INVESTIGATING THE TRACEABILITY OF FISH AND FISH PRODUCTS IN NAMIBIA

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I hereby declare that this work is the product of my own research efforts, undertaken under the supervision of Mr Albert Samakupa and has not been presented elsewhere for the award of the degree or certificate. All sources have been duly and appropriately acknowledged.

This is to certify that this report has been examined and approved for the award of the degree of Bachelor of Science in Natural Resources (Fisheries and Aquatic Science) of the University of Namibia.

The external examiner...

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Supervisor...

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Abstract

This paper focuses on the traceability of fish and fish products in Namibia and the level of preparedness if a genuine recall were to happen in the fishing industry. A key issue is the ability to definitively identify fish and fish products and trace the fishing ground where they originated. High profile instances of food contamination high light the need for better seafood food traceability i.e. knowing when and where the products were produced with the ability to trace them back to the fishing grounds where they originated.

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Dedication

I dedicate this work to my late Mom, Ms Alphonsina Lumba Sibungo. Mom thank you very much for the care, advices and support you gave me when I was still a young boy up to the time when you passed away. Your advices are still fresh in my mind even though you are gone. May her soul rest in eternal in peace.

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1. INTRODUCTION

1.1.1 Background

The world's fisheries are a basic source of food, employment, recreation, trade, and livelihoods around the world, with fish constituting one of the major food exports from the developing world. Over the past decade fisheries have provided more than 2.6 billion people with at least 20 percent of their average animal protein intake; of the about 97 million tons of seafood consumed annually, approximately half of this is landed by small-scale and subsistence fisher folk (FAO,2008).

Fish and fisheries products are among the world's most widely traded foods, and important source of food and source of revenue for millions of people around the globe (Eurofish, 2004). In 2006, aquaculture and capture fisheries supplied the global market with a record of about 110 million tonnes of fisheries product. The figure was the highest compared to previous data mainly due to an increase in aquaculture which accounted for 47 % of the total fisheries production. The global capture fisheries for both marine and inland contributed a total of 92 million tonnes. However, over the past few decades, world capture fisheries have been stagnant or have declined whereas aquaculture continues to grow at an annual rate of 6.9%, and is expected to overtake capture fisheries in the near future (FAO, 2008).

Among the top ten fisheries producing countries, China is by far, the leading fisheries producer accounting for about a third of the world's production, followed by Peru, Japan and USA. The Asia/Pacific region is the dominant player in world aquaculture accounting for 89 % of the world's aquaculture production (FAO, 2008). Africa accounts for 23.5% of inland capture fisheries and 1.5% for aquaculture production (FAO, 2008). Fish products are among the most exported food products by developing countries to the developed countries (Globefish, 2009).

In Namibia, the fishing industry is the second biggest export earner of foreign currency after the mining sector; contributing N$ 3,883 million per year. Among fish species exploited are Hake, pilchards, monk, horse mackerel, orange roughy, red crab and rocky lobster. Hake is the most valuable commercially exploited and traded fish species, mainly exported to EU countries such as Spain, Germany, Italy, Netherlands; Australia and neighbouring South Africa. It is mainly exported in the form as whole fish or in the form of frozen products such as cutlets, blocks, sausage, minced, wings, babe hake and roes (MFMR, 2007).

The EU is the main market for the bulk of other commercial fisheries such as monk. Horse mackerel and pilchard in the form of canned products are mainly exported to SADC countries such South Africa, DRC and Mozambique (MFMR, 2007). In 2006, the export value of fish products stood at N$ 3883 million, which is 5% increase from N$ 3697 million recorded in the previous year (MFMR, 2007).

Since Namibian fish products are mainly exported to the EU which has very strict regulatory safety requirements, it is important that the importing countries meet such requirements to assure the safety of exported fish and fisheries product entering the EU. Documenting all process as part of the HACCP system is also very important as it also offers product traceability in the whole chain, from catch until the product is delivered to the consumer (Huss, 1994). Traceability does not only ensure good quality or safe food, but enable products to be traced back to their origin if anything goes wrong. Food safety has become a significant priority for the fish supply chain. In response to this mounting concern, many nations are focusing on traceability systems as a way to restore confidence in the food supply and limit costs incurred by the trade and supply of insecure products (Thompson *et al.* 2005).

1.1.2 Problem Statement

With more and more fisheries resources being processed into secondary products substitution and adulteration of fish product may occur, with an intention to make more profits by substitution of higher value species with low value species. Mislabelling of fish products i.e. species name or geographic location may hinder traceability in times of recall of fishery products. The focus of this study is to evaluate the level of preparedness in terms of traceability in the fish industry in case a food scare initiated a recall or in other words to see if it is possible to locate the origin of fish and fish products tested by following them along the supply chain in the Namibian fishing industry.

H_o: $\Pi = \Pi$ (the probability of the "success")

$H_{1:}$ $\Pi \neq \Pi$ (the probability of the "failure")

1.1.3 Rationale

Food scares are a constant threat to fish and fishery products and it is here that traceability has its justification. There is an increasing demand for traceability throughout the food chain globally to ensure consumer safety, image and brand protection, minimize recall volume, homogenous supply of fishery products and "green issues".

1.2 LITERATURE REVIEW

1.2.1 Hazard Analysis Critical Control Point (HACCP)

Traceability is not a new concept to the fish and food industry. Fresh fish is a highly perishable product and traceability systems have been used systematically in the fishery industry. The traceability concept has also been included, explicitly or implicitly, for food safety purposes in several fish and fish product regulations for many years, in particular since the introduction of HACCP-based regulations (Lupin, 2006).

