EFFECTS OF COMPLIANCE WITH FOOD SAFETY STANDARDS ON COSTS, BENEFITS AND ORGANIZATION OF NILE PERCH EXPORT SUPPLY CHAIN IN TANZANIA

BY

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ABSTRACT

Trading in high-value agro-food and fishery products like Nile perch represents one of the main possibilities for reducing poverty in Tanzania. Nile perch earner foreign exchange and provides employment to communities around Lake Victoria. However, Tanzania has experienced challenges in maintaining and expanding her share of global markets given stringent food-safety requirements in the European Union (EU). Following the three EU Nile perch export bans in the 1990s, several efforts have been made to conform to EU food safety standards in the Nile perch supply chain. This study it analysed levels of conformity to standards, costs and benefits associated with compliance with food safety standards at various stages along the chain; and their effects on the organization of Nile perch supply chain. Secondary data were obtained from different sources including the Fisheries Department of the Ministry of Livestock Development and Fisheries and fish processing plants. Primary data were collected from 239 Nile perch chain actors including processors, traders, boat owners and fishers. The data were analysed using accounting method and categorical logit regression model. Despite inadequate finance and human capacity constraints, the Nile perch industry conformed successfully to HACCP, ISO 9000, ISO 22000 and BRC standards to access to EU market. Compliance was found to be higher at processing stage of the chain than fishing stage. It was associated with high costs depending on the existing quality standards, availability of required equipment, understanding of compliance requirements and common practices in the industry. The benefits associated with compliance accruing to the different actors in the chain and nation exports were higher than the associated costs. Several changes occurred in the organization and governance of the Nile perch supply chain since late 1990s when compliance with food safety standards started. However, these changes could not only be attributed to compliance with the standards. Decline in fish stock also contributed to the observed changes. Notable changes were greater investments, increased fishing efforts and contractual agreements emergence between actors in the supply chain. Results of the logit model suggested that business location, scale of investments, negotiation power and extent of integration along the chain were main factors influencing changes in the Nile perch vertical structure. The government needs proactively to sustain compliance with standards and fishery resources by strengthening Beach Management Units (BMUs), regulations enforcement, food safety standards training and improving actors' access to financial services.

DECLARATION

I, Zena Theopist Mpenda, hereby declare to the Senate of Sokoine University of Agriculture that this thesis is my own original work and has not been submitted for a higher degree award in any other University.

Signature ______________________________ Date _______________________

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This declaration is confirmed.

Signature ______________________________ Date _______________________

Professor Ntengua Mdoe

Supervisor

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DEDICATION

I dedicate this work to my beloved parents, Shamsa Mohamed and Theopist Mpenda whose blessings and patience have been the perennial source of my strength and inspiration.

TABLE OF CONTENTS

ABSTRACT ii

DECLARATION iv

COPYRIGHT v

ACKNOWLEDGEMENT vi

DEDICATION viii

TABLE OF CONTENTS ix

LIST OF TABLES xvi

LIST OF FIGURES xx

LIST OF PLATES xxi

LIST OF ANNEXES xxii

ACRONYMS AND ABBREVIATIONS xxiii

CHAPTER ONE 1

INTRODUCTION 1

1.1 Background 1

1.2 Problem Statement and Justification 5

1.3 Study Objectives 9

1.3.1 General Objective 9

1.3.2 Specific Objectives 9

1.3.3 Hypotheses 10

1.4 Organization of the Study 10

CHAPTER TWO 12

LITERATURE REVIEW 12

2.1 Overview 12

2.2 Evolution of Food Safety Standards 13

2.3 Nile Perch Exports and Food Safety Standards 20

2.4 Food Safety Standards and Methods Applied in Fish 23

2.4.1 Standards applied in fish 23

2.4.2 Food safety methods applied in fish 28

2.4.3 Approaches to food safety 35

2.5 Food Safety Compliance Costs and Benefits 38

2.5.1 Compliance costs 38

2.5.2 Benefits of standards compliance 43

2.6 Theoretical Framework and Empirical Methods 44

2.6.1 Theoretical framework 44

2.6.2 Transaction costs and governance structure 45

2.6.3 Supply chain concept 47

2.6.4 Review of empirical methods 50

2.6.4.1 Methods for assessing choice of governance structure 50

2.6.4.2 Methods for quantifying compliance costs and benefits 51

CHAPTER THREE 55

METHODOLOGY 55

3.1 Overview 55

3.2 Conceptual Framework 55

3.3 The Study Area 60
3.4 The Research Approach 61
3.5 Sampling Procedure 62
3.5.1 Selection of fishers 63
3.5.2 Selection of boat owners 64
3.5.3 Selection of traders 65
3.5.4 Selection of processors 65
3.6 Data Collection 65
3.6.1 Secondary data 65
3.6.2 Primary data 66
3.6.2.1 Phase I: Preliminary survey 66
3.6.2.2 Phase II: Questionnaire survey 68
3.6.2.3 Phase III: Visits to fisheries office and laboratory agencies 68
3.6.2.4 Phase IV: Follow-up survey 69
3.7 Data Processing 69
3.7.1 Computation of relevant variables 70
3.8 Data Analysis 73
3.8.1 Level of compliance with food safety standards in Lake Victoria 73
3.8.2 Influence of food safety standards on governance structure 73
3.8.2.1 Model setting 73
3.8.2.2 Empirical model for assessing change in governance structure 75
3.8.2.3 Variables for the fishing contractual model 77

3.8.2.4 Variables for trading contractual model 80

3.8.3 Assessment of compliance costs and benefits 82

3.8.3.1 Compliance costs 82

3.8.3.2 Benefits of compliance with standard 87

3.8.4 Limitations of the study 88

CHAPTER FOUR 90

RESULTS AND DISCUSSION 90

4.1 Overview 90

4.2 The Nile Perch Supply Chain 91

4.3 Key Actors in the Nile Perch Supply Chain 95

4.3.1 Fishers (Wajeshi) 95

4.3.2 Boat owners (Matajiri) 101

4.3.2.1 Assets owned by Nile perch and dagaa boat owners 101

4.3.2.2 Capital investment levels for Nile perch and dagaa boat owners 104

4.3.2.3 Capital investment amongst categories of Nile perch boat owners 106

4.3.3 Traders (*Ajenti*) 108

4.3.3.1 Demographic characteristics and experience in fishing business 111

4.3.3.2 Markets served and products sold 113

4.3.3.3 Assets owned 114

4.3.4 Processors 118

4.3.4.1 Nile perch processing plants requirements 118

4.3.4.2 Infrastructure requirements 120

4.4 Extent of Compliance with Food Safety Standards in Nile Perch Industry 121
4.4.1 Government or fisheries department 122
4.4.2 Quality requirements and methods of quality assurance at fishing stage 132
4.4.3 Quality requirements and methods of quality assurance at trading level 135
4.4.4 Food safety standards and their implementation at the processing level 136
4.5 Costs and Benefits of Compliance at Different Stages in the NP Supply Chain 146
4.5.1 Costs and benefits for boat owners 146
3.5.1.1 Investment cost 146
4.5.1.2 Boat owners' recurrent costs 151
4.5.1.3 Transaction Costs to Boat Owners 162
4.5.1.4 Benefits of compliance with standards for boat owners 168
4.5.2 Cost and benefit of compliance to standards for Nile perch traders 170
4.5.2.1 Investment costs for traders 170
4.5.2.2 Recurrent costs for traders 172
4.5.2.3 Transaction costs to traders 175
4.5.2.3 Compliance benefits for traders 176
4.5.3 Standards compliance costs and benefits for processors 178
4.5.3.1 Investment costs to processors 178
4.5.3.2 Recurrent costs for processors 191
4.5.3.3 Compliance benefits for processors 198

