188,526	317,892	980,719
Fish –dried, salted or in brine, smoked	1,495	9,351	1,834	9,254
Crustacean & mollusk – fresh, chilled, frozen, salted dried	116,992	1,446,864	60,259	772.792
Crustacean & mollusk – prepared or preserved	31573	353,267	21,709	147,484
Total	238,229	2,072,229	406,190	1,935,041

Source : DoF Malaysia, Annual statistic

Table 2.3 : Malaysian major trading countries, 2004

Eksport			Import		
Country	RM (million)	value (%)	Country	RM (million)	value (%)
USA	527,808	25.46	Thailand	465,146	24.04
Singapore	226,836	10.94	China	272,275	14.07
Japan	210,056	10.13	Indonesia	245,234	12.67
Italy	157,971	7.62	Singapore	161,722	8.36
China	112,297	5.42	Vietnam	161,093	8.33
Others	837,982	40.42	Others	629,571	32.54
Total	2,072,950	100		1,935,04	100

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2.3 Role of Aquaculture Versus Fisheries Supply

Similar to other Asian countries, fish and its product continue to play a vital role as a main supplier of cheap source of protein to their population. The fact that there is very little landing from inland fisheries and typical of Malaysian which put preference to marine fish has make the need to put much weight to increase production from the marine sector. Apparently however, landings from the coastal water which supply more than 80 percent of the fish sources was long time exploited to maximum and practically will not contribute extra. The rely on sources from deep-sea water however was not taken seriously by locals. Till end of 2004 the deep-sea fishing fleet stand at only 761 units. Still a small fleet, it practically will not bring any significant changes to marine landing to the country within these coming years. Hence, the only area left is aquaculture. Obviously thus the government put up strategies to develop marine aquaculture and clearly defined under Third National Agricultural Policy (NAP3) 1998-2010 as outlined earlier in the text. The sector is trusted with a task of to enhance food security and create income to balance out food import bills (BOT) which were long time showed a deficit.

While recognizing aquaculture as one of the thrust areas for development, the government of Malaysia is fully aware of the growing concern over sustainability and environmental impact of shrimp aquaculture. Human greed, coupled with profit driven, irresponsible, shortsighted activities, are not to be allowed to tarnish the image of aquaculture. In step toward realizing this, the impacts of aquaculture on coastal eco-systems including mangroves, water and soil quality, as well as socio-economic linkages in rural communities, are carefully studied. The government also interested in attracting foreign capital and appropriate know-how whenever is available to develop this sector through environment friendly technologies.

Malaysia fully supports the initiatives taken by UN bodies, such as FAO (FAO, 1997), to introduce a Code of Conduct for Responsible Fisheries. The government has already initiated steps to zone specific areas for aquaculture and develop standard for sustainable aquaculture practice that do not lead to ecological imbalances. Legislative measures on

code of practice for shrimp aquaculture and establishment of fish health management programmes of international standard are under active consideration (FAO, 2004).

2.3.1 Production status

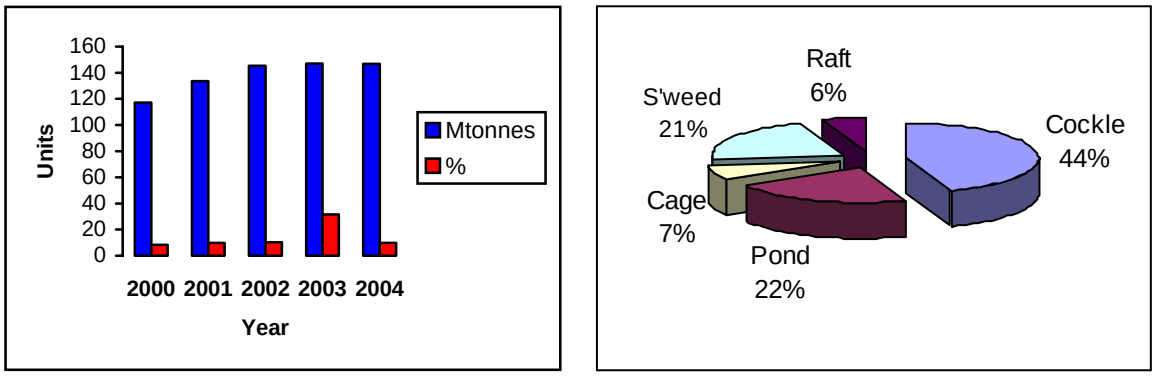

Fig 2.2 : Annual production and contribution according to system from brackish water culture sector, 2004

Aquaculture from marine sector of recent contributed about 133 to 146 thousand metric tones annually. This represented about 8 to 33 percent of total fish production in the country (Fig.2.2). There are six major sectors which contributed to the production. The most and traditional contributor is from cockle cultivation. In the year 2004 this was 44 percent. Pond and mainly shrimp production encounter to about 22 percent. The next major contributor was from seaweed cultivation which a share of about 21 percent. Production from cages mainly finfish and raft mainly mussel each contributed to about 6 and 7 percent, respectively.

2.3.2 Contribution to food security

Following a decision by government to increase fish production through aquaculture, under NAP3 thrust plan various strategies were put forward and implemented since year 1998. Marine shrimp of particular was given priority as a commodity to generate income and hence contribute to foreign currency earning. However, the planned development was not to expectation due to reason of diseases, land matters, market regulations and price fluctuation as well as competition with those from labor extensive countries. Apparently for the reasons, production from marine aquaculture since year 2000 to 2004

as a whole did not indicate much development. Obviously annual growth rate of about 20 percent is expected under NAP3. In early year of its implementation there seemed to be a jump, however a temporary. After a slight jumped of about 13 percent from about 117 thousand metric tones in the year 2000 production from marine aquaculture almost did not indicate any development as to the year 2004. The contributions were maintained in the range of 133 to 146 thousand metric tones annually. From an increased of about 8 percent in the year 2002, the three consecutive years after that showed only an annual increased of 1 percent (Fig. 2.2).