Documenting all process as part of the HACCP system is very important as it offers product traceability in the whole supply chain, from catch until the product is delivered to the consumer (Huss, 1994).

The HACCP was first conceived by The Pillsbury Company to develop safe food for astronauts in collaboration with NASA and the US Army Laboratories (Kanduri & Eckhard 2002).

It is a system that was developed to prevent or eliminate the occurrence of hazards that may cause illnesses and/or injury to the consumers. HACCP is also supported by pre-requisite programmes such as Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP) and Standard Sanitation Operation Procedure (SSOP) in order to make it effective (NACMCF, 1997). Other prerequisite programmes to ensure food safety include establishment of proper facilities, supplier control, material specification, ingredients, packaging materials and products, cleaning and sanitation, personal hygiene and basic food hygiene training, pest control and others (NACMCF, 1997).

1.2.2 Traceability

Traceability refers to the ability to trace the origin of materials and parts, the processing history, and the distribution of product after delivery (ISO 2000). Traceability is the underlying principle used to by regulatory agencies and industry in product recall, removing potentially harmful food products once they are in the distribution. In general the term ‘trace’ is used when the history of product origin is searched, and 'track' is used for searching the product's history after delivery (Tracefish, 2001).

The crucial characteristics of traceability systems, *i.e.* identification, information and the links between, are common in all systems independent of the type of product, production and control system that are served. In practice, traceability systems are record keeping procedures that show the path of a particular product or ingredient from supplier(s) into the business, through all the intermediate steps which process and combine ingredients into new products and through the supply chain to consumers (FSA, 2002).

The ability to classify fish products uniquely at any point in the supply chain is fundamental in traceability systems. The manufacturer or importer determines the size of a batch, which is branded uniquely. Throughout the food chain, new identities are constantly being created as ingredients are combined in recipes, goods are bulked up for delivery, and/or large batches split to a number of destinations. Traceability requires both that the batch can be identified and that this identification gives a link to the product history (FSA, 2002).

A product traceability system, and particularly a food traceability system, is primarily based on four pillars: product identification, data to trace, product routing, and traceability tools. (Derick and Dillon 2004).

1.2.3 Origin of traceability

Traceability is not a new concept to the fish and food industry. Fresh fish is a highly perishable product and traceability systems have been utilized systematically in the fishery industry. The traceability concept has also been incorporated, explicitly or implicitly, for food safety purposes in numerous fish and fish product regulations for several years, in particular since the introduction of HACCP-based regulations (Lupin, 2006).

Historically, traceability was an important part of trade and social organisation. Research on traceability in the fisheries chain has been ongoing for a few years in Europe focusing on the logistics of the products to ensure that products can be linked to their source while protecting products of declared origin (both geographical and production system). Research on sophisticated molecular biology techniques as tools to verify the authenticity of species and for tracing contamination of products has also been the focus of research (Börresen, 2003).

1.2.4 Why is it important

There is an increasing demand for traceability throughout the food chain globally. The root causes of many of the recent food safety problems have been found in the primary production sector, although the problems are manifested at the other end of the food chain in the products sold to consumers. Hence there are needs to trace back through the chain to determine the causes of the problems and then, in taking remedial action, to trace forward from those causes to withdraw or recall all the unsafe products produced (Magera and Beaton, 2009).

When implementing a traceability system, the added value of such a system needs to be considered because it can serve many purposes. The importance of traceability systems is that it improves supply chain management; facilitate trace back for food safety and quality; and differentiate and market foods with subtle or undetectable quality attributes.

The benefits associated with these three primary objectives of using traceability systems include lower cost distribution system, reduced recall expenses, and expanded sales of products with attributes that a difficult to discern. In many cases, the benefits of traceability translate into larger net revenues for the firm (www.ers.usda.gov/publications/aer830/, accessed 26 April 2010). Furthermore,of recent, traceability has been used in addressing concerns of food-terrorism or tampering with the food supply chain. Last but not least an effective traceability system optimises the supply chain: based on historical data, it enables members of the supply chain to identify sources of problems quickly and rapidly (CIES 2005).

1.2.5 Different types of traceability

Traceability is normally divided into two categories: internal traceability and external traceability (Derrick and Dillon, 2004). Internal traceability is related to the product and information relating to it internally in a factory, company and even a conglomerate of companies. External traceability relates to the product information that a company either receives or provides to the next link in the supply chain from primary producer to the end. It deals with the data you receive and the data you send. External traceability typically has the following characteristics:

- It occurs between companies
- It depends on internal traceability being present
- There are major privacy issues
- Standards for recording and exchange of data are needed

Each system deals with the same basic principle that is to give a unique identification to individual sales units or products and to follow these when they transfer from one part of the process or chain to another (SEAFISH, 2008).

1.2.6 Application of traceability system

Several studies have shown that traceability could be applied in the food chain with the following scopes: safety (risk management), quality, biosecurity, business management.

Traceability as a risk management tool is perhaps the objective most generally accepted to support a possible regulatory system. There are two aspects are usually related to this objective; one is the possibility to recall unsafe products once defective units are identified, and the second is post market monitoring of aspects related to food safety (e.g. storage temperature at retail posts, actual way of consumption). Traceability may also be a key risk management tool in the extreme case of food outbreaks due to hazards not included for some reason in HACCP plans (e.g. as occurred in the EU chicken dioxin crisis) (COFI, 2004).

Traceability as a quality management tool is a possibility with manifold alternatives. From a regulatory point of view, prevention of fraudulent practices and consumer deception (e.g. inferior quality, weight shortages, misleading packaging, fish species substitution), are perhaps the clearer possibilities to utilize traceability to ensure fair practices in the food and fish trade (COFI, 2004).

