

**FOOD AND WEALTH
FROM THE SEAS**
Health Check for
the Marine Fisheries
of Malaysia



PROF. DATO' DR. TAI SHZEE YEW

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ABSTRACT

From the bio-economic perspectives, the state of health of the Malaysian marine fisheries is far from satisfactory. Studies have shown that almost all fish stocks are either fully or overexploited due to excessive fishing effort and fleet overcapacity applied to these stocks, resulting in the dissipation of millions Malaysian Ringgits of resource rent. Thus the marine fisheries sector is an underperforming natural asset. In order to reverse the situation and to restore the full potential of the sector that will be able to contribute to the economic growth and social development of Malaysia, marine fisheries management reform is suggested.

Fisheries reform is a complex, arduous and long process that requires political will and institutional supports. Successful fisheries management reform requires adaptively creating and continually adjusting a sound management plan or “road map”. It entails rebuilding of the depleted fish stocks through the establishment of artificial habitats such as artificial reefs and marine protected areas, the curtailment of excessive fishing effort and fishing capacity and the stamping out of the illegal fishing as well as the unregulated and unreported catches. The rebuilt fish stocks will improve productivity, increase sustainable yields, lower fishing costs, increase profitability and economic benefits. The success of fisheries reform also entails the management of the political and economic processes. It requires changing the marine tenure structure from the “common pool” that promotes competition to one such as co-management that delegates exclusive and secures user-rights to the fishers’ communities that encourages cooperation in management and responsibilities among stakeholders. The success of fisheries reform requires building consensus on common visions among stakeholders and consequently gaining their confidence as well as support for the reform agenda. These need to be based on the dissemination of

information generated from scientific research to raise awareness among leaders, stakeholders and the public of the need to undertake fisheries management reforms. Successful fisheries reform needs to safeguard social equity through transparent equitable sharing of benefits. Social equity also requires providing social safety nets and creating alternative employment and economic opportunities for affected and displaced fishers. The pernicious fishing input subsidies need to be restructured, rationalized and gradually removed as they provide the economic incentive to continue fishing even though it is unprofitable.

INTRODUCTION

More than two thousand years ago, Lao Tze, the ancient Chinese Philosopher said:

“If you give a man a fish you feed him for a day but if you teach a man to fish you feed him for life”.

Obviously at that time the quote was written, there was abundance of fish in the oceans and the fishing technologies were such that they were prohibitively costly and dangerous to fish beyond the narrow coastal strips of a nation. Thus it was believed then that the fisheries resources of the oceans were inexhaustible.

The situation is vastly different today. With increasing number of vessels equipped with modern technologies used in fishing, more and more marine fish stocks are facing the pressure of excessive exploitation. The health of the world marine fisheries resources are deteriorating. FAO (2006) has reported that globally, the proportion of overexploited, depleted or recovering fish stocks has been increasing from slightly above 50 per cent of all assessed fish stocks in the mid-1970s to about 75 per cent in 2005.

Closer to home, the state of health of the marine fisheries of Malaysia also needs scrutiny. A healthy state for the marine fisheries is desirable in order to positively contribute to the development of the Malaysian economy. The health check on the marine fisheries of Malaysia in this presentation attempts to focus on three questions:

1. Why are we concerned about the health of marine fisheries of Malaysia?
2. What is the state of health of the marine fisheries of Malaysia?
and
3. What can be done to improve the state of health of the marine fisheries of Malaysia?

CONTRIBUTIONS OF A HEALTHY MALAYSIAN MARINE FISHERIES SECTOR

Malaysia is a coastal nation. It has 4,810 km of coastline, 450,000 km² of shelf areas (200 m depth) and 418,000 km² of up to 200 nautical miles Exclusive Economic Zone (EEZ). It is obvious that the total marine aquatic area of Malaysia is larger than its land area of about 329,758 km² (FAO 2009). The aquatic environment of Malaysia is further expanded if the inland aquatic ecosystems, estimated to be 39,384 km², consisting of rivers, mangrove/peat swamps, reservoirs and mining pools, is included (Yusoff and Gopinath 1995).

With the vast aquatic area, the fisheries sector of Malaysia has made important and significant economic contributions. In Malaysia, attaining food security is one of the important agenda items in the Government Transformation Plan (GTP) and Economic Transformation Programs (ETP). For decades, fish is consumed by most ethnic groups and with a per capita consumption of 45.1 kg in 2009 (Ministry of Agriculture and Agro-based Industry Malaysia 2010), fish provides an important source of animal protein for Malaysians. The apparent fish consumption for Malaysia trended upwards between 1990 and 2010 (Figure 1) and Malaysia achieved more than 85 per cent fish self-sufficiency during this period.

The marine fishery resource is a renewable natural asset capable of growth and generating a sustainable flow of net economic benefits or wealth into the indefinite future and is “truly a gift of nature” (World Bank, 2005). The net economic returns from the natural fishery capital play two key roles in the economic development of a nation: (1) to provide for the subsistence needs of the poor coastal communities; and (2) to provide a source of development finance for investment in other forms of capital, e.g. produced and human capital (World Bank, 2005).

Fisheries resource as natural capital and wealth therefore needs to be accounted for in the computations of the Net Domestic Product (NDP) account of Malaysia in order that the nation's overall capital and economic performance can be measured correctly and accurately (Hartwick 1990, 1991; Hung, 1993, Maler, 1991, Repetto et al. 1989; Tai et al. 2000). However, only the values of landed fish are included in the Malaysian NDP account. The omission of fish wealth has important fishery policy implications for Malaysia as it provides false signals to exploit and even deplete the fish stocks to achieve rapid rates of economic growth, resulting in illusory short run income gains but permanent losses to its national wealth in the long run.

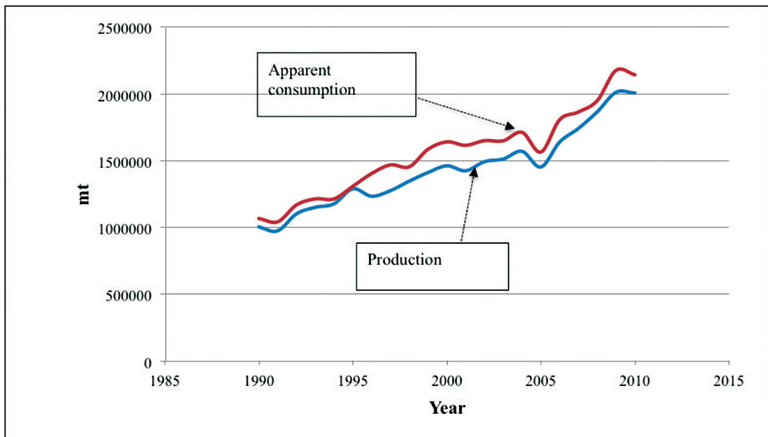


Figure 1 Fish production and apparent consumption in Malaysia, 1990-2011

Source: Department of Fisheries Malaysia, various years.

The fisheries sector contributes to the Malaysian economy in many other ways. Total fisheries landings in 2012 amounted to 1,472,240 mt, with an estimated value of RM7,982 million, together

with 377 million pieces of ornamental fish valued at RM632 million and 114 million bundles of aquatic plants valued at RM12 million (Department of Fisheries Malaysia, 2012). In 2009, the sector accounted for about 11 per cent of agricultural GDP and 1.2 per cent of the country's GDP (Department of Fisheries Malaysia, 2009). The sector provided direct employment to 136,514 fishers and 52,260 fish culturists in 2012 and the figures could be several folds higher if those indirectly involved in the sector are counted.

Malaysia is a net importer of fish and fishery products. In 2011, export value of fish and fishery products amounted to RM2,826 million while import value amounted to RM3,078 million in the same year with a negative trade balance of RM252 million (Department of Fisheries Malaysia, 2011).

The Malaysian fishery sector is highly diversified. The sector is made up of three major industries namely marine capture fishery, aquaculture and inland capture fishery. The marine capture fishery essentially involves hunting activities, has contributed significantly to total fish supplied in Malaysia. As shown in Figure 2, the marine fishery contributed more than 80 per cent of the total fish supply between 1990 and 2007. Even though the trend has been on the decline since 2007, the marine capture fishery nevertheless still contributes a substantial percentage (more than 70 per cent) of the total fish supplied in Malaysia. Aquaculture, basically involves farming activities of table fishes or ornamentals, has been growing rapidly since 2008, contributing more than 25 per cent of total Malaysian fish supplied (Figure 2). The inland capture or riverine fishery is relatively insignificant in terms of its contribution to fish supplied in Malaysia.

A healthy marine capture fishery in Malaysia is important to ensure that it will continue to contribute significantly for achieving food security and economic wealth of the country. The remainder

of this paper aims at analysing the state of health of the Malaysian marine fishery based on research evidences and to discuss ways to improve the sustainable supply of food and wealth from the Malaysian seas.

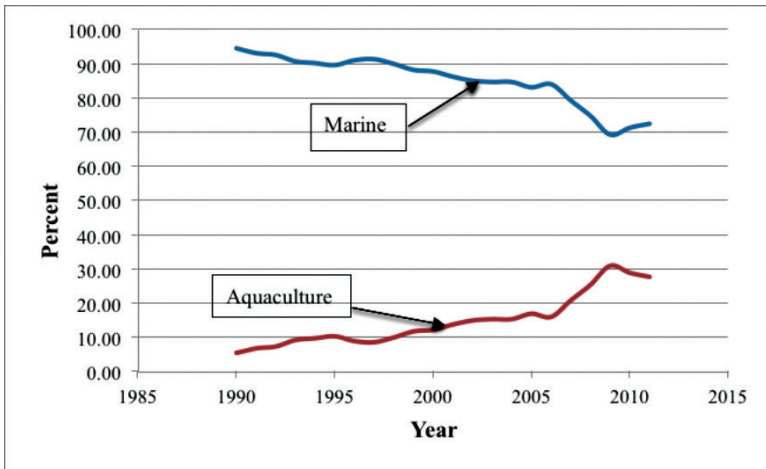


Figure 2 Percentage contributions to total fish production by the marine fishery and aquaculture, Malaysia, 1990-2011.

