INFLUENCE OF FISH TRADE ACTIVITIES ON THE ENVIRONMENT IN GIKOMBA FISH MARKET, NAIROBI COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or award.

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DEDICATION

I dedicate this research work to my wife Monica, my mum Njeri and son Jimmy for their support over the period of study.

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TABLE OF CONTENTS

Page No.

CHAPTER 3 METHODOLGY

CHAPTER 4. RESULTS AND DISCUSSIONS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

BMP	Best Management Practices
BOD	Biological 0xygen Demand
BMW	Biodegradable Municipal Waste
CAC	Codex Alimentarius Commission
CAP	Chapter in the Laws of Kenya
CCRF	Code of Conduct for Responsible Fisheries
FAO	Food and Agriculture Organization of the United Nations
GHP	Good Handling Practices
GOK	Government of Kenya
HACCP	Hazard Analysis Critical Control Points
LVFO	Lake Victoria Fisheries Organisation
LVEMP	Lake Victoria Environmental Management Programme
MMT	Million Metric tons
NEMA	National Environment Management Authority
NCC	Nairobi County Council
PPA	Public Private Sector Alliance
UNEP	United Nations Environmental Programme
UNCHS	United Nations Commission for Human Settlement

ABSTRACT

Post-harvest fisheries activities have been cited as contributors to environmental degradation. The current sanitary situation in urban fish markets is worrying and present threats to the public health and the surrounding environment. The research aimed to investigate and understand how the fish trader's activities influence the environmental situation in fish markets. A descriptive survey design was used for the research. The target for the study was the fish traders of Gikomba fish market, Nairobi. Random sampling of fish traders was done from a register, using Fischer's formulae, to calculate the number of respondents. Data was collected through a structured questionnaire and was processed using EXCEL and SPSS software packages. Descriptive statistics (frequencies, percentages,) and inferential statistics (Chi square and Logistic Regression) were used to explain the variables. 54% of the respondents did not get piped water. 63.5% of the respondents did not have waste bins and only 31.5% participated in clean-ups. Majority (60.5%) of the respondents noted that fish wastes had a negative effect on the environment. Chi square tests results for fish operator practices in most attributes was statistically associated with environmental situation ($P< 0.05$). Logistic regression tests results proved that practices such as use of water, disposal of wastes, use of protective clothing and participation in cleanups had a statistically significant influence on the environmental situation ($P< 0.05$). Perceptions attributes on amount of waste generated, possession of health certificates, drainage infrastructure had a significant influence on the environmental situation ($P< 0.05$). The researcher noted that 76%, respondents exhibited high level of awareness on the governmental institutional requirements on hygiene and participation in environmental management. Awareness on government institutions services and options available on fish wastes recycling were attributes that significantly affected the environmental situation ($P< 0.05$). The overall findings led to a support of the key research hypotheses that fish handling practices is significantly related to the environmental situation ($P<0.05$), perception on environmental management is significantly related to the environmental situation ($P<0.05$), and awareness on institutional guidelines is significantly related to the environmental situation($P<0.05$). The study concluded that fish trade activities affect the environmental situation. Improving on the identified key attributes would result in an improved environmental situation. The research recommended that the Department of Fisheries needs to review the modalities for fish handling throughout the marketing chain. Emphasis should be put on disposal of fish wastes in the major fish markets, fish wastes recycling options, training of fish operators and capacity development of staff.

CHAPTER 1. INTRODUCTION

1.1 Background

The Kenya fisheries sub sector has significantly contributed to the national economy through employment creation, foreign exchange earnings, poverty reduction and food security support. Fish production data for the year 2012, shows that during the period,5126.23 MT of fresh water fish valued at 559,939,800 Kshs and 68.5 MT of marine fish valued at 18,829,000 Kshs was traded in Nairobi (Nairobi Province Fisheries Annual Report 2012). This is against a national production of 150,000MT (Fisheries Bulletin 2012). The report cites that fish market's poor sanitation and lack of physical facilities as some of the challenges experienced in the fish marketing outlets.

Capture fisheries and aquaculture supplied the world with about 142 million tonnes of fish in 2010 (FAO, 2010). Of this, 115 million tonnes was used as human food, providing an estimated apparent per capita supply of about 17 kg (live weight equivalent). The fisheries sector is a significant source of income and livelihood for millions of people around the world. Employment in fisheries and aquaculture has grown substantially in the last three decades, with an average rate of increase of 3.6 percent per year since 1980. It is estimated that, in 2008, 44.9 million people were directly engaged, full time or, more frequently, part time, in capture fisheries or in aquaculture (FAO, 2010).

The sources of fish traded in Nairobi markets are the Indian Ocean, Lake Naivasha, Tana River dams, Lake Baringo, Lake Turkana, other smaller dams and fish farms.

The main species are tilapia (*Oreochromis niloticus*), Nile perch (*Lates niloticus*), omena (*Rastrineobola argentae*) and mixed marine species The fish is transported to the main market of Gikomba from where it is retailed to the fish mongers, fish shops and consumers in the city. Other sources of fish products are the fish processing factories who sell their process by- products, like the filleting off- cuts, fat, lower grade fish fillets, fish frames, to fish traders for retail trade in the markets.

The Government has a responsibility of providing and servicing market facilities for fish sale, which meet acceptable hygiene standards. Lack of adequate, or improperly maintained physical marketing facilities can be a constraint to efficient marketing and utilization of fish (FAO, 2002). Fish handled in poor sanitary conditions may produce extra costs for the government in additional medical costs and lost man-hours. Abila (2003) noted that consumption of unwholesome fish and fishery products accounts for as much as 30 percent of the worldwide food-borne illnesses. The fact is that if less fish is wasted, there will be less fish requiring disposal into the environment and so the negative environmental impacts may be reduced. The market's sanitary standards are regulated by the Fisheries Act CAP 378 (*Safety of Fish, Fishery Products and Fish feed Regulations* (GOK, 2007) which complements the Public Health Act (GOK, 1986) whose purpose is to secure and maintain public health.

One of the fisheries contributions to environmental degradation is mainly through discharge from post-harvest fish processing activities. The water that is used to wash the fish or clean the working environment picks up contamination that once released into natural water bodies affects the biological equilibrium. Such water may also

contain cleaning chemicals that can pollute the environment. Cross contamination of the fish and fish products with this waste water is also possible where sanitation is not effective.

The other contribution to environmental degradation is the disposal of fish solid waste, mainly trimmings and fish frames from fish filleting, scales, discarded rotten fish and fish packaging materials. The solid wastes may also contain strong smells especially in dried and smoked fish. The problem of smells could apart from general nuisance and discomfort, also bring about flies, which can be a vector of human disease and potential fish contaminants. Solid waste and poorly maintained sanitation facilities are also possible breeding grounds for flies and cockroaches, which can contribute to the spread of faecal matter in the environment. Inadequate methods of handling, hygiene, sanitation and distribution may provide ideal conditions for pathogens to proliferate and reach infective levels (Wekell *et al*., 1994). Fish wastes disposal and management is therefore very necessary to reduce environmental pollution and reduce incidences of possible diseases from cross contamination of fish.

Fish contamination especially with pathogens like *Salmonella sp., Staphylococcus aureus, Escherichia coli, Vibrio parahaemolyticus*, may occur at various stages in fish chain including prior to harvest, during capture, processing, distribution or storage (Venugopal, 2002). The increased irresponsible fish waste disposal, dumping of litter and rubble, has led to severe impacts on the health of the environment.

Behavior change in fish wastes disposal practices and proper waste management, improved sanitation, increased water quantity and healthy hygiene practices, may all contribute to controlling the state of the environment. Proper fish waste disposal and effective sanitation management in the fish markets will therefore, help to create a cleaner, healthier environment.

1.1.1 Waste Management in Urban centers

According to Ogunja and Okemwa (1992) solid fish wastes make up 30% to 40% of total production, depending on the species in fish being processed. Muniafu and Otiato (2010) further observed that lack of effective waste management systems in Nairobi leads to high possibilities of negative and short term impacts on human health and the environment in general. To overcome these, there are wide range of requirements and suggested solutions which include creation and enforcement of waste management policies as well as procedures, incentives, community participation, education and awareness, proper waste disposal collection procedures and disposal sites among others. The sustainable management of waste is a major challenge for municipal authorities (UN-HABITAT, 2007). Waste is a product or material that does not have a value anymore for the first user and is therefore thrown away; however, it could have value for another person in a different circumstance or even in a different culture (Klundert and Anschutz, 2001). Many approaches to waste management exist. Generally, solid waste is managed through landfills, incineration and recycling or reuse. However, in developing countries, properly engineered landfills are not common while the cost of modern incineration is too expensive to sustain, hence the most common method of waste disposal is some

form of landfill, including variants such as uncontrolled dumping in undefined areas, collection and disposal on unmanaged open dumps, collection/disposal on controlled dumpsites (UNEP, 2004).

One alternative waste management technique is the urban poor's re-use of refuse. Waste recycling is often undertaken as a survival strategy when the urban poor are unable to obtain formal employment, and when non-waste resources are scarce or unaffordable. Reducing the total amount of solid waste headed for the landfill (or left lying to rot in the streets); recycling and composting are land-saving and pollution-reducing strategies. Waste re-use also plays a valuable resource-conserving role by recycling materials further, exploitation of scarce natural resources is minimized, thus containing the spreading ecological footprint of the city. Despite these environmentally and socially beneficial aspects of waste recycling, it is not without its negative impacts, which include exploitation by waste buyers and poor health and living conditions for the urban poor who deal in waste picking (Furedy,1992).

Kenya has made efforts to put in place policy structures necessary to manage waste. On the ground however implementation of these policies are weak and that is why waste continues to be a major challenge in all urban centers. Instead of waiting to deal with environmental crises caused by wastes, preventive and precautionary measures can be activated within the households through use of technology, education and awareness campaigns and the law simultaneously (Waswa *et al.*, 2007). This approach can be pursued at the fish market levels. The other options available for disposal of fish waste is through utilization e.g. use in fertilizers,

animal feeds, but are rarely pursued in Kenya. The recycling of solid and organic waste is one approach that has positive ramifications in creating informal employment and offering an environmentally sound solution to waste management problems.

1.1.2 Fish handling in fish markets

Majority of domestic fish markets are unhygienic and the fish storing and handling facilities are poor. There is also a lack of proper and adequate fish handling facilities and basic equipment. Availability of potable water, good quality ice and waste disposal system is inadequate.

Overall the aim of the research was to study and understand the fish trader's practices, their perception on the environmental management, and awareness on government institutions in the market. The study was designed to isolate critical attributes that might be responsible for maintenance of a good environment. By identifying and quantifying such influencing factors and by suggesting feasible recommendations based on findings of research, it will enable planners and policy makers to take appropriate actions that are helpful for improving efficiency in fish wastes management in fish markets and surroundings areas.

Lessons learnt from this study could be extended to other counties in the country and elsewhere.

1.2 Problem Statement and Justification

The current environmental situation in fish markets raises concerns on whether the level of awareness on government institutional sanitation guidelines, poor perception on sanitary management and deficient fish handling practices may be the contributing factors. Environmental management at Gikomba market is evidently constrained, primarily, by logistical factors, which presumably include inability and difficulties in waste collection by local authorities for transport to the disposal centers. Lack of basic facilities to handle fish in markets, ignorance on appropriate disposal of fish wastes or recycling for useful by-products are some of the identified challenges in fish markets. Generally, capacity among stakeholders (technocrats, extension agents, fish traders) in addressing sanitary situation issues are some of the factors that needed to be examined to understand how they relate with the environmental status in the market.

Understanding these practices and perceptions and their influence on the environment is essential for development of policy, infrastructure and support services that may enhance the fish trader's ability to improve on these deficiencies

1.3 Research Questions

The key questions the research sought to understand are-;

- Which are the demographic factors amongst the fish traders that affect the environmental situation in the market?
- What are the effects of fish handling practices on the environmental situation in Gikomba market, Nairobi?

- What are the effects of fish operator's perception on fish wastes management on the environmental situation in Gikomba market, Nairobi?
- What are the effects of level of awareness on the environmental situation in Gikomba market, Nairobi?

1.4 Objectives

1.4.1 Overall Objective

The overall objective of the research was to investigate and understand how fish trade activities affect the environmental situation in urban fish markets.

1.4.2 Specific Objectives

1. To examine the demographic factors amongst the fish traders that affects the environmental situation of the fish market.

2. To identify the trader's fish handling practices, perceptions on environmental management and level of awareness on government's sanitation guidelines in Gikomba market, Nairobi.

3. To establish the effect of fish operator's practices, perceptions and level of awareness on the environmental situation in Gikomba market, Nairobi.

1.5 Research Hypotheses

The study was guided by the following hypotheses:

1. Demographic factors amongst the fish operators affect the environmental situation of the fish market.
2. The trader's fish handling practices have an effect on the environmental situation in the market.
3. Fish trader's perceptions on wastes management have a significant effect on the environmental situation in the market.
4. Fish trader's levels of awareness on institution's guidelines have a significant effect on the environmental situation in the market.

1.6 Theoretical framework

A theory is a systematic collection of concepts and statements purporting to explain events or behaviours [Timasheff, 1957]. Theory is the axis around which research revolves. Theory establishes a cause and effect relationship between variables with the purpose of explaining and predicting phenomena and may indicate missing ideas, or links to the kind of data required [Kerlinger, 1964:30]

The most common conceptual frameworks used, within the context of environmental assessments, in indicator based studies are the driving force–pressure–state–impact–response (DPSIR), pressure–state–response (PSR), or driving force–state– response (DSR) conceptual frameworks, which organize and structure

indicators in the context of a so-called causal chain (Smeets and Weterings, 1999; Wascher, 2000). In the causal chain, social and economic developments are considered driving forces that exert pressure on the environment, leading to changes in the state of the environment. In turn, these changes lead to impacts on human health, ecological systems and materials that may elicit a societal response that feeds back on the driving forces, pressures, or on the state or impacts directly (Smeets and Weterings, 1999).

Based on these theories, the research conceptualized that fish trade in a market as an economic activity has a number of processes that exert pressure on the environment. Operational activities include fish processing, packaging and display. These operational activities are conducted by personnel (fish traders) and would also require facilities, infrastructure and equipment. The operational activities also produce fish wastes, mainly fish frames, visceral, packaging materials, oils, scales and trim offs. These by-products will affect drainage infrastructure, working surfaces and immediate surroundings in fish markets and hence the fish wastes disposal and management is necessary to reduce environmental pollution and incidences of possible diseases from cross contamination.

