FISHERIES TRAINING INSTITUTE

MINISTRY OF EDUCATION AND SPORTS

DIPLOMA PROJECT THESIS.

ON

SOCIO-ECONOMIC IMPACTS OF MUKENE(*Rastrinaneobola argentus*) FISHERY USING LAMPARA NETS AT BWONDHA FISH LANDING SITE IN MAYUGE DISTRICT

ENTEBBE-UGANDA

2009

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A NATIONAL DIPLOMA IN FISHERIES MANAGEMENT AND TECHNOLOGY.

BY CANDIDATE: ISABIRYE FRED

INDEX NO. ID 2550 – 3209

SUPERVISED BY: MR. KIZITO D.W

LECTURER – FMGT DEPARTMENT

DECLARATIONS AND CERTIFICATION

I **ISABIRYE FRED** the undersigned candidate here by declare that this Dissertation was produced by me and has not been duplicated, reproduced, or presented or published else where.

Signed ..... Date 1st / June / 2009

(Index No. ID 25550 - 3209)

RESEARCH CANDIDATE

I certify the above Declaration, and recommend the submission of this dissertation to the Board of Examiners for assessment.

MR. KIZITO D. W. ..... 04th June '09

RESEARCH PROJECT SUPERVISOR. **SIGNATURE** **DATE**

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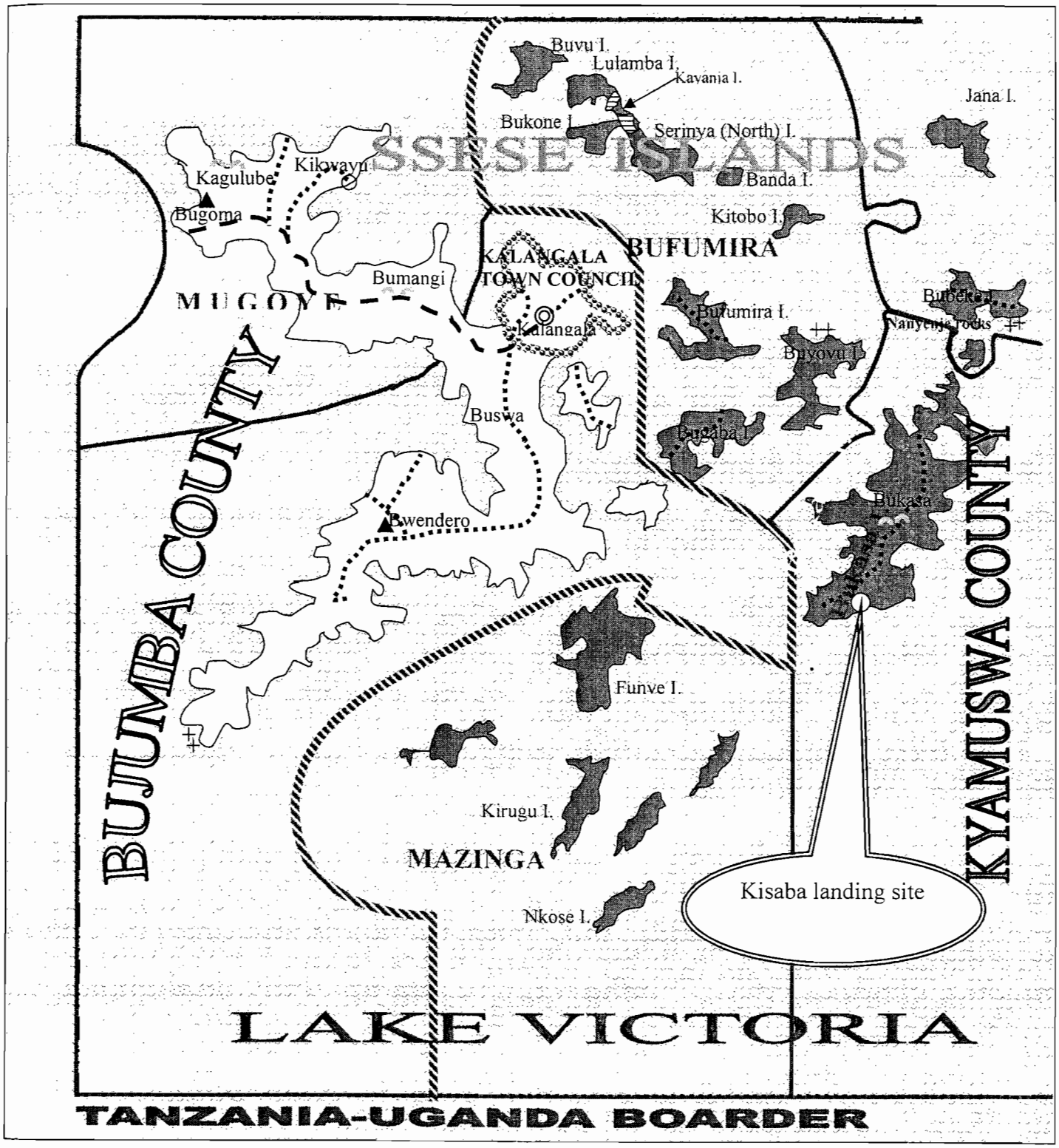
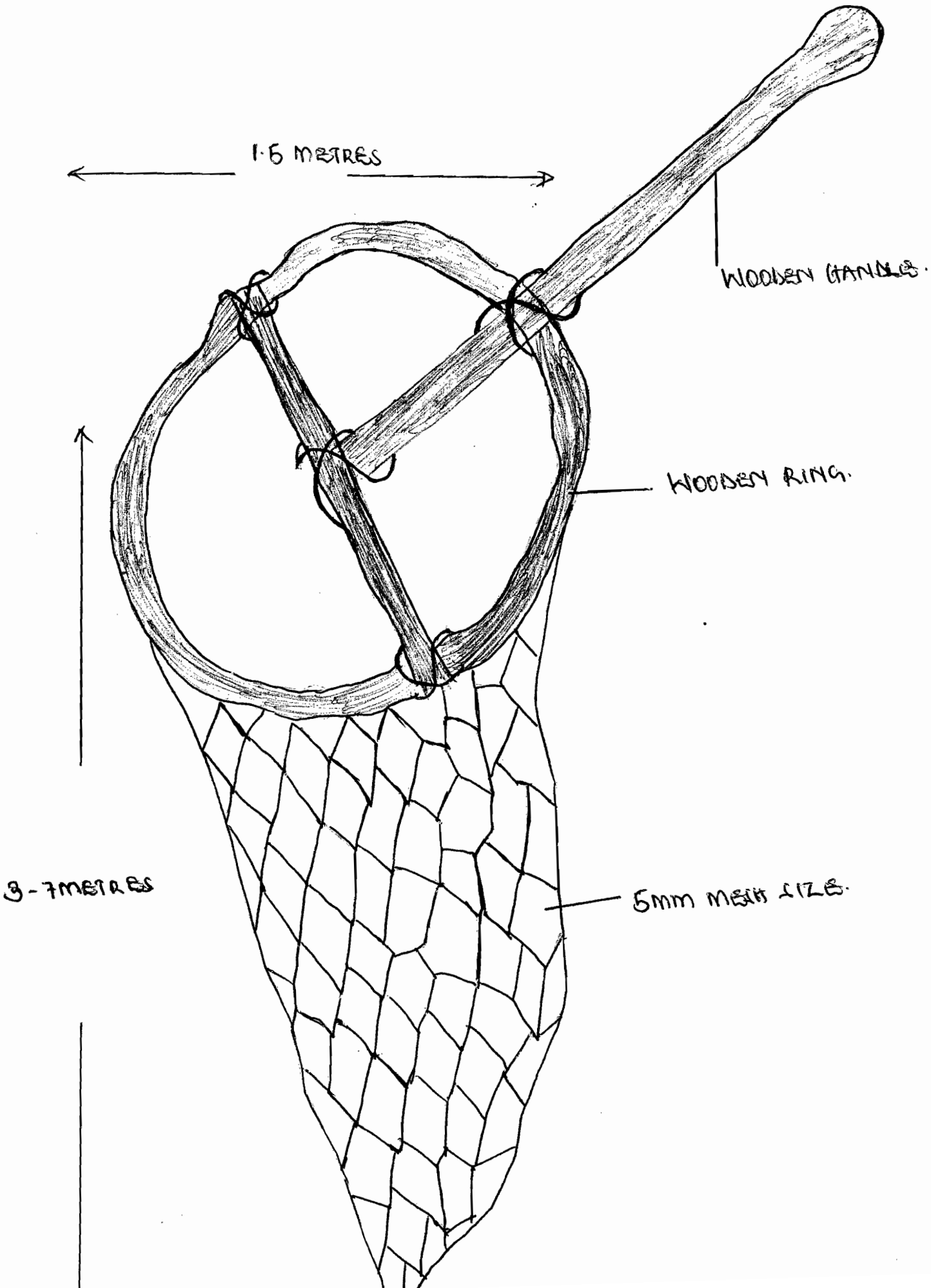
Location of Kisaba landing site on lake Victoria Kalangala district



Key:

- District boundary
- International boundary
- County Boundary
- +++ Rocks
- Sub-county boundary
- Kisaba Fish-landing site
- Kalangala Municipal council
- Main roads

APPENDIX III DESIGN OF SCOOP NET FOR MUKENE FISHERY.