2.3.3 Contribution to national economic

According to recent Malaysian Fisheries Annual Report (DoF, 2004a) fisheries production as a whole contributed between 1.37 to 1.73 percent to national GDP during the year of 2002 -2004. More than 85 percent of the contributions were from marine fisheries landing and the contribution from aquaculture sector as a whole was about 15 percent for the past four years or so. Majority or slightly more than 70 percent of the share were marine aquaculture origin. Further break down apparently put an estimation on GDP from marine aquaculture production at about 0.11 to 0.14 percent. These monetary gain were mainly generated from the trading of 145 to 147 thousand metric tones of fish and its products which were worth at whole sale value of RM 843.5 million to 931.1 million. Further to generating income, this sector at that time provide job opportunities to about 4000 to 4200 people (Table 2.4). By percentage the number representing about 20 percent of the workforce in aquaculture related activities during the last four years period.

Table 2.4 : Production, Income and labor involve in respective aquaculture activities during year 2002-2004.

	2002			2003			2004		
	Mt '000	RM mill.	men	Mt	RM mill.	men	Mt	RM mill.	men
Inland	46.40	237.7	17074	49.95	241.2	16679	55.57	255.1	17298
Marine	145.44	843.5	4090	146.93	931.1	4435	146.79	903.4	4209
Total	191.84	1081.3	211644	196.87	1,172.3	211144	202.24	1,158.5	21507

- wholesale value

Table 2.5 : Contribution of marine aquaculture (in percentage -%) to fisheries and national economic during year 2002-2004.

Parameters	2002	2003	2004
GDP	0.13	0.11	0.14
Employ in aquaculture	19.3	21.0	19.5
Fisheries	20.0	13.3	13.2
Volume (mtons)	75.8	74.6	72.5
Value (RM)	78.0	79.4	78.0

Note : Fisheries to GDP - 1.5% (2002); 1.37% (2003); 1.73% (2004)

2.4 The Market Chain Organization, Trend and Vulnerability

2.4.1 Shrimp

Shrimp is considered marketable after 120 days of culture period. For shrimp, harvesting is usually done by draining the pond and attaching a net around the outlet pipe to trap the shrimp. The harvested shrimp is then washed using the waste water from the pond. Then shrimp left in the pond is collected manually. Before harvesting, the buyers take a random sampling to determine the average size and its price. Ex-farm price of black tiger shrimp of 40 pieces/kg range from RM 20-25. White shrimp *P. vanamei* of standard size (70 pcs/kg) deserved an ex-farm price between RM12-15. Buyers provide ice, boxes and also transportation for the shrimp to be sent to processing plants. The distribution channel for cultured shrimp is straight forward, buyers are also processors or exporters. Most of the products are for export market and only significant quantity goes to local market such as restaurants, hotel or other retail chains. Despite the vast market, like elsewhere in Asian countries the industry is vulnerable to threat from disease and impact of fluctuating prices on world market. On set to that is the subject of market regulation and traceability issues which may slow down production from small-scale farmers. In term of new area, not much can be developed if there is there is a boycott of shrimp from mangrove area. This is further hindered by competition in term of production cost between major producing countries. Labor wise Malaysia is on the disadvantage side. Presently most of the farms employed foreigners to run their operation. As government is tightening the

procedure for entry Obviously however, if Malaysia could make used of fuel as its strong point to reduce cost of production probably the industry have little more space to remain competitive.

2.4.2 Finfish

Marine finfish is considered marketable at about 500 g. However, different markets may takes different sizes. Consumers in Hong Kong prefer 600 g to 1.2 kg sizes for life grouper. There are two mode of marketing channels. One to local markets and the other is to overseas, mainly Hong Kong. Species cultured for local market are mostly seabass, various species of snapper and black grouper. The ex-farm price for seabass is between RM12-14 per kg, black grouper and snapper is between RM18-25 per kg. Despite that local market for live marine finfish is very .limited to festivals and the peak season for consumption is around January-March coincided with Chinese New Year. On ordinary days the main outlet are Chinese seafood restaurant. The price of fish in restaurant is least double than of the farm. Export market are fish of high-value such as tiger grouper and mouse grouper. The price is reflected in international market.

For live finfish, handling and packaging are given a serious attention to ensure the best price. Shipment of fish from cages to local market or to holding tanks or nets is done by using truck equipped with an aerated seawater tank. Shipment of live fish is done in two ways, one is actual packing in plastic bag and the other usually in large quantity is by Live Fish Transport Vessel (LFTVs), usually owned by Hong Kong importer. Fish in plastic bags are commonly for airfreight transportation. They are placed about 4-5 kg per bag in a 4 layers plastic bag followed by a final packing into styrofoam boxes or simply into cardboard boxes.