Research has shown that sanitary facilities and hygiene practices are key environmental risk factors which are increasingly shown to influence public health. The Government has strong regulatory controls in place to safeguard human and environmental health in public auction centers like fish markets. Once applied, it may result to raising awareness amongst the fish operators on available legislations and institutions and in turn influence the environmental situation in markets.

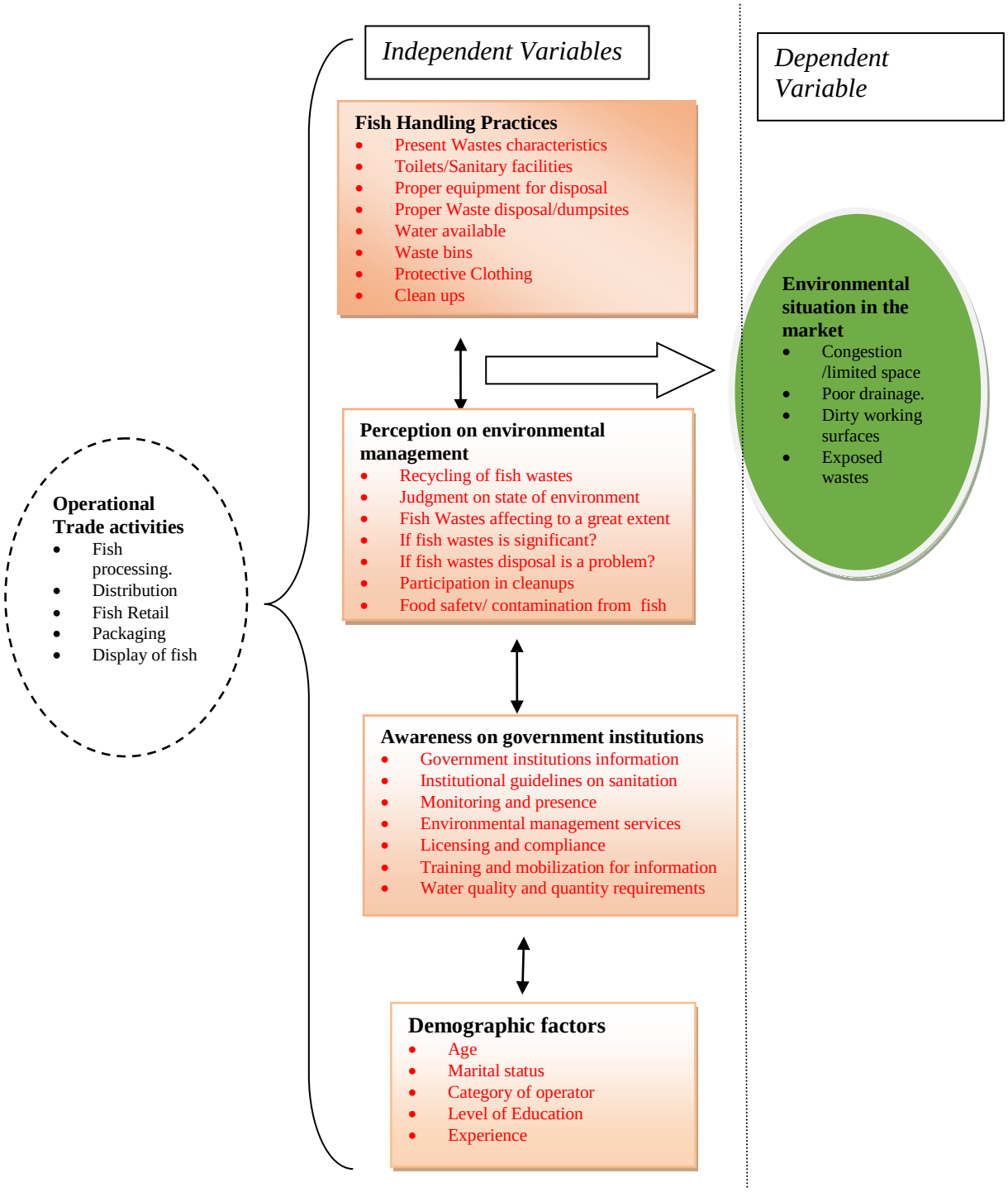

Fig.1.1 Conceptual framework, Source Author

In summary, the research theorized that as the operators fish handling practices, perception on environmental management and the awareness on sanitary legislations

improve; there will be a corresponding increase in the probability of state of the environment in the market being good. It predicts that improving GHPs and awareness will have a greater impact on the likelihood of improving the sanitary standards in fish handling outlets.

1.7 Definition of Terms

- **Fish Trade**-Means commercial trade dealing in fish, with a natural or legal person and may involve operations related to handling, processing, storage, packaging, transport or distribution and marketing of fish and fishery products**.**

- **Fish Market-**A centralized point for holding, displaying or offering of fish and fishery products for the purpose of sale or any other form of transfer.

- **Waste-**A man made substance in a given time and places which in its actual structure and state is not useful to the owner and/or is an output without an owner and purpose. Waste may be in solid or liquid states.

- **Fish Wastes**-Remnants produced from fish processing operations and may include waste in a solid form (fish carcasses, viscera, skin, scales and heads) or liquid form (washing and cleaning water discharge, blood water from drained fish storage tanks, ice).

- **Environmental situation-**The sanitary state of the market particularly the cleanliness of the drains, floors and working surfaces. Other parameters may include offensive smell from spoilt fish and fish wastes, congestion due to limited working space and infrastructure.

- **Fish processing-**The application of a technique to preserve the fish quality which may include temperature control, filleting, frying, drying or smoking. Fish processing operations may include proper waste management techniques.

1.8 Limitations

This study was conducted in the market of Gikomba, Nairobi County. The market is centralized and operates as a collection centre of fish delivered from across the country for sale in the city. This fish market has location dynamics and operational differences that make it unique in its own way. There are other fish markets in the City of Nairobi and the observations and results obtained from Gikomba fish market may not reflect the situation in all other urban markets. The results of this study may not, therefore, be universally applicable to all other fish markets in the country

CHAPTER 2. LITERATURE REVIEW

2.1 Fish trade and fish processing

Fish production is very significant to global food trade and food security. It provides more than 15% of total animal protein supplies and averaged at 129 million metric tons (MMT) during the period 1998-2002, with a record high of 1330 MMT in 2002 (Ababouch, 2003). For many developing countries, fish exports have become an important source of foreign exchange earnings. About 38% of world fish production enters international trade and approximately 50% (in value terms) of this trade originates in developing countries (Ababouch, 2003).

As more and more trade restrictions are being imposed on the fishery products exports, a well-developed domestic marketing system can ensure the viability of the fisheries sector. Fish consumption varies considerably between different geographical regions and population groups within the country (Abila *et al*., 1997). It is highest in the vicinity of the principal fisheries resources and in the cities and major towns and lowest in traditionally pastoral areas in the north and parts of the Rift Valley. Types of fish products for trade include whole fish, fillets (skin -on or skinless), headless and gutted fish, fish maws, frames, belly flaps, fish oil, heads, chests, trimmings and cured fish. The fish produced in the country both from marine and inland sectors, is marketed domestically through a network of wholesale, major retail, minor retail, roadside markets, etc. (GOK Fisheries Bulletin, 2012). The establishment of domestic markets plays a very crucial role in the development of fisheries sector in the country. Apart from ensuring nutritional and food security, it also helps in minimizing post-harvest losses, increase revenue; enhance employment

opportunities and offers high standards of hygiene and sanitation leading to food safety. The importance of domestic marketing can be understood from the fact that only about 15% of the total fish landing in Kenya is utilized for export and the remaining 85% is distributed through domestic markets (GOK, 2012).

Fisheries sub-sector has experienced a 6% GDP growth rate in recent years and continuous change in consumer habits. Fish has become an important part of Kenya's household diet directly and indirectly (Abila, 2003). The majority of domestic fish markets do not have proper fish storing and handling facilities, therefore more sensory quality loss would be anticipated in fish from local markets due to unhygienic conditions and poor handling that necessitates increased bacterial loading (Diei-Ouadi and Mgawe, 2011). Good Hygienic Practices (GHP) is essential to ensure food safety. They are required by law under national and international food hygiene regulations and are frequently considered as pre-requisites to food safety systems.

In the last three decades, there has been a global trend of growing awareness about the economic, social and environmental aspects of optimal use of fishery byproducts, and of the importance of reducing discards and losses in post-harvesting phases (storage, processing and distribution). The utilization of fish by-products has become an important industry in various countries, with a growing focus on handling by products in a controlled, safe and hygienic way (FAO, 2012). Improved processing technologies have also helped in their utilization. At the same period, the amount of fish waste generated from processing has been gradually increasing and its treatment and disposal has become a major social and environmental problem.

Fish spoils faster than any other food and therefore consumption should be soon after catch. However, fish can be preserved through chilling, freezing, drying, salting, smoking etc. to reduce the spoilage rate. The fragility of fresh fish as a food item means that if marketing conditions are disrupted the fish would spoil and be discarded. This is a problem particularly with unpreserved fish and this is worse in tropical ambient temperatures, where the shelf life is restricted to a few hours. Spoilage would also occur in preserved fish in the event of things going wrong in the mechanism designed to preserve the product (FAO/CCRF, 2003). Methods adopted for disposal of spoilt fish can have serious health concern with significant environmental, social and health costs associated with them.

Fish processing operations produce waste in a solid (fish carcasses, viscera, skin, and heads) or liquid form (washing and cleaning water discharge, blood-water from drained fish storage tanks, ice). Gourly, (1992) noted that waste is more easily recognized than defined. Something can become waste when it is no longer useful to the owner or it is used and fails to fulfill its purpose. Fish solid wastes can be used for industrial fish meal production and other economically viable options. The organic components of fish wastes have a high biological oxygen demand and, if not managed properly, can pose environmental and health problems. Generally, the fish solid wastes make up 30% to 40% of total production, depending on the species in fish processing (Ogunja *et al.*, 1992). It is imperative to consider the time frame between production of the waste and its ultimate disposal. Most fish wastes degrade rapidly in warm weather and can cause aesthetic problems and strong odours as a result of bacterial decomposition if not stored properly or disposed of quickly. If

further processing or recycle of the waste is considered a viable alternative, it is essential that the waste be fresh and handled properly.

2.2 General Perceptions on Fish trade and the Environment

Environmental perception is understood as the relationship human beings have with the environment. This relationship determines the attitudes of the people in favor of or against the environment (Leung and Rice, 2002). It is widely accepted that what individuals do in their life time has a direct connection to their beliefs and values. Thus, environmental attitudes and behaviors are frequently linked to those personal values. Related to this, attitudes are favorable or unfavorable feelings inspired by an object or situation. Mwaura, (1991) noted that lack of adequate waste disposal in an area often results in negative attitudes that contribute to a general deterioration of community development. Uncollected solid waste is currently one of Nairobi's most visible environmental problems: The municipal service which seems to fail most strikingly is garbage collection and disposal because it causes littering and untidiness which has an immediate adverse psychological impact. People’s apathetic attitude towards matters pertaining to personal hygiene and cleanliness should also not be underestimated. Individuals may struggle with their household waste, not knowing where to put their waste as there are no official waste bins located nearby to ease disposal. Uncleared garbage, even with the introduction of Public Private Sector Alliance (PPA) initiative, remains a challenge to both individuals and municipal authorities. Past independent, individual, commercial and industrial responses to waste generation and control have not yielded very positive results.

Therefore, we need to employ a more integrated approach which would combine a life cycle analysis with modern methods or waste disposal through composting, incineration and recycling for energy, chemical and other positive uses.

Fish processing generates large amounts of solid waste or residue of high nutrient content which if not properly utilized or treated is likely to be deposited in the environment creating pollution and health problems (Hwang and Hansen, 1998).The general principles of the Code of Conduct for Responsible Fisheries (CCRF) is that the harvesting, handling, processing and distribution of fish and fishery products should be carried out in a manner which will maintain the nutritional value, quality and safety of the products, reduce waste and minimize negative impacts on the environment. Consideration should be given to the reduction of wastes at source, the recovery of value/utility waste, the final disposal of waste in descending order of preference. Waste should be managed as near as practicable to their point of production to mitigate the costs and impacts during transportation (FAO, 2003). Further, this waste must be stored so as to prevent the contamination to the processing environment, and should be disposed of in a manner that is not detrimental to the receiving environment. The magnitude of the problem of waste management in the fish industry depends on the waste volume, its polluting charge, rate of discharge and the assimilatory capacity of the receiving medium.

Thus, the absence of suitable facilities (equipment and infrastructure); the underestimates of waste generation rates, the inadequate management and technical skills, along with improper route planning are largely responsible for poor collection of municipal solid wastes (Bolaane and Ali, 2004; Hazra and Goel, 2009).

2.3 Fish Wastes management

According to Gumisiriza *et al*, (2009), currently, there are limited options available for reuse or recycling of fish wastes and there is need to employ modern fish waste management options to circumvent inefficient management of fish wastes in East Africa.

The most important environment-friendly and profitable options for utilization of fish wastes have recently been reviewed by (Arvanitoyannis and Kassaveti, 2008). These include production of animal food supplement, fish meal, organic fertilizers or extraction for industrial use.

In many countries, solid fish waste is recycled into fish meal or treated along with the municipal waste, whereas liquid waste is disposed of through the municipal sewage system or directly into a water body. In the latter case, care must be exercised to ensure that the receiving water body can degrade the biological and chemical constituents of the waste in a manner that is not detrimental to the aquatic fauna and flora. There are several challenges that face any integrated municipal solid waste management system when source reduction is attempted. Challenges include the fact that that the consumer and the system have no control of the products that enter a certain locality; the economic and institutional barriers to instituting source reduction programs; and the amount of reduction versus the effort and costs to reach that amount (Mwaura,1991).

Internationally, approaches that have been the most attempted with varying levels of success include encouragement and support of Localized Waste Composting Programs. Such programs tend to be voluntary rather than mandatory and would

normally be applied to family dwellings and public institutions e.g. markets. The sponsors of this approach either provide a composting vessel at little or no cost, or provide plans for building a composting bin (Asomani and Haight, 1999).