Traceability as a biosecurity management tool is a recent possibility not yet fully discussed on an international level. Food and fish can be maliciously tampered or contaminated (e.g. with pathogens or poisons) due to terrorist actions. This possibility is seriously gaining international recognition, and food and fish traceability with this purpose is being required under the US Bioterrorism Act.

Traceability as a business management system could be very useful to the industry for a number of reasons, such as maintaining contractual quality; develop commercial partnerships, optimization of production, distribution and marketing; horizontal and vertical industrial integration. A number of techniques that are, or contain basics linked to traceability, are commonly utilized at industrial level (e.g. FIFO: First In First Out) (COFI, 2004).

1.2.7 Report on previous studies and findings

The legal and regulatory scenario does not help companies to manage product traceability. However, in recent years several significant contributions to traceability have been made. The first significant contribution dates back to the 1970s. Pugh (1973) established the fundamental principles of product traceability. In recent years Borst, Akkermans, and Top (1997), and then Gordijn and Akkermans (2001), studied the global impact and the ontological requirements of a traceability system. The relevance of product tracing in both the external supply chain and inside the production system is underlined by Stein (1990) and by Ramesh et al. (1995). Traceability helps product recall, an aspect fully explored by Abbott (1991). Several authors (Kim, Fox, & Gruninger, 1995; Moe, 1998) ‘‘do not trace” the product, but apply a dedicated unit called traceable resource unit (TRU).

According to Palacios (2001), a traceability system can be a valuable tool to trace the history of a product given that there is a system recording all the information generated in the production and distribution chain. The key to tracing back and forward and finding the information needed are correct labelling and well defined batches and units (Palacios, 2001).

Traceability is based on a clear relationship between batch, trade units and logistic units, thus it must be presented to fulfil traceability (Kim and others, Moe 1998). According to Karlsen and Senneset (2006), the relationship between units varied with the companies in the supply chains and further more they found that some companies had an overview of received products and shipped products, but could not trace the product internally, simply because they did not record information about the fish products during processing. As the result the information was lost and ultimately it was not possible to trace the fish product further back in the supply chain to find the fishing vessel or the breeder. Furthermore, Karlsen and Senneset (2006) reported that almost 40% of the fish product tested could not be traced back to the fishing vessel or breeder. And finally the survey revealed that the traceability system in the Norwegian fish industry and the food retail was unsatisfactory and hence more was needed to be done to remedy the situation (authors comment). The date was used as the key to traceability instrument in reception, production and delivery of the fish products (Karlsen and Senneset, 2006).

The Danish 'Info-Fish' project developed and performed a full scale test of traceability system in a fresh fish chain, starting on board a fishing vessel in the North Sea, going through the operation of collecting (unloading, sorting and repacking the catch), auction, wholesale and ending at the retail counter. The result of this project is that today, more than 50 Danish vessels are using systems that allow them to sort, weigh and pack the catch on board the vessel and then sell it at auction with all the information included i.e. fish species, size, catch date, vessel identity; and even more information if necessary (Larsen and Villareal, 2009).

1.3 General Regulations on traceability

1.3.1 WHO/Codex Alimentarius Commission

Traceability requirements was first mentioned in 1985 by the CODEX and can be found in sections under the heading "the country of origin of food" (ACFS 2003). However at the time

CODEX did not define traceability until in July 2004 during its 27th session, where traceability was adopted and added into one of the Procedural Manuals as the ability to follow the movement of a food through specified stage(s) of production, processing and distribution (CAC, 2004).

Despite the late definition, Codex Standards encompass key elements of traceability such as recall procedure and labelling requirements of pre-packaged foods and these are adopted by most national Governments in their own legislation. The Codex Alimentarius Commission defines traceability as the ability to follow the movement of a food through specified stage(s) of production, processing and distribution.

1.3.2 European Union (EU) regulation

The European Union (EU) has required traceability records for seafood products since 2005. The general principles, requirements and procedures are laid down in a series of regulations known as the General Food Law or regulation (EC) No.178/2002. This law require that all food and feed producers to record supply information on a "one up, one down" principle (Petersen and Green, 2004).

The EU defines traceability " as the ability to trace and follow a food, feed, food-producing animals, or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution", and specifies traceability requirements in Article 18 (see appendix).

1.3.3 Food labelling regulations

According to COFI (2004), there exist a direct relationship between a traceability system and food labelling. For example, traceability could be used for product identification (e.g. fish species or origin of the product) that usually is information appearing on labels. A traceability system may be applied without being used for labelling. But for labelling to be trustful it requires some kind of traceability and control.

The minimum requirement for traceability is that each traceable unit has been distinctively labelled to allow identification. The EAN-13 and UCC-12 codes are the most common labelling method used in labelling products (European Article Number and Uniform Code Council). However, these codes, which can be read by retail units, do not allow addition of a unique identifier, which is the innermost for traceability. Other bar codes (EAN/UCC-128) include the identifier however cannot be read by the retail bar code scanner (Frederickson and Gram).

The two main regulations with respect to labelling are the Council Regulation 2000/104/EC (European Economic Community (EEC) 2000b) and the Council Directive 2000/13/EU (European Economic Community (EEC) 2000a). Three sets of information are compulsory on the label of any fishery products on sales at retailers and include the commercial name of the species, production method (caught at sea, in inland water or farmed) and catch area (especially for the products caught at sea).

