TRACEABILITY AND QUALITY MANAGEMENT IN THE FISHING INDUSTRY: A CASE STUDY OF KENYA MARINE AND FISHERIES RESEARCH INSTITUTE (KISUMU)

By

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DECLARATION

This research project is my original work and it has not been presented for any award in any other university.

Sign---------- Date----------

Barbara Naliaka Wasilwa

D61/60371/2010

This research project has been submitted for Examination with my approval as the university supervisor,

Signed: ---------- Date----------

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DEDICATION

This research project is dedicated to my beloved parents John Wasilwa and Alexandra Wasilwa who gave me a lot of encouragement and inspiration as they were determined to ensure that all of us (me and my siblings) got quality education. I would also like to appreciate my colleagues at Kenya Marine and Fisheries Research Institute in Kisumu who made this research possible with their continual help during the data collection phase.

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LIST OF ACRONYMS AND ABREVIATIONS

BSE – Bovine Spongiform Encephalopathy

CCP – Critical Control Points

EC – European Community

EEC – European Economic Community

EFMIS – Electronic Fish Management Information System

EU – European Union

FDA – Food and Drug Administration

FOA – Food and Agriculture Organization

FSSC – Food Safety System Certification

FQLM – Fish Quality Labelling and Monitoring

GMP – Good Manufacturing Practices

HACCP – Hazard Analysis Critical Control Point

ISO – International Organization for Standardization

IUU – Illegal, Unreported and Unregulated

KMFRI – Kenya Marine and Fisheries Research Institute

LVEMP – Lake Victoria Environment Management Project

NACMCF – National Advisory Committee on Microbiological Criteria for Foods

NASA – National Atmospheric and Space Agency

QIM – Quality Index Methods

QMS – Quality Management System

SSO – Specific Spoilage Organisms

SSOP – Standard Sanitation Operational Procedures

TAM – Technological Acceptance Model

TMAO – Trimethylamine Oxide

TTI – Time-temperature Indicators

TVC – Total Viable Count

ABSTRACT

A field study of how traceability relates to quality management was conducted at KMFRI – Kisumu, this is a research institute that covers all the Kenyan waters. The process from catch to transportation up to the shipping company is followed and recorded through a traceability system that has been developed to trace back and forward the history of fish products. High quality and safe products are as a result of an effective quality and traceability system. This research is based on the assumption that there are various potential drivers of an organization's investments into traceability systems; food traceability has become an essential and effective way in food quality and food safety management systems around the world. The main objective of this research was to identify the relationship between traceability and quality management in the fishing industry. The research found out that 89 % of the respondents believed that traceability has influenced the handling quality of fish products at landing sites, while 91% believed that there is improved product quality due to traceability and quality mechanisms employed at the fish factories. This shows that in deed there is a relationship between fish traceability and the quality management of fish products.

CHAPTER ONE: INTRODUCTION

1.1 Background

Traceability is an integral component of any food safety management program, which makes it possible to trace a safety issue to its source, track the distribution of unsafe items, and recall them from commerce (Golan, 2003). In addition, traceability is a critical tool that enables Product Marketing, Chain of Custody, cold chain monitoring, Sustainability and other claims such as eco- friendly and fair-trade.

This research was based on the assumption that there are various potential drivers of an organization's investments into traceability systems. Besides mandatory, but often not very sophisticated traceability concepts, there are also voluntary traceability systems that provide a higher degree of information associated with a single product (Banterle, Stranieri 2008; Golan et al. 2004). This situation can result in very diverse motivations of food manufacturers to improve their tracking and tracing systems.

Within the EU, article 18 of Regulation EC/178/2002 is the most important legal driver of the improved traceability of food products. Article 18 requires the traceability of food at all stages of production, processing and distribution. Paragraphs 2 and 3 of the article lay down the so called "one step up–one step down" principle. This means that food business operators must be able to identify any person from whom they have been supplied with a food or a food producing animal (Fritz, Ricker &Scheifer *et al* 2009). Furthermore, food business operators must also be able to identify the other businesses to which their products have been supplied. Article 18 mandates that business operators

have adequate systems and procedures in place and make information available to competent public authorities on demand. Other legislation, such as Regulations EC/1829/2003 and 1830/2003 on GMO labeling or beef labeling laws, force at least parts of the agribusiness sector to improve the traceability of their products.

In 2010 the EU council passed another law relating to Traceability and IUU-Illegal unregulated fishing, requiring exporters to employ electronic means to provide proof of origin and Catch certificates to validate origin information. This seeming challenge could yet provide an opportunity for the producer fisher communities to reinvent themselves by becoming a reliable source of traceability data relating to fish products for downstream consumption (FAO, 2012).

The Traceability law places the onus and responsibility of maintaining accurate data on the exporter and therefore the exporter must work backwards to ensure that there is full chain visibility of traceability information. Transforming Beach management units into centers of compliance, data capture and control points of fish product could very well lead to a linkage between price discovery and quality management.

The pricing mechanism within the fishing sector is largely an informal auction process that does not adhere to any benchmarks giving credence to the situation that has existed where agents take advantage of the players by manipulating prices and chains to their advantage. A reliable and consistent system for providing catch data will address the challenge of equitable management of payments to fisher communities and processors.

Fisher communities will benefit from a knowledge based transparent pricing mechanism that can be queried backwards for audit and performance analysis.

Providing avenues for implementation of mechanisms that could potentially increase earnings to small scale fisher communities like eco labeling and Fair trade are largely dependent on their ability to sustain these claims, Traceability allows producers to prove claims relating to their product for premium marketing initiatives.

1.1.1 Traceability

Traceability refers to the completeness of the information about every step in a process chain. Under EU law, "traceability" means the ability to track any food, feed, food-producing animal or substance that will be used for consumption, through all stages of production, processing and distribution. Traceability is a way of responding to potential risks that can arise in food and feed, to ensure that all food products in the market are fit for human consumption (Majcen *et al* 2010).

Traceability emerged as an important concept in food safety since the breakout of the Bovine Spongiform Encephalopathy (BSE) and dioxin crises in Europe (Majcen, 2010).

Food traceability has been proven to bring both social and industrial benefits; from the public or social point of view, good traceability practice in food supply chain reduces risks and costs associated with the outbreak of food borne diseases. Traceability systems can reduce the magnitude and possible health impact, reduce or avoid medical costs,

reduce labour productivity losses or reduce safety cost arising from widespread food borne illnesses. Readily verifiable traceability information can reduce costs for consumers in verifying the information associated with food quality (Hofstede *et al* 2003). From industrial perspective; value chain actors can meet the demands of their customers and thus extend and retain their markets by implementing traceability systems. Traceability also helps to expand the sale of high quality products. Implementation of traceability is also considered as a measure to save costs associated with product recall due to recall management efficiency (Pieternel, 2006). An electronic based traceability can reduce labour costs as compared to a paper based system, it can also improve the supply chain and company management.

1.1.2 Quality Management

Quality is difficult to define, since it means different things to different people. One general definition is 'degree of excellence'. In commerce, quality limits are set by what the customer is prepared to pay for; generally the customer will pay more for fish/Product that he considers to be of higher quality, and will continue to buy as long as quality remains constant. (Connel, 2001)

Quality management ensures the effective design of processes that verify customer needs, plan product life cycle and design, produce and deliver the product or service. This also incorporates measuring all process elements, the analysis of performance and the continual improvement of the products, services and processes that deliver them to the

customer. The effective management of quality not only creates value for an organisation and its stakeholders but also manages its exposure to risk and can make the difference between success and failure.

1.1.3 Quality Management and Traceability

The increased use of quality management could meet the traceability demands in an efficient way. While Quality Management has been widely adopted in other industries such as manufacturing and professional services, the agriculture sector has begun to understand the internal benefits that such initiatives bring.

Quality Management focuses on the achievement of results, in relation to quality objectives, to satisfy customer needs and expectations. To create a coherent format for quality management requirements, the International Organization for Standardization (ISO) created the ISO 9001 series (American Society for Quality, 2000a).

There are some studies of ISO 9000 and food traceability. The ISO standard states that an organization, where appropriate, shall identify the product, and its components, by suitable means throughout production (American Society for Quality, 2000a; 2000b). A recent benchmarking study of international food companies found that most food processors focus on safety prevention through quality assurance (QA) systems which include traceability (van der Vorst, 2006). Manning and Baines (2004) state that such QA schemes are based on company needs rather than on meeting mandatory requirements of traceability. Bailey, Jones, and Dickinson (2002) state that meeting

traceability requirements will be most difficult for commodity handlers due the blending from multiple sources before processing.

1.1.4 Kenya Marine and Fisheries Research Institute

The Kenya Marine and Fisheries Research Institute (KMFRI) is a State Corporation that was established by an Act of Parliament (Science and Technology Act, Cap 250 of the Laws of Kenya) in 1979 and run by a Board of Management. The research mandate of KMFRI is defined by article No. 4 of the Science and Technology Act of 1979, Cap 250. The Institute is empowered to carry out research in Marine and Freshwater fisheries, Aquatic biology, Aquaculture, Environmental Chemistry, Ecological, Geological and Hydrological studies, as well as Chemical and Physical Oceanography.

The Department of fisheries has various functions which include; Fisheries policy formulation and review, Fisheries licensing, Management and development of marine fisheries including the Exclusive Economic Zone (EEZ), Management and development of Fresh water Fisheries, Commercialization including formation of fisheries groups for local fishermen, Promotion of fish quality assurance, value addition and marketing, Development of aquaculture, Marine and Fisheries Research, Promotion of recreational fisheries, Facilitation of ice production and cold storage at landing sites, Promotion of credit facilitation to fishery sub-sector in liaison with financial Institution, Promotion of affordable and safe fishing boats and appropriate gears, Promotion of appropriate fishing technology (Fishery industry challenges, 2012).