Source: Department of Fisheries Malaysia, various years

SALIENT FEATURES OF THE MALAYSIAN MARINE FISHERY

The marine fishery of Malaysia is a complex industry. There are multiple stakeholders, operating various sizes and types of vessels and gears, fishing in the Straits of Malacca, South China Sea and Sulu Sea. The species landed consist of demersal, pelagic, crustaceans and molluscs, with numerous individual species within each species group. The salient features of the marine fisheries of Malaysia presented below aim to provide the context for discussions in later sections.

Food Fish Supply

Food fish in Malaysia are supplied by the marine capture fishery, aquaculture and inland fishery industries. The marine fishery is the main supplier, and its total landings amounted to 1.63 mil mt in 2011, of which 84 per cent were food fish while the remainder 16 per cent were trash fish. The trend for food fish landings has been rising gradually between 1990 and 2011, although the trend has shown slight decline recently (Figure 3).

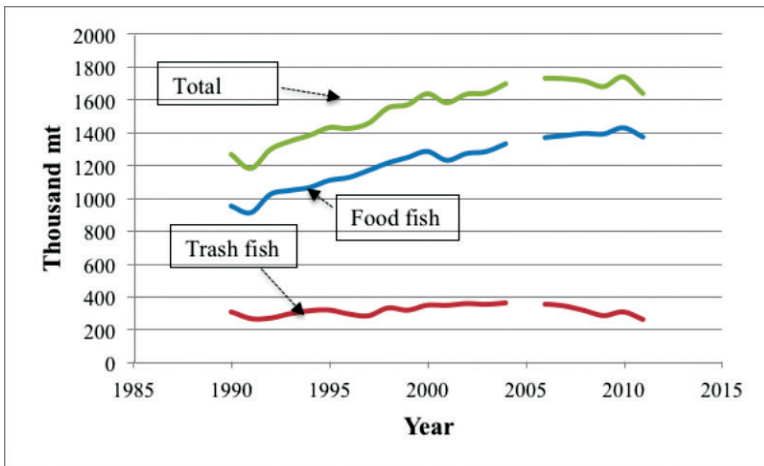


Figure 3 Marine fishery landings of food, trash and total fish in Malaysia, 1990-2011

Source: Department of Fisheries Malaysia, various years

Marine food fish landings of Malaysia comprise demersal, pelagic, crustacean and molluscs species groups. Demersal fish live and feed on or near the bottom of the sea beds. There are approximately 43 commercially important demersal species listed in the Annual Fishery Statistics of Malaysia caught by various gear types, in particular the trawlers. The major demersal fish caught

are threadfin bream (*Nemipterus* spp.), jewfish/croaker (*Pennahia* spp., *Johnius* spp. and *Otolithes* spp.), rays, goatfish (*Upeneus* spp., *Parupeneus* spp.), lizard fish (*Saurida* spp., *Trachinocephalus* spp.) and marine catfish (*Arius* spp., *Osteiogenoisus* spp.). In 2011, the demersal species landings amounted to 616 thousand mt, contributed the highest landings of food fish in Malaysia. As shown in Figure 4, its percentage contribution trend has been rather stable between 45 and 53 per cent from 1990 to 2007 but decline slightly thereafter.

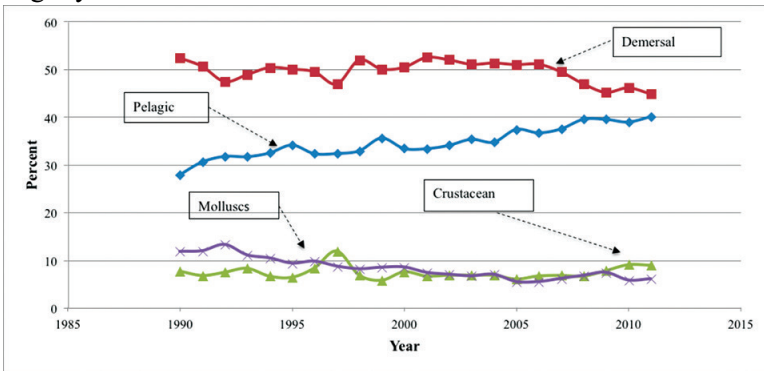


Figure 4 Percentage of marine food fish landings by species groups in Malaysia, 1990 - 2011

Source: Department of Fisheries Malaysia, various years

The pelagic fish live and feed near the surface of the ocean water and are highly migratory and trans-boundary. There are about 28 commercially important pelagic species listed in the Annual Fishery Statistics of Malaysia and they are caught mainly by purse seines, trawls and drift nets. The major pelagic species landed are Indian/short mackerels (*Rastrelliger* spp.), round scad (*Decapterus* spp.), neritic tunas, sardines (*Sardinella* spp. and *Dussumieria* spp.), hardtail scad (*Megalaspiscordyla*), ox-eye scad (*Selarboops*),

anchovies and yellow-tail scad (*Alepes* spp.) The quantity of pelagic species landed in 2011 amounted to 550 thousand mt and is the second most important species group in terms of food fish landings in Malaysia. The percentage contribution trend of the pelagic species shows slight increases between 28 and 40 per cent from 1990 to 2011 (Figure 4).

Two other important food fish species landed are crustaceans and molluscs. Crustaceans caught in Malaysia include prawns, crabs, lobsters, crayfish and shrimp while molluscs includes squid, octopuses, and cuttlefish. The landing trends for these species groups were quite stable and accounted for about 10 per cent of total food fish landings in Malaysia between 1990 and 2011 (Figure 4). In 2011, total landings for crustaceans and molluscs were respectively 123 thousand mt and 83 thousand mt.

Fishing Fleet and Fishing Capacity

FAO (2000) defined fishing capacity as “*the amount of fishing effort that can be produced in a given time by a fishing vessel, or fleet under full utilization for a given fishery resource condition*”. Fishing effort is a composite indicator of fishing inputs such as the number, type and power of fishing vessels, the navigation and fish finding equipment on-board vessels, the number and type of fishing gear, as well as the skill and experience of the skipper and fishing crew. The size of the fishing fleet and the type of fishing gear are the primary factors determining the fishing effort.

The marine fishery in Malaysia can be characterized as a multi-gear fishery, consisting of numerous stakeholders operating various types of gear. These gears can be categorized as commercial gears such as trawl net, purse seine net and drift/gill net, and traditional gears such as lift net, hook and line, stationary and portable traps, push/scoop net, bag net, as well as barrier net. In 2011, there

were 51,892 licensed fishing vessels in operation, of which the majority (about 80%) used commercial gears. The number of vessels using drift net is the highest and its trend is increasing since 2005 (Figure 5). Trawl net is the next numerous gears used and its trend had shown slight increase from 1990 to 2000 but had declined slightly since then. The percentage of traditional gear to total gear in operation trended steadily from 1990 to 2000 and has increased slightly thereafter. In terms of number, purse seine net had the lowest percentage to total gear in operation and its trend was quite stable between 1990 and 2011 (Figure 5).

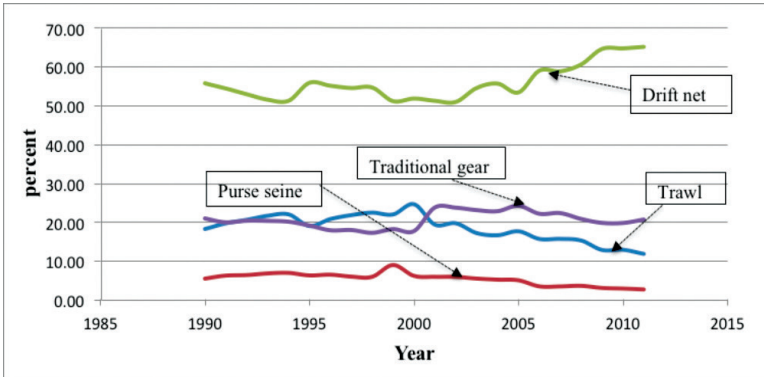


Figure 5 Per cent of number of fishing gear in operation by gear types in Malaysia, 1990-2010

Source: Department of Fisheries Malaysia, various years

In Malaysia, the marine waters are usually divided into two main fishing regions, the inshore (within 30 nautical miles from the shore) and the offshore (beyond 30 nautical miles to the outer boundary of the EEZ). Fishing zones are created and fishing licenses are issued according to the vessel size and type of gear used for their fishing operation in these zones. Zone A (0-5 nautical miles) is reserved for owner-operated traditional gears. Owner operated vessels of less

than 40 Gross Registered Tonnage (GRT) operating commercial gears are allowed in Zone B (5-12 nm). Larger Malaysian owned vessels (between 40 and 70 GRT) operating commercial gears are allowed in Zone C1 (12-30 nm). Vessels larger than 70 GRT, including foreign owned, joint ventured or chartered, are only allowed in Zone C2 beyond the 30 mile limit.