4.6 Effects of Compliance with Food Safety Standards on Organization of the Nile Perch Export Supply Chain 201

4.6.1 Fishing contractual agreements 204

4.6.2 Fish trading contractual agreements 215

4.7 Results of Multinomial Logit Analysis 225

4.7.1 Estimation results for fishing contractual model 225

4.6.3 Estimated results for the trading contractual model 231

CHAPTER FIVE 235

CONCLUSION AND RECOMMENDATIONS 235

5.1 Conclusions 236

5.1.1 Implementation of food safety standards and level of compliance 236

5.1.2 Costs and benefits associated with compliance to food safety standards 236

5.1.3 Effects of compliance to food Safety standards on organization and governance of the Nile perch supply chain 237

5.2 Recommendations 237

5.2.1 Enforcement of food safety standards 237

5.2.2 Improving access to financial services 238

5.2.3 Training 239

5.2.4 Involvement of developing countries in setting standards 239

5.2.5 Ensuring sustainability of fishing 240

REFERENCE 241

ANNEXES 260

LIST OF TABLES

Table 1: Examples of microbiological hazards in fish and fish products 24

Table 2: Microbiological tests required in fish in Tanzania and Kenya 25

Table 3: Maximum residual limits (MRL) for heavy metals 28

Table 4: Description of HACCP costs variables 41

Table 5: Secondary data collected and their sources 66

Table 6: Fishing contracts' variables for Multinomial Logit model 81

Table 7: Trading contracts' variables for Multinomial Logit model 83

Table 8: Places of origin for Nile perch and dagaa fishers 95

Table 9: Comparison of features between Nile perch and dagaa fishers 96

Table 10: Fishers movement status in the landing sites or fishing camps 99

Table 11: Mean comparison for investment between Nile perch and dagaa........... 104

Table 12: Total investments on boat and engine in Nile perch fishing................... 106

Table 13: Comparison on the amount of capital investment among NP boat owners 107

Table 14: Number of engines operated in Nile perch fishing 107

Table 15: Mean comparison: No: of boats and engines owned in Nile perch fishing 108

Table 16: Mean comparisons on age, time and duration in fishing business.......... 112

Table 17: Distribution of fish traders by tribe 113

Table 18: Processing plants established in Lake Victoria and their current status.. 119

Table 19: Percentage of royalty charges on FOB fillet consignment value in 2007 121

Table 20: Tanzanian national critical limits for microbiological hazards in fish 125

Table 21: Proportion of boat owners adhering to CA quality assurance requirement by size of fishing business 133

Table 22: Alternative fish handling methods used by Nile perch boat owners 134

Table 23: Quality requirements and adherence by fish traders in Nile perch 136

Table 24: Plants structural change to achieve compliance to food safety standards 141

Table 25: Plants capacity before and after re-construction 143

Table 26: Training provided to plants personnel 144

Table 27: Cost of fishing assets owned by Nile perch and Dagaa fish boat owners 147

Table 28: Mean comparison: assets owned by Nile perch and dagaa boat owners . 149

Table 29: Share of the cost of total assets owned to total investment 150

Table 30: Annual and daily traditional cost items in Nile perch and dagaa fishing 153

Table 31: Quality recurrent cost items in Nile perch and dagaa fish fishing 158

Table 32: Assumption used in estimation of recurrent cost between Nile perch and Dagaa boat owners 161

Table 33: Comparison of average annual recurrent cost between Nile perch and dagaa boat owners 165

Table 34: Mean comparison: fish volume, unit cost, selling price and annual net revenues between Nile perch and dagaa boat owners 170
Table 35: Assets owned by Nile perch fish traders and their costs at current price 171
Table 36: Comparison of traders recurrent cost before and after compliance 173
Table 37: Comparison of Nile perch and dagaa traders' net prices and gross margins 177
Table 38: Summary of total investment cost for fish processors before and after food safety standards (TZS)... 179
Table 39: Fish processing plants rehabilitation cost in TZSS as at 2007................ 184
Table 40: HACCP implementation costs incurred by processors and FD (TZS).... 186
Table 41: Process and certification cost to processors... 188
Table 42: Laboratory equipment purchased by processing plants and their cost 190
Table 44: Processors additional recurrent costs as a result of compliance- 2007 ... 191
Table 45: HACCP manual and audit costs: Processors and Fisheries Department . 192
Table 46: Costs for laboratory testing for microbiological and chemical hazards .. 196
Table 47: Plants' quality monitoring agent and frequency 197
Table 48: Boat owners' purpose: Comparison between Nile perch and dagaa fish 205
Table 49: Comparison of agreement purposes between landing sites location....... 206
Table 50: Main type of fishing contractual agreements in Lake Victoria............... 207
Table 51: Summary of main features of the identified fishing contractual agreements in Lake Victoria 218
Table 52: Traders' purpose for engaging in trading contracts 219

Table 53: Types of trading contractual arrangements in Nile perch business.........220

Table 54: Loan Actual repayment time against agreed repayment period.............222

Table 55: Distribution of Nile perch boat owners by type of fishing contract........226

Table 56: Variable descriptive and prior assumptions on choice of fishing contracts..227

Table 57: Multinomial logit model for fishing contractual agreements 228

Table 58: Multinomial logit model marginal effects for fishing contracts 229

Table 59: Analysis of Variance test on unit fishing cost amongst Nile perch boat owners..230

Table 60: Distribution of NP traders by type of trading contractual agreement 231

Table 61: Variables descriptive and prior assumption on choice of trading contracts..232

Table 62: Multinomial logit model for choices in trading contracts 233

Table 63: Marginal effects on choice of trading contract in Nile perch 233

LIST OF FIGURES

Figure 1: Value of Nile perch exports to the EU by the Riparian States (000'€) 3

Figure 2: Conceptual framework for the study 58

Figure 3: Nile perch supply chain before implementation of food safety standards 91

Figure 4: The evolved Nile perch export supply chain in Tanzania 93

Figure 5: Comparison of unit cost by size of business amongst NP boat owners 161

Figure 6: Trend in NP fish catch (tons) and real price (TZS) in Mwanza 1996-2007 169

Figure 7: Preparation costs "before and after" compliance with standards 180

Figure 8: Trend on NP export volumes (Tons) and values US$ ('000) by processing plant..199

Figure 9: Nile perch export volumes (tons) and value ('000 US$) from 1998 to 2002 200

Figure 10: Trend on NP export volumes (Tons) and values in US$ ('000), 1996-2007 201

Figure 11: Changes in fishing efforts in lake Victoria in Tanzania- 1998 to 2006...202

LIST OF PLATES

Plate 1: Fishing boats with an outboard engine parked at landing site 102

Plate 2: Fish collection boat docking at Bulongelo Landing site, Geita District 103

Plate 3: Insulated trucks with label on its body saying fish only (samaki tu) 116

Plate 4: Floating bay at Mchangani BMU improved landing site in Geita District 117

Plate 5: New building of the NFQCL and its accreditation certificate 129

Plate 6: Biological safety cabin that was procured by NFQCL in 2007 131

LIST OF ANNEXES

Annex 1: EU-SPS approval and/or certification requirements 260

Annex 2: Compliance cost centres identified using SSOP 262

Annex 3: Checklist for institutions dealing with food safety standards 264

Annex 4: Checklist on compliance knowledge to actors in Nile perch fishing 266

Annex 5: Structured questionnaire for fishers, boat owners and traders 267

Annex 6: Structured questionnaire for industrial processors 286

Annex 7: A summary of processors HACCP approval procedure 294

ACRONYMS AND ABBREVIATIONS

BMU	Beach Management Unit
BRC	British Retailers Consortium
CA	Competent Authority
CoA	Contractual Agreements
Cuf/g	Colon Forming Unit/ gram
DFC	Danida Fellowship Centre
DFI	District Fisheries Inspectors
DIIS	Danish Institute for International Studies
DRC	Democratic Republic of Congo
EC	European Commission
ER	Equal Revenue share
ET	Equal distribution of fishing days or turnover
EU	European Union
Euro-GAP	European Good Agricultural Practices
FAO	United Nations Food and Agricultural Organization
FD	Fisheries Department
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
GPCL	Government Principal Chemist Laboratory

HACCP	Hazard Analysis Critical Control Point
HP	Horse Power
ISO	International Organization for Standards
LOD	Limit of Determination
LDC	Less Developed Countries
LVEMP	Lake Victoria Environment Management Program
LVFO	Lake Victoria Fisheries Office
MAFS	Ministry of Agriculture and Food Security
MEC	Management Executive Committee
MIT	Ministry of Industry and Trade
MLDF	Ministry of Livestock Development and Fisheries
MoH	Ministry of Health and Social Welfare
Mpn/g	Most Probably Number/gram
MRL	Maximum Residue Limits
NFQCL	Nyegezi Fisheries Quality Control Laboratory
NP	Nile Perch
NTP	National Trade Policy
OECD	Organization for Economic Cooperation Development
P,A/25g	Presence, Absence/25 gram
PCB	Poly-Chlorinated Binpheyls
PHA	Polycyclic Aromatic Hydrocarbons

