

A CRITICAL VIEW OF THE FISH PROCESSING SECTOR IN MAURITIUS WITH PARTICULAR REFERENCE TO SEAFOOD SAFETY AND QUALITY ASSURANCE

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ABSTRACT

The fishery industry is subjected to challenges of seafood safety and quality assurance due to differences in food standards within and between countries. The purpose of this study is to identify the weaknesses and constraints of the present quality assurance system and find measures necessary to enhance quality and safety of fishery products in Mauritius. An overview of the fish processing sector gives an insight into the shortcomings of the industry, the legal framework, competent authority and the quality control system in place. Comparison between the Mauritian quality assurance system and the Iceland shows the importance of the legal framework in the management of seafood safety. There is need for a conceptual change in Mauritius from the traditional quality assurance system to modern food safety and quality assurance methods. Hazard Analysis Critical Control Point system is recommended as a seafood safety management tool.

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1 INTRODUCTION

1.1 Background

The Republic of Mauritius is an independent sovereign state within the Commonwealth since 1968. Mauritius is a maritime state with an Exclusive Economic Zone of 1.9 million square km. It is a small island situated in the south western part of the Indian Ocean at latitude 20° 17 S and longitude 57° 33 E (Figure 1). It forms part of the volcanic chain of Mascarene Islands and is located 800 km east of Madagascar.

Mauritius is only 1969 km² and has a population of about 1.2 million. About 48% is allocated to agricultural land, 13% is occupied by built-up areas and 2% by public roads. The rest is covered by forests, scrub land, grass lands, reservoirs, ponds, swamps and rocks. The country enjoys a subtropical climate. There are two seasons, a hot and wet summer, and a cool and dry winter. The average seawater temperature is 25°C.

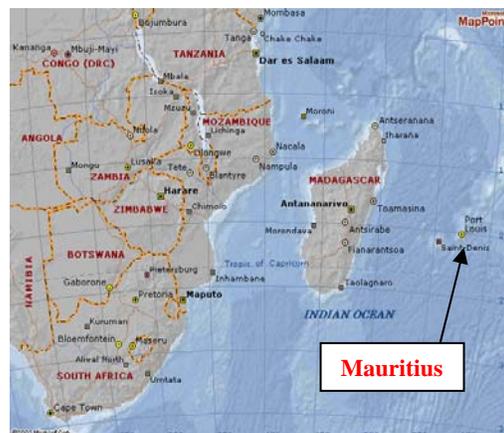


Figure 1: Map of Mauritius

The Mauritian economy is based on exportation of sugar, textile products, tourism and fisheries. Agriculture represents the main economic activity; sugar cane, tea, fresh vegetables, and cut flowers are the main products. The export processing zone and tourism are quite well developed. The economy has also diversified into offshore and free port activities since the beginning of the 90's (UNCTAD/WTO 1999).

1.2 Fishery Sector

The fisheries sector falls under the responsibility of the Ministry of fisheries. All the fisheries activities are governed by the Fisheries and Marine Resources Act of 1998. The main objectives of the ministry is to give necessary support to the development of the fisheries industry and to ensure that the fishery resources are exploited in a sustainable fashion by integrating development and other objectives into rational natural resource management practices and ensure the contribution of fisheries to national economic and social development (Ministry of Fisheries, 1997).

The fisheries sector contributes about 1% of the GDP through export earnings and provides employment directly or indirectly to some 10,000 people. The fishing industry is divided into five subsectors; coastal fishery, banks fishery, aquaculture, sports fishery and fish processing. Moreover, transshipment of frozen fish in the free port is an important area which is progressively gathering momentum due to the cold storage facilities provided by the Mauritius free port development authority. The balance of trade in fish

and fish products has been positive for the last ten years due to substantial export of canned tuna to EU markets (*UNCTAD/WTO 1999*).

The banks fishery represents the main source of supply of frozen fish to the country. It contributes about 30% of the local consumption while the coastal fishery, aquaculture, sports fishery and imports cater for 70% of the local demand. Handline and hook method is used to catch demersal fish species such as lethrins, seranids and lutjanids. No preservation techniques are applied during fishing operations to preserve the catch except freezing on board mother vessels. The average annual catch from the bank fishery amounts to 4000 t. The bank fishery is managed through a vessel monitoring system and quota imposition to avoid over-exploitation (*Ministry of Fisheries 1998*).

The coastal fishery is the only source of fresh fish supply to the country. About 4400 fishermen are involved in this fishery. The average annual fresh fish production is approximately 3000 t. The method of fishing includes hook and line, basket traps, gill nets and large nets and the catch is kept in a pirogue until unloaded at fish landing stations. The sport fishery emerged with the expansion of the tourist industry. This fishery supplies an additional 1000 t of pelagic fish to the market (*Ministry of Fisheries 1998*).

Aquaculture is carried out in ponds and natural water enclosures in the coastal areas. This sector has not developed to a commercial scale due to competition from imports, high cost of production, limited space and acceptability of the products. The annual average aquaculture production amounts to 90 t (*Ministry of Fisheries 1998*).

1.3 Fish consumption and trade characteristics

Mauritius is a net importer of food due to the size of the island, population density, climatic conditions and economic constraints. However, some food industries such as fresh poultry, canned meat, and canned tuna are relatively well developed and even export to the EU. As regards the fishery sector, demand for fish and fish products is higher than supply. The local production caters for 50%, while the rest is imported. Fish is an important component of the Mauritian diet and there is every likelihood that the level of fish consumption will further raise given the increase in purchasing power of the consumers. The population is now also more conscious of the nutritive value of fish, fish being a good, healthy and low risk protein food. Thus, there has been a constant increase in the demand for fishery products when compared to other animal proteins. The present per capita consumption of fish and fish products is around 23 kg (*Ministry of Fisheries 2000*).

Different types of fish and fish products are imported from European Union, African countries, Madagascar, Australia, New Zealand, Oman, Canada, Peru, Chile, Morocco, India, Malaysia, Thailand, China, Singapore and calling vessels. The raw material (tuna) used by the cannery is transhipped from EU vessels operating in the Indian Ocean. About 52,000 t of seafood comprises of fish, crustacean, cephalopods and shellfish were imported in 2002 out of which 20% was intended for direct consumption while 80% was meant for processing (*Ministry of Fisheries 2002*).

Processed fish is partly sold on the local market or exported, mainly to the EU. In 2002, 24,000 t of canned tuna, 34 t of fresh fish and 100 t of salted fish were exported to UK, France and Reunion. About 30 t of smoked fish were sold on the local market and in the duty free shops. Moreover, about 19,000 t of frozen pelagic fish were processed in the free port zone and exported to EU, USA and Japan (*Ministry of Fisheries 2002*).

1.4 Fish processing in Mauritius

The fish processing sector is economically very important to the Mauritian fishery industry. It is also a source of earnings in terms of foreign currency and provides employment opportunities to people. The major part of the processing sector is dominated by tuna processing and canning which is export oriented, while small scale industries focused on the local market. The raw materials for processing are obtained through imports and to a lesser extent from the local production.

The exporting establishments operate under the EU standards, while the small scale fish processors are operating under the national food law. Fish is being processed and prepared under different operating conditions and standards due to:

- inter-country differences regarding the production practices and quality standards;
- differences in production practices within the country;
- inefficient inspection and quality control system;
- absence of legal framework for implementation of food safety management programmes;
- absence of a food safety management programmes.

