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POST HARVEST LOSSES PREVENTION IN ICELAND AND MAKING OF A MODEL TO BE APPLIED IN MALAYSIA

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ABSTRACT

This study analyses post-harvest losses (PHL) in Iceland and Kuantan, and points out methods to reduce PHL in Kuantan and Malaysia using the experience of Iceland.

In this study a model for PHL is made for Malaysia based on five common fish species in Kuantan namely mackerel, squid, threadfin, scad and yellow blended scad. The model uses Weighted Index Result to analyse and evaluate the complicated handling activities from the sea to the primary market and an HACCP system to identify critical actions, develop preventive measures and suggest a controlling mechanism.

It is assumed that by following the identified improvement process in Kuantan, the quality and quantity of the fish sold at auction in Kuantan will increase. The volume of fish will increase and the average price will increase resulting in a revenue gain that can pay for the cost of the corrective actions and more. By using assumptions that are considered conservative for the five species, revenue increase in Kuantan can be estimated at RM 3.5 million per year due to higher quality and quantity.

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1 INTRODUCTION

Fish is a perishable product and needs proper handling. Careless handling will reduce both quality and quantity. Losses after capture or harvest are called Post Harvest Losses (PHL). In a situation of limited resources and overexploitation, it is importance to reduce PHL. The significance has been recognized by the FAO, in the code of conduct for responsible fisheries (FAO Fisheries Department Code of Conduct) and manuals on PHL (Campbell and Ward 2003).

Efforts to improve post-harvest handling continue, although, millions of tons of fish are believed to be lost annually through post-harvest losses throughout the world (FAO Focus). PHL starts at capture and continues until the end consumer is reached. It is important to find out the main factors contributing to PHL and to understand the economics of reducing PHL. Species selection, weighted index and HACCP approach is used as a method in detecting the potential losses and analysing the information at certain areas or fish centres.

This study addresses the issues to be improved in Kuantan, using a prevention model based on the experience of Iceland. The expected outcome from this study is a tool for stakeholders to use in making decisions on reducing PHL with respect to economic losses/gains. Iceland has been a successful country in fishery management, having an improved fish handling process with minimal PHL. In 2003, the total fish landing in Iceland was recorded at 2 million tons, valued at more than USD1 billion. In the same year, fishery products exported were worth USD1.8 billion (MOF 2004). Many aspects used in Iceland regarding PHL prevention will be adapted through a new model, which will be applied in Kuantan and Malaysia as a whole.

This study starts with an overview on PHL as a universal issue and assesses the current situation of PHL in Kuantan and Iceland. This will be followed by a brief on the operational procedures in PHL. A reason why the model was developed and the methodology used in the study will also be explained. In addition, the study will analyse the main factors to obtain the preferences and revenue gains. The results of the analysis will provide some ideas or tools for all stakeholders to use in the management of the fishery.

2 OVERVIEW OF PHL

2.1 Scope and definition

The post-harvest sector can be divided into three components: supply, transformation and consumption. Supply includes sources, forms, variability and sustainability of supply. Transformation includes product, place, promotion and price transformation. Consumption refers to a variation in consumption patterns, which includes quantity or species consumed by different groups, in different locations, at different times for a range of reasons (Campbell and Ward 2003).

This study will focus on quantity and quality losses along the handling chain from fishing to the primary customers. PHL includes freshness degradation and devaluation of fish as products or raw materials. These losses may occur in the net, in fish containers, at storage, or on the way to the shore, on the jetty, during transport and at the market.

> At first sight, post-harvest losses appear a straightforward matter. An amount of fish is caught but a smaller quantity reaches the consumer. The difference is what concerns us now. However, the real situation is far from straightforward. Losses are not simply a matter of quantities of material. We must also consider losses of value, what the fish is worth in monetary terms through the handling, processing, distribution and marketing cycles. There are losses of quality, when stale or mouldy fish becomes less attractive to consumers. However, these can regarded as either losses in material or more usually, losses in value; as the quality drops there is nearly always a decrease in value. In addition, there are losses in nutritional value, when the fish contribute less towards the diet of consumers than it did, or might have done. It is convenient to start by considering these different types of loss (FAO1992 pg 1).

Scientists identify fish freshness through a freshness index called the "K-Value", that is the process of decomposition which involves biochemical change in muscles of fish and shellfish. Three European fisheries institutes (Icelandic Fisheries Laboratories (IFL), the Netherlands Institute for Fisheries Research (RIVO) and the Danish Institute for Fisheries Research (DIFRES)) have decided to establish a strategic alliance called QIM Eurofish. Their mission is to promote and implement the use of a Quality Index Method (QIM) as a versatile quality tool within fisheries distribution or production chains in Europe. The QIM is based upon an objective evaluation of certain attributes of raw fish (skin, eyes, gills etc) using a points scoring system (from 0 to 3). The lower the score, the fresher the fish (Martinsdottir *et al*.2001), as shown in appendix 1. Sensory evaluation methods using QIM are useful for PHL prevention.

2.2 Manual and guidelines

The objectives and principles of the FAO's Code of Conduct for Responsible Fisheries are the basis for an international commitment to responsible fishing; article 11 of the code deals specifically with PHL (Appendix 2). It is accepted that the right to fish carries with it the obligation to do so in a responsible manner. This has become widely recognised as the demand for fisheries products continues to grow whilst the resource remains limited.

A post-harvest overview (PHO) manual developed by a research project funded by the Department for International Development (DFID) is a tool that allows the post-harvest sector to be systematically analysed and easier to understand. It also provides a hierarchy of questions, which can be used to guide analysis of a particular situation such as in PHL prevention (Campbell and Ward 2003). The related questions in PHO are shown in Appendix 3.

A code of practice for handling has been discussed for a long time. In 1971, an FAO technical conference in Canada considered that a code of practice is valuable in facilitating compliance with Codex Standards and as a source of useful advice to countries wishing to improve their existing food handling and processing regulations. It recognized that:

> product specification and standard cannot be met satisfactorily and consistently unless raw material quality is controlled, and handling practices and facilities, processing conditions and distribution methods meet reasonable hygienic and technological standards (Rudolf Kreuzer 1971, p.288).

Therefore, a fish processing industry that depends on highly perishable raw material requires practical guidelines to assist in economical utilization of the landings.

2.3 Worldwide loss and impact

The economic losses through PHL are difficult to calculate but net annual losses have been estimated as USD10-20 billion per year. In Africa, some estimates, put post-harvest losses at 20 to 25%, and sometimes as much as 50% (FAO Focus). Korea experiences substantial post-harvest losses every year, estimated at around 10% of the total fish production (OECD 2000). In Iceland, a released report in 1993 cited a demersal discard range from 1-6% of total catch (Arnason 1993).

In 1999, the FAO estimated that 47% of the world's fish stocks were fully exploited and 18% over-fished (OECD 2003). World capture production in 2002 was about 93 million tons and has been stable for the past six years (FAO Statistics Summary Tables - 2002). At the same time the world's population has had an approximately annual average growth rate of 1.2% (U.S. Census 2002). With no increase in fish capture and an increase in population, food security from marine resources is jeopardised in the future. For this reason improved handling and reduced PHL is of vital importance. Regarding increased demand for new end products (final products), the raw material must be processed to get the best final product to the consumer. A first class end product can never be produced from defective raw material.

As experienced in Iceland, before the 1970s fish stocks were overexploited and the fisheries sector was in difficulties. However, since the 1970s , policy management has been reformed; fishers have better knowledge in capture planning, technology has changed and as a consequence there has been a huge improvement in the fisheries sector. For example, the outputs of sea processing vessels have increased, especially in ground fish and flatfish as shown in Figure 1.

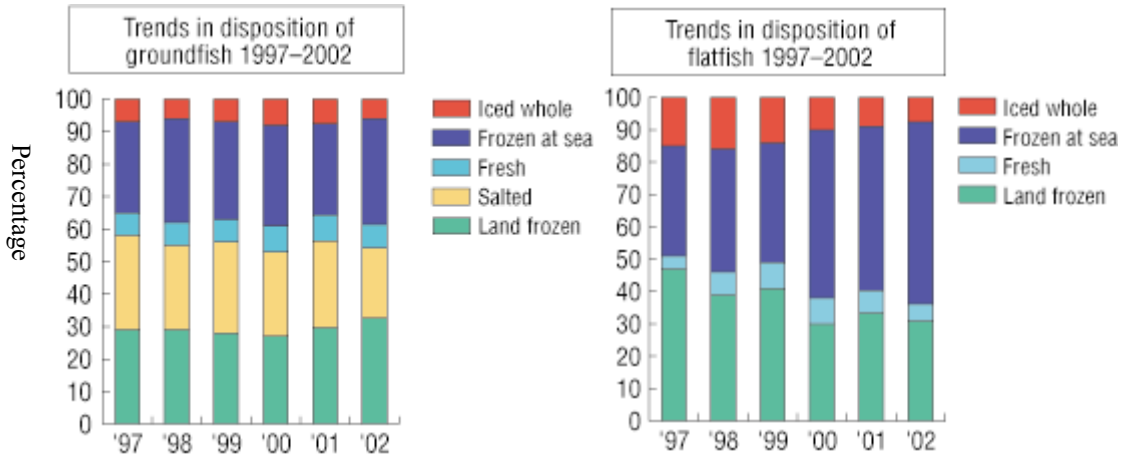


Figure 1: Trend in disposition of groundfish and flatfish (MOF 2003).

Presently, handling activities have totally changed both on-board and on-shore and accordingly there has been a change in the production and marketing patterns. Some parts of the handling and semi-processing activities on-shore have been replaced by on-boat activities. The ability to produce a continuous supply of good raw material and high class end-products has made Icelandic fish a worldwide product. This effort, supported by a strong marketing company in international promotion, has accelerated marketing growth mainly in Europe, the USA and Japan as shown in Figure 2. Icelandic fisheries have contributed much to world food hygiene and security and have reduced the impact of scarce fish supplies. Without proper planning in the past decade, Icelandic fisheries would not be in the comfortable position they are in today.

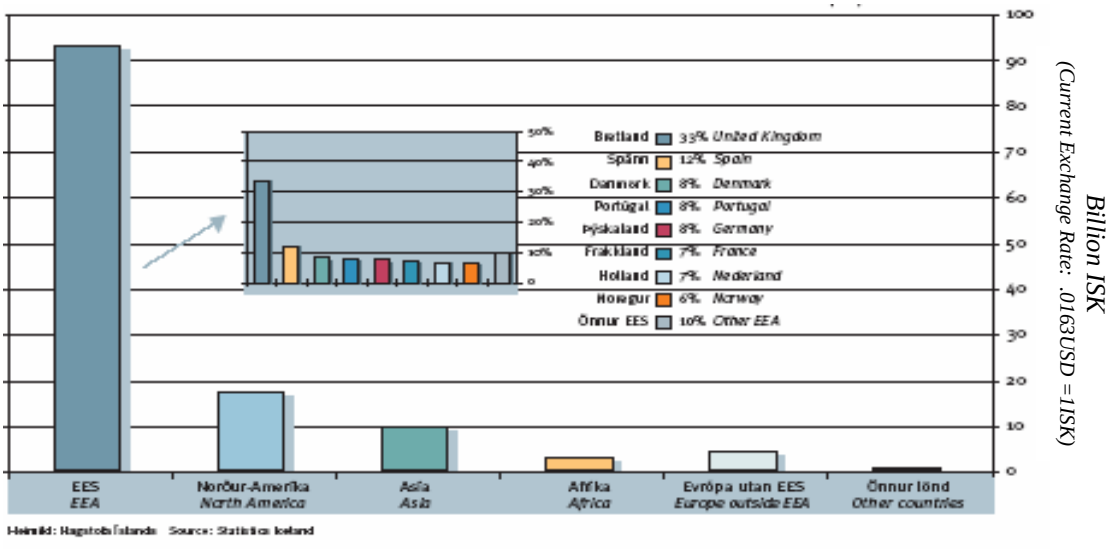


Figure 2: Value of marine product exports from Iceland by trading countries (MOF 2004).

2.4 Development in preventing PHL

In the 1960s, a few countries became aware of losses in the post-harvest. Studies in general were not focused on post-harvest or PHL, but indirectly touched upon them when discussing preservation, refrigeration, packaging and such handling activities. In the 1970s, the discussion was more on technical matters and application and greater emphasis was placed on fish landings and market systems. However, from the 1980s onwards post-harvest has been an important issue. A code of conduct, code of practice and a manual on PHL were established and widely used as a reference in fisheries development in many countries (Exon 1970, Kreuzer 1971, Peters *et al*. 1965)

Presently, a new approach to fisheries development that incorporates sustainable use of resources and increases added value seems urgently needed. Minimizing post-harvest losses is one key to increasing revenues and food security, without intensifying the fishing effort. Improved processing techniques are a large part of the answer (FAO Fisheries Department Code of Conduct 1995).

In the development of the post-harvest sector, developed countries have seen more emphasis on quality losses. In 2000, the European Community adopted revised legislation on food hygiene and new rules concerning the allowable levels of dioxin in foodstuffs. This legislation came into force two years later. Also, Japan has appointed food hygiene inspectors to control bacteria numbers by conducting surveillance through the sampling of fish or fish products at wholesale markets, in cold storage and retail stores (OECD 2003).

In order to encourage efficiency in the post-harvest use of resources, the European Community has developed its market support regime. In Iceland, measures to reduce PHL and waste are on going in many projects carried out by research institutions (OECD 2000). By-products in Iceland are re-processed as a valuable product. For example in 2001, Iceland produced about 12,000 tons of dried cod heads valued at 23 million USD which were mainly exported to Nigeria. (Arason 2003).

Artisanal fisheries have make efforts to develop PHL prevention, but they are still on the basic stages. A study using a unique data set of the Malaysian gill net fisheries, justifies the shift from technical assistance and training in the harvesting of fish to a broader and more comprehensive development strategy that integrates sustainable fisheries development (ISFD). One component of the strategy is “target assistance in fisheries to onshore development and infrastructure that reduces wastage,increases the value-added and utilization of fish, reduces fishing, and promotes supplemental or alternative employment to fishing” (Squires, Grafton, Alam and Omar 1998. P. 18). This has potential to improve the situation of the poor.

3 ASSESSING THE CURRENT SITUATION OF PHL

3.1 Developed and developing fisheries

PHL prevention varies between the fisheries sectors in developed and developing countries. Developed countries are strong financially and have the latest technology in upgraded handling activities. Most of the stakeholders are aware of the need to increase quality and put a lot of effort into PHL prevention.