Although there has been progress in managing the fish processing and trade activities, the management of the volume of fish waste in fish markets currently generated is an issue that needs to be addressed. Disposal of fish wastes is in uncontrolled dumpsites, possibly occasioned by lack of disposal facilities like waste bins or lack of awareness about waste disposal, is the norm. Blocked drainage because of fish scales, trim offs is a challenge that complicates the environmental situation.

2.4 Waste Management in Municipalities.

Waste management is the process by which products and by-products generated by human activities are collected, stored, transported, treated, disposed off, recycled or reused in an effort to reduce their effect on human health or local aesthetics (Zake, 2007).

According to Muniafu and Otiato (2010), waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. He states clearly that management for non-hazardous

residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator. However, in the case of Kenyan municipalities and cities, local government authorities are unable to cope with the rate of waste build up due to lack of the capability and the technical knowledge to combat the situation.

The percentages of organic matter in municipal solid waste in selected African cities were recorded as 56 percent in Ibadan, 75 percent in Kampala, 85 percent in Accra, 94 percent in Kigali and 51 percent in Nairobi (Asomani-Boateng and Haight, 1999). Many approaches to waste management exist. Generally, solid waste is managed through landfills, incineration and recycling or reuse. However, according to UN-HABITAT (2002), in developing countries, properly engineered landfills are not common while the cost of modern incineration is too exorbitant to bear. Hence, the most common method of waste disposal is some form of landfill, including variants such as uncontrolled dumping in undefined areas, collection and disposal on unmanaged open dumps, collection/disposal on controlled dumpsites.

Gourlay (1992) argued that by focusing on the production process itself, examining where wastes are generated, and exploring how they can be reduced, even simple measures, such as separating wastes so that they can be reused more easily, using different raw materials or replacing non-biodegradable products with biodegradable ones, can help achieve large waste reduction results. He also claimed that the greater part of present waste arises not because the producer does not want it, but he fails to use it, or at least use it in such quantities that waste is inevitable. This argument

places emphasis on recycling and conversion of waste as important solid waste management practices.

According to a United Nations Conference on Human Settlement report, one third to one-half of solid waste generated within most cities in low and middle-income countries, of which Kenya is no exception, are not collected. They usually end up as illegal dumps on streets, open spaces, and wastelands (UNCHS, 1996). One of the problems with waste disposal and sanitation is that it is rarely a strongly felt need, especially in poor urban zones. Few people realize that many diseases are caused by poor hygiene behavior, dirty environment and sanitation; neither do they understand the way these diseases are transmitted. Waste reduction and management process need to be always in place, and it is necessary to improve communication on waste issues i.e. to the communities, consumers and regulatory authorities. At a national level, the policies that guide on environmental health need to be assessed, as well as the implementation of such policies at the lower government levels. It is therefore essential to assess at the municipal/district level on who is responsible for what aspects of environmental management, guided by what policies and what are the targets (GOK, 2000). There is also need to strengthen the weak integration of waste management issues in different sectors e.g. health, industry and education.

In Kenya, 30 to 40% of all solid waste generated in urban areas goes uncollected and less than 50% of the population is served. In some cases, up to 80% of Municipal waste collection vehicles are out of service or in need of repair (JICA, 1998). Legislation regulating waste management in Kenya is weak and fragmented and it is necessary to start working on a Waste Act to address these deficiencies. According

to a Government report (GOK, 2000), the objective of such an Act should be to align the national waste management policies with international conventions, and to provide framework legislation.

2.6 Institutional Management and Hygiene Awareness

Public education is an essential tool in any environmental health management program. While public participation will vary and at times may not be high, any measure of sanitation improvement has it value. Actual source reduction in a localized area will also be modest as it relates to the weight of materials placed out for collection. However, involvement of the public has a broader impact on their attitudes and a sustainable environment and material usage (Reinhart, 1991). Implementation will probably require-state policy leadership, legislation and assistance (technical and financial) and local governments to find funds to implement source reduction at that primary level.

Wastage from fish spoilage is also significant and fish operators needs knowledge on how to minimize it. There is considerable time lag during the processing and handling of fish in markets, which may result in poor quality of fish and post-harvest loss. About 10 percent (13 million metric tons) of the world's total fish production is lost due to spoilage. Between the year 2001 and 2002, seafood formed about 1/10 of the refused food products of imports to the United States of America with *salmonella* detection forming 25% of the reasons after filth at 50% (Huss et al., 2003).

According to (Reij *et al.*,2003) unwanted microorganisms may access fish handling environments (outlets) through raw material, personnel or mobile equipment such as vehicles, through leakage and openings in buildings, or through pests and some pathogens may even become established in the work- surfaces and form niches where they can survive for long periods of time. Kenya is faced with great challenges in implementing stricter food safety measures set by different stakeholders. This is because of the small development budget. It therefore exports fish under huge costs (Abila, 2003). The stakeholders have both competing and complementary interests. However, their overall strategy is to target satisfaction of a specific consumer preference. Studies have shown significant faecal contamination and the presence of *Salmonella*, and antimicrobial resistant *E. coli* in *R. argentea* fish sold on markets in Kisumu (Sifuna, 2007). This possess a real health risk through consumption or directly through contact with the fish products including livestock that may feed on contaminated animal feeds produced from *R. argentea* (KEBS,1989). It is, therefore, important for public health workers to create awareness for the need to institute Good Handling Practices (GHP) and Hazard Analysis Critical Control Points (HACCP) as tools for ensuring that fish products are handled under hygienic conditions and that food safety measures are in place in fish handling outlets and premises.

Huss (2003) also noted that the highly nutritious properties of fish flesh provides an excellent substrate for the growth of most heterotrophic bacteria and the composition affects the bacterial growth and related biochemical activities. This can be inhibited by handling fish in low temperatures. It is therefore important to transport fish under adequate ice.

Unclean water, lack of sanitary facilities and improper hand washing and hygiene practices due to lack of proper sanitation facilities are key environmental risk factors which are beginning to receive more attention from scholars because they are increasingly shown to influence public health significantly. In addition, unlike many other risk factors, water sources and sanitation facilities are factors that can be changed, given appropriate technology and funding (Rehfuess *et al*., 2009).

Another environmental concern is the preservation of smoked and dried fish products especially the use of chemical insecticides during storage to prevent attack by insects. Most of the chemicals used are environmentally persistent and harmful to consumers if not used properly, (synergized pyrethrins, pirimiphos-methyl are the only chemicals recognized by FAO). Most fish traders and consumers may not be aware of the health risks associated with use of these chemicals and additives. Many bacterial species are indigenous part of fish, but they can also be found on the food processing surfaces, where they can subsequently contaminate the fish products (Vogel *et al*., 2001). Attachment of pathogens and other bacteria to food contact surfaces can lead to product contamination, spoilages and surface deterioration. Research in the food industry has revealed that most bacteria are able to colonize surfaces in natural habitats (Wirtanen *et al*., 2000). It is therefore imperative that strong regulatory controls be put in place to safeguard human and environmental health in public auction centers like fish markets

2.7 Environmental Health Policies and Legal guidelines

The legal provisions that aim to enhance human and environmental health in Kenya are contained in a number of laws that range from the Environmental Management and Coordination (EMCA) Act 1999, Water Act, Local Government Act, Public Health Act and Occupation Safety and Health Act, Fish Quality and Safety Regulations (2000) and other applicable regulations that are reasonably exhaustive. However, lack of public awareness about the operative legal framework, light, ineffective and inconsistent enforcement of these laws and lack of coordination among the authorities with an environment-health mandate such as NEMA, Fisheries department, Nairobi City County's department of Environmental Sanitation and Hygiene, continue to hamper the effective implementation of the legal and regulatory framework.

The Environmental Management and Coordination Act (1999), provides framework legislation for many statutes in Kenya, which contain Environmental provisions for Environmental Management. Section 75 (1) states that no local authority operating a sewerage system or owner or operator of any trade or industrial undertaking shall discharge any effluents or other pollutants into the environment without an affluent discharge issued by the authority. Acts of negligence are by extension, therefore, a contravention of the regulations. NEMA is the principal government agency in all matters relating to environmental management with its mission being to safeguard and enhance the quality of the environment through coordination, research, facilitation and enforcement, while encouraging responsible individual, corporate and collective participation towards sustainable development (Muniafu and Otiato, 2010).

2.8 Wastes Recycling Options

Fish waste from industrial or artisanal fish processing/markets operations represents an inherent value and it is therefore necessary to consider waste reduction and prevention options. Prevention means eliminating or reducing the quantity of waste that is produced in the first place, thus reducing the quantity of waste which must be managed. Prevention can take the form of reducing the quantities of materials used in a process or reducing the quantity of unusable materials which may be contained in a product (Mwaura, 1991). Prevention can also include the reuse of products. Prevention is the most desirable waste management option as it eliminates the need for handling, transporting, recycling or disposal of fish waste. It provides the highest level of environmental protection by optimizing the use of resources and by removing a potential source of pollution. Minimization includes any process or activity that avoids, reduces or eliminates waste at its source or results in re-use or recycling.

Recycling is very popular among developed countries, which have long realized that waste is not necessarily a wasteful - it can be turned into money. Recycling, according to (Reinhart, 1991), is in most developing countries, the widespread collection and reuse of everyday waste materials such as empty beverage containers. These are collected and sorted out into common types so that the raw materials can be reprocessed into new products.

The dumping of fish waste should be compared with the alternative disposal options. Dumping should only be selected if it can be demonstrated that it is the most environmentally acceptable and practicable option. According to Reinhart (1991),

the first option should therefore always be to have use of fish waste as a raw material. Particular attention should be given to potentially beneficial uses, such as: recycling to food for aquaculture; recycling to food for domestic animals (pigs, sheep etc.); recycling to fishmeal; production of silage; production of fertilizers and soil conditioners for land farming; and manufacturing of biochemical industry products (health products etc.). Biodegradable waste can be commonly found in municipal solid waste (sometimes called biodegradable municipal waste, or BMW) as green waste, food waste, paper waste, and biodegradable plastics. Fish wastes are generally biodegradable in nature.

Ogunja (1992) notes that, in developing countries like Kenya, there is limited appropriate technologies and practices for fish waste management (innovative technologies, good practices along the waste management chain e.g. reduce volume of waste, recycling). This partly, may be due to inadequate or fragmented research and poor information flow among stakeholders to inform policy formulation. Recycling is something that Kenyans must come to terms with if we are to adopt an integrated solid waste management approach.

Opportunities exists to make maximum use of waste fish and fish wastes in situations where the quantity involved, or the transport costs, prohibit conversion into fishmeal (Ogunja *et al*., 1992). They observed that in a country like Kenya where investment capital is not available and fish waste is not concentrated in one area, the only way to make use of fish waste is to produce silage. Fish silage can be utilized as animal feed in pig and poultry industries. The technology of fish silage production is simple, essential equipment is cheap and the scale of production may be varied at will.

2.9 Industrial Fish Processing in East Africa- Opportunities Available

Fish processing industries in East Africa comprise an important segment of the economy. There are over thirty fish processing industries along the shores of Lake Victoria employing thousands of people (LVFO, 2007). The nature of fish processing wastewater suggests that they have high biological oxygen demand (BOD) together with inorganic compounds from detergents and disinfectants used in these factories. These wastes are not sufficiently treated leading to eutrophication of the lake, which may result into changes in species composition, and even loss of species (Muyodi *et al.*, 2004). Besides, all these fish processing factories are located in areas with no land for building conventional centralized wastewater treatment systems like stabilization ponds or wetland.

In the long run, the fish industry in East Africa will not be sustained due to water pollution (LVFO, 2007). The prospects of generating value added products from fish processing waste will encourage factories to utilize their wastes before discharge. This approach will be in line with the 7th Millennium Development Goal number seven that emphasizes sustainable development and reversal of loss of environmental resources. The most important environmental-friendly and profitable options for utilization of fish waste for the recovery of marketable by products and production of value added products through bioconversions has been recently reviewed by Arvanitoyannis and Kassaveti (2008). These include production of animal feed such as swine and poultry feed, monogastric animal feed supplements, aquaculture feed, fishmeal and oil production, fish silage production, production of renewable energy in form of biodiesel and biogas, composting for production of

organic fertilizer, extraction of natural pigments and extraction of novel and industrial enzymes like proteases.

2.10 Summary of Gaps

In Kenya, there are notably weak measures by the Regulatory Authorities for monitoring environmental compliance to environmental, sanitary standards and guidelines in the public sectors (e.g. markets). The fact that waste emanating from fish trade is existent calls for compiling a listing of Best Management Practices (BMPs) and Strategies for the fish industry in Kenya, to forestall its significant contribution to organic wastes and environmental degradation.

It has been established in literature that the deficits in the provision of environmental services can cause environmental hazards and risks. To this end the study investigated the practices of the users of Gikomba fish market, their perception on environmental management and awareness on the adequacy of the environmental services available.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This chapter introduces the study area, research design, data collection procedures in the field and the methods used in the analysis of data collected.

3.2 Study Location

Gikomba market is located in Pumwani Division of Nairobi City and is situated between latitude 1°16.2769"S and 1° 16.4615" S and between longitude 36° 48. 4718" E and 36° 48.5998" E, at an altitude of 1,795 metres above sea level (Fig.3.1). Rainfall is bimodal with long rains occurring between March and May while the short rains in October to November with a total annual rainfall of 900 mm. High temperatures are experienced during the day and low temperatures during the night. The lowest temperatures are experienced in the months of June and July and averages 10°C., while the hottest months are January and February with an average of 24° C.

Nairobi County lies at the south–eastern end of Kenya's agricultural heartland and occupies an area of approximately 696 Km^2. The city is governed by the Nairobi City County Government. According to 2009 population census Nairobi City had a population of 3.1 million (CBS, 2009). Although it covers only 0.1 per cent of Kenya's total surface area, Nairobi has about eight per cent of the country's total population. The city's overall population density is 3,079 people per square kilometer. Nairobi's early growth was fueled by rural migrants and a growth

explosion took place between 1979 and 1989 when 772,624 newcomers came to the city (NEMA, 2003). The motivating forces for migration to the City include better economic prospects, opportunities for higher education, employment and the attraction of Nairobi as a market for goods and services.