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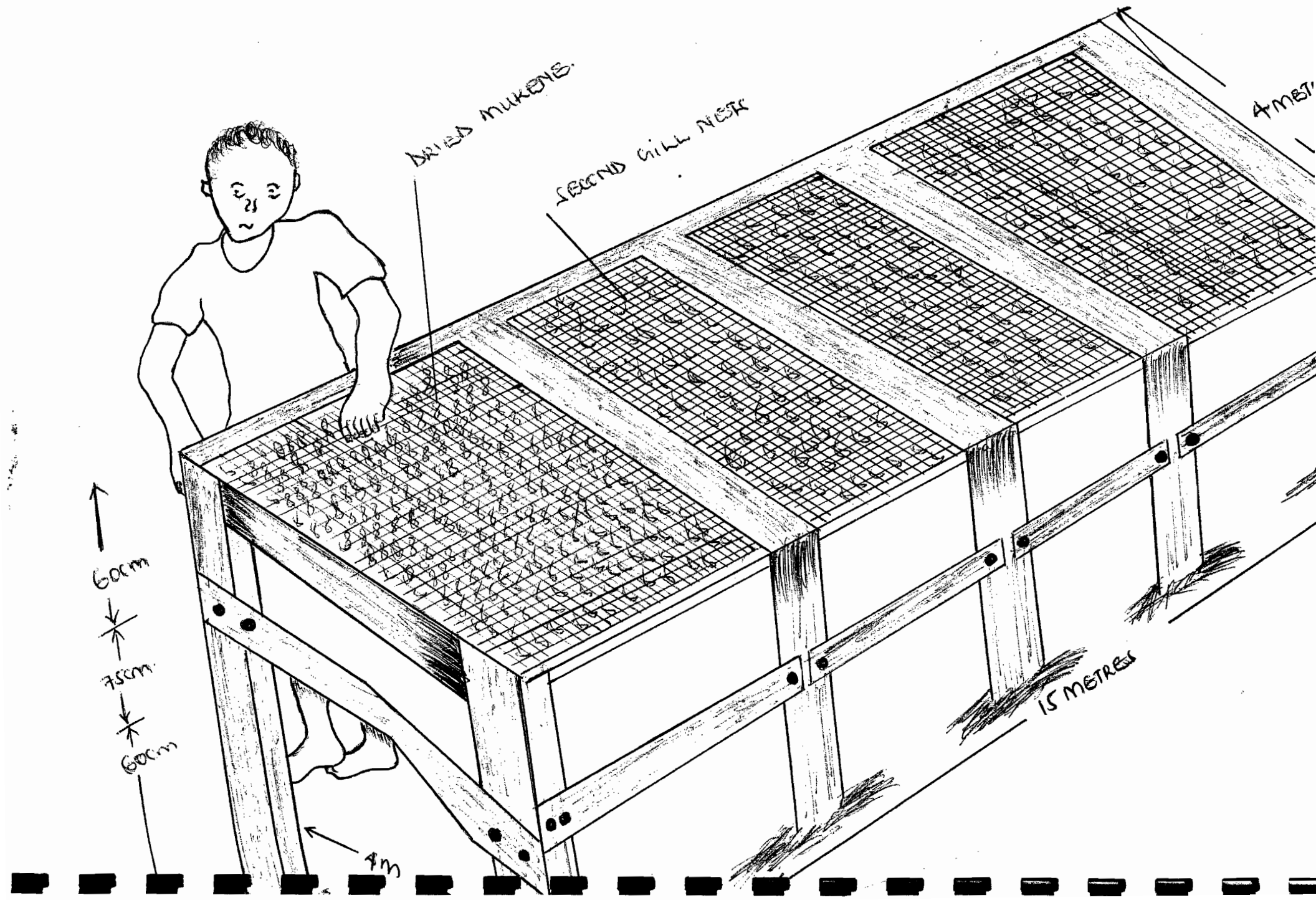

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DECLARATION

I NAMISANGO ESTHER, the undersigned candidate here by declare that this project thesis was produced by me, and is original in context and has not been duplicated, reproduced and presented or published else where.

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APPROVAL

I certify the above Declaration, and recommend the submission of this project thesis to the Board of Examiners for assessment.

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DEDICATION

I sincerely dedicate this research work with love and appreciation to my beloved parents Mrs. Naluyima Leah and Mr. Sendawula Fred, to my beloved brother Sendawula David and my beloved sisters Nakimera Solomy and Nansikombi Sarah for all they offered to bring me up and their sacrifice for my bright future.

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ABSTRACT

The research on causes of spoilage of fresh fish in the market was carried out from Ggaba market from January to February 2009.
The objectives of the research were to;

Identify the causes of fresh fish spoilage; assess the fish handling practices and their impact on the quality of fish.
Identify spoilage rates of different fish species and assess the effect of hygiene and sanitation of the rate of spoilage.

Data for the project was obtained from various sources for example visiting libraries like Fisheries Training Institute Library where information was useful for the project's literature review.

Information from the field was obtained by questioning the fish handlers, fishermen and the fisheries staff, and personal observations and experiments were also used.

The results obtained show that spoilage of fish is due to poor handling of fish during storage and lack of handling facilities in the market.

Fish sellers mainly face a problem of lack of quick spoilage of fish due to lack of enough ice used to store fish or reduce the temperatures.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Fish is extremely perishable food stuff. Spoilage of fish begins as soon as the fish dies or is caught.

In high ambient temperatures of the tropics, fish will get spoiled within 12-20 hours depending on species of the fish method of capture, (Clucas, 1981).

Spoilage refers to a series of chemical reactions which take place in food/fish making or rendering it unacceptable for consumption.
Spoilage in fish is reflected to gradual developments of undesirable flavours, softening of the flesh, hard belly, back gills and dull eyes with green pupils, (FAO, Fisheries Technical Paper 340).

The different types of spoilage in fish are;

Autolytic spoilage which is due to enzyme activities, microbiological spoilage, this is due to the bacteria found in the fish guts and on the surface /skin and lastly, oxidation which is a reaction between fish fats and oxygen.
The spoilage of fish is attributed mainly to; poor handling practices right from the fishing ground to the distribution centers, poor sanitation and hygiene at the landing sites, processing plants, fishing vessels, and bad weather conditions like stormy and drought, (NEMA, 1998).

1.2 Problem statement

It has been a long time in Uganda since spoilage of fish has been a problem especially in markets for example Ggaba market .When fish is exposed,(uncovered) it tends to attract flies which always surround it and as well as the sellers who are always dressed in dirty clothes. For this reason, many consumers fail to buy fish in such environments.

1.3 Scope of the research

- The research project is going to be carried on the causes of fresh fish spoilage, spoilage rate of different fish species and the effects of sanitation and hygiene on the rate of spoilage.

1.4 Objectives

1.4.1 General objective

- To improve on the quality of fresh fish in the market.

1.4.2 Specific objectives

- To identify the causes of fresh fish spoilage.
- To assess the fish handling practices and their impact on the quality of fish.
- To identify the spoilage rates of different fish species.
- To assess the effect of hygiene and sanitation on the rate of spoilage.

1.5 Justification

The information got from the project will be used for proper management of fisheries resources followed by the reduction of fresh fish spoilage in the market through proper handling of fish, good sanitation and hygiene practices of the fish handlers.
This will contribute to the benefits of the country in that, nutritional status of people will be improved, quality of fish sold hence the sector or industry will have an increased contribution to Uganda's economy.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General over view

The amounts of elements in fish vary with sex, age, season, and salinity of the water in which fish lives. The main compositions of fish include;

- **Proteins:** These are components of every living cell. It is composed of elements like carbon, hydrogen and oxygen, they also contain nitrogen. In fish muscles, proteins are divided into structural proteins and connective tissue.

- **Water**: Its amount in fish ranges from 70-80% and up to 90% in dermisal fish. The high water content rises when fish are stored in melting ice or refrigerated sea water.

- **Fats /lipids**: These are heterogeneous carbon compound insoluble in water but soluble in organic solvents. The fats in fish are widely spread along the internal organs and during the hot season, the fats migrate to form fatty cover which keeps the fish warm.

- **Carbon hydrates:** They are stored in fish as glycogen. There quantity also varies seasonally. Fish contain less carbohydrates than food of plant origin.

- There are minor components of fish and these are; minerals, vitamins (A, B, E&K), water extractable components, free amino acids, glucose and sugar phosphates.

2.2 Spoilage

It is a process in which fish under goes and becomes less acceptable or completely inedible to consumers.
Fish spoils very fast as soon as it is taken out of water. Spoilage affects normal appearance, flavour, texture. However, it is important to note that the most effective way of reducing spoilage is by cooling the fish immediately it is captured and keeping it cool, (Huss, 1985).

2.2 .1 Types and causes of spoilage

There are three main types of spoilage;

(a) Autolytic spoilage

After the death of fish, the most mechems are chemical in nature or enzymes native to fish. The digestive juices in the stomach of the fish begin to digest the lining of the stomach.
The uncontrolled enzymes bring about chemical break down of various substances in the tissues of fish. The autolysis spoilage is responsible for early changes in the fresh fish. There is quick growth of off flavours and the odours, discoloration and change in texture, (Huss, 1985).
The process of autolysis, because of its chemical nature, the rate at which it occurs is governed by temperature there fore to decrease the rate of spoilage, it is necessary to lower the temperature of fish.

Fish exposed to high temperatures has an effect on elasticity and texture of the muscle. The flesh then becomes soft , in most cases, the collective tissue between blocks of muscles begin to be destroyed so that if the fish is skinned or filleted, the flesh gaps.Autolytic changes in frozen fish are of great importance . One example is the reduction of trim ethylamine oxide (TMAO) which in chilled fish is bacteria process with formation of trimenthylamine (TMA).TMA is broken down by autolytic enzyme to dimenthylamine (DMA) formaldehyde (FA), (Huss, 1985).
Autolytic enzymes are active even at -20°C and below but proceed much faster at higher temperatures, (FAO, 1985).

(b) Microbiological spoilage

The skin of a newly caught fish carries a large number of micro-organisms, many of which are of various species of bacteria. Fish caught in the tropic zones may carry a slightly higher load of gram-positive organisms and enteric bacteria. During storage of fish, a characteristic flavour develops bit only part of this flavour contributes to spoilage. The specific spoilage organisms are producers of metabolites.
After death of fish especially when autolysis has began, some of these bacteria begin to attack the tissues of the fish, these results into changes in the texture, flavour, smell, and elasticity of fish muscles.

Putrificiens is typical for aerobic chilled spoilage of many fish from temperate waters and produce trim ethylamine, hydrogen sulphide, and other volatile sulphides which gives to fish sulphidic-cabbage-like off odours and flavours, (FAO, 1985).
Microbiological activities are also the causes of many preserved fish products stored at temperatures greater than 0°C, (Wheder, 1993).