MODELLING OF THE MARINE FISHERIES SYSTEM

In order to diagnose the health of the marine fisheries in Malaysia, models have to be developed since fish cannot be seen prior to capture and except for demersal fish, they are mobile. Moreover, there are species interactions and the effects of environmental and economic shocks that are unobservable.

In general, a model is a representation of a real entity such as an object, system or idea (Shannon, 1975, p4). The typologies generally used for a model include physical or iconic, abstract or symbolic, static or dynamic, deterministic or stochastic, discrete or continuous, analytical or simulation models. According to Shannon (1975, p7), a model is developed for descriptive and/or prescriptive purposes. The former is associated with the need to understand while the latter is with the need to predict certain behavioural aspects of the real entity. Obviously to make good predictions we need to understand the real entity well. According to Walters (1986), many public policies have utilised models for predictive purposes because public policy almost always involves making choices and a choice is always based on some kind of inference or prediction about alternative outcomes. In the predictive use of models, experiments can be conducted based on models because the real entity may not yet be in existence (for example, the development of new designs) or experiments on the real entity may be too costly or just impossible

(for example, the effect of reducing fishing effort by 50 per cent). In addition, models are useful in enhancing our understanding of the real entity and communicating it to others. The need to model may also help to crystallize our thoughts by focusing on the more important aspects of the real entity and their specific relationships to each other.

In this section, the important components and their interactions of the marine fishery system will be described. This is followed by the presentation of the model used to diagnose the health of the Malaysian marine fishery.

The Marine Fisheries System

The marine fishery is a complex system. The analysis of the system requires the understanding of biological, economic, social, political, institutional and environmental components. It is recognized in the literature that the biological, socioeconomic and industry components are cores to the analysis of the marine fishery system. As shown in Figure 6, the biological component describes the fish population dynamics whereby changes in the biomass of the fish stocks are determined by the recruitment, growth of individual fish and natural and fishing mortalities. The industry component describes the supply of fishing effort which is a composite input comprises a combination of myriad inputs used in catching fish. The socioeconomic component describes the prices, revenues and costs of harvesting the fish stock. The three components are interconnected by various interfacing variables: fish catch connects the biological and socioeconomic components, fishing effort connects the industry and biological component and socioeconomic indicators such as price, rent, profit, employment, income and consumer's surplus connect the socioeconomic and industry components.

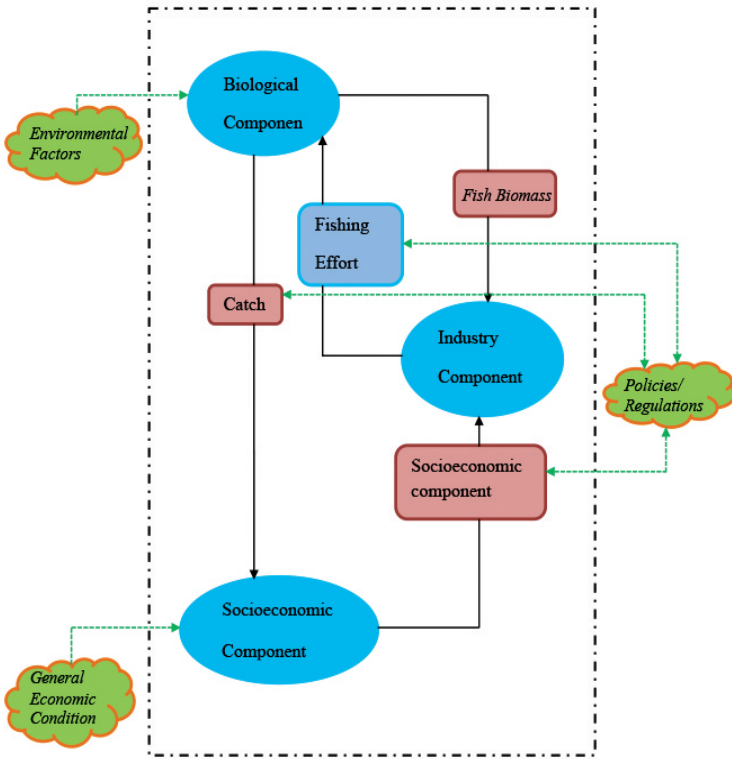


Figure 6 A Simplified Structure of the Marine Fisheries System Model

The Bio-Economic Model of Marine Fishery

Over the last several decades, researches have been conducted to model the biological and economic components of the marine fishery system (Bjørndal et al. 2004). For fish biological modelling, the influential contributions include the Schaefer's surplus production model (1957), Ricker's fish stock and recruitment model (1975), Beverton and Holt's discrete dynamic pool model (1957),

Gulland's model on fish stock assessment and stock population dynamics (1983), Mangel's mathematical stock assessments (1985), Holling's ecosystem modelling approach (1965), and Pauly's multispecies trophic level models (2000). For economic modelling of fishery, Gordon (1954) and Scott (1955) were the pioneers to develop the basic static bio-economic fishery model. Since then, systems modelling have been used to analyse the management of fisheries through the application of a system approach to decision making. The fishery systems modelling approaches include: (1) mathematical programming and optimisation (for example, Rothschild, 1986; Clark, 1985; Clark and Kirkwood, 1986; Clark and Munro (1975), Ludwig and Walters, 1982; Mangel, 1985; Clark et al. 1979; Boyce, 1995; Charles, 1983; Larkin and Sylvia 1999; and Onal et al. 1991); (2) statistical analysis and estimation procedure (Schnute, 1985; Pope, 1972; and Clarke, Yoshimoto and Pooley, 1992); (3) computer simulation (Mercer, 1982; Hilborn and Walters, 1992; Tai, 1992; and Tai and Heaps, 1996); and (4) decision theory (Walters, 1986, Opaluch and Bocksteal, 1984; Lane, 1989; and Bjørndal et al. 2000).

The analyses of the health of the marine fishery sector in Malaysia used the static bio-economic model as shown in Figure 7 for two main reasons: (1) many ecological processes of the multi-species tropical fisheries, such as those of Malaysia, are complex and are still poorly understood, and (2) lack of adequate data or sparsely available data precludes more detailed specifications of the fishery system. A brief description of the static bio-economic model will be presented in the following section.

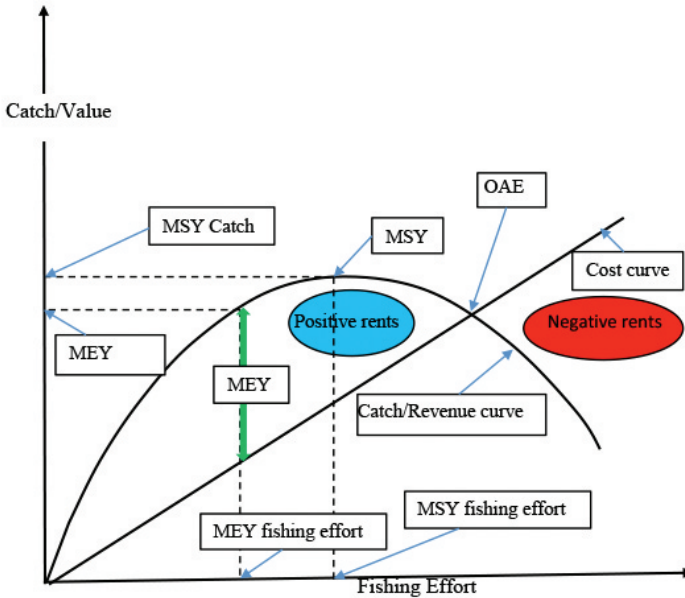


Figure 7 The Bio-Economic Model of Marine Fisheries

Source: Adapted from World Bank and FAO, 2009

The bio-economic model shown in Figure 7 is a simplified model as it glosses over several abstractions from the real world. Specifically, the model assumes a single fish stock with an aggregate biomass growth function without giving details regarding the recruitments, intrinsic growth, and natural as well as fishing mortalities of each species in a multi-species tropical fishery of Malaysia. Second, the multi-gears, multi-vessels and all other inputs used in fish harvesting have been condensed into a single composite input called fishing effort. Third, many environmental and economic factors such as climate, salinity, pollution, water temperature, fish prices, fishing costs, interest rates and level of

employment are all treated as exogenous in the model. Treating the diverse multi-species and multi-gear tropical fisheries as a single aggregate fishery model reduces data requirements and allows the number of model parameters estimation to be manageable.

The Sustainable Revenue Curve

The bio-economic model in Figure 7 posits an aggregate long-run harvesting function that relates catch to fishing effort and fish biomass. The population dynamics of the exploitable biomass can be modelled through the logistic or Gompertz function (as shown in Figure 8) by using the catch and effort data since detailed information on the biological parameters for the marine fisheries of Malaysia are sparse and mostly unavailable. The logistic relationship such as the Schaefer (Schaefer, 1957) or Schnute (Schnute, 1977) assumes a symmetrical curve implying stock collapses at high level of effort. On the other hand, the Gompertz function such as Fox (Fox, 1970) or CY&P (Clarke, Yoshimoto, and Pooley, 1992) assumes that catch declines non-proportionately as fishing effort increases. This implies that the stock is more resilient and the fishery does not collapse even at very high levels of fishing effort. Multiplying the sustainable harvesting function with the 'average price' of all fish species landed yield the sustainable total revenue function.