RASFF	Rapid Alert System for Food and Feed
RIA	Risk Assessment Measure
SAFE	Standard Agri-Food Export
SABS	South Africa Bureau of Standards
SGS	Société Générale de Surveillance (Verification, testing and certification)
SME	Small and Micro Enterprises
SPS	Sanitary and Phyto-Sanitary
SPSS	Statistical Package for Social Sciences
SSOP	Sanitation Standard Operational Procedures
TAFIRI	Tanzania Fisheries Research Institute
TAFU	Tanzania Fishermen Union
TBS	Tanzania Bureau of Standards
TBT	Technical Barriers to Trade Agreements
TCP	Traceability Control Point
TFDA	Tanzania Food and Drug Authority
TIFPA	Tanzania Industrial Fish Processors Association
TIRDO	Tanzania Industrial Research Development Organization
TZS	Tanzanian Shillings
UNCTAD	United Nation Conference on Trade and Development

URT	United Republic of Tanzania
UT	Unequal distribution of fishing days or turnovers
WHO	United Nations World Health Organization
WTO	United Nations World Trade Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Over the past two decades, the share of traditional tropical products in developing countries' exports has been declining, while that of non-traditional products has increased. This shift presents new possibilities for developing countries to increase export revenues from non-traditional food trade including fish. As pointed out by Henson and Mitullah (2004), exports of fish and fishery products are widely seen as a developing country success story and a welcome contrast to the cyclical decline in markets for many traditional commodities. Over the last decade, developing country exports of fish and fishery products have increased at an average rate of 6 percent per annum. The share of fish in its contribution to foreign currency in developing countries has been increasing making it an important earner of foreign exchange. Comparing data of 1983, 1989 and 2003, net exports from developing countries reached 18.3 billion US$ in 2003, which compares positively to commodities such as coffee, cocoa, rubber, etc. (Josupeit, 2005).

In Tanzania, fish exports largely comprise of fresh water fish known as Nile perch (*Lates niloticus*[1]) from Lake Victoria. Nile perch exports from Tanzania and the other

[1] Nile Perch (Lates niloticus) is a freshwater fish belonging to the family Centropomidae. Nile perch was deliberately introduced in Lake Victoria more than 50 years ago. Nile Perch grows really large and is it not uncommon for a mature Nile Perch to be over 195 cm long and weigh over 200 kg. They need warm waters to grow this big. The juveniles are found in shallow waters, usually close to the shore. The Nile Perch is commonly found in high densities and feed on fish, insects and larger crustaceans. The young Nile Perch fry eat plankton. The Nile Perch becomes sexually mature when it is around 3 years of age, and it can live for up to 16 years. Nile Perch spawn most of the year and a female Nile Perch can produce up to

two riparian States have generally shown an increasing trend (Fig. 1). In 2008, the Nile perch exports amounted to US$ 153 million which was equivalent to 1.1% of the Gross Domestic Product (GDP) (*Hali ya Uchumi*, 2009). In the same period, the Nile perch industry provided direct employment to about 80 000 fishermen. Over the past decade, the fishing industry in Lake Victoria had increased employment opportunities to the people around the Lake. For example, licensing of fishing boats which are normally manned by 3-4 people (depending on power source) had increased to about 1760 boats per annum (Fisheries Frame Survey Report, 2004). This translated into about 7040 new employees annually. In Mwanza region, the processing plants employed 2825 people in the seven plants during 2006 with 1195 on fulltime basis. The industry also supported fish-mongers and livelihoods[2] of other people around Lake Victoria (Musonda and Mbowe, 2001; Abila, 2005; LVFO, 2006).

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16 million eggs at a time. The female Nile Perch commence spawning when she has grown to 50-80 centimetres. When the female has deposited the eggs and they have been fertilized by the male, the eggs are left alone. The Nile Perch do not guard eggs or raise fry

[2] A recent report by Mwanza Regional fisheries Officer, Mr. Angelous Mahatane, estimates that, by February 2009, daily cash flow amongst Nile perch fish stakeholders was 600 million and about 119 000 families livelihoods depend on lake Victoria (Star TV broadcasting on 25 August 2009)

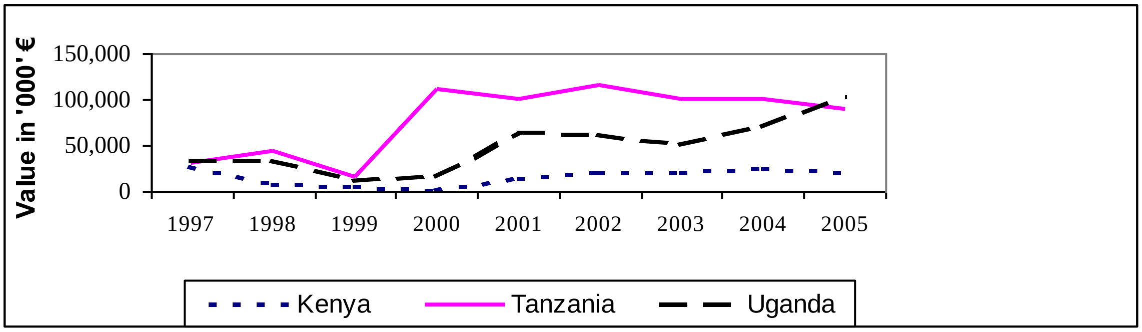

Figure 1: Value of Nile perch exports to the EU by the Riparian States (000'€)
Source: Eurofish (2006).

Over the past two decades however, the Nile perch industry which emerged as an important contributor to national economy has been experienced challenges in seeking to maintain and expand its share of fish export markets. One of the major challenges facing Tanzania in seeking to maintain and expand its share of fish export markets is stricter food safety standards imposed by Northern countries. Compliance with food safety standards has become mandatory to any agro-food exporter targeting high value international markets following the recent increased awareness of potential health risks associated with food consumption. These standards are perceived as a barrier to the continued success of developing countries' exports of high-value agro-food products including fish either because these countries lack the technical and administrative capacities needed for compliance or because these standards can be applied in a discriminatory or protectionist manner.

Nevertheless, as a result of the imposition of restrictions on exports to the EU and the Tanzania's desire to maintain and expand Nile Perch export share, significant efforts have to be made to upgrade hygiene and other food safety controls along the Nile Perch supply chain in Lake Victoria. Previous studies suggest that exporters in a number of developing countries have experienced problems complying with these requirements (see for example Henson *et al.*, 2000; Rahman, 2001; Musonda and Mbowe, 2001; Zaramba, 2002). Failure to comply may be due to high compliance costs, given the already high production costs. Compliance costs are high because actors in the supply chain are compelled to adopt necessary structural and technological changes. Though the cost is high, the economic cost of the lack of compliance is enormous. Intermittent import bans by EU in 1997, 1998 and 1999 were a shock to the Nile perch exporting countries, Kenya, Tanzania and Uganda. Given the high cost of the bans to the economies of the three riparian States, the governments and industry were compelled to act swiftly to rectify the anomalies as they happened.

This study seeks to determine the level of compliance to the food safety standards in Nile perch export supply chain, the costs and benefits associated with compliance to the standards as well as the effects of compliance on structure and governance of the Nile perch supply chain in Tanzania.

1.2 Problem Statement and Justification

The need for developing countries to earn more foreign currency through exports has always compelled them to diversify their exports away from traditional crops to fresh and processed food which have lucrative markets such as the EU. In early 1990's, Tanzania, Kenya and Uganda saw the opportunity of benefiting from Nile perch following increased demand and better prices being offered in the EU market. The three countries also referred to as Riparian States took the opportunity and exported smoothly into the market before the three intermittent EU import bans in 1997, 1998 and 1999 (Abila, 2005; Thorpe and Bennett, 2004; Henson and Mitulla, 2004; Waniala, 2002). The bans were in reference to failed compliance with the EU food safety standards following high bacterial (salmonella) contamination, cholera outbreak in East Africa and pesticide contamination in Ugandan side of the lake respectively.

The intermittent import bans on Nile perch exports by EU therefore exacerbated pressure for more policy reforms and processing plants' restructuring in order to attain compliance with food safety standards. As a consequence, observance of HACCP and EU regulations on food safety and hygiene[3] for fish and fishery products was made mandatory (Henson and Mitulla, 2004). Implementation of this was however

[3] The main features on EU fishery specific regulations on food safety and hygiene include (a) third countries need to have health and sanitary regulations that are at least equivalent to the ones required within the EU; (b) they need to have competent authorities that can guarantee effective implementation of the relevant regulations through inspection, monitoring and sanctioning systems; (c) business operators need to apply specific sanitary and health practices in catching, handling, processing and packaging fish and fishery products, and a system of risk management based on HACCP. These features are found in the regulations EC 178/2002, *EC* 852/2004, *EC* 853/2004, *EC* 854/2004, *EC* 882/2004, EC 91/493, EU 466/2001, EU 2065/2001

constrained by Nile perch chain actors' different ability and capacity to understand terminologies used in food safety standards and to finance required technologies, machinery and equipment. Ultimately, this led to emergence of various chain governance structures such as contracts, joint ventures and strategic alliances. The chain actors had thus to reposition accordingly to fit in the new settings or else risk exclusion from the chain.