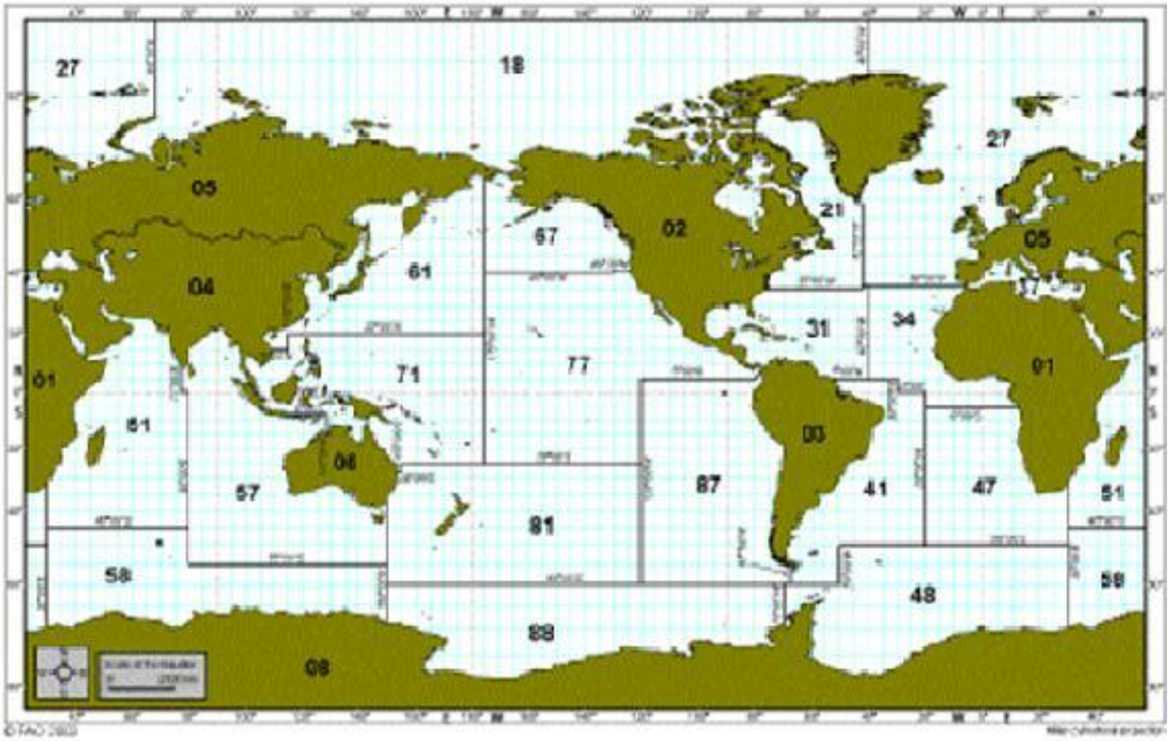

Fig 1: FAO codes: the general catch areas (FAO 1999).

The FAO area codes are used for labelling in relation to documenting the origin of the products for traceability.

The EU issued a compulsory labelling of fish regulation after recognising that there was a need to improve consumer information related to fish (Commission Regulation 2065/2001/EC).

The basic traceability information that is required is: the commercial designation (i.e. common name and scientific name), the production method (e.g. 'caught at sea') and the catch area (e.g. 'FAO 47'). Additional market information required: size grade, nett weight and country of origin.

These further aspects of traceability are important in relation to food safety, quality and labelling. Traceability concerns only the ability to trace things, which means that the necessary information must be available when required. It does not mean that the information must at all times be visible by being labelled on the food.

CHAPTER TWO

2 MATERIAL AND METHOD

2.1 Study Area

This survey was carried out in retailers in Katima Mulilo in the Caprivi Region as well as in Windhoek the capital city of Namibia.

2.2 Experimental Design

In many experiments and survey in which variables of interest is being recorded at the normal level, there are only two possible values or outcomes. The following simple probability model underlies the binomial distribution: a certain chance experiment has two possible outcomes ("success" and "failure"), the outcome success having a probability of P and the outcome "failure" a given probability of 1-P. An experiment of this nature is called Bernoulle Experiment. Therefore it is for this reason that the design of this experiment is based on Bernoulle Experiment.

The experiment was replicated 12 times, with only two outcomes expected "Success" and "Failure" at each trial. The trials are independent of each other. There is a constant success probability P at each trial. The variable X is the total number of successes in the trails (n=12).

$$P(X = k) = \binom{n}{k} p^{k} (1-p)^{n-k} \ \ for\ k = 0,1,2, \dots, n.$$

The expected value of the binomial variable X is given by: $E(X) = np$.

2.3 Data Collection

A total of twelve (12) fish and fish products were purchased one at a time with an attempt to trace them back to the fishing vessel. The information on the consumer package or the information from the shop personnel was used as the starting point for the tracing of the fish products (see figure 2).

For each of the twelve products tested, the retailers and fish shops were required to identify the sources of the fish and fish products and the transporter from which they received the products. for each product the information such as the: 1) the name, address, telephone/fax number of the source and transporter; 2) the date when the products were received by the fish shop or retailer; 3) the quantity of the product and finally the product description.

To continue with the study, all facilities that were identified by retailers and fish shops as source of the products were contacted via telephone. As it was done with retailers the facilities were provided with a description of the product and were requested to provide product and contact information of the next step (source) and transporter(s) of the fish products. The steps were repeated until when the original source of the fish products were reached. The exercise stopped were a facility (other than the retailer/fish shop) did not provide information about it sources. The last step in the chain i.e. the processors were asked to verify the information that was received from the retailers or fish shops that listed them as a source.