In developing countries, more depends on government intervention. Stakeholders put PHL prevention as a second or third priority. The first priority is usually to complete all basic infrastructures in the sector. The differences between developed and developing countries fisheries sectors are analysed below:

Fisheries in developed countries	**Fisheries in developing countries**
Source of supply: variations in handling preparation.	
Supply comes from various sources: ocean, inland and imports. Industrial and commercial effort use high-technology resources in both gears and vessels. Stakeholders have similar capacity, needs and strategy for fish handling and quality.	Supply comes from ocean and inland, imports are insignificant. Semi-industrial /artisanal fishers use moderate technology resources in gears and vessel types. Stakeholders have many differences in capacity, needs and strategy for fish handling and quality.
Form of supply: more flexibility in utilization of resource.	
Have high standards and are precise in quality and quantity. Good catch planning for size, species and area to catch. Form of supply is to produce to customer's needs. Therefore, almost all produce is utilised and there is less by-catch and less discard.	Is not precise and of a low standard in quality judgment. All species caught in order to get more volume. Target species and form of supply is not specific. Poor in consumer needs planning, and is normally for local market. The form produced is not fully utilised, and therefore there is increased by-catch and discard, and some undervalue species.
Variability of supply: planning preparation in order to get consistent supply.	
Variability of supply is stable due to long term catch planning based on a one-year operation. Reduction of potential losses.	Catch planning is not long-term. Certain fishing gears have monthly catch planning schedules. The variability depends on whether it is a good or hard season. Free access management. Peak period and glut season cause increased PHL.
Sustainability of the supply: management of the resources.	
Pollution and over-exploitation among suppliers is generally prevented. Good legislation and enforcement to maintain sustainable input supply to producer. Action	Enforcement is on debated issues and enforcement is more political. There is less awareness of pollution and over-exploitation whichresults in low quality

based on researched facts.	and polluted supplies. Some species, especially those found at estuaries and rivers, are polluted.
Product transformation: diversified alternatives in use by others.	
Preparation for product transformation is better. Gutting and filleting done at sea along with chilling and freezing. Factories on shore receive good fish and pay higher price for quality. Advances new product development and the by-products are used for other processes. Product transformation increases quality.	Preparation for product transformation is mainly done on land. Preservation and freezing is mainly done on land. By-products are used for fishmeal and some thrown out.
Place transformation: mobilized for less waiting time (storing/freezing hold).	
Species and product mobilization is good. Fish is still fresh when it gets to the consumer. This is facilitated by good transportation, information exchange and marketing system facilities (online-computerised auctions).	Neither refrigerated trucks nor cargo shipping is used. Information exchange and marketing systems need further improvement. Some landing centres are just for local consumption and limited to certain buyers. Landing information is not available to local consumers (not as in open market) and product traceability is poor.
Promotion transformation: encourage improvements in every link of the handling chain.	
Fish and product appearance is good. It is-Compliant with product traceability, good packaging, good promotion and bulk production. Mainly for human consumption and matches HACCP criteria. Established in the international market, for example: cod fillets from Iceland and tuna fillets from Japan.	Poor promotion. Product appearance and traceability needs to be improved. Stakeholder's perception on quality grade product must change. The product is mainly for human and domestic consumption. Semi-processed products are for export. Factory produce final product mainly for domestic use.
Price transformation: forcing/rewarding good handling.	
National framework price to control and enhance the quality of the product. Price fluctuations can be supported by market support regimes or from other sources of production like aquaculture or frozen stock. Transparency in price structure, especially in computerised auctioning. All the marketing chain (including fishermen) gain from the price increment. Price is as a tool to improve fish handling along the chain.	National framework price is not a priority for fish or fish products as in other commodities. Price fluctuation is a current issue that needs to be tackled. Improvement are necessary in product traceability and marketing systems and more transparency price formation. Middlemen gain more benefit for price changes. Price is not a tool to improve fish handling along the handling chain.
Consumption: provide a broad alternative to utilise all species/forms.	
Generally good consumption by all the population, from all locations, at all times	Some species are limited to certain areas or seasons. They are not fully consumed

throughout the year. Products can be preserved, frozen or processed to provide more flexibility in various consumption patterns. In Iceland, by-products are reproduced for export. In Japan surimi is kept and used throughout the year for multipurpose end- products. All this can reduce potential PHL.	throughout the year. Products should be frozen or processed to be more flexible in various consumption patterns. In Malaysia, sardines and herring are mainly used in the east coast for fish crackers or fish sticks. These species peak in certain seasons which increase the potential PHL during the year.

3.2 Post harvest handling in Kuantan

Kuantan is a regional fishery centre, located in Pahang state on the east coast of Malaysia (Figure 3). It represents a fisheries management model based on various boats sizes, fish species and handling activities. Kuantan has a big fish-landing complex, handling more than 50 thousand tons of fish per year (FDAM 2003b), which is about 33 % of the total fish landed in Pahang state or 4% of the total catch in Malaysia (DOFM 2003).

Figure 3: Map of Malaysia

The Kuantan fish landing complex was constructed in 1990 at a cost of RM 6.7 million to cater to more than 3,000 boats in Kuantan. The main function of the complex is to improve fish handling in Kuantan from conventional methods (scattered woody jetties) to a centralised and systematic landing site. It has a 14,000 m² landing jetty of which 10,000 m² are used for auctioning and packing, and 65 business offices. Other facilities include craneage, packing sheds, parking spaces and cold rooms (FDAM 2003a). Transportation and fish containers are supplied by private companies. Ice crushers and ice flakes are supplied by the Kuantan Fishermen Association. There are grading tables and electronic scales in some auction areas. Just by the fish landing complex there are wholesale markets, open markets, a surimi factory, a fish ball factory and a fishmeal plant.

Post harvest handling on boats and on-shore facilities in Kuantan is considered good in Malaysia. The flow handling activities can be illustrated as in Figure 4 below.

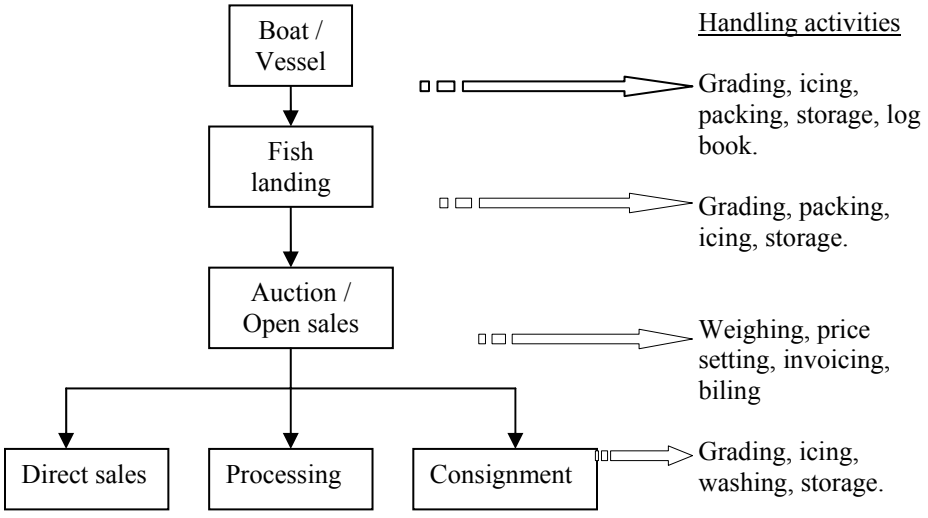


Figure 4: Simulation of handling activities in Kuantan.

Most boats are equipped with insulated iceboxes and a fish hold. Commercial boats (≥ 70 GRT) are more comprehensive with a winch, net hauler and a refrigerated sea water system (RSW).

The existing facilities are sufficient to cater for all types of handling under normal conditions.

Certain species in the glut season, August to November, are liable to suffer substantial PHL. The fish landed in the east coast of Malaysia shows fluctuation trends as illustrated in Figure 5.

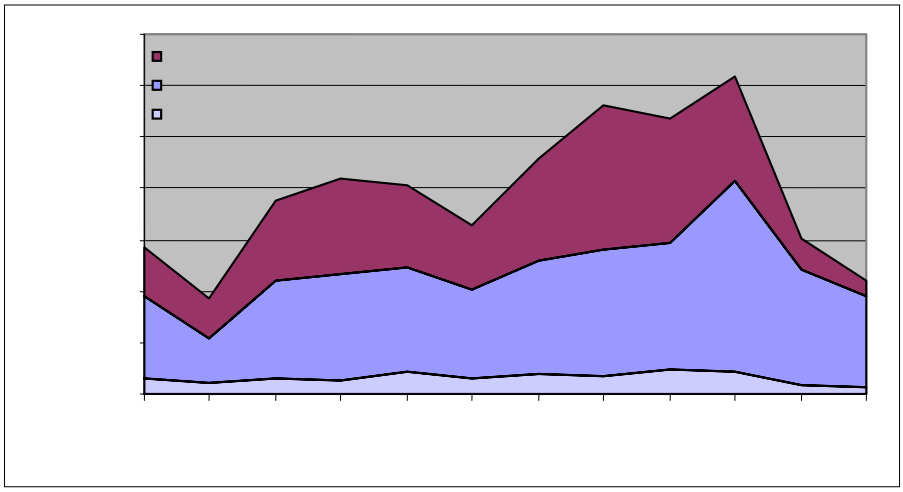


Figure 5: Monthly fish landing in east coast complexes (FDAM 2003b)

PHL are suffered as the fish landed in Kuantan do not have the option to be mobilized from the east coast during the glut season as the peak situation occurs all over the east coast. The concern here is how to get new effort in the form of supply, variability of supply, product transformation and place transformation as explained in the previous section.

3.3 PHL prevention in Iceland

Iceland ranks among the leading fishing nations as shown in Figure 6. Total catch reached 2 million metric tons in 2003, accounting for 2.3% of the worlds catch. Fisheries contribute about 7% to GDP and fish processing about 3% (MOF 2004).

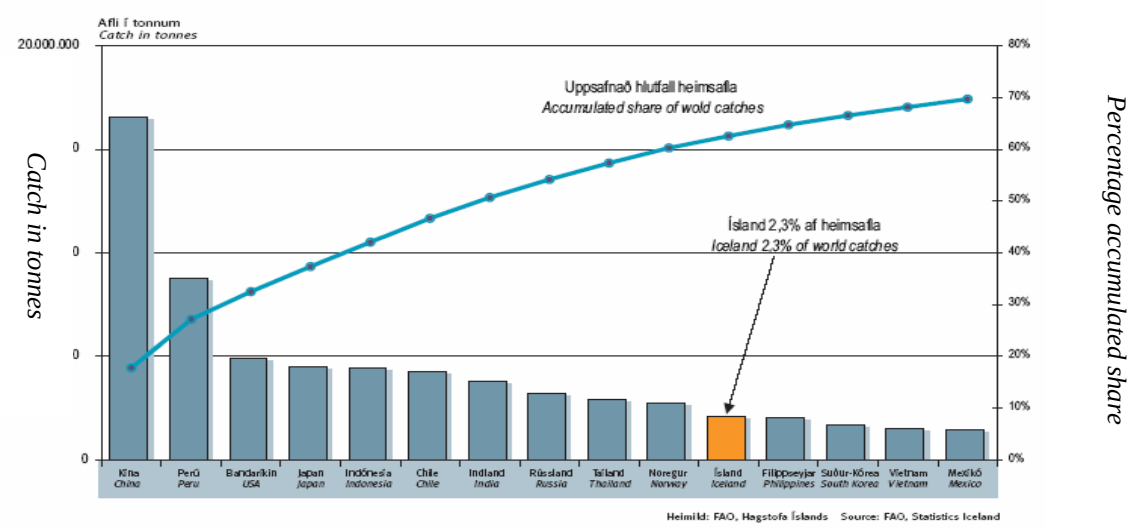


Figure 6: Fish catch of the world's main fisheries countries in 2002 (MOF 2004).

A system of individual transferable quota (ITQ) has been practiced by Icelandic fisheries management since 1984 (MOF 2004). **"***This has meant that owners are able to plan their fishing over a full year to maximize the profit from each kilo that is caught, instead of fighting each other for every kilo available from the ocean. It's saved fishing gears and salaries"* (Bjarnason1992 p.14)**.**

Handling of fish in Iceland has undergone major changes in the past 40 years. In the 1960's handling of fish was poor and PHL was high. Between 1970 and 1990, with limited resources, the people of Iceland started thinking of quality improvement. It was a challenge to find out ways to improve handling and increase fish value. In the transformation process, several elements as regards PHL prevention were acknowledged:

1. *Education and training*: brought forward awareness issues from customers. This was done through customer complaints, recording of the complaints, highlighting the areas of failure and introducing new procedures and a code of conduct.
2. *Pricing system*: determined the prices based on a standard grade, introduced incentives for good products, transparency in the pricing system and a price mechanism to spark more motivation in improving quality *(*Bjarnason 1992).
3. *Independent inspectors*: brought in to ensure that guidelines and operational procedures are applied. *(*Hallgrimsdottir and Gudlaugsson 1992*).*
4. *Reporting system*: introduction of good reporting practices on quantity, quality, sizes, grades and catch or production per day, as well as traceability for corrective measures (Jonsson S. 1992).

The result from the experiences encouraged innovation in handling practices among all stakeholders. Standard handling practices are now used all over the country along the trade chain from capture to the market. At first, some groups questioned the benefit of the effort put into PHL prevention. However, as shown in Table 1 total export in fresh and semi-processed fish has not changed in the period but the value has increased by 65% (MOF Statistics Iceland).

Table 1: Differences in export value within 12 years in Iceland (DOFM 2003).

Fresh & semi-processed fish	Year 1988-1992		Year 1999-2003	
	Quantity (tons)	ISK '000,000	Quantity	ISK '000,000
Frozen	924,751	174,770	1,110,329	290,583
Salted	360,175	63,340	299,446	109,482
Fresh & chilled	653,962	46,023	499,362	65,375
Dried	27,598	4,972	60,587	10,828
Total	1,966,486	289,105	1,969,724	476,268

Another good experience that can be learned from Iceland is the involvement of professionals and academia in the fisheries industry. There are also good opportunities available for post graduate involvement in the sector and internal training or short courses which have been prepared by stakeholders in the private sector.

4 OPERATIONAL PROCEDURES IN POST HARVEST HANDLING

4.1 Differences and similarities

4.1.1 Fishing vessel and fishing gear

Many differences can be identified between Kuantan and Iceland. Kuantan has nearly 500 vessels; 180 vessels are commercial vessels (with tonnage capacity of more than 70 GRT) and the rest traditional vessels (with tonnage capacity of less than 70 GRT) (DOFM 2002). Iceland has close to 2,000 vessels in its fishing fleet, including 1,100 small undecked boats and 900 decked vessels.. The total capacity is close to 175,000 in gross tons (MOF 2003).

Boat design and on-board equipment in Iceland are much better. The vessels in Iceland are well equipped with cooling systems and ice machineries. Loading and unloading facilities are mechanised and conveyer systems are commonly used. These vessels include freezer trawlers, which are like sea-going fish plants with good facilities for washing, grading, bleeding and gutting. Here, the operation is mainly computerised and controlled by automated systems from a control room and the information can be accessed directly on-shore. Normally, the catch from this type of vessel is auctioned directly from the ocean.

Vessels in Kuantan do not have such sophisticated equipment but satisfy the basic facilities for handling short term fishing days such as a fish box, winch and ice facilities. Commercial vessels have better equipment such as net haulers and RSW.

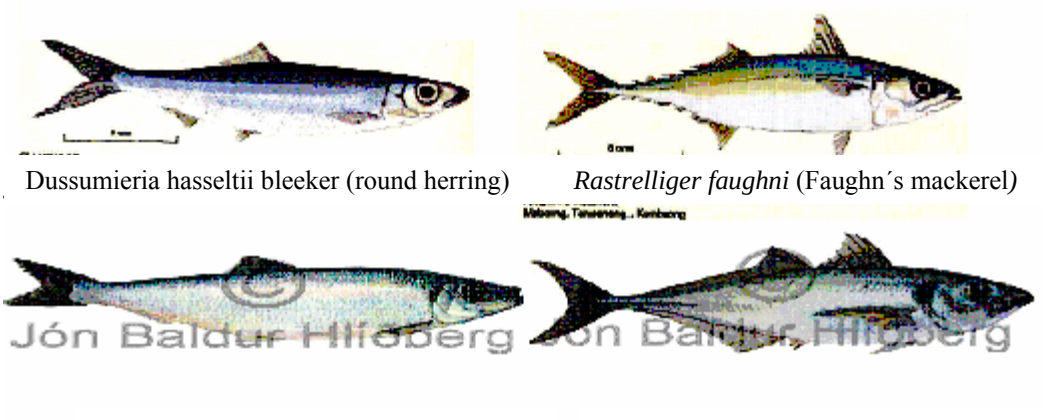
The basic principles of catching fish by hook, gill net, purse seine or trawling are almost the same in Iceland as in Kuantan. However, in Iceland, the fishing gear has been revolutionised. Computerized jigging reels and trawls are now common handling in Iceland. Gear devices for improved selectivity of catch have been developed and are increasingly required in many of the fisheries in Iceland. The captain has use of the latest instruments for locating his catch and regulating its intake on board (MOF 2003).

The most common fishing gears in Kuantan are trawlers, purse seines and long lines. Normally traditional fishers use traditional fishing gear alternately depending on the seasons.

4.1.2 Temperate and tropical species

Temperate and tropical seas are different in many ways. Cold ocean waters offer a smaller variety of habitats for a few species, but the majority of commercially valuable marine species are found here. In contrast, a tropical sea is crystal clear, with almost nothing suspended in the water, there are hundreds, even thousands, of different kinds of plants and animals, but the number of individuals of each species is limited. Mainly the fish species in tropical waters are smaller in size than temperate. Malaysia is located in a tropical region while Iceland is in a temperate region.