Compliance is important as it provides opportunity for developing countries to access international agro-food markets. This access is highly competitive as it is driven by consumers whose concerns are increasingly shifting from general food quality to more stringent food safety attributes (Henson, *et al.*, 2000). However, compliance has been a great challenge to developing countries following inadequate human skills, managerial and technological infrastructure associated with food safety standards. The solution opted by developing exporting countries was to adopt the international food safety standards and incur the necessary costs to acquire the required skills and technology with expectation of receiving high returns from the markets through premium prices. Costs that have been discussed (Unnevehr, 2000; Cato, 1998; Antle, 1998a, b) include, construction costs (plant production layout is required to meet HACCP requirements), managerial skills (need to have managerial team that can design and operationalise HACCP manuals), installation of modern machinery and equipments, and technical skills (personnel who can conduct laboratory testing as per international standards) and laboratory accreditation. Unnevehr (2000) contends that compliance costs can be reduced through quality control at each node of the food chains rather than conducting border inspections. This means improving human skills and infrastructure at each stage in the supply chain. As the compliance challenges are different at each stage in the chain, so are the costs and benefits. Initial level of safety-related investments before implementation of market-specific food safety standards and size of business may also determine the level of costs and benefits of compliance.

Most studies have conducted quantification of compliance costs and benefit on specific food industries such as meat, poultry and sea food in US, Europe and Asia (Antle, 1998a, b, 2000; Jensen and Unneverh, 1999; Goodwin and Shiptsova, 2002; Cato and Santos, 2000; Rahman, 2001). Few studies related to costs and benefits of compliance with food safety standards have been conducted in Africa. These include Bans, tests and alchemy. Food safety standards and the Ugandan fish export industry by Ponte (2005), Kenyan fish exports to European market by Henson and Mitullah (2004), impact of implementing SPS and TBT (Technical Barriers to Trade) agreements in fish exports from Tanzania by Musonda and Mbowe (2001), impact of SPS measures on fish exports in Uganda and Zambian vegetable exports into EU by Freidberg (2004). The study on Uganda fish exports analysed exporting countries compliance efforts under contradictory objectives between compliance and business. The fish export study in Kenya assessed the impact of compliance with safety standards on the structure of the Nile perch market. The studies on impact of the standards on Tanzanian and Ugandan fish exports to EU focused on effects of EU import bans to their respective national economies. Contrary to the above studies in Africa, the present study does not only quantify compliance costs but also assesses the transaction costs involved in standards compliance in the Tanzanian Nile perch industry. It further assesses the compliance benefits for individual actors at various stages in the export supply chain. A study by Kadigi *et al.*, (2007) analysed compliance costs and benefits at the upstream end of the chain which does not involve processing or any industrial activities. Hence it is important to assess the compliance costs and benefits at all stages of the chain so as to provide insights on how these costs affect all upstream and downstream actors in the supply chain.

This study therefore seeks to determine compliance level in Nile perch export supply chain, the magnitude of compliance costs and benefits for every actor category along the chain as well as the effects of compliance on structure and governance of the supply chain. The study provides important cost information to private and public agencies for economic analysis of safety regulation which can assist them to analyze their costs to/and returns from their decisions to integrate safety standards measures in their activities. In addition, the study provides informed insights on the changes in the structure of the chain as affected by food safety requirements. The study also provides an overview of the causes of changes in the structure and assesses whether those changes originate solely from compliance with the standards Furthermore, the study provides information on the efforts needed in assisting the industry in regulatory reform that can be used for making policy decisions. This is because additional safety requirements may add costs to economic actors along the chain. This study attempts to understand the intricacies of international food safety standards when applied to third world fish fillet exporters using the Nile perch fishing industry in Tanzania as a case study so as to provide policy makers with a tool for decision making concerning compliance with food safety standards in food industries and provide recommendation that can optimize the compliance benefits to all actors in Nile perch industry.

1.3 Study Objectives

1.3.1 General Objective

The overall objective of this study was to assess the benefits and costs associated with conformity to food safety standards and effects of compliance on the organization of the Nile perch export supply chain.

1.3.2 Specific Objectives

The study has three specific objectives. These are:

(i) To assess levels of compliance with standards at each stage of the Nile perch export supply chain,

(ii) To identify and assess costs and benefits associated with conformity to food safety standards at various stages in the Nile perch export supply chain, and

(iii) To examine the effects of compliance with food safety standards on the organization and governance of Nile perch export supply chain.

1.3.3 Hypotheses

Three general hypotheses of the study are presented below with specific hypotheses presented under specific objectives in the methodology chapter.

(i) It is expected that the implementation of food safety standards that increase total production costs in terms of new investments in machinery, human skills and management will enforce actors to integrate vertically in order to minimize costs. When total costs increase, different governance structures may be chosen by actors along the chain to carry out the transactions. *It is therefore hypothesized that implementation of food safety standards has led to re-organization of the Tanzanian Nile perch industry.*

(ii) It is expected that the larger the business the lower per unit cost of compliance due to economies of scale. *It is thus hypothesized that the cost of compliance with safety standards in the Nile Perch industry varies with the size of business.*

(iii) It is expected that actors with bigger capital assets will have high level of compliance with food safety standards as they will be able to meet costs associated with food safety standards. *It is therefore hypothesized that the levels of conformity to food safety standards depend on actors' capital endowment.*

1.4 Organization of the Study

Apart from the foregoing introduction chapter, the rest of the thesis is organized in five chapters. Chapter Two reviews literature on the subject matter and methods used in previous studies to address the problem. Specifically, the chapter reviews literature on food safety standards requirements, compliance challenges, methods of analyzing effects of compliance on organization and governance structures in supply chains and methods of quantifying compliance costs and benefits. Chapter Three describes the conceptual framework, approach and methodology employed in the study. Choice of the study area, sampling method, model setting and procedures for data collection, processing and analysis are key methodological issues described in this chapter. Chapter Four presents and discusses the results of the study. The chapter presents and discusses the extent of compliance with food safety standards in Nile perch industry, costs and benefits of compliance at different stages in the chain and effect of compliance on organization and governance of the chain. Chapter Five is on conclusions and recommendations emanating from the major findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter is divided into six sections including the overview. The second section presents a critical review on existing literature on issues related to development of food safety standards. The third section dwells on international food export market requirements for fish and approaches used to implement the standards. The critical review focused on interpretation of the standards during implementation, its possibility in improving or reducing business and areas that raise costs to producers.

The fourth section provides a review on the concepts of food safety standards compliance costs and benefits and empirical evidence of standards compliance effects. Section five provides a review of theoretical framework and empirical methods for assessing effects of compliance to food safety standards. In this section, the review focuses on quantification methods for costs and benefits of compliance and their distribution to various actors along the supply chain. The section also reviews different methods including mathematical approaches that have been applied in assessing changes in the organization and governance structure of supply chain as a result of standards compliance. The chapter concludes with section six that reviews methodologies that have been used in similar studies and provides justification for the chosen methodologies in this study.

2.2 Evolution of Food Safety Standards

Various authors[4] using different words described food safety as absence of hazard (e.g. microbial pathogens and chemical contaminants) or risks of food borne illness that cause ill-health in humans immediately after consumption or in deferred future (Jensen *et al*., 1995; Henson, 2003). In addition to controlling exposure to food hazards[5] along the food chain, the concept of food safety is based on proper follow-up of intended use guideline during preparation and ultimate consumption of food (Food and Agricultural Organization (FAO), 1999).