1.5 Seafood safety and quality assurance in the Mauritian fish processing sector

Nutritionally, fish is a very important source of easily digestible, high quality protein, vitamins and fats not obtainable in such high concentrations elsewhere. Nonetheless, fish is a highly perishable foodstuff and spoils very fast unless appropriate preservation and processing techniques are applied. In addition, fish as any other foodstuff pose the risk of becoming unsafe due to hazards or contamination along the food chain. Fish in their natural environment is relatively safe food but food-borne disease and illness may occur due to infections or intoxications. These food safety hazards are closely linked to hygiene, sanitation, processing or preparation operations and marketing of fish. Thus, there is the element of risk in consumption of processed fish (*Ahmed 1991*).

The Mauritian fish processing sector is confronted with challenges of seafood safety and quality standards at both the national and international level. At the national level, the tourist industry is very important to the country. Visitors from EU and other countries come to Mauritius for the sun, sea and seafood. An outbreak of food-borne illness due to consumption of fish and fish products could jeopardise this industry which represents one of the three pillars of the economy. Moreover, the Mauritian consumers also have the right to have safe, quality, wholesome and unadulterated seafood for consumption. On the other hand, fishery products from the small scale industries can not accede to the

international market because they do not satisfy the food safety standards. Thus, food safety and quality assurance programmes are needed to satisfy the emerging domestic market and for exports.

1.6 Purpose of this study

At the dawn of this millennium where food safety and quality is gaining worldwide heightened importance, we can not acknowledge impediments to the development of the fish processing sector due to difference in food safety standards within the country and between countries. The fish processing sector therefore needs to be revisited with a view to identifying measures necessary to enhance quality and safety standards through improved production and processing practices. The purpose of this study is:

- to give an insight of the weaknesses and constraints that are hampering sustainable development of the industry;
- to compare the Mauritian and Icelandic seafood safety and quality control system;
- to find out means and ways to improve the quality and safety of fishery products in the Mauritian fish processing sector.

1.6.1 Aim

Food safety is an important aspect of the need to protect fish consumers and to ensure the sustainability of the industry. Without consumer confidence in the safety of fish as food the demand can collapse having a knock-on effect on the rest of the industry.

The aim is therefore to improve the overall quality and safety of fish and fish products offered for sale on the local market and at the same time to increase market opportunities for the producers.

1.6.2 Objective

The main objective is to help the fish processing industry attain a level of assurance in fish safety and quality using internationally recognised food safety management system such as HACCP that will promote food safety and sustainable development of the industry.

1.6.3 Goals

This document focuses mainly on the safety aspects and the quality assurance programmes. The overall goal is to provide a systematic approach to the control of seafood safety and inspection activities through a management programme based on scientific principles. The food safety management programme is expected to upgrade and modernise the facilities with a view:

- to ensure that only good quality and safe fish and fishery products are marketed;
- to provide a quality conscious approach to handling, processing, production and marketing;
- to create confidence, comfort and safety on the processed fishery products;
- to harmonise the standards;
- to show the importance of prerequisites and safety management programmes;
- to provide appropriate proposals/recommendations to the shortcomings;

2 AN OVERVIEW OF THE SEAFOOD SAFETY AND QUALITY CONTROL SYSTEM IN THE FISH PROCESSING SECTOR IN MAURITIUS

2.1 Background

Fish processing is one of the most important sectors of the Mauritian fishery industry. It is dominated by tuna processing and canning. The canned tuna represents the bulk of the processed fish and it contributes about 60% of the non sugar agro-based export earnings. In addition, two companies are engaged in the production of salted fish and their annual production range between 750 t and 800 t. The salted fish is used locally and partly exported to France and Reunion. Companies involved in exportation of fishery products to EU are operating under HACCP system and have approved establishments to enable them export their products to international markets (*Ministry of Fisheries 1999*).

The medium and small scale fish processing industries are either family based or companies operating with 5 to 25 employees. They are engaged in a production of a wide range of products such as salted fish, smoked fish, frozen fish, frozen fish fillets, fish steaks, fish loins, fish slices and pieces which are sold on the local market. These fish processors are interested in identifying export outlets for their products but can not accede on the international markets because they do not meet the required seafood safety and quality assurance standards (*UNCTAD/WTO 1999*).

2.2 The legal framework in Mauritius

To prevent the occurrence of health hazards arising from consumption of food, Mauritius has enforced a food law since 1998. The Ministry of Health and Quality of Life enacts the food law, enforcement ordinance, regulations, food standards and specifications for food. The legislation is kept as general as practicable and does not define the processing standards required by the fish processing industries. The aim of the legislation is to achieve a suitable overall hygienic environment in which food can be produced. There is no specific legislation controlling the processing of fish in Mauritius. The existing regulations deal with general food items. It caters for the food processing plant requirements and environmental health (*MHQL 1998*).

Furthermore, there is no legal framework for the authority to enforce HACCP implementation. There is no legal operating condition concerning the actual handling, and processing of fish and fish products in the country. The producers show little interest in the use of hygiene, GMP or HACCP-based control system in the fish processing sector.

The principal regulations concerned with food and fish and fish products in the Republic of Mauritius are as follows:

- Food Act 1998
- Fisheries and Marine Resources Act 1998

- Supplies and Control Act 1994, GN 132/97
- Local Government Act 1984 /Trade and Industries Classification Act 1954.

2.3 Competent authority for seafood control in Mauritius

Fish processing, import and export and sale of fish and fish products on the local market falls under the responsibility of three different ministries.

2.3.1 Ministry of Fisheries

The Fisheries and Marine Resources Act 1998, deals mainly with protection of marine resources and the ecosystem, fishing activities and gear used in the EEZ of Mauritius, licensing of fishing vessels and authorization to import and export fish and fish products. The ministry of fisheries is the regulatory body in as much as import and export and quality control for fish and fish products are concerned. All imported fish and fish products are inspected for quality at the ports of entry and random samples are collected for bacteriological examination before being released for sale. The microbial tests are carried out by the animal health laboratory. Import and export of fishery products are authorized under specific import and export conditions imposed by the ministry.

2.3.2 Ministry of Health and Quality of Life

The Ministry of Health and Quality of Life is the competent authority and is responsible for food control in Mauritius. They inspect fish products processing facilities in the country. They are involved in inspection and certification of all imported and locally produced foodstuffs. The duties of health inspectors are related to both hygiene and sanitation and inspection of food premises in terms of hygiene, environmental health, ingredients, food item, storage, water supply and waste disposal. Food samples are collected for chemical and microbial analysis at the laboratories of the ministry.

2.3.3 Ministry of agriculture, food technology and NR

The Division of Veterinary Services of the Ministry of Agriculture, Food Technology and Natural Resources has been empowered by regulation GN 132/97 under the Supplies and Control Act of 1994 to control fishery products for export. They have to ensure that all conditions imposed by the importing country are fully complied with. The Veterinary Service is the competent authority for control of fishery products intended for exports to EU. Therefore, inspection and certification of fishery products fall under their responsibility. The Animal Health Laboratory is the official laboratory for fishery products in Mauritius. The veterinary inspectors are involved in inspection of establishments, official HACCP control, verification of consignments intended for exports and sampling of raw materials, water and finished products (*EU 1998*).

2.4 Current seafood inspection and quality control system

Fishery products that are produced locally and intended for sale on the local market should conform to the requirements of the National Food Act of 1998. Health inspectors of the Ministry of Health and Quality of Life are involved in inspection of all foodstuffs including fish at sale points. The fishery products are examined by sensory evaluation for example, smell, colour, texture and physical appearance. If products are suspected of being adulterated the lot is detained and samples are collected for microbiological analysis. Based on the results the products are either released for sale or destroyed.