Some species, which are recognized by the same name and almost the same characteristics such as herring and mackerel, are found in both regions, but the sizes are different (Figure 7). Small herring in temperate and tropical regions comes from the same family, *Clupeidae*, but the size of the round herring (*Dussumieria hasseltii bleeker*) in tropical waters is about 15-20 cm, while the common size for Atlantic herring (*Clupea harengus*) is about 40-50cm. It is similar to the short mackerel. Atlantic mackerel (*Scomber scombrus*) is a temperate species with a maximum fork length of about 47 cm**,** while in Malaysia, the short Faughn's mackerel ((*Rastrelliger faughni)*) is about 20-25 cm. The bigger the size is the easier the handling, and therefore reduced handling and processing costs.



Dussumieria hasseltii bleeker (round herring) *Rastrelliger faughni* (Faughn´s mackerel)

Clupea harengus (Atlantic herring) *Scomber scombrus* (Atlantics mackerel)

Figure 7 : Small herring and mackerel in temperate and tropical waters (Sunnychai and www.fauna.is)

The differences between temperate and tropical species are illustrated in Figure 8, which shows the fish landing patterns in Iceland and Kuantan.

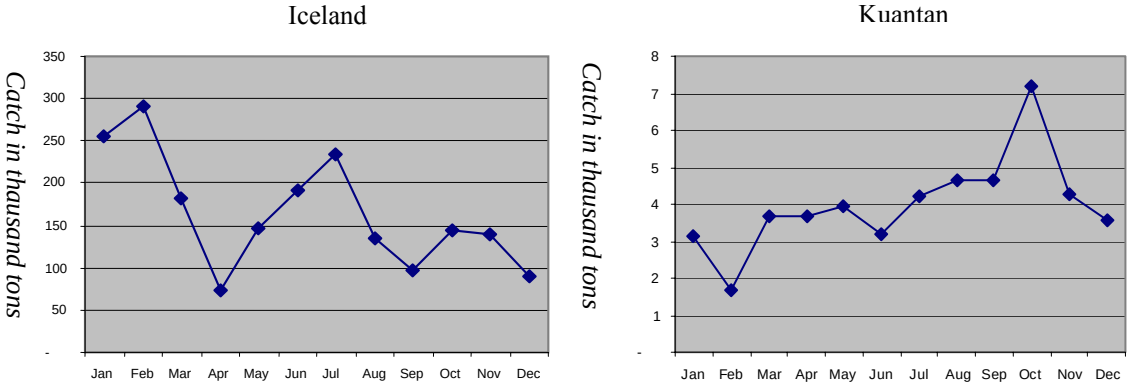


Figure 8: Fish landing trends in Iceland and Kuantan (MOF Statistics Iceland 2003 and FDAM 2003b).

Kuantan lands more than 100 species throughout the year. Some species are big and expensive (high value) but the catch is not much. Mainly small species are caught in high quantities but have lower values and are made available for processing at fishmeal plants. The highest catch in Malaysia is a waste fish called 'Ikan Baja' and it all goes for making fishmeal. The high value species, crustacean and squid, are mainly caught by trawlers (FDAM 2003b) whereas in Iceland, there are typically 38 different species caught (MOF Statistics Iceland) most of which are commercial and high value fish.

4.1.3 Other constraints and assumptions

Catch limitation – Malaysia practices free access in limited zoned fishing grounds, while Iceland uses Individual Transferable Quota (ITQ) as an authorized permit to catch. This means that Malaysian fishermen can catch any amount at any time they like in any particular zone, but in Iceland fishermen can only catch a certain amount. Therefore, fishermen in Iceland must plan their fisheries in relation to where and what to catch.

Climate and geography – The temperature in Iceland is always cool, which means that perishable species keep better in Iceland than in Malaysia. In terms of location, Iceland is also closer to international markets such as Europe and USA compared to Malaysia.

Core business – In Malaysia, agriculture contributes 14% to the GDP. The fisheries sub-sector comprises 4% of the total agricultural contribution. However, in Iceland, agriculture contributes 15% to GDP; of which the fisheries sub-sector contributes 13% (World Facts and Figures 2000).

4.2 Handling activities

4.2.1 Planning fishing activities

Preparation before catch and catch technique are relevant and complimentary to prevent PHL. Good planning must take place to make the right selection and right handling from the start. The issues to consider are:

1. Right area / right place – Fish caught in areas that are not affected by bacteria or parasites and not polluted by chemicals.
2. Right time – Catch must take place at the right time in terms of maturation and feeding of the species and weather conditions.
3. Right equipment and mesh size – Type of fishing gear must be appropriate to the target species either for demersal, pelagic, bottom or for middle water fish. The mesh sizes are also important to get the right sizes or species, and not to catch restricted species.

4.2.2 Fishing

Catching technique includes how long to trawl or allow the net in the water in order not to stress the fish. Loading technique is also important for the fish not to be stressed and damaged by the hooks. Stress and physical tension in the fish will reflect in the quality grade.

4.2.3 Bleeding and gutting

Some species need to be bled and gutted especially big fish and white meat fish. This work must be done on the boat. Studies by Valdimarsson (1992) show that the most important factor regarding good colour of fillets is to bleed the fish alive. In addition, it is

necessary to immerse the fish in running seawater for about 10 minutes immediately after bleeding and gutting.

4.2.4 Washing

Washing is an important activity to leach out fish from all contamination materials and organisms. This work is normally repeated several times at every stage on the boat and land.

4.2.5 Grading

This work can be done either on the boat or on land. Grading is a process of sorting or classifying the fish in uniform sizes, species and quality. It can be done manually or mechanically. A grading team must have proper knowledge about the grade they want to produce. Sometimes, the grade is variable and depends on the purpose for which the fish will be used and what the customers need. Therefore, grades must be standardised and well-known between the buyers and suppliers as shown in Figure 9.

Figure 9: Onboard equipment and graded fish packed on boats.

4.2.6 Packing

After washing and grading, the fish are packed into boxes and/or containers with an ice to weight ratio of 3:1 (Peters *et al.*1965). Salt can be mixed in to give colder temperatures. Some places use packing sheets and packing bags to separate the fish in the containers to make handling easier on land. In good handling conditions, the container must be of a standard size, easy to move, easy to clean, easy to drain and easy to maintain.

4.2.7 Storing

Storing can be done on the boat or on land. Packed fish can be kept in storage. In the storing facilities the temperature needs to be maintained between 0°C to 4°C. Storage structuring and layout should consider the movements of fish boxes, especially for loading and unloading. To make the temperature more secure, storage must have automatic controlling and alarm systems (Hassan 2000).

4.2.8 Reporting

Reporting is a management activity to support the efficiency of handling. The fish are graded and packed in terms of species, size, grade, and day of catch. Normally this is done immediately before storing on the boat because it is difficult to identify on land. This report is very important for traceability. Good reporting assists traceability. Problems in handling are easier to correct in the future. Figure 10 shows fish being unloaded in Iceland.

Figure 10: Picture of fish unloading in Iceland.

4.2.9 Unloading

It is important to unload the catch from the boat as quickly as possible to ensure that the fish is less exposed to unfavourable conditions and so that the people in charge of selling the fish and processing will get it faster. In addition, the boat is prepared for the next fishing trip as soon as possible. Normally this handling is done using simple machines like winches, pullies, cranes, conveyer systems or fish pumps to make it faster with less damage to the fish (Exon 1970) (see Figure 10 above). Improper handling and delays in unloading will result in losses due to fish spoilage. In addition, pests like birds, cats, rats and even people may gain access to the fish.

4.2.10 Icing

The purpose of icing is to maintain the fish temperature between 0°C and 4°C at all times (Bjarnason .1992). It can be added to the container during packing and during waiting time for selling, weighing or processing on land. If icing is repeated along the chain the cost will be higher (time and ice) and there will be higher stress to the fish. Proper packing and storing can reduce icing during handling.

5 DEVELOPING A MODEL FOR KUANTAN

5.1 Method and tools

Many factors determine PHL. Different areas have different practices and different priorities in PHL judgment. Stakeholders always have conflicts in opinion as to sources and ways to solve the problem. Several factors are of interest for the study. The issues which cause current conflict in Kuantan can be broken down as follows:

1. Prices

   The price paid for fish depends on the quality, in addition to supply and demand. A good price is paid for good quality. Sometimes, when the supply is higher than demand which is what happens in the glut season, even good quality fish will be bought at lower prices whilst poor quality fish may receive higher prices when there is little competition in a hard season.

2. Catch:

   Fishermen believe high catch volumes will give more money. Thus, to them it does not matter what or how the fish is caught. All the catch will sell, although some finally goes to fishmeal. However, in some seasons, when too much fish is landed, it causes problems because of inadequate ice, packing boxes, space and transportation. It has always been a big issue for fishermen and traders in the Kuantan landing complex when such situation arises.

3. Fluctuation:

   Some traders take advantage of price and catch fluctuations to make good profits. During a period of glut, they can keep fish frozen and sell it at higher prices during the hard period. They can also mobilise fish from other places to cover the shortages.

4. Fishing gear:

   The perception is that trawlers contribute more to PHL, especially in quality losses. The argument is based on the facts that trawlers operate for a longer time at sea, keep

fish frozen, use RSW and the fish are stressed and contaminated with ground sediments. However, trawlers contribute much catch and meet the needs of factories.

5. Species:

Many fish species are landed throughout the year. Normally big fish are higher in demand and obtain better prices and there is high competition among retailers, seafood restaurants and fish exporters. The boat's crew tend to give high priority for better prevention of PHL in big fish, which obtain higher prices than small or medium sized fish. However, small and moderately sized species, which obtain lower prices are in high demand in factories for processing and semi-processing especially for surimi and fish sticks.

In addition, there are other issues that may influences priorities on PHL such as:

1. Formerly, traditional fishers found it easier to catch big fish near the coastal area. Recently the bigger sized fish seem to have disappeared and traditional fishers find it more difficult to get sufficient income unless they spend more in operation costs in fuel and time in the sea. The same has occurred with commercial boats and lately a number of commercial boat operators have collapsed.

2. Assumption is that most fish caught is low grade. However, the exact figures in species contribution are not clear and not public information, making it difficult to plan for improvement. Low-grade fish may need a new form of supply or product transformation.

3. Several factories are not well operated because of uncertain supply and need outside fish to maintain continuous operation. Sometimes fish from outside sources are not affordable since the price is too high. Inconsistencies in factory operations have implications for employment in the sector.

4. Consumers complain about the fish price being too high. To ensure consumers' security, the government has introduced price control for certain species like Indian and Faughn's Mackerel (DOSM 2004).

5. Many activities are involved in fish handling. However, because there is no record keeping, the stakeholders do not have enough facts to make judgment on which activities to prioritise investment for improvement.

6. Public opinion is usually based on what they see, even if it is not based on facts and figures. The public always assumes the problem of PHL comes from poor facilities in complexes based on abundance of fish on auction without investigating the actual problem.

In identifying an improvement plan for the prevention of PHL, several questions have to be addressed, namely, if improvements are needed: who will bare the cost; who will get

the benefit; who will be responsible; and what is to be improved? Therefore, the process of analysing all these issues and questions must have a method. In this study, a model will be developed for selecting species and activities which will address the prevention of PHL. The model's aim is to identify those issues which will result in the highest profit and benefit. The following steps are included in the model:

1. ***Species Selection*** – Five species will be selected as representing the most important species in terms of price, catch and fluctuation (refer to chapter 5.2).
2. ***Weighted Index*** – Using a worksheet form, a scoring system will be used to produce a critical PHL index in handling activities by fishing gear and species to determine the PHL situation, identify critical areas and which activities and what species to address. The scores will range from 0 to 5, where 0 is not important and 5 the most important (refer to chapter 5.3).
3. ***HACCP Approach*** –The objective of preventive measures using the HAACP approach is to analyse the potential areas for PHL, identify the Critical Control Point (CCP) and establish procedures for preventive and corrective action in implementing PHL prevention. (refer to chapter 5.4).

The primary and secondary data used in the model is based on the Kuantan Fish Landing Complex. Primary data was collected by asking experienced people in Kuantan to fill out forms, while the secondary data comes from the Ikanonline database (the Ikanonline database is a database conducted by the Fisheries Development Authority of Malaysia (FDAM) to collect all fish landing information from all FDAM Complexes in Malaysia).

5.2 Species selection

The objective of species selection is to identify the five most important species out of the 100 species currently landed. Each species has its own characteristics in terms of value, catch and season. The most important species were selected based on the following factors:

1. Quantity of catch – The Ikanonline database was used. At first, 20 species were selected based on highest total landings.
2. Prices of species – From the list of 20 species, an average price per year was calculated and 10 species with the highest prices were selected.
3. Fluctuation in price and catch – From the list of 20 species, 10 species with both prices and catches above the calculated average were selected.

Five species from the combination of highest price in step 2 and highest revenue in step 3 were selected as a final selection for the study. All the processes were automatically done using a special design technique in the Excel programme called '*Species Selection Frame' (SSF)*. This programme is not fully automatic and certain parts were generated manually as shown in Appendix 4. The graph in Appendix 5 is constructed from SSF data and gives further clarification on the combination of the three factors above. SSF is useful for identifying and forecasting species for special consideration. The results of the SSF are shown in Table 2. The selected five species are listed in Table 3.

Table 2: Results from the Species Selection Frame.

Assumption and result

Select 20 highest total catch

	Species	Qty (tons)	RM '000s
1	Mix species (small fish)	22,998	3,684
2	Purple spot big eye	3,494	2,271
3	Squid	2,941	14,750
4	Round scad	2,000	3,216
5	Faughn's mackerel	1,772	7,611
6	Mix species (big fish)	1,718	1,787
7	Lizards fish	1,707	720
8	Oxeye scad	1,519	2,701
9	Yellow banded scad	1,211	2,356
10	Threadfin	1,207	3,209
11	Fringescale sardinella	1,139	894
12	Snapper	1,013	1,900
13	Scad	941	3,606
14	Octopus	880	2,906
15	Frigate mackerel	430	1,194
16	Hardtail scad	426	836
17	Ribbon fish	316	487
18	Shark	228	367
19	Stingray	206	526
20	Kacang-Kacang	148	183

	First 10 species
1	Squid
2	Faughn's mackerel
3	Threadfin
4	Scad
5	Round scad
6	Yellow banded scad
7	Octopus
8	Oxeye scad
9	Frigate mackerel
10	Purple spot big eye.
	Final 5 species
1	Mackerel
2	Squid
3	Threadfin
4	Scad
5	Yellow banded scad

Table 3: Description of the selected five species.

	Common mame	Scientific name	Local name
1.	Mackerel; (Indian and Faughn's mackerel)	*Rastrelliger kanagurta* and *Rastrelliger faughni*	Kembong
2.	Squid; (swordtip, Indian and Sibogae squid)	*Loligo edulis*, *Loligo duvaucelli* and *Loligo (Doryteuthis) sibogae*	Sotong
3.	Threadfin; (Japanese and delagoa threadfin bream).	*Nemipterus japonicus* and *Nemipterus delagoae*	Kerisi
4.	Scad; (Yellow scad and scad)	*Atule mate* and *Alepes vari*	Selar
5.	Yellow bended scad	*Selaroides leptolepis*	Selar kuning

5.3 Weighted Index

The objective of the Weighted Index (WI) process is to categorise a combination between 22 handling activities, three types of fishing gear and the selected five species in order to determine different scores that explain potential PHL. A blank Weighted Index Result (WIR) form was filled out by fishers involved in fish handling activities. The form was filled out with the code in Table 4 and analysed in Excel to calculate the final score.

Table 4: Code used to fill in the WIR form.

Code	Index preference	Score	Solver score
MI	Most important	5	0.416
IM	Important	4	0.333
MD	Moderate	2	0.167
LI	Less important	1	0.083
NI	Not important	0	0.001
	Total score		1.000

Appendix 6 shows the score in WIR as recorded by an ex-manager of the Kuantan Area Fishermen's Association and the manager of the Kuantan Fish Landing Complex. The results are summarised in Table 5, by grouping the species and fishing gears differently. WIR can be used as an early detector to recognize a problem in fish handling for any particular area or fisheries centre. Critical PHL index (the column titled "total weighted index" in Table 5) can be used as an immediate measurement to categorize the fish centre as critical or not. For this study based on the assumption that if all scores are moderate the par value for the total critical PHL index is 60 all results above or below 60 will determine whether the PHL is critical or not.