According to the Ministry of Fisheries Development there are various challenges that KMFRI and the fishing industry as a whole is facing and these challenges include the following: There is use of illegal and unregulated gears by the fishermen which in turn result in the capture of young fish and thus reduction of fish population in the lake. This also leads to capture of underweight fish which cannot fetch a good price for the fisherman. There is also the use of outdated technologies; the crafts with or without motors are a common occurrence in the fishing community. The use of modern fishing gears is negligible and hence the quality and quantity of the capture fish is severely affected. The use of remote sensing and Geographic Information Systems is non-existent which otherwise would have helped in augment the capture by the fisherman (Fishery industry challenges, 2012).

Information gap on price and market has created a gap and reduced the bargaining power of the fisherman. The due diligence of the fisherman is severely downsized because of the nonexistent information channel on prices and demand of the various species in the bigger markets. The player has to completely depend on the middleman to fix the price of the catch and hence has to compromise on the income aspect. The absence of parallel information channel has limited the awareness to the players (Fishery industry challenges, 2012).

1.2 Research Problem

Developing countries are responsible for more than 50 percent of fish and fishery products involved in international trade (FAO, 2001). Almost all developing countries export some fishery products and for most of them the revenue from these

exports is a major source of foreign currency. One of the most serious difficulties faced by exporters from developing countries consists of the different standards and regimes that are being imposed by importing countries to ensure products meet their domestic quality requirements.

In these developing countries sub-standard products with very short shelf life or very little appeal are being produced. The need for proper hygiene and quality control practices is often overlooked. Very little effort has been made to mechanize, improve the efficiency and modernize the operations. Fish markets are invariably located in the most inaccessible parts of town. They are often old, without adequate facilities for ensuring even basic standards of cleanliness and sanitation. Fish landing places generally offer the same poor picture. Transport, storage and distribution facilities follow the same pattern.

Palacios (2001) studied quality management systems and the traceability of a product in a fish processing company in Cuba. This study was carried out to assess the traceability system from catch to transport to the shipping company and how an effective quality management affects traceability of a product.

Nga (2010) studied quality management of fresh fish supply chain through improved logistics and ensured traceability in Iceland. The study was to get an insight into organizations perspectives on the benefits of implementing traceability.

Rijswijk and Frewer (2008) studied Consumer perceptions of food quality and safety and their relation to traceability.The purpose of the research was to gain understanding of consumers' perceptions of the concepts of food quality and safety, the two concepts that

play an important role in how consumers perceive food, and that are used in decision making.

Studies by Dalian Fisheries University in China have proved that traceability and quality management go hand in hand to ensure consumer or customer trust in a product as traceability can trace a product back to its origin and thus call back to defective products can be easily achieved.

Traceability and quality management in the fishing industry in Kenya has not been studied extensively and it therefore justifies a research study in this area. This study seeks to determine the effects of traceability and quality management in the fishing industry in Kenya (Kisumu). Therefore, "How does traceability relate to quality management in the fishing industry?"

1.3 Research Objective

The objective of this research was to determine the relationship between traceability and quality management in the fishing industry in Kenya.

1.4 The Value of the study

This study will help the management at KMFRI to understand the benefits of the traceability system and how it relates with quality management this will in turn boost consumer confidence in the fish products being produced in the country.

The country will also participate in international trade while being confident in the products being exported from the country. To the academicians and scholar, this study is

going to fill the knowledge gap that has always existed in Kenyan fishing industry particularly in Kenya Marine and Fisheries Research Institute on effects of traceability and quality management on the fish products.

The study will also gain an insight in consumer perceptions of food quality and safety in relation to traceability and specific products and food safety in general, and how these were related to each other. Further understanding was gained of how consumers might use these concepts in judgments about food, which, in turn may influence their purchase decisions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter gives an in depth understanding of traceability and quality management as understood by other researchers. It also discusses the importance of traceability in food chains and the benefits that can be gained when implementing traceability.

It is a widely shared view that traceability and related concepts, such as trust and transparency, deserve more attention in agribusiness management (Fritz, Fischer, 2007; Hanf, Hanf, 2007; Deimel et al., 2008; Jansen, Vellema, 2004). According to Hofstede (2003), effective information exchange is the key to improving value chain performance and competitiveness in today's complex and rapidly changing environments. The implementation of traceability systems is controversially discussed, not only in theory but also and especially in practice. One of the most common complaints is that while regulations result in a huge bureaucratic workload, they offer little advantages for day-to-day operations in the agrifood sector (Schulze et al., 2008; Theuvsen, 2005). Consequently, many members of the food chain did not implement a traceability system voluntarily but were forced to do so by mandatory regulations. At the same time, other companies have decided deliberately to invest in traceability systems that are much more comprehensive and effective than those required by legislation (Banterle, Stranieri, 2008).

2.1.1 Traceability

ISO (International Organization for Standardization) defines traceability as the "ability to trace the history, application, or location of that which is under consideration" (Golan 2004). It refers to "the original of the materials and parts, the processing history, and the distribution and location of the product after delivery" In other words, traceability involves in the whole supply chain.

In the food chain, traceability is "the ability to trace and follow a food, feed, food-producing animal or substance through all stages of production and distribution" (Food standards Agency 2002). As mentioned before, it requires that the product should be able to be traced through the whole supply chain at any time and at any stage "A requirement is traceable if it can identify all parts of the product that exist because of the requirement and, for any part of the product you can identify the requirement or requirements that caused it." (Robertson & Robertson 2006)

2.2 Why is Traceability Necessary in Food Chains?

Traceability is necessary to a food chain because control of hazards that may be present is not possible unless it can be demonstrated where all inputs into the food chain have been sourced. It is also necessary to be an active participant in this process through the application of interactive communication, system management, and hazard control through the use of Hazard Analysis Critical Control Point (HACCP) tools. This logic is well described by Faergemand (2004) in a description of how ISO 22000 works to enhance Food Supply Chain Management.

According to Setboonsarng, Sakai, and Vancura (2009), the need for traceability is also being driven by other factors including:

Significant contamination due to contamination with a hazard, the emergence of Bovine Spongiform Encephalitis (BSE) or "Mad Cow Disease" in cattle, deliberate adulteration of ingredients in the food chain to artificially elevate the apparent protein levels in food such as melamine in gluten and dairy products. Contamination of a food with a chemical hazard because of adulteration in one part of the food chain such as dioxin contamination of poultry feed by one processor

2.2.1 Traceability in the fish industry

According to ISO 9000:2000, traceability is defined as the ability to trace the history, application or location of that which is under consideration. In terms of products it relates to the origin of materials and parts, the processing history, and the distribution of the product after delivery (ISO 2000). In other words traceability means the ability to trace and follow a food through all stages of production and distribution (Tall 2001).

Two types of traceability can be identified: internal and chain traceability. Internal is within one company and relates to data about raw materials and processes to the final product before it is delivered. Chain traceability is focused on the information about the product from one link in the chain to the next, it describes what data are transmitted and received, and how (Tracefish 2001). Chain traceability is between companies and countries and depends on the presence of internal traceability in each link (Olsen 2001).

The public confidence in food safety has been damaged by recent food scares associated with beef because of mouth and foot disease and BSE - mad cow disease, in cattle, dioxin in fish meal and other. This is driving the industry and government agencies to improve controls at all stages in the food chain (Tall 2001). Traceability is then needed to meet food safety requirements, especially in case of product recall, for commercial reasons to ensure supply chain standards and because it is required by legislation relating to labeling, animal health and welfare, fish marketing, fisheries control and product liability and safety (Denton 2001).

The EU Fisheries Control Regulations demand a specific traceability system from the fishing grounds to the processors. The EU Fish Marketing Regulations demand that from 2002, much of the fish at retail sale (including wet fish) will have to be labeled with its area of origin. The proposed revision of the EU General Product Safety Directive requires full traceability by 2003, including product recall systems. The EU Food Law, which is now under revision, requires full traceability by 2004 (FQLM 2001). The proposed new Regulation on the General Principles and Requirements of Food Law lays down the general food safety requirements. Regarding traceability, it establishes the need for traceability at all stages of production and distribution. It is proposed that food and feed business operators must identify their raw material suppliers and identify to whom they supply products (one up, one down traceability).

They must have systems to provide those data to the competent authorities, label or identify products to ensure traceability, and withdraw and recall unsafe food from the

market (Tracefish 2001). The fish industry trades globally in a vast range of species and products and is diverse in comparison to other protein sources. There are hundreds of different species of fish captured with different methods of catching, handling and food safety requirements. A wide range of live, chilled, frozen and value added fishery products are produced and traded within the various distribution chains, which also have their specialized food handling and food safety requirements. There is a huge and complex international trade in the raw materials and in primary and secondary processed products (Tracefish 2001).

Below is an example of the chain from catch to the consumer with the multiple links and information flow. If the information is available with all the data and a unique identifier to label the batch at each link, then the product can be traced.