In the literature, many authors agree that food safety concerns started a long time ago only that their dimensions have changed over time (Nadvi and Waltring, 2002; Kastner and Powell, 2001). Kastner and Powell (2001) trace food safety concerns back to year 1800 when problematic livestock diseases were introduced into Great Britain through the transatlantic trade. The identification of pleuro-pneumonia in cattle and trichinae

[4] Jensen and Unnevehr (1995) described food safety as an attribute of food products associated with reduced risks or chance of food borne illness. Henson (2003) described food safety as absence of hazards in food (e.g. microbial pathogens and chemical contaminants) that can cause ill-health in humans

5 FAO (2005) describe food safety hazard as an agent that can either be in or on food and can either be biological, chemical, or physical while the condition of the food itself can be hazardous. The hazards can be found in or on animal feed and feed ingredients and may be transferred to food through consumption of animal products and cause adverse human health effects. The organizations that do not directly handle food and feed may also compromise food safety. These include producers of packaging materials, cleaning agents, and other products that eventually come into contact with food or feed. If such products have been exposed to hazardous agents and they come into contact with food or feed, adverse human health effects can occur (www.foodproductiondaily.com/news).

parasite in pork[6] in 1879 that caused death to investors and threatened customers' health respectively was said to raise concerns to governments to institute food safety regulations. However, Kastner *et al.,* (op. cit) argued that those regulations were non-scientific and were politically based[7]. Jensen and Unnevehr (1995), Cato (1988) and Zepp *et al.* (1998) argued that an emphasis in food safety started in the 1980s as a result of increased outcry in developed countries for a need to protect people from food safety hazards. The outcry was based on:

(i) Increase in highly susceptible population[8] to microbial food borne illnesses that needed to be protected (Jensen and Unnevehr, 1995);

(ii) Increase in demand for fresh food and processed food products which involved a number of handling and processing stages before reaching the consumer and therefore highly susceptible to contamination (Cato, 1998); and

(iii) Trade liberalization that led to an increase in the diversity of products traded following products coming from distant locations with varying origins and different quality standards (Calvin and Krissoff, 1998; Zepp *et al.,* 1998)

International recognition of food safety as a new perspective based on scientific evidence for protecting customers from food health hazards started in 1986 when the Uruguay Round negotiations were initiated. This followed the signing of the Sanitary

6 Pleuro-pneumonia caused death to British stock owners and dairymen and in 1879 there was a ban of US pork because of trichinae parasite
7 Many animal health and food safety concerns were mis-presented, confused with other public health problems and used as a pretext for protecting domestic agricultural producers (Kastner and Powell, 2001).
8 The increase in aged population, the increase use of medical technology that keeps ill people alive longer, and the spread of chronic illness (cancer, AIDS, diabetes) that suppress people's immune systems

and Phyto-sanitary Measures (SPS) Agreement by the World Trade Organization (WTO) member countries in 1994 and adoption in 1995 (WTO, 1995). The SPS measure is referred to as a regulation adopted by nations to protect human, animal or plant life and health within its territory from certain enumerated biological and toxicological risks (Roberts *et al.*, 1999). The agreement provided guidance on implementation of food safety regulation and urged member countries to base their national standards on the international food safety standards without interfering with free international trade (Antle, 1998a).

Each WTO member country is required to determine a level of acceptable health risks and impose technical requirements for imports to maintain that level. However, scientific justification assessment of risks is required and supposed to be imposed strictly to address the risk (Roberts *et al.*, 1999). The CODEX Alimentarius (established by FAO and WTO in 1963) is to harmonize the setting and implementation of food safety regulation among the WTO members with a requirement for scientific based safety regulation on ports. The 1995 SPS Agreement gave Codex standards legal status and initiated establishment of national focal points in developing countries e.g. Tanzania Bureau of Standards (TBS) in Tanzania. The focal points were established to ensure transparency in terms of communicating changes on standards (OECD, 1999).

Food safety standards are explained as conditions set by importers and consuming public to ensure that the products sold to their countries' markets are completely safe and constitute low risk to human health as can be technically measured. In economics, food safety standard can be referred to as a method to circumvent the problem of imperfect and asymmetric information on the markets (Antle, 1999). Unlike many other quality attributes, safety characteristics pose a challenge in marketing because it is difficult or impossible to be verified before and even after being consumed (Antle, 1999), for example, salmonella cannot be detected until the product is consumed and cause illness to the consumer. Other risks cannot be verified even after consumption because they take long time to reveal (e.g. cancer). Jensen and Unnevehr (1995) argued that if consumers can ascertain the level of safety or risk associated with food prior to its purchase and understand the true risks to health, they could choose among products to obtain the preferred level of food safety and in so doing, they could express their willingness to pay for varying levels of safety. Thus, the market for safety attribute would exist with the cost of safety balanced against its value to consumers.

However, food safety is usually not ascertainable directly because consumers do not always have complete information about the safety of the food when buying it (Antle, 1998; 1999) and if they became ill from food-borne pathogen, they may have difficulty in recognizing the source. Jensen *et al.* (1995) argued that consumers' willingness to pay for varying levels of safety is limited by lack of complete information on level of safety or risk associated with food prior to its purchase. Producers on the other hand, do not always have information about safety of their products and it may be costly or impossible for them to respond to consumers demand for improved safety (Krisoff, 2002). This lack of information may create market failure.

Producers have little incentive to provide greater levels of food safety since consumers will pay for an attribute that they cannot verify. Therefore, the value consumers place on food safety depends on their information about foodborne risks and their own susceptibility and ability to take precautions (Jensen and Unnevehr, 1995). Another aspect of market failure is that the transaction costs of reaching agreement on the level of safety and the price premium are high. Thus this together with lack of information, create a public health problem, which is a fundamental justification for public intervention to improve food safety (Buzby, 2003).

Thus in food market, a market failure is associated with imperfect and asymmetric information with distinction focusing between search, experience and credence goods. For search goods, the characteristics are known prior to consumption through available information that assists customers in purchasing decisions. In this circumstance market failure is not a problem and therefore government regulatory activity becomes relatively minor (Caswell *et al.*, 1996[9]). For experience good, quality is being signalled to customers vie reputation[10] effects (Brian and Sheldon, 2000). Repeat purchase make

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9 Krisoff et al (edited 2002): In Brian and Sheldon (2000). The impacts of Labelling on Trade in Goods that may be Vertically Differentiated According to Quality.
10 Experience goods, the characteristics are known at the point of consumption. Credence goods, the characteristics are not known even after consumption although they may become known after sometime e.g. food poisoning caused by eating contaminated food.

consumers aware of the quality of the product and communicate to other customers. Klein and Leffler (1981), contend that, for ‘experience” goods whose characteristics are known at the point of consumption, investment in firms’ reputation will assist in attaining equilibrium (Krisoff *et al.*, 2002). However, according to Brian and Sheldon (2000), most of experience goods are also ‘credence’ goods, that their characteristics are not known even after consumption although they may become known after sometime. Caswell *et al.* (1999) argued that, many goods are credence rather than ‘experience’ goods because their quality is difficult to signal via private, reputation-type mechanism. Its quality cannot be known by the customer before and even after purchase (MacLaren, 2004; Antle, 1999). Theoretically, there are three ways to overcome market failure problem (MacLaren, 2004). These include setting standards either on the production process or on the resulting product, imposing legal liability on firms for damage caused to human health and well-being and provision of information to consumers through certification and labelling.

Evolution in standards is triggered mostly by the need for importing countries to strike a balance between national interests in higher standards and reducing trade barriers (Bostock, 2004). National interests cause exporting countries to implement standards based on importing countries’ requirements, for example to export to EU or US, the exporting country has to comply with stringent EU or US standards respectively. However, there is a growing concern amongst scholars as to whether food standards are truly meant for human, animal and environmental safety or are just requirement for market access. Ponte (2005), when discussing on Nile perch export from Uganda, argued that the export quality assurance system is in theory but in practice is privately based on commercial principles. The study indicate that either there is leeway to compliance that non-conforming products find markets in importing countries or else standards are too stringent to allow access to target markets. As the imminent of food safety issues today are critical, the second reason seems to be more common. Other authors like Ollinger (1998), Antle (2000) and Crutchfield *et al.* (2002) explain the barrier effect of standards on international trade in terms of high costs involved in the purchase of machinery, training, laboratory equipments and other quality-related investments.

In harmonizing importing countries challenges, bilateral agreements with exporting countries have been fostered. For example, EU can allow imports from an exporting country that has harmonized its national standards with EU standards and establish processing quality monitoring and control systems based on principles of equivalency (EC, 1999). However, the bilateral agreements have raised questions of extent of implementation of standards or whether the standards are implemented to the letter. EU inspections reports (EC, 1999; 2006; URT, 1999; 2006) indicate that implementation of standards cannot be taken as blue print in developing countries because of inadequate infrastructure, human skills and technology. Hence standards implementation becomes difficult and thus implemented in phases with conformity being enforced through pre- and post-shipment testing.