Typically the practice of production for live fish market will not see drastic scale up of the production in near future as expected by government which was stipulated in NAP3. Foremost it is constraint by seasonal demand and secondly dilemma to suit the changing demands of market which need multi species of production. On set to that the industry is vulnerable to supply of seed and space to expend the operation. Disregard the result of

ever changing species and seasonal in demand, seed is still a major constraint in development of traditional fish such as seabass. While practically the number of supplier is enough, most of them however practicing pond-based production system which adversely vulnerable to infection and poor survival hence quality delivered to farmers. Due to seasonal demand and multi species fish culture operation in nature also effect seed supply. Seed producer is in dilemma to upgrade their system. On space of culture, there seem to be little can be done as area is restricted and is further vulnerable to carrying capacity and increasing coastal water pollution problem. Unless deep sea cage or land-based system is employed the future direction of this industry is limited.

2.4.3 Molusk

By large production from cockle cultivation, green mussel and oyster are sold at local market through middlemen. The retail price of a kg of cockle is RM1.50-2.00. Raw mussel usually has retail price of about RM 5.00. The dried form may fetch a retail price of about RM12-15. In volume fresh oyster is still small and mostly sent direct to seafood restaurant or hotel. A piece of fresh mussel may fetch a ex-farm price of RM 1-3. Typically a nature given commodity, harvest from cockle cultivation depend largely on availability of suitable mudflat area and environmental free pollution zone. Future plan to expand the cockle, mussel and oyster culture may look into constrain in the aspect of seed supply, effect of harm full algal bloom and food safety issues. The food safety issue need to address with rigorous environmental monitoring and quality controls.

2.4.4 Seaweed

Singularly a Sabah product, main commercial species culture is *Eucheuma. cottonii*. Environmental conditions around the Sabah coastline are generally favorable for culture of the species. Many of the operator there are Fillipino ancestry. Seaweed is sold as dried item. It take approximately 9 kg of seaweed to produce a kg of its dried form. Seaweed culture is low capital investment and has a fast turn over. In general according to report by DoF seaweed production still profitable from steady production volume recorded of recent (DoF, 2004a). Seaweed from Sabah is mainly for export market mainly to Denmark . Its dried form is sold directly to exporter without using any middlemen.

Usually the later assists farmers by providing its aquaculture facilities hence an obligation to sell the product back. The price for a kg of dried form is about RM1.50. Of late however not many people wanted to get involve in the culture of seaweed because of better opportunities in other sectors. Beside price incentive, commercial production of it is quiet risky as the price is generally fluctuates and harvest largely depend on good sun-drying condition. In addition future expend need to take into consideration of conflict with trees passing of fishing boats and promotion of tourism industry.

3 Livehood Opportunities Related To Mariculture Development

3.1 Information On Coastal Communities

Majority of the coastal communities earned a living from activity related to fisheries. The most common occupation is as fisherman. Other economically important activities include small scale aquaculture and food processing related to fish products. As fishermen, majority still dominate the traditional fishing sector. Unofficial estimate put a figure of about 10 percent from total of more than 80,000 fishermen fall into poor category or below poverty level (RM 529 per month) (Table 3.1). This category of people mostly are employer which work in commercial fishing boats or as helper in traditional fishing boats. The reason for them to remain in this part of occupation is education background. Data from reliable sources indicated that 50 percent of the coastal communities which involved in fishing industry finished their education up to only primary level. Close to 20 percent did not has any formal education or never attended school at all. Due to their economic well being about 20-25 percent do not own house.

Table 3.1 : Income of various categories and level of fishermen

Category	Owner	skipper	workers	Divers
Comercial	3,326.27	1,631.54	507.41	1,118.27
Traditional	816.15	623.17	417.47	266.25

3.2 The Role of Mariculture In Poverty Reduction

The implementation of commercial scale aquaculture projects in coastal areas has good potential to contribute to food production and poverty alleviation to coastal communities beside earning income to producers and generate foreign exchange earning to the country The activities can create employment to the communities and hopefully with much better take home and a less risk job to that as fishermen. Beside, the infrastructure such as electricity supply and communication and road access will spur up related economic activities which finally has a direct impact to coastal communities. As envisaged by government if the aquaculture production as targeted is fulfilled to maximum there is a possibility that the percentage of population fall into poverty level will drop drastically within few years from now (Table 3.2) and may be eradicated totally by end of 2009 or before the final date of Ninth Malaysian Plan (RM9).

Table 3.2 : Annual increment projection in aquaculture and poverty reduction in coastal Fishermen

Suibject	2004	2005	2006	2007	2008	2009	2010
Aqua prod'n (mtons)	200	200	300	400	500	600	600
Below poverty level (%)	20	15	10	5	2	0	0

4 Existing and Potential Mechanisms for Technology Transfer

4.1 Identify Training Centres of Excellence

Presently DoF has two training centres to cater for marine aquaculture related activities (DoF, 2006). Another such centre will be built within 1-2 year with specialization in brackish water grow out. Beside cater for local requirement both the centres also train overseas participants, mainly those under Malaysia Technical Cooperation Programme (MTCP) which was established for aquaculture since 1989. One of the centre situated north of peninsular Malaysia is Institute of Marine Aquaculture (IAM), kg Pulau Sayak, Kedah which was operated in the year 1987. Among the courses offered at the center are marine finfish seed production, finfish aquaculture in cages, marine shrimp seed and grow out program, seed and grow out production of oyster and as mussel and feed

formulation for farm practice (DoF, 2006). The second training centre for marine aquaculture in Malaysia is Marine Finfish Production and Research Centre (MFPRC) Tanjung Demong, Besut, Terangganu located at the east coast of peninsular. At MFPRC courses offered are marine finfish fry production and cage culture operation.

4.2 Existing and Propose Alternative for Technology Transfer Mechanism

In making a concerted bid to develop the aquaculture into a major industry by 2010 government of Malaysia through DoF had put emphasized on acquisition of technology through research and development (R&D) and by mean of training mechanism to acquire and transfer that technologies.