The information received about each product traced was recorded on a traceability log. The different fish products were documented with figures describing the material flow in the supply chain. The information obtained from companies via telephone or email was accepted as the basis for the assessment of traceability system in the Namibian fish industry and seafood retail trade.

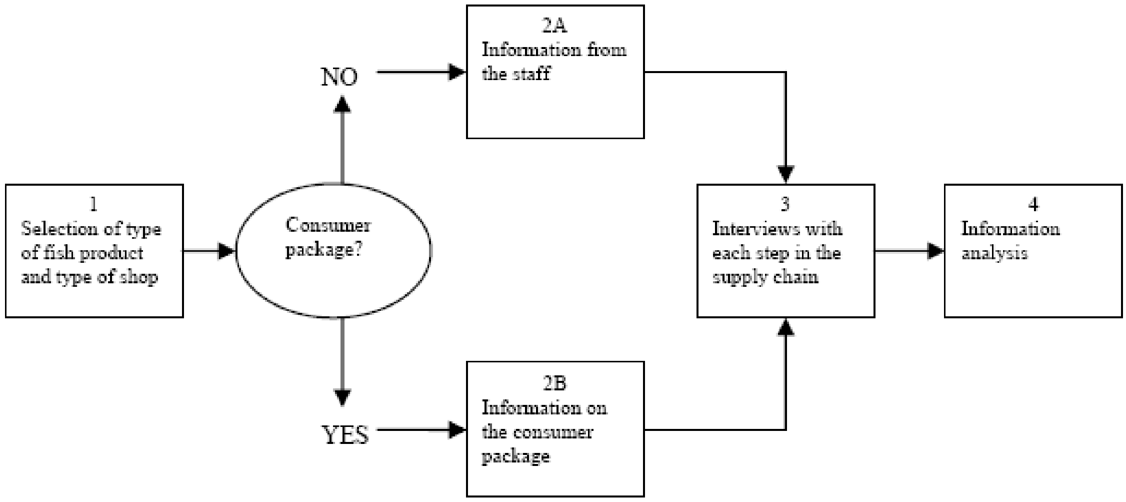

Figure 2: Overview of the survey (Karlsen and Senneset, 2006).

2.4 Statistical Analysis

The data was analysed using BINOMDIST of excel 2007 to find the probability of getting five successes in twelve trials with a P value of 0.5.

CHAPTER THREE

3. RESULTS

It was found that there was a 38.7% chance of tracing five out of twelve of the fish and fish products to the origin in the present study. Which represent a P value of 0.387, the probability of obtaining a chance deviation of this magnitude (or greater) from the expected ratio is 0.387. This probability is greater than α=.05, hence too large to claim that the experimental traceability ratio of 5 to 8 is a significant, therefore we reject the null hypothesis.

Figure 3 shows the pie chart presentation of the data i.e. the traced fish products and those that were not traced back to the origin. The pie chart shows that 42% of the 12 products were traced back to the fishing vessel. Further more fish traders were asked to estimate the time it would take their facilities to identify the fault batches if there were a need to recall products and it was found that at retail level it would take 0 to 30 minutes while the processors needed a day to successfully locate the fault batch.

The results obtained from the survey are shown in Table 1 and 2 below.

Table 1: Fish and fisheries product survey

Product description	**Type of traceability key**			
	Production date/code	**Best before date**	**Batch no:**	**Date Received**
Baby hake (skin on bone in, uncooked frozen, 800g), individually pouched cleaned hake.	9311	05/2011	188753	21.04.2010
Haddock Fillets (Smoked, skin on deboned 500g, wild caught)	10006	07/2011	1924219	21.04.2010
Hake fillets petite (skin on, deboned, uncooked frozen, 400g, wild caught)	9175	12/2010	2271002	21.04.2010
Simply Steam (4 seasoned hake portions, skinless deboned, uncooked frozen	9138	11/2010	2623306	21.04.2010
Hake fillets, frozen	11.07.2010	24 month from production if stored at -18 °C	3938	17.08.2010
Horse Mackerel, frozen	11.07.2010	24 month from production if stored at -18 °C	3951	17.08.2010
Silver Angel, frozen	11.07.2010	24 month from production if stored at -18 °C	3911	17.08.2010
Reds, frozen	11.07.2010	24 month from production if stored at -18 °C	3943	17.08.2010
Snoek, frozen	12.07.2010	24 month from production if stored at -18 °C		17.08.2010
Sea frozen horse mackerel		3 month	67502	15.09.2010
Kingklip fillet cuts, skinless deboned uncooked, 600 g		09/2010	9090	19.05.2010
Deepwater hake fillets		12/2010		19.05.2010

Table 2: The results from the tracing of fish and fishery products

	Product	Product description	Track pack to vessel	No. of Links
1	Snoek	Fresh chilled, random weight	yes	5
2	Reds	Frozen, random weight	yes	5
3	Horse Mackerel	Frozen, random weight	yes	5
4	Silver Angel	Frozen, random weight	yes	5
5	Hake fillets	Frozen, 5kg boxes	yes	5
6	Sea frozen horse mackerel	Frozen, 10 kg boxes	No	3
7	Baby hake	Skin on bone in, uncooked frozen, 800g). Individually pouched cleaned hake.	No	3
8	Haddock Fillets	Smoked, skin on deboned 500g, wild caught	No	3
9	Hake fillets petite	skin on, deboned, uncooked frozen, 400g, wild caught	No	3
10	Simply Steam	4 seasoned hake portions, skinless deboned, uncooked frozen	No	3
11	Kingklip fillet cuts	skinless deboned uncooked, 600 g	No	3
12	Deepwater hake fillets	Frozen, uncooked	No	3