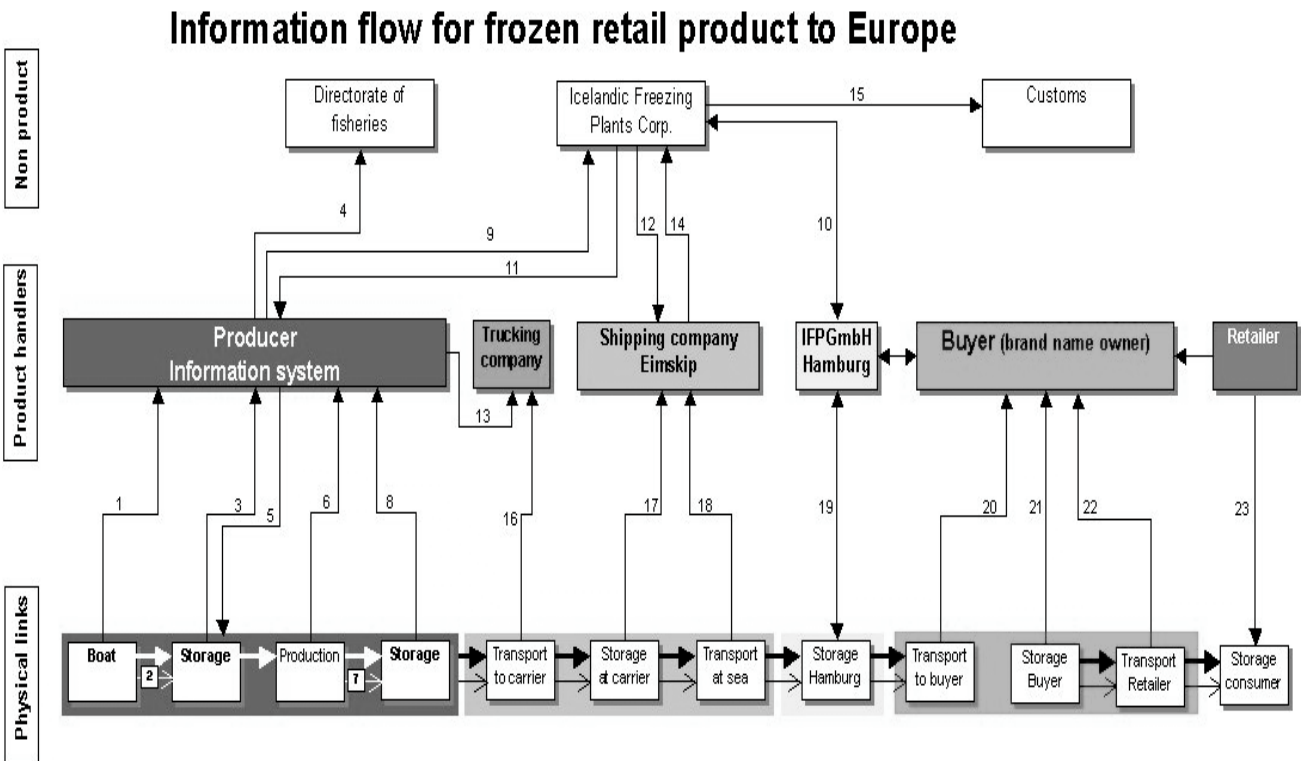

Figure 1 : Example of the chain and information flow for redfish caught and processed into frozen fillets in Iceland and sold to Germany (Pálsson and Ólafsdóttir 2001).

A product can be traced either backward or forward. Backward leads to the origin and history, everything that went to a batch and depends on all links mapping identification (ID) of output batches to ID of input batches. Forward trace explains what happened to a certain batch, all the processes and output batches that the batch in question went into. Keeping track of batches and their properties is the key to implementing chain traceability. It means that we must record what batches we use, we must have the ability to access to their properties, and we must relate input batches and properties to the batches we make (Olsen 2001).

2.3 HACCP based quality system

Hazard Analysis Critical Control Point (HACCP) is a management system in which food safety is addressed through the analysis and control of biological, chemical and physical hazards from the raw material, to processing, distribution and consumption of the finished product (NACMCF 1997).

It was developed nearly 30 years ago by the Pillsbury Company working together with the National Atmospheric and Space Agency (NASA) in USA, with the objective of finding a method to provide safe food for astronauts. The system focuses on preventing hazards that could cause food-borne illnesses, by applying controls to the production line, from raw material to the finished products (FDA 2001).

HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying on end-product testing. Implementation of HACCP enhances food safety and promotes trade by increasing confidence in safe foods (Codex 1997).

2.4 Quality Management and Quality Control Factors

Definitions of quality as applied to food products vary according to the author. Different qualities with respect to seafood include safety, nutritional quality, availability, convenience and integrity, and freshness quality (Bisogni *et al.* 1987, Botta 1995, Bremner 2000). The most important is seafood safety.

Quality management can enhance the value of the product along the fish supply chain. The quality of raw fish may affect the quality of the ultimate fish products and must be critically monitored. Quality assurance systems require monitoring of fish freshness as a critical parameter throughout the fishery chain (Liu, 2002).

The processing factors that most affect quality in the fish industry are; Time: Since fish is so perishable, it is important that it be processed quickly; systematic checks must be made on the time fish takes to pass through the process, and it is useful to prepare a schedule of permitted times. The rate of spoilage of wet fish at different temperatures is known accurately; thus it is possible to specify maximum allowable times in order to keep spoilage to a permitted level. For example, it might be specified that fish off the market should not be iced back for more than 24 hours, or that the interval between

packing fillets at normal factory temperature and freezing them should not be longer than 1 hour (Bisogni *et al.* 1987).

Temperature: Wet fish should be held as closely as possible to 0°C throughout handling, processing and distribution in order to reduce spoilage to a minimum. Good practice when handling wet fish is dealt with in detail in several notes in this series. When it is impractical to hold fish at a specified temperature, then a maximum permissible temperature should be given.

Contamination: The product can be contaminated in a number of ways during processing, for example by dirt, scales, bones, blood, water, lubricating oil, unpleasant odours and flavours, and hair. The process specification should detail the main methods of avoiding contamination, for example the wearing of protective clothing. Much of what needs to be specified under this heading is a matter of common sense and experience.

Hygiene and sanitation: Fish is a food, and must be handled hygienically; if hygiene is not dealt with as a separate management function, then appropriate measures should be written into the process specification. Cleaning and sanitation procedures should be specified here; Advisory Note 45 deals with this subject (Quality Control in the Fish Industry, 2012)

Equipment and methods: Rather than specify how the job should be done, it is sometimes simpler to specify the equipment that will do it; for example a deboning machine that produces material of the required quality, or a labeling machine that affixes labels of the right type, may be easier to specify than the job to be done. A certain type of freezer may

be specified to ensure that freezing is done in the required manner but, where the equipment can be used in several ways, it may be necessary to specify exactly how it should be used; for example, it is usually necessary to specify the manner of loading and the freezing time for each product in an air blast freezer, or the brine strength and product residence time in a continuous briner.

Packing for product appeal: The eye appeal and finish of the product is important, and the process specification should cover these aspects; for example instructions to cut and trim neatly, and to arrange the fish attractively in the pack, will help to ensure the product is displayed to the best advantage; filling the pack with the right number, size and weight of fish, and the manner of labeling and stapling can be specified under this heading. (Quality Control in the Fish Industry, 2012)

2.5 Quality Changes in fish products

Fish quality, regardless of the species characteristics, in terms of safety and shelf life, is highly influenced by non-visible factors such as autolysis, contamination, and growth of microorganisms. These effects can only be assessed long after the damage has occurred, and the proper procedures must thus be based on knowledge about the effects of the different factors involved. The details of biophysical and biochemical mechanisms will not be dealt with in this paper. A comprehensive review has been summarised by Sikorski et al. (1990) and the FAO book on Quality and Quality Changes in Fresh Fish in Huss (1995).

Until fish reaches the consumer, its quality attributes are prone to change because of the post-harvest handling. Sikorski and Sun Pan (1994) concluded that biological variations, harvesting conditions and post-harvest handling were the three major factors affecting the loss of quality in fresh fish.

Quality management can enhance the value of the product along the fish supply chain. The quality of raw fish may affect the quality of the ultimate fish products and must be critically monitored. Quality assurance systems require monitoring of fish freshness as a critical parameter throughout the fishery chain (Liu, 2002).

2.6 Link between Traceability and Food Quality

According to Rijswjk and Frewer (2008), the implementation of traceability systems can contribute towards restoring consumer confidence in food quality and safety, one of the goals of the European Food Law. Traceability, in the absence of quality verification, is of limited value to individual consumers. Bundling traceability with quality assurances has the potential to deliver more value (Hobbs and Bailey, 2005). "Traceability" by itself may not deliver much value to most consumers; most people want to know their food is safe before they eat it! Quality assurances with respect to specific credence attributes, bundled with traceability, have more appeal. Traceability may be a necessary but not sufficient condition for verification of quality attributes (Hobbs *et al* 2005).

Fish quality, safety and shelf life are highly influenced by non-visible factors such as autolysis, contamination, and growth of microorganisms (Liu Junrong 2002). Biological variations, harvesting conditions and post-harvest handling were considered to be the

most relevant aspects (Huss 2001) to enable quality and safety. The effects of these factors can be assessed long after the damage has occurred, proving that proper procedures to prevent it should have been implemented.

In a well-functioning distribution chain where each step can be relied upon in terms of temperature control, quality and traceability can be implemented by a time recording. Still, an important aspect of quality and safety assurance is to be able to trace products, ingredients, suppliers etc., through the food production chain (FAO 2004), especially when failures occur.

The implementation of quality assurance systems (HACCP), Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP) and well recorded harvesting, processing, transportation and distribution information (traceability) are the keys to increasing fish products' quality, safety, trade and consumption (Lees 2003).

2.7 Traceability in Kenya

Food safety and traceability are global concerns that demand effective and harmonized food production systems which in turn ensure the final product is suitable for consumption. Kenchic Ltd, which is at the forefront of traceability in the region, has been awarded the SGS, Food Safety System Certification (FSSC) 22000 – 2010, Certification.