Table 5: Weighted Index Result (WIR) summary.

Handling activities along the chain	Total Weighted Index	Species					Fishing gear		
		Mackerel	Squid	Thread-fin	Scad	Y.B. Scad	Trawler	Purse seine	Long line
Catch preparation		Kembong	Sotong	Kerisi	Selar	S.Kuning	Tunda	Jerut	Kail
Setting area/place	2.67	0.58	0.33	0.50	0.42	0.83	1.25	0.75	0.67
Setting time	2.34	0.50	0.33	0.33	0.33	0.83	1.17	0.67	0.50
Mesh size/equipment	1.01	0.09	0.17	0.25	0.25	0.25	0.75	0.25	0.00
Catching	1.58	0.50	0.25	0.25	0.25	0.33	1.08	0.25	0.25
Subtotal	7.59	1.50	1.26	1.75	1.25	1.83	4.25	1.92	1.42
On-boat									
Bleeding	0.34	0.09	0.17	0.00	0.00	0.09	0.17	0.01	0.17
Gutting	0.59	0.00	0.17	0.00	0.00	0.42	0.34	0.17	0.09
Washing	1.83	0.50	0.25	0.33	0.33	0.42	1.00	0.58	0.25
Grading	2.42	0.67	0.50	0.17	0.17	0.92	1.42	0.17	0.83
Packing	2.09	0.50	0.50	0.17	0.17	0.75	1.08	0.01	1.00
Reporting	1.59	0.25	0.25	0.33	0.33	0.42	0.83	0.50	0.25
Storing	2.67	0.50	0.33	0.50	0.25	1.08	0.92	1.08	0.67
Unloading	2.17	0.42	0.33	0.42	0.33	0.67	0.75	0.92	0.50
Subtotal	13.70	3.09	2.68	3.01	1.59	3.33	6.50	3.44	3.75
Land									
Grading	2.33	0.42	0.25	0.50	0.42	0.75	0.75	1.33	0.25
Weighing/selling	3.33	0.58	0.50	0.83	0.58	0.83	1.58	1.25	0.50
Washing	2.00	0.33	0.17	0.50	0.33	0.67	1.00	1.00	0.00
Packing	2.58	0.42	0.33	0.58	0.25	1.00	1.00	1.08	0.50
Icing	2.75	0.50	0.33	0.50	0.42	1.00	1.00	1.25	0.50
Reporting	2.67	0.33	0.33	0.67	0.67	0.67	1.33	0.84	0.50
Storing	3.08	0.58	0.50	0.50	0.50	1.00	1.00	1.08	1.00
De-heading/gutting	1.34	0.00	0.34	0.33	0.33	0.33	0.83	0.50	0.00
Transportation	2.33	0.33	0.25	0.67	0.67	0.42	1.17	0.92	0.25
Marketing	2.17	0.58	0.25	0.50	0.50	0.33	1.00	0.92	0.25
Subtotal	24.59	4.09	3.26	5.58	4.67	7.00	10.66	10.17	3.76
Critical PHL index	**45.88**	**8.68**	**7.19**	**10.34**	**7.51**	**12.16**	**21.42**	**15.53**	**8.93**

5.4 HACCP Approach

The objective of preventive measures using the HAACP approach is to analyse the potential areas for PHL, identify the Critical Control Point (CCP) and establish procedures for preventive and corrective action in implementing PHL prevention. The approach is a management system in which PHL prevention is addressed through activities developed using a Handling Analysis Worksheet (HAW) and a PHL Plan Form. To analyse the criteria in this approach, one species namely mackerel, was selected. The reason mackerel was selected is because:

1. It had the highest ranking under SSF, which means that it is a high catch species, obtains high prices and has a high fluctuation gain.
2. It had the highest ranking in WIR, which means that it has high potential losses in fishing trawlers and almost all handling activities, especially in setting area/places, packing, storing, unloading, weighing / selling, icing and reporting.
3. It is one of Malaysia's favourite species and is under government policy in price control (DOSM 2004).

HAW in Appendix 7 is a worksheet used to identify the potential losses introduced, controlled or enhanced at every step in post harvest handling. From there, the measurements to prevent significant losses will be justified and the most critical parts of the handling activities will be categorized as CCP (Critical Control Point). The HAW process identified seven critical parts (CCP1 - CCP7) as important criteria in the study.

All CCP will be further analysed in the PHL Plan Form as in Appendix 8 to observe the significant loss and critical limit for each preventive measure. This plan will justify the monitoring process to see what to monitor, how to monitor, when (frequency of monitoring) and who will be involved. Finally, this plan will determine the corrective action to be used in implementation.

6 ANALYZING THE MAIN COMPONENTS

6.1 Results

6.1.1 Species selection result

The results are based on secondary data obtained from the Kuantan complex. The selected five species from SSF are the most important for analysis. The species selected here were used in subsequent steps of analysis. The results from the SSF are shown in the *Select3 Sheet* in Appendix 4 and are summarised in Table 6 below.

Table 6: Score in Result SSF.

	Mackerel	Squid	Threadfin	Scad	Yellow-bended scad
Final score	19	19	15	15	10

Based on these results, the selected species were analysed. Figure 11 shows the fish composition: big fish decreased and small fish increased within three years. This can give an idea of what has to be improved in the future. The annual average price for the years 2002, 2003 and 2004 are RM4.25, RM4.30 and RM4.56 respectively. There was not much increase in price and the margin becomes smaller if inflation is taken into account.

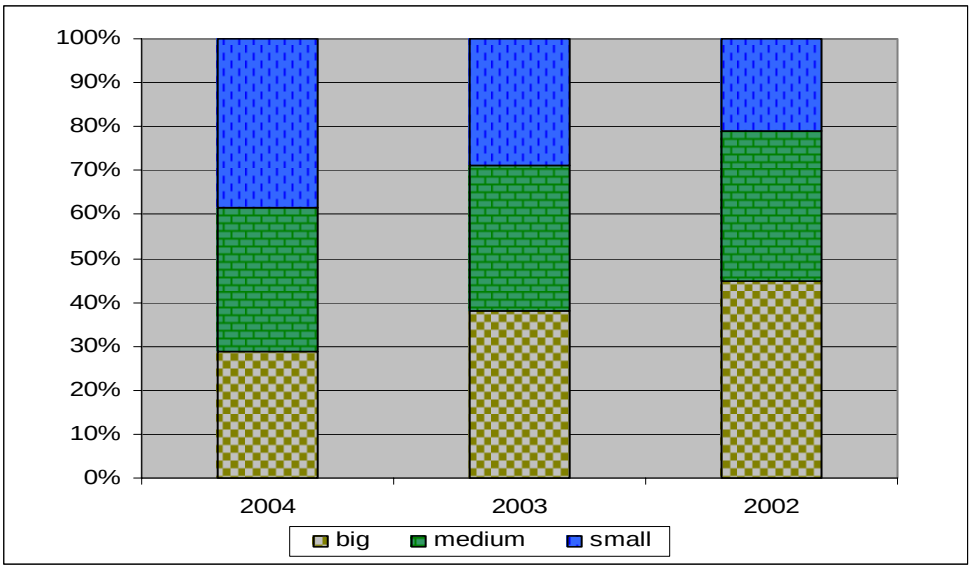


Figure 11: Size composition versus price (Ikanonline 2003).

Figure 12 shows the percentage of total fish landed by different fishing methods. Total distribution among trawlers, purse seines, and others were: 79%, 16%, and 6% respectively. The trawlers landed the most and therefore should receive the highest priority in a PHL improvement plan.

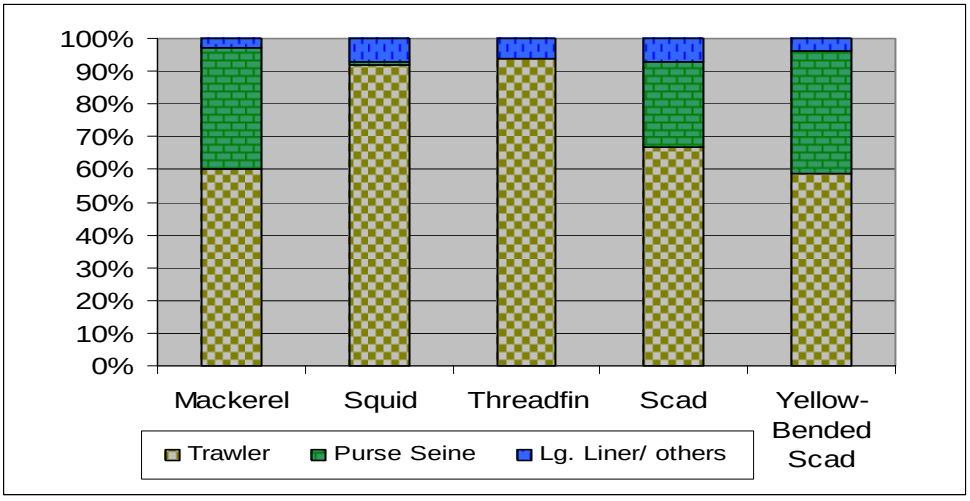


Figure 12: Percentage of catch by species and type of fishing gear .

The selected species may also be used for New Product Development (NPD) (Table 7).

Table 7: Characteristics of selected species (Sunnychai website).

Characteristics		Mackerel	Squid	Threadfin	Scad	Y.B.Scad
Scale / unscaled		Unscaled	Unscaled	Scaled	Unscaled	Unscaled
Texture		Soft	Rigid	Soft	Soft	Soft
Flesh colour		Colour	Clear	Clear	Colour	Clear
Shape		Oval	Round	Oval	Flat	Flat
Size (cm)	Length	20 - 35	20 - 40	15 - 25	20 - 30	10 – 20
	Width	3 - 5	2 – 4	3 - 6	3 - 6	2.5 - 3.5
	Thickness	2 - 4	2 – 4	2 - 4	1.5 - 2	1 - 1.5

6.1.2 Weighted Index Result

The critical PHL index in WIR is important to analyse as the results reflect the evaluation based on human experiences (primary data) in Kuantan. The WIR determined which types of species and fishing gear have the highest potential for PHL. The score results are summarised in Table 8.

Table 8: Summary of WIR by grouping of species.

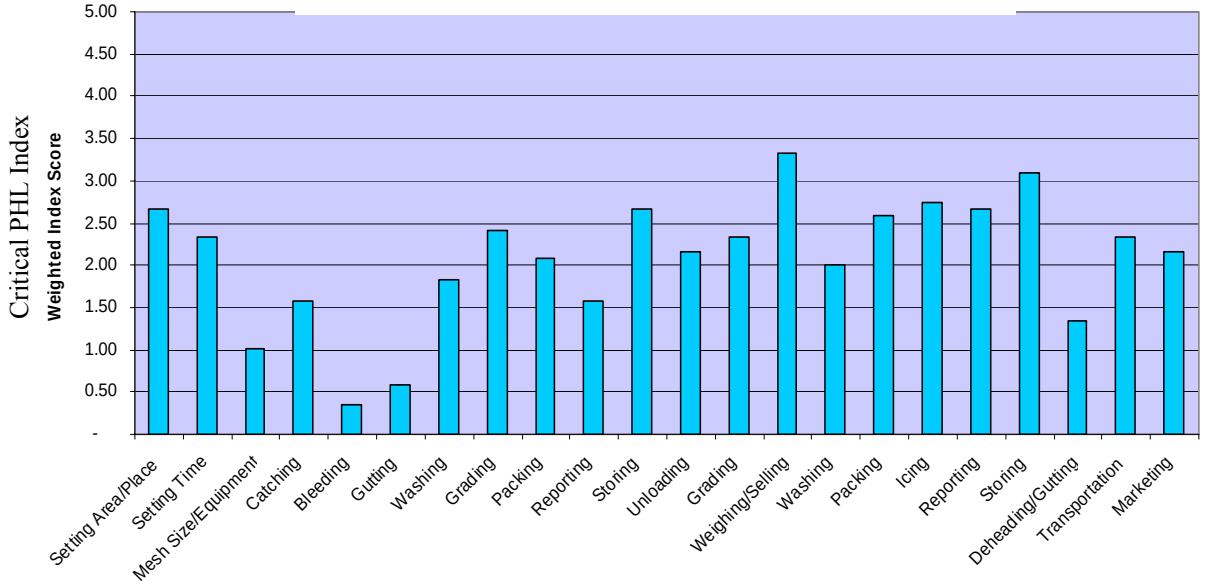
Handling activities	Total weighted value	Mackerel	Squid	Threadfin	Scad	Yellow-bended scad
Critical PHL index	45.88	12.16	8.68	7.19	10.34	7.51

Critical PHL index in the column 'total weighted value' is 46, and lower than the par-value 60, which means that the Kuantan area is below the nominal value and not critical in PHL prevention. However, the new improvement plan will be more specific, based on the above results. To determine the improvement plan, activities will be identified as simplified in the graphs in Figure 13 and explained as follows:

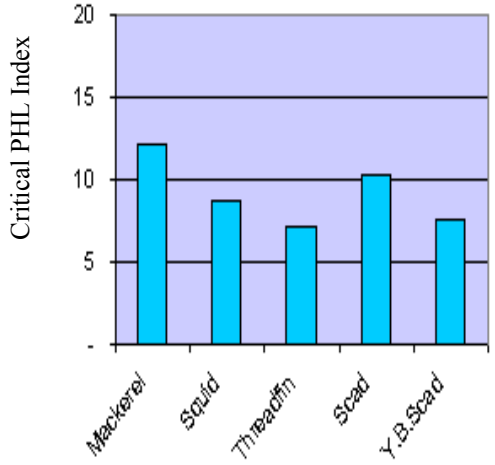
Graph (a): Compares individual activities for all species and fishing gears. The graph shows that setting area, storing, weighing/selling, packing, icing and reporting recorded the highest scores.
Graph (b): Groups activities by species. This graph shows that mackerel received the highest score, indicating that this species is more sensitive to PHL.
Graph (c): Groups activities by fishing gear. The graph shows that trawling (as a fishing gear) received the highest score, meaning that fish caught by trawling are likely to be subject to high PHL.
Graph (d): Shows that handling activities on land give the highest PHL.

From the analysis, it is shown that overall handling activities on land have the highest potential for improvement in PHL, especially in trawling for squid and mackerel.