4.2.1 Technology Acquisition Through R & D

Realizing that private sectors play a critical role to spur development in this sector but yet they may not keen to invest in research due to long term result government hence practice a joint project. The area that is most looking for is in quality seed production, an example is in production of SPF broodstock. Beside government too will provide high grade broodstock to farmers as a mean to initiate them to produce high quality seed. To facilitate research in such area government will develop her staff capability and skill in area such as biotechnology, genetic engineering, breeding and disease. At the same time outsourcing mechanism may be adapted as to bring in knowledge from outside.

4.2.2 Training As Mechanism of TOT

Since sometimes it was an obligation on the part of DoF to provide knowledge and technology to aquaculturist and aquaculturist to be. With an increase demand from the industry and to fulfill manpower requirement for development available facilities are being upgraded and those new one will be built to increase the number so enable more participant enrollment and access to knowledge. On side to that syllabus is improved and personnel upgrade. Latest development in this aspect, DoF alongside with National Vocational Training Authority (MLVK) lunched training school to produce qualified skill manpower in various field of aquaculture.

4.3 Present Training Activities and Likely Future Requirement

Currently DOF is officially conducting 8 training programs in brackish water/marine aquaculture as listed in Table 4.1 in two of her training station specialize in brackish water/marine sector. Include in the syllabus of these training programme are subject as disease diagnosis and water quality management. In near future no doubt additional programme need to be included. Area that most likely to be likely included is finfish broodstock management and spawning, and management and application of recirculating system.

Table 4.1 : Training program in marine aquaculture conducted by DoF in 2005

	Title of the training program	Duration (days)	Intake per year (head)
1.	Fundamental aquaculture practice	7	20
2.	Seed production and management of marine finfish	30	15
3.	Cage culture of brackish water finfish	5	15
4.	Seed production and management of marine shrimp	20	20
5.	Culture and management of marine shrimp in pond	12	20
6.	Feed formulation and preparation at farm scale	3	20
7.	Seed production and culture of oyster	30	20
8.	Seed production and culture of mussel	14	20
9.	Giant fresh water prawn seed production	30	20

5 Existing Major Mariculture Species and Farming Technologies

As for sometimes, mariculture activities in Malaysia constitute of products from five major commodities. The commodities are finfish, shrimp, cockle, molask and seaweed. In term of volume cockle stay put as the highest quantity of aquaculture product. In year 2004, its production was closed to 64.56 million metric tones. The next highest

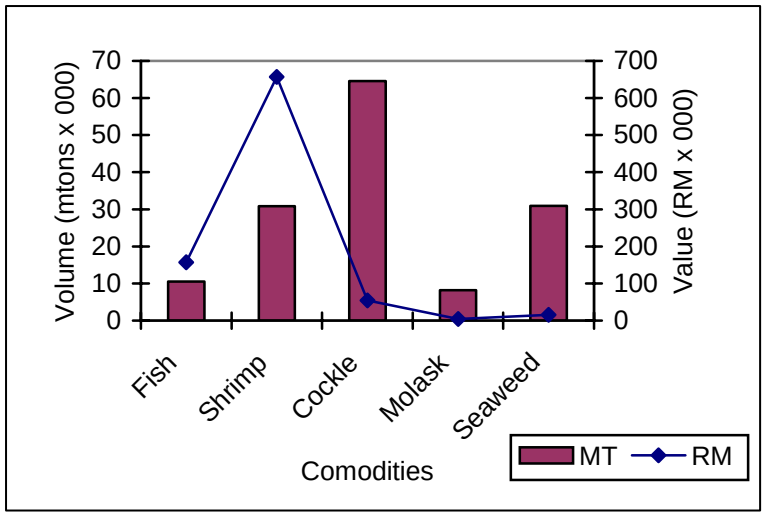

Fig 5.0 : Quantity and value from mariculture production based on commodities in year 2004

production was from seaweed cultivation which a production of 30.96 metric tons. This was followed by shrimp production which contributed 30.84 million metric tones.. During the same period finfish culture brought in about 10.51 million metric tones of fish and harvest from molask culture was 8.17 million metric tones. Despite the volume, income generated from sale of cockle production was only third on the line or RM 54.2 millions. In general, shrimp production continue to dominate the income earning in aquaculture. In year 2004 this was recorded at RM 656.5 millions. The second most income was from finfish culture trading. During the same year this was recorded at RM 157.48 millions. Each of seaweed and molask generated an income of RM 15.48 and RM 4.60 million respectively in year 2004.

5.1 Status of Farming of Selected Species

5.1.1 Marine Shrimp

a. Species of Interest

The sea around Malaysia is a habitat of more than 15 species which are classified as commercial. Of these, five are of very high export value and form the back bone of sea food trading in the country. These are the black tiger shrimp *Penaeus monodon*, the

banana shrimp *P. merguiensis/indicus*, the flower shrimp *P. semisulcatus* and the greasy back shrimp, *Metapenaeus ensis.* Despite having varieties, only *P. monodon* is cultured at commercial scale ever since. Apparently, however the popularity of black tiger shrimp *P. monodon* is slowly taken over by the Hawaian white shrimp *Penaeus vanamei*. The illegal introduction of the species was recorded since year 2000. Despite being a prohibited species, illegal production during year 2003 to 2005 was estimated between 5000 to 7000 metric tones. Considering of the yet unsolved disease problem in black tiger shrimp, government finally took a stand to legalize its culture effective as April 2004. Nevertheless, in a step to contain disease transmission there is still a control on fry and brood stock entry into the country.