Traceability has also been applied in the livestock industry to reduce, control or eliminate safety scares that result from transbounadry diseases outbreaks. Recent studies on Livestock Identification Traceabilty System in Kenya have been focused on testing

innovative technology, information and traceability system management, and examining the determinants for effective implementation. This paper analyzes the strengths and limitations of the operating a LITS institutional and organisational mechanisms in Kenya.(Ogara *et al* 2010)

2.8 Conceptual discussion

The focus of the conceptual framework is a behavioural research model. In detail, the theoretical framework of the empirical study is the tracking and tracing systems investment model proposed by Theuvsen and Hollmann-Hespos (2005b). The model presented is based on both the theory of planned behaviour (Ajzen, 1991) and also on the technology acceptance model (Davis, 1989; Venkatesh, Davis, 2000) developed on the basis of the first mentioned.

The technology acceptance model is an extension of the theory of planned behavior and was mainly developed as a theoretical background for understanding decisions to use or not to use new information technologies such as graphics systems, email and editors (Davis, 1989). The model assumes that the decision how and when to use a technology is determined by the behavioural intentions of individuals to adopt this technology. The intention is determined by people's attitudes toward this technology. The attitudes are a determinant of "the degree to which a person believes that using a particular system would enhance performance" (perceived usefulness) and "the degree to which a person believes that using a particular system would be free of effort" (perceived ease of use) (Davis, 1989, p. 320).

Both perceived usefulness and perceived ease of use are influenced by external factors. Venkatesh and Davis (2000) operationalize perceived usefulness by introducing two additional theoretical constructs into an extended version of the technology acceptance model (TAM 2): social influence processes (subjective norm, voluntariness, image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, perceived ease of use).

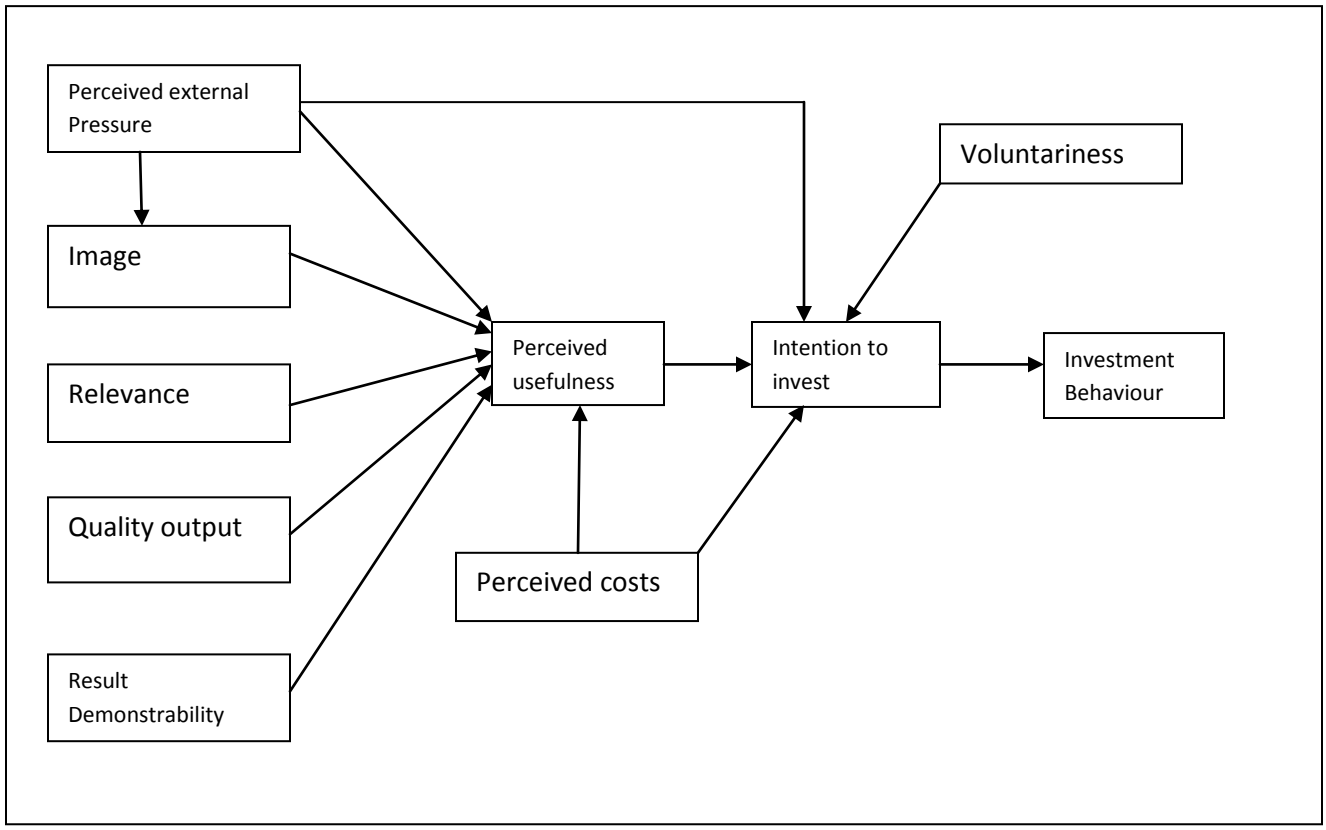

Figure 2: Tracking and tracing systems investment model

Source: Theuvsen, Hollmann-Hespos, 2005b

The basic assumption of the model is that investment behaviour is influenced by the attitudes of decision makers, who may depend on cost-benefit evaluations and subjective

perceptions of food manufacturers concerning the usefulness of tracking and tracing systems. Usefulness depends mainly on perceived external pressures, including those from powerful customers, image effects, relevance of available technology to firm management, demonstrability of results vis-à-vis, for instance, external stakeholders, and output quality, that is, the reliability and technical capabilities of the systems. The model mainly assumes positive relationships between independent and dependent variables; only perceived costs have a negative effect on perceived usefulness and intention to invest.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This Chapter describes the methodology that was used in conducting the study. This included: the study area, the research design applied, target population, sampling design and procedures, the types of data, research instruments used for data collection, the research process, reliability and validity of the research instruments as well as data processing and analysis techniques.

3.2 Research Design

The research was conducted through a single case study design of KMFRI-Kisumu, this was used because it gave an in-depth and holistic investigation that was required. The study was focused on traceability and quality management of the fish products. A similar case study was carried out in the Icelandic Group, an exporting company in Iceland in 2002. The aim was to study the traceability and quality system for frozen product from catching to exporting; this research enabled the Icelandic group to capture data that in turn helped improve its quality management system that ensured production of quality products.

3.3 Data Collection

Quantitative and qualitative data collection methods were used to collect information whereby self-administered questionnaires were issued to the managerial staff, lab technician at the Kenya Fisheries and Research Institute – Kisumu. The nature of data to be collected was both; Secondary data where the researcher went through records kept at

the KMFRI-Kisumu library and database and primary data whereby the researcher/interviewer conducted face to face interviews and administration of questionnaires to the interviewees.

The study target group was the managerial staff at the KMFRI – Kisumu offices, lab technicians and EFMIS project officials. The KMFRI – Kisumu office has a population of 200 staff but not all the employees were interviewed because not all of them are involved in the traceability and quality aspects of the organization. Therefore the interviewees were the managerial staff of the organization, laboratory technicians who handle specimens and are aware of specifics of quality requirements that affect fisheries. Technicians working on the efmis/traceability project at the fisheries institute.

3.4 Data Analysis

After data collection, the Questionnaires collected were cleaned of errors made during Data Collection. The Data was then be summarized, coded and entered into the computer where Analysis of Quantitative Data was done using the Microsoft excel package. Frequency Means and Percentages were used for Descriptive Statistics

The data was analyzed by the use of descriptive statistics to summarize and relate variables which were attained from the administered questionnaires. The data was classified, tabulated and summarized using means, standard deviation, and frequency distribution. Tables and graphs were used for presentation of the findings. However, before final analysis performed, data was cleaned to eliminate discrepancies and

hereafter, classified on the basis of similarity and then tabulated. Cross tabulation was used to compare the existence of relationship between quality management and traceability

CHAPTER FOUR: DATA PRESENTATION, INTERPRETATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This section presents findings of the study it explains data that was obtained for analysis. The data was analysed on the basis of the research questions that were presented through a questionnaire to the respondents. Questionnaires were used to collect data from a sample size of thirty five respondents (35). The questionnaire is attached as an appendix at the end of this research paper.

4.2 Departments

The following figure shows the number of respondents per department that were involved in the research. There were 5 respondents from the management department, 20 from the laboratory department and 10 efmis/traceability department.