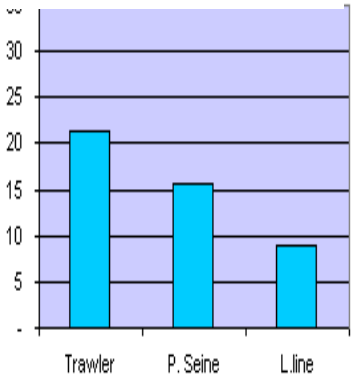
Graph (a) : All handling activities by total weighted index



Graph (b) : Species by total activities



Graph (c) : Fishing gear by total activities



Graph (d) : Subtotal activities by total activities

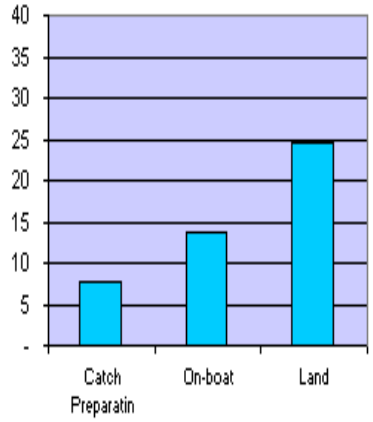
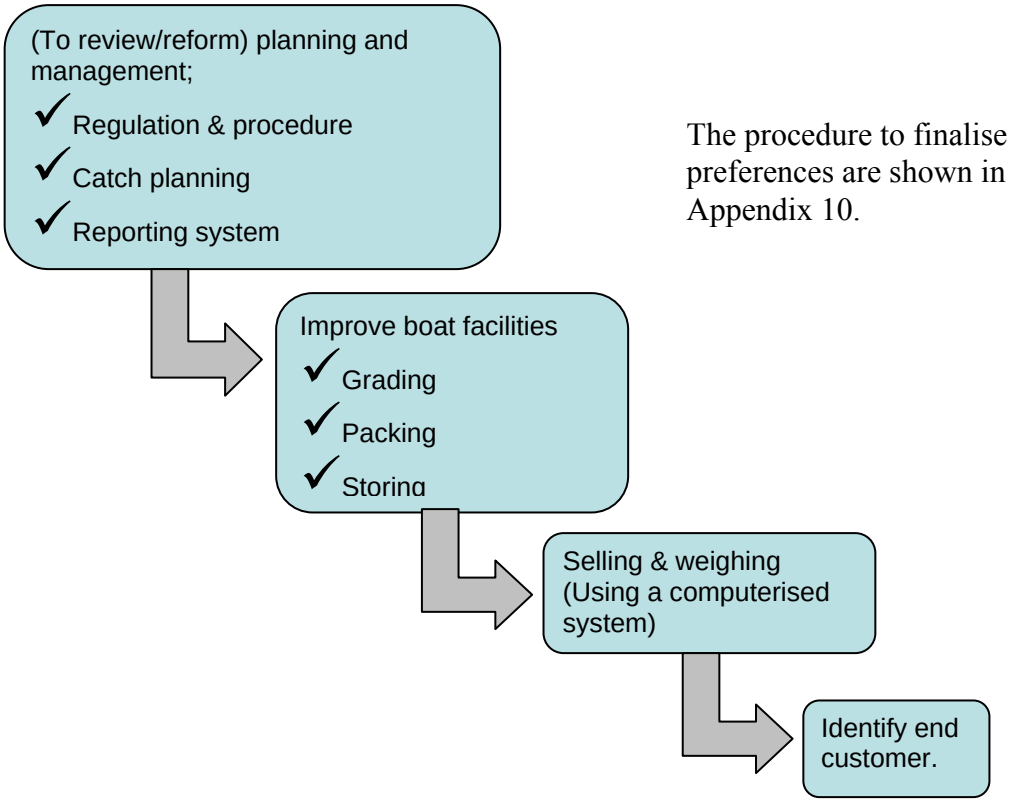


Table 9: Summarized criteria using the HACCP approach

Critical Control Point	Corrective Action Plan
CCP1 :Setting area: Restricted areas are violated.	Skipper must know the right area to set down. Enforcement officer to do routine patrols. Restricted areas must be recognized based on facts and figures
CCP2: Storing on boats: Temperature and space are not adequate.	Install a sound/light signal to detect mechanical problems. Always put the valuable fish in the front of the boat. Produce a standard manual on settings and technical checks
CCP3: Weighing and selling: Long waiting, potential of infection.	Do the species and size selection on the boat according to the final recognised customer or plant. Schedule/plan the landing time.
CCP4: Packing and repacking: Poor containers and packing techniques	Standardise the container management. Bigger containers for identified customers (factory), planning straight from boat and reduce repacking.
CCP5: Icing: Type of ice and time to icing	Reduce waiting time, continuously add enough ice and minimise fish exposure.
CCP6: Reporting: Prolong the time in linked activities.	Reporting must be straight from boats. Use recognised packing sheet and produce standard report card.
CCP7: Storing on land: Temperature and space is inadequate.	Install a sound/light signal to detect mechanical problems or temperature fault. Produce standard manual on settings and technical checks)

6.2 List of preferences for reducing PHL

Using all the facts in the above analysis, the most important priorities will be used to design an improvement plan (model) which will give the highest gain in terms of PH reduction and profit. In the overview chapter, the integrated sustainable fisheries development (ISFD) was mentioned and it described the change to comprehensive development strategy (Squires *et al.*1998). The preferences identified in this study will contribute as an input for the ISFD in Kuantan and Malaysia as a whole, and are summarized according to priority in Figure 14.



The procedure to finalise the preferences are shown in Appendix 10.

Figure 14: List of preferences.

6.2.1 Good forward planning on boats to ensure fish freshness

Management and planning

To review and reform planning is not costly and will not involve new technology. However, it is urgent and a priority compared to other activities. Activities upstream can not improve PHL much if the catch is small in size or the fish are stressed at the starting point. A regulation to control fishing areas are already in placed, therefore routine patrols in the areas should be more intensive. The skippers must have good knowledge of the regulation so as to improve the planning of their fishing trips. The government should make information about the regulation and its impact available to the skippers and other stakeholders. A reporting system for traceability must be put in place and adapted by skippers and boats owners for good vessel management. The task to improve fishing planning and good management is the responsibility of all stakeholders, but it must be motivated by authorities. Implementation of good management and planning will result in shortening handling time and an increase in composition of big and medium sized fish of commercial value. In the end, the work will be done easier and faster and with traceability it will be easier to make corrective action plans.

Improving boat facilities

Commercial boats need high investment. To build a new commercial boat in Malaysia costs from 200,000 USD to 400,000 USD. Therefore, the model proposes priority areas in which the boats owners can make investment towards modification of on-board facilities:

a) Grading facilities – increase skill of workers through training or mechanise equipment to get a standard grade and to reduce fish stress. The grading done on the boats should be according to customers' specification to reduce re-grading on shore. The grade used must be understood and satisfactory to all stakeholders in the local area. Therefore, there is a need to introduce a standardised grade.

b) Packing facilities – use appropriate containers or packing bags/sheets to make the reporting easy as well as the, loading and unloading, storing, processing and cleaning in order to reduce fish stress. The packaged fish can be delivered directly to customers according to species and sizes without opening the container. Further study to find out the most practical container size for fish packing should be carried out.

c) Storing facilities – the storage space and cooling techniques have to be determined carefully depending on type of boats, fishing gear and fish species. Standard manuals on the cooling systems should be introduced and followed by fishers (Hassan 2002).

6.2.2 Improving on shore preparation to prolong higher quality

When on-board facilities are improved, it will simultaneously assist in reducing the on-shore handling problems and reduce handling activities. Jetty or fish landing is a transit point. Efficiencies in transit will accelerate fish flow through the complex and earlier transportation to the primary customer. Hence, there is less waiting and the fish will be less stressed with minimum chance of infection. All this can be done if:

1. Selling and weighing is improved by quickening the process without stressing or exposing the fish. This is possible if the grading, packing and reporting is well done on-board. It is more efficient if a computerised auction system is applied (Latiff 2002).

2. Customers' preferences for species and sizes are identified earlier and communicated to the boat to ease sorting and grading. This is applicable where on-land activities such as frozen, semi-process and processing are active.

This improvement will protect fish from being exposed to infection from microorganisms or bacteria or from being stolen. Finally the fish stress is less and the fish temperature is maintained during handling along the chain.

6.3 Quantity and quality gain using the new model

The price and quality will be higher since the catch planning technique and the handling on-board and on-shore is improved. The results from the analysis are explained and summarised in Table 10.

Table 10: Description of quantity and quality gain after implementing the new model.

CCP1-Setting area: under control.	Fishing in the right area will give higher catches of big and moderate sized fish and reduce polluted fish. It is expected that there will be an increase in quantity and quality.
CCP2- Storing on boats: adequate temperature and space.	This preserves the water and element content in fish flesh and the state of whole fish will look better. It is expected that there will be a small increase in quantity and a great increase in quality.
CCP3- Weighing and selling: reduced waiting and potential infection.	Efficiency in this activity will reduce waiting time, potential of infection and losses. It is expected that there will be a small increase in quantity and a great increase in quality.
CCP4- Packing and repacking: improved container and technique.	Good handling in packing and less repacking will reduce fish stress, preserve water and element content in fish flesh, and reduce the potential of infection. Expected increase in quantity and quality.
CCP5- Icing: planning straight from boat and reduce waiting.	Adequate ice availability at all linked handling stages will preserve the water and element content in fish flesh and reduce the potential for infection. Expected increase in quantity and quality.
CCP6- Reporting: regular and standard reporting.	Good reporting will improve the other activities, reduce missed calculations and the risk of lowering the fish grade. A small increase in both quantity and quality is expected.
CCP7- Storing on land: adequate temperature and space.	Good preparation and less waiting for storing will preserve the water and element content in fish flesh and the state of whole fish will look better. A small increase in quantity and a large increase in quality is expected.

Based on the above, an estimate on the handling contribution rate (HCR) of each activity is given in Table 11. The sum of the HCR is the expected contribution to the increment in price and quantity as a whole if the corrective action is done.

Table 11: HCR of each activity with respect to quantity and price (estimation developed with supervisor Magnus Magnusson, former plant manager and fleet manager one of the biggest fishing companies in Iceland).

Improvement in CCP activities	**Handling Contribution Rate (HCR)**	
	Quantity	**Price**
CCP1- Setting area: restricted area under control.	2.0	3.0
CCP2- Storing onboard: adequate temperature and space.	1.5	8.0
CCP3-Weighing and selling: reduce waiting and potential infection.	2.0	6.0
CCP4- Packing and repacking: improve containers and techniques.	2.0	5.0
CCP5- Icing: plan from boat and reduce waiting.	1.0	5.0
CCP6- Reporting: regular and standard reporting.	0.5	2.0
CCP7- Storing on land: adequate temperature and space.	1.0	6.0
Total Handling Contribution Rate (HCR)	**10.0**	**35.0**

The total HCR will be used as a multiplier factor in estimating price and quantity increment for each species. Using the result from SSF and WIR (as shown in Table 6 and Table 8 (respectively)), the respective total scores are used as Species Adjusted Value (SAV) as shown in Table 12. The total HCR from Table 11 for quantity is 10 and for price is 35. These will be multiplied with all the SAV to get the Estimated Percentage Increment (EPI) for quantity and price in each species. EPI determines distribution of increment in price and quantity according to each species once the corrective action is done.

Table 12: Distribution value of each species.

Species	Score result		Total score WIR & SSF	Species Adjusted Value (SAV)	Estimated Percentage Increment (EPI)	
					Quantity	Price
	WIR	SSF			**10**	**35**
Mackerel	12.16	19	31.16	0.25	2.5%	8.8%
Squid	8.68	19	27.68	0.22	2.2%	7.8%
Threadfin	7.19	15	22.19	0.18	1.8%	6.3%
Scad	10.34	15	25.34	0.20	2.0%	7.2%
Y. B. Scad	7.51	10	17.51	0.14	1.4%	4.9%
			123.88	1.00	10.0%	35.0%

6.4 Total revenue gain in Kuantan

The estimated percentage increment from Table 12 is used as a quantity and price increment multiplier factor for the model. Estimated Revenue Gain (ERG) for the five species calculated in Table 13 gives a total of RM 3.5million (USD 930,000).

Table 13: Estimated TRG from the selected five species in Kuantan for one Year.

Species	Before new prevention model			Increment (EPI)		**Increment after new prevention model**			
	Qty	Price	Total	Qty	Price	Qty	Price	Total	Gain (ERG)
Mackerel	1,620,086	4.56	7,386,637	2.5%	8.8%	1,660,840	4.96	8,239,161	852,524
Squid	2,977,688	5.56	16,553,636	2.2%	7.8%	3,044,226	5.99	18,247,111	1,693,475
Threadfin	1,736,311	2.52	4,368,865	1.8%	6.3%	1,767,416	2.67	4,725,972	357,107
Scad	1,244,210	3.90	4,852,690	2.0%	7.2%	1,269,658	4.18	5,306,431	453,741
Y.B. Scad	1,294,079	2.10	2,717,965	1.4%	4.9%	1,312,366	2.20	2,892,704	174,738
Total	8,872,374		35,879,794			9,054,506		39,411,379	3,531,585

In the process of implementing the new model, there will be a marginal increase in gain every year. Based on experience in Iceland, within 12 years the total revenue increase will be up to 117% (MOF, Statistics Iceland). In this study, the increment is 10%.

6.5 Cost implication

The first preference, '*Management and Planning*' is not costly, but it will take time to mobilise all components involved and it needs the corporation of all stakeholders. For the '*Improving Boat Facilities'***,** a financial injection will be needed. With respect to the second preference, to prolong higher quality on-shore, this is more costly and will involve entrepreneurship and innovation for product development. Based on experience in Iceland regarding the annual gain that was estimated, some cost implications for the Kuantan fisheries sector can be foreseen as shown in Table 14.

Table 14: Cost implication for PHL improvement in Kuantan.

Item	Cost	Number of Benefit
Two thirds of the total gain for staffing improvements: • 50% for intake of new professional workers (estimated at: RM 18,000/graduate staff/annum) 50% for course and training (estimated at RM 1,500/staff /annum)	RM2.2 million (RM1.1 mil) (RM1.1 mil)	- 60 workers 730 workers
One third of the total gain for other expenditures • 100% for quick/fast freezer (estimated cost/unit RM 100,000/unit /annum)	RM1.1 million -	11 freezer units

The above explanation gives a simplified picture of the benefit which was not taken into account when the Kuantan fish landing complexes were constructed 12 years ago, to improve to the modern and systematic facilities that currently exist in Kuantan.

6.6 National implications

Accordingly, the gain and benefit from PHL prevention will also effectively contribute in the national and regional context. Fishermen, a target group for national poverty reduction, will have additional incomes. In terms of food security, Kuantan producers will contribute a hygienic and safe food product for the consumers. The fishery sector in Kuantan will help in nation building through reducing unemployment especially for post-graduate students. By producing hygienic and good raw material, it will encourage the factories to produce high-class products which can be exported and have a good impact on trade and reduce export deficit. All the improvements will increase gross domestic production (GDP) for the agriculture and services sectors.

All parties should receive their part of the gains as everybody will pay for the handling cost: suppliers will bear the cost of labour and technology; primary customers will bear the cost of the higher weight, long shelf life and higher element content; while end users or consumers bear the cost of the whole product. Therefore, as a whole, all parties will share the cost and the gain. In real benefit, not only the five species mentioned in this paper will be improved, but also almost all valuable species in Kuantan.

7 CONCLUDING REMARKS

The objective of the study was to analyse fish handling activities which can be improved in Kuantan using a prevention model developed with the experience of Iceland. The fish species and handling activities that are important in PHL prevention were identified. The preferences showed that some elements in management and planning, boat facilities, auctioning and the marketing system needed immediate improvement. Therefore, based on the experience in Iceland, improvements were highlighted that can be applied in Malaysia. PHL still remains a universal problem. It will be a continuous effort at least for the next decade. Hopefully, the model developed here, will also be applied in other areas of the country and the region.

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APPENDICES
APPENDIX 1: *QIM-EUROFISH*

QIM EUROFISH

QIM - your ideal tool for quality determination of fish freshness

QIM - the principle

The Quality Index Method (QIM) is based upon objective evaluation of certain attributes of raw fish (skin, eyes, gills etc) using a points scoring system (from 0 to 3). No excessive emphasis is laid on a single attribute so a sample cannot be rejected on the basis of a single criterion. Minor differences in results for any one criterion do not unduly influence the total QIM score. The lower the score the fresher the fish.

QIM - how does it work?

The example for salmon is described below. A trained QIM inspector gives a score from 0 to 3 for each of the key attributes of a fish. A minimum of three fishes per lot is evaluated and averaged to reduce effects of natural variations. The total QIM score is then compared to a QIM calibration curve to establish the relative freshness in terms of storage days in ice. In this way an estimate of remaining shelflife can also accurately be made.

QIM - rapid and reliable

A software program for the determination of fish freshness based upon QIM has also been developed. Using convenient hand-held terminals a QIM assessment is fast and reliable. The software guides the inspector through the inspection. To facilitate judgement, pictures of the attributes (gills, eyes, skin) to be inspected can also be used. QIM procedures for 12 fish species have now been developed. New ones are under development. QIM schemes and calibration curves are currently available for cod, plaice, haddock, red fish, sole, shrimp (*Pandalus borealis*), turbot, ocean perch, brill, pollock, dab and salmon.

QIM - the benefits

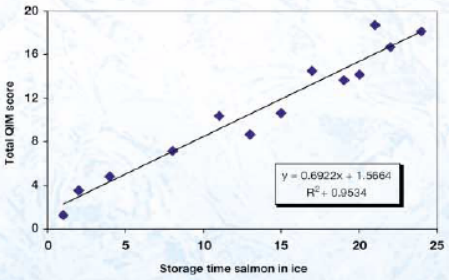
Fast, more accurate than previously possible. The key benefit of QIM is that the method provides the user (producers, buyers, sellers and retailers) with a reliable and standardized freshness measure of a product. Measurements can of course be done at any time - on arrival at the fish plant, in stock or during sale at auction. The potential of a computerised QIM system, linked with the latest telecom technologies, creates possibilities far beyond those of traditional paper documentation. Implementation of QIM across Europe is discussed in the EU Concerted Action FAIR PL98-4174 'Fish Quality Labelling and Monitoring'.