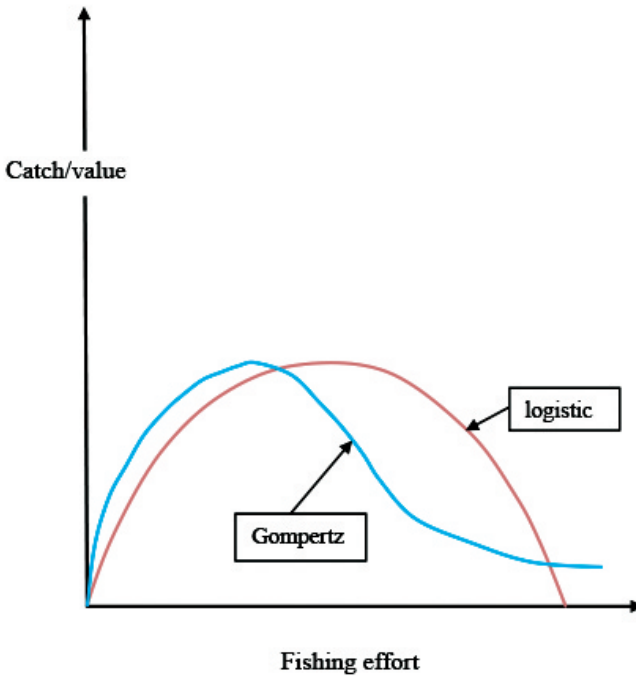


Figure 8 The logistic and Gompertz catch-effort curves

Source: Adapted from World Bank and FAO, 2009

Fishing Effort and Costs

Fishing effort is a composite index of a multitude of fishing inputs used by the fishing industry. These inputs include the number, tonnage and engine power of fishing vessels, the type and number of fishing gear, the navigation and fish finding equipment, the number of crews as well as the experience and the skill of the skipper and fishing crew and the duration of fishing. In biological terms, fishing effort equates fishing mortality. In a multi-gear fishery, the combination of these inputs imposed differential fishing mortality on the fish stocks. For example, a hook and line vessel is obviously

different in terms of fishing power compared to a trawler. The fishing power of trawlers is increasing over the years as vessels are equipped with more sophisticated and technologically more efficient equipment over time. Thus there is a need to convert the fishing effort of various types of vessels and gears to standardized units such as standardized vessel or standardized fishing days (Tai, 1992, Tai and Heaps, 1996). The standardized effort is then used in the estimation of the catch-effort relationships.

The model also includes an aggregate cost function that relates fish harvesting costs as a constant proportion of fishing effort. Fishing costs comprise capital, labour, operating and opportunity costs. The depreciation cost of fishing vessels, equipment, gear and fish aggregating devices constitutes capital cost. Labour costs include remunerations to skipper and crew members. Fuel cost (inclusive of fuel subsidy) is a major cost item, constituting about 45 per cent of the total operating costs (Md. Ferdous, 1990). The opportunity cost of fishing represents the normal returns to the owner or manager of the fishing vessel.

Resource Rent or Profit

Whenever total revenue is greater than total fishing cost, 'supernormal' profit or positive rent (which measures the benefits accruable to the fish capital stock) will be generated. Different levels of rent will be generated for different fisheries. For example, a fishery that catches high-value species closer to coastal waters, the costs of harvesting will be low and the fishery can generate high rent. On the other hand, resource rent will be much lower or even negative for a fishery that catches low-value species in distant waters far from the coast.

The levels of harvest and rent will depend on the levels of fishing effort being applied to the fish stock. In an unregulated fishery where

there is free entry or exit of fishing effort, harvests will continue to an effort level until total revenues just equilibrate total costs. This is the open access equilibrium (OAE) where resource rent that could be potentially generated is completely dissipated. This level of effort is socially and economically inefficient because effort is too high and typically the level of catch will be much lower than the biological maximum sustainable catch (MSY) of the fishery stock. From an economic perspective, maximum economic yield (MEY) where fishery rent is maximized when the marginal revenue equals marginal cost. In principle, a fully exploited fishery is the situation where additional fishing effort is not able to increase catch, while overexploitation refers to the level of fishing effort such that the fish stock is not able to replenish itself. Thus the levels of fishing effort above the MSY point constitute biological overfishing (or biologically unhealthy fish stock) while the levels of effort in excess of the MEY point are considered to be economic overfished. From Figure 7, it is obvious that fishing at the economic optimum level of effort is more resource conservation oriented since economic overfishing can exist even if fish stock itself remains biological healthy or sustainable.

INDICATORS OF HEALTH FOR THE MALAYSIAN MARINE FISHERIES

Status of Fishery Stock Exploitation

The bio-economic model discussed above has been used in numerous studies to diagnose the health and wealth of marine fisheries at the international, regional and national levels. For the Malaysian marine fisheries, several studies that applied the bio-economic model are listed in Table 1 (which may not be exhaustive). Two major results can be discerned from these studies. First, the

marine fishery of Malaysia is in an unhealthy state as almost all fish stocks have been either fully or overexploited. The current levels of effort applied to exploit the fish stocks far exceeded the bio-economic optimal levels. For the demersal fisheries, the current fishing efforts exceeded the bio-economic optimal levels from between 39% in 2000 to 78% in 1991. The percentage difference for the pelagic ranged from 2% in year 2000 to 79% in 1993, crustaceans from 11% in 2000 to 43% in 1993 and molluscs from 4% in 2000 to 88% in 1993. Abu Talib et al. (2000) examined the results from various research trawl surveys conducted over the years and concluded that the demersal fish resources in all marine waters of Malaysia have been overexploited and the level of fishing effort is beyond that needed for maximum sustainable yield. Natural fish stocks in Malaysia, in particular those of Anchovy and low value fish, have been overexploited (Tai et al., 2008). There is simply too much fishing effort in chasing too few fish.

Table 1 Comparison of Economic Optimum and Current Levels of Fishing Effort and Fishing Rent

Species group	Region	Current year	Optimal level - Current level (%)		Source
			Effort	Rent	
Demersal	NWPM	1991	-78	6572	Tai Shzee Yew, 1996
Demersal	Sabah	1993	-64	825	Tai Shzee Yew and Kusairi Mohd. Noh, 2001
Demersal	NWPM	2000	-72	127	Tai Shzee Yew, 2006
Demersal	SWPM	2000	-39	23	Tai Shzee Yew, 2006
Pelagic	Sabah	1993	-79	232	Tai Shzee Yew and Kusairi Mohd. Noh, 2001
Pelagic	NEPM	1993	-38	32	Shzee Yew, Tai, Kusairi Mohd. Noh and Nik Mustapha Raja Abdullah, 2000
Pelagic	NWPM	2000	-57	1157	Tai Shzee Yew, 2006
Pelagic	SWPM	2000	-2	1	Tai Shzee Yew, 2006
Crustacean	Sabah	1993	-43	37	Tai Shzee Yew and Kusairi Mohd. Noh, 2001
Crustacean	NWPM	2000	-11	3	Tai Shzee Yew, 2006
Crustacean	SWPM	2000	10	1	Tai Shzee Yew, 2006
Molluscs	Sabah	1993	-88	243	Tai Shzee Yew and Kusairi Mohd. Noh, 2001
Molluscs	NWPM	2000	-48	1521	Tai Shzee Yew, 2006
Molluscs	SWPM	2000	-4	14	Tai Shzee Yew, 2006

Second, it is noted that the states of exploitation of fish stocks at different locations are different. For example, demersal stocks in NWPM and Sabah, pelagic stocks in WCPM and Sabah, as well as molluscs stocks in Sabah are all heavily overexploited while other

fish stocks are moderately or lightly overexploited. The uneven state of fishery exploitation among various locations and regions throughout Malaysia may imply that marine fishery management need to be tailored for each region or location in consonance with the state of the resource exploitation.

Several reasons may be offered to explain the unhealthy state of exploitation for the Malaysian marine fisheries stocks. Among others, they include overinvestment in fishing capacity which will increase fishing costs and reduce fishing efficiency; proliferation of the non-selective commercial fishing gears such as trawlers; and the encroachment of foreign fishing vessels into the Malaysian EEZ waters. It is also noted that input subsidies such as fuel subsidies or grants for new fishing vessels are given to the fishers. These subsidies reduce actual fishing costs and create perverse incentives for continued fishing even though catches are declining, leading to overfishing, fleet overcapitalization, reduced economic efficiency and dissipate resource rent.

In addition, pressure on coastal fishery resources has also been exacerbated by the rapid development of townships and industrial estates in the hinterland. Marine ecosystems are threatened when these activities that pollute and degrade critical coastal habitats, threatening sustainable yield of fish stocks besides possible modification of the resource species composition.

Pressure on fishery resources will continue to intensify and endanger many exploited stocks, including those from the deep-sea fisheries. Effective management of the sector requires curtailment of the excessive fishing capacity and stamping out the encroachment of foreign fishing vessels and illegal fishing. A precautionary approach to fisheries management needs to be promoted such as those recommended by the UN Fish Stocks Agreement and the FAO Code of Conduct for Responsible Fisheries by shifting from

single fishery stock to ecosystem based management. Obviously, such efforts require better understanding and knowledge of a wide range of environmental processes and predator-prey relationships that affect a fishery.

Resource Rent Drain

As mentioned earlier, resource rent is a measure of the benefits (or profits over and above the economic costs of fishing) generated by the fishery resource assets. As more fishers join a profitable fishery, they add to the aggregate costs of catching the limited quantity of available fish. Excessive effort and fleet overcapacity cause fishing costs to escalate and hence diminish the returns for fishing effort. As a result, the potential economic rents from the marine fishery resources are dissipated.