2.3 Nile Perch Exports and Food Safety Standards

Though according to LVFO (2006), and World Bank (2005a) Nile perch export volumes were increasing prior to EU import bans, there were no parallel efforts by authorities in coordination and enforcement of export national standards throughout the chain. The inadequate coordination of standards setting and enforcement resulted from the use of departments and national agencies from multiple Ministries. For example, the agencies involved in the regulatory system and standard-setting system were the Tanzania Bureau of Standards (TBS), under the authority of the Ministry of Industry and Trade, the Plant Health Services (PHS) in the Ministry of Agriculture and the Tanzania Food and Drugs Authority (TFDA) under the Ministry of Health (Musonda *et al.*, 2001; UNIDO, 2003; Abila, 2003).

Laboratory testing was conducted using a number of public laboratories with the capacity to perform plant and food analysis. The key laboratories include the TBS Test House, composed of a chemical laboratory and food and microbiological laboratory; the TFDA chemical and microbiological laboratories; the Government Chemistry Laboratories Agency (GCLA), and the TIRDO laboratories. The standard setting agencies were formulating standards to suite local quality demand for imported products and quality demands for exports as they deem fit. In this case, some of the nationally established standards were equivalent to international standards in terms of microbial limits but using national testing methods that were not internationally accepted.

Enforcement of the standards was also complicated by being spread into departments and agencies under seven ministries.

The intermittent import bans of fish and fishery products from East Africa by the European Commission between 1997 and 2000 forced the countries to adopt stringent standards in fishing activities. The bans were based on concerns about the safety of fish from the East Africa region claiming the presence of Salmonellae in 1997, cholera outbreak in 1998 and pesticide contamination in Lake Victoria in 1999. Though the commission to-date has not been able to justify the bans (Ponte, 2005), Nile perch exports declined by 65 percent in 1999 compared to the previous year. A year after the EU ban the exports increased by over 400 percent. (Kadigi *et al.*, 2007) The effects of the bans led to significant changes in fishery regulation around Lake Victoria hence major changes in coordination of standards setting and enforcement throughout the chain.

The fact that the major importer of the Nile perch product is Europe, the industry therefore has to adhere to the European food safety standards. Tanzania adopted the Codex code of hygiene and European Union Sanitary and Phyto-Sanitary (EU-SPS) directives related to imports and exports of fish and fishery products in 1998 (URT, 1999). The Codex and directives provided direction on maximum residue limits for heavy metals, pesticides and maximum residual levels of mycotoxins and emphasizes on the use of HACCP and traceability as key standard methods. To improve coordination of standards setting the country had to engage itself in bilateral agreement with EU who in collaboration with the mandated National Bureau of Standards incorporated the directives in the country's national standards. However, complicated procedures together with country specific problems in terms of inadequate infrastructure, human skills and facilities[11] required for testing resulted into deviations in levels of compliance to standards during implementation. Bilateral agreement between exporting country and EU provide provisions for correction of inadequacies in a given period. For example, in Tanzania inspection of the implementation of the standards in the fishing sector has been carried out regularly as stipulated under EU Commission Decision 98/422/ EC[12] of 1998.

The Commission inspection reports thereafter indicate deviations of implementation of standards ranging from legislation issues, competency of the Competence Authority in quality control, laboratory testing procedures in factories and documentation of quality issues by quality inspectors (EC, 1999; 2004; 2006 and URT, 1999; 2006). These, together with other deficiencies reported in various inspection reports (e.g. EC, 1999;

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[11] Inadequate laboratory equipments and reagents and the fact that the laboratories were not accredited

[12] The decision laid down special conditions governing imports of fishery and aquaculture products originating from Tanzania. The agreement was temporary upon appointment of Competent Authority (CA) and guarantee by CA that special conditions governing imports of fisheries product into EU following Commission Decision 98/422/EC of 1998 was respected. The guaranteeing was provided after consecutive inspections conducted by the EU Commission in (i) August 1999 with view to considering the removal of import ban imposed by the Commission Decision 1999/253/EC; (ii) October 2000 aimed at assessing the measures taken regarding pesticides contamination in the Lake and assessment of conditions of fishery products production stipulated in Council Directive 91/493/EEC of July 1991, Commission Decision 98/422/EC of June 1998 and Commission Decision 2000/127/EC which was an amendment of Commission Decision 1999/253/EC and (iii) October 2006 with the objective to assess whether the Competent Authority was capable of guaranteeing special conditions governing imports as laid down in the decisions mentioned above. See EU commission reports in Appendix 3

2004; 2006 and URT, 1999; 2006) suggest that the “new generation of standards” are not blue prints, strictly applied as stipulated in the papers. It is however, worth noting that efforts were made by the Fisheries Department to correct the raised problems in standards implementation.

2.4 Food Safety Standards and Methods Applied in Fish

2.4.1 Standards applied in fish

Holland and Wessells (1998) indicate that safety attributes in fish started to be differentiated since 1997 by citing a study done by Green and Srinivasan in 1990 on consumers’ appeal on potential products and services based on attributes using fish as an example. The Green’s (1990) study indicates that fish customers’ choices were influenced by multi-attributes of various fish size, colour, texture and prices. Starting 1990s the multi-attributes shifted to origin, price and inspection and later a proliferation of sector oriented Codes of Practice (COPs) incorporating ranges of standards relating to all elements that make up the food management chain (growing, processing and handling) (Holland *et al.*, 1998).

In protecting humans, animals and plants from microbial, chemical and physical hazards, scientific critical limits for each hazard were set. As food safety hazard differs with variety of food (Unnevehr, 2000), the limits set provide challenges to implementers. The Maximum Residual Limits (MRL) is set depending on the type of hazard as described in the next section. The MRL challenges are associated with their frequency of change that is determined by available technology and new scientific evidence (Otsuki and Wilson, 2003).

(i) Microbiological Hazards

A microbiological hazard arises from the presence of bacteria, viruses, yeasts, moulds and algae, parasites, and their toxins or metabolites in fresh or processed food (Reilly, 2006). In fish and fishery products the microbial hazards include bacterial, virus, parasites, biogenic and toxins as shown in Table 1.

Table 1: Examples of microbiological hazards in fish and fish products

Hazard	Example of the hazard
Bacteria	*L. monocytogenes*, *Salmonella* spp., *E. coli*, *C. botulinum*, *S. aureus*, *Vibrio* spp
Viruses	Hepatitis A, Noroviruses
Parasites	Nematodes, Cestodes, Trematodes
Biogenic	Amines Histamine
Toxins	PSP, ASP, AZP, DSP, Tetrodotoxins, Ciguaterra

Source: Reilly, 2006

Unnevehr (2000) and Reilly (2006) contend that contamination of these potential hazards in food production can enter through any point along the chain and at any production place be it in LDCs or DCs, though the risks may differ with climate, infrastructure, and methods of production and consumption. Based on this, management of hazards is argued to be effective if (a) the whole chain from primary production to consumption is taken into account, (b) scientific knowledge of the microbiological hazards is provided, and (c) understanding of the fishing, processing technologies and handling during preparation, storage and transport, retail and catering is ensured. Reilly (op. cit) argue that the third option above is more meaningful as the hazards may vary with location, climatic conditions, and handling or production methods among others. For example there are different requirements for microbiological testing parameters for Tanzania and Kenya as indicated in Table 2.

Table 2: Microbiological tests required in fish in Tanzania and Kenya

Test parameters	**Critical limits**		**Parameters tested in Tanzania**	**Parameters tested in Kenya**
	units	**limits**		
Total plate/viable count/g	*Cuf/g*	1×10^5	Y	Y
Total/faecal coli form/g	*Mpn/g*	4×10^2	Y	Y
Salmonella/shigella sp/25g	*P,A/25g*	Absent	Y	Y
Vibrio cholerae/25g	*P,A/25g*	Absent	Y	Y
Staphylococcus aureus/g	*Cuf/g*	1×10^3	Y	Y
Enterobacteriaceaea/g	*Cuf/g*	1×10^3	Y	-
Escherichia coli	*Mpn/g*	1×10^1	Y	-
Sulphite-reducing clostridium		NA	-	Y

Source: Zone fisheries Division, Mwanza (2007) and Plant Quality manual, Kenya (2006)[13],

NA=not available, *Cuf/g=colon forming unit/gram, Mpn/g=most probably number/gram, P,A/25g=Presence or Absence/25gram*

(ii) Physical Hazards

Physical hazards originate from different sources which include (URT: Fishery regulations, 2005), (a) mud, sand, weeds (b) fish transporting facilities such as metal, pieces of wood (c) human such as nails, hair (d) factory facilities such as wood, plastics,

[13] Plant quality manual (Sanitation Standard Operation Procedures) was obtained under confidentiality of the processing plant, hence not indicated in the study reference.

metal, glass particles that are considered harmful to human health when consumed in food. Controls of the hazard involve regular inspection of workers cleanliness, production equipment and machines, transportation facilities and the general production environment. In the fishing industry, modern equipment such as metal detectors, plastic white fluorescent tube-lights are required to replace the glass fluorescent tube-light in the production area; and washable cutting tables and walls.