As happening to many traditional *P. monodon* producing countries, in the coming years will see a transitional period. *P. vanamei* is expected to take over the leading role in shrimp aquaculture industry if there is yet anything come out toward revitalizing the later species culture operation. While hoping for a better, department of Fisheries is always encourage farmers to put interest on culture of local white shrimp *P. merguiensis*. Rather not new, this local shrimp species was already being cultured at some scale prior to a shift to *P. vanamei.* The product as lived shrimp market were mainly shipped to Singapore. Beside the *P. vanamei* factor, for sometime poor interest shown toward accepting *P. merguiensis* as an aquaculture organism is due to a fact that it shows poor-growth-performance under high culture density. In long run however the problem could be solved through selective breeding program. Such practiced was proven effective in shrimp like *P. vanamei*, *P. stylistoris* and *P. chinensis* alike.

Being a great income generator government look forward to increase shrimp from aquaculture production. Under NAP3 the target set was to achieve a production of 150,000 mt (Table 5.1) before or on year 2010. Concurrent to that various contingency measures were undertaken of which the utmost is to increase culture area.

Table 5.1 : Shrimp culture status in Malaysia from 1995-2004.

Year	acrage (ha)	farmers (number)	Shrimp production (metric tones)	
			black	white
1995	2,623	1,010	6,779	NA
1996	2,958	971	7,748	NA
1997	5,910	931	10,385	NA
2000	7151		17,231	NA
2002	7813	1150	23,987	845
2003	7011	1239	25,375	804
2004	7555	1252	25,721	5,118
2010*	30,000			150,000

* projected figure based on NAP3 (1998-2010)

With the scale of production to achieve, estimate put a total of 30,000 ha pond area is needed. This mean a four foul increase in area compare to present one (Table 5.1). Though the set target need to take a longer time due to reason to land matters, diseases, market issues and regulation plus the ever increasing production from labour-extensive countries the set target partly will be achieved if a very drastic and holistic action is implemented.

b. Fry Production

Presently there are about 50-60 number of fry production centres which supply the seed to growout farmers. Though were mend for production of *P. monodon* but lately majority of them shift to production of *P. vanamei*. Till sometime in year 2005 three hatcheries facilities were granted permit to import SPF *P. vanamei* broodstock. On the government side, there is National Prawn Fry Research and Production Centre (NAPFRE), a training and research facilities for marine shrimp. There is also one fully biosecure hatchery system with capable of production clean/SPF *P. monodon* fries. Include also 2-3 other with 'partially' biosecure system belong to well establish aquaculture companies such as CP and Grobest which are still adhere to production of *P. monodon*. Overall, there was rather a static development in this sector of late at small scale level. Among other this is

attributed to inconsistent demand, strict quality requirement of fry and the demand for warranty after some period in pond. System wise, most of the hatcheries are indoors type and capable to produce 20-30 million seeds per year. Beside chlorination as a mean to treat water it is also a common thing to see local hatcheries system equipped with extra gadget such as UV or ozone facilities. Besides, there is also a trend toward application of biotechnology products such as probotic bacteria, bioremediation and enzyme. Due to space and limitation most hatcheries apply a single tank system to complete the fry production cycle. Only those few establish one have a separate larval and nursery tanks for that purpose.

With regard to *P. monodon,* currently local supply of the brood stock are still sufficient. In fact following the interest on *P. vanamei* saw the demand on *P. monodon* dropped drastically from time to time. In term of volume and quality stock from east of Malysia mainly from Sabah waters is sort after. Once, those from strait of Malacca was good enough but lately majority of the stock are found to be carrier of harm full pathogens. As a biosecurity approach it is already become a practice for spawners to be screened for MBV, WSSV and TSV pathogens. Except small scale operators which do direct spawning or purchase only nauplii larval stage the procedure may not be adhered so strictly. There are few wild spawners collecting centres which deliver such products to small scale operators. The price for a million nauplii of *P. monodon* is around RM 400-600 where as gravid broodstock is prized at RM200-250.00 a piece with body weight size range of 130-160 g.

c. Pond Operation

Once, shrimp pond in Malaysia is synonym with mangrove swam area. However it is slowly make way to less critical and better area such as coastal land, abandoned coconut estates or paddy field which is close to infrastructure and facilities. Water source is supplied by mean of pump or connected by canals. Commercial farms integrate reservoir and sediment ponds to cater for their operation in ensuring good quality water supply. Aside to that separate inlet and outlet drain is installed. Be it a small scale or commercial operation, by large rectangular ponds of 0.5-1.0 ha dominate the present system of

operation. The depth is usually 1.2- 1.5 m. Water exchange is make less frequent or reservoir is make as one of the accessory and facility in the farm. Pond sizes are in the range of 0.5-1.0 ha. Ponds structure and design are of several types. The most common one are earthen pond. Pond with plastic lining represent a small portion of the system. Though available, pond with concrete wall structure is slightly rare.