(c) Chemical spoilage (oxidation)

The fats, oils combine with oxygen to form pre-oxides. This leads to formation of rancid flavours which are unpleasant and bitter. The accumulative effect of rancidity in the human body can be poisonous.
The fats have lipids which are characterized by being unstable and can be attacked by oxygen, this leads to formation of hydro-preoxides which are tasteless. They cause brown and yellow discoloration of the fish flesh. The dehydration of the hydro-preoxides gives raise to the formation of alhydes and ketons which have unpleasant tastes.
The factors that accelerate chemical spoilage are;

- **Light:** This accelerates the rate of formation and decomposition of peroxides especially the solar energy, the degree of unsaturated fish fats which are weakly bound. The reaction increases with temperature raise and the pressure of pro-oxidants accelerates reaction.

- Pre-oxidants are catalysts which are composed of metal. They are naturally in the iron composition, (Wheders, 1993).

2.2.2 Spoilage rate of different fish species;

Considering tilapia and Nile perch

Under the same storage conditions at room temperature around 28-30°C, the rate of spoilage is different for different fish species, (FAO, 1985).

Nile perch (*Lates niloticus*) is stored at ambient temperature of 29°C and 71% relative humidity, spoils within 12hours that is when the rejected fish is tested. It has a bitter taste and flavour, soft texture and black gills.

Tilapia O.niloticus stored at the same conditions is rejected after 16.5 hours. This difference in spoilage rates is attributed to the difference in the following chemical indices.

The two species have the same k-values below 5% right after catch. But at rejection-value changes as follows; Tilapia 53%, Nile perch 60%, Hx concentration, Tilapia 08N, /g, Nile perch 2.22Nm/g, TMA content, Tilapia 15mg%, Nile perch 13%, (FAO, 1985).

2.2.3 Handling practices and the impacts on fish quality.

Good handling practice in fish is meant to ensure that the food/fish will be highly acceptable when it reaches the consumer.
The following are keys for good practice;

Avoid conditions which might speed up the normal spoilage process. The activity of enzymes in the gut and bacteria on fish is dependant on temperatures as far as possible.

Every precaution should be taken to avoid the fish warming which will happen if left under the sun.

Spoilage is accumulative and accelerating. Failure to keep the fish cool immediately after harvesting will accelerate spoilage at a latter stage in its distribution.

Under normal conditions, it takes time for enzymes and bacteria to penetrate the flesh. Don't speed up the process by mishandling the fish , this can happen by standing on the fish or mishandling fry to keep smell fish which tend to spoil more rapidly, separate from the large fish.

If some of the fish tend to have soft bellies, keep them separate. If the guts are being removed, all traces of the gut should be kept away from other fish. Don't put fish on the ground, even simple concrete/ wooden benches, if frequently cleaned, will reduce contamination.

Conclusion

Good handling practices depend on;

- ❖ Keeping the fish cool
- ❖ Keeping the fish undamaged
- ❖ Keeping the fish flesh clean

2.2.4 Effects of hygiene and sanitation on the rate of spoilage.
Sanitation and hygiene

In order to prevent food/ fish, poisoning standards of hygiene must be maintained. It is also aesthetically pleasing if fish is processed under hygienic conditions using hygienic equipment in a hygienic place.
The main aims of food/ fish hygiene are;

To prevent the fish from being contaminated with food poisoning to prevent the multiplication of any food/ fish poisoning bacteria which do get into food. Fish poisoning bacteria comes from three sources, that is;

- ➢ Fish handlers
- ➢ Salmonella
- ➢ Staphylococcus aureus and
- ➢ Clostridium perfiringens may be carried by personnel involved in fish handling in any other way that might bruise the flesh, split the skin or burst the gut. Do not stack fish or ice.
- ➢ Fish mixture to too great depth; if using boxes, don't over fill.
- ➢ Large pieces of ice may damage the fish, (Clucas, 1981).
- ➢ Slow down normal spoilage, the rate at which bacteria reproduce and grow depends on temperature, has the rate at which gut enzymes will digest the flesh,

by lowering the temperature will slow down the rate of spoilage. It has been suggested that, one (1) hour at normal air temperature will cause as much spoilage as one day at zero degrees ($0^{o}C$).

- Cool the fish as quickly as possible by any convenient method as soon after catching as possible. Make sure the fish are kept cool by use of ice, chilled vehicles during storage; be suspicious of a load of fish well kept at the long journey. Check that there is ice mixed with the fish through out the container.

- It takes time for the fish to loose heat. The rate of cooling is inversely proportional to the thickness squared. That is, if the thickness is double, it will take four times as long for the centre, (Clucas, 1981).

- Avoid or minimize contamination. Fish will spoil quickly when contaminated with other micro-organisms or enzymes from fish guts or rotting fish will make them spoilt at an even faster rate.

- The spores of clostridium perfiringens and bacillus aureus may be found in dust, fish storage rooms. Almost most types of fish poisoning bacteria may be spread by cross contamination in the handling facilities or rodents/ pests.

- The fish itself contains bacteria, when brought out from water or due to faulty handling during fishing. The measures to prevent food/ fish poisoning or contamination can be demanded into three categories, that is;
  - personal hygiene
  - hygiene of the equipment
  - Hygiene in fish handling.

Personal hygiene

Personal hygiene is aimed at preventing the spread of food/ fish poisoning bacteria from the body or clothing to food/ fish. It's the responsibility of the individual and all fish handlers to have an elementary knowledge and understanding of its importance.
The following list contains the mains points of personal hygiene;

Hands should be washed frequently especially before handling fish, this is important since bacteria are always present on the surface of the skin.

Between fish/ food handling operations, this is necessary to prevent cross-contamination of all types of fish poisoning bacteria.

After leaving the lures/ toilets and before leaving the wash room; this reduces the risk of the transfer of bacteria e.g. salmonella.
Coughing and sneezing; this may be responsible for the spread of staphylococcus into fish, a fish handling equipment and should therefore be avoided whenever there is handling of fish.

Handkerchiefs and tissues should be used at all times.

Smoking; it is against the law to smoke while handling fish. It involves contact between the hand and the mouth and can be responsible for the spread of *staphylococci aureus,* (Gaman & Sherington, 1996).

CHAPTER THREE

3.0 METHODS AND MATERIALS

3.1 Research design

DATE	ACTIVITY DONE
10th Nov- 2008	Meeting the supervisor for briefing on research proposal
10th-20th-Nov-2008	Start of research work from the library of Fisheries Training Institute
21st-Nov-10th-Dec-2008	Summarize research, organizing it up, typing and printing it up
11th-Dec-2008	Submission of the proposal
20th-Dec-2008	Collection of data from various groups from the market for the project
2nd-15th-Jan-2009	Final analysis of collected data
17th 28th Jan-2009	Final writing of the project

3.1.1 Study area (geographical location)

Ggaba market is local at Ggaba landing site in Makindye Division, Kampala district; 6.5 miles south East of the city centre on the Northern shore line of Lake Victoria specifically on the Western inner Murchison Bay

3.1.2 Research methods

In view to succeed in doing the aims and objectives of the research project, "Causes of spoilage of fresh fish in Ggaba market", three approaches were used, that is;

1. Questionnaire approach
2. Personal observations and
3. Experiments

3.1.2.1 Questionnaire approach

Three sets of questionnaires were set and directed to:

1. Fishermen
2. Fish traders and
3. Fisheries staff

3.1.2.2 Personal observation

In an effort to attain the objectives, physical observations were made on the following;

- The handling practices used in the market
- Sanitation and hygiene
- Methods used to preserve fresh fish

3.1.2.3 Experiments

The major aim of this experiment was to determine the shelf life of fresh fish when exposed to different conditions and these where;

(a) Fish is gutted, washed and iced
(b) Fish is ungutted, unwashed and not iced.

Materials used for fish when gutted, washed and iced were;

- Nile perch
- Sharp knife
- Weighing scale
- Jerry can
- Portable water
- Basin
- Ice
- Ice box (insulated)

Procedure 1

Seven newly harvested Nile perch were needed weighing at least 6kgs. These were then washed in portable water using a basin. After which they were gutted using a sharp knife. After gutting, the fish were then washed again.
Flake ice was used, if block ice was available, then it was to be broken down into smaller particles. A layer of ice was to bee put in the insulated box at the bottom followed by that of fish then lastly leaving a layer of ice at the top.
Fish should only get into contact with ice alone. The melt ice was allowed to drain out through the hole made at the bottom of the box. Changes in appearance, texture, off odours were noted and recorded every after 48hours for 10 days.

Materials used when fish were ungutted, unwashed and uniced and these were;

- Nile perch
- Ice
- Weighing scale
- Ice box (insulated)

Procedure 2

The same procedure was taken for icing fish in the insulated box (ice box) but for this case the fish was not washed and the changes in texture off odours and recorded every two days.

3.2 Samples

The research involved 40 people of which, 20 were women, 10 fisheries officers, and 10 fishermen.
This was because the women were the ones who usually sold fish in the market and it became easy to approach them.
Fisheries officers were needed so to get the information for the research project.

3.3 Instruments/ research materials

Questionnaire stationeries such as; pens, books, pencils, white over coat and gum boots were also used.

3.4 Proposed data analysis

The data was collected were arranged in form of long tables, bar graphs and pie charts. Further more, decision was made under the section of results and the analysis of the project proposal.

3.5 Procedure

The Institute (Fisheries Training Institute) provided the introduction letter to the district fisheries officer were the research was to be carried out. The district fisheries officer granted me permission to start my research through his assistant who later introduced me to the fisheries staff at the landing and to the market staff. My research was carried out through personal observation, interviewing and carrying out experiments.

Use of questionnaire

Three sets of questionnaires were used, addressed to the fishermen, fisher sellers and the fisheries staff. I got representatives for each group.
All the individuals (respondents) who were sampled were given questions which were written in English and those who could not read or understand English, I had to read the questions for them and translate it in luganda which was the common language spoken. This was done in order to get the true and right information and recording it down.

3.6 Limitation during the study

The bad weather, during rainy seasons, made going to the market very difficult since it would rain heavily and some parts of the market would flood.

Lack of enough funds to buy enough materials especially for the experiments.

False information from the respondent especially the fishermen who thought giving real information would cause them problems like being arrested.