(iii) Chemical Hazards

Chemical hazards originate from fishing waters and processing plants and include; heavy metals (Mercury, Lead, Cadmium), pesticides and toxics (over chlorination, detergents other than food grade). Heavy metals are a major concern as they are invariably toxic once they are accumulated in the body following repeated exposure. Other metals such as zinc, iron or copper are essential for life, but each is toxic in excessive amounts. Thus the standards are concerned with the toxicity of the metals that the maximum residual limits were set as control measures. Table 3 provides examples of some important maximum residue limits for heavy metals as per Commission Directive 67/548/EEC. The 0.05mg/kg in Cadmium indicate the Limit of Determination (LOD) which implies no authorization for any amount of this metal in the product (ICSMF, 1988).

Commission Directive 93/351/EEC restricts heavy metals' presence in fish and fish products on account of their carcinogenic nature. While Cadmium may accumulate in the human body and induce kidney dysfunction, skeletal damage and reproductive deficiencies, Mercury is said to induce alterations in the normal development of the brain of infants and at higher levels may induce neurological changes in adults. Lead may induce reduced cognitive development and intellectual performance in children and increased blood pressure and cardiovascular diseases in adults. Commission Directives and regulations such as 396/2005[14] (EC) and 466/2001[15] direct on frequent testing to ensure no prior contamination in production source.

The challenges with implementation of the hazards management lies with frequent changes in and amendments to the various regulations and directives that require higher maximum levels, understanding of emerging new concepts and relatively short time required for transformation to comply, since some requirements need to be sourced from outside the sector, ministry or abroad (Nanyaro, 2009).

As the decision on management of risk in fish and fish products is the responsibility of national authorities, a wide range of food safety measures are implemented either alone or in combination. This together with meagre financial resources, low technological

[14] The Commission Directive directs on maximum residual levels of pesticides in or on food and feed of plant or animal origin. It is argued that pesticides may drift and contaminate water bodies where fish accumulates these pesticides to their bodies over time through food chain. Pesticides which are called persistent organic pollutants such as DDT have very long half life that can contaminate water bodies after being used in the past.

[15] European Commission regulation 466/2001 directs on Mycotoxins maximum residual levels in food. The standards require monitoring of Mycotoxins such as aflatoxins, *ochratoxin* A, *patulin* and *trichotecenes* in fish and fish products. Aflatoxins are Mycotoxins produced by certain species of *Aspergillus*, which develop at high temperatures and humidity levels. Aflatoxins may be present in a large number of foods but aflatoxin B1 are genotoxic carcinogenic substances that there is no threshold below which no harmful effect is observed.

capacity and standards assessment capacity in developing countries complicate the implementation of standards.

Table 3: Maximum residual limits (MRL) for heavy metals

Type of heavy metal	**Product**	**Maximum level (mg/kg wet weight)**	**Performance criteria for sampling**	**Performance criteria for methods of analysis**
Lead (Pb)	Muscle meat of fish as defined in category (a), (b) and (e) of the list in Article 1 of Council Regulation (EC) No 104/2000 (18) excluding fish species listed in point 3.1.4.1	0. 2	Directive 2001/22/EC	Directive 2001/22/EC
Cadmium (Cd)	Muscle meat of fish as defined in category (a), (b) and (e) of the list In Article 1 of Regulation (EC) No 104/2000, excluding fish species listed in 3.2.5.1.	0.05	Directive 2001/22/EC	Directive 2001/22/EC
Mercury	Fishery products, except those in 3.3.1.1	0.5	Directive 2001/22/EC	Directive 2001/22/EC

Source: Commission regulation (EC) No 466/2001, Annex 1 section 3 (2001)

2.4.2 Food safety methods applied in fish

Food safety standards applied in fish are based on hazard and risk analysis. The analyses include assessment, management and communication of hazard and risk in the industry. The fundamental difference between a hazard and a risk, according to FAO (2002) is based on their description. A hazard is a biological, chemical or physical agent in, or condition of food, with the potential to cause an adverse health effect while risk is an estimate of the probability and severity in exposed populations of the adverse health effects resulting from hazard(s) in food.

Risk analysis is widely recognized today as the fundamental methodology underlying the development of a food safety standard that provides adequate health protection and facilitates trade in food (WTO, 1995; 1999) and it involves three components of risk assessment, risk management and risk communication. Risk assessment is the scientific evaluation of known or potential adverse health effects resulting from human exposure to food-borne hazards. Risk management is the process of weighing policy alternatives to accept, minimize or reduce assessed risks and to select and implement appropriate options. Risk communication is an interactive process of exchange of information and opinion on risk among risk assessors, risk managers, and other interested parties. Hazard analysis involves identification of the hazards, setting of critical limits and testing using control standards or equivalent standards which are the national harmonized standards. Food safety methods used in fish include HACCP, EU-SPS, International Standards Organization (ISO 9000:2000, ISO 22000:2005 and British Retailers Consortium (BRC), (Unnevehr and Jensen, 1996; EC, 2001; Shafaeddin, 2007).

(i) Hazard Analysis Critical Control Point (HACCP)

The hazard analysis critical control points (HACCP) is a worldwide recognized systematic and preventative approach to the identification, evaluation and control of food safety (FAO, 2003a). It addresses biological, chemical and physical hazards by anticipating and preventing, and therefore provides the greatest safety while reducing dependence on finished product sampling and testing which is more costly. This method has been used by private firms since 1960 and is mandated by government regulation in some parts of food chain in some nations such as EU, US, Australia, New Zealand and Canada (Unnevher, 2000). The growing use of the system in public regulation means it has become internationally recognized.

HACCP system is a subset of more general quality management systems, and is used to address food safety hazards that can be introduced at different points in the food chain or are difficult to measure (Unnevehr and Jensen, 1999). An advantage of HACCP is to focus resources on the most important control points, which can minimize resources used to improve safety. Properly applied, HACCP may lead to process redesign, which can reduce the cost of providing quality (Mazzocco, 1996). HACCP involves analysis of the entire system, with the corresponding need to coordinate preventive actions throughout the production process. The HACCP application consists of a logical sequence of twelve steps encompassing HACCP seven basic principles[i]. The basic principles are provided to guide industries or firms to form HACCP, but each one is required to have its own HACCP plan tailored to its individual products. The general principles of HACCP have been adopted by the Codex Alimentarius Commission (CAC) in 1997, 1999 and 2003 (FAO/WHO, 2003). In fish the principles require that:

(a) Fish products are processed in certified plants and/or establishments. The certification process requires that the plant meets minimal requirements in terms of layout, design and construction, hygiene and sanitation;

(b) Industry takes responsibility in fish safety control and implements HACCP-based in-plant quality control programmes;

(c) A regulatory competent authority is in charge of certifying fish plants and establishments, approving and monitoring HACCP-based in-plant quality control programmes and certifying fish and fishery products before distribution;

(d) Where necessary, national surveillance programmes in harvesting areas should be in place to control the threats of bio-toxins and other biological and chemical pollutants; and

(e) For exports, an additional control can be exercised by the importing party and involves an audit of the national control system of the exporting country to ensure that it meets the requirements of the importing country. This should lead to the signing of mutual recognition agreements between trading countries (FAO, 2003b).

The HACCP system is entrusted in ensuring food safety internationally. However, in countries like EU it has been accepted only when in combination with other food safety standards. The EU-SPS requires a combination of HACCP with testing using an accredited laboratory which means higher compliance costs to the EU exporting country or no access to EU markets (EC, 2001).