2.4.1 Inspection of imported fish and fish products

Imported fishery products are inspected at the points of entry by officers of both the Ministry of Fisheries and Ministry of Health and Quality of Life. The importers should provide documentary evidence that the products have been checked by the competent authority of the exporting country. The consignments should be accompanied by a health certificate issued by the competent authority certifying that the products are fit for human consumption. The products are examined physically for species composition, storage temperature, packaging, labelling and presentation. Samples are collected and analysed before a consignment is released for sale. In case of suspicion, the consignments are detained and subjected to further investigation and based on results of examination consignment may be released or destroyed.

2.4.2 Inspection for exports of fish and fish products

All fish and fish products intended for export should satisfy health criteria set out by the importing country, for example the EU Council Directives. Export of fishery products is authorized by the Ministry of Fisheries and the products are inspected and certified by the veterinary authority. Here the products are followed from catching to exportation through all handling and processing activities. The production is based on an HACCP management system whereby safety and quality of the products are controlled and monitored along the production process by the industry. The Veterinary Service is using a HACCP based inspection system involving the seven principles of HACCP. The fishery products are inspected and certified by the veterinary authority (*Ministry of Fisheries 1999*)

2.5 Current industry operating conditions

Since the demand for fishery products is higher than supply the fish processors pay little attention to product safety and quality as required by the food regulations. Practically they have limited knowledge of the GMP and good hygienic practices as described in appendix 2 and 3 which form the basis of and prerequisites for production of safe and quality fish and fish products. Critical components of seafood safety such as factory hygiene, personal hygiene, storage temperature, and risks during processing are not addressed properly. There is no commitment from the processors regarding the production of safe and good quality fishery products.

2.6 Current safety and quality issues in the fish processing industry

Fish is assumed to be the safest food for consumption and therefore all the risks associated with processing activities are ignored leading to substandard hygienic operating conditions and without any Hazard control mechanisms. Thus food safety as defined below cannot be guaranteed.

Definition of food safety:

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (Codex Alimentarius Commission, 1997).

Moreover, the legislative framework does not cover the controlling of such highly specific fishery products and action is taken only after a problem has occurred.

2.6.1 Hygiene and good manufacturing practices

In general, most of the processing plants do not conform to international hygienic and sanitation requirements. There is absence of pest control mechanisms in most of the establishments and many other deficiencies regarding the environment under which they operate. The food contact surfaces, walls, floor and equipment are dirty. Appropriate facilities regarding hand washing and sanitising are not met. The products are not protected from cross-contamination and temperature fluctuations that could lead to adulteration or spoilage. The processed products are not labelled for traceability in case of problems or disease outbreaks. There is no proper waste management system. There is no control on the water used in the establishment which is from the general water supply (reservoirs or boreholes).

2.6.2 Hazard identification and control

The processors and all those involved along the food chain are not conversant with the hazards linked to fish and fishery products that present a threat to the health of the consumers. They can not identify the biological, chemical or physical hazards that may occur during processing, transportation, and sale.

2.6.3 Food poisoning risks

Fish poisoning risks of concern to the Mauritian fish industry are ciguatera fish poisoning (species of fish listed as toxic fish in the fisheries Act 1998), histamine poisoning (tuna, mackerel, bonito, mahi mahi) and chemical contaminants (mercury, lead, and pesticides).

2.7 Shortcomings of the present system and the consequences

An overview of the Mauritian fish processing sector shows that the current inspection and quality control system has some limitations and weaknesses giving a false sense of security for the following reasons:

- QC is based on examination of end product testing which is also known as traditional quality control program.
- The existing legislation is too broad to cater for highly specific fishery products.
- The prerequisite programmes are not being applied as per specifications.
- Food safety aspect has been ignored by the processors.
- There is no legal framework for implementation of food safety management programme such as HACCP.

Four problem areas have been identified in the fish processing sectors that need urgent attention of all the stakeholders as well as the government. The problem areas consist of:

1. the environment under which the industry is operating
2. lack of skills in the production practices
3. inefficient quality control system
4. lack of a food safety management tool

2.7.1 *Industry operating environment*

The present industry operating conditions are influenced by factors such as the market structure whereby the demand is higher than supply. The regulations are inappropriate for fishery products. There is lack of professionalism and interest for investment. High competition from imported fishery products is an important factor deterring development of the processing sector. The social and cultural background of the processors is also reflected in the actual operating conditions.

As a consequence of the industry environmental operating situations the requirements of the legislations are not met and the food safety aspects are ignored during processing. The processed seafood is constantly subject to the element of risk. In such circumstances the products does not comply with the international standards required by import markets. The problem analysis in Figure 2 gives an indication of the causes, consequences and problem of the industry operating environment.

2.7.2 *Lack of skills*

There are many reasons affecting the skills of the operators. The fish processors do not understand the principles of hygiene and GMP. They do not have good handling and processing skills. There is no control over production by the competent authority. The market structure is to some extent favouring the operating conditions. Last but not least, the operators are not committed to the production of safe products of good quality.

As a result, the fishery products do not satisfy the requirements of the international standards. The international markets are inaccessible and the fish and fish products can only be sold on the local market. In this system there is no guarantee for food safety and quality as required by the international market. There is the element of risk of seafood poisoning and illnesses. Furthermore, there is deceptive and fraudulent presentation of products, and product traceability becomes difficult in case there is a problem. Therefore the quality of fish and fish products offered for sale is suspect. The problem analysis in Figure 3 highlights the causes and the consequences due to lack of skill in the fish processing industry.

2.7.3 Inefficient quality control system

The food law has a very wide range of food control activities which makes it too broad to cater to the fish processing sector. The regulation is not specific for the production and sale of seafood. The current problems of the fish processing sector are also related to the overlapping fields of action among different authorities.

In essence the regulations require a suitable standard of construction and cleanliness in food premises, facilities and amenities and the food handlers. Such a system is neither economical nor effective for producers and does not guarantee safety and quality of the products.

Fish quality control is based on traditional end product testing and as such food borne illnesses or hazards in processed fish are controlled by inspection and surveillance of the final products. This system is considered retroactive as actions are taken after the event.

The traditional quality control method has lots of drawbacks because even the most careful and thorough inspection program and the final product testing scheme will not help in the proper management of risks. This method is considered inefficient because it is costly to test products, it takes several days before results are obtained, the chances of finding a hazard will be low, the testing gives a sensation of being in control and creates false security and involves lots of waste in case results are positive. The problem analysis in Figure 4 shows the inefficiency of the present quality control system.

2.7.4 Lack of food safety management tool

There is no food safety management system in the fish processing industry. The fish processing industry is operating under substandard hygienic conditions. The basic hygiene and good manufacturing practice are already in the regulations but these are not applied effectively because there is no management system to control the prerequisite programmes. There is no legal framework for mandatory application of food safety management tool.

As a consequence, inspection is limited to end product testing. The competent authority is not able to control and monitor production operations. Corrective actions can not be implemented at the right time. Fish is being processed under substandard hygienic conditions. Thus the seafood is subjected to the element of risks and hazards. The problem analysis in Figure 5 shows how the lack of a food safety management tool affects the Mauritian fish processing industry.