QIM - how to implement?

QIM Eurofish can help you implement QIM to evaluate the freshness of raw fish. Introductory QIM workshops and selecting and training staff as inspectors in your organisation are possible with QIM Eurofish. Development of new QIM standards for species of interest for your company is also feasible with QIM Eurofish.

For more information consult the website www.qim-eurofish.com or send an email to info@qim-eurofish.com to contact your national QIM Eurofish expert.

QIM - calibration curve for salmon



QIM - scheme for salmon

Freshness quality parameters		Description	QIM score
Skin	Colour/ appearance	*Pearl-shiny all over the skin*	0
		The skin is less pearl-shiny	1
		The fish is yellowish, mainly near the abdomen	2
	Mucus	*Clear, not clotted*	0
		Milky, clotted	1
		Yellow and clotted	2
	Odour	*Fresh seaweedy, neutral*	0
		Cucumber, metal, hey	1
		Sour, dish cloth	2
		Rotten	3
	Texture	*In rigor*	0
		Finger mark disappears rapidly	1
		Finger leaves mark over 3 seconds	2
Eyes	Pupils	*Clear and black, metal shiny*	0
		Dark grey	1
		Mat, grey	2
	Form	*Convex*	0
		Flat	1
		Sunken	2
Gills	Colour	*Red/dark brown*	0
		Pale red, pink/light brown	1
		Grey-brown, brown, grey, green	2
	Mucus	*Transparent*	0
		Milky, clotted	1
		Brown, clotted	2
	Odour	*Fresh, seaweed*	0
		Metal, cucumber	1
		Sour, mouldy	2
		Rotten	3
Abdomen	Blood in abdomen	*Blood red/not present*	0
		Blood more brown, yellowish	1
	Odour	*Neutral*	0
		Cucumber, melon	1
		Sour, reminds of fermentation	2
		Rotten/rotten cabbage	3
Total QIM score			0-24

APPENDIX 2: ARTICLE 11 – POST HARVEST PRACTICES AND TRADE IN CODE OF CONDUCT FOR RESPONSIBLE FISHERIES

- **Article 11.1 Responsible fish utilization**
- Article 11.2 Responsible international trade
- Article 11.3 Laws and regulations relating to fish trade

11.1 Responsible fish utilization

11.1.1 States should adopt appropriate measures to ensure the right of consumers to safe, wholesome and unadulterated fish and fishery products.

11.1.2 States should establish and maintain effective national safety and quality assurance systems to protect consumer health and prevent commercial fraud.

11.1.3 States should set minimum standards for safety and quality assurance and make sure that these standards are effectively applied throughout the industry. They should promote the implementation of quality standards agreed within the context of the FAO/WHO Codex Alimentarius Commission and other relevant organizations or arrangements.

11.1.4 States should cooperate to achieve harmonization, or mutual recognition, or both, of national sanitary measures and certification programmes as appropriate and explore possibilities for the establishment of mutually recognized control and certification agencies.

11.1.5 States should give due consideration to the economic and social role of the post-harvest fisheries sector when formulating national policies for the sustainable development and utilization of fishery resources.

11.1.6 States and relevant organizations should sponsor research in fish technology and quality assurance and **support projects to improve post-harvest handling of fish, taking into account the economic, social, environmental and nutritional impact** of such projects.

11.1.7 States, noting the existence of different production methods, should through cooperation and by facilitating the development and transfer of appropriate technologies, ensure that processing, transporting and storage methods are environmentally sound.

11.1.8 States should encourage those involved in fish processing, distribution and marketing to:

a. **reduce post-harvest losses and waste**;
b. **improve the use of by-catch to the extent that this is consistent with responsible fisheries management practices**; and
c. use the resources, especially water and energy, in particular wood, in an environmentally sound manner.

11.1.9 States should encourage the use of fish for human consumption and promote consumption of fish whenever appropriate.

11.1.10 States should cooperate in order **to facilitate the production of value-added products** by developing countries.
11.1.11 States should ensure that international and domestic trade in fish and fishery products accords with sound conservation and management practices through improving the identification of the origin of fish and fishery products traded.

11.1.12 States should ensure that environmental effects of post- harvest activities are considered in the development of related laws, regulations and policies without creating any market distortions.

Note 1 :

Source: Code of Conduct for Responsible Fisheries, http://www.fao.org/fi/agreem/codecond/codecon.asp

APPENDIX 3: QUESTION AS A GUIDE IN ANALYSIS FROM PHO MANUAL

SUPPLY

POLICY CHECK:

• How have supplies of fish changed in recent years and what have been the major reasons for such changes?

Planning Check:

• How have landings changed in terms of species and total landings?
• How have these changes occurred across the seasons?
• What are the reasons for these changes?
• How has the distribution of landings changed across different landing sites? Why has this occurred?
• Are the landings originating from different classes of vessels/gears? If so why?
• How is the ownership of catching capacity changing? Why has this occurred?
• What role has the expansion of aquaculture and increased fish imports played in increasing supplies?
• How has the role of by-catch in supplies changed?

TRANSFORMATION

POLICY CHECK:

• How has the way fish are preserved and processed changed and why?
• How have the prices of fish relative to other protein sources changed?
• What major changes in the destination of fish have occurred and why?

Planning Check:

• To what extent has ice production, freezer and cold storage facilities increased in capacity and distribution throughout the country?
• What impact has this had on traditional processing activities?
• It what ways has the concentration of fleets on fewer landing sites affected traditional processing and trading practices?
• How have changes in fuel wood and salt supplies affected processing?
• How has the role of by-catch changed in the market?
• How have these changes affected the different stakeholders in processing and trading? Why have they been affected?
• How have the different roles and responsibilities of men and women in the sector changed? How has this affected the household?
• How have these changes affected the makers of traditional packaging materials?
• How has demand for product from overseas changed processing, packaging, storage and handling procedures?
• How have foreign safety, environmental, and hygiene regulations impacted upon the sector?

CONSUMPTION

POLICY CHECK:

• How have changes in fish supply and transformation affected national food security and how are the poor specifically affected?

Planning Check:

• How has macro-level consumption patterns changed?

• Does a greater percentage of fish now enter the international markets? If so, which ones?

• How has the consumption of fish in fishing villages changed and why?

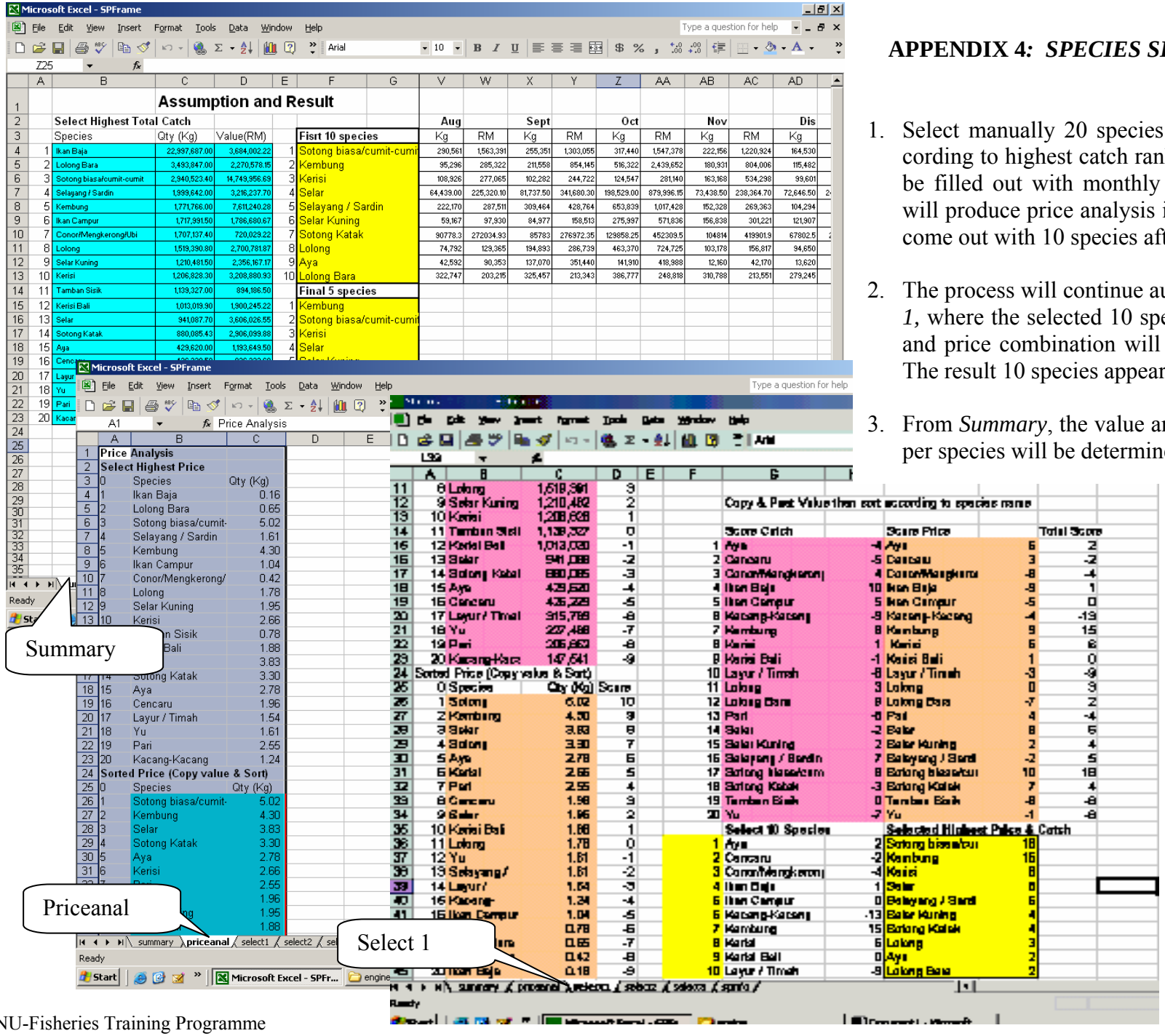
• How have changes in the price of fish affected access to fish by different consumers?

• How have the poor been affected? How have they adapted or coped?

• Is any domestic shortfall in supply being met by increased imports or fish from aquaculture?

Source : PHO manual DFID.2003.

APPENDIX 4: *SPECIES SELECTION ENGINE*



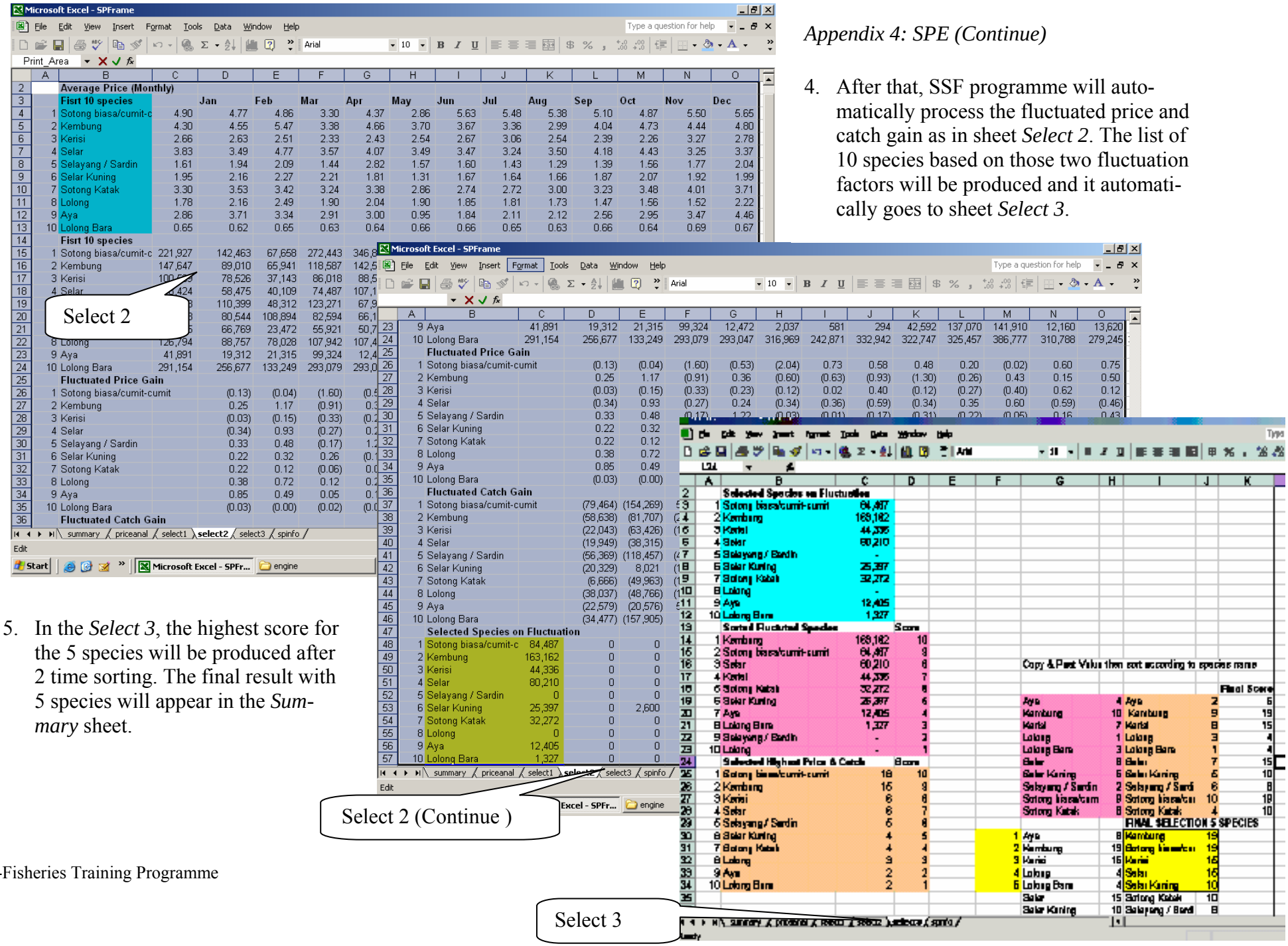
1. Select manually 20 species by sorting all species according to highest catch ranking per year. The list will be filled out with monthly value for each species. It will produce price analysis in sheet *Priceanal* and will come out with 10 species after sorting.

2. The process will continue automatically in sheet *Select 1*, where the selected 10 species based on factor catch and price combination will be produced after sorting. The result 10 species appear in *Summary* sheet.