CHAPTER FOUR

4.0 Results

4.1 Results from questionnaires

Table 1: Showing fisher men responses

Respondents	Washing and cleaning of vessels	Time taken from fishing ground to landing site	Handling on board	Equipment used to offload	Presentation of fish from spoiling	Conditions for a fisherman
1	Rarely	2 hours	Bad	Baskets	Non	Non
2	Twice a day	2 hours	Bad	Sacks	Non	Non

Table 2: Showing fish sellers' responses

Respondent	Requirement for a fish seller	Containers used to cure fish	Delivery fish to consumers	Handling facilities	Safcty of fish
1	Medicating fish	Plastic containers	Bicycles	Insulated boxes	Put in wooden boxes
2	Hygienically accepted	Plastic containers	Bicycles	Insulated boxes	Use of wooden boxes

Table 3: Showing fisheries staff responses

Respondents	Handling facilities in relation to quality improvement	Traditional habits affecting fish quality	Steps to improve fish quality
1	Gutting display tables	Selling fish on the ground	Medical examination
2	Fish shades	Containers not washed	Gutting of fish

4.2 Results from personal observation

According to physical observation made, fish sellers in the market are unhygienic in such have long and dirty nail and always use dirty ropes for typing fish together. Grading of fish according to size, species and freshness is have done.

the few drainage channels are always dirty and usually blocked by wastes which are dumped into them.

Fish is always pilled in wooden boxes during storage with little or no ice and these boxes are sometimes not washed.
Icing the common method used in preserving fish or sometimes in the absence of ice fish is put in water to cool down the temperature. This practice is done by a few fish sellers in the market.

4.3 Results from experiments

Experiment 1: Shelf life of wet fish when gutted, wooden and iced

Time (days)	Appearance	Odour	Texture	Quality score	Remarks
00	Shinny bright colours, gills bright reddish	Fresh lake smell	Firm and elastic	9	High quality wet fish
02	Surface of the fish was wet	Fresh lake weed smell	Firm elastic scales were still from on the body	8.5	High quality wet fish
04	Shinny bright	Slightly fresh lake weed smell	Flesh was firm and hard and scales still firm on the body	8	High quality wet fish
06	Bright colours and redden gills	Flesh fish lake smell	Flesh firm and hard	7	High quality wet fish
08	Most bright colours cornea transparent	Lake weed smell	Flesh slightly hard and firm	7	High quality wet fish
10	Fish most with bright colours, eyes, hard transparent cornea	Feeding lake weed smell	Flesh was slightly hard and firm	6	Medium quality wet fish
12	Surface colours were fading, cornea was concave shaped	There was a bad odour and flavour	Flesh was soft, scales were loosely attached	5	Has quality wet fish

Experiment 2: Shelf life of wet fish when ungutted, unwashed and iced

Time (days)	Appearance	Odour	Texture	Quality score	Remarks
00	Shiny bright colour, eyes clear, gills were bright reddish	Fresh lake weed smell	Firm and elastic scales firm on the body	9	High quality wet fish
02	Moist surface shiny bright colours	Slightly fresh lake weed smell	Flesh was hard and firm	7.5	High quality wet fish
04	Moist, bright colours, gills were reddish	Lake weed smell	Flesh hard and firm	5	Medium/goal quality wet fish
06	Fish surface colours were fading, cornea was translucent	Loss of odour and flavour	Flesh soft, scales loose on the body	4.5	Low quality wet fish
08	Gills pale, reddish with a slight scare of mucus, general appearance was dull	Characteristic smell off odour smell due to microorganisms	The flesh soft and scales loose on the body	3.5	Poor quality wet fish
10	Gills were dark brown and general appearance remained dull	Developed and mixed odours and flavours	Flesh soft and scales loose on the body	3	Poor quality wet fish
12	The gills were brown with mucus	Bad odour	Flesh was so soft	2.5	Poor quality wet fish

CHAPTER FIVE

5.0 RESULTS, ANALYSIS AND DISCUSSIONS

5.1 Results

According to experiment 1 carried out, it shows that fish when ungutted, unwashed and iced spoils faster than gutted, washed and iced fish, this is because;

The skin of a newly caught fish carries a large number of microorganisms, the gills and in the digestive tract; therefore, the fish which was ungutted, unwashed and iced contained large amount of microbial load and those on the surface penetrated include the fish if it was bruised. The bacteria continued to grow and multiply leading to quick spoilage of ungutted, unwashed and iced fish.

For the gutted, washed and iced fish, the bacteria iced on the surface of the fish or stain was reduced by washing the fish and that in the body was reduced by removal of the guts. The removal of the guts eliminated the enzymes present in the digestive tract hence prolonging its shelf life.

The digestive enzymes in the stomach of the ungutted fish after death continued to digest the stomach lining rendering it soft. The softness facilitated the easy penetration of bacteria hence quality deterioration.

5.2 Discussion

According to J.J Clucas, (1981), fish is the most perishable food stuff which spoils taste if not carefully handled and immediately processed or consumed. High losses of fish observed at the project area was attributed to lack of enough knowledge about good practices of fish handling by some fish handlers and lack of enough ice, clean water plastic boxes which are easy to wash or clean and poor hygiene.

In reference to the literature review (2.2.4), hygiene and sanitation have and effect on the rate of spoilage and according to my observation, I observed that;

Respondents had no access to clean water, dust bins and pit latrines, the rest disposes off their wastes around the lake shores and around the market. This causes cross contamination by house flies which transfer bacteria from the waste to the fish hence causing spoilage.

Fish sellers and other handlers are unhygienic in such a way that they have long dirty finger nails and dirty clothing. Personal hygiene is aimed at preventing the spread of food poisoning bacteria from the body including the clothes to the fish.

Some people in the market including some fish sellers especially men were smokers. Smoking is against the law while handling or smoking near a place was fish is sold or processed. It involves contact between the hands and the mouth and responsible for spread of *staphylococci aureus*

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

From the findings, it is concluded that fish should be gutted, washed then ices to reduce spoilage, because when fish was washed, gutted and iced, the shelf life was extended, this implies that with the presence of digestive juices, in the stomach, microorganisms on the surface, in the guts and on the gills of the fish were responsible for the quick spoilage in ungutted, unwashed and iced fish.

Gutting and washing of fish was one factor for prolonging shelf life but cooling the fish or icing fish to lower the temperature prolonged its shelf life. This indicates that activities of enzymes in the guts and bacteria on the surface increase with high temperature. Therefore when the temperatures are lowered, the enzymes and bacteria activities are reduced.

When fish was put in ice, ice melt was released immediately reducing graduating in for fish to reach the temperature of $0^{o}C$ and also drawing or removing heat from the fish.

6.2 Recommendations

Fish being perishable food stuff whose spoilage can not be stopped but retarded in order to produce a good quality product. The following recommendations have been made;

In order to prolong the shelf life of fish or retarding spoilage in the market, I recommend that fish should be washed before being iced, this will reduce the microbial load on the surface of the fish and water used for washing should be portable water.

Fish should be stored in ice or iced when well gutted, and then the ice should not be contaminated and should be made from portable water.

Fishermen, fish traders and processors should be taught how to identify hazards. This will also reduce post harvest losses.

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RESEARCH QUESTIONNAIRE: TO THE TARGET GROUPS

Fishermen

1. How often do you wash and clean the fish hold and vessels?

.....

2. What hygienic and medical conditions are fulfilled by the fishermen?

.....

3. What is the average time taken from the fishing grounds to the landing site and then to the market?

.....

4. What is the main source of water for washing fish?

.....

5. What do you do to prevent the catch from spoiling immediately it is caught?

.....

6. How is the fish handled on board?

.....

7. What equipment is used during off loading fish from the boat to the fish shade and to the market?

.....

To the sellers

1. What are the requirements of a proper fish seller?
   .....
2. What types of containers are used in curing fresh fish?
   .....
3. What do you do to ensure that fish is safe?
   .....
4. You deliver fresh fish to the consumers?
   .....
5. Are handling facilities available at the place where you sell the fish from?
   .....

To the fisheries staff

1. What fish handling facilities are in place in your market in relation to quality improvement of fresh fish?

.....

2. What traditional habits do you think affect the quality of fresh fish in the market?

.....

3. What steps have you taken to improve or maintain the quality of fresh fish in the market?

.....

FISHERIES TRAINING INSTITUTE

MINISTRY OF EDUCATION AND SPORTS

DIPLOMA PROJECT THESIS

ON

CATCHABILITY CHARACTERISTICS OF GILLNETS USED FOR COMMRECIAL EXPLIOTATION OF NILE PERCH (*LATES NILOTICUS*) AT MALIJA LANDING SITE ON LAKE VICTORIA, MUKONO DISTRICT.

ENTEBBE-UGANDA

JUNE, 2009

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DISSERTATION SUB MITTED TO THE BOARD OF EXAMINERS OF FISHERIES TRAINING INSTITUTE IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF A NATIONAL DIPLOMA IN FISHERIES MANAGEMENT AND TECHNOLOGIES.

BY CANDIDATE: KIGGUNDU CHARLES

INDEX NO: ID-2350-3209

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DECLARATION

I KIGGUNDU CHARLES, declare that this project is original and has never been produced, presented, published or submitted for any diploma in this or any other institution of higher learning. All the information in this project thesis is based on my findings and observations unless otherwise stated.

Signed..... Date.....

MR. KIGGUNDU CHARLES

Research candidate

I certify the above declaration and recommend the submission of this project thesis to the board of examiners for assessment.

Signed..... Date.....

MR. Ogwang Sam Patrick

Research project supervisor

DEDICATION.

This project thesis has been dedicated to my guardians, Mrs. Bayiga Betty and Mrs. Namukasa Gorrette, my Grand parents, Mrs. Nabitaba Nasitazia and Mrs. Nalubuga Keviina plus my fiancée Nabaweesi Florence for the encouragement they gave me and constant prayers focused on seeing that my education is a success.
May the Almighty God bless them all.

I finally dedicate it to my father, the late Kawuki Francis, "May his soul rest in eternal peace".

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I am finally indebted to Ms. Topaccu Gloriah, the librarian Fisheries Training Institute for the hard work done in providing me with reference books and advising were necessary.

"May the Lord reward them abundantly"

KIGGUNDU CHARLES

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Figure 3: Selectivity curves of gillnets at Malija fish landing site.

ABSTRACT

The research project was based on the topic "Catchability characteristics of Gillnets, used for commercial exploitation of Nile perch (*lates niloticus*) at Malija landing site on Lake Victoria, in Mukono district".