Problem analysis sheet:

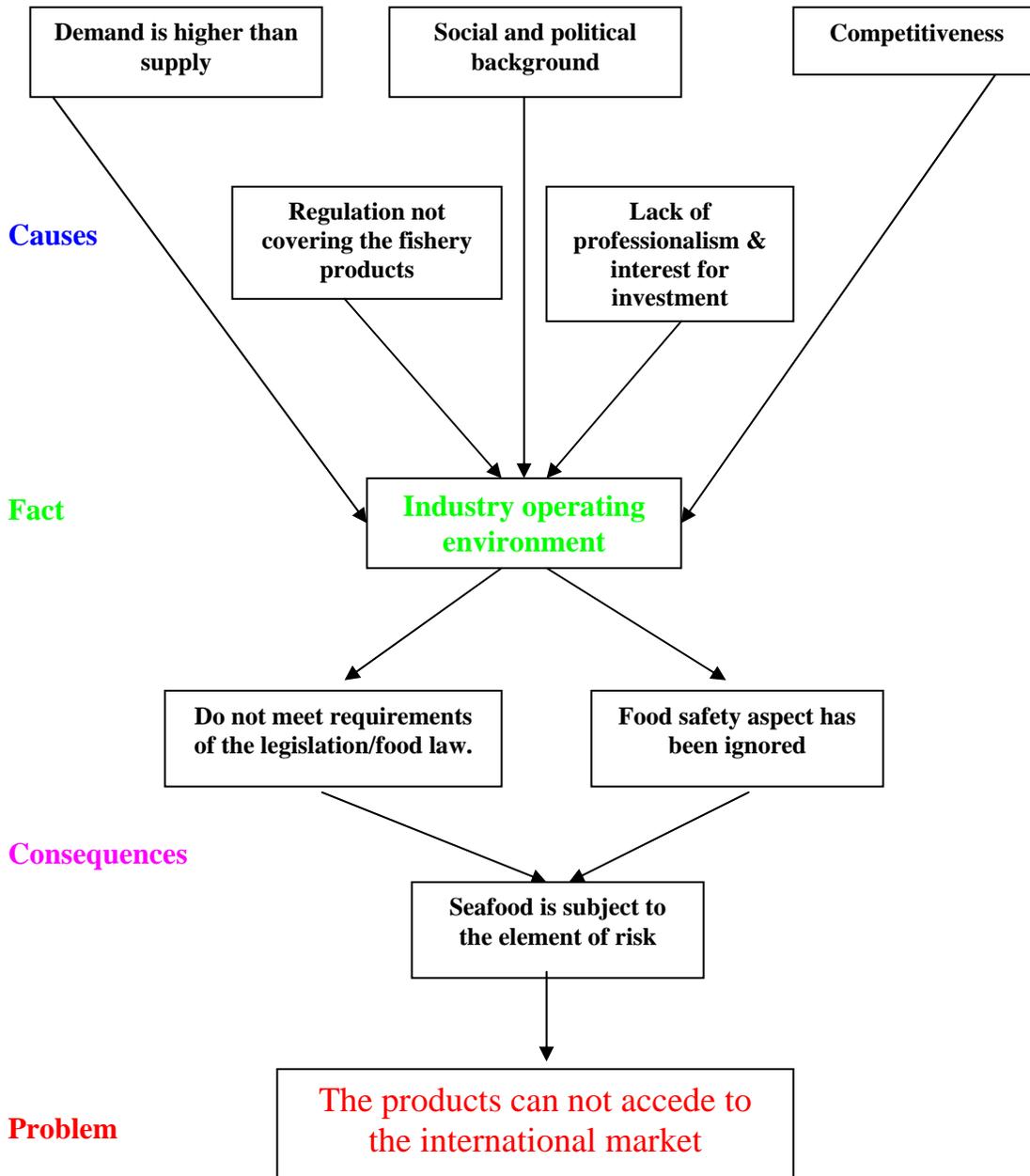


Figure 2: Problems due to industry environment

Problem analysis sheet:

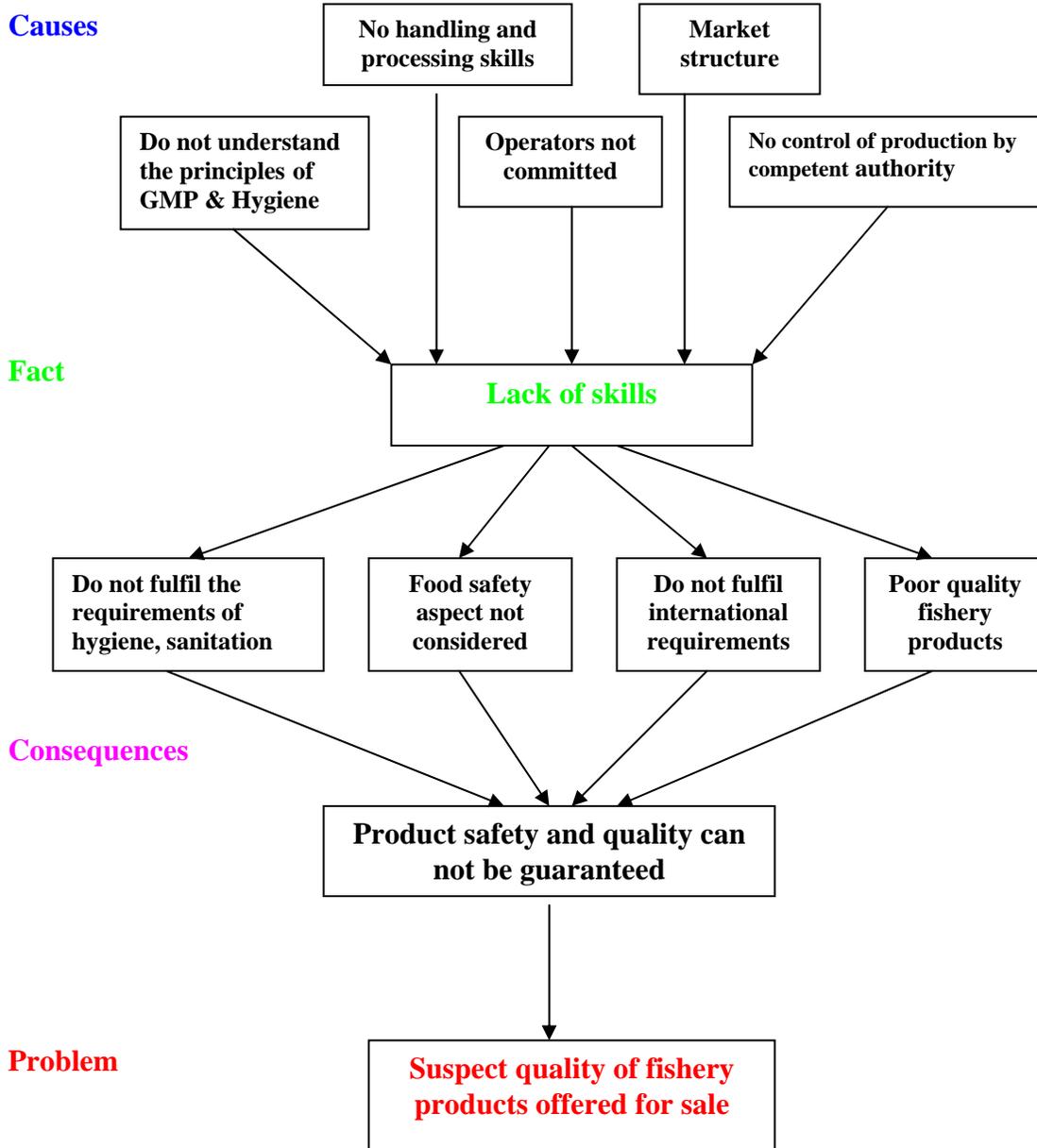


Figure 3: Problems due to lack of skills

Problem analysis sheet:

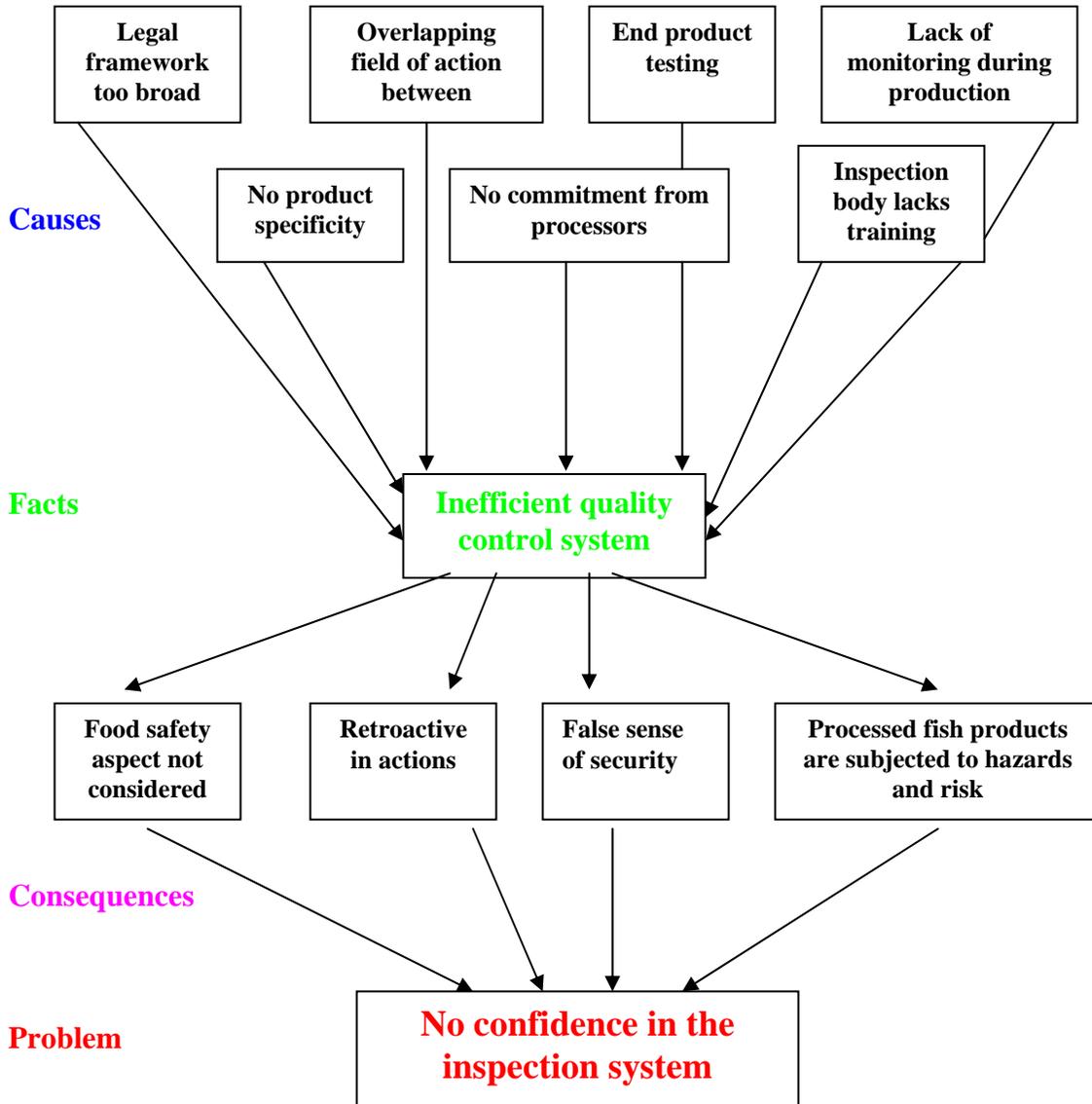


Figure 4: Problems due to inefficient quality control system

Problem analysis sheet:

Causes

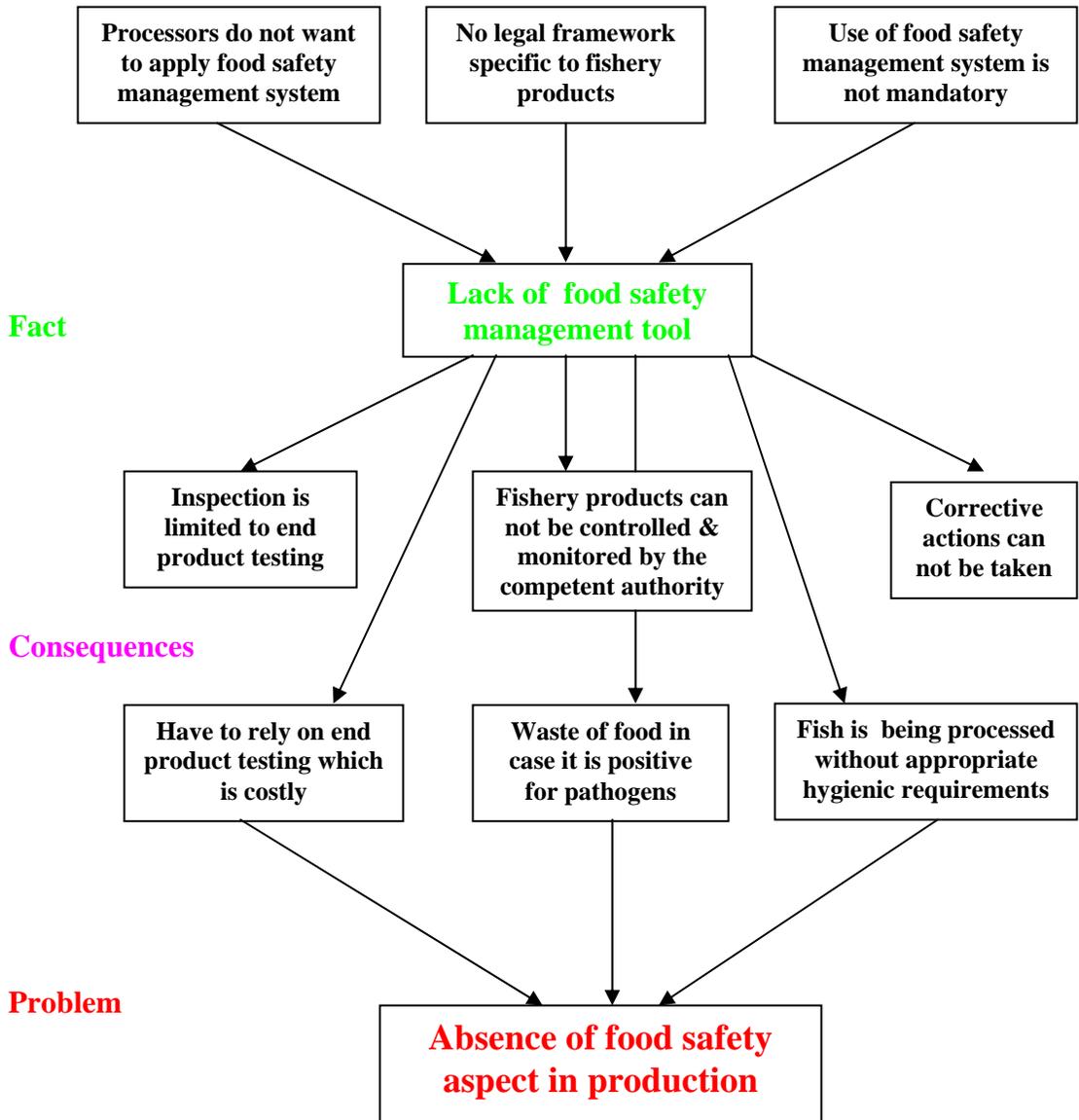


Figure 5: Problems in industry due to lack of a management tool

3 AN OVERVIEW OF THE SEAFOOD SAFETY AND QUALITY CONTROL SYSTEM IN THE FISH PROCESSING SECTOR IN ICELAND

3.1 Background

Iceland is among one of the fifteen largest fishing nations in the world. Economically the fishery industry is very important to the country. Fisheries provide 13% of the GDP and the processing sector provides direct employment to about 12 000 people. In 2002, seafood represented 63% of the total export earnings. The Icelandic average total annual catch amounts to 1.6 to 2 million tons which represents 1.5% of the total world catch. Almost all the catch is export oriented. The most valuable export resources in Iceland include cod, capelin, shrimp, redfish, haddock and herring. The total export earnings for the year 2002 approximately 1.5 billion Euros (*Moller 2003*).