3. From *Summary*, the value and quantity for each month per species will be determined.

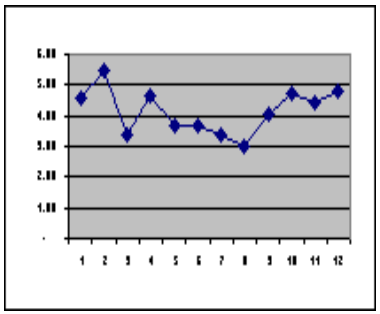
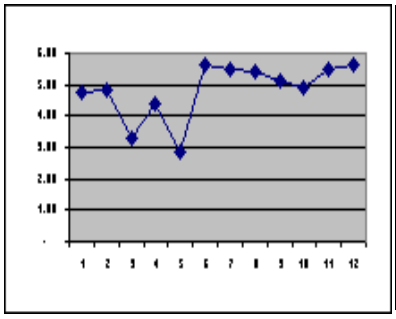
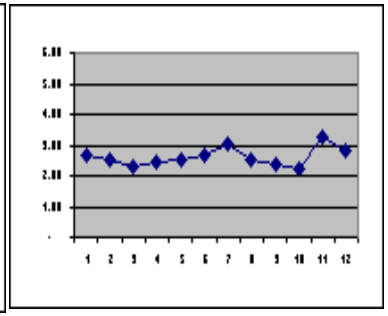
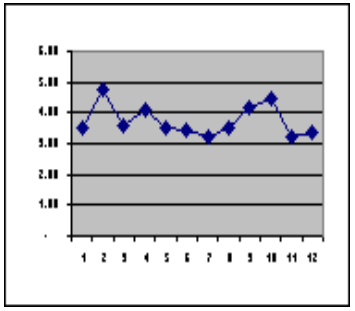
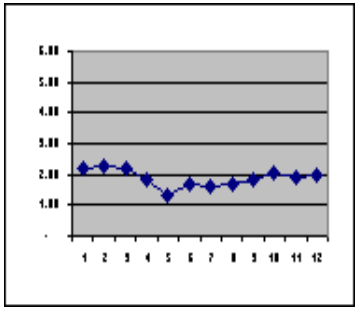
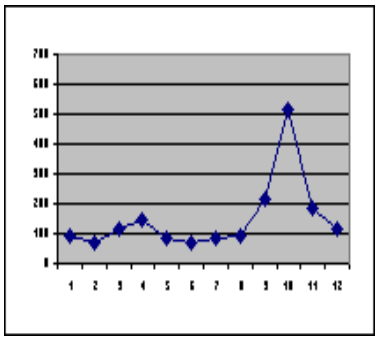
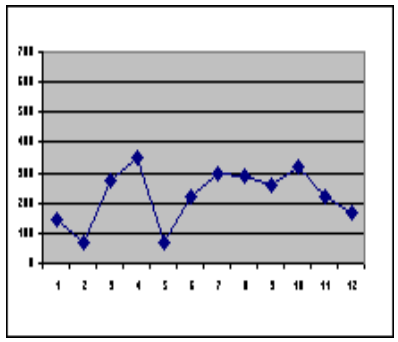
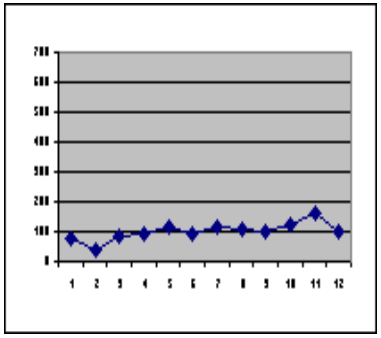
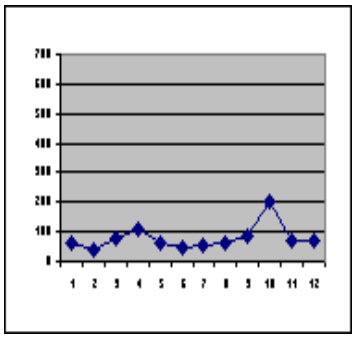
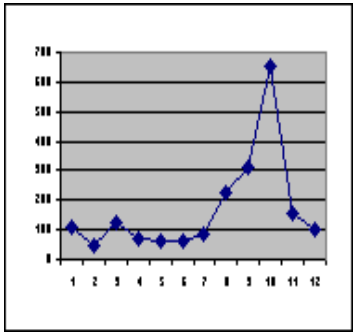
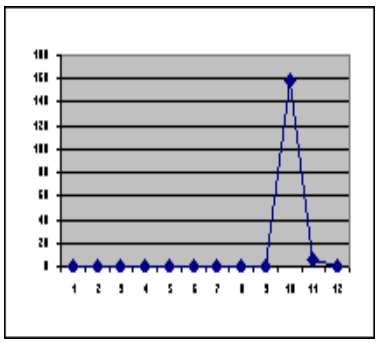
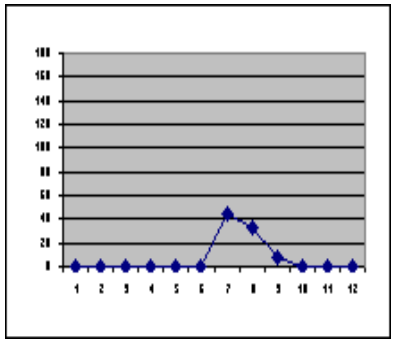
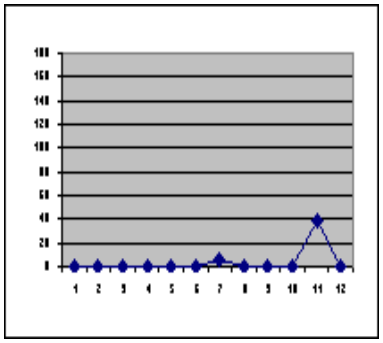
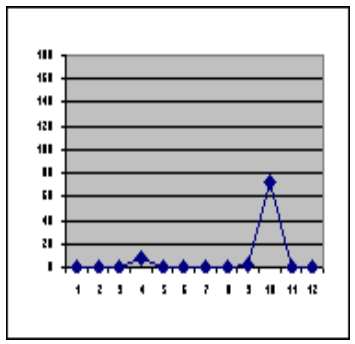
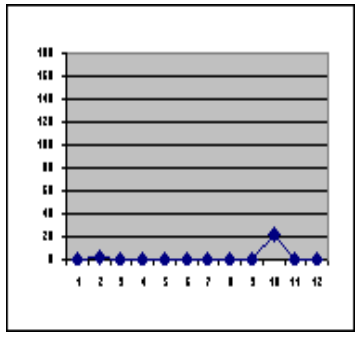
Appendix 4: SPE (Continue)

4. After that, SSF programme will automatically process the fluctuated price and catch gain as in sheet *Select 2*. The list of 10 species based on those two fluctuation factors will be produced and it automatically goes to sheet *Select 3*.



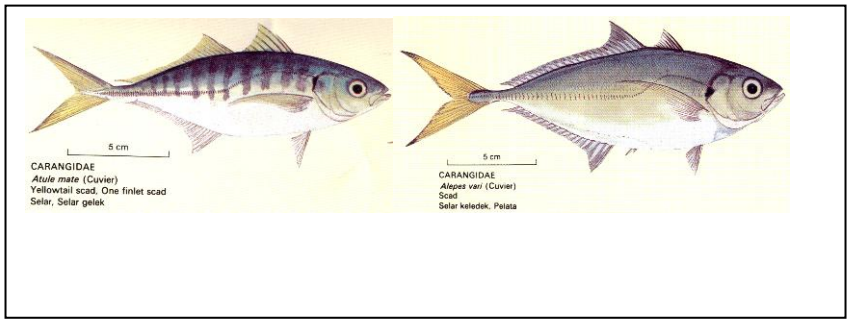
5. In the *Select 3*, the highest score for the 5 species will be produced after 2 time sorting. The final result with 5 species will appear in the *Summary* sheet.

APPENDIX 5 : FLUCTUATION GRAPH FROM THE 'SPECIES SELECTION FRAME'.

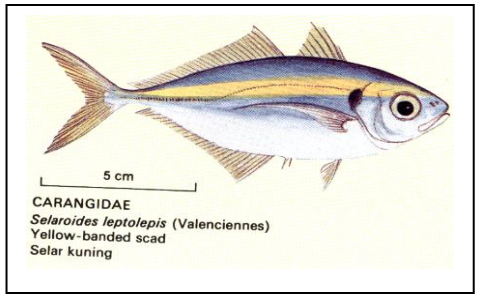
	Mackerel	Squid	Threadfin	Scad	Yel. Bended Scad
Price (RM / kg)					
Catch (Thausand Kg)					
Revenue from Fluctuation (Thau RM)					

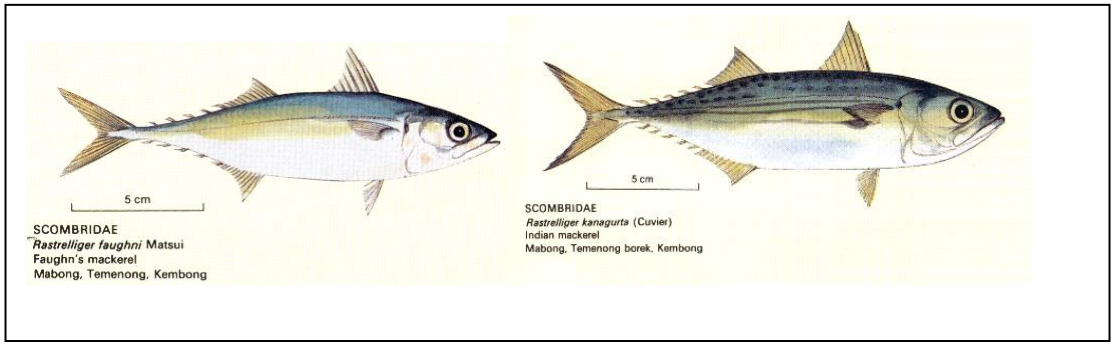
APPENDIX 6 : CARANGIDAE, SCOMBRIDAE AND NEMIPTERIDAE FAMILY

Selar (Scad)

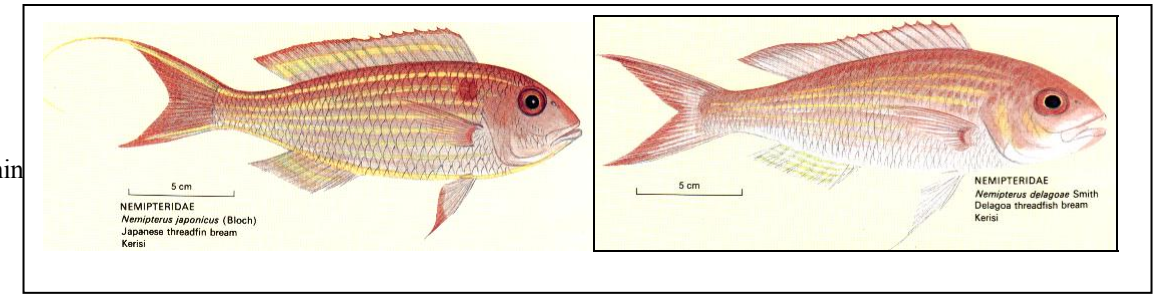


Selar kuning (Yellow bended scad)



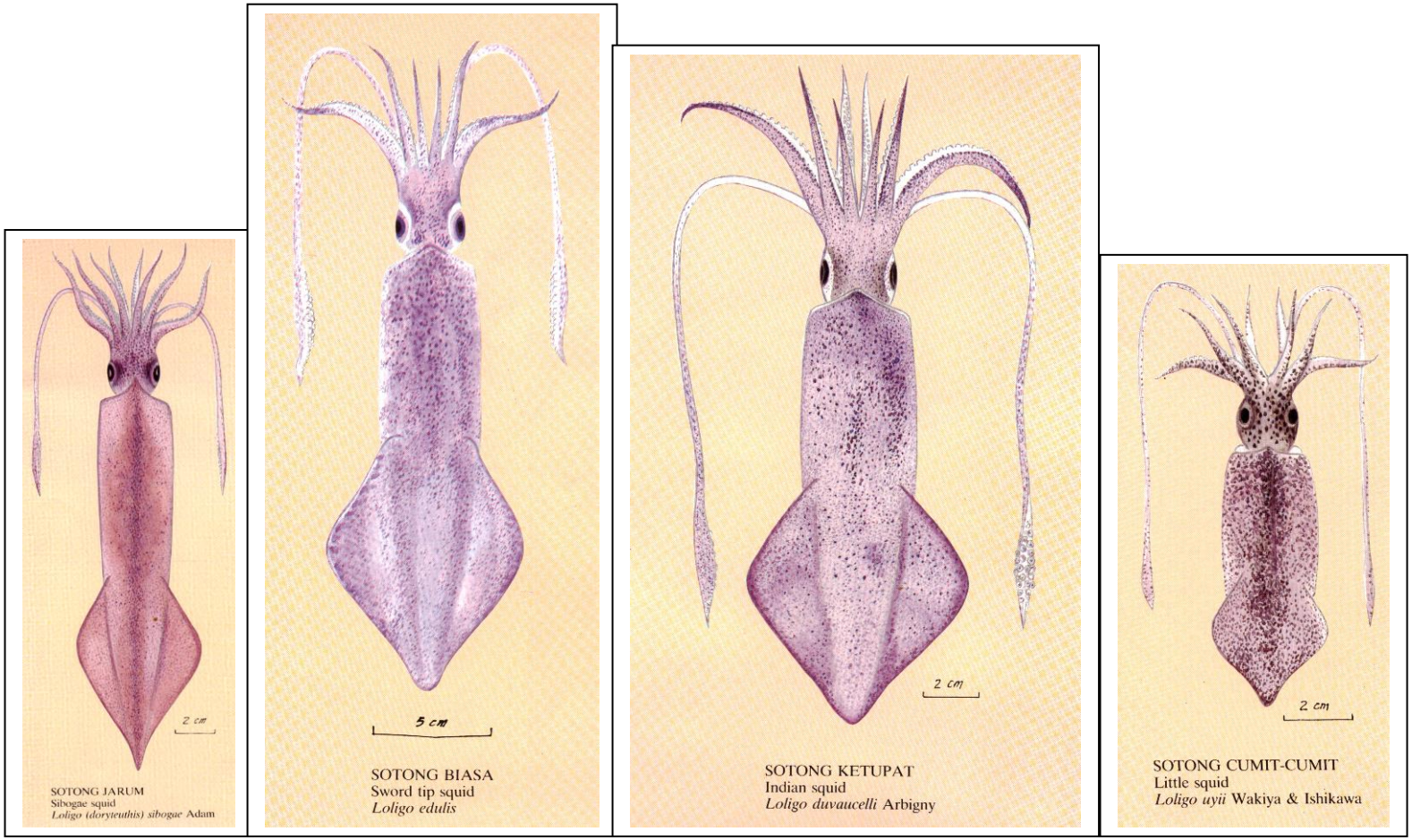


Kembong (Mackerel)



Kerisi (Threadfin)