The study objectives were to determine design and construction of gillnets, to establish the technology and techniques used in gillnetting. The methodology employed comprised scheduled visits, questionnaires and personal observation which included sampling as the basic unit.
This methodology yielded results which reflected that this gear was effective and efficient for commercial exploitation of Nile perch.

Results showed that Nile perch is mostly abundant comprising of 98.2% followed by *tilapines* comprising of 1%. Also the gillnets have a high catchability rate and efficiency in the artisanal fisheries at the project area. The selectivity increased with mesh sizes.

The research results are useful in the formulation of management regulations for gillnet fishery to ensure sustainable utilization of the resources to meet the future and present generation.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Until 1970s Lake Victoria maintained a multi species fishery dominated by *Tilapine* and *Haploechromine* cichlids. (source)

Subsidiary fisheries comprised of 28 genera of non-cichlids including cat fishes, *Bagrus docmak*, *Clarias gariepinus*, *Protopterus Aethiopicus* and *Labeo victorious*, **(Green wood, 1974 and Cordane, 1999).**

Stocks of most of these species declined and others disappeared following the introduction of *Oreochromis niloticus, Oreochromis leucosticus, Tilapia rendalii* and *Tilapia zilli* and Nile perch (*Lates niloticus*) during the 1950s, **(Weleomme 1968 and Ogutu, 1990).**

Despite this, the lake fishery maintained the status of the "multi-species fishery" taking in stock *Oreochromis esculents* and *Oreochromis variabilis* as the most important economical fish species, **(Graham, 1929).**

However, since 1950s, the fishery has been dominated by *Lates niloticus* and the native cyprinid species *Rastrineobola argentea.* A decade ago, Lake Victoria fishery of Uganda sector was showing systems of decline in annual yields from 132,000 tonnes in 1989 to 120,000 tonnes in 1991 and 103,000 tonnes in 1994, despite the increase in fishery effort, **(Okaronon, 1994)**.The increase in fishing effort and investment was made without clear knowledge of the magnitude and sustainability of the stocks, **(Odongkara and Okaronon 1992).**

Tilapines, the major economic species were abundant only in the sheltered inshore waters of depth less than 18m and other cichlids and non-cichlids had a wider distribution pattern as opposed to other fish species.

Experimental gillnets had been carried in the inshore waters of Lake Victoria west (Mpigi, Masaka, Rakai and Kalangala) on a monthly basis.

The fish species retained were *Lates niloticus*, *Labeo victorianus*, *Mormyrus kanume*, *Synodontis afrofisheri* and *Oreochromis niloticus,* **(FIRRI Report, 1998).** *Lates niloticus* constituted the bulk (over 90%) by weight of the fish retained and *Mormyrus kannume and labeo victorianus* were encountered in the rocky areas of lake victoria-west.
In both areas, the maximum catch of about 11kg per net/day was recorded in 1998/1999 in 54mm mesh size gillnets having dropped from about 2 kg per net/day 1992/1993 to less than 1kg per net/day in 76mm mesh size gillnets by 1995/1996, **(FIRRI Annual Report,1998).**

1.1.1 Project area: Historical profile of Malija fish landing site.

Establishment

Malija landing site is situated on Lake Victoria, Bwema sub-county in Mukono district and boarders Bwama landing site to the south, Serinya Island to the east, Zilu Island in the west and Kibibi Island in the north, (Ref map 1)

It existed way back in 1920s and was occupied mainly by Baganda and Basoga.It slanted as a fishing ground and a trading outlet to Senyi landing site.

The area is characterized by equatorial climate, and experience wet and dry seasons during the year. The bottom topography is mostly muddy and rocky in isolated places, the depth is generally shallow (5-15m deep). Its beach is sandy and rocky in contain places of the 400m shoreline which is also wide enough to accommodate over 100 canoes landing on it.

1.2 Statement of the problem

The global demand for Nile perch (*Late niloticus*) products has increased. Currently people world wide know the importance of fish consumption. Commercial exploitation of Nile perch with gill nets should be at a level that sustainably leaves stock for the future generation. Hence the research based on catchability characteristics of gill nets which are presumed to be gears with a high catchablity rate.

1.3 Justification

Substantial reports on over fishing of fisheries resources on Lake Victoria using gill nets have been seen.

Further, it's generally claimed that gears catch mature fish when their designs are irrational (small mesh size). Therefore, there is an urgent need to ascertain the correct situation and asses the level of gillnets fishery. This research is specifically designed to address this need.

Appropriate recommendations will be made to rationalize these gears with view to promote the concept of 'responsible fisheries' and achieving sustainable exploitation of the fisheries resources for the benefit of the present and the feature generation.

1.4 Scope of the research

This research study will cover various catchability characteristics which include; length of the gillnets, the mesh size of the gillnet, time of setting of the net in water, twine thickness of each net, number of nets per fleet, floats and sinkers used, ways of setting the net in water and approximate depth of the water were setting is done, it will be carried out within time limit of one month.

1.5 Objectives.

1.5.1 General objective

- To asses the catch ability characteristics of gillnets used for commercial fishery of Nile parch (*Lates niloticus*) at Malija landing site.

1.5.2 Specific Objectives.

- To study different designs and construction of gillnets
- To find out technological process and techniques in the gillnet fishery.
- To find out the impact of gillnets on Nile parch fishery.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Gillnet fishery

Gillnets constitute a major and widely used gear about 80% for capture, **(Oluka, 1997)** in major and minor water bodies. Their webbing is either hand-braided or machine made using nylon mono-filament or multi-filament twines or any other suitable material such as sisal, **(Oluka, 1997).**

They are kept in vertical position in water by using plastic floats or buoyant wood-stems and sinkens (stones wrapped in polythene papers). Preparation of gear for setting is done at convenient hours of the day (morning and evening). Several nets are joined in to a fleet and the size varies according to canoes, seasonality of the catches and other operational conditions. At dusk, a fleet is set in the inshore or off shore waters targeting either pelagic or demersal fish species, **(Oluka, 2000).** Setting process is done by crew of 2-3 men aboard a canoe who simultaneously pay out the flat line and sinker line then the anchor line bad bough line, **(Oluka, 2000).**

Different techniques of setting stationary gillnets vary from place according to technological development and species being exploited. These include top set, mid water set and bottom set. Drift gill netting is commonly practiced on Lake Albert, but rarely on other water bodies, **(Oluka, 1997).**

The catchability of gillnets mainly depend on various factors, such as mesh-size, fishing ground characteristics, fish behaviour towards the gear, fish school size and diversity and fishermen's skills and techniques, **(Oluka, 2001).**

2.1.1 Preview of the current artisanal gillnet fishery design and construction of gillnets.

By design, a gillnet is rectangular panel of a net-webbing, **(Oluka, 2001)** that is suspended vertically like a curtain in the water column. It is rigged with a number of floats attached to the float line (main line) and sinkens seized to the sink line (ground

line) such that the up thrust forces caused by the sinkers maintain the vertical stretch of the net, which is additionally supported by the bough line carrying a marker bough on the water surface and the anchor line carrying the anchor at the water bottom, while stakes support the frame lines along the width (depth) of the net, **(Prado et al, 1991).**

In this form, the gillnet appears set rigid and stiff and does not collapse. Several gillnets can be joined together to make a fleet and set the target either surface, mid-water or bottom swimming fish.

A gillnet can be constructed either by hand braiding or machine-knitting, **(Oguttu, 1994).** In hand braiding, the technical process requires skillful used of a braiding needle which is loaded with appropriate twine foe weaving a panel of netting using a recommended knot for example reef knot and sheet bend (weaves knot).

Usually, the slippage of those knots is overcome by trying double knots and that maintains the knot stability (ability of the knot to retain the original form and resisting, loosening and inversion into another form without twine slip).

Hand-braiding can conveniently be done using a braiding needle and flat or oval wooden braiding gauge of a reasonable length designed to make half a mesh in circumstance. Different gauges are used for different mesh-size. In the braiding process, the net of the required length is braided depth wise while mounted normally on a rope.

Braiding is done by making firm knot with wooden or metal or plastic braiding needle and forms one of the edges and selvedges. The selvedge may be strengthened by doubling several meshes, may be doubled by braiding them twice or by using a needle loaded with double twine and adding the selvedge after a panel of net has been made, **(Oluka, 2001).** Automatically, the selvedge may be made of thicken twine than of the rest of the net. A full mesh is formed every two news, so a piece of netting can be braided for example 26 meshes deep.

A rectangular panel of net is braided by forming a series of loops (usually by elove hitching on a straight rope) and then working back a long the row of loops tying a knot at each loop leaving sufficient slack twine between knots to form the next row of half mesh, thus to make size of 120mm, each loop must be 120mm long, **(Baranov, 1976).**

2.1.2 Operation of the gillnet

(a) Gillnetting principle

The gill netting principle consists in placing a fleet of gillnets in the path of the fish such that any fish which attempts to pass trough the mesh, thrashing its head through the mesh, becomes caught by the gills, **(Holt, 1963).**

(b) Technological process of gillnetting

(i) Pre-setting preparations

Preparations for setting the gill nets are normally undertaken at the landing site at convenient hours of the day (morning and evening).

A fleet of gillnets is prepared for setting by identifying and rectifying damages on the net-webbing and replacing any missing accessories in the rigging.

The fleet is then assembled in the canoe; normally the float line and bough line astern, the sinken line and anchor line a fare and the netting in the middle of the canoe. The canoe sets off to the fishing ground to set the gear.

(ii) Setting a fleet of gillnets

The gear is normally set at dusk on the leeway to avoid he fleet entanglement in the water. The anchor line set by lowering the anchor to the water bottom, then simultaneously paying out the bough line, sinken line and float line. The first maker bough is set, and then the float line and sinken line are uniformly released into the water.

Towards the end of the setting, the last end of the fleet is fixed on the anchor line and bough line, and the fleet that is left to catch fish passively normally overnight.

(iii) Hauling the gear

The gear is normally hauled at dawn by disengaging the anchor line and hauling nets in a fleet one by one while carefully removing the catch from the gillnet. The last net in the fleet is hauled and the marker bough is removed, the gear is eventually packed into the canoe ready for the next setting.

(iv) Disposal of the catch

The catch disposal is done either at the fishing ground to the waiting transport canoe on site, or at the landing site. At the canoe for drying before another fishing operation commence.