Table 1 : Percentage of respondents

Respondents		
Departments	Frequency	%
Management	5	14%
Laboratory	20	57%
Efmis/traceability	10	29%
Total	**35**	**100%**

Source: Microsoft excel analysis of the data collected

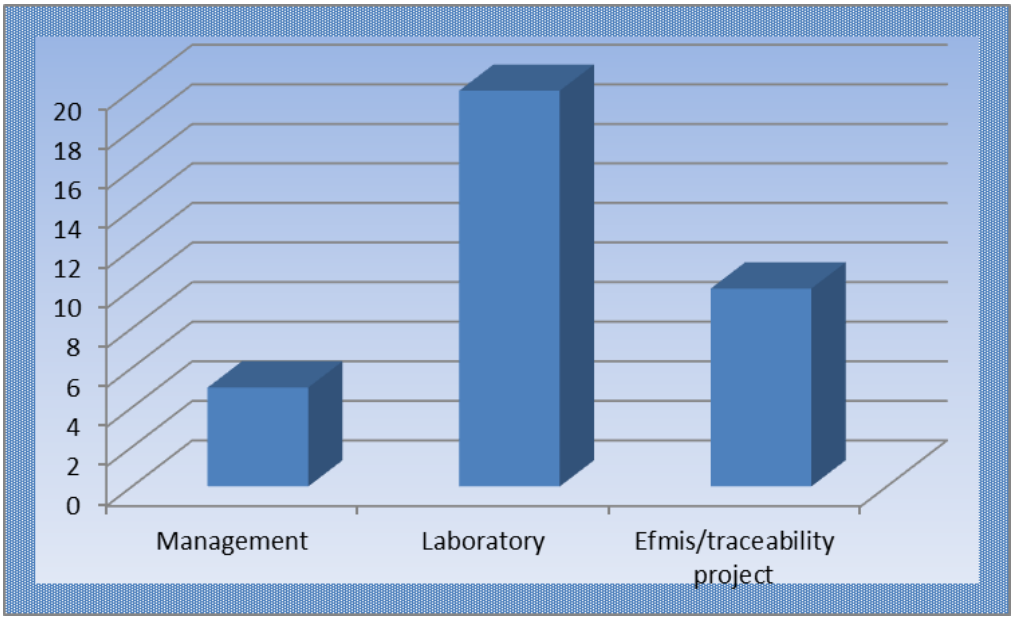

Figure 3: Departments

4.3 Importance of food traceability and quality

The results from the analyzed questionnaires confirmed there is comparable importance of food quality and food traceability in general. Whereas food quality was more important for some respondents, for an equal number food traceability was also more important. Overall both traceability and quality management proved to be more important when applied to a product

From table 2 below, the mean for fish product quality and fish traceability was 7.00 most respondents showed that there is a relationship between fish traceability and quality management while the standard deviation for product quality was 12.92 and the standard deviation for fish traceability was 11.38, this shows that there is wide variations and most

respondents showed that implementing traceability and quality management to fish products is of utmost importance in the fishing industry.

Table 2: Importance of food traceability and quality

	1	2	3	4	5	Mean	StDEV
Fish product quality	30	3	2	0	0	7.00	12.92
Fish product traceability	27	5	3	0	0	7.00	11.38
Both fish product quality and fish product traceability	31	4	0	0	0	7.00	13.53

Source: Microsoft excel analysis of the data collected

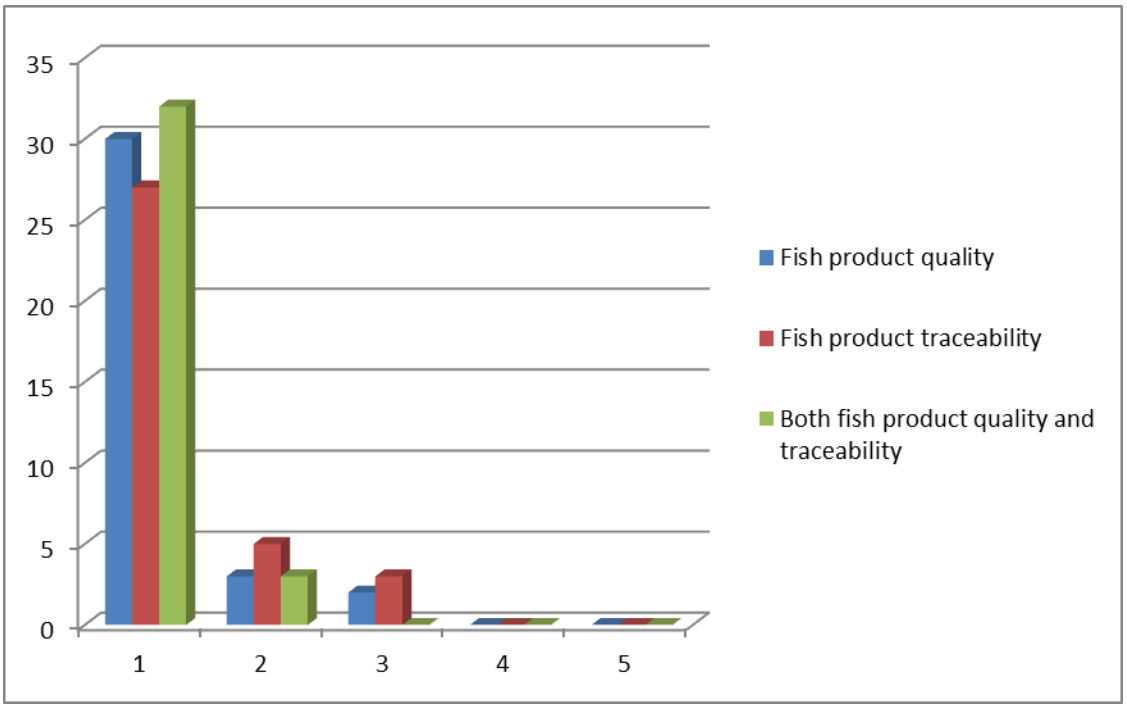

Figure 4: Importance of quality and traceability

When asked which concept - traceability or quality - was more important when manufacturing or processing fish products 77% of the respondents claimed that both quality and traceability should be put in place to ensure food safety which is highly regarded by consumers when purchasing fish products.

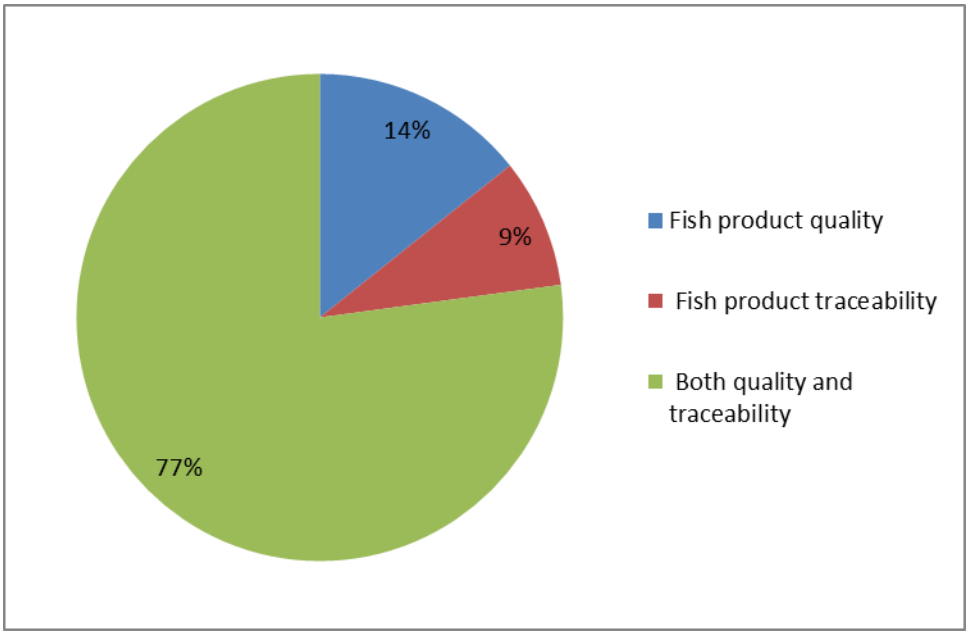

Figure 5: proportions regarding importance of quality and traceability.

4.4 Perceived Benefits of traceability

Out of the 35 respondents that were involved in the research, the table below shows how they responded to the potential benefits of implementing traceability.

With a mean of 7 and a standard deviation of 9.95 on improved product quality, 24 respondents felt that when traceability is applied there is improved quality on the fish

product, this in turn shows that there exists a relationship between quality and traceability.

Table 3: Perceived benefits of traceability

Scores		Improved product quality	Increased recall	Reduced customer complaints
1	Very unlikely	0	0	0
2	Unlikely	0	0	1
3	Neither	4	4	3
4	Likely	7	5	6
5	Very likely	24	26	25
	Mean	7.00	7.00	7.00
	StDEV	9.95	10.86	10.32

Source: Microsoft excel analysis of the data collected

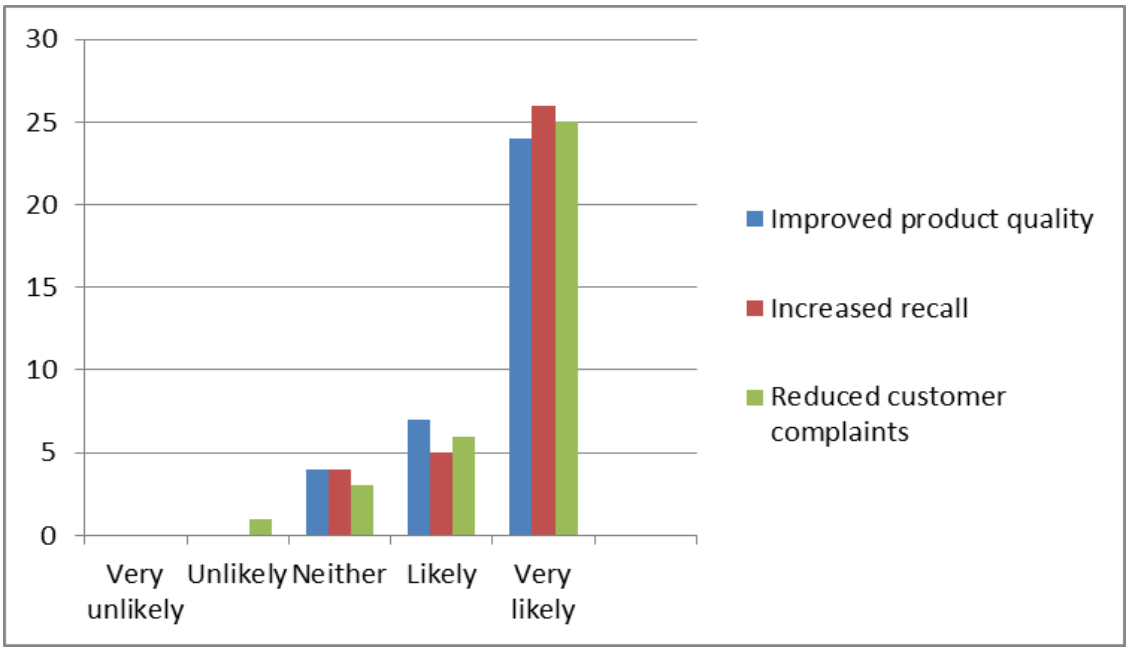

Figure 6: Perceived benefits of traceability

4.5 Difficulties faced while implementing traceability

The respondents were asked to rate the scores of the difficulties that they faced while traceability is being implemented and the table below show how they rated the difficulties faced. While recording difficulties faced while implementing traceability, a mean score of 7 was recorded. A standard deviation of 4.69 was recorded with a highest number of respondents saying that the organization had technical capabilities of implementing traceability. A standard deviation of 5.79 also revealed that the organization has unified quality standards in place which can help when implementing traceability