As shown in Table 1, the gap between optimal bio-economic and current rents for the demersal, pelagic and molluscs fisheries ranged from several millions to billions RM. If these fisheries are to be managed optimally, the potential rents that could be generated from these fisheries would be massive. It is also noted that the generation of potential rents depends on the status of the fish stocks in different locations. According to the World Bank report (2005), resource rent can provide a source of development finance for investment in other forms of capital such as produced and human capital. The dissipated rents represent permanent losses to Malaysia's wealth in the long run and indicate that the marine fishery resource is an underperforming asset.

One reason for the excessive effort, fleet overcapacity and rent drain is due to the nature of the marine fishery resources, that is, they are essentially "common property" resources where effective property rights (whether private or public) are very difficult to establish. Under the "common property" regime, there is a lack of

incentive for rational fishers to refrain from harvesting in order to rebuild the resource stocks since such resource investment action will not create any positive return to them but rather may increase the harvests of their competitors. Clark and Munro (1975) have shown that future returns from the fishery essential count for nothing as fishers in such fisheries will act as if they are applying an infinite rate of discount to these future returns. Thus the incentive structure under the “common property” regime essentially encourages fishers to mine the fishery resources, similar to the mining of a non-renewable resource.

Another incentive structure that may aggravate the problems of excess capacity and economic wastes is the provision of direct and indirect financial support by the public sector to the fisheries sector. These financial supports such as grants, concessional credit and insurance, fuel price support, vessel buy-back schemes, and fish price support (Schrank, 2003) essentially lower the costs of fishing operations, thereby enable the continuation of uneconomic fishing operations or enable fishers to maintain their previous catch or profits levels by increasing their fishing efforts. These result in greater overexploitation of the fish stocks and further erosion of potential rents attainable from the marine fisheries. While not all forms of public financial contributions and supports to the fisheries sector are harmful, Munro and Sumaila (2002) has estimated that about 50 per cent of these supports are both biologically and economically damaging.

The estimation of lost rents in the analyses does not include some other costs and benefits due to data deficiencies and the difficulties involved in collecting these data. The costs of illegal, unreported, and unregulated (IUU) catches are not included due to data deficiencies. Illegal fishing adds to existing effort but at a lower. In order to account for the economic impacts of IUU fishing, Sutinen

and Kuperan (1994) and Sumaila *et al.* (2004) argued that greater knowledge regarding the scale and the economics of IUU fishing are required. One study has quoted the Minister of Agriculture giving two sets of very wide estimates of RM4.86 million and RM 1 billion in 2002 due to illegal fishing based on more than 500 encroachments (Asia Pacific Economic Cooperation, 2008). Furthermore, the value of unreported catches for home consumption and not sold are valued at RM190 million annually (WWF Malaysia, 2009). IUU fishing essentially will undermine fishery governance structure, incur additional enforcement costs, undermine market prices for legitimate products and affect rent generation.

The public costs of fisheries management such as the costs of enforcement (monitoring, control and surveillance) activities, the generation of scientific information and advice, and the administrative costs of management have not been taken into account in the estimate of lost rents for the Malaysian marine fisheries. Kelleher (2002) has estimated that the enforcement costs constitute around 1 – 14 per cent of the fish landing values and the High Seas Task Force (2006) estimated that enforcement costs constitute more than 10 per cent of management costs and imposing a substantial burden on fisheries management processes of many jurisdictions.

The estimated fisheries rents did not take into account the economic benefits from downstream processing activities. They also did not include all ‘intangible’, non-used and existence values of the marine resources such as those from recreational fisheries, marine tourism, biodiversity, mega flora and fauna, environmental services from natural assets such as healthy reefs, ocean carbon sequestration and from reduced carbon footprint of a fleet capacity in relation to the fish stocks. Additional information and knowledge on these aspects need to be generated through scientific research.

Changes in the Composition of Landings

Another indicator of the health of the Malaysian marine fishery sector is the changes in species composition of total landings over time. Choo (1995) used data from trawl surveys of the Department of Fisheries reported that some food fish such as trevally (*Lactarius lactarius* and *Hilsa* sp.) commonly caught in Peninsular Malaysia in the 1970s had virtually disappeared in the 1990s. Changes in demersal fish composition over time had also been detected (Nuruddin, 1998 cited in Choo, 1998). Croaker (Sciaenids), commonly caught species in the 1970s had decreased in abundance in 1995. Squids, a less dominant species caught in 1970 had become the most dominant group in 1995.

Changes in species composition can also be indicated by the proportion of trash fish to total landings. This indicator has often been used to detect overfishing and/or dwindling resources. The term trash fish includes that part of the landings not fit for direct human consumption, including undersized fish of commercially important species. High proportion of trash fish in overall landings is an indication of gross overfishing (Kusairi et al., 1997) and excessive landings of juvenile fish constitutes recruitment and growth overfishing.

Figure 9 shows the percentage of trash fish to total landings in Malaysia between 1990 and 2011. In terms of quantity, trash fish contributed around 25 per cent of total fish landed in 2009. The percentage remained quite steady at about 20 per cent from 1993 to 2006. The trash fish landing trend showed a slight decline from 2007 to 2011 to about 16 per cent. Trawl gear, due to its non-selective nature, has contributed substantially to the trash fish landings in Malaysia. So far, changes in species composition over time in various ecosystems are generally not well studied. Research

to address the above concern and the management options available are extremely limited and superficial.

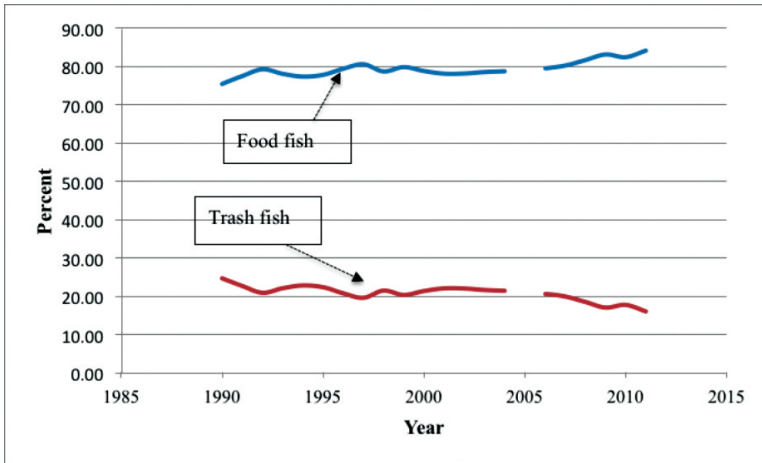


Figure 9 Percentage of food and trash to total fish landings in Malaysia, 1990-2011

Source: Department of Fisheries Malaysia, various years

Fish Price Increases

Fish price is determined by the interplay of the forces of supply and demand. Increase in the price of fish grossly indicates the unhealthy state of the marine fishery sector as supply is inadequate to meet the demand for fish. Ishak et al. (2004) reported that fish consumption and demand in Malaysia is projected to increase due to the increase in population and household income, but with limited supplies available, domestic fish prices have increased substantially in recent years, although part of the price increases can be attributed to inflation. This has been supported by the price trend shown in Figure 10. Prices for all grades of finfish and molluscs have risen since 2006, except for crustacean or prawn where their

prices are determined in the export markets. Fish price increases, especially for grade 3 fish may undermine the attainment of food security objective, in particular for the low income group as they tend to demand lower value fish and fish products. For example, a few decades ago, prices of anchovy were low and the fish was consumed mainly by low income consumers. However, the price of anchovy has increased many folds in recent years and is beyond the affordability of the low income households.

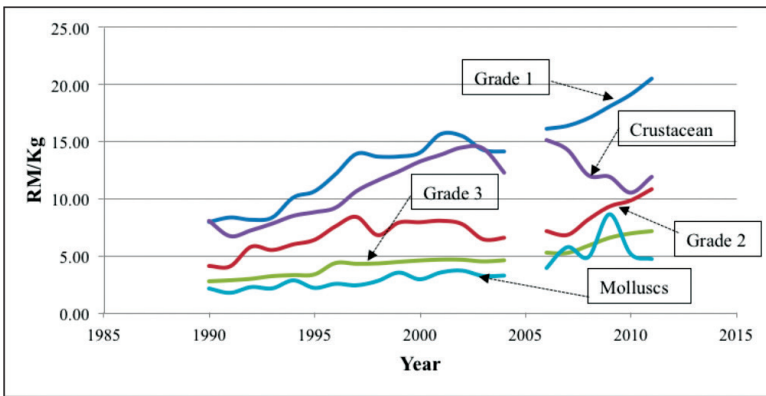


Figure 10 Retail price trend of fish by grade and species group in Malaysia, 1990-2010

Source: Department of Fisheries Malaysia, various years

THE WAY FORWARD

From the bio-economic perspectives, the state of health of the marine fisheries sector in Malaysia is far from satisfactory with overexploitation of almost every fish stock, high overcapacity of the fishing fleets, large dissipation of rent or natural wealth of the nation, high though stable landings of trash fish and increasing harvesting costs that leads to increasing inputs subsidies even though fish prices have trended upwards. If the sector's present situation persists into

the future, the Malaysian marine fisheries sector may not be able to contribute significantly in achieving the objectives of attaining food security and increasing the economic wealth of the country.