Fishing and processing activities are controlled by a permit system administered by the Directorate of Fisheries. 1700 ships have been licences to operate in the EEZ of Iceland and 748 licences were issued for land based activities which include freezing, salting, fresh seafood production and fishmeal production (*Directorate of Fisheries 2003*).

The fishing companies are owned by large corporations and since 1995, these companies have been on the stock market. They are involved in production of quick frozen fillets, portions, fillet block, speciality dishes, salted fish fillet, iced whole fish, fish fillets or portions and whole quick frozen uncooked or cooked shrimps, lobster, scallop meat and fishmeal and oil. There are many smaller companies engaged in different areas of seafood production. These products are exported mainly to EU, USA and Asian countries and to a smaller extent to Africa (*Moller 2003*).

3.2 Legal framework

In view of the seafood market structure in Iceland, the laws and regulations have been institutionalised to cater to the requirements of the importing countries. The regulations on fish safety and quality assurance are based on the requirements of European Union Directives and adapted to the Icelandic situation. All the activities related to seafood production, handling, processing and export are controlled by law. The regulations cover the hygienic operating requirements which include:

- hygiene in handling, processing and distribution of marine catch and products;
- catching, handling, processing and distribution of live bivalve molluscan shellfish;
- production of fishmeal and oil;
- own check system in fish production (HACCP);
- inspection of fishery products;
- fishing vessels – freezer vessels;
- heat treatment – bivalve mollusc;
- microbiological criteria;

- parasites, TVBN, HACCP organoleptic criteria;
- contaminants and
- biotoxins – laboratory.

3.3 Authority for inspection and quality control system in Iceland

The Ministry of Fisheries is the authority responsible to set all rules in respect to seafood production, processing and issues the necessary regulations and has the right for the interpretation of Icelandic Regulation being consistent with the EU Directive and others that are of concern. Their main objective is harmonisation of standards to promote free trade between Iceland and EU, USA and some Asian countries.

The Directorate of Fisheries under the Ministry of Fisheries is the central competent authority. They undertake surveillance of inspection bodies and licensed producers and are involved in the measuring of the effectiveness of the system. They are responsible for the licensing of producers provided all the conditions as required by law have been fulfilled, approval of inspection body; issue of public documents of certification where demanded, production of inspection manuals for fishery product, harmonisation of inspections between inspection bodies, individual inspectors and the fisheries directorate and comparison between inspections and their statistical evaluation (*Directorate of Fisheries, 2003*).

The laboratories and the accreditation bodies provide support services to the processors and the inspection bodies in terms of product testing and assessment of quality systems.

3.4 Current inspection system

There are private inspection bodies who undertake inspection of the conditions for production and placement of fisheries products on the market, including plant inspection and own checks of processors which are licensed as producers. They provide the Directorate of Fisheries with regular information on the state of the licensed producers. All non conformities are reported to the competent authority (*Directorate of Fisheries, 2003*).

3.5 The industry

Conscious of the requirements of the importing countries and the regulations for production and placing on the market of fishery products, the processing sector has undertaken all necessary precautions through safety management systems to ensure seafood safety and quality. The production and processing industries are responsible for the production of good quality and safe seafood using own check mechanisms which based on HACCP principles. The production is consumer oriented and most of their production is meant for export. Production practices, including hygiene and sanitation are controlled and monitored accordingly by the industry. However, the inspection body carries out checks for insight verification and on implementation of the regulations (*Directorate of Fisheries, 2003*).

3.6 Comments on the Icelandic system

The Icelandic system is unique and very efficient in controlling the seafood production and processing. When compared to EU the main difference lies in the third party inspection system. The competent authority is not directly involved in inspection of establishments and products (*Directorate of Fisheries, 2003*).

Some of the salient features of the Icelandic system are highlighted below:

- They have a good legal framework to cater for fishery products.
- Inspection, control and monitoring of operations are based on HACCP system.
- The regulations are product specific and cover wide range of seafood productions.
- There is one competent authority responsible for setting of appropriate regulations for the production and placing on the market of fishery products.
- There are approved laboratories for product testing purposes.
- There is an independent accreditation body for accreditation of inspection bodies, testing bodies and certifying bodies.
- The industries show commitment to the production of safe and quality fish and fish products.
- All the activities regarding establishments, factory vessels, freezer vessels, wholesale markets/auctions are controlled by the competent authority through licensing.

4 COMPARING THE MAURITIAN AND THE ICELANDIC SEAFOOD SAFETY AND QUALITY CONTROL SYSTEM

The Icelandic food safety and quality control system is very good at managing fish production and processing. However, the Mauritian quality control system is quite different from the Icelandic system in terms of background, production capability, fishing history, marketing structure and the requirement of the markets.

The seafood safety and quality control systems of both countries are compared in Table 1 to show the most important features responsible for the present weaknesses and strong points within the quality control system in terms of food safety and quality.

The comparative study between the Icelandic and the Mauritian quality control system shows that the Icelandic system has been successful with regard to seafood safety and quality assurance due to the following reasons:

- Iceland has a good legal framework in fisheries.
- The regulations are product specific and cover all the aspects of hygiene, GMP and HACCP as management tool.
- HACCP own check system is mandatory.
- Iceland has only one competent authority responsible for production and placing on the market of fishery products.
- The competent authority has an inspection manual to facilitate inspection.
- The producers are committed towards production of safe and quality products to satisfy their customers.

The above features are interesting and could be implemented in Mauritius with a view to upgrading the present system of inspection and quality control in the fish processing sector and fisheries in general. From this comparative study it can be deduced that HACCP and the legal framework in fisheries are very important for proper management of seafood safety and quality.

Table 1: Comparison between the Icelandic and Mauritian quality control system.

S/N	Icelandic system	Mauritian system
1	Has a good legal framework to cater for fishery products.	Do not have a legal framework to cater for fishery products.
2	The regulations are product specific	The regulations are too broad and general.
3	Inspection and quality control are based on HACCP management system.	Inspection and quality control are traditional type and concerned with end product testing.
4	The competent authority has produced an inspection manual to facilitate and harmonise inspection.	There is no manual for inspection of fishery products.
5	There is one competent authority responsible for setting of standards, verification and controlling inspection bodies. The Directorate of Fisheries (Ministry of Fisheries) is the competent authority.	Ministry of Health is the competent authority for imported and locally produced foodstuffs. The Ministry of Fisheries is the regulatory body for import and export of fish products. Veterinary Service is responsible for inspection and certification of fishery products intended for export.
6	Third party inspection body is used for inspection.	The competent authority is the inspection body. No third party inspection body is used.
7	The industry has own check system to control and monitor hygiene, GMP and process operating conditions.	There is no own check system in Mauritius except for those processors involved in exportation to EU.
8	Industry is committed to the production of safe and quality seafood.	The processors are not committed because the local demand is greater than the supply.
9	Production is more towards consumer interest.	Production is more towards industry interest.
10	Industry forms larger groups to better enforce safety regulations based on HACCP.	Mostly small processing establishments.
11	Industry uses innovative technology with a view to mechanisation.	Use of simple equipment and man power.
12	Seafood safety is a priority issue for market	Seafood safety is not a priority for the industry.
13	Establishments are new and built for fish processing	Most of the establishments are old.
14	Have approved laboratories for testing	Have approved laboratories for testing

5 HOW TO ACHIEVE FOOD SAFETY AND QUALITY IN THE FISH PROCESSING SECTOR IN MAURITIUS

5.1 Using a food safety management tool

Based on the weaknesses and salient features of the seafood safety and quality control system highlighted in the previous sections, seafood safety and quality assurance can be achieved through application of a preventive system that would emphasise control and monitoring along the food chain, for example over the raw materials, the process, the environment, personnel, storage and distribution. The system should operate in such a way that the final product could be guaranteed for safety with a high level of confidence and assurance without any testing of the packaged product.