Nairobi is the largest city in East and Central Africa and is an important economic hub in regard to transport, manufacturing, services, infrastructure and economic activities. Other economic activities are small scale retail shops. It provides an important link to the Port of Mombasa that is a gateway to the land locked countries of Uganda, Rwanda and Burundi and the Democratic Republic of Congo. It also houses regional and international organizations among them the United Nations Environmental Programme (UNEP).

Gikomba fish market falls within the Nairobi city's administrative zone of Pumwani and is recognized as a market center. It is also regarded as the central wholesale point for fish products in the City and neighbouring counties. Various fish products from different fish landing sites and processing industries are handled in the market daily. Other economic activities taking place in the wider Gikomba area include grocery shops, sale of second hand clothes, carpentry workshops and hotels.

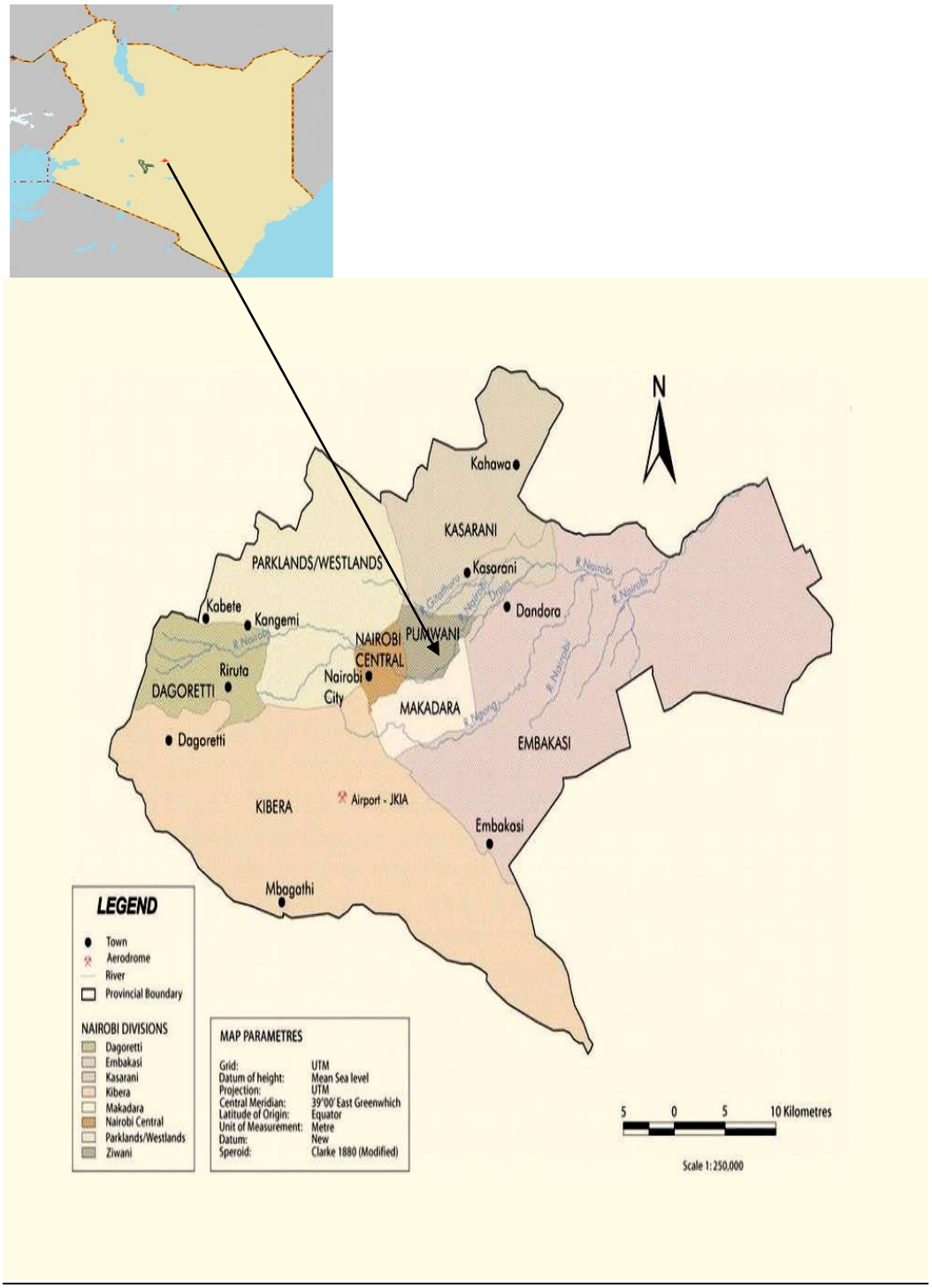

Figure 3.1: Study area map of Nairobi County. Source Google Maps

3.3 Research Design

A descriptive survey research design was used for the study. The descriptive survey enabled data to be collected qualitatively through the use of questionnaires. Data was collected from the fish traders on their operational practices, perception of the fish traders on environmental management and awareness on government institutions sanitary management regulations. The overall aim was to collect information to assess the behavior and attitudes of the fish operators on the environment and how it is influenced by the fish trade activities in the market.

Mugenda and Mugenda (1999) describes survey design as means to obtain information that describes existing phenomena by asking individuals about their perceptions, attitudes, behavior or values. This therefore gave the researcher the need to use the survey design with descriptive analysis.

3.4 Sampling Procedures

3.4.1 Target population

The target population for this study were the fish traders operating in the market. They included the fish dealers who bring loads of fish to the market, the wholesalers and retail traders who display their fish for sale in the market. They were believed to have the necessary information required for the successful completion of this study. There were 700 fish traders in the market according to the local Fisheries Officer register.

3.4.2 Sample size determination

According to Mugenda and Mugenda (1999), a large population requires a formula to come up with the sample. A sample from a large population is assumed to be normally distributed at a confidence interval of 95% or significance interval of 5%. The sample for a large population is determined using the formula given as;

$n=Z^2*p*(1-p)/d^2$

Where:

n = Sample size for large population

Z = Normal distribution Z value score, (1.96)

p = Proportion of units in the sample size possessing the variables under study, where for this study it is set at 50% (0.5)

d = Precision level desired or the significance level which is 0.05 for the study

The substituted values in determining the sample size for a large population are as follows.

$$n= \frac{(1.96)^2*(0.5)\ (0.5)}{(0.05)^2} = 384$$

The sample size will be 384. However, since the population was less than 10,000 (the population was 700), Fischer's formula was used to adjust the sample size of 384 as follows.

$n_0 = n/ (1+ ((n -1)/ N))$

$n_0= 384/ (1+ ((384-1)/700)$

$248= 384/ (1+ ((384-1)/700))$

$n_0 =24$

Sample size for the study was determined as 248 fish traders.

3.4.3 Sampling technique

The study focused on the fish traders in the Gikomba urban market. A simple random sampling was done guided by the Fisheries department's register of fish traders in the market; every third name was recruited for the study, with a target of 248 fish traders.

3.5 Research tools

The main research instrument was the questionnaire. The questionnaire was designed to capture the objectives of the study. The questionnaire had coded and open ended items. Coding was used where open form and other verbal responses occur to enable use of quantitative analysis (Stern *et al*., 2004). Likert type scales were used to measure the opinions of the respondents. This assisted to collect information from the respondents on views and attitudes about the various objectives of the research.

Pre-testing of the questionnaire was conducted before the survey involving 20 fish traders. The pre-testing was used to harmonize the methodology, data collection, and recording and ensure more clarity in the research purpose.

3.6 Data collection procedures

Data was collected using both secondary and primary sources. Acquisition of secondary information entailed review of documents on industrial fish processing, journals, internet, books and thesis which contain relevant information. The primary data were collected mainly through the use of structured questionnaire and direct observation. Majority of the interviewees (195) filled the questionnaire on their own, while the others (53) were directly interviewed by the researcher and the assistants. Overall, there were 200 respondents who completed the interviews, which is an 81% response rate. The information collected concentrated on the fish trader's activities and practices during normal operations. The information was collected on a weekly basis and was spread out over a period of three (3) months in view of varying fish production periods and other logistical factors.

3.7 Data Analysis

The study aimed to model the relationship between improving fish handling practices, fish waste management perceptions and awareness on legislation with the status of the market environment.

Independent Variables-; Fish handling practices, perceptions, awareness and the demographic characteristics were the key independent variables. These variables had several attributes that were analyzed for proof of relationship.

Dependent variable-; The environment situation was the independent variable. The measurement of the environmental situation was based on observed respondent's opinions from a scale of very poor, poor, fair, good and excellent. The dependent variable observations were scored and averaged against an average borderline score of 3. The outcome variables in this analysis are binary. The scores on the environment situation was grouped into a dichotomous category and rated Good (Yes) or Not Good (No), with a probability score of Yes=1 and No=0.

Data was coded and processed using Ms. Word EXCEL and Statistical Package for the Social Science (SPSS) modular software. The use of SPSS eased summarizing of the data in descriptive statistics of frequencies and percentages that shows the trends in the collected data. The software was also used to conduct inferential tests in the data collected. Most of the data was categorical and Chi-square test was used to analyze and broadly describe the data related to the environmental situation and to identify the factors associated to the environmental situation in the market. Because the outcomes of interest are binary, a non-linear model was used to predict the probability that an observation falls into one of the two categories. Binary logistic regression was undertaken to determine which factors predict a good environmental situation. Four (4) regression models were used. The predictors entered into the regression models included the demographics factors and all factors that are significantly related (from Chi-square results) to the environmental situation as per the objectives of the study. The tests were conducted at 5% level of significance with a critical value of 0.05. Significant independent attributes on practices, perceptions, and awareness were identified from the logistic regression results

(models summary, variables in the equation) and used to proof relationships in the data.

3.8 Ethical Consideration

Permission was sought from the local divisional fisheries office and the leadership of the fish trader's association on authority to conduct the research. Research assistants were sensitized on how to respect the rights of the study subjects and no one was coerced to participate. The respondents were also informed of their rights to participate or refuse to participate in the study.

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of data analysis and discussions of the study. The results were presented using tables, pie charts and bar graphs.

4.2 Demographic Information

4.2.1 Gender of the Respondents

According to Bene and Heck (2005) gender division of roles generally characterizes fish trade. Fishing is a preserve for men while women dominate marketing nodes in the value chain. Though this is slowly ebbing away, it can still be seen to be governing fish trade especially in the market. Generally, there are more women than men involved in the fish marketing.

Study results indicate that there were 63% females and 37% males operating in the market. Chi square results indicated that the relationship between gender of the operator and environmental situation was significant. This was supported by (χ^2, = 7.903, df (1), P=0.005).

The odd ratio regression for gender was statistically associated with environmental situation (P<0.05). As one moves from male to female the probability of being conscious about good environmental situation increases by 3.825. (Appendix II). Generally, it can be argued that women are more conscious on hygiene and environmental sanitation than men.

4.2.2 Age of the respondents

Thirty-five percent (35%) of the respondents indicated that they were between 41 to 50 years, 31% indicated that they were between 31 to 40 years, 27% were between 18 to 30 years and 7% were above 50 years. The findings implied that the respondents were mature and would give relevant information. It is also worthwhile to note that the youthful age of below 30 years' category, which is the most productive age, constitute a very small percentage which can be argued that this is the college schooling age.

The chi square analysis results also indicated that the relationship between age and environmental situation was significant. This was supported by (χ^2, = 33.252, df (1), P=0.001).

The odd ratio regression results proofed that age was statistically significant with environmental situation (P=0 .003).

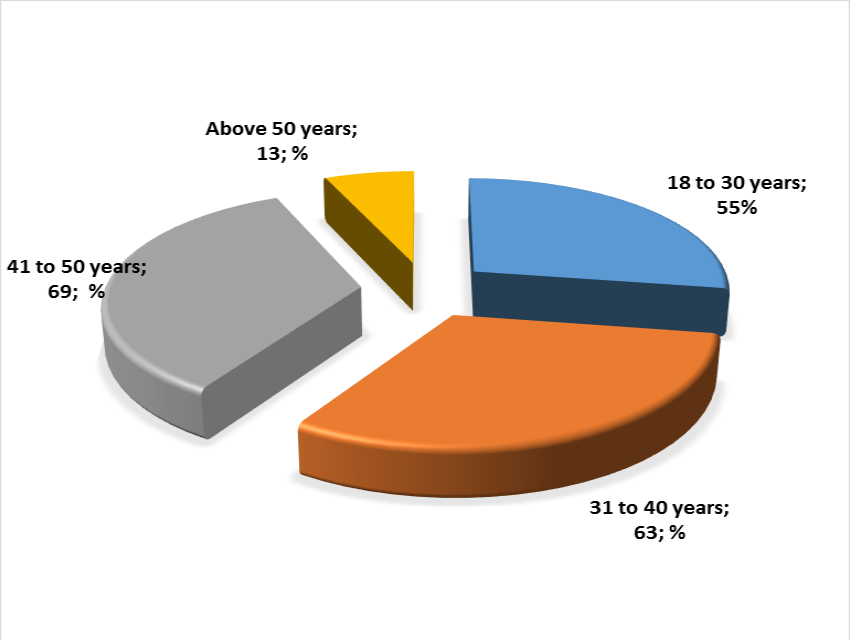

Figure 4.1: Age of the respondents

4.2.3 Marital Status of the Respondents

The respondents were asked to indicate their marital status. 57% were married, 23% were widowed and 20% were single. The findings implied that most of those working in the market were married.