Marine fisheries resources in Malaysia are public properties and the Malaysian Government is entrusted with the stewardship of these national assets. Thus, it is the responsibility of the Malaysian Government to ensure that these assets are managed and used productively and sustainably, both for current and future generations. The depletion of the nation's fish stocks constitutes a loss of the wealth. Concerted national actions are required to restore and rebuild fish health and wealth. These actions are further supported by the facts that fuel and food prices have risen, pressures from climate change require greater fish stock resilience, as well as the undesired carbon footprint have increased for some fisheries. The national wealth hemorrhage needs to be stopped and reversed by stepping up efforts in pursuing management reform so that the sector can be transformed in accordance to the guidelines proposed by the FAO Code of Conduct for Responsible Fisheries (Tai Shzee Yew, et al.,2008). However, it is not the intention of this paper to prescribe detailed, concrete management plans. Rather, some general principles, considerations, issues and challenges for the management reform and transformation of the Malaysian marine fisheries sector will be set forth below.

Rebuilding Fish Stocks

Pressure on fishery resources will continue to intensify and endangering many exploited stocks, including those from the deep-sea fisheries. There is enormous potential to rebuild fish stocks and increase the net benefits or wealth that Malaysia could derive from its marine fisheries resources. Rebuilding of fish stocks involves creating spawning areas, nursery habitats, productive

surface areas, and sites for the aggregation of filter-feeding benthic species, demersal, semi-pelagic and pelagic fishes. In Malaysia, these areas are created by establishing artificial reefs and marine protected areas.

Construction and Management of Artificial Reefs

Artificial reef, an artificial habitat consists of any man-made structure placed in the water body. It provides additional critical habitat that increases the environmental carrying capacity of the water body and subsequently the abundance and biomass of marine resources (Polovina, 1990, Bortone et al., 1994). Artificial reef potentially provides (1) the substrata for benthic fauna and thus additional food and increased feeding efficiency; (2) shelter from predation or tidal currents (Spanier, 1996); (3) a recruitment habitat for individuals that would otherwise be lost from the population; and (4) a reduction of harvesting pressure on natural reefs (Harmelin and Bellan-Santini, 1996). In Malaysia, artificial reefs are also used as an effective tool to prevent the encroachment of trawlers, reduce conflict between commercial and traditional fishers and increase the opportunities for small-scale fishers to improve their income from fishing (Jothy, 1982).

Even though artificial reefs have been proposed as a tool for the rebuilding and enhancement of fish stocks, there have been debates regarding whether they really enhance fish stocks or are merely act as fish aggregating devices (Bohnsack, 1989). For the latter, artificial reefs may not be a solution to overfishing if fishing effort and fleet overcapacity are not curtailed. On the contrary, it will exacerbate the overfishing and stock depletion problems since it is now easier to catch fish when they congregate around the artificial reefs. Results are mixed from research conducted on the role of artificial reefs for stock enhancement (Saharuddin et al.,

2011). More research need to be conducted to ascertain the stock enhancement impact of artificial reefs.

Artificial reefs have been constructed in the Malaysian fisheries waters since 1975 using various materials such as discarded tires, derelict and confiscated fishing vessels, reinforced concrete, Polyvinyl Chloride (PVC), fiberglass reinforce concrete (FRC), fiberglass, ceramic, combination of several materials (reef balls) as well as abandoned oil platform (Saharuddin, et al., 2011). These reefs have been constructed with huge sum of public funds by four main government agencies namely, the Department of Fisheries Malaysia (DoFM), the Fisheries Development Authority of Malaysia (FDAM), the Malaysian Maritime Enforcement Agency (MMEA) and the Marine Park Department Malaysia (MPDM). According to Saharuddin, et al. (2011), these government agencies have differing objectives and unclear guidelines with regards to the purpose, function, material use, deployment and impact assessment of artificial reefs. The DoFM and MPDM viewed artificial reefs as fisheries enhancement and rehabilitation tools while the FDAM and MMEA treat the artificial reefs as aggregating and harvesting devices. Thus, there is a need to synchronize the functions and management of artificial reefs among the various agencies involved.

Marine Protected Areas (MPAs)

A marine protected area (MPA) is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, managed through legal or other effective means (Kelleher and Kenchington, 1992). The World Wide Fund for Nature (WWF) uses the term MPAs to describe an area designated to protect marine ecosystems, processes, habitats and species which can contribute to the restoration and replenishment of resources for social, economic

Food and Wealth from the Seas: Health Check for the Marine Fisheries of Malaysia and cultural enrichment. MPAs if manage effectively, can maintain ecosystem structure and functions, protect habitats and species, and enable sustainable use of resources.

There is a growing body of evidence on the importance of MPAs in maintaining or enhancing fisheries (Holland and Brazee, 1996). These include:

- Provision of support for fish stock management including the protection of specific life stages (such as nursery grounds),
- Protection of critical functions (feeding grounds, spawning grounds),
- Provision of spill-over of an exploited species when mature fish swim from protected areas into fishing grounds and by the movement of eggs, larvae and juveniles out of protected areas,
- Provision of dispersion centres for supply of larvae to a fishery,
- Improvement of the social-economic outcome for local communities, as MPAs benefit local fishers by protecting fish from unsustainable harvesting during spawning and vulnerable life stages, and
- Improvement of the quality of catch in nearby fisheries through catches of larger-size fish and reducing the year to year variability in catches.

Since the establishment of the Tuanku Abdul Rahman Park in Sabah, the first MPA in Malaysia in 1994, Malaysia has established 53 coral reef MPAs. There include 42 coral reef MPAs in Peninsular Malaysia established by the MPDM, eight in Sabah by the Sabah Wildlife Department and three in Sarawak by the Forest Department of Sarawak (Jabatan Taman Laut Malaysia, 2011, Irwan Isnain, 2011). These Marine Parks are protected areas of sea with a one

or two nautical miles “no-take” zone from the shore at lowest tide. Fishing is prohibited within the Parks, except for non-extractive activities (Wilkinson, 2004).

The DMPM may not be able to achieve their objective of resource conservation and fish stock enhancement due to a number of threats that have degraded the coral resources where fishes seek food and shelter (Gazi et al., 2013; Harborne et al., 2000; Tamblyn et al., 2000; Burke, 2002). These threats arise from increased tourism activities, siltation and pollution from land-based activities such as construction of tourism infrastructure, improper waste disposal, littering and run-offs from agricultural activities as well as illegal fishing (Reef Check Malaysia, 2011). In addition, there is also overlapping jurisdictions between the government agencies in MPAs management. Specifically, land matters are under the jurisdiction of the state governments while the MPDM has jurisdiction over MPAs’ water areas from the lowest tide line up to two nautical miles seaward. On top of that, the DoFM has jurisdiction pertaining to the conservation of fisheries resources. These overlapping jurisdictions may pose a major detriment to coral resources conservation and fish stock enhancement for MPAs by DoFM. The conservation of the mosaic of habitats at the seascape and landscape is very important as stressed by Gray (1997) since aquatic organisms are known to use more than one habitat at different times of their lifecycles. Thus, biodiversity conservation and marine resource enhancement in MPAs will be more effective and sustainable if there is a better understanding, and integrating as well as extending the management of the seascape habitats to include the landscape matrix of ecosystems. In addition, better coordination among various government agencies involved is required.

Fisheries Management Reform

Recall that a major ill of the marine fisheries in Malaysia is the depletion of resource rent. The root cause of the rent drain lies in the perverse incentive structure in the form of “common property” nature of marine fisheries. As such, fishers have every incentive to compete for greater share of and to mine the fishery resources by increasing fishing efforts and expanding fleet capacity (Munro, 2010). Even if the stock has been successfully rebuilt, but if it is not accompanied by a management scheme designed to prevent the emergence of excess capacity or if the incentive to “race for the fish” is not altered, the stock rebuilding effort will be pointless as resource rent will eventually be depleted. In order to halt the rent drain, measures are introduced to block the perverse incentives from fishers.

In Malaysia, the limited entry or license limitation scheme according to zones has been implemented to restrict the number of vessels allowed to fish within the designated zone. In theory, if the fleet is reduced to the size that commensurate with optimal resource rent, nothing more would be required. However, with progress in fishing technology, Tai and Heaps (1996) have shown that fishing power of vessels and fishing capacity of fleets continue to grow even if the number of vessels remains unchanged. Fishing power and fishing capacity have many components such that it is difficult and often is beyond the capabilities of resource managers to control all of them. Even if these capabilities exist, the enforcement costs are usually exorbitant. The incentive-blocking approach to resource management is therefore ineffective as vessel license holders are able to circumvent the goals of the limited entry scheme. They will compete by increasing their fishing capacities to gain a bigger share of the resources even though they are aware that such competition

will harm their mutual economic returns from the fishery. Thus the current fishery governance regime is in need of reform.

Changing the “Property Rights” Structure of the Marine Fisheries

A necessary condition for the transformation from the competitive mode to a cooperative mode of operation among fishers is to create a workable mechanism for the sharing of the economic benefits and responsibilities among the fishers. Kurien and Willmann (2009) argued that community-based fisheries management or fisheries co-management schemes can turn the fisher competition into cooperation. According to Shamsul Kabir et al. (2013), co-management approach had improved the fisheries governance in Bangladesh. Gazi and Tai (2013) have shown that the livelihoods of fishers in Bangladesh under co-management have improved either through fishing income increases or through diversification of income sources from non-fishing activities.

In order to ensure the success of fisheries co-management regime, it is essential that fisher communities, together with the government, non-governmental organizations, and other stakeholders participate at all levels of planning and implementation of the fisheries management. Enhancing and improving stakeholders' participation can be a complicated and challenging task, and the prevalence of following conditions are critical.