The food safety programme should provide an appropriate level of protection to the consumer. It must also help the processors to introduce food safety measures into the process of production. The programme must guide the processors in effective use of prerequisite programmes such as hygiene and good manufacturing practices. It must facilitate risk assessment and elimination and provide corrective measures immediately from any deviation. The management tool must emphasise on building product and services name in terms of food safety and excellence and to facilitate trade of fishery products on the international market (*Dillon and Griffith 1996*).

Thus to achieve food safety and quality in the fish processing sector in Mauritius there is need for a food safety management tool. HACCP is one such preventive food safety management system that has been successfully applied in seafood industries in Iceland and many developed countries. Furthermore, HACCP is becoming increasingly important for all food businesses as an effective tool for ensuring food quality and as means of complying with legislation.

In essence, the processing operations should be based on prerequisite programmes such as good hygiene and good manufacturing practices as described in Appendix 2 and 3, together with an efficient food safety management system such as HACCP. This will help the fish processing sector produce good quality and safe fish and fish products for both local and international markets.

Rationale

Fish handling procedures based on hygiene and GMP along with HACCP-based food safety management programme encompass all the operations aimed at maintaining food safety and quality from time of catching until it is consumed.

5.2 Why HACCP?

Some of the salient features of HACCP favouring its application in the fish processing sector are explained.

5.2.1 Developed countries use HACCP

In order to thrive in this competitive world market, developed countries such as EU, USA, Canada, Iceland and Australia are using HACCP as a management tool to ensure safety and quality in the fishery sector. In most of these countries, HACCP implementation includes the mandatory maintenance of the sanitation standards, and process and product specifications in seafood plants. Labelling standards are also mandated. However, in some countries ISO 9000 quality management systems is being used voluntarily while others have integrated the ISO with the HACCP concept into their overall quality control systems. HACCP adoption in some countries is voluntary for the domestic market but mandatory for exports (*OECD 1998*).

5.2.2 HACCP is a modern food safety and quality assurance method

Several methods are available to ensure safety and quality of seafood products. These include good hygienic practices, good manufacturing practices, HACCP, QA/QM – ISO 9000 standards and total quality management (TQM). These methods are considered as food safety management tools used by industries to manage quality and safety. Some of them are prerequisites for or complement another as indicated in Figure 6.

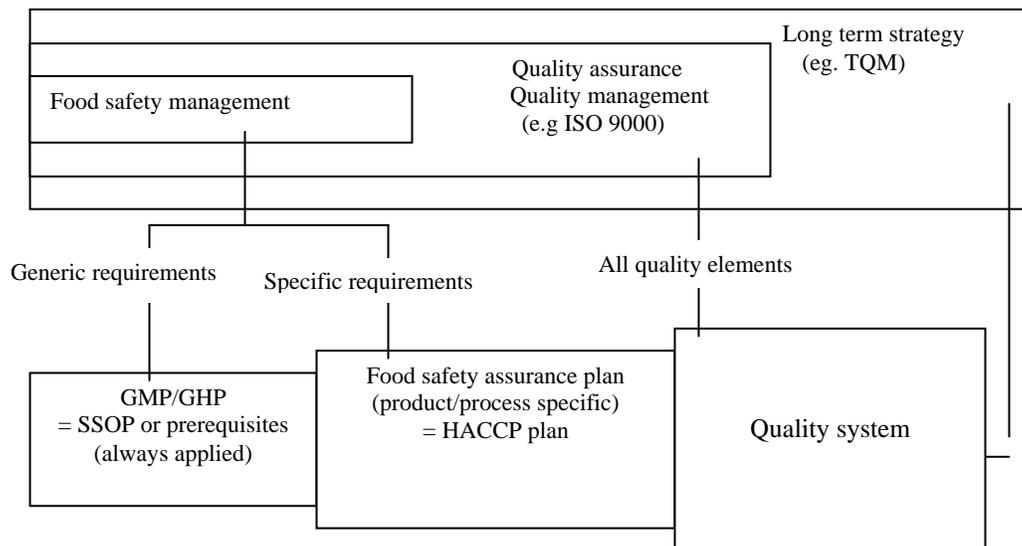


Figure 6: Different food safety management tools for QA (Huss 2003).

Among the methods, HACCP is well known for ensuring safety and quality in food industries. It is a systematic and scientific approach which identifies, evaluates and

controls hazards that are significant to food safety. It ensures safety through an approach that is built upon prerequisite programmes such as GMP and hygiene practices. It is built into the production process. It identifies the critical points that require constant control and monitoring to make sure the process stays within identified limits. HACCP has been in use for more than thirty years and application of HACCP systems will enhance quality and safety of the products.

5.2.3 Importance of HACCP with trade liberalisation

In view of the world trade liberalisation process, increasing emphasis is being put on sanitary and phytosanitary issues based on scientific methods to control free trade among countries. The increasing demand for fish and fish products has raised major concerns about the overexploitation of aquatic resources and the quality and safety of products that are internationally traded. Globalisation has highlighted the need for harmonising fish safety and quality assurance approaches with a view to ensuring fish safety and fair trade practices. Thus international fish trade business while offering numerous benefits and opportunities also presents new safety and quality challenges. The only way to meet these challenges would be the adoption of HACCP-based management measures that can guarantee safety and quality of the produce (Cato 1998).

5.3 Importance of HACCP on the international market

It has been accepted worldwide that HACCP based management system can provide seafood safety and quality assurance. It helps in achieving equivalency and cooperation among countries, thus reducing barriers to seafood trade. Ultimately, HACCP provides for harmonisation of norms and standards, mutual recognition and better coordination (Cato 1998).

5.4 Benefit consideration of HACCP

HACCP being an effective tool for achieving good production, sanitation and manufacturing practices in fish production, can also give economic benefits to industries, consumers and government. HACCP is a system that focuses on hazards and their prevention, and can be viewed as a non-traditional food safety method and offers long term benefits (Dillon and Griffith 1996).

5.5 HACCP and sanitation

Sanitation and GMP usually form part of the prerequisite programmes that are essential for the proper functioning of the HACCP system. Therefore, sanitation as well as process control can be integrated into the HACCP concept for the overall management of safety and quality of fishery products. HACCP encourages better compliance with the existing sanitation requirements. In addition, corrective actions with regard to deficiencies could be brought in a timely manner (Ward 1995).

5.6 HACCP in relation to seafood inspection

HACCP is not an inspection system. However, it supplements and enhances inspection rather than replacing inspection procedures. It is mainly concerned with control of manufacturing process with regard to identification of food safety hazards reasonably likely to occur and to find preventive measures against significant hazards in processing steps to ensure the safety of seafood. Inspection in relation to HACCP provides for an official examination of the facility to determine its compliance with regulations. The responsible inspection body is concerned with inspection of processing, handling and storage operations. It also includes sanitation, specifications, labelling and monitoring of safety system (*OECD 1998*).