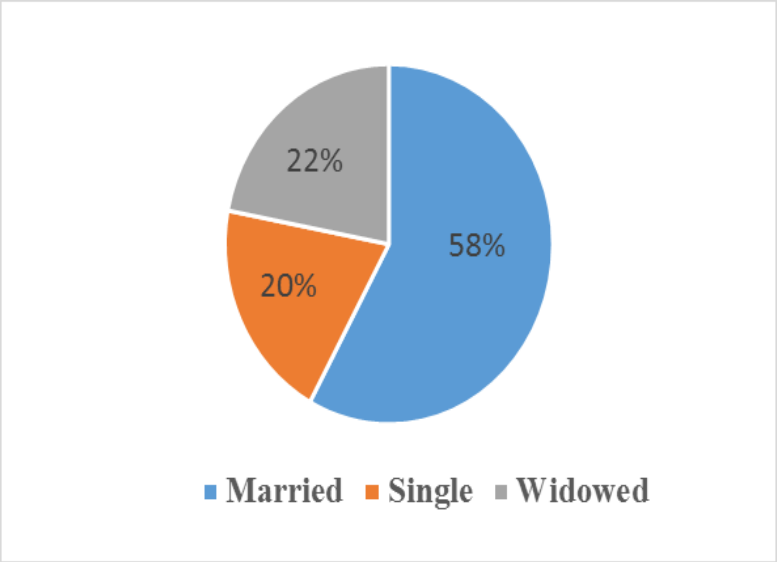

Figure 4.2: Marital Status of the Respondents

Marital status has implication on the choice of enterprise and extent to which women participate in entrepreneurship (Ngigi and Kamau, 2013). There is widespread belief that women who are divorced, widowed or single dominate fish trade. This is informed on the perception that they have limited options to support their livelihoods. The research noted on the contrary that most of the fish operators were married.

Chi square tests results showed that there is relationship between marital status and environmental situation (χ^2, = 38.573, P=0.001). Regression results indicated that the status of being married was statistically significant with the environmental situation (P< 0 .05).

4.2.4 Working Experience of the Respondents

The respondents were also asked to indicate their working experience. 39% indicated that they had worked between 2 to 5 years, 24% had worked over 10years, 22% had worked between 6 to 10 years and 15% had worked for less than one year. The chi square results indicated that the relationship between working experience and environmental situation was significant (χ^2, = 19.467, P=0.003). The findings implied that the respondents had enough working experience and were knowledgeable on the issues regarding the environmental situation.

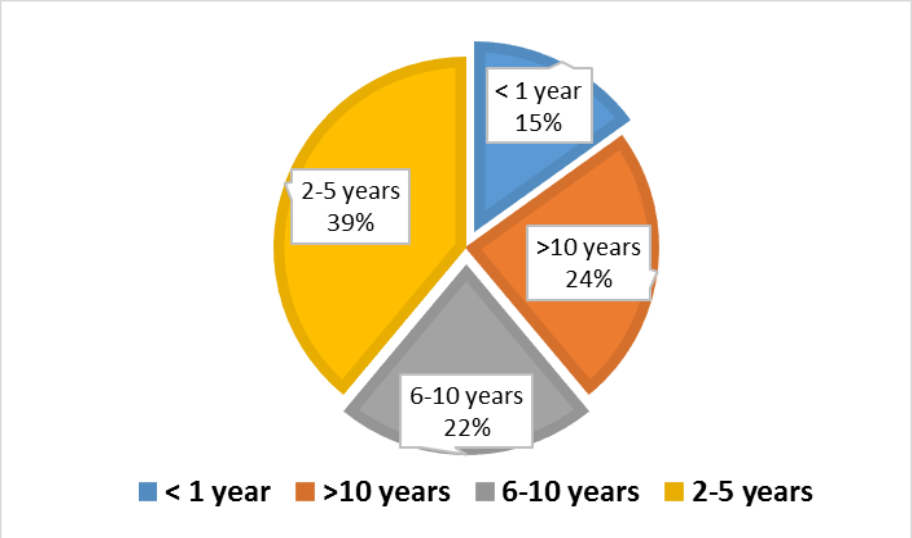

Figure 4.3: Working Experience of the respondents

4.2.5 Education level of the respondents.

Majority of the operators had primary level of education (65%), while those with secondary school education were 30% and some college education were 5%.

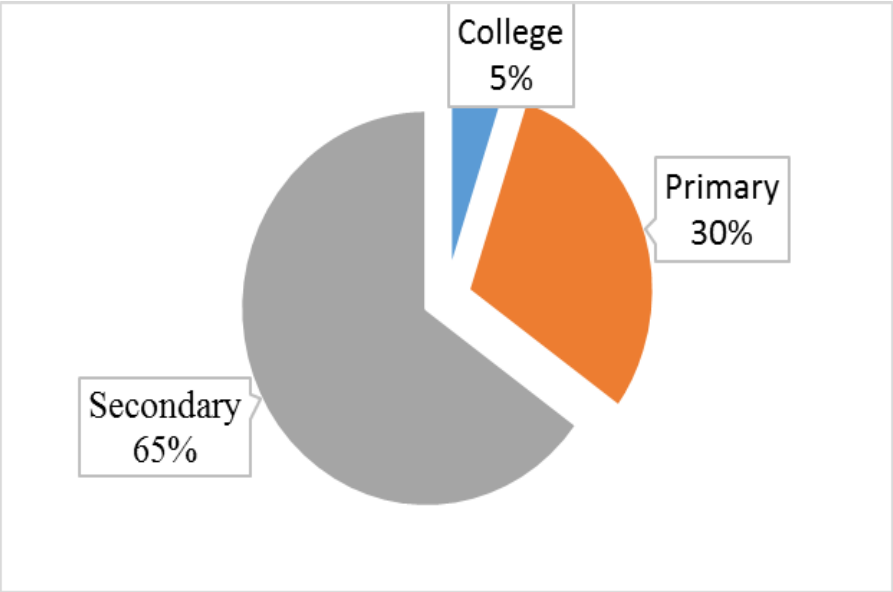

Fig 4.4: Level of education of the respondents.

4.2.6 Category of the operator

The fish traders in the market can be categorized as fish retailers (69.5%), fish wholesalers (17%) and fish processors (13.5%). The analysis showed a significant association between category of operator and environmental situation (χ^2, = 9.281, df (2), P=0.010).

Odd ratio regression shows the fish retail trader's category was statistically associated with environmental situation (P< 0.05). The category of the operator is important when studying the fish operator's fish handling practices. For example, operators who are involved in fish processing are more concerned with water availability, operating space, maintenance of drainage more than a fish retailer who are selling smoked fish.

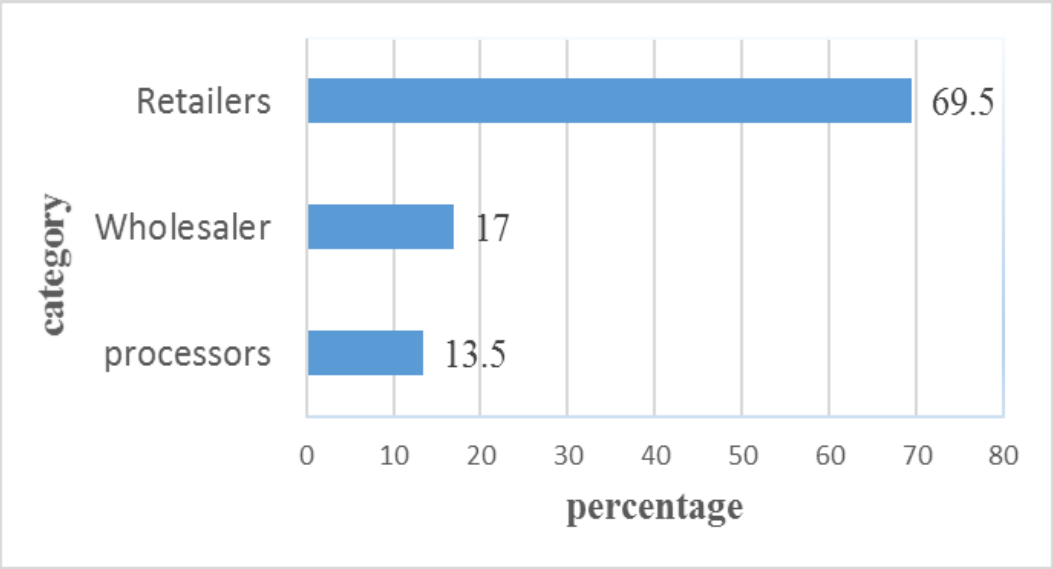

Figure 4.5 Category of fish operator

4.3 Trader's fish handling practices, perceptions on environmental situation and awareness on institutional guidelines.

The other objectives of the study were to assess the fish operator's handling practices during their normal operation, their perceptions on the environmental management in the market and awareness of the Government's institutions guidelines on public health and sanitation.

4.3.1 Fish operator's fish handling practices

Table 4.5 shows that 34.5% of the respondents indicated that the state of their fish when receiving it for sale was preserved in adequate ice. Huss (2003), noted that the highly nutritious properties of fish flesh provides an excellent substrate for the growth of most heterotrophic bacteria and the composition affects the bacterial

growth and related biochemical activities, hence the need to keep fish at low temperatures. Ice provides that low temperature medium. The low level of use of adequate ice in Gikomba market may therefore compromise the quality of fish sold. Food processing establishment's major goal is to control microorganisms in order to provide safe, wholesome and acceptable food to the consumers (Baggen-Ravn *et al*., 2003). However, this can be challenging as contamination of the products take place at all stages of the food chain (De Roover, 1999).

Adequate water is very important in fish handling establishments. 54% indicated that they received water for fish processing somehow (from vendors and other sources), though only 25% received piped water, with the rest receiving no water. It may be argued that not all operators require water as some of them trade in smoked or sun-dried products that do not require water to process.

Most of the respondents (63.5%) indicated that they had no waste bins in this market, 53.5% indicated that they process their fish (cleaning, filleting, descaling) in the market. 49.5% indicated that neither did they dispose of the fish wastes, recycled, throw in dumpsite, throw away nor contain in waste bins. Wekell *et al.*, (1994) noted that inadequate methods of handling, hygiene, sanitation and distribution may provide ideal conditions for pathogens to proliferate and reach infective levels. This emphasizes the need to put in place effective measures for the disposal of fish wastes after fish processing, since the current procedure is wanting, and basic handling practices and equipment are lacking.

Only 36.5% of the respondents indicated that a likely reason for the fish contamination as due to overstaying, 57.5% indicated that they did not have controlled dumpsite in the market, 72.5% indicated that they used uncontrolled dumpsite to dispose their packaging material and excess ice. Various outbreaks of food-borne illnesses, among which fish has been implicated as one of the vehicles, in various countries, in the past years have led to strict food quality/safety rules and regulatory system worldwide (Huss,1995). It is therefore imperative that fish operators observe GHPs in the markets.

Hygiene, cleanliness and consistent Good Handling Practices (GHPs) are critical components in environmental management of fish handling establishments. Results of the study indicated that 52.5% of the respondents had a food handler's medical certificate, 51% indicated that they did not wear food hygiene protective gear such as boots, 67% indicated that they wore food hygiene protective gear such as aprons, 83% indicated that they did not wear food hygiene protective gear such as gloves. 68.5% indicated that the operators in the market participated in environmental management activities though only 12% indicated regular participation. Environmental management of fish markets is crucial, otherwise more sensory quality loss would be anticipated in fish from local markets due to unhygienic conditions and poor handling that necessitates increased bacterial loading (Diei-Ouadi and Mgawe, 2011)

Table 4.1: Fish operator's fish handling practices

Attribute	Practice Response	Frequency	Percentage
State of fish preservation	In adequate ice	69	34.5
	Not adequate ice	58	29
	Fresh Non iced	55	27.5
	Smoked/Dried	18	9
Water use	No water	42	21
	Non piped	108	54
	Piped	50	25
Use of waste bins	No	127	63.5
	Yes	73	36.5
Processing fish i.e. filleting	No	107	53.5
	Yes	93	46.5
Disposal of process waste	Recycling	9	9.7
	Dumpsite	18	19.3
	Throw away	35	37.6
	Contain in bins	31	33.4
Possible reason for the fish contamination	From Source	42	21
	At the market	24	12
	Overstaying	73	36.5
	Other reasons	61	30.5
Controlled dumpsite in this market	No	115	57.5
	Yes	85	42.5
Disposal of packaging wastes	Uncontrolled dumpsite	145	72.5
	Throw away	52	26
	Waste bins	3	1.5
Food handlers' medical certificate	No	105	52.5
	Yes	95	47.5
Wear protective gear - boots	No	102	51
	Yes	98	49
Wear protective gear - aprons	No	66	33
	Yes	134	67
Wear protective gear - gloves	No	166	83
	Yes	34	17
Participation in environmental management activities	No	137	68.5
	Yes	63	31.5
How regular the operator's in the market participate clean ups	No Response	134	67
	Never	3	1.5
	Rarely	39	19.5
	Frequent	24	12

4.3.2 Fish traders' Perceptions on Environmental Management

Another objective of the study was to assess the perception of fish operators on the environmental management in the market.

Table 4.2 shows that the characteristic wastes in the market emanating from fish trade activities are solid fish wastes (fish frames, scales, offals), baskets, and packaging plastic bags.

Table 4.2 Fish trade waste characteristics

Characteristic	Frequency	Percent
Spoilt/bad fish	16	8
Baskets	18	9
Fish frames	47	23.5
Fish scales	54	27
Fish bones	11	5.5
Offals	6	3
Plastic Packaging materials	48	24

The researcher personally observed that the packaging materials and baskets were occasionally re-used though some of the fish operators disposed off the excess packaging materials just adjacent to their working area. Fish scales constituted 27%, offals 3%, fish frames 23.5% and fish bones 5.5% of the by- products of fish processing in the market which are the key contributors to blocking of drains and dirtying the working surfaces. Packaging materials and basket constituted another 24% and18% respectively. In situations where cleanliness of the drains and working surfaces is not effective, there is potential for cross contamination especially from fish contact surfaces, equipment and fish handling operators. There is therefore need

for conscious on adequacy of preventive measures like personal hygiene, sanitation, fish handling equipment and facilities (Jacxsens *et al*., 2010).

Table 4.3 shows that only 34.5% of the respondents indicated that the state of the environment in the market was good, while 38.5% indicated that packaging material affected the environment they worked in to a large extent.

A study proportion of 60.5% indicated that the amount of waste generated was significant to interfere with the adjacent environment while 59.5% indicated that amount of waste generated was significant to warrant being recycled or some other management strategy. This implies that the Fisheries department and the other environmental management institutions could encourage firms to invest in recycling of fish wastes into usable products such as animal feeds and compost manure/ fertilizers.

The researcher observed that there are two establishments who sun- dry fish skins to be used for recycling. The government should also give incentives to such ventures who utilize the fish wastes from the market to encourage them. Up scaling of recycling practices could also create gainful employment. The overall gain would avert poor hygiene, dirty environment because of poorly disposed fish wastes.