Table 4: Difficulties faced while implementing traceability

Scores		Lack of technical staff	No unified quality standards	Lack of support from the government	Uncertainty about future benefits	Lack of managerial support
1	Very unlikely	15	17	26	25	20
2	Unlikely	7	7	4	5	6
3	Neither	3	4	1	3	6
4	Likely	5	4	2	2	3
5	Very likely	5	3	2	0	0
	Mean	7	7	7	7	7
	StDEV	4.69	5.79	10.68	10.22	7.68

Source: Microsoft excel analysis of the data collected

4.6 Effects of traceability and quality management

With a score of 1 representing Very unlikely to 5 representing Very likely, the effects of traceability on the quality of fish produced, perception of consumers on the quality of fish and the effects on the sale of fish products that can be traced back to the producer/manufacturer are depicted in the figures below.

Table 5: Effects of traceability and quality management

	1	2	3	4	5	Mean	StDEV
Quality of fish produced	0	0	4	8	21	6.60	8.71
Perception of consumers on quality of fish	0	0	8	3	24	7.00	10.05
Increase product sales	0	0	4	4	24	6.40	10.04
Influenced quality management practices of the organization	0	0	4	4	26	6.80	10.92

Source: Microsoft excel analysis of the data collected

This figure shows the effects of traceability on the quality of fish produced. 63% of the respondents felt that there is increased quality in fish produced when traceability is applied to the fish value chain.

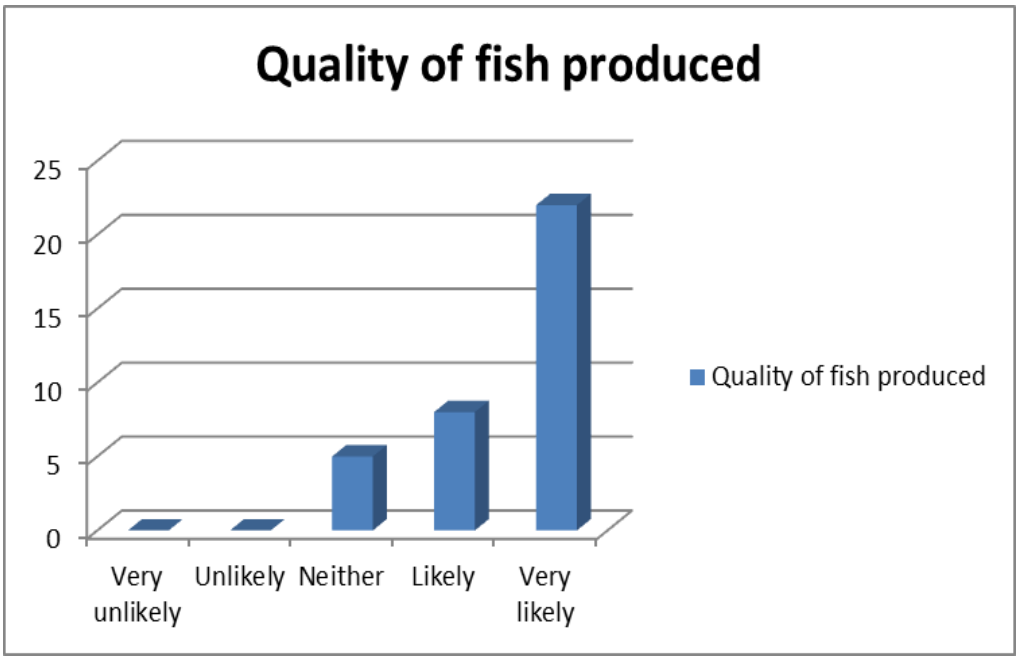

Figure 7: Quality of fish produced

The figure below shows how consumers perceive the qaulity of fish products that can be traced back to the manufacturer/catch area. 67% of respondents said that perception of consumers on quality of fish produced has improved with the advent of implementing traceability to fish products.

Figure 8: Perception of consumers on quality

There is an increase in the sales of fish products that are traceable since consumers associate these products with high quality. This is shown with the results in the figure below. 24 out of 35 respondents (69%) believed that product sales have improved because consumers are more confident in the food products.

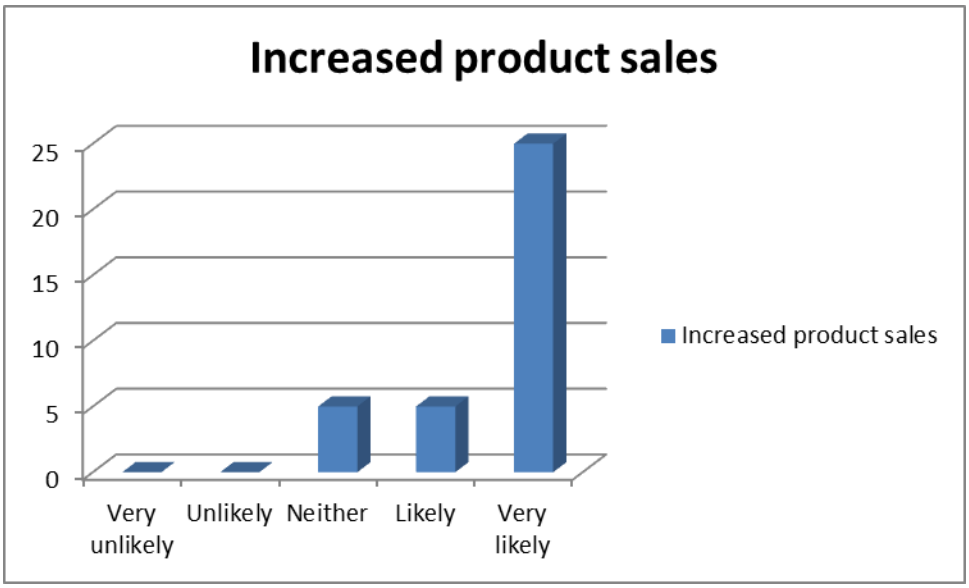

Figure 9: Sales on fish products

Traceability has influenced the quality management practices of the organization by 72% agreeing that traceability has very likely influenced quality management within the organization.

Figure 10: Quality practices of an organization

Figure 8 shows the influence of traceability on the quality practices of the organization. The respondents interviewed 26 out of 35 respondents showed that traceability has a high influence on the quality management practices at the KMFRI offices in Kisumu. 30 respondents felt that traceability has helped influence the quality management standards at the organization.

Figure 9 summerises the effects of quality management and traceability of fish products. Traceability and quality management increases the quality of a product as well as increasing the sales of these products. Consumers are more confident in products that are traceable and perceive them as being of high quality.

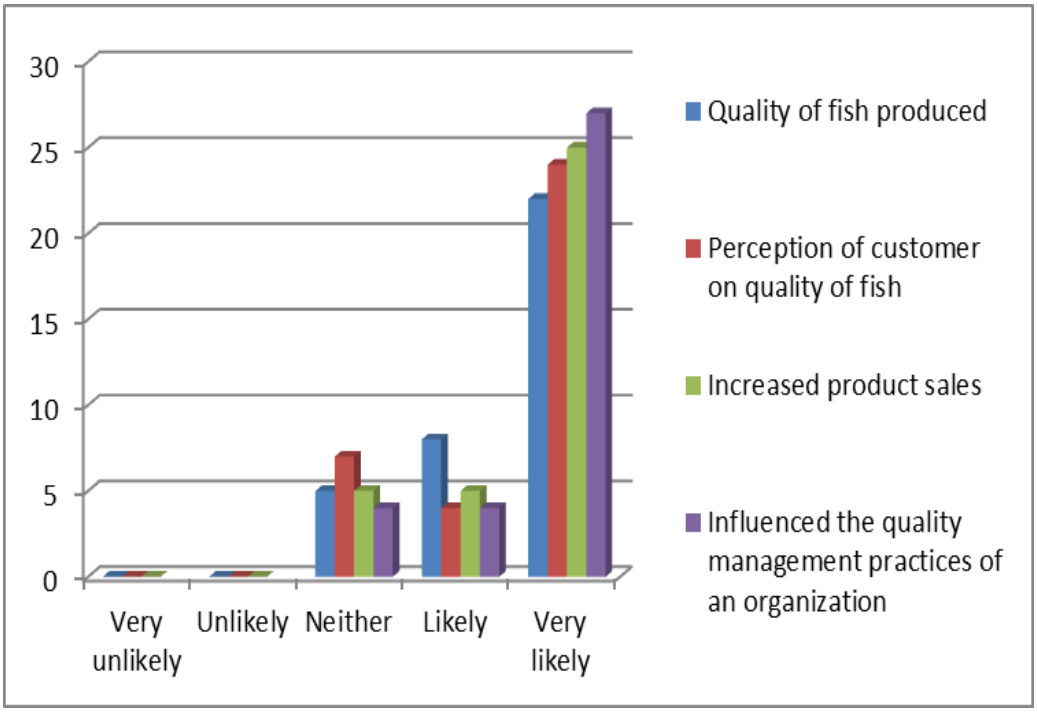

Figure 11: Relationship between quality management and traceability

4.7 Quality management and traceability in the following areas

Traceability and quality management has affected the way business is conducted and carried out in different areas within the fishing industry. The areas that are mostly affected are highlighted below.