In a believe to sustain water quality and increase productivity, of late farmers put aside investment on various biotechnology products. Some of these are bacteria domination compound, enzyme, yeast, inert feed, simple sugar and vitamins. A common practice for tiger shrimp culture is to stock fry at PL stage 15-20 however for *P. vanamei* this is done at PL 7-10. Under present system stocking are applied at 30-40 for *P. monodon* and up to 120 for *P. vanamei*. Prior to stock in, responsible farmers will do the acclimatization and selection as a final step of to guarantee that only quality and healthy fries are stock in. Fries are delivered by mean of plastic bag. In standard plastic bag of 5-8 liters, they are packed between 500-1000 per liter. As a criteria for fry quality farmers insists on disease test and certification beside adhere to physical, microscopic observation and stress test implementation. In ensuring sufficient oxygen supply, paddle wheel of single or double blades are installed between 4 – 6 pieces per pond. Aside to that long arm paddle wheels of six to more blades are also installed at some corners to sweep and accumulate left over feed from the feeding area. In feed adjustment process feeding trays of 1 m sq. usually will be hanged between 4-6 in n umber per pond. Feeding commence with rate of 2x per day and is increased to 4 and up to 6-8 times daily upon reaching the harvesting size. During the process various type of lime is applied to stabilise water pH. Harvest usually commence upon the shrimp attained size of 30-50 pieces per kg for *P. monodon* and about 70 pieces for *P. vanamei*.

5.1.2 Marine Finfish

Despite known activity existed about the same time as that of marine shrimp aquaculture practice, the development of marine fish in Malaysia was however slow and less dominance. One of the prominent reason is, it is over shadowed by the *P. monodon* farming activity which was once attracted all level of people as it was a fast and lucrative

source of income at that moment. Another single factor is, it is not a land-based activity hence restricted to certain small area. Being still at infant stage thus the industry still hold concept of traditional farming. Almost all of the produce come from open floating net-cages and is basically of small to medium size cage farms. As a commodity which contribute to national economic and food security government has put a target production of 120,000 metric tons to be achieved by year 2010 through aquaculture venture. Presently this amounted about 10, 500 metric tons (Table 5.2). In term of value the sale brought in about RM 158 million as income to the country, an increased about 24 percent to that of year 2002. Hence, with the target to achieve and demand for fish is increasing there is a need to change the concept of subsistence farming to commercial scale by all mean.

Table 5.2 : Production in metric tones and wholesale value in RM million of main fish species during year 2002- 2004.

Fish species	2002	2003	2004
Asian sea bass	4003.73	4210.93	4000.54
Mangrove snapper	591.44	706.56	572.97
Yellow snapper	1556.15	2351.55	2,263.33
Red snapper	989.68	1402.09	1,162.85
Grouper	1210.43	1977.33	2,283.59
Tilapia	283.97	222.07	264.42
Total (m.tones)	**8635.4**	**10,870.53**	**10,547.7**

Fish species	2002	2003	2004
Asian sea bass	46220.13	49,260.86	46,241.57
Mangrove snapper	6157.05	8415.69	7,742.36
Yellow snapper	20,188.00	32,491.55	32,771.81
Red snapper	12,951.31	18,513.27	14,687.02
Grouper	30,385.26	49,954.09	54,628.69
Tilapia	1683.98	1049.09	1,387.08
Total x 000	**117,585.73**	**159,684.55**	**157,458.53**

a. Species of Interest

In Malaysia this sector of activity started it aquaculture proper with seabass *Lates calcarifer* culture during 70's. Like other Asian countries this sector as well is characterized by the culture of a range of fish species regard as high value. The choice of which is related to availability of seed stock and the ever-changing preferences of

Table 5.3 : Species of interest in mariculture in Malaysian waters.

Commodities	Common name
Sea Bass	
Lates calcarifer	Barrahmudi, giant sea perch
Snapper	
Lutjanus lemniscatus	Yellow streaked snapper
L. argentimaculatus	Mangrove red snapper
L. johni	John's snapper
L.erythropterus	Crimpson snapper
Grouper	
Epinephelus coiodes	Orange spotted grouper
E. malabricus	Malabar grouper
E. sexfasciatus	Sixbar grouper
E. fuscoguttatus	Tiger/marbe grouper
E. leopardus	Coral trout
Cromileptes altivelis	Humpback hind
Threadfin	
Eleutheronema tetradactylum	Fourfinger threadfin
Cobia	
Rachycentron canadum	Cobia
Tilapia	Red tilapia
Pompano	
Trachinotus blochii	Golden pompano

consumers in Hong Kong to Singapore. The species also being switched when current stocks are affected by disease problems. Since the last five years number of species coming into play increase drastically following the success of breeding either locally or fries which were brought in from outside the country. Till the moment at least ten species of fish are being cultured through out the country. Leading in culture practice still is the

traditional species sea bass, *Lates calacarifer*. Next to it is the Lutjanidae which comprise of yellow streak snapper *Lutjanus lemniscatus*, mangrove snapper *L. argentimaculatus* , John's snapper *L. johni* and red snapper *L. erythropterus* (Table 5.2). The interest in grouper has led to at least six species already being introduced. Among the common one are tiger grouper *Epinephelus fuscoguttatus, Orange spotted E. coiodes* and Malabar *E. malabricus*. Other minor species are fourfinger threadfin *Eleutheronema tetradactylum*, cobia *Rachycentron canadum,* pompano Trachinotus blochii and not the least is the red tilapia.

b. Seed Production

Seed supply still a constraint in development of marine fish culture in Malaysia. Quiet a significant amount are still being imported from neighboring countries such as Indonesia, Thailand and Singapore and as far as from Taiwan. Beside seeds, eggs are also brought in. At present, local seed production centres are still too small to supply the demand especially when dealing with multi species way of fish production. More over most are still crude in approach hence does not always meet the requirement to supply good quality seed for a sustainable grow out farms. To supplement the demand, there are two typical seed production system employed. These are the tank or hatchery system and the pond-based system. Unofficial record indicated twelve land based fish hatcheries are on operation currently. Two of them are government research and training centres which on occasions distribute their produce to farmers. Each of the private hatchery has a capacity of to produce about 0.5-2.0 million fries per year. As a complete set up some of these hatcheries maintain broodstock where as the other still need to acquire eggs from outside.