2.1.3 Catchability and efficiency

Catchability is the ability of the net to catch fish. This is done with varying degrees of success.

Efficiency is a relationship between the numbers of fish which encounter the net and numbers of fish captured by the gill net expressed as a percentage, **(Oluka).**The following factors determines high catchability of a gill net.

(i) Twine thickness

For high efficiency of the gillnet, it is desirable that the twine of the gillnet be as thin and as soft as possible.

Thinner and soften twines tend to grip fish bodies more firmly than the thicker and rougher twine, and they also tend to be less visible to the fish in the water column.

(ii) Colour of the net

Gillnets are normally used at dusk, dawn and day-time in clear or turbid water caused by floading.When the fish see a set of gill net, and they get scared and try to dodge it or retreat if they are not forcefully driven into that net. In day-time, the visibility of the net

is practically reduced by dyeing the net with appropriate colour (blue, green, yellow, white, khaki among others) which blends or camouflages well with the water so that fish can not see it, **(LVFO,2000).**

2.1.4 Size selectivity of the gillnets

Size-selectivity can be defined as the probability of fish being retained in the fishing gear and mathematically expressed as a function of length of the fish. It is further observed that gillnets are selective fish curtain length ranges of fish captured, **(Baranov, 1914).**

The intensified fishing pressure which led to localized over fishing, especially of indigenous fish spp such as *Oreochromis esculentus* was due to the presence of Nile perch increasing population from 300333000 between 1975 to 1990, **(Graboval and Mannin 1992).** Currently the catch is dominated by Nile perch, rastrieneobola argentae and Nile tilapia.

Fishing gear in use include gill nets, mosquito net, seine, beach seines and others like long lines and hand lines, but gill nets are the most popular for catching Nile perch and tilapia, **(LVFO,2000).**

To maintain catch per unit effort with intensifying fishing effort, fisher men have reduced the mesh size of their nets which leads to over fishing.

It is a characteristic of gills that specific mesh sizes will harvest particular size of fish. On Lake Victoria the control of mesh size remains a priority in Nile perch fishery, **(LVFO, 2000).**

Gillnets have a very high degree of size selectivity which is the ability of a mesh size to catch fish of recommended sizes therefore a gillnet fishery can effectively be regulated, gillnets bearing less than 5 (127mm) mesh-size, catch immature Nile perch and tilapia spp and by-catches such as *Bargrus, Clarias*. Gillnets associated with the use of tycoon disrupts fish ecosystem.

Drift gillnetting destroys aquatic macrophytes and other organisms by entangling.

Monofilament gill inflict pain or body harm to fish on gripping them, **(Oluka, 2001).**

CHAPTER THREE

3.0 METHODOLOGY (METHODS AND MATERIALS)

3.1 Visits

Visits were made to Mukono District Fisheries Office to obtain material, necessary data and information for the project. Malija Fisheries Office was also visited to obtain necessary statistical data and other information about the project. Various libraries for example FIRRI library, Fisheries Training Institute library, were visited to extract the required qualitative information and data for his project.

3.2 Questionnaires

Data was collected by interviewing various respondents for example fishing community and other fisheries stake-holders on the relevant aspects of the research project particularly its historical profile and fishery trends of the gillnet fishery, (Ref. appendix 2).

Wrong ref
Not seen anywhere in this book.

3.3 Physical observations

These were made as per research programme of the fish-landing site; observations on the technological processes of gillnetting were also made at the fishing ground such as colour, some nets were white while others were dyed with several colours like blue, green and yellow.

Twine thickness: Some nets were soft and thin, while others were rough and thick.

Mesh size: Several mesh sizes were observed like 5.5", 6", 7", and 8" as they were using a mesh size gauge, and the impacts included; gillnet of mesh size of less than 5" caught immature fish species and gillnet also inflicted pain or mutilated body harm to the fish.

3.4 The following formulas were used in results analysis

$$\text{Average catchability rate (ACR)} = \frac{\text{Total weight (kg) of fish species caught in gillnet of a particular mesh size}}{\text{Average total sampled number of gill nets per day}}$$

$$\text{Catchability rate (CR)} = \frac{\text{Total number (quantity) of fish caught per day}}{\text{Total number (quality) of gillnets used that day}}$$

$$\text{Average catchability rate of sampled days} = \frac{\text{Overall total weight (kg) of fish species}}{\text{Total number of days sampled}}$$

Proportional abundance

$$\text{P.A} = \frac{\text{Total weight per fish species} \times 100}{\text{Total weight of all fish species}} = \frac{\text{Total weight per fish species} \times 360^{\circ}\text{C}}{\text{Total weight of all fish species}}$$

CHAPTER FOUR

4.0 RESULTS

4.1: Fishery statistical data from project research

Table 1: Project research statistics from Maija fish-landing site

Sampling date:Feb, 2009	*Lates niloticus*		*Tilapines*		*Clarias*		Other spp		Total wt per day	Total no. per day
1ST WEEK	No.	wt (kg)	No.	Wt (kg)	No.	Wt (kg)	No.	Wt(kg)		
13th	220	850	6	18	2	6	0	0	886	232
14th	522	2930	26	78	4	16	0	0	3069	567
15th	100	500	10	30	10	30	0	0	560	120
17th	130	700	12	36	0	0	4	9	745	146
18th	220	8000	12	36	1	3	0	0	8039	233
2ND WEEK										
19th	240	1000	15	45	0	0	5	8	1053	260
20th	200	1600	0	0	1	3	6	10	1613	207
21st	224	1840	0	0	0	0	0	0	1906	246
22nd	260	2840	0	0	0	0	7	11	2895	281
23rd	300	2000	15	30	10	25	8	12	2069	334
3RD WEEK										
24th	320	2900	19	38	13	27	0	0	2977	358
25th	315	3400	4	16	16	31	9	17	3468	347
26th	6003	1500	0	0	7	11	2	10	1544	622
27th	800	1780	1	3	5	8	1	2	1793	807
28th	788	1652	10	25	20	5	7	10	1737	825
Total	10642	33492	130	335	89	165	49	89	5565	34354

No nursery system.

Abundance of commercial fish stock

Figure 1: Proportional abundance of fish stock at Malija fishing ground (data derived from Table 1)

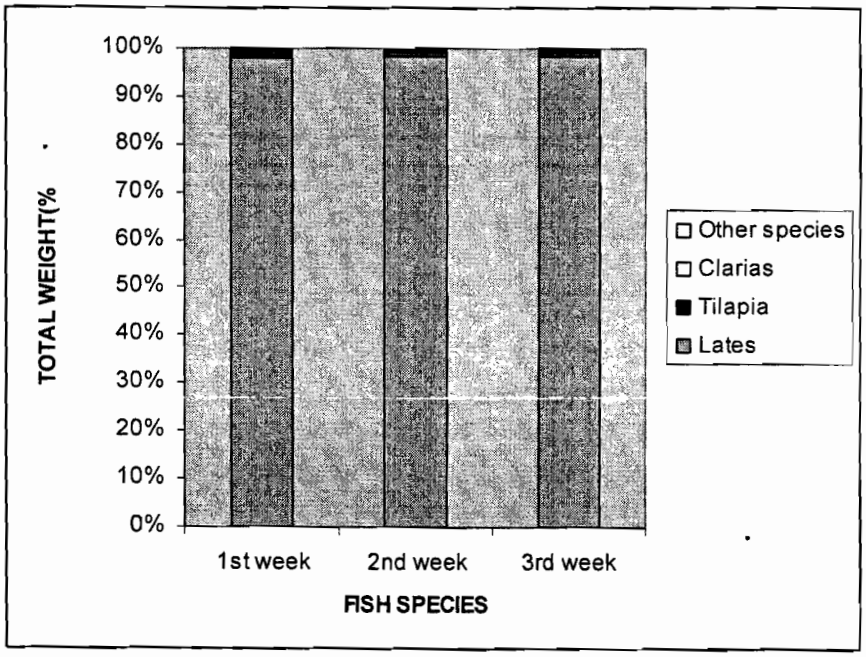
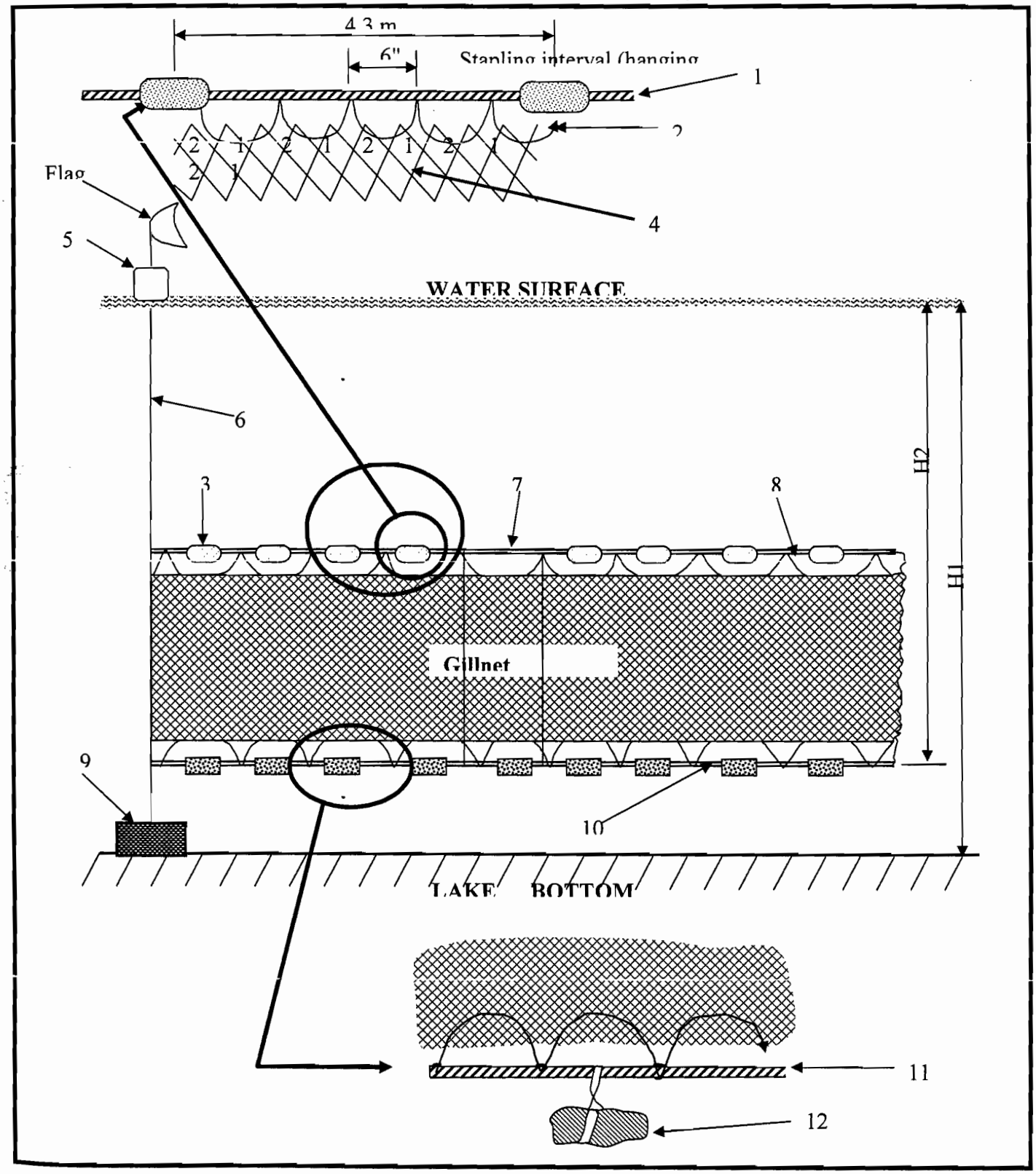