- Establish co-management institutions, through which the exclusive and security of user rights and access to fisheries resources are delegated to the fisher communities (Gazi et al., 2013). If the terms of the user rights are long enough and secured, fisher communities can have a considerable degree of certainty about future fisheries management policy and do not perceive the policy as being capricious. Hence, fisher

communities will have the incentive to invest in the resource by setting and enforcing local rules and regulations for the fishery. Effective enforcement of fishery regulations by fisher communities is able to ease the burden and costs of enforcement by the relevant public agencies.

- Consensus through consultation needs to be built among all stakeholders involved in fisheries co-management. A common understanding of the potential net benefits, the current level of benefits and transparency in the allocation of these benefits from marine fisheries need to be forged among stakeholders. Awareness and knowledge of the status of the fisheries stocks, their state of exploitation by the fishing industry, the political and social costs and benefits, and discussions on management alternatives and options (including transition out of fisheries) will help in forming stakeholders' consensus. Without the social consensus, problems of non-compliance (cheating) and/or free-riding (poaching) may arise. These problems may also be compounded if the number of participating fishers is large (Munro, 2009). Thus, more manageable fishery units of suitable size need to be created. Building consensus may take time and the availability of relevant information to stakeholders is essential to achieve these ends.
- Strong and continuous support and commitment of the government are needed to ensure the success of fisheries co-management. Also, experience shows that the desired outcome of co-management may be enhanced through champions who have greater command of 'social capital', a broad term encompassing norms and networks facilitating collective action (Woolcock, 1998; Burt, 2000; Narayan and Pritchett, 1997; Putnam, 1995), or require crises to catalyze the process. In addition, substantial management capacity is critical and is

demanding of the managers in co-management as stressed by Kurien and Willmann (2009). Without adequate management capacity, the cooperation may again degenerate into competition among fishers. Thus, managers in fisheries co-management must equip themselves with management knowledge and skills.

Restructuring and Rationalizing Fishing Subsidies

In Malaysia, input subsidies such as fuel subsidies and grants for new fishing vessels and gears are given to fishers. These subsidies are justified on social arguments to increase fishers profitability and hence their incomes from fishing. However, input subsidies will reduce the costs of fishing and restore profitability of the hitherto uneconomic fishing units to continue fishing. World Bank and FAO (2009) argued that input subsidies are pernicious as they foster fleet overcapacity, overfishing, reduce economic efficiency, dissipate resource rent and provide the economic incentive to continue fishing when it is unprofitable. Thus input subsidies tend to reinforce the poverty trap in the marine fishery sector and undermine the creation of surplus that could be invested in alternative development.

Input subsidies are often conceived as a short term intervention but they tend to become entrenched and resulting in high cost to society. More affluent fishers such as vessel owners will benefit more from these subsidies than the targeted poor crew members. Input subsidies often constitute a political expedient means of sidestepping the challenge of helping unprofitable and displaced fishers to seek gainful alternative economic opportunities (World Bank and FAO, 2009).

The perverse incentives created by fishing input subsidies imply that they need to be restructured, rationalized and eventually removed. However, since abrupt and immediate removal of input subsidies may result in social disruptions, their removal should be

implemented gradually by following a scheduled pathway based on consensus after consultation with the stakeholders involved. During the transition period to their complete removal and the return of healthy fisheries, there will be reduction in fishing effort and fleet capacity, resulting in displaced fishers. From the social equity perspective, helps need to be extended by the government to create gainful alternative economic opportunities (including involvement in aquaculture) and to establish social safety nets for these affected fishers. Public funds will be used to finance these costs but some of these costs can be recovered later through charges on the remaining fishers when the health of the fisheries has been restored.

Not all subsidies are bad. The World Bank has suggested that subsidies should be used temporary as part of a broader strategy to improve fisheries management and enhance productivity. Public grants can be used to improve in the quality of public goods, such as scientific research, infrastructure, human capital, access to credit, improving investment climate, and strengthen governance of fisheries resources through secure user and property rights and strengthening collective action in fisheries co-management.

Strengthening Scientific Research and Information Sharing in Fisheries

The success of fishery management reform hinges on having consensus, support and cooperation of all stakeholders involved, which can be enhanced through scientific information generation and sharing. Fisheries management reform void of data and information is no better than guesswork.

The availability and accessibility of basic management data and information are essential to proper fisheries management reform. Indeed, major and economically painful crashes are inevitable due to chronic lack of essential management information and data and

these have created far more long-term harm to fishing dependent communities (Glen Spain, 2000). Increasing fisheries management reform failure has also been caused by serious public underfunding for fisheries research and data collection programs, including fisheries resource survey data.

Scientific research requires adequate institutional support and research capacity. Although fisheries research are conducted by a number of local fishery based institutions such as DoFM, FDAM, MFRDMD, MARDI, DMPM as well as universities and international fisheries research bodies such as WorldFish Centre and SEAFDEC, there is little synergy in the research efforts. There are considerable overlaps in research topics and poor sharing of data and research findings to assist in formulating and planning of fisheries management reform. The creation of an information and data repository center may help to avoid repetitions in research and provide better information exchange and communication. In addition, lack of research manpower and capacity, particularly in the field of fisheries economics, often hinder comprehensive fisheries reform efforts. Fisheries research capacity needs to be increased. Fisheries managers and researchers alike are required to improve their capabilities in comprehending the increased complexities of issues and challenges, as well as in seeking ways to transform the sector to the healthy state.

CONCLUSION

The marine fisheries sector provides many services to Malaysia. Among others, a healthy marine fisheries sector will be able to provide sustainable food supply and help Malaysia to attain its food security goal. In addition, marine fisheries resources constitute the natural wealth of the nation and a healthy sector can be a source of development finance for investment in other forms of capitals.

Several studies using the bio-economic model to diagnose the health of the Malaysian marine fisheries have shown that its health is far from satisfactory. Almost all fish stocks have been either fully or overexploited due to excessive fishing effort and fleet overcapacity applied to the fish stocks. The evidence indicated that the current levels of effort far exceeded the bio-economic optimal levels, ranging from as low as a few per cent to more than 75 per cent for all species groups. In addition, the gap between optimal bio-economic and current rents for the demersal, pelagic and molluscs fisheries ranged from several million to billion RM. The rent drains constitute wastes to the Malaysian economy. The changing composition of the catch and the increasing proportion of trash fish in total landings from 16 to 25 per cent also indicate overfishing. Dwindling fish supplies against rising demand due to increases in population and income had caused domestic fish prices to escalate. Fish price increases, especially for lower grade fish demanded by the low income groups may undermine their attainment of food security.

There are enormous potential benefits to be derived from a healthy marine fisheries sector. Concerted national efforts in fisheries management reforms are required to achieve sustainable fisheries and to restore fish health and wealth for Malaysia. Fisheries reform involves complex governance issues that span across biological, economic, social, political and legal considerations and challenges. It is a long-term and challenging process that requires political will founded on a consensus of all stakeholders. Successful fisheries management reforms require adaptively creating and continually adjusting a sound management plan and “road map” that incorporates and integrates the following challenges.

1. Rebuild and replenish depleted fisheries stocks. This can be done by directly enhancing the marine ecosystems through the creation of artificial habitats such as artificial reefs and/or marine protected areas. In addition, the curtailment of excessive fishing effort and fleet overcapacity can indirectly enhance the rebuilding of fish stocks. Also, measures need to be taken through effective enforcement to address illegal fishing as well as unregulated and unreported catches.
2. Restructure, rationalize and gradually remove fishing input subsidies since they are pernicious as they foster fleet overcapacity, overfishing, reduce economic efficiency, dissipate resource rent and provide the economic incentive to continue fishing when it is unprofitable.
3. Ensure the support of appropriate institutional and legal frameworks. Reforms will require changing the marine tenure structure from the “common pool” that promote competition to one that delegating exclusive and secure user-rights to the fishers’ communities.
4. Build consensus among fisheries stakeholders by engaging them through consultations and dialogues. The interests of all stakeholders that may affect management objectives, targets, strategies and activities need to be recognized. This will involve development of a process for engagement of the stakeholders and identification of their objectives. The engagement process may likely to forge a common vision for the planned reform that incorporate the interests of all stakeholders and is more likely to garner support from them.
5. Safeguard social equity through transparent equitable sharing of benefits from successful fisheries management reforms. Social equity also requires providing social safety nets and creating

alternative employment and economic opportunities for affected and displaced fishers.

6. Strengthen scientific research and disseminate research information on the status of the marine resources, the potential economic and social benefits, as well as the social and political costs in order to raise awareness among leaders, stakeholders and the public of the need to undertake fisheries management reforms.

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BIOGRAPHY

Professor Dr Tai Shzee Yew was born in Rumbia, Melaka. He obtained his Bachelor of Science degree in Resource Economics from Universiti Pertanian Malaysia in 1980 with a sponsorship from the Public Service Department of Malaysia. His Master degree education was sponsored by the Agricultural Development Council (ADC) scholarship and he graduated with a Master of Economics (Agricultural Economics) degree from the University of New England, Australia in 1984. In 1989, he went to Simon Fraser University in Canada under the International Development and Research Council (IDRC) scholarship and graduated with his Ph. D (Fisheries Economics) degree in 1992.