To supplement further to seed requirement there are more than 50 fry production unit which adopt earthen or partially concrete ponds as their production system. Each of the unit employs 3-10 ponds of 0.1-0.5 ha on average. The operation start with hatching of eggs in hapar installed in pond or in separate tanks put closed to the pond. Few days after hatching when larvae ready to consume outside food they are released. Prior, pond are enriched with live food by mean of organic or inorganic fertilizers. Being low capital and

food-chain based, survival from this production system is on average between 1-5 percent. In fact, on occasion when natural food availability is not sufficient nothing is produced. Nevertheless however production from this sector is quiet significant. Often, each farm can produce between 0.2-1.0 million fingerling per year.

Broodstock and egg production is another part of job which is scrutinize and getting improved. Currently egg are distributed by broodstock breeders which keep the stock in floating cages. Egg production normally come out from process of natural spawning. Indirectly so the operator need to keep large number of spawners so that by chance there are few ready to release egg when needed. Upon spawning eggs are collected by net. Though wild caught spawners are preferred for egg production but due some problem or other collection are from those fish stock from normal cage production system. The price of a million egg varies from RM 500-3000.00, depend on species of fish.

5.1.3 Farm Operation and Production

The main production system for marine fish is still floating net-cages. Pond production till this moment is yet given a due consideration. Despite the volume it can produce, pond production may yet be suitable for high value fish species which demand water of higher salinity then pond located inland . Beside, pond culture is susceptible to off-flavor effect and may not be convenient as a system for live fish market. Seeing the potential, the venture into mass production using deep sea cage was initiated by government through department of Fisheries a decade ago. Since then however there was not much a development. The main reason seemed to be fish fry supply. The demand in term of number and quality is yet match. Apparently this is due result to being a multi species style of production. As of end of 2005 there were 100 units of the square type cages measuring 6m x 6 m each and a total of 21 units of round type with a diameter of 15 m each. All of these cages were harbored at Langkawi island, north of peninsular Malaysia. Beside still faces with technical problems most of the time the cages were operated under capacity.

Until a new system of fish production or cage culture technology could be introduced effectively, traditional floating cages will continue to be core marine fish production system. As of 2003 and 2004 there were a total of 1.0 million meter square of cage area, an increased about 14 percent from year 2002 (Table 5.4). These cages were run by about 1400 and 1600 operators respectively during the production year 2002 and 2003-04 (Table 5.4). Majority of the operators are small scale farmers run small (3 m x 3m) to medium size cage (6m x 6m) farms. Stocking in cages varies from 300-1000 fingerlings per cage. The culture extend 6-12 months depend on species. As for feeding, trash feed remain the major feed type and only on occasion commercial feed is supplement. It is still difficult for farmers to change to pellet for the sake of disease and environmental factor. The main reason is the cheap price of trash fish and that the supply is readily available. More to that many farmers still believe that trash fish still produce market preference fish, quality and texture.

In recent years, due to increasing intensification in production and area in cage farming used have lead to many disease problems. As a result there were regular records of mass mortality which were related to water quality and oxygen depletion. The die-hard farmers seemed take this for granted and willing to invest in new operation for the sake of fish production.

Table 5.4 : Facilities and operators involve in marine fish operation during year 2002-04.

Facilities	2002	2003	2004
Hatcheries (unit)	12	59	56
Cages (m^2)	940,948.28	1,034,664.10	1,110,221.04
Cage operator (head)	1374	1651	1623

5.1.3 Mollusk

Malaysia has a long tradition of mollusk culture. In term of quantity mollusk, of particular cockle contribute the most or about 40 percent harvest from aquaculture sector. Annually since the past three years the production from cockle was in the range of 70,000

metric tones (Table 5.5). The value from sale of cockle during year 2004 was about RM 54 millions. The total area covered for the cultivation of cockle is about 7000 ha presently and record indicated that there are about 300 operators operate the cultivation of the commodity. Mussel which come next were harvested in the range of 6000-7000 metric tones whereas oyster were produced in the range of 250-285 metric tones annually during 2002-04. Both mussel and oyster are cultured in raft and lately there are about 100-150,000 m^2 and 100,000 m^2 of area respectively for the production of the two commodities. Number of operators involved in the culture activities during the last three years were about 300-350 and 260-300 respectively for each mussel and oyster production (Table 5.5). In term of revenue both produce created income of about RM 5 million during year 2004 (Fig. 5).

Table 5.5 : Production, areas and number of operators in mollusk aquaculture during year 2002-04

Commodities	2002	2003	2004
Cockle	78,706.64	71,067.29	64,564.75
Mussel	5919.85	7,701.73	7,904.76
Oyster	285.66	256.43	260.68
Total	84,912.15	79,025.45	72,730.19

Commodities	2002		2003		2004	
	area (ha/m^2)	men	area (ha/m^2)	men	area (ha/m^2)	men
Cockle	6891.17	297	7447.06	311	6662.70	276
Mussel	82,186.09	288	109,816.75	347	156,798.71	357
Oyster	103,145.25	264	103,212.25	282	104,008.05	309
Total	192,222.51	849	220,476.06	940	267,469.46	942

5.1.4 Seaweed

Compare to other marine aquaculture products, seaweed culture is localizes in one state that is Sabah and in one area only (Anon, 2004), Semporna. Culture of the commodity

has a long tradition and since 2002 its annual production has increased around 3 million metric tones from 26 to about 31 million metric tones in 2004 despite a record of decreased in culture area, i.e. from 1900 ha to an area of about 1000 ha (Table 5.6). Apparently also there was a dropped in operator involved in the cultivation, that is from about 712 to about 392 in 2004. In term of quantity seaweed cultivation contributed the about 21 percent of the share from marine aquaculture sector. Annually since the past three years the production from this sector was in the range of 26-31,000 metric tones (Table 5.6). The value from sale of the product during year 2004 was about RM 15.48 millions.