Fig. 2: Design of a demersal gillnet at Malija fishing ground



(Source: Oluka, 2001)

KEY

1. Mounting cord of float line ply 12
2. Stapling twine 210d/6
3. Float
4. "Complete stapling (2 meshes on one staple)
5. Marker buoy
6. Anchor line
7. Guy
8. Float line
9. Anchor
10. Sinker-line
11. Ground cord (210d/24)
12. Sinker (small stone)

Table 3: Data sheet of the gillnet at Malija area

(i) Fishing unit	**Particulars**				
Name of the gear	Gillnet				
Type of the gear	Demersal gillnet				
Country/water today	Uganda/ lake victoria				
Locality: Landing/ground	Malija fish landing site				
Main fish species	*Lates niloticus*				
Fishing ground bottom	Sandy, muddy and rocky				
Fishing depths	15 meters				
Fishing vessel type	Wooden-ssese pointed canoe at one end				
Length over all	29 feets				
Propulsion	Motorised:15 Hp "Yamaha"				
Crew	2 men				
(ii) Net webbing parameter	**Specification**				
Material	Nylon				
Type of knot	Sheet bend				
Preservation	Ordinary				
Twine-size	Ply 4,6,9,12				
Mesh size	5", 6",7", 8"				
Full stretched length	90m				
Depth/meshes deep	26MD				
Colour	White, blue, yellow				
Handling ratio	0.5				
Twist	Z				
Lay	Soft				
Rigging details	**Floats**			**Sinkers**	
Riggings	No.	Material		No.	Material
	8	PVC		10	Stones
Riggings	**Buoy line**			**Anchor line**	
	No.	Material		No.	Material
	2	Jerry can		2	Wooden stakes

Table 4: Fish catch statistical data from Malija fish landing site of different mesh-sizes

Sampling date in Feb,2009	No. of sampling gill nets	Quality of Nile perch caught in gill-mesh size							
		$5^1/_2$"		6"		7"		8"	
		No.	Wt (kg)	No.	Wt (kg)	No.	Wt (kg)	No.	Wt (kg)
3rd	10	40	43	50	54	15	27	10	25
4th	40	40	40	42	47	40	60	20	50
5th	30	30	31	38	50	30	55	28	70
6th	37	37	37	40	48	28	56	40	100
7th	40	40	44	36	52	30	60	54	135
8th	35	35	33	20	28	15	28	44	110
9th	50	50	50	30	45	20	40	40	102
10th	20	20	20	40	55	19	38	20	48
Total	262	292	298	296	379	196	364	256	640
Catchability rate of particular mesh sizes per day			298/ 8= 37.3		379/ 8= 47.4		364/ 8= 45.5		640/ 8= 80

Catchability rate of gillnets by mesh-sizes.

Table 5: Catchability rate of gillnets per mesh-size used for catching Nile perch at Malija fishing ground (Data derived from Table 2).

Average total No. of sampled gillnets per day		Total catchability of gillnet per catch mesh-size			
		$5^1/_2$"	6"	7"	8"
	12	298	379	364	640
Wt (kg) of catches per gill net of a particular mesh-size per day.		24.8	31.6	30.3	53.3

Table 6: Selectivity of gillnet for *Lates niloticus* on sampled dates at Malija fish landing site.

Total length (cm)	$5^1/_2$" Tally	Frequency No.	6" Tally	Frequency No.	7" Tally	Frequency No.	8" Tally	frequency No.
21	//	2						
22	/	1						
23	////	4						
24	///	3						
25			///	3				
26			////	4				
27								
28			//	2				
29					/	1		
30			///	3	////	4		
31							//	2
32					///	3		
33							///	3
34					/	1		
35							////	4
36								
37							/	1

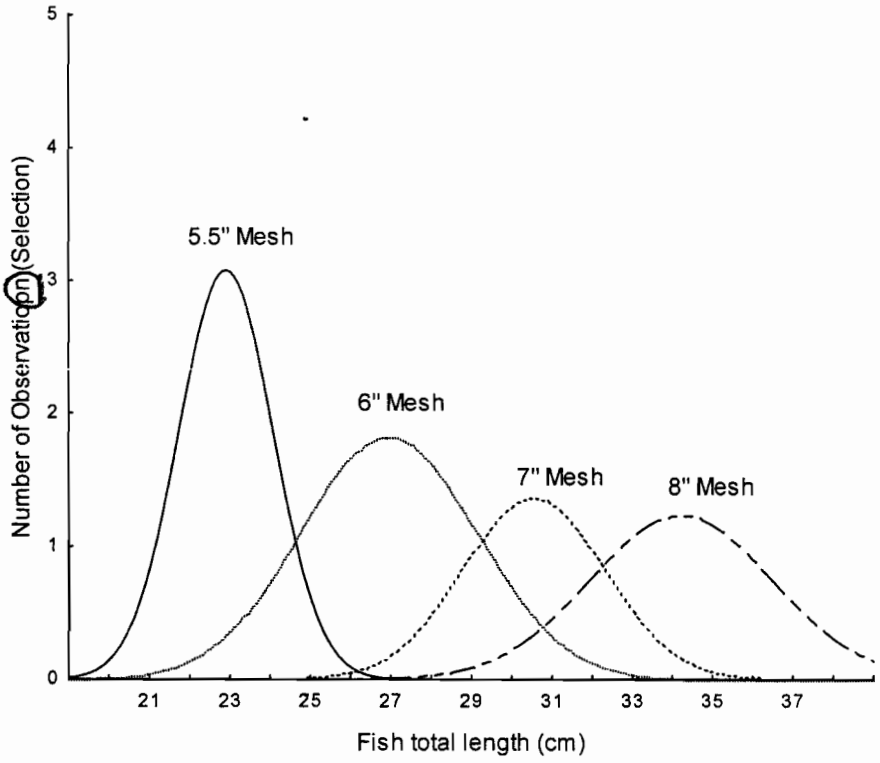


Fig 3: Selectivity Curves of Gillnets used at Malija fish landing site

CHAPTER FIVE

5.0 RESULTS ANALYSIS AND DISCUSSION

5.1 Abundance of commercial fish stock at Malija fishing ground

At Malija fishing ground, Nile perch (*Lates niloticus*) is the most abundance fish species caught and comprised (98.2%) and followed by T*ilapines* (1.%), *Clarias gareipinus* (0.5%) and other species of (0.3%).

This is attributed to the predating behaviour of Nile perch which has preyed over all the native species (that is *Tilapines, Bagrus, Clarias* and others).Thus dominating the waters and therefore being the mostly highly caught fish in the present situation at Malija fishing ground and lake victoria generally.

Also the increasing demand for Nile perch both locally and internationally implies that fishers invest more skills and effort to catch Nile perch in large quantity compared to other species which fetch low prices. Thus their abundance in the catch reflects the financial returns from its fishery. backup.

For commercial catches sampled, the gillnets mesh-sizes of $5^1/_2$" and 6" were dominantly used. The decline in mesh-sizes from 8" to 5" is due to high demand foe similar fish sizes on the local market.

The gillnet mesh-sizes of 8" have a good catchability rate despite a low demand for large fish at the local markets and the increasing reduction in the abundance of mature/ large fish in the lake that can be caught by such nets (8" mesh size).

5.2 Fishing gear

5.2.1 Design and construction

Results from table 3 about design of gillnet shows that nets used are properly designed and are recommendable for gill net fishery. They are made of nylons. Their rigging comprises 8 floats and 10 sinkers for dermersal gillnets among which were sampled, thus

5 gillnet. This is right according to (Prado et al, 1991) who stated that for a vertical sketch of the net to be maintained for dermesal gills in water, upthust force by floats should slightly cover weight the force of the down thrust by sinkers which is observed here by the difference in the number of sinkers used and floated on dermersal gill net at Malija fish ground.

The design of gillnet comprises sheet bend knots to avoid slippage of the knots and to maintain knot stability which contribute to the effectiveness of the nets, **(Oluka, 2001)** asserts on the importance of using double knots during construction of net webbing.

This design has made the catches of the fishermen to increase more especially during the months of April and August and the other rainy months of the year. Also this good design of the nets enables more catches to be obtained during the dark nights of the month and towards the end of the new moon.

Gillnet fishery at Malija fishing ground is still viable for especially the *Lates niloticus*, *Tilapia spp,* and *Clarias*, but more control on the size of gears to be used and fishing methods applied need to be done for sustainable future and current resource exploitation using gillnets.