Professor Tai has been with the Faculty of Economics and Management, UPM for more than 25 years, as a tutor, as a lecturer, as an Associate Professor and as a full Professor of Fisheries Economics and Management. He teaches at both undergraduate and graduate levels in his specialized area of Fisheries Economics and Management as well as Natural Resource Economics, Econometrics, Mathematical Economics, Economic and Business Statistics, Research Methodology in Economics Microeconomics and Principles of Economics. He was briefly attached at the Johor State Department of Agriculture in 1980 and the Institute of Fisheries Analysis of SFU, Canada from 1989 to 1992. He was the coordinator of the UPM/IDRC Graduate Fisheries Economics Specialization Program and the UPM/IDRC Pre-Master Program in Economics. He was the head of the Bioresources and Environmental Policy Laboratory of the Institute of Agricultural and Food Policy Studies, UPM from 2005 to 2007. In 2007, he was appointed as the Deputy Vice Chancellor of UPM, taking charge of the Industry and Community Relations and held the position until 2012.

His research interest is in policy analysis and modelling of the fisheries sector, as well as valuation of natural resources. He has published papers in local, regional and international journals including the Malaysian Journal of Agricultural Economics, Pertanika Journal of Social Science & Humanities, Borneo Review, Trends in Applied Sciences Research Journal, the International Journal of Social Sciences, Journal of Agricultural Science, Ocean & Coastal Management, Ecological Economics, Research Journal of Forestry, International Journal of Business and Society, Asian Economic Bulletin, Journal of Rural Development, Asian Fisheries Science Journal, Thai Fisheries Gazette, Marine Resource Economics, and Environmental and Resource Economics. He has also contributed chapters in books and conference proceedings. He has published 5 books and proceedings and has translated Lee G. Anderson's book entitled "The Economics of Fisheries Management" into Bahasa Malaysia. He has presented numerous papers at national and international seminars, conferences and workshops.

He is actively involved in research and consultancy works for the Malaysian Government, Industries and international agencies. He had received research grants from the Economic Planning Unit of Malaysia, Ministry of Science, Technology and Innovation Malaysia, Malacca State Government, Malaysian Institute of Economic Research, Maritime Institute of Malaysia, Malaysian Fisheries Development Authority, Malaysian Agricultural Marketing Authority, Department of Fisheries Malaysia, Bank Rakyat, Tanjong Pelapas Port, International Development and Research Center, Food and Agricultural Organization, WorldFish Center, Asian Development Bank, International Centre for Living Aquatic Resource Management, International Development and Research Council of Canada, Asian Fisheries Social Science Research

Network, Economic Research Institute for ASEAN and East Asia, United Nation Environmental Program, Agriculture Development Council, Japanese International Cooperation Agency, Institute for International Trade Negotiations and Hewlett Foundation.

His expertise, research and administrative capabilities enable him to get involved in professional and extension services. These included a member of the steering and technical Committees for the evaluation of the use of 38mm trawl cord end mesh size in 2007, the Technical Committee member for the preparation of Fisheries Sector Policies under the National Agricultural Policy (NAP) 3, a Joint Coordinating Committee member of the Malacca Straits Research and Development Center, (MASDEC-JICA-UPM), the coordinator of the UPM/IDRC Graduate Fisheries Specialization Program - Phase I and II and the Pre-Master Program in Economics, a member of the UPM technical evaluation panel for IRPA Social Science Research, the secretary, executive committee member, and treasurer of the Malaysian Agricultural Economics Association, the business manager and an editorial board member of the Malaysian Journal of Agricultural Economics, and the secretary of the Asian Fisheries Social Science Research Network of the Social Science Section of the Asian Fisheries Society. In addition, he has been invited to be a reviewer of articles in several journals including the *Pertanika Journal of Social Science and Humanities*, the *Journal of Environmental and Development Economics* and the *Journal of Environmental and Resource Economics*, and as resource person to deliver lectures and talks in areas pertaining to natural resource economics, particularly on fisheries economics, modeling and management, as well as economic and business statistics and econometrics.

In recognition of his professional and extension services, he has received several awards from international and national institutions.

These included UPM's Excellent Service Awards, the silver Medal at the 2008 UPM's Inventions, Research and Innovation Exhibition , the Best Paper Award at the 2nd International Borneo Business Conference, the International Educator of the Year Award 2003 by the International Biographical Center Cambridge, the D.H. Drummond Dissertation Prize by the University of New England, Australia, the Malaysian Agricultural Economic Association (PETA) Gold Medal Award, the Dunlop Award, and the Honorary member of the Golden Key International Honour Society. He was conferred the Johan Setia Mahkota (J.S.M.) title by the Yang Di Pertuan Agung of Malaysia in 2010 and the Dato' Sharafuddin Idris Shah (D.S.I.S.) which carried the title Dato' by the Sultan of Selangor in 2012.

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I would like to extend my gratitude to all the public and private institutions from both domestic and international, for extending to me their financial support, confidence and encouragement in all my research and consultation works. Thanks to Universiti Putra Malaysia for giving me the platform and opportunities to develop my academic career. Last but not least, my love, appreciation and gratitude are extended to my late parents, my spouse Yong Kwee Peng, my children Ling Ling, Liang Kwang and Jie Chuin, my siblings and all my other family members for their endless love, support, sacrifices and encouragement.

LIST OF INAUGURAL LECTURES

1. Prof. Dr. Sulaiman M. Yassin
*The Challenge to Communication
Research in Extension*
22 July 1989
2. Prof. Ir. Abang Abdullah Abang Ali
*Indigenous Materials and Technology
for Low Cost Housing*
30 August 1990
3. Prof. Dr. Abdul Rahman Abdul Razak
*Plant Parasitic Nematodes, Lesser
Known Pests of Agricultural Crops*
30 January 1993
4. Prof. Dr. Mohamed Suleiman
*Numerical Solution of Ordinary
Differential Equations: A Historical
Perspective*
11 December 1993
5. Prof. Dr. Mohd. Ariff Hussein
*Changing Roles of Agricultural
Economics*
5 March 1994
6. Prof. Dr. Mohd. Ismail Ahmad
*Marketing Management: Prospects
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6 April 1994
7. Prof. Dr. Mohamed Mahyuddin Mohd.
Dahan
*The Changing Demand for Livestock
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20 April 1994
8. Prof. Dr. Ruth Kiew
*Plant Taxonomy, Biodiversity and
Conservation*
11 May 1994
9. Prof. Ir. Dr. Mohd. Zohadie Bardaie
*Engineering Technological
Developments Propelling Agriculture
into the 21st Century*
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10. Prof. Dr. Shamsuddin Jusop
Rock, Mineral and Soil
18 June 1994
11. Prof. Dr. Abdul Salam Abdullah
*Natural Toxicants Affecting Animal
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29 June 1994
12. Prof. Dr. Mohd. Yusof Hussein
*Pest Control: A Challenge in Applied
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9 July 1994
13. Prof. Dr. Kapt. Mohd. Ibrahim Haji
Mohamed
*Managing Challenges in Fisheries
Development through Science and
Technology*
23 July 1994
14. Prof. Dr. Hj. Amat Juhari Moain
Sejarah Keagungan Bahasa Melayu
6 Ogos 1994
15. Prof. Dr. Law Ah Theem
Oil Pollution in the Malaysian Seas
24 September 1994
16. Prof. Dr. Md. Nordin Hj. Lajis
*Fine Chemicals from Biological
Resources: The Wealth from Nature*
21 January 1995
17. Prof. Dr. Sheikh Omar Abdul Rahman
*Health, Disease and Death in
Creatures Great and Small*
25 February 1995

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18. Prof. Dr. Mohamed Shariff Mohamed Din
Fish Health: An Odyssey through the Asia - Pacific Region
25 March 1995
19. Prof. Dr. Tengku Azmi Tengku Ibrahim
Chromosome Distribution and Production Performance of Water Buffaloes
6 May 1995
20. Prof. Dr. Abdul Hamid Mahmood
Bahasa Melayu sebagai Bahasa Ilmu-Cabaran dan Harapan
10 Jun 1995
21. Prof. Dr. Rahim Md. Sail
Extension Education for Industrialising Malaysia: Trends, Priorities and Emerging Issues
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22. Prof. Dr. Nik Muhammad Nik Abd. Majid
The Diminishing Tropical Rain Forest: Causes, Symptoms and Cure
19 August 1995
23. Prof. Dr. Ang Kok Jee
The Evolution of an Environmentally Friendly Hatchery Technology for Udang Galah, the King of Freshwater Prawns and a Glimpse into the Future of Aquaculture in the 21st Century
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24. Prof. Dr. Sharifuddin Haji Abdul Hamid
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25. Prof. Dr. Yu Swee Yean
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27. Prof. Dr. Mohamed Ismail Abdul Karim
Microbial Fermentation and Utilization of Agricultural Bioresources and Wastes in Malaysia
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28. Prof. Dr. Wan Sulaiman Wan Harun
Soil Physics: From Glass Beads to Precision Agriculture
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29. Prof. Dr. Abdul Aziz Abdul Rahman
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34. Prof. Dr. Ho Yin Wan
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48. Prof. Dr. Lee Chnoong Kheng
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49. Prof. Dr. Mohd. Ghazali Mohayidin
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51. Prof. Dr. Nik Mustapha R. Abdullah
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52. Prof. Dr. Gulam Rusul Rahmat Ali
*Food Safety: Perspectives and
Challenges*
23 March 2002
53. Prof. Dr. Zaharah A. Rahman
*Nutrient Management Strategies for
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56. Prof. Dr. Syed Tajuddin Syed Hassan
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57. Prof. Dr. Dahlan Ismail
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58. Prof. Dr. Ahmad Zubaidi Baharumshah
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75. Prof. Dr. Yusof Ibrahim
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76. Prof. Datin Dr. Sharifah Md. Nor
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