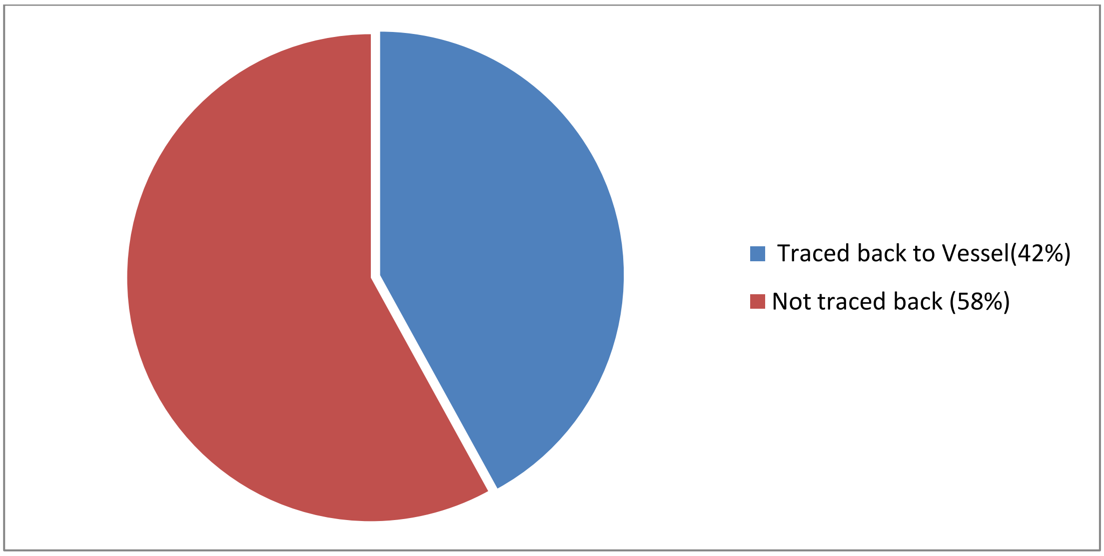

Fig 3: Pie Chart Showing the traced products and untraced product

CHAPTER FOUR

4. DISCUSSION

The last traceable steps vary from one vessel to three vessels. It is important to note that in five cases out of 12 (42%); it was possible to trace the fish products back to the fishing vessel(s). Karlsen and Senneset (2006) were able to trace 63% of 16 fish products in Norway back to a single vessel or fish farm while Frederiksen et al (2007) were able to trace 56% of the 18 products to a single vessel in a revised study of Karlsen and Senneset (2006) report.

This means that the concept of fish traceability is still not widely practised though of recent it has been gaining momentum. Because if fish traders had effective traceability systems it would have been possible to trace back all the products investigated to their origin(s). Furthermore, the 42 % of the traced products were all Namibian products and no imported fish and fish products were traced back the origin.

It was possible to identify the facilities that handled all the twelve (12) products and move one step back from retailer or fish shop. For 8 of the 12 products it was not possible to move from the second step to the next step backward because no information was obtained from this link while in some instances the information obtained from the retailers and fish shop could not be linked with this link of the supply chain. For example, the information obtained from this other particular shop such as the contact information like contact person and telephone number was of a company not involved in fish trade. This can be attributed to poor documentation and because traceability is a new concept in Namibia and has not been widely practised.

If the products under investigation in Frederiksen et al (2007) were to be recalled, the economic losses for the companies involved could have been minimized since all products that they traced originated from a single vessel while in the present study the traced products came from three different vessels of the same fish processor, hence economic losses could have been minimal in this case also. It is important to note that traceability of fish and fish products has not been addressed adequately in both developing and developed countries since the EU regulations on fish regulation came into force in 2005 because of all the studies that focused on traceability of fish products there is no single study that reported a 100% recall.

Furthermore, in some cases the batch sizes were not clearly defined this shows that improvement of chain traceability is needed at the steps at the beginning of the supply chains (e.g. the vessel and processors) because batch sizes are normally determined by the producer(s). The enhancement of traceability practices, also in other parts of the supply chain, could in the best case limit the recalled batch size to one single fish, but it is also possible to achieve a larger batch size, which is reasonable, yet cost-effective in terms of a recall (Frederiksen and others, 2007).

The batch number and date when the fish and fish products were received and dispatched was used as the key traceable units to further the tracking of the fish and fishery products in the respective supply chains. Eleven of the products assessed were labelled or had a batch code compelling to basic Tracefish and EURO Fish standards such as scientific name, common name, batch code and shelf life. A batch is defined as the quantity that has gone through the same processes (ECR). The date and batch code was found to be the fundamental tool in transmitting information back and forth among companies in the given supply chain. On average there were four links in the supply chain.

According to FSAI (2010), a traceability system should be reviewed at least yearly to ensure that it is delivering the required level of traceability and can produce accurate traceability records in a short period of time and not greater than one working day. This conquers with present study, where it was found that some retailers and processors conduct periodic tests to assess their traceability system at least once a year. Of the products tested at retail level it was found that time necessary to successfully remove or identify the fault batch in times or crisis or during this investigation was just under 30 minutes. This means that some retailers and fish shops in Namibia have an effective method of storing traceability information and this is particularly due to the fact that the products has to be on shelves for a at least a minimum of three month only. And all this information was electronically stored on computers and Radio Frequency Identifiers (RFID). RFID is an electronic version of bar code technology in its most basic case, it is not necessary that the readers have direct line of sight to the tag since the information is passed via radio waves (Nkondola, 2006).