5.7 HACCP and the role of the regulatory body

HACCP based food safety management system changes the role of the regulatory body. The competent authority must show leadership by promoting and facilitating the implementation of HACCP. They must also develop guidance on HACCP principles for the processing sector and may act as:

- A facilitator and help industries to understand the goals and scope of HACCP and provide expertise during establishment of a HACCP plan or its verification.
- The enforcers to assess the correct application and implementation of the seven principles of HACCP.
- A trainer to provide training courses on HACCP for industries and inspectors.

6 PROPOSAL FOR CHANGE IN SEAFOOD SAFETY AND QUALITY ASSURANCE SYSTEM

In view of the shortcomings of the Mauritian seafood safety and quality control system, there is need for a conceptual change in the quality assurance system for both local and export markets. The immediate responsibility for ensuring seafood safety and wholesomeness lies on all those involved in the production process, for example from catching to retailing through processing, distribution, storage and transportation. However, the role of the state is to take care of the population through appropriate legislation which makes it mandatory such that producers have a functioning and effective safety programmes in place, qualified personnel for running the food safety programme and must ensure that fish processing is carried out under hygienic conditions.

Priority consideration should be given to the interest and health of the consumers. The objective of this study could be achieved through fundamental changes in the legislation, harmonisation of standards, designation of competent authority and proper education and training of all those involved in the fish processing, distribution and marketing sector. In this regard, changes concerning the seafood safety and quality assurance system are proposed for consideration.

6.1 Legal framework

The Mauritian authority should establish and maintain effective national seafood safety and quality assurance systems. The legislation must therefore be reviewed to better enforce the application of hygiene and good manufacturing practice using HACCP as a food safety management tool.

The legislation should be specific to fish and fish products and should be equivalent to the Codex Alimentarius or the European Union standards. The legislation should cover all aspects of health conditions necessary for the production and the placing on the market of fishery products as specified below:

- Specific conditions for imported fishery products.
- Conditions for establishments on land.
- Conditions for handling of fishery products on land.
- Health control and monitoring of products.
- Packaging and labelling.
- Identification mark for traceability.
- Storage and transportation.
- Appropriate conditions for sale of fishery products.

As an underlying principle, there is a need to show that preventive measures are taken at the national level to safeguard the health of consumers and this could only be achieved through endorsement of HACCP.

6.2 Mandatory application of food safety management programme

It would be advisable to mandate the use of HACCP for both domestic and imported products such that the system becomes more efficient and effective in controlling food safety and quality. It will help to attain conformity with standards and specifications as required by the law.

6.3 Harmonisation of norms and standards

It is of paramount importance to harmonise the national sanitary requirements with international standards. Consumer protection and international trading will be enhanced where standards and legislation are harmonised based on Codex Standards, guidelines and recommendations and where effective food control systems are in place. The norms and standard should be made equivalent and aligned to the developed countries.

6.4 Establish a competent authority

The designation of a competent authority for inspection of all fish and fishery products would be helpful in controlling and maintaining seafood safety in the country. In this regard, it would be advisable that the Division of Veterinary Services be appointed as the official competent authority because they already have the experience in the field of HACCP implementation and inspection systems for fishery products intended for export. They also have an approved meat and fish laboratory. The Veterinary Authority may therefore be entrusted the responsibility to manage inspection systems to control requirements of production, processes and establishments and also for certification of all fishery products intended for sale in Mauritius. The role of the veterinary authority should be limited up to the factory level.

As regards the ministry of health and quality of life, it will continue to be the competent authority for sale of fishery products on the local market. Moreover, the necessary efforts could be diverted towards safety and quality aspect of fishery products offered for sale on the local market. - OR – The ministry of health and quality of life may be appointed as the competent authority for production and placing on the market of fishery products. However, all the health inspectors would have to be trained in HACCP for effective inspections and control. This option would be time consuming and costly to the state.

The Ministry of Fisheries as the regulatory body should have an overall control on the fish processing sector. This authority should act as a coordinator and facilitator with a view to promote sustainable development in the fish processing sector. It should also provide support services in terms of guidelines, education and training activities to the processors and consumers.

6.4.1 Approval of fish processing establishments

All fish processing establishments should be inspected and approved for hygiene and sanitation by the competent authority. They should be delegated the power to control all conformities and non conformities with respect to the environmental and technical requirements of the legislation.

6.4.2 Application of HACCP based seafood inspection system

Responsibilities and activities of the inspection body will change with the application of a HACCP based inspection system. Unlike in the traditional inspection system, control measures should focus on control of the water quality, process control, verification of procedures, plant hygiene, personnel hygiene, microbiological test results, records and corrective actions undertaken by the processing plants and validation to ensure that all safety measures are being taken along the production chain.

6.5 Education and training programme

The effectiveness of the food safety programme depends on the education and training of all the seafood handlers including the management. The employees should understand and recognise the importance of the food safety management principles and learn the skills necessary to make it function properly. Technical guidelines and awareness programmes would be helpful in proper disseminations of information for use in the industry.

6.5.1 Prepare guidelines on hygiene, GMP and HACCP

The regulatory body should produce guidelines on GHP, GMP and HACCP in such a way that it would be simple, easily understood, accepted and applied in the fish processing sector. The guide in addition to technical requirements should also elaborate on the importance of food safety and quality and how it could be beneficial to both producer and consumer.

6.5.2 Prepare technical guidelines on processing, storage, distribution and sale of seafood

This guide should give the appropriate technical requirements for distribution and sale of seafood, based on codex standards. It must include handling procedures, appropriate temperatures, importance of respecting cold chain and the required infrastructure with respect to storage, sale and distribution of fishery products. The guide should be simple and easily understood by the targeted readers.

6.5.3 *Consumer awareness programmes*

The regulatory body should provide consumer awareness programmes on seafood safety involving identification of fish quality and how to differentiate between fresh and spoiled fish. It must demonstrate how to recognise fish under deterioration and to avoid buying adulterated fish. It should also give the importance of labelling and explain fish handling prior to cooking and how to avoid the risks associated with food borne diseases and illnesses. This could be done using different means of communication available in the country, for example booklets, media, TV, video shows, radio etc.

6.6 **Consumer protection services and food safety**

The Consumer Protection Service which is an independent body should be more proactive with regard to seafood safety and must be involved in handling consumer complaints, economic fraud issues and sale of adulterated fishery products. They should make use of the media to communicate shortcomings and drawbacks of the current system. This institution should fight for the benefit of the consumers.

6.7 **Comments**

The needs highlighted above are bound to have an effect on the whole fishery industry and in particular the fish processing sector and conscious of the implication of funds, the state role should be to provide an acceptable level of health safety to the consumer. The food safety management strategy is aimed at:

- improving the general health of the public by focusing on the cause of disease;
- reducing food born illnesses and preventing them before they occur;
- producing safe and good quality fishery product;
- promoting compliance through improved communication between government body and private sector;
- reducing confusion and overlapping between different ministries.

7 RECOMMENDATIONS

Considering the importance of the tourist industry, the health of consumers and the risks associated with seafood consumption, implementation of HACCP is highly recommended for the Mauritian fish processing sector. An effective food safety and quality assurance system is the basis for protecting both the health of the consumers and the interest of the industry. Specific seafood safety legislation is needed to cater for the fish processing industry. It is of paramount importance to ensure that the prerequisite programmes are in place as a good starting point for HACCP implementation. The regulatory body should also ensure that there is an efficient education and training programme on HACCP designed for both the processors and the competent authority.

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