The result revealed that the concerns such as hygienic handling practices, wholesomeness, fish waste disposal, and smell and preservation concern were of great importance in regard to fresh fish and processed fish products traded. Amongst the respondents, 63.5% of the respondents indicated that hygienic handling of fish products traded was a very important concern of the market community. Fish

freshness, safety to eat, and the state of preservation is also a major concern of the community operating here as regards the fish and fish products traded.

At least 49% of the respondents were of the opinion that disposal of fish wastes was important which indicates an average perception. This may also imply that the operators are not aware about the negative environmental effects of the fish wastes. However, 66.5% of the respondents agreed that a bad environmental situation in the market would influence the fish trade activities negatively, while 66.3% agreed that the unsellable fish and other fish wastes could be utilized as animal feed, compost manure and fertilizers. Sixty-six percent (66%) of the respondents agreed that recycling fish wastes would improve the environmental (sanitary) situation of the market. Only 43.5% rated as significant, the environmental effects caused by the fish trade as compared to other economic activities e.g. sale of old clothes (*mituba*), carpentry and groceries the environmental situation while 30.5% indicated that the fish operators' personal practices were excellent.

Table 4.3: Fish traders Perceptions on environmental management in the market

Attribute	Perception response	Frequency	Percent
Judgment on the state of environment in this market	Not aware	28	14
	Very poor	15	7.5
	Poor	42	21
	Fair	46	23
	Good	69	34.5
Wastes affecting the working environment to a great extent	Packaging material	77	38.5
	Fish frames	69	34.5
	Viscera and offal	27	13.5
	Water effluents	27	13.5
If amount of waste is significant to affect environment.	No	79	39.5
	Yes	121	60.5
If amount of waste is significant to be recycled or re used	No	81	40.5
	Yes	119	59.5
If hygienic handling of fish products is a major concern.	Not important	8	4
	Important	65	32.5
	Very important	127	63.5
If the fish freshness and safety to eat the major concern	Not important	95	47.5
	Important	65	32.5
	Very important	127	63.5
If the fish smell the major concern	Not important	104	52
	Important	21	10.5
	Very important	75	37.5
If the disposal of fish wastes the major concern	Not important	100	51
	Important	21	9.5
	Very important	75	37.5
If the preservation of fish state, the major Concern.	Not important	47	23.5
	Important	100	50
	Very important	53	26.5
If environmental status Influences fish trade negatively.	No	67	33.5
	Yes	133	66.5
If the unsellable fish and fish wastes can be utilized.	No	73	36.5
	Yes	127	63.5
Utilization of fish wastes	Animal feeds	69	34.5
	Compost manure	40	20
	Fertilizers	18	9
	No	73	36.5
If recycling fish wastes improve the environmental (sanitary) situation	No	68	34
	Yes	132	66
fish trade Vs. other trade activities	Not aware	56	28
	Insignificant	57	28.5
	Significant	87	43.5

4.3.3 Fish Trader's Level of Awareness on Institutional Guidelines

The study also had an objective that sought to assess the level of awareness. Table 4.4 shows that 54% indicated that they were aware of project(s) in the recent past that had attempted to address/improve the status of the environmental in the market. The researcher observed that there was a project by Fisheries Department to provide fish traders dealing with dry fish with shades and display racks. The fish operators indicated that they were aware of NEMA, Fisheries, and NCC Public health guidelines on food handling and sanitation (76%) while and a proportion of 64.5% indicated that NEMA, Fisheries, and NCC Public health government institutions were doing enough in environmental management and that they were satisfied with the services offered.

Further, 42% of the respondents indicated that the extension services or expected services of NEMA were not there. This could be explained that NEMA as a regulatory agency relies on other governmental institutions as lead agencies. Out of all the respondents, 55.5% indicated that the extension services or expected services of the Fisheries Department was frequent, 31.5% indicated the same for NCC Public Health Department. 51% of the traders indicated that they were aware of Government guidelines on importance of availability of water in fish handling premises. 70% were aware of Government guidelines on the importance of personal hygiene in fish handling premises and 55.5% of the traders indicated awareness that recycling of fish wastes can improve the sanitary situation in the market.

Table 4.4: Fish traders Level of Awareness on Institutions

Awareness attribute	Awareness level	Frequency	Percent
Aware of government initiatives to improve the environmental situation	No	92	46
	Yes	108	54
Aware of NEMA, Fisheries, and NCC Public health guidelines	No	48	24
	Yes	152	76
Satisfied with the government institutions in management	No	71	35.5
	Yes	129	64.5
Extension services from NEMA	Not there	84	42
	Occasional	57	28.5
	Not frequent	29	14.5
	Frequent	30	15
Extension services from Fisheries Department	Occasional	54	27
	Not frequent	20	10
	Frequent	111	55.5
	Frequent	15	7.5
Extension services from NCC.	Not there	8	4
	Occasional	57	28.5
	Not frequent	53	26.5
	Frequent	63	31.5
	V. Frequent	19	9.5
Guidelines on availability of water.	No	98	49
	Yes	102	51
Guidelines on personal hygiene in fish handling premises.	No	60	30
	Yes	140	70
Recycling of fish wastes can improve the sanitary conditions.	No	89	44.5
	Yes	111	55.5

4.3.4 Environmental Situation of the Market

According to the Public Health Act (Cap 242) section 118(n), any trade premises must be kept in a clean state and free from offensive smells arising from any drain, privy, water-closet, or not ventilated so as to destroy or render harmless and inoffensive as far as practicable any gases, vapours, dust or other impurities generated. This almost sums up the expected environmental situation in fish handling premises.

In fish markets, the scales and fats clog and block the drainage screens that results into additional cost in labour to mechanically scoop off these scales and fats. The scales are semi- recalcitrant and take long to decompose once dumped on the ground. Fish frames, filleting cut offs, fish bones and packaging materials interferes with the facilities, infrastructure and the general state of environment, in the market. The knowledge, handling and management of all these different fish wastes would to a great extent determine the environmental situation in the market.

The state of the working surfaces (tables, slabs), wastes drains, and congestion (adequate space) were the parameters used to measure the dependent variable; environmental situation. Rating was on a symmetric Likert- type scale where the respondents specified their level of agreement or disagreement on state of the parameters (Table 4.5). The responses were then summed and averaged to create a score for the group of items, as discussed in the methodology, to rate if the environmental situation was good or not good. (Table 4.6).

Table 4.5 Environmental Situation of the market (Initial scores)

Situation	Response	Frequency	Percent
Working surfaces (tables/slabs) *Free of fish scales, fish frames, oils or other exposed fish wastes?*	Very poor	24	12
	Poor	66	33
	Fair	40	20
	Good	52	26
	Excellent	18	9
Drainage. *Free of fish scales, fish frames, cut offs, stagnant effluent waters or other exposed fish wastes?*	Very poor	15	7.5
	Poor	69	34.5
	Fair	60	30
	Good	56	28
	Excellent	0	0
Working space (congested) *If limited and congested by packaging baskets, exposed fish frames, odours ?*	Very poor	52	26
	Poor	60	30
	Fair	26	13
	Good	46	23
	Excellent	16	8

Table 4.6 Environmental Situation category (Final computed scores)

Category	Score	Percent
Good- environmental situation	1	52.3
Not good –environmental situation	0	47.7

4.4. Influence of Practices, Perceptions and Awareness on Environmental Situation

The key objective of the study was to find out the influence the fish traders' practices, perceptions and level of awareness influenced the environmental situation of the market.

4.4.1 Influence of Fish Operator's Practices on Environmental Situation

Table 4.7 shows a summary of the Chi square results on the influence of fish operator practices. The state of preservation of the fish when received for sale, confirmed an association with environmental situation (χ^2, = 52.315, P=0.001).

Fish operators source of water for fish processing, has a significant relationship with environmental situation, (χ^2, = 34.559, P=0.003). Disposal of the fish waste, offal's, skins, skeletal frame, showed a significant relationship with environmental situation, (χ^2, = 19.775, P=0.001).

Chi square results on the most likely reasons for the fish contamination confirmed an association with environmental situation (χ^2, = 23.681, P=0.004) which implies that a clean environment is crucial in forestalling contamination of food products.

Wearing of food hygiene protective gears such as boots confirmed an association with environmental situation, this was supported by (χ^2, = 12.708 P=0.000) while the fish operator's participation in environmental clean-up activities, confirmed a significant relationship with the market's environmental situation (χ^2, = 22.974, P=0.001). This observation can imply that the operator's practices e.g. regular cleanups could define the market's sanitation situation.

Table 4.7 Chi Square Results on Influence of Practices on Environmental Situation

Practices-attributes	χ^2	P-value
State of Preservation	52.315	0.001
Water source	34.559	0.003
Waste disposal	19.775	0.001
Cause of Contamination	23.681	0.004
Protective clothing (aprons)	12.708	0.000
Clean up participation	22.974	0.001

Chi Square detailed results in Appendix III.

4.4.1.1 Odd Ratio Regression operator's Practices against Environmental Situation

Having established a relationship for most of the attributes, logistic regression test was done to proof and measure the degree of the relationship.

The results of Odd ratio regression for fish operator practices indicated that the source of water for fish processing was positively and statistically associated with environmental situation (P= 0.001). The odds of being associated with good environmental situation were 3.855 higher for those who had access to water compared to those who reported otherwise. This reveals that use and access to water is very critical in fish processing operations. According to Montgomery and Elimelech (2007), substantial evidence exists documenting the relationship between improved water and sanitation and improved environmental health. This underscores

the importance of adequate portable water to improve the environmental situation in fish markets.

Regressions results also show that other significant practices as wastes disposal (P=0.003), protective clothing (P=0.008) and participation in clean ups (P=0.001). (See details on Appendix III).

The model explained 74.8% (Nagelkerke R^2) of the variance in the independent variables. Overall, at 0.05 level of significance, the results showed that the environmental situation is influenced by 4 (four) key practice parameters and was further cross tabulated and confirmed at 0.01 level of significance. This led to the rejection of the hypothesis that fish operator's practices do not have a significant effect on the environmental situation ($P<0.05$) and to conclude that fish handling practices influences the environmental situation in the market.

4.4.2. Influence of Perception on Environmental Situation

Chi square results on the influence of perception on environmental situation indicated that amount of fish waste generated is significant to warrant being recycled or other waste management strategies; the Chi square results confirmed an association with environmental situation (χ^2, =15.574, P=0.016). The safety of fish and fish products traded in the market was a major concern of the community operating in the market, the Chi square results indicated a significant relationship with environmental situation (χ^2, = 44.402, P=0.000).

Chi square results on whether having a food handler's certificate is important in reducing health threats in the fish traded, confirmed an association with environmental situation (χ^2, = 14.506, P=0.046).

The operator's comparison of effects caused by other trade activities e.g. sale of old clothes, carpentry and groceries as compared to fish trade indicated a significant relationship (χ^2, = 27.118, P=0.001).

A recent study of the World Health Organization estimated that environmental risk factors account for 34 percent of the disease burden (Pruss and Corvalana, 2007). This implies that if the sanitary situation in the market is compromised there is likelihood for a disease outbreak. Chi square results on the question if the sanitary situation at the market influences the fish trade activities (business) negatively, confirmed a significant association with environmental health situation, (χ^2, = 12.658, P=0.001).

Table 4.8 Chi Square results on influence of Perception

Perception-attributes	χ^2	**P-value**
If quantity of waste is significant	15.574	0.016
Comparison with trade(business) activities	27.118	0.001
Fish products quality safety	44.402	0.000
Possession of medical certification.	14.506	0.046
Influence of sanitation on trade (business).	12.658	0.001

Chi Square detailed results in Appendix II

4.4.2.1 Odd Ratio Regression of Perception against Environmental Situation

Odd ratio regression on the judgment of the state of the environment was positively and statistically associated with environmental situation (P= 0.001). The odds of having a good environmental situation were 4.419 higher for those with a positive perception compared to those with a poor perception.

The significance of the amount of waste generated to warrant being recycled or subjected to other management strategy" was negatively and statistically associated with the environmental situation (P=0.013). The odds of being associated with the good environmental situation were 0.005 higher for those agreeing with the statement compared to those who disagreed with the statement.

Judgement on whether having a food handler's certificate was important in reducing health threats was positively and statistically associated with environmental situation (P= 0.036). The odds of being associated with good environmental situation were 30.957 higher for those who agreed on possession of a health certificate compared to those who did not.

Rating of the environmental effects caused by the fish trade as compared to other economic activities was negatively and statistically significant with environmental situation (P< 0.000). The odds of being associated with good environmental situation were 0.013 higher for those who regarded it significant compared to those who regarded it otherwise. Regression results on whether the drainage systems and sanitation facilities in the market were affected by the fish processing was positively and statistically significant with environmental situation (P= 0.008). The odds of

being associated with good environmental situation were 72.177 higher for those agreeing that fish processing affect drainage.

In summary, this reveals that perception on the drainage systems/sanitation facilities (P= 0.008) was strongest followed by possession of food handlers medical certificate (P= 0.036) and were all statistically significant. Other significant attributes on perception were comparison of fish trade with other trade activities (P= 0.013) and the amount of waste being significant to warrant recycling or other waste management (P= 0.003). The model explained 64.5% (Nagelkerke R^2) of the variance in the variables.

The results led to the rejection of the null hypothesis that perception has a no significant effect on environmental health (P< 0.05), thus concluding that perception on environmental management influence the environmental situation in the market.

4.4.3 Influence of Awareness on Environmental Situation

Table 4.9 shows a summary of the Chi square results on awareness against the environmental situation. Results on awareness of Governmental institutions (NEMA, Fisheries, and NCC Public health) guidelines on food handling, confirmed a statistically significant association with environmental situation supported by (χ^2, =11.735, P= 0.001).

Rating the extension services or expected services of the governmental institutions indicated a significant relationship with the environmental situation, NEMA (χ^2 = 44.633, P=0.005), Fisheries Department (χ^2, = 69.906, P=0.008), NCC Public Health

Department, (χ^2, = 52.119, P= 0.003).Chi square results on awareness of Government guidelines on importance of availability of water in fish handling premises confirmed significant relationship with environmental situation (χ^2, = 24.828, P= 0.011).

Traders awareness on fish wastes recycling strategy to improve the sanitary situation in the market, confirmed an association with environmental situation, supported by (χ^2 = 19.262, P= 0.000).

Table 4.9 Summary of Chi square results on influence of awareness.