At retail level it was observed that the products are marked in such a way that the business operator(s) are able to trace them internally and externally, using barcodes and computerised systems and the existing information about the paths of the product is readily available on RFID and this is very important for traceability implementation, because barcodes are easy to read whenever batches are transferred inside or outside of the step, and they also enable quick access to the stored information (Nguyen, 2004).

It is of great importance to mention that it was easier to track back the products that were repacked by retailers or fish shops themselves compared to those that were packed by the processors this is because the product passed through a shortest supply chain compared to those that were packed by processors because they had to pass through a longer chain and hard to pass through the storage facility where most information was lost and hence no information was lost from product repacked by retailers because the shorter the supply chain the lesser the information is lost and vive versa. All products that were traced originated from FAO area 47 see figure 1 that is from fish vessels registered to operate in this zone this provides more information to the consumers about the history of the fish they are consuming when it comes to the issues of sustainability and/or “green issues”.

In effect, bar coding has modified handling of all materials along the supply chain and moreover particularly affects the traceability question. The automation, the high speed, the great precision (it is a practically error free system) guaranteed by a bar code structure permits simpler, more economical, and exact traceability systems (Nguyen, 2004). At the time of writing more and more business operators, especially in the retail sector and small fish shops use bar codes as a principal means of identifying items.

Though not all the products have been traced back to their origins during the present study, the time necessary to identify the last traceable and corresponding batch codes varies from 30 minutes to a day which is reasonable because during a real recall companies would have prioritised to remove the fault batch in order to avoid economic losses and mistrust from consumers. Karlsen and Senneset (2006) state that the time recorded does not give a realistic picture because the companies would have prioritized differently in case of a real recall. As with Frederiksen et al (2007), in this study the companies were asked to estimate the time they would need to find the information if a real recall were to happen. The time used on unsuccessful telephone conversations and time spent waiting for a return call, for example, were not used because no valuable information was obtained from the interviewee. Some interviewees were not willing to take part in this study while in some instances if the person responsible for that particular department was absent or say on leave then no information was obtained and hence that particular link was closed.

Besides the retailers themselves, health inspectors from the Ministry of Health and Social Services had excess to their traceability data. Kim and others (1995) reported that traceability is based on a clear relationship between batch, trade units and logistic units, thus it must be presented to fulfil traceability this true because of the products that were tracked back to the origin the batch numbers from the retailers and fish shop corresponded with the batch numbers from the supplier(s).

Some supply chains investigated in this study meet the terms of the “one step forward, one step back” traceability requirement stipulated in the EU Regulation (EC) No. 178/2002 (Anon., 2002), as it requires, as a minimum, the ability to establish which group of products is supplied from which group of suppliers (The Standing Committee on the Food Chain and Animal Health, 2004). Thus, a last traceable step of more than one vessel complies with the one step forward, one step back requirement of the EU Regulation.

In some cases it was difficult to obtain the information required especially if the person assigned to that duty was absent or not available at the given company while in some cases there was no proper flow of information from one company to the other and this can be attributed to poor documentation or lack of qualified personnel or the unwillingness of the respondent and hence this made it difficult to trace back the products towards the origin.

According to Ratliff (2010), food products move through the food chain from production to consumption, they are normally transferred between several entities for packing, processing, storage and transportation, creating the potential for food safety issues at each point of the chain. He adds that there are particular risks at the transfer points because the product must be handled and because knowledge of how the product needs to be treated, and its expected remaining life, is often lacking.

During this study, there was a stumbling block between some retailers and the commercial storage because none of the fish products that passed through the aforementioned storage were traced back to the origin, this was basically due to loss of information from the storage as no response was received from them.

The breakdown occurs because there is no sufficient information at each transfer point concerning the age of the product, its expected life and how it has been treated prior to that point. Further, there are vague specs on how the product should be handled, which results in products being stored, handled and delivered at wrong temperatures creating quality issues and potentially food safety concerns (Ratliff, 2010).

5. CONCLUSION

The time necessary to find traceability information of the products were all under 30 minutes at retail level and a day for processors, signifying that the available traceable information is reasonably easy to find. However as a whole, the fish industry in Namibia is not prepared to recall fish and fish products from the market if the there was a need for a recall. Hence, the traceability of fish and fish products needs to be improved in all sectors of the fishing industry.

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7. APPENDIX

I. Article 18 of the EU regulation on the General Principles and Requirements of the Food law (EEC 2002a)

1. The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution. *2. Food and feed business operators shall be able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed. To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand.* *3. Food and feed business operators shall have in place systems and procedures to identify the other businesses to which their products have been supplied. This information shall be made available to the competent authorities on demand.* *4. Food or feed which is placed on the market or is likely to be placed on the market in the Community shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions.* *5. Provisions for the purpose of applying the requirements of this Article in respect of specific sectors may be adopted in accordance with the procedures laid down in Article 58(2).*

II. Fish traceability log.

Date of purchase:
Place of Purchase (name and address):
Link number 0: information on the consumer package
Product Name:
Product number/code:
Producer:
Production date:
Best before date:
Contact information of the next link:

Link	company	aid	contact person	date	time start	time end	Info received
Retailer:							
Transporter:							
Producer:							
Transporter:							
Auction market							
Fishing vessel							

III. Additional information was obtained via a questionnaire

<u>Questionnaire</u>

Supplier traceability information

The information obtained from the retail/fish shop

1. Supplier name, address and contact details
   ....
   ....
   ....
2. Nature and description of the food supplied
   ....
   ....
3. Any supplier batch codes
   ....
4. Delivery date/Dispatch date
   ....
5. Confirmation of acceptance
   ....
6. Number of packs in a case
   ....
7. Weight of the packs if applicable
   ....
8. Number of cases in a delivery/dispatced
   ....
9. Lot number (if any) assigned to the delivery
   ....
10. Details of the haulier and vehicle (as applicable)
    ....
    ....