4.7.1 Fish landing site

Figure 10 shows that traceability has improved product handling at the fish landing site with 89% respondents saying there is improved quality in fish products due to traceability which in turn improves the quality of products from the landing site. This is due to the fact that the products can be traced back to a specific landing site and this therefore has forced the fishermen to be more careful when handling fish to maintain the reputation of a particular landing site.

Table 6: Quality management at landing sites

	Frequency	Percentage
Improved product quality	31	89%
Slight Improvement	4	11%
No Improvement	0	0%
Worse off	0	0%

Source: Microsoft excel analysis of the data collected

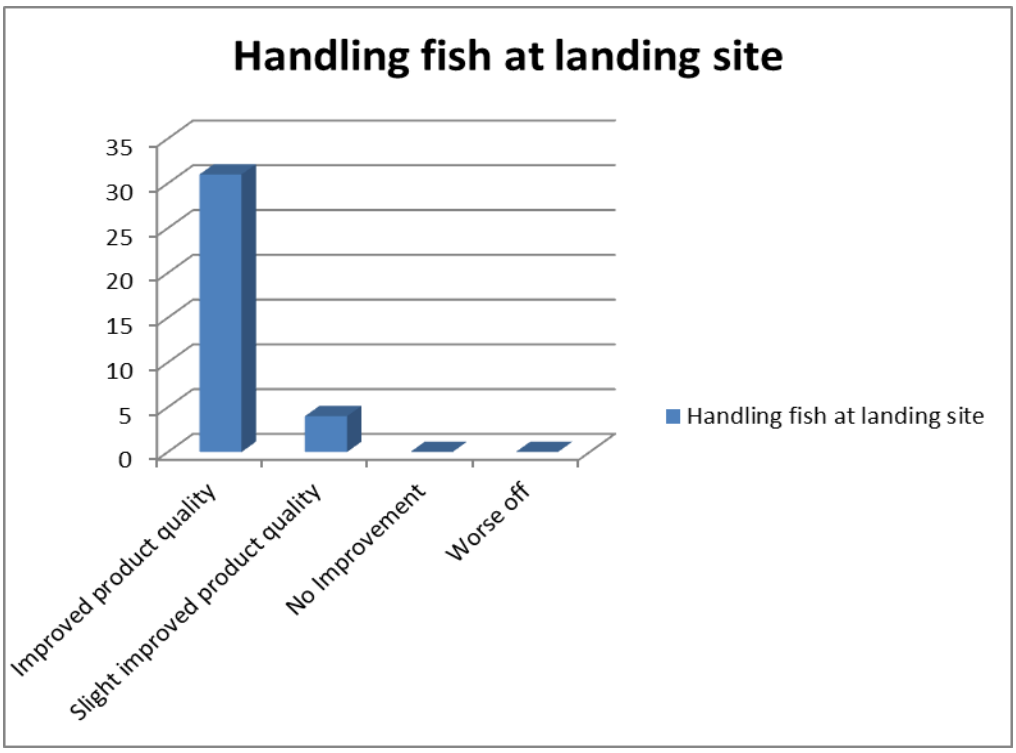

Figure 12: Handling fish at fish landing sites

4.7.2 Fish/fish product handling at the factory

Product handling at the factories has also improved with 91% respondents agreeing that there is high improvement in product handling due to the implementation of traceability and quality management systems. This has improved the quality of products being produced by the factories. The respondents that were interviewed showed that there is high improvement on the quality of products that are sampled at the laboratories at the KMFRI Kisumu offices.

Table 7: Quality Management at Fish Factories

	Frequency	Percentage
Improved product quality	32	91%
Slight Improvement	3	9%
No Improvement	0	0%
Worse off	0	0%

Source: Microsoft excel analysis of the data collected

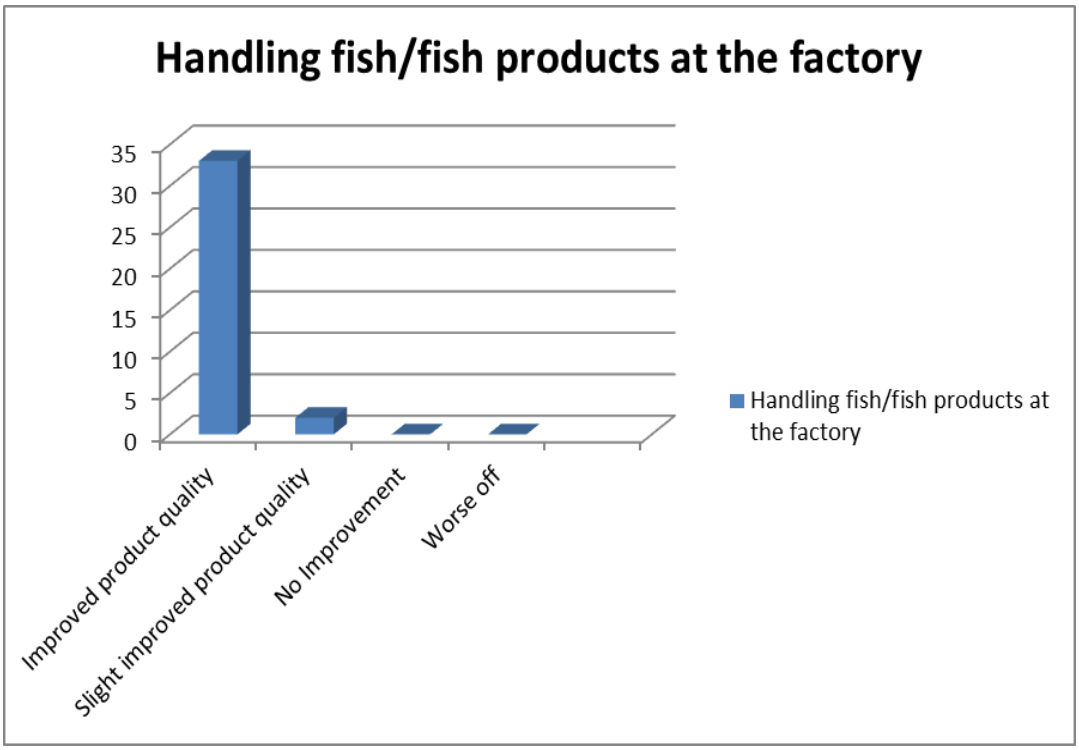

Figure 13: Handling fish at the factory

4.8 The effects of EU regulations on the traceability and quality management of the organization.

Figure 12 shows that 30 respondents out of 35 agree that the organization has adjusted the traceability and quality management standards to make them compliant to the EU regulations that were put in place regarding the standards that countries must meet for them to be involved in the exportation of fish and sea products to the European countries.

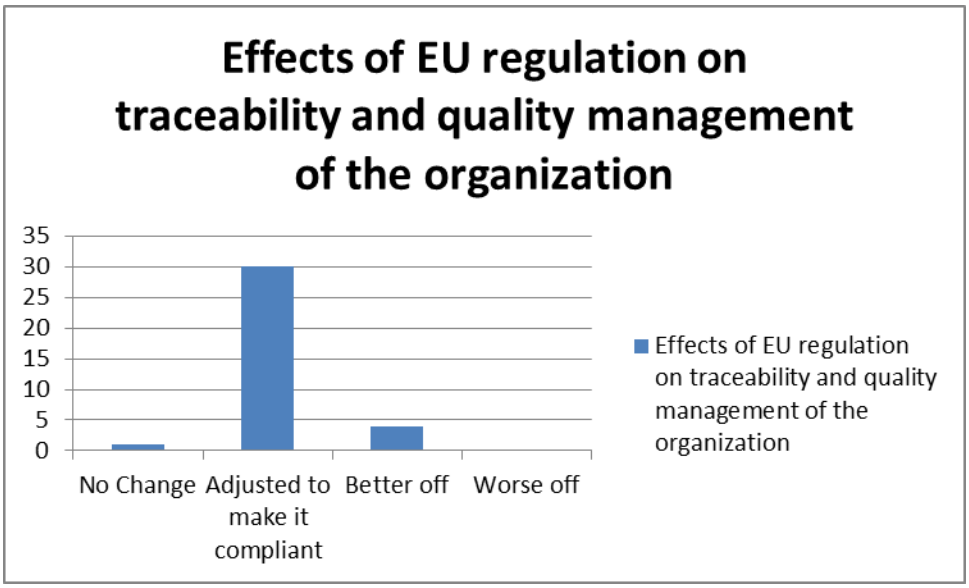

Figure 14: Effects of EU regulation on the quality practices of an organization.

4.9 Quality Management at KMFRI

Traceability and Quality management were the focus of this study and the following area e.g. Quality Management Division and Efmis/traceability department were visited to collect data relevant to information flow and traceability. As a core division responsible for quality/safety controlling and products labeling, the Efmis/traceability department provided a lot of information during the visits.