Awareness-attributes	χ^2	**P-value**
Government institutions on food health.	11.735	0.001
Rating extension services (Fisheries)	44.633	0.008
Rating extension services (NEMA)	69.906	0.005
Rating extension services (NCC)	52.119	0.003
Availability of water guidelines	24.828	0.011
Recycling of fish wastes	19.262	0.000

The Chi Square results are detailed in Appendix III.

4.4.3.1 Regression for level of awareness against environmental situation

Logistic regression for level of awareness indicated that the quality of extension services by the Fisheries Department was positively and statistically associated with the environmental situation (P=0.003). The odds of being associated with good environmental situation were 4.903 higher for those who had a higher rating of the

NEMA institution as compared to those who rated it otherwise. The quality of extension services by NEMA was significant (P= 0.000) while the services from NCC was also significant (P= 0.015). Awareness on the fact that "recycling of fish wastes can improve the sanitary situation in the market" was negatively and statistically associated with environmental situation (P= 0.004). The odds of being associated with good environmental situation were 0.312 higher for those agreeing on need to recycling as compared to those who disagreed. The model explained 68.7% (Nagelkerke R^2) of the variance in the variables. Overall at 0.05 level of significance, the results showed that the environmental situation is influenced by awareness. This supports the hypothesis that awareness on institutional guidelines is significantly related to the market's environmental situation ($P<0.05$).

The results imply that increasing awareness on the extension services from Government institutions, and increasing awareness on the need to recycle fish wastes could contribute to an improved the environmental situation of the fish market.

CHAPTER 5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the findings of the research, the conclusions and the recommendations of the study, which sought to understand the influence of fish trade activities on the environment in Gikomba fish market, Nairobi County, Kenya.

5.2 Summary of the Study

The findings indicated that the respondents were mature in age, had enough working experience. Gender and category of the operator were demographic characteristics that had a significant influence on the environmental situation of the market.

Notably, 54% of the respondents did not get piped water. 63.5% of the respondents did not have waste bins and only 31.5% participated in clean-ups. The findings also indicated that fish operator's practices such as use of water, disposal of waste, use of protective clothing and participation in cleanups were key significant attributes that determine the environmental situation.

A proportion of 60.5% of the respondents noted that fish wastes had serious negative effect on the environment. In summary, the drainage systems/sanitation facilities, possession of food handler's medical certificate, other trade activities not related to fish trade, and the significance of amount of waste generated were key perception attributes that influenced the environmental situation. The study noted

that whereas fish wastes in markets are not very harmful, they have the potential for reducing the quality of environmental sanitation and cleanliness significantly.

The study shows that the respondents exhibited high level of awareness on the governmental institutional requirements (76%), institutions roles and participation in environmental management. Awareness on the extension services from government institutions and awareness on the need to recycle fish wastes were statistically significant factors that predict the environmental situation of the fish market.

5.3 Conclusions

The status of the environment in any surrounding will most likely be dependent on the people inhabiting it and activities being carried out. The practices, attitudes, perceptions and knowledge amongst the inhabitants would contribute to the influencing factors.

The study concluded that gender and category of operator are important demographic factors that influenced the environmental situation. Interventions on addressing environmental deficit could, therefore, be more effective if it targeted women and retail fish traders. Improved water supply, disposal of wastes practices, use of protective clothing and regular cleanups are key practices whose improvement can lead to improved sanitary status in the market.

Good perception on maintenance of the drainage system, use of protective clothing, confining the market to fish trade activities only and limiting the quantities of fish wastes generated can contribute to the maintenance of a good environmental

situation in the market. Increased awareness on the extension services from government institutions and awareness on the need to recycle fish wastes amongst the fish traders can result in sustainably maintained cleanliness in the fish market.

The study concludes that fish trade activities influenced the status of the environment. The trader's fish handling practices; their perceptions on environmental management and the level of awareness on institutional hygiene guidelines are factors that proofed a statistically significant effect on the environmental situation in Gikomba fish market, Nairobi. The study also concludes that improving on the identified key attributes would result in an improved environmental situation.

5.4 Recommendations

The following recommendations are based on the findings and conclusions of the study:

- The Department of Fisheries should review the modalities on fish handling throughout the fish marketing chain. Emphasis should be given to provision of water, use of ice, proper disposal and re-use of fish wastes and cleanups in the fish markets.
- Sensitizing fish traders and enforcement of basic environmental requirements on maintenance of drainage systems, use of protective clothing, confining the market to fish trade activities only and minimizing wastes generation.
- The Government should draft programs that will educate fish traders on the existing sanitary regulations. In addition, institutional strengthening

programs which facilitate training opportunities for Government agencies staff operating in the fish market should be established.

- Finally, an audit or further study of the detailed description and characterization of the fish wastes in the market.

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APPENDIX I: QUESTIONNAIRE

Good morning/Afternoon

My name is ……. I am doing a research on environmental management of fish trade activities in fish markets. I would like to ask you some questions. I assure you that your responses will be treated as confidential and will only be used for my research purposes.

General Information

Date of interview……

Name of interviewer…..

Name of respondent……

Demographic factors

1. Gender-; **Male** ☐ **Female** ☐

2. Age-**. 18 to 30 years** ☐ **31 to 40 years** ☐ **41 to 50 years** ☐ **Above 50 years** ☐

3. Marital status. **Single** ☐ **Married** ☐ **Widowed** ☐ **Divorced** ☐

4. Level of Education. **Secondary** ☐ **Primary school** ☐ **college** ☐

5. Working experience-; less **than 1 year** ☐ **2 to 5 years** ☐ **6 to 10 years** ☐ **over 10 years** ☐

6. Category of fish operator-; **Retail Fish Trader** ☐ **Wholesale fish trader** ☐ **Processor** ☐

Fish operator's handling practices

1. In what state of preservation is your fish when you receive it for sale? (Tick the most Applicable)

1*. Preserved in adequate ice.* ☐

2. Preserved, but not with adequate ice ☐

3. Non iced ☐

4. Smoked/dried ☐

2.How do you get your water for fish processing? (tick the most applicable)

1. *Piped* ☐ ***2. Non Piped*** ☐ ***3.no water*** ☐

3. Do you have waste bins in this market? 1.***Yes*** ☐ ***2. No*** ☐

4. Do you process your fish i.e. cleaning, filleting, descaling etc. here?

1.***Yes*** ☐ ***2. No*** ☐

5. If YES continue. How do you dispose of the fish waste, offal's, skins of skeletal frame? (Tick the most applicable) ***1. Recycling*** ☐ ***2. Dumpsite*** ☐

3. Throw away ☐ ***4. contain in Waste bins.*** ☐

6. Do you have a controlled dumpsite in this market? 1.Yes ☐ 2. No ☐

7. How do you dispose your packaging material and excess ice? (Tick the most applicable) ***1. Waste bins*** ☐ ***.2. Throw away*** ☐ ***3. uncontrolled dumpsite*** ☐

8. What is the most likely reason for the fish contamination amongst the following (Tick the most applicable)

1. ***Contamination at source*** ☐ ***2. Contamination at the market?*** ☐

3. Due to overstaying ☐ ***4. Other environmental effects.*** ☐

9. Do you have a food handlers medical certificate***-; 1. Yes*** ☐ ***2. No*** ☐

10. Do you wear food hygiene protective gear such as boots, aprons and gloves

Boots **Yes** ☐ **No** ☐

Aprons **Yes** ☐ **No** ☐

Gloves **Yes** ☐ **No** ☐

11. Do the operators in this market participate in environmental management activities? ***1. Yes*** ☐ ***2. No*** ☐

12. If **YES**, how regular is it? ***Often*** ☐ ***Rarely*** ☐ ***Never*** ☐

Perception on environmental management

1. The characteristic fish wastes in this market emanating from fish trade activities are……

2. From your understanding of the environment, what is your judgment on the state of the environment in this market now? ***1. Good*** ☐ ***2. Fair*** ☐ ***3. Poor*** ***4. Very Poor*** ☐ ***5. Not aware*** ☐

3.Which amongst the above do you think affect the environment you work in to a great extent? (Tick the most applicable)

1.Packaging materials ☐ ***2. Fish frames*** ☐ ***3. Viscera and offals*** ☐

4. Water effluents ☐

4. Do you think the amount of fish wastes generated is significant to interfere with the adjacent environment? 1, ***Yes*** ☐ ***2. No*** ☐

5. Do you think the amount of fish waste generated is significant to warrant being recycled or any other management strategy? 1.***Yes*** ☐ ***2. No***☐

6. What do you think will be the major concern of the community operating here as regards the fish and fish products traded?

	Very important	***Important***	***Not important***
Hygienic handling			
Fresh and safe to eat			
Smell			
Disposal of fish waste			
Preservation state			

7. Do you think that having a food handler's certificate is important in reducing environmental threats in the fish traded? 1.***Yes*** ☐ ***2. No*** ☐

8. Do you think the environmental situation at the market influences the fish trade activities negatively? 1.***Yes*** ☐ ***2. No*** ☐

9. Do you think the unsellable fish and other fish wastes can be utilized?

1. ***Yes*** ☐ ***2. No*** ☐

10. Which use could fish wastes be put into? (Tick the most applicable) ***1. Animal feeds*** ☐ ***2. Compost manure*** ☐ ***3. silage*** ☐ ***4. Fertilizers*** ☐

10. Do you think that recycling fish wastes would improve the environmental (sanitary) situation of the market? **1. Yes** ☐ **2. No** ☐

11. How would you rate the environmental effects caused by the fish trade as compared to other economic activities e.g. sale of old clothes (*mituba*), carpentry and groceries?

1. Significant ☐ ***2. Insignificant*** ☐ ***3. Not aware*** ☐

12. Do you think the drainage systems and sanitation facilities in this market are affected by the fish processing activities**? *1. Yes.*** ☐ ***2.No*** ☐

13. Do you think that lack of water in the market affects the environmental situation?

1. Yes ☐ ***2. No*** ☐

14. What do you think of the fish operator's personal practices when handling fish wastes?

Excellent ☐ ***Good*** ☐ ***Fair*** ☐ ***Poor*** ☐

Very Poor ☐

Level of Awareness on Government Institutions

1. Are you aware of any project in the recent past that attempted to address/improve the environmental situation in this market? ***1. Yes*** ☐ ***2. No*** ☐

2. Are you aware of NEMA, Fisheries, and NCC Public health guidelines on environmental sanitation (cleanliness)?

1. Yes ☐ ***2. No*** ☐

3. Do you think the above government institutions are doing enough in environmental management **OR** Are you satisfied with the services offered?

1. Yes ☐ ***2. No*** ☐

4. Using a scale 1-5, how can you rate the environmental extension services or expected services of the following institutions?

***(a)*NEMA**

5Very frequent ☐ *4. Frequent* ☐ *3. Not frequent* ☐ *2. Occasional* ☐

1. Not there ☐

(b)Fisheries Department

5. Very frequent ☐ *4. Frequent* ☐ *3. Not frequent* ☐

2.Occassional ☐ *1. Not there* ☐

(c)NCC Public Health Department

5. Very frequent ☐ *4. Frequent* ☐ *3. Not frequent* ☐

2.Occassional ☐ *1. Not there* ☐

5. Are you aware of Government guidelines on importance of availability of water in fish handling premises ***1. Yes*** ☐ ***2. No*** ☐

6. Are you aware of Government guidelines on the importance of personal hygiene in fish handling premises ***1. Yes*** ☐ ***2. No*** ☐

7. Do you know that recycling of fish wastes can improve the sanitary situation in the market? 1. ***Yes*** ☐ ***2. No*** ☐

Environmental situation in the market

How would you rate the environmental/sanitary state of the market due to fish operator's activities? (Tick using the most appropriate for every item)

1. ***Working surfaces i.e. Tables and slabs – Free of fish scales, fish frames, oils or other exposed fish wastes?***
   Excellent ☐ *Good* ☐ *Fair* ☐ *Poor* ☐ *Very Poor* ☐

2. ***Drainage (fish wastes and blocked)- Free of fish scales, fish frames, cut offs, stagnant effluent waters or other exposed fish wastes?***
   Excellent ☐ *Good* ☐ *Fair* ☐ *Poor* ☐ *Very Poor* ☐

3. ***Working space - (If limited and congested by packaging baskets, exposed fish frames, odours)***
   Excellent ☐ *Good* ☐ *Fair* ☐ *Poor* ☐ *Very Poor* ☐

APPENDIX. II CROSS TABULATION RESULTS

Table 4.10 Chi Square Results-Demographics

	Responses	Yes	No	Chi square and P-value
Gender	Male	30	44	
	Female	77	49	χ^2 =7.930(0.005)
Age	18 to 30 years	21	34	
	31 to 40 years	48	15	
	41 to 50 years	38	31	
	Above 50 years	0	13	χ^2 =33.252(0.001)
Marital status	Single	6	34	
	Married	81	34	
	Widowed	20	25	χ^2 =38.573(0.001)
Education	Primary drop outs	69	61	
	Secondary drop outs	33	27	
	College drop outs	5	5	χ^2 =0.113(0.945)
Working experience	Less than 1 year	12	18	
	2 to 5 years	39	39	
	6 to 10 years	36	8	
	Over 10 years	20	28	χ^2 =19.467(0.003)
Category of operator	Retail fish trader	66	73	
	Whole sale fish trader	26	8	
	Processor	15	**12**	χ^2 =9.281(0.010)

Table 4.11 Odd Ratio Regression for Demographics

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Gender(1)-female	1.342	.492	7.432	1	.004	3.825	1.458	10.036
	Marital status-1 single			37.790	2	.000	.966	.389	5.613
	Marital status(2-married	5.587	1.124	24.687	1	.000	266.978	29.465	419.051
	Marital status(3)-widowed	.241	.604	.159	1	.690	1.273	.389	4.161
	Category -1 Retail trader	4.327		10.248	2	.006	7.36	2.458	9.036
	Category (2)-Whole saler	1.174	.733	2.567	1	.109	3.235	.769	13.604
	Category (3)-Processor	-.569	.945	.362	1	.548	.566	.089	3.613
	Age	1.857	.426	18.966	1	.003	6.404	2.777	14.771
	Constant	6.860	1.494	21.082	1	.000	.001		

a. Variable(s) entered on step 1: Gender, Marital status, category fish operator, Age.