Record keeping and retrieval

1. How long does your institution keep traceability information?
   a) 0 to 6 months
   b) 7 to 12 months
   c) 1 year to 3 years
   d) 5 years
   e) If other specify
2. Who else beside your company have access to your traceability data, regularly or in time of crises?

	Regularly	Crisis
Suppliers		
Customers		
Customers or consumer group		
Other government agencies		
Others(please specify)		

3. How often do you undertake periodic tests to assess the effectiveness of your traceability system within one year ?..................times/year
4. In times of food safety incidents or scare, or as part of this investigation, how long will it take your institution to successfully identify the fault batch and remove it from the shelf?
   a) 0 to 30 minutes
   b) 31 to 60 minutes
   c) 1 to 3 hours
   d) *Other specify*...........................

5. Do the given batch number correspond with your traceability data? *Yes*/No
6. What information is recorded for an individual batch/lot? And which of these are regularly linked with the output? (Check all that apply).

	Recorded	Linked with output
Supplier details(e.g. address, fax, telephone etc)		
Date of harvest		
Method of production (farmed/wild capture)		
Date of production		
Type of product		
Common name of species		
Scientific name of species		
Quantity		
Quality grading		
Storage condition		
FAO fishing area		
Country of origin		

7. For how long does your institution keep traceability records?
   a) 0 to 6 months
   b) 7 to 12 months
   c) 1 to 3 years
   d) 5 years
   e) If other specify:
8. Who else beside your company has access to your traceability data and how often, regularly or in time of crisis?
   a) Suppliers
   b) Customers
   c) Customer or consumer groups
   d) Government agencies
   e) Other (specify):

9. Do you undertake periodic tests or simulations to assess the effectiveness of your traceability system? If yes, how often do you undertake such tests within one year?

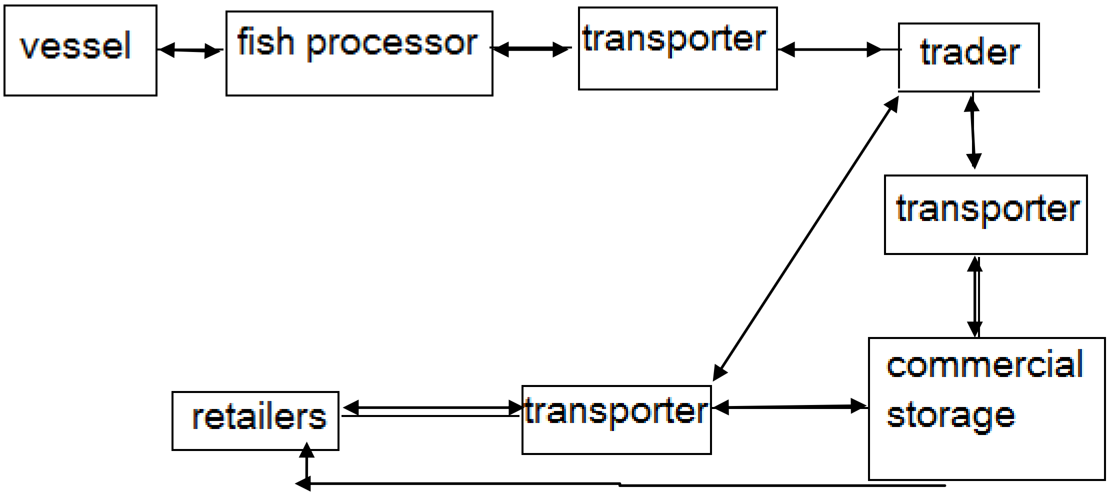
10. In times of food safety incidents or scare, or as part of this investigation, how long will it take your institution to successfully identify the fault batch and remove it from the shelf?

a) 0 to 30 minutes
b) 31 to 60 minutes
c) 1 to 3 hours
d) A day
e) Other specify

IV. Label information according to EUROFISH

Attribute	Meaning
Product ID	Unique identification number for each product
Grade ID	Unique identification number for each grade
Batch number	Unique identification number for each batch
In-feed batch ID	Unique identification number for each in-feed batch
Product type	Type of the product
Production date	Date of production
Company name	Name of the company
Company address	Address of the company that produces the product
Net weight	Net weight of the product
Product origin	Origin of the product (marine, aquaculture)
Pallet number	Unique identification number for each pallet
Unit number	Unique identification number for each unit
Product name	Name of the product
Scientific name	The scientific name of the product
Fishing area	The fishing area the product raw material caught
Country of origin	The country which produces the product
Best before date	The expiry date of the product
Storage condition	The conditions under which the product should be stored

Source: EUROFISH



The Namibian fish supply chain

V. Key traceability information

Below are the examples of relevant information that was recorded at each step in the supply chain and necessary to maintain traceability of fish and fisheries product from the suppliers:

– Supplier name, address and contact details of the last traceable step

– Nature and description of the food supplied

– The Best before date (expiry date)

– Supplier batch codes

– Delivery date

– Confirmation of acceptance/Dispatch

– Number of packs in a case

– Weight of the packs if applicable

– Number of cases in a delivery

– Lot number (if any) assigned to the delivery

– Details of the haulier and vehicle