Table 5.6 : Statistic on seaweed aquaculture 2002-04.

Sp	2002	2003	2004
Volume (mtons)	25,624.92	27,607.90	30,956.90
Acrage (ha)	1908.32	1206.25	986.02
Operator (no.)	712	605	392

5.2.1 Priorities for Development and Research

Being a sector that traditionally supplies food and continuously contribute to the national economic, aquaculture potential was lately given a special attention by government of Malaysia. The strategy and action plan to develop the sector was clearly spelled out in the Third National Agricultural Policy (NAP3 1998-2010), a long term plan for agricultural development. A volume of 600,000 metric tones was set aside for aquaculture sector to deliver by year 2010. Based on record in Annual Fisheries Report current achievement is around 202, 225 metric tones. Hence, a different of about 400,000 metric tones to achieve. With another 5 years to go, an annual production growth of about 22 percent is necessary to achieve the target. In the marine sector, two top most income generate commodities, shrimp and finfish was each set with a production of 120,00 and 150,000 metric tones respectively. Presently each of the commodity attained a production of only about 10,500 and 32,000 metric tones, a far way to achieved. While the massive

increment in production will no doubt come from increase in area under culture, most of it probably will be from intensification of existing culture practice.

5..2.1 Marine Shrimp

The major constraint in the development of traditional black tiger shrimp is disease problem. Hence research priority in scope as listed below need to be considered :

a. Production of SPF broodstock and disease free post larvae
b. Application of best management practices
c. Automation toward reducing production cost
d. Development of sustainable production system

While the long traditional shrimp species need to be scrutinize and its problem solved the importance of indigenous shrimp species such as the banana shrimp *Penaeus merguinsis* should be given a due consideration to create interest for commercial production. In a way this will create diversity of choice beside slowly get away with exotic species *P. vanamei*. To attract commercial culture of the species mean research has to go all out to solve the problem of poor-growth-performance under high density culture and to realize a culture period of 120 days, a stereotype benchmark to many shrimp farmers in Malaysia. As an action plan, research in the aspect listed below should be given due consideration.

a. Domestication and selective breeding programme
b. Development of feed for its aquaculture program
c. Develop culture technology

5.2.2 Marine Finfish

Being at pioneer stage the marine finfish industry can learn a lot from story of success and failure in shrimp industry. Foremost, seed should be of high quality and if possible a SPF standard. To pursue, domestication and selective breeding program should be in the list. Come along with the set is a biosecurity system. On the development aspect, foremost to turn into a food industry focus should be given to a specific species to be developed. Indirectly mean one cannot rely much on live fish market. Frozen fish market should be main agenda and diversify the market through value added and varieties to

increase intake by local consumer. On set to that land based production system be it in pond or tank should be a mean of production in future as environmental may no longer permit waterway to use for cage operation. Forsee the upcoming problem hence priority in research and development should be given to the list as underline below:

a. Research and Development on selected fish species
b. Development of broodstock bank
c. Research and development in domestication and selelctive breeding program.
d. Development of biosecurity fish fry production centre
e. Research and development in live food production.
f. Research and development in growout production facilities.
g. Research and development in nutrition and feed formulation.

5.3 Identification of Better Management Practices To Mitigate Environmental Impacts

As a mean to mitigate environmental impact DOF in Malaysia comes out with a guide line on Good Aquaculture Practices (GAqP). Mainly for shrimp industry at this moment (FAO, 2003), this guide line uphold the standard requires by international body such as FAO. The same guideline soon will be developed for marine finfish aquaculture activities and others. A major task by government currently is however is to ensure that the guide line is practice by culturist, of particular the down stream farmers. At this stage for that level it is still difficult to implement because a free-for-all situation already existed for a long time. Lack of institutional and legal support may jeopardize the action plan or otherwise local government has to impose rule on domestic food safety standard from aquaculture as being the requirement by many importing countries. Big scale operators however on their own initiative implement good aquaculture practice as to comply requirement for quality fish/shrimp products for export market. To be part of food producer one has to has standard and environmental friendly production protocol.

Along this line, Department of Fisheries Malaysia for the past few years introduced Farm Certification Scheme or SPLAM. The objective of SPLAM is to provide official recognition to aquaculture entrepreneurs who have practiced Good Aquaculture Practices

(GAqP) and environmental friendly concepts to ensure the safety, quality, consistency and competitiveness of the products based on the criteria, guidelines and standard determined by the Department of Fisheries Malaysia. Farmers can obtain quality certification for their products after some period of quality assessment by authorities. The benefits derived from participating in the SPLAM programme among others are to ensure the aquaculture products from the farm meet the food safety standards require by domestic and international market. Secondly is to assist and expedite the issuance of Health Certificate and Sanitary and Phytosanitary (SPS) Certificates, so that it does not solely depend on the final product testing. The third benefit is to encourage consumer acceptance of aquaculture product from local farms. Not the least is to assist the development of the aquaculture industry in a sustainable and environmentally friendly manner.

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