Table 4.12 Chi Square results on Fish Operator Practices

	Response	**No**	**Yes**	**χ^2 and P-value**
State of fish preservation on receipt	Adequate ice	27	42	χ^2 =52.315(0.000**)**
	not adequate ice	50	8	
	Non iced	15	40	
	Smoked/Dried	15	3	
Water source	No water	39	3	χ^2 =34.559(0.000)
	Non piped	50	58	
	Piped	18	32	
If they have waste bins	No	74	53	χ^2 =3.179(0.075)
	Yes	33	40	
Processing fish i.e. cleaning, filleting, descaling	No	48	59	χ^2 =6.905(0.009)
	Yes	59	34	
If YES. How fish waste is disposed	Recycling	18	0	χ^2 =19.775(0.001)
	Dumpsite	6	3	
	Throw away	20	17	
	Waste bins	15	22	
	None of the above	48	51	
If there is a controlled dumpsite the market	No	60	55	χ^2 =0.191(0.662)
	Yes	47	38	
How packaging material is disposed	Uncontrolled dumpsite	77	68	χ^2 =3.828(0.147)
	Throw away	30	22	
	Waste bins	0	3	
Likely reason /points for the fish contamination	At source	24	18	χ^2 =23.681(0.000**)**
	At the market	6	18	
	Overstaying	53	20	
	Other reasons	24	37	
Have medical certificate	No	57	48	χ^2 =0.055(0.815)
	Yes	50	45	
Wearing protective gear BOOTS	No	42	60	χ^2 =12.708(0.000)
	Yes	65	33	
Wearing protective gear APRONS	No	27	39	χ^2 =6.277(0.012)
	Yes	80	54	
Wearing protective gear GLOOVES	No	89	77	χ^2 =0.005(0.943)
	Yes	18	16	
Participation in environmental management	No	89	48	χ^2 =22.974(0.000**)**
	Yes	18	45	
How regular are clean ups	None of the above	89	45	χ^2 =61.770(0.000)
	Never	0	3	
	Rarely	0	39	
	Often	18	6	

Table 4.13 Correlation matrix between practices and Environmental situation

		Environmental situation	fish_operator_practices1	fish_operator_practices2	fish_operator_practices4	fish_operator_practices5	fish_operator_practices8	fish_operator_practices11a	fish_operator_practices10b
Environmental situation	Pearson Correlation	1.000							
	Sig. (2-tailed)								
fish_operator_practices1	Pearson Correlation	-0.063	1.000						
	Sig. (2-tailed)	0.372							
fish_operator_practices2	Pearson Correlation	0.126	-.190**	1.000					
	Sig. (2-tailed)	0.075	0.007						
fish_operator_practices4	Pearson Correlation	-.186**	-0.084	.438**	1.000				
	Sig. (2-tailed)	0.008	0.238	0.000					
fish_operator_practices5	Pearson Correlation	.253**	.193**	-.260**	-.748**	1.000			
	Sig. (2-tailed)	0.000	0.006	0.000	0.000				
fish_operator_practices8	Pearson Correlation	0.044	0.047	-.386**	-.357**	.506**	1.000		
	Sig. (2-tailed)	0.534	0.509	0.000	0.000	0.000			
fish_operator_practices11a	Pearson Correlation	-.177*	0.024	0.135	.654**	-.439**	-.247**	1.000	
	Sig. (2-tailed)	0.012	0.731	0.058	0.000	0.000	0.000		
fish_operator_practices10b	Pearson Correlation	.339**	-.207**	.380**	.490**	-.591**	-.335**	.224**	1.000
	Sig. (2-tailed)	0.000	0.003	0.000	0.000	0.000	0.000	0.001	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4.14. Odd Ratio Regression for Fish Operator Practices

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	fish_operator_practices1	.231	.226	.203	1	**.006***	2.411	.711	2.723
	fish_operator_practices2	1.349	.391	11.925	1	**.001***	3.855	1.792	8.293
	fish_operator_practices4	16.555	5346.5	.000	1	**.003***	5.445	.287	5.958
	fish_operator_practices5	36.356	3528.5	.000	1	.992	9.387	.324	9.676
	fish_operator_practices8	-.529	.233	2.97	1	**.008***	1.234	.424	1.556
	fish_operator_practices11a	108.13	9586.9	.000	1	**.001***	3.669	.197	4.658
	fish_operator_practices10b	.129	.487	.750	1	**.003***	2.581	.587	3.958
	Constant	.183	17642.8	.000	1	.992	.000		

a. Variable(s) entered on step 1: state of preservation-1, water source-2, disposal of waste-4, likely source of contamination-5, protective gears-aprons-8, environmental clean ups-11a, how regular cleanups are- 10b.

Table 4.15 Cox & Snell and Nagelkerke R squared for Fish Operator Practices

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	112.198a	.560	.748

Table 4.16. Chi Square results on Perception

	Response	Yes	No	Chi square and P-value
Judgment on the state of the environment in this market now	Not aware	18	10	χ^2 =4.526(0.339)
	Very poor	6	9	
	Poor	26	16	
	Fair	24	22	
	Good	33	36	
Fish wastes affecting the environment	Packaging material	39	38	χ^2 =0.412(0.938)
	Fish frames	38	31	
	Viscera	15	12	
	Water effluent	15	12	
Wastes is significant to interfere with the adjacent environment	No	39	40	χ^2 =0.897(0.016)
	Yes	68	53	
If amount of waste generated is significant to warrant being recycled	No	50	69	χ^2=15.574(0.016)
	Yes	57	24	
Concern on fish handling	Important	6	43	
	V.Important	101	50	χ^2=44.402(0.000)
	Not important	0	8	
Concern on fish freshness	Important	27	38	
	V.important	80	47	χ^2=17.542(0.000)
	Not important	36	59	
Concern on waste disposal	Important	44	34	
	V. important	27	0	χ^2=33.032(0.000)
	Not important	38	66	
Concern on preservation state	Important	21	0	
	V. important	48	27	χ^2=33.603(0.000)
If food handler's certificate is important	No	68	34	
	Yes	39	59	χ^2=14.506(0.046)
If environmental situation influences the fish trade	No	24	43	χ^2=12.658(0.000)
	Yes	83	50	
If fish wastes can be utilized	No	39	34	χ^2 =0.000(0.987)
	Yes	68	59	
How wastes can be utilized	Feeds	30	39	χ^2 =8.679(0.034)
	Manure	29	11	
	Fertilizers	9	9	
	No	39	34	
If recycling fish wastes would improve the environmental (sanitary) situation	No	29	39	χ^2 =4.878(0.027)
	Yes	78	54	
Environmental effects	Not aware	15	41	χ^2=27.118(0.001)

caused by the fish trade as compared to other economic activities	Insignificant	30	27	
	Significant	62	25	
Are sanitation facilities affected by the fish processing activities	No	39	52	χ^2 =7.602(0.006)
	Yes	68	41	
If lack of water affects the environmental situation	No	30	56	χ^2=21.019(0.104)
	Yes	77	37	
What do you think of the fish operators personal practices	Very poor	15	8	χ^2 =7.681(0.004)
	Poor	6	3	
	Fair	9	7	
	Good	53	38	
	Excellent	24	37	

Table 4.17. Odd Ratio Regression for Fish Operator perceptions

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	perception2	1.486	.295	25.445	1	.001*	4.419	2.481	7.871
	perception5	-5.349	1.132	22.344	1	.003*	.005	.001	1.044
	perception6e	-.363	.493	.542	1	.461	.695	.265	1.828
	perception7	3.433	.607	31.997	1	.036*	30.957	9.424	101.695
	perception12	-4.373	.735	35.403	1	.000*	.013	.003	.053
	perception13	4.279	1.114	14.766	1	.008*	72.177	8.138	640.176
	perception14	-.935	.752	1.547	1	.214	.393	.090	1.713
	Constant	5.361	1.699	9.956	1	.002	212.894		

a. Variable(s) entered on step1: judgement on environment-2, significance on the amount of waste -5, fish products ds safety -6e, possession of medical certificate-7, influence on fish trade-10, comparison with other trade activities-12, effects on sanitation facilities-13, operator personal practices-14.

4.18 Cox & Snell and Nagelkerke R squared for Fish Operator perceptions

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	144.241[a]	.483	.645

Table 4.19. Chi Square results on Awareness.

Attribute	Response	Yes	No	Chi square and P-value
Aware of any project to improve the market	No	54	38	χ^2=1.849 (0.174)
	Yes	53	55	
Aware of NEMA, Fisheries, and NCC guidelines on food handling	No	36	12	χ^2 =11.735(0.001)
	Yes	71	81	
Are they doing enough in environmental management services	No	42	29	χ^2 =1.415(0.234)
	Yes	65	64	
Extension services or expected services of NEMA	Not there	51	33	χ^2 =44.633(0.005)
	Occasional	18	39	
	Not frequent	29	0	
	Frequent	9	21	
Extension services or expected services of the Fisheries Department	Occasional	45	9	χ^2 =69.906(0.008)
	Not frequent	20	0	
	Frequent	42	69	
	Very frequent	0	15	
Extension services or expected services of the NCC Public Health Department	Not there	0	8	χ^2 =52.119(0.003)
	Occasional	45	12	
	Not frequent	35	18	
	Frequent	27	36	
	Very frequent	0	19	
Aware of guidelines on importance of water in fish handling premises	No	70	28	χ^2 =24.828(0.011)
	Yes	37	65	
Aware of guidelines on importance of personal hygiene in fish handling	No	35	25	χ^2 =0.805(0.370)
	Yes	72	68	
Aware that recycling of fish wastes can improve the sanitary situation in the market	No	63	26	χ^2 =19.262(0.000)
	Yes	44	67	

Table 4.20 Cox & Snell and Nagelkerke R squared for level of awareness.

Model Summary

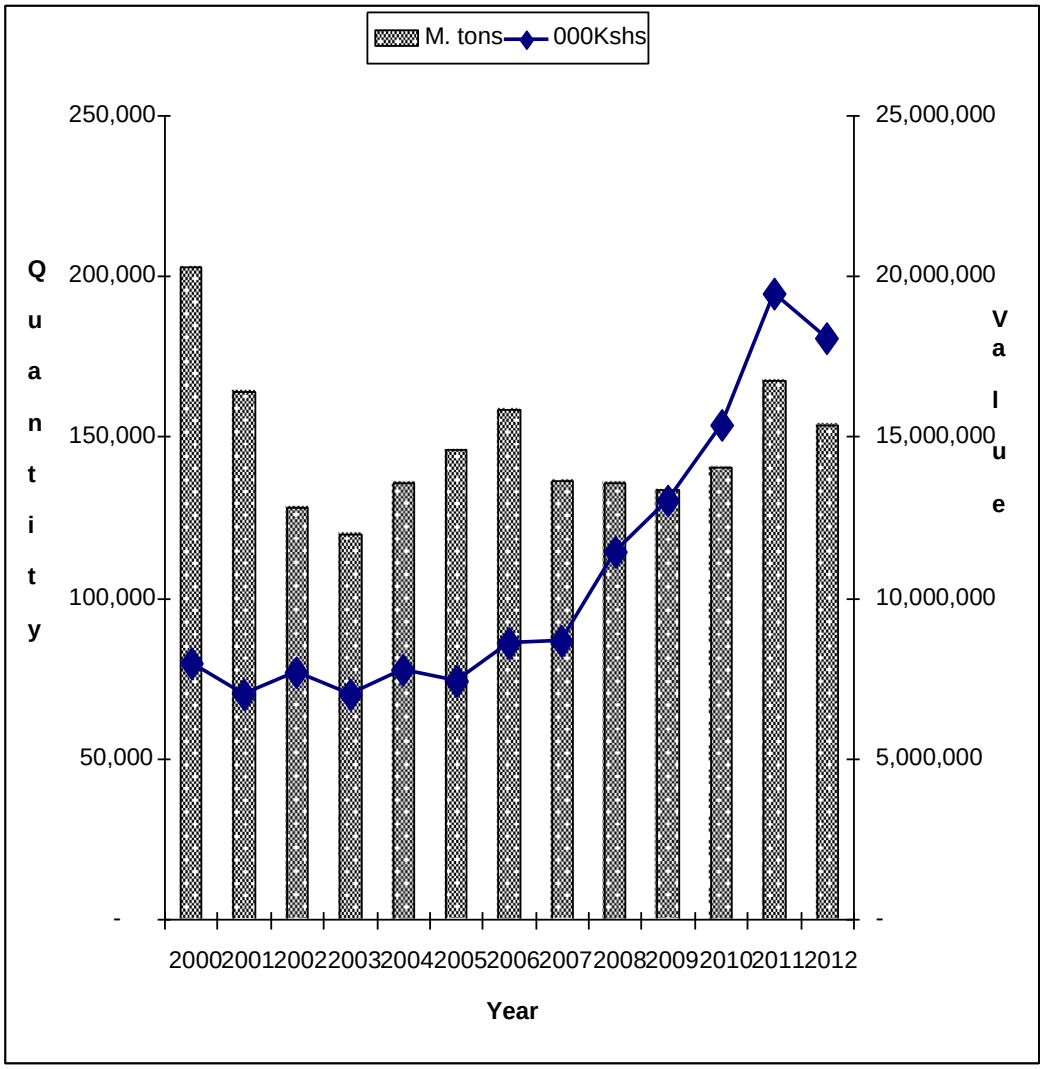
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	207.783[a]	.590	.687

Table 4.21 Odd Ratio Regression for level of awareness.

Variables in the Equation							
		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	level_awareness4a	0.025	.160	.166	1	.003*	.728
	level_awareness4b	1.590	.310	26.355	1	.001*	4.903
	level_awareness4c	-.102	.194	.274	1	.015*	.903
	level_awareness5(1)	.628	.506	1.538	1	.215	1.874
	level_awareness7(1)	-1.166	.406	8.261	1	.004*	.312
	Constant	-5.110	1.298	15.511	1	.000	.006

a. Variable(s) entered on step 1: Aware of Nema -4a, Aware of Fisheries-4b, Aware of NCC-4c, Water guideliness-5, waste recycling options-7.

APPENDIX III; FISH PRODUCTION BY QUANTITY AND VALUE 2000-2012. Source Fisheries Bulletin 2013



APPENDIX IV; MAP OF NAIROBI COUNTY. Source- Google maps