5.2.2 Selectivity

The results from table 6 on selectivity of gillnet for *Lates niloticus* on sampled dates at Malija landing site show that the $5^1/_2$" gillnet had a spread of selection of 21cmTL fish to 24cmTL fish sampled. The 6" gillnet had a spread of selection of 25cmTL to 30cmTL fish. The 7" gillnet had a spread of selection of 29cmTL to 34cmTL fish and 8" had a spread of selection ranging from 31cmTL to 37cmTl fish. This shows that selectivity of gillnet is a factor of the mesh size of the gillnet and the size of the fish caught.

From the graph on selectivity curves of gills used at Malija landing site, it shows that the 5.5" mesh gillnet has the highest peak followed by the 6" mesh gillnet, then followed by the 7" mesh net and finally the 8" mesh gillnet. The 5.5: mesh gillnet does not have wider

spread selectivity as compared to the other gillnets sampled. This is because the gillnet of mesh size 5.5" allows a small number of fish to pass through it as compared to the 6", 7" and 8" mesh gillnet with bigger meshes which allow an increased number of fish below their mesh sizes to pass through. Thus a wider range to selectivity.

Back up your argument.

5.2.3 Technological process of gillnetting

Result from Malija fishing ground indicates that, for a set gear not to be easily seen by fish, they have to be used during dark nights or at dawn and dusk, also they can be used under certain conditions of turbidity, this is so because fish can easily see a set gill net, for it would dodge it. This is right according to **(LVFO, 2000).**

Gillnets used at day time are normally dyed to reduce the visibility of the net during fishing.

Very rigid gill nets can easily be detected by fish on encountering it, and they tend to avoid the net by either going around it or retreating. Rigging a gill net with many floats and sinkers also impants undue rigidity to the gear making it not sulky enough to receive fish, **(Oluka, 2001)**. Dyed gillnets to achieve the effect of stiffness also tend to become undesirably rigid.

5.2.4 Impact of gillnetting

Results in table 4 on fish statistics indicates that all gill nets, mesh-sizes used at Malija fish ground, only harvest mature fish since mesh-sizes of $5^1/_2$", 6". 7" and 8" nets were used. This implies also that the gill net fishery at Malija is effectively regulated this is in line with the assentation according to **(Oluka, 2001)** that gill nets of mesh sizes of less than 5" (127mm) catches immature Nile perch and other by catches such as bargus, clarias, whose population may be lowered in the catchments ground if there catches tends to increase annually

5.3 Conclusions

According to the results obtained, it was realized that the thinner the twine, the higher the catchability rate of the gill nets and the higher the gill net mesh size, the higher the selectivity characteristics of gill nets.

It was noted that Nile perch fishing is done in inshore waters rather than in off shore waters.

Dyed gillnets (yellow, brown, khaki and white) were most effective in the gill net fishery.

Gillnets are passive gears bearing a simple design and are easily adaptable.

Nylon gillnets of various twine thickness are in common use in project area.

Hanging ratio of 0.5 was in common use.

5.4 Recommendations

Gillnets are highly recommended for use in Lake Victoria chiefly because of their high degree of selectivity. this is none recommd.

Gillnet fishery using 5.5 inches and above lager mesh nets for the exploitation of *Lates niloticus* and *Oreochromis niloticus* on Lake Victoria is recommended. to who ??

Gillnet fishery associated with the use of tycoons should be prohibited because they alters or destroys the fish species and lake ecosystem. who should ensure this ??

Gillnet in off shore waters is recommended, to who but in the inshore waters should be prohibited because this destroys fish breeding grounds and interfere with nursing.

Fishing with monofilament gill nets should be prohibited by who?? for they inflict bodily harm to the fish which may lead to post harvest losses.

For higher gillnet efficiency and catchability, it is recommended to use coloured gill net in the fishery.

The fisheries resources department should also improve on the collection of fisheries statistics so as to produce reliable information and data on fish exploitation levels.

The fisheries resources department should intensify the sensitization programmes for the fishing communities on the dangers of using small mesh-sized gillnets.

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APPENDIX I

QUESTIONAIRE FORMAT.

Format 1: Respondents: Local fishing staff.

Sample questions.

1 (i) Sex of respondent

Male ☐ Female ☐

(ii) Age of respondent

.....

2. Who are the founders of this landing site?

.....

3. When did you start this fishing activity?

.....

4. For how long have you been engaged in this activity/job?

.....

5. How many gill nets do you own?

.....

6. Of what mesh sizes are the nets that you operate?

(a) $1^1/2$ ☐ (b) 2 ☐

(c) $2^2/2$ ☐ (d) 4 ☐

(e) Others, specify.....

7. What fish species are normally caught?

(a) Tilapia ☐

(b) Nile perch ☐

(c) Others, specify.....

8. What factors influence the catch ability of fish by gill netting?

(a) Gill net colour? ☐

(b) Mesh size? ☐

(c) Geographical location? ☐

(d) Others, specify.....

9. How are gill nets operated?

(a) Stationary ☐

(b) Active ☐

(c) Others, specify.....

10. What is the comparative catch ability of gill nets to other fish methods?
    (a) Same ☐ (b) Higher ☐
    (c) Low ☐ (d) Moderate ☐

11. At what time do you realize high catch rates?
    (a) Morning ☐ (b) Evening ☐
    (c) Night ☐ (e) others, specify.....

12. What factors influence the cause for gill net to be used?

    (a) Fishing in deep water ☐
    (b) Artisanal fishery ☐
    (c) Mesh depth ☐
    (d) Others, specify.....

Format 2: Local opinion from leaders and administrators.

1. Sex

Male ☐ Female ☐

2. In which year was this landing site established?
.....

3. How many fishermen are engaged in fishing here?
.....

4. Gill nets of what mesh sizes do you use here?
(a) $2^1/2$ inches ☐ (b) $1^1/2$ inches ☐
(c) 2 inches ☐ (d) 4 inches ☐

(e) Others, specify.....

5. What fish species are commonly landed here?
(a) Tilapia ☐ (b) Nile perch ☐

(c) Others, specify.....

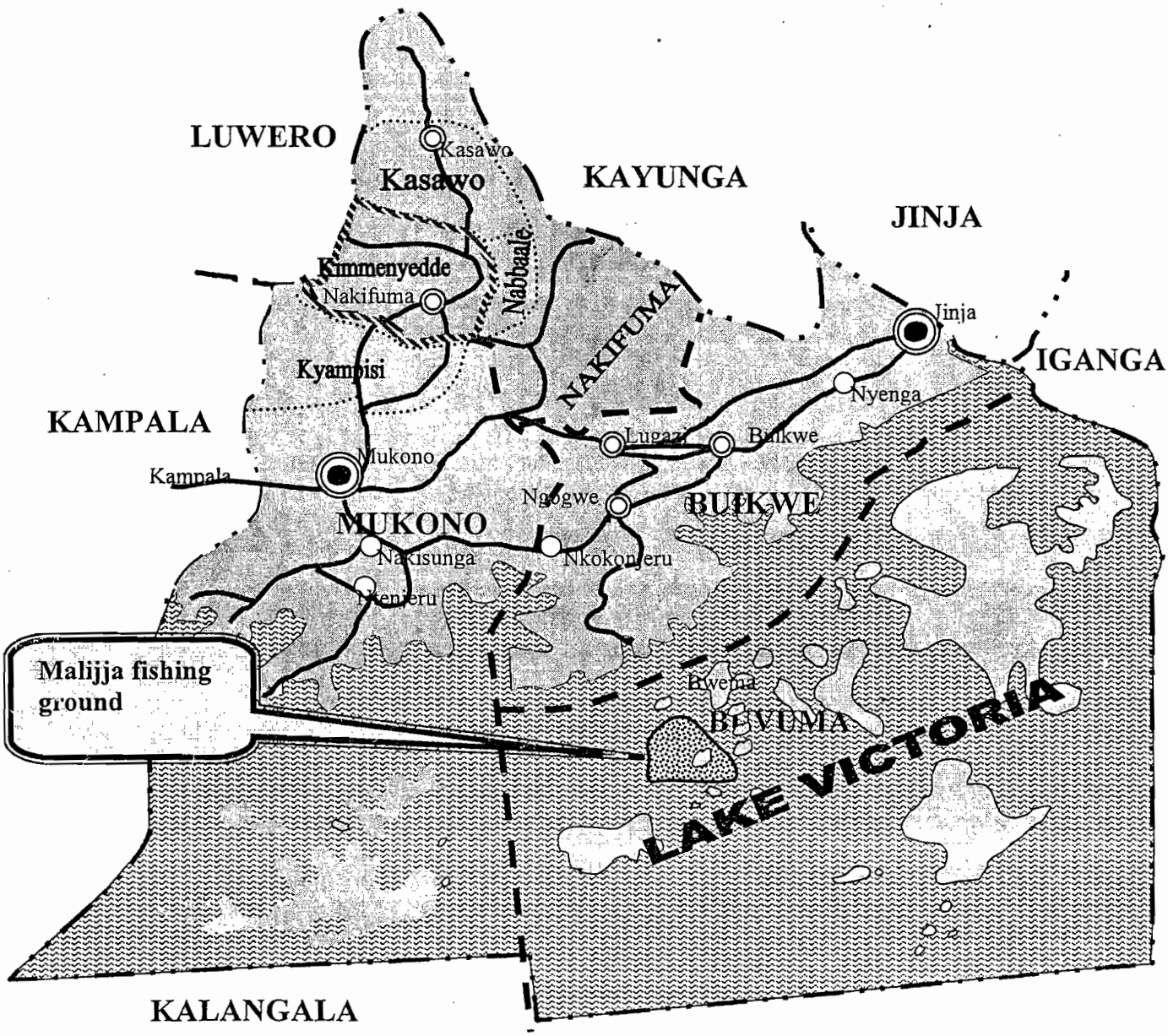
6. What factors influence the catch ability of fish by gill netting?

(a) Gill net colour? ☐
(b) Mesh size? ☐
(c) Geographical location? ☐
(d) Others, specify.....

7. What is the comparative catch ability of gill nets to other fish methods?
(a) Same ☐ (b) Higher ☐
(c) Low ☐ (d) Moderate ☐

8. At what time do you realize high catch rates?
(a) Morning ☐ (b) Evening ☐
(c) Night ☐ others, specify ☐

MAP SHOWING LOCATION OF MALIJJA FISHING GROUND IN BWEMA SUB-COUNTY-MUKONO DISTRICT



Key:

Mukono District Boarders

County boarders

Sub-county boarders