The Quality management Division provides manuals issued by the EU on quality and traceability regulation on fish products, the Quality Division has inspectors that provide fish companies and fishing vessels required services involving quality assurance. KMFRI issues and implements its own quality standards. Quality management is carried out through a constant supervision of quality at the processing plants of fish products to control that the production meets the quality agreed upon by buyer and seller.

However KMFRI is yet to apply the EAN.UCC traceability system offers a global traceability solution by assigning unique numbering with related bar codes. This system offers a helpful tool to implement a cost effective and efficient traceability system to satisfy markets and legal requirements. The system can be implemented in fishing enterprises that are aiming t0 export fishing products to international markets.

CHAPTER FIVE: DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter presents the summary of findings, conclusions, recommendation for further research. The main objective of this research was to determine the relationship between traceability and quality management in the fishing industry in Kenya. Data was gathered and analyzed and presented in the previous chapter.

5.2 Discussions

This study revealed that there is a relationship between traceability of a product and the quality management of a product. This is proved by the improved quality of fish in the market, which is due to the imposed standards by EU to ensure that the fish products can be traced back to their origins.

When the respondents were asked to gauge the importance of traceability and quality management, most respondents responded by implying that both traceability were essential for consumer/market confidence in the product. This is shown in Table 2 whereby a higher number of 31 respondents said both quality and traceability as compared to quality and traceability as stand-alone. This therefore shows that there is a link between quality management and traceability.

The potential benefits of traceability depicted in figure 6 above show that there exists a relationship between traceability and quality of fish products since implementation of traceability systems has improved the quality of fish products. This is seen through

reduced customer complaints about the fish products in the market. The country also benefits through exporting fish products to European markets and this proves that the European market has confidence in the products from the country.

Table 3 also show that through traceability products have a higher ability to be recalled in case of an emergency, for example if the food products have been contaminated and unfit for consumption, they can be traced forward to a specific market that the products have been sold to and returned. This has been made possible through traceability and quality management standards that have been put in place.

From Figure 10 above it can be deduced that implementation of traceability has also affected the quality management standards of various institutions involved in the manufacturing and production of fish products. One of these institutions is KMFRI which has to ensure that factories involved in fish processing adhere to quality standards put in place, KMFRI also has to ensure that the fishermen and fishing vessels are using legal equipment and gears to capture fish.

Traceability and quality management has improved the way fish is handled at the fish landing sites; this is done through the use equipment such as refrigerated vessels to keep the fish fresh for a longer time before it is transported to factories and market areas. This is the long run improves the quality of fish. The landing sites are also kept clean so that fish handled at this premises are not contaminated and thus reduce recalls that might be caused due to spoiled and contaminated food products.

Figures 12 and 13 in the study revealed that fish handling and production at the factories has also improved because of the traceability and quality management standards that have been recommended by EU to be put in place for these factories to be able to export their products to internationally. KMFRI has adjusted its quality management and traceability systems to be compliant with the European Union regarding traceability, in that regard KMFRI has made it a requirement to all the industries involved in fish processing to adhere to certain quality standards and traceability measures to ensure food safety for human consumption.

The study shows in table 4 above that Kenya Marine and Fisheries Research Institute is well equipped to ensure that quality standards and traceability systems in the fish factories because they have qualified technical staff who can provide training on quality management in the fishing industry wherever it is required.

5.3 Conclusions

The results of this study show that food quality is linked to food traceability, whereas traceability is as yet primarily viewed as a tool for the food safety by providing means for recall, it was also related to food quality. Since both quality and safety are shown to be related to confidence, the results show that traceability may indeed boost consumer confidence through quality and safety assessments.

A well implemented traceability and quality management system results in high quality and safe fish products. A traceability system can be a valuable tool to trace the history of a product. It is important to have a recording system for all the information generated in

the processing and distribution chain. Labeling and definition of batches and units is the key for tracing back and forward and finding the information needed. Problems exist in the catching link, because the units (catching day) are not identifiable once the fish enters the processing line.

Analysis of the results showed that for the fishing industry the concepts of food traceability and food quality are interrelated and sometimes it is even thought of as the same thing. For most industries food quality is an important indicator of food safety through the supply chain of a food product.

The fact that quality has always been seen as an important factor does not necessarily mean that traceability is not as important to consumers, mostly those from developed countries. Indeed, consumers may indicate that quality is most important; either because to them this implies safety anyway, they assume that for all products sold a basic level of safety is guaranteed and therefore safety is a factor that does not differentiate products when making purchase decisions, or because they feel they cannot personally assess the safety of food products. When people cannot determine the safety of a product themselves, they have to rely on their trust in the producers and other chain actors.

It is therefore advisable for food manufacturing organizations to focus communication about traceability to consumers more in terms of quality – information that consumers may be able to use better and more confidently in purchasing decisions.

5.4 Recommendation

Some recommendations are suggested to improve quality management and traceability in the fishing industry. Though the quality of fish at the landing site and the quality of fish taken to factories for processing is generally good, it could also be useful to evaluate the quality of the fish using other parameters than fish handling, for example, sensory evaluation applying the QIM method. The QIM method can reduce the cost of processing by rejecting raw material that might be of doubtful quality, in the first step of the production. A further research is recommended to exhaustively discover how traceability and quality management relates to the whole value chain in the fishing industry.

5.5 Suggestions for further research

The study was carried out in a specific region, which is KMFRI Kisumu. How traceability relates to quality management can be researched in other regions within the country and the research can also involve other dynamics other than the fishing industry.

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APPENDICES

APPENDIX 1: BUDGET ESTIMATES

ACTIVITY/ITEM	QUANTITY	UNIT COST (KSHS)	TOTALCOST (KSHS)
Researchers travel			
Allowance (Within Kisumu	30 days	100	8,000
From Nairobi to Kisumu	15 days	3000	45,000
Stationery			
Field note books	4	30	120
Document holder	6	70	420
Ball pens	30	15	450
Secretarial work			
Typing proposal	30 pages	10	300
Photocopying proposal	300 pages	2	600
Typing thesis	80 pages	10	800
Photocopying thesis	200 pages	2	400
Binding thesis	5 copies	100	500
Sub-Total			56,590
Contingency (about 10% of total cost)			5,659
GRAND TOTAL			**62,249**

APPENDIX 2: INTRODUCTORY LETTER

Dear Sir/Madam,

This questionnaire is designed to help carry out an analysis on the relationship between quality management and traceability in the fishing industry. A case study of the Kenya Marine and Fisheries Research Institute has been selected to aid the researcher in this analysis

Being one of the employees of KMFRI you are humbly requested to participate in this important exercise. Please keep in mind that there is no answer considered in this study as right or wrong. You are also free to withdraw your consent of participation at any time.

Your responses shall also be treated confidentially. The result of this survey will appear in the form of statistical reports. After 3 months of study completion, this schedule shall be destroyed.

Thank you for assistance and participation.

Yours sincerely,

Barbara Naliaka Wasilwa
(Student)

Gerald Ondiek
Lecturer/Supervisor
Dept.of management Science
University of Nairobi

APPENDIX 3:QUESTIONNAIRE

I want to thank you for taking the time to meet with me today. I would like you to answer the attached questionnaire about your experiences with the traceability project that is being implemented. The questionnaire concentrates on the concept of traceability and how it affects the quality of the products that will be produced to the consumer. The interview should take less than thirty minutes. I will be taking some notes during the session, I might ask for clarifications of some points if it is not clear enough. All responses will be kept confidential. This means that your interview responses will only be used for research purposes and we will ensure that any information we include in my report does not identify you as the respondent.

Quality Management and Traceability Survey

This research work is a study to find out how traceability influences the quality of fish in the fishing industry. Thank you.

Instruction: Please mark your answer with an "X" where appropriate

SECTION A

1. **Please specify which department you belong to**

   ☐ **Management**

   ☐ **Laboratory**

   ☐ **Efmis/Traceability project**

SECTION B

1. **Please rate the importance of the following concept with regards to fish production?**

   Scale range

   Very important **Not Important**

   1___ ____ ___ ___ ___ ___ ___5

	1	2	3	4	5
Fish product quality					
Fish product traceability					
Both quality and traceability					

2. **Which of the following scores are the potential benefits of implementing traceability in your organization?**

	Very unlikely (1)	Unlikely (2)	Neither Unlikely or Likely (3)	Likely (4)	Very Likely (5)
Improved product quality					
Increase the ability to recall back products					
Reduce customer complaints					

3. **Please mention any other potential benefits of implementing traceability in your organization. Please choose N/A if you think there is no other benefit.**

4. **What are the scores for facing difficulties while implementing traceability in your organization?**

	Very unlikely (1)	**Unlikely (2)**	**Neither Unlikely or Likely (3)**	**Likely (4)**	**Very Likely (5)**
Lack of Technical staff					
No unified quality standards in the market					
Lack of support from the government					
Uncertainty about future benefits					
Lack of Managerial support					

5. **Please rate any other difficulties faced if not mentioned above. Write N/A if there is no other difficulty.**

6. **What are the scores of traceability affecting the following;**

	Very unlikely (1)	Unlikely (2)	Neither Unlikely or Likely (3)	Likely (4)	Very Likely (5)
The quality of fish produced.					
Change the perception of consumers on the quality of fish products					
Increase sale on fish products					
Improving production process of fish products					
Influenced the quality management practices of the organization.					

7. Please rate the scores of how traceability has affected the following areas.

	Improved quality of products (1)	**Slight Improvement on quality (2)**	**No Improvement (3)**	**Worse off (4)**
Handling fish at the landing site				
Handling fish/fish products at the factory				

8. How did EU traceability regulation affect/change your view on the quality management of the organization?

☐ No change

☐ Adjusted to make it compliant with the regulation

☐ Better off

☐ Worse off