Appendix 6: (Continue) Squid



APPENDIX 7 : *WEIGHTED INDEX RESULT (WIR)*

Handling Activities Along the Chain.	Total Weighted Value	Trawler					Sub Total Weighted Index	Purse seine					Sub Total Weighted Index	Long Line					Sub Total Weighted Index
		Indian/spanish mackerel	Squid	Japan/Delago Th.fish Bream	Scad/Yellow tail Scad	Yellow Bended Scad		Indian/spanish mackerel	Squid	Japan/Delago Th.fish Bream	Scad/Yellow tail Scad	Yellow Bended Scad		Indian/spanish mackerel	Squid	Japan/Delago Th.fish Bream	Scad/Yellow tail Scad	Yellow Bended Scad	
Weighted code:																			
MI,IM,MD,LI,NI		kembg	stg	krsi	selar	S.kng		kembg	stg	krsi	selar	S.kng		kemb	stg	krs	selar	S.kng	
Catch Preparation																			
Setting Area/Place	2.67	0.33	0.08	0.17	0.33	0.33	1.25	0.33	0.17	0.00	0.17	0.08	0.75	0.17	0.33	0.17	0.00	0.00	0.67
Setting Time	2.34	0.33	0.33	0.17	0.17	0.17	1.17	0.33	0.00	0.00	0.17	0.17	0.67	0.17	0.17	0.17	0.00	0.00	0.50
Mesh Size/Equipment	1.01	0.17	0.08	0.17	0.17	0.17	0.75	0.08	0.00	0.00	0.08	0.08	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Catching	1.58	0.17	0.42	0.17	0.17	0.17	1.08	0.08	0.00	0.00	0.08	0.08	0.25	0.08	0.08	0.08	0.00	0.00	0.25
Subtotal	7.59	1.00	0.92	0.67	0.83	0.83	4.25	0.83	0.17	0.00	0.50	0.42	1.92	0.42	0.58	0.42	0.00	0.00	1.42
On-boat																			
Bleeding	0.34	0.08	0.00	0.08	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.08	0.08	0.00	0.00	0.17
Gutting	0.59	0.17	0.00	0.17	0.00	0.00	0.34	0.17	0.00	0.00	0.00	0.00	0.17	0.08	0.00	0.00	0.00	0.00	0.09
Washing	1.83	0.17	0.33	0.17	0.17	0.17	1.00	0.17	0.08	0.00	0.17	0.17	0.58	0.08	0.08	0.08	0.00	0.00	0.25
Grading	2.42	0.42	0.33	0.33	0.17	0.17	1.42	0.17	0.00	0.00	0.00	0.00	0.17	0.33	0.33	0.17	0.00	0.00	0.83
Packing	2.09	0.42	0.17	0.17	0.17	0.17	1.08	0.00	0.00	0.00	0.00	0.00	0.01	0.33	0.33	0.33	0.00	0.00	1.00
Reporting	1.59	0.17	0.17	0.17	0.17	0.17	0.83	0.17	0.00	0.00	0.17	0.17	0.50	0.08	0.08	0.08	0.00	0.00	0.25
Storing	2.67	0.33	0.17	0.17	0.17	0.08	0.92	0.42	0.17	0.00	0.33	0.17	1.08	0.33	0.17	0.17	0.00	0.00	0.67
Unloading	2.17	0.42	0.08	0.17	0.08	0.00	0.75	0.08	0.17	0.00	0.33	0.33	0.92	0.17	0.17	0.17	0.00	0.00	0.50
Subtotal	13.70	2.16	1.25	1.42	0.92	0.75	6.50	1.17	0.42	0.01	1.00	0.84	3.44	1.42	1.25	1.08	0.01	0.01	3.75
Land																			
Grading	2.33	0.33	0.17	0.08	0.08	0.08	0.75	0.42	0.17	0.00	0.42	0.33	1.33	0.00	0.08	0.17	0.00	0.00	0.25
Weighing/Selling	3.33	0.33	0.33	0.33	0.42	0.17	1.58	0.33	0.08	0.00	0.42	0.42	1.25	0.17	0.17	0.17	0.00	0.00	0.50
Washing	2.00	0.33	0.17	0.17	0.17	0.17	1.00	0.33	0.17	0.00	0.33	0.17	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Packing	2.58	0.42	0.17	0.17	0.17	0.08	1.00	0.42	0.08	0.00	0.42	0.17	1.08	0.17	0.17	0.17	0.00	0.00	0.50
Icing	2.75	0.42	0.17	0.17	0.17	0.08	1.00	0.42	0.17	0.00	0.33	0.33	1.25	0.17	0.17	0.17	0.00	0.00	0.50
Reporting	2.67	0.33	0.17	0.17	0.33	0.33	1.33	0.17	0.00	0.00	0.33	0.33	0.84	0.17	0.17	0.17	0.00	0.00	0.50
Storing	3.08	0.33	0.17	0.17	0.17	0.17	1.00	0.33	0.08	0.00	0.33	0.33	1.08	0.33	0.33	0.33	0.00	0.00	1.00
Deheading/Gutting	1.34	0.17	0.00	0.33	0.17	0.17	0.83	0.17	0.00	0.00	0.17	0.17	0.50	0.00	0.00	0.00	0.00	0.00	0.00
Transportation	2.33	0.17	0.17	0.17	0.33	0.33	1.17	0.17	0.08	0.00	0.33	0.33	0.92	0.08	0.08	0.08	0.00	0.00	0.25
Marketing	2.17	0.08	0.42	0.17	0.17	0.17	1.00	0.17	0.08	0.00	0.33	0.33	0.92	0.08	0.08	0.08	0.00	0.00	0.25
Subtotal	24.59	2.91	1.92	1.92	2.17	1.75	10.66	2.91	0.92	0.01	3.41	2.92	10.17	1.17	1.25	1.34	0.01	0.01	3.76
Critical PHL index	**45.88**	**6.08**	**4.08**	**4.00**	**3.92**	**3.34**	**21.42**	**4.91**	**1.51**	**0.02**	**4.92**	**4.17**	**15.53**	**3.01**	**3.09**	**2.84**	**0.02**	**0.02**	**8.93**

APPENDIX 8: HANDLING ANALYSIS WORKSHEET (BASE ON MACKEREL)

(1)	(2)	(3)	(4)	(5)	(6)
Process or Step in PHL Handling	Identify potential PHL Introduced or Controlled at step (1) (Quality/Quantity)	Are there any potential to PHL Significant (Yes / No)	Justify the decision on potential in column 3	What Preventive Measure can apply to prevent the significant PHL?	Is this step a Critical Control Point (Yes/No) (CCP)
Catch Planning					
Setting Area / Place	Quality and quantity	Yes	In the spawning and polluted area – It is small fish, less weight and low price.	Zoning the Area and routine enforcement (Coastal / EEZ)	CCP1
Setting Time	Quality	Yes	Right time for the right species or fish size and length of fishing day determined the quality of catch.	Limit the efforts in certain areas and season.	
Setting Mesh Size / Fishing gear.	Quantity	Yes	No mackerel for bottom trawls. Mesh size and gear determined the fish sizes.	Get the experiences skipper for middle trawls and right mesh size and length.	
Catching technique- the way of handling catch from water	Quality and Quantity	Yes	Net intervening time and the way of loading can determine fish stress. Wrong selection part of school caused full feed fish.	Get the experience skipper. Get ready with loading facilities onboard. Set net intervening time or install sensory equipment.	
On-Boat Handling					
Bleeding	No	No	It is not suitable for bleeding and no special demand for bleeding fish.		
Gutting and / de-heading	Quantity and Quality	Yes	It is new Proposal - to give new choice for customers. Waiting time and improper gutting method will decrease weight and quality.	Look for NPD in gutted mackerel. Do handlings immediately. Keep clean and always in icing. Increase workers or new machinery for gutting on-boats.	
Washing	Quality (Chemical and Biological)	Yes	Microorganism, waste, mud and smell trapped. Bacteria active after rigor process cause higher losses.	Use clean seawater immediately. Use suitable container or equipment to less fish stress.	
Grading	Quality and Quantity	Yes	Inaccurate grading reflected the price setting. Is a complimentary step to faster weighing and selling.	Standardize the grade. Special request for factory or bulk supply recognize earlier before packing and storing.	
(1)	(2)	(3)	(4)	(5)	(6)
Process or Step in PHL Handling	Identify potential PHL Introduced or Controlled at	Are there any potential to PHL Signifi-	Justify the decision on potential in column 3	What Preventive Measure can apply to prevent the significant PHL?	Is this step a Critical Control Point

	step (1)	cant			(Yes/No)
Packing	Quantity and Quality	Yes	Waiting[1] time increased fish temperature. Different grade and species in one box difficult for next handling. Packing determined the whole fish structure look like.	Clean boxes, plastics, container and ice are sufficient. Right fish arrange. Right ratio; Ice:Fish. Clear in reporting the packed container.	
Reporting	Traceability of Quality and Quantity	Yes	Used for management purposes. Confusing in day of catch, species, sizes and grade would be difficult other handling activities.	Prepare with standard sheet/form to put the report. Do the reporting immediately before storing.	
Storing	Quality	Yes	Temperature is not meet as required. Poor arrangement- some fish compress, unrecognized the first in / first out. Improper storage delay unloading and increase waiting time.	Storage facility must easy to manage, sufficiency shelf / space. Install automatics device and alarm system to control temperature.	CCP2
Unloading	Quality and Quantity	Yes	Fish structure is stressed and fish fallen and some are confiscated (Klepek)[2]. Long waiting is disappointed good customers.	Mechanize (Crane and conveyer system) and use suitable container to less stress and faster.	
Land Handling					
Weighing and selling	Quality and Quantity	Yes	Long waiting and too much touching of fish will increased fish temperature & spoil fish muscle. Less precise in estimated water and ice. Some are confiscated.	Find the alternative method to reduce time. Use automatic scale and keep fish on icing during waiting or use new technology in computerized auction.	CCP3
Grading and Re-grading	Quality and quantity	Yes	Long waiting will increased fish temperature. Too much touching wills spoilage fish muscle. Exposed to confiscated and bacteria infection.	No repeating practice, do it once onboard and report clearly to ease other handling get traced customer's feedback. Mechanize for certain part.	
Gutting and / Beheading	Quality and Quantity	Yes	Long waiting and exposed; increased fish temperature and infection by parasite / bacteria. Confiscating and improper work reduces fish weight.	Operate in close area, no fly, no glass and no smoke, smooth concrete floor easy to clean. Always keep fish on icing. Mechanization certain part.	
(1)	(2)	(3)	(4)	(5)	(6)
Process or Step in PHL Handling	Identify potential PHL Introduced or Controlled at	Are there any potential to PHL Signifi-	Justify the decision on potential in column 3	What Preventive Measure can apply to prevent the significant PHL?	Is this step a Critical Control Point

[1] Waiting refers to the time fish sits without being handled.

[2] 'Klepek' or 'makan laut' is famous local term in east coast of Malaysia to describe fish lost taken by workers or local residency without permission and no payment as buyer.

	step (1)	cant			(Yes/No)
Washing	Quality and Quantity (Chemical and Biological)	Yes	Contaminated sources of water (oil waste, parasite etc.). Fish stressed and temperature declined.	Use only pipe water supplied by authority and cool water. Use good container to less stress or faster job.	
Packing and Repacking	Quality and Quantity (Physical and Biological)	Yes	Broken and dirty containers are caused bacteria infection and not fully trap ice temperature. Some are confiscated (Klepek) and taken out.	Special and standardize the containers to less fish stress, easy to move, good water outflow and easy to wash and more safety.	CCP4
Icing and Re-icing	Quality (Chemical)	Yes	Size of ice crash can give stress to fish muscle. Some ice contaminate with ferrous, or chemical.	Selection of the blade size in crasher must be right or use flake or liquid ice.	CCP5
Reporting and Re-reporting.	Traceability of Quality and Quantity	Yes	Used for management purposes. It is difficult in tracing the quality and quantity problem. Clear in reporting can increase efficiency the whole handling activities.	Practice reporting system, right record on each fish box. Without open box or touching the fish, the quality and quantity can be recognized. Use standard sheet/form/card to report. Always keep record in database.	CCP6
Storing	Quality	Yes	Temperature or space is insufficient. Improper storage facilities will increase fish temperature and reduce quality. Sometime electricity is breakdown or mechanical problem.	Storage facilities must be easy to control temperature or adding ice. Good in shelf arrangement and has enough storage space. Install automatics device and alarm system to control temperature.	CCP7
Transportation	Quality		The destination is far (8-10 hours) and sometime delay; increased fish temperature and stress. Workers or driver used hook to flow out water in box to reduce lorry's load weight.	Using covered lorry or refrigerated truck. Do not overload to give more available, faster to reach the destination. Plan the trip always on schedule.	
Markets preparation.	Quality and Quantity		Not enough ice, more touching, exposed and stressed. Long waiting, transfer to many boxes or container and improper display table or shaft.	Direct market or delivered – need customer's information to prepare packing or grading as customer's need especially for factory (small size).	

References for Appendix 8 – 9;

1. Mike Dillon and Chris Griffin. 1996. *How to HACCP 2nd Edition an Illustrated Guide*, M D Associates.
2. Quality Issues in the Fish Industry (Rognvaldur Olafsson, Agust H. Ingporsson) – University of Iceland
3. Fish Handling and Preservation .Paris 1965. (Organization for Economics Cooperation and Development).
4. *Rudolf Kreuzer.*1971. (Fish Inspection and Quality Control), FAO.

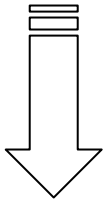
Appendix 8 : *Post Harvest Losses (PHL) Plan Form*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Critical Control Point (CCP)	Significant PHL	Critical Limit For Each Preventive	Monitoring				Corrective Action
			What	How	Frequency	Who	
CCP1-Setting Area ; Restricted area violated.	Quantity; Less weight because small fish. Quality; Polluted and Small fish have soft muscle easier to stress.	Area ≤ 12 miles in spawning area, size of fish =< 10cm. Full matured egg.	Latitude – longitude to be avoid. Sample of fish	Gazette the area and publish. Patrol regularly. Warning or suspend the license. Take fish sample.	Patrol as scheduled. Fish sample	Skipper, Enforcement officer.	Skipper has to know the area. Enforcement officer has to plan the patrol. The restricted area and month must identified base on fact and figure.
CCP2-Storing on boats; Low temperature and too compact space.	Quality: Compress and low temperature cause fish stress and poor water holding. Poor arrangement difficult to other handling.	Temperature failure in 6 hours. Fish is not in order of quality or grade. Overflow when not enough spaces.	Equipment and space is good condition. Leaking in RSW pipe.	Proper checking - blower and alarm system before fishing. Good planning for proper order.	Checking every trip. Planning in shelf arrangement start from first caught.	Technician and skipper.	Install light signal to detect mechanical problem. Valuable fish always in front. Refer to standard manual of setting and checking.
CCP3-Weighing and Selling; Long waiting, potential of infection.	Quality: Infection by parasite/bacteria. Quantity: Accuracy of scale or method to less water and ice trapped miscalculation.	Delay more than 1 hour. Standard scale checking not more than one year. Overloaded.	Fish pack, Scale, container or auction space condition.	Make enough/ clean space/ container. Appropriate scale. Re-icing if delay or long waiting.	During peak period, Friday & Saturday morning .Check every evening before auction.	Auctioneer and scale worker and government inspector.	Separate the species and sizes start from boat for recognized customer. Schedule / planning the landing time.

CCP4-Packing & Repacking; Poor container and packing technique.	Quality: Fish stress and bacteria infection	Ice contamination or container not clean. Ice less than ratio 3:1(Fish: Ice)	Source of ice / crasher, crack container and Loader. Fish arrangement.	Checking and clean before / after used.	Every time during packing.	Supervisor and packing group workers.	Standardize the container management. Bigger container for identified customers.
CCP4 : Icing; Type of ice and time to icing	Quality: Fish stress	During waiting time in every step before reach primary customer.	Source of ice / the crasher machine / type of ice.	Improve source of ice and crasher machine.	Every day, Routine schedule	Ice factory or Ice crasher worker.	Reduce waiting. Minimize fish exposure. Shortcut some activity; boats to consumer.
CCP6: Reporting; Less time for other activities	Quality: Difficult to trace or manage.	Too many fish pack, bag & container in whole market or on the jetty.	Fish Pack, container and records information.	Right report and re-checking information and database.	Every day	Packing group worker. Auctioneer and database operators.	Record must be right from boats. Identified packing sheet or good form card.
CCP2-Storing on land; Low temperature and too compact space.	Quality: Low temperature caused fish muscle spoilage.	Temperature failure in 6 hours. Overflow not enough stores.	Equipment and space is good condition.	Proper checking - blower and alarm system	Checking every day. Checking order in every new arrival.	Technician and store keeper.	Sound signal to detect mechanical problem or temperature fault. Refer to standard manual of setting and checking.

APPENDIX 9 : THE PROCESS OF ANALYZING 'WEIGHTED INDEX' AND 'HACCP APPROACH', IN ORDER TO OUTLINE THE PRIORITY COMPONENT TO THE LIST OF PREFERENCES.

Weighted Index	HACCP Approach
• Use WIR [3] form. • To identify general view on PHL in Kuantan base on people experiences as a detector instrument to the general problem • Based on five species selects by SSF. • Justified the important to be prevent and high potential PHL. • This worksheet can be use as format in layout questionnaire for real survey or interview. • Target group or respondent to answer questionnaire for this format is supervisor or officer, which direct experiences to fish handling. • Filled out by immediate peoples experienced on the landing site: - Manager Fish Landing Complexes - Manager Area Fisherman Association	• Use HAW[4] and PHL Plan[5] form. • To identify more specific on hygienic and hazard analysis as fixing instrument to the real problem. • Based on one favorite species from the selected • To justified the decision on identification of PHL. • This worksheet can be use as further analysis in plan of corrective action for management. • Target group or officer to be involved in discussion to fill up this format is management people, which have knowledge about hygienic and preventive measure. • Filled out by a committee or personnel on the management site: - Officer in HQ (Division Involved) - State of Directors.



Combination of weighted index and HACCP approach will identified and decided as list of preferences by the committee with considering;

The handling activities, species or fishing gears which is higher score as shown in WIR or related graph.

The criteria that was categorized under CCP, which is more important to monitoring, and do corrective action as produced in PHL Plan form.

All those selection should be satisfied the answer for preference Question as follows:

- Is it costly to implement?
- Does it look urgent compare to other factors?
- Does it involve new policy to implement?
- Is there any new technology to be applied?

[3] WIR – Worksheet Index Result form as in Appendix 6.
[4] HAW- Handling Analysis Worksheet is as in Appendix 7.
[5] PHL Plan is an Appendix 8.