(ii) International Standards (ISO standards)

The demand by some countries such as EU for a combination of HACCP with other food safety standards led to the International Standards Organization efforts to incorporate as many measures to ensure more food safety. The ISO which is an internationally recognized certification organization is sometimes referred to as "standard of standards" (Unnevehr, 2000) as it involves application of framework for verifying the elements of a firm's production process that assures quality. The ISO[16] has been evolving by harmonizing private and public standards. The recent harmonized standard is ISO 22000:2005. During the study, negotiations were still going on between

16 The ISO include ISO 9000:2000 and ISO 22000. The ISO 9000:2000 harmonizes ISO 9000 which comprised three basic standards namely ISO 9001, ISO 9002 and ISO 9003. ISO 9001 is the most comprehensive standard that encompasses design, development, production, installation and servicing. ISO 9002 guides the development of quality management system when design control is not a requirement and ISO 9003 is the least comprehensive that addresses only the final inspection and testing. Certification of ISO 9000:2000 requires implementation of Good Hygiene Practices (GHP), Good Manufacturing Practices (GMP) and HACCP. The ISO 22000 is the latest regulation launched in 2005. According to FAO and WHO (2005), the ISO estimates that there are about 20 different schemes both private and public in various countries worldwide relating to food safety and the supply chain, each providing for various levels of checks, balances and procedures that may generate risks of uneven levels of food safety, confusion over requirements, and increased cost and complication for suppliers that find themselves obliged to conform to multiple programmes. It is claimed that ISO 22000 was launched harmonise these worldwide.

ISO and European Food Quality and Safety standards to recognize ISO 22000: 2005 so that firms do not have to be certified for more private standards, like BRC.

(iii) Traceability

Traceability is described as a system for collecting and managing information on individual food and feed products at every place where a change is made to a product or its circumstances (www.trceability-t.org, 2007). The place where a change is made is referred to as Traceability Control Point (TCP). The TCP can be applied at all levels of supply chain, process and data system. Its implementation is applied all across products as it is used to enhance the ability to identify and trace the history, location, and application of products and materials. A traceability system records and follows the trail as products and materials come from suppliers and are processed and distributed as end products. Its capability is critical in the event of a food safety problem because it can help to identify the source of contamination. This seemed to be a challenge with the poor record keeping history in developing countries. It therefore increases cost following the need for training and follow ups to ensure record accuracy and consistency.

(iv) EU-SPS

EU-SPS is a standard that direct fishery activities to apply EC directives as per article XX (b) of GATT[17]. In the directives, the European Union and its member States have enacted specific legislation concerning fishery products, which are applied to both

17 The evolution of food safety standard are traceable to GATT rules with article XX(b) that allows countries to introduce SPS measures to protect human health, animal and plant life and health.

exports and imports. The Directives provides for standards and standards methods to be applied (where HACCP and traceability are mandatory) and procedures for approval for EU-destined exports (see Annex 1). In this case direct or third party certification by an accredited and EU approved agency is required.

(v) Pre-requisite Programs (PRPs)

GMP and GHP are critical in implementation of food safety standards in food processing. The two provide basics or foundation for quality management in a plant which include the programs named as Pre-requisite (PRP) and Operational Pre-requisite Programs (OPRPs). The PRP involve the Sanitation Standard Operational Procedures (SSOP) required in the operations while OPRP provides controls during operations. HACCP therefore complements the PRPs and OPRPs and is effective when food safety hazards cannot be controlled by them. Unnevehr, (2000) contend that, implementation of food safety standards is complicated by lack or partial implementation of SSOP. Upgrading of processing facilities is required by those with SSOP while restructuring is mandatory for those with no SSOP. In this study the SSOP and HACCP were used to identify compliance cost centres (Annex 2).

(vi) British Retailers Consortium (BRC)

BRC is a voluntary private standards initiated by retailers in Britain. In fish processing it is implemented over and above mandatory national standards (e.g. HACCP in Tanzania) applicable in the industry). The private standards are not only often more stringent than the official Government standards, but they are less transparent than the public standards as they are not reported to WTO (Shaffaedin, 2007). The private firms have incentive to set their own standards (Hatanaka *et al.,* 2005) not only to differentiate their products and create or improve reputation (Fulponi, 2006), but also to be able to choose the form of standards, as against public standards, that minimizes their own costs (McCluskey, 2006). The BRC requires implementation of standards on labelling in addition to food safety. However, Jaffee and Henson (2004) consider the emerging public and private standards as necessary means in bridging between the increasingly demanding consumers and distant suppliers. The standards can provide a common language within the supply chain and promote consumer confidence in food product safety.

2.4.3 Approaches to food safety

In recent decades, control of final products through examination and inspection of processing operations have been replaced by integrated, multidisciplinary approaches depending on risks associated with the food. Though the holistic approach has been applied by many developing countries, the food chain approach is currently favoured by importing countries ((www.foodproductiondaily.com). FAO (2003a) defines the food chain approach as that where the responsibility for the supply of safe, healthy and nutritious food is shared by all involved with the production, processing, trade and consumption of food. This is a challenge to developing export countries because the food chain approach considers the whole food chain and in some cases goes beyond what is conventionally regarded as food chain (Slorach, 2002). Though food chain is an area of concern, this study is focused on the supply side as most developing countries are implementing the standards to meet export market requirements.

Holistic approach is thus more common in exporting developing countries as it entrusts food safety to the food processing sector and government control services. This brings in the need for government and private sector collaboration. Nadvi and Waltrings (2002), Buzby (2003) and Unnevehr *et al.* (2002) provide explanation as to need for government and private sectors' investment in food safety. Government involvement in food safety standards in importing countries is normally centred on market failure in provision of safer food product where government intervention is needed to protect consumers. This is in respect to filling the gap of social cost on food safety which cannot be accounted for by the market transactions[18] (Buzby, 2003). In exporting countries, government involvements in the standards is based on facilitating implementation of standards at lower costs to the community and private sector and reduce their barrier effect on market access. According to Unnevehr (2000) the role of the government can revolve around research, regulation, infrastructure development and provision of technical support. Government involvement is also argued around trade dispute settling. The complexity of food safety issues has always brought disputes and difficulties in trade between producers and consumers, thus government involvement can help the private sector allay food safety concerns by providing guidelines for good practices (Buzby, 2003).

18 Under uncertainties and asymmetric nature in food safety information, consumers will be willing to pay but not to the level of including society risks and because the consumers demand and are willing to pay for the attribute, the private producers will be willing to provide the product but to the level where the consumers are willing to pay (recast)

The private sector involvement in food safety standards revolves around changes in production practices and investment in sanitation. This raises the issue of vertical coordination to ensure export of safe product which needs the attention of both the public and private sector (Buzby, 2003). Worldwide, private sector has been using different methods so as to ensure safe food products through self regulation, vertical integration, third party certification and common approaches to risk identification, assessment and management. In assurance of food safety, many producers institute quality assurance programs with firms often using a mix of approaches such as:

(a) Vertical integration which is characterized by single firm controlling the flow of a commodity across two or more stages of production (Martinez and Reed, 1996). The approach guarantees safety and quality of a firm's inputs and enhance the ability to trace production ingredients or process back through the food production and marketing chain

(b) Third-party certification provides assurance to consumers that the information supplied by the firm is correct (Golan *et al.,* 2000).

(c) Risk identification, assessment and management approaches such as HACCP which essentially identify, monitors and controls hazards at critical points in food production and processing need to be certified (Buzby, 2003 and Unnevehr, 2000).

2.5 Food Safety Compliance Costs and Benefits

2.5.1 Compliance costs

A compliance cost is described in literature as necessary cost incurred to meet standards. Antle (1998) distinguishes between conventional and quality-related costs. Accordingly, compliance costs differ from one firm to another depending on the initial level of investment on that line. The cost difference can also be from the type of standard in question (performance or design standard). Unnevehr and Jensen (1999, 1996) and Antle (2000) describe performance standards as those imposing a quality requirement without specifying the technology that must be used while design standards require the firm to modify its plant or farm with reference to the type of technology in use. According to Antle (1998a), the incremental costs in performance standard occur in variable production costs and variable quality costs hence compliance cost sum up the two while in design standard, the incremental cost occur in both variable and fixed costs. Antle's (1998a) argument is supported by Mitchell's (2003) argument that, the main effect of safety regulation is to increase production costs through increase in variable and sometimes fixed costs. The resultant effect is to shift upwardly the supply curve and reduction of quantity supplied hence raising equilibrium price.

According to McCormick (2000), food safety standards affect developing countries in three different ways:

(i) Introduction of new cost activities in complying with food safety standards. These activities range from certification, inspection, testing facilities, requirement for sophisticated processing plant and technical and managerial personnel.

(ii) Concentration of power of trade in the hands of importers and therefore primary decision-making is moved away from the developing countries to the importing developed countries. This creates a warning in the quest for market share as some may seek to exercise their power over the supply chain for their benefits.

(iii) Growing preference for developed importing countries to deal with large producers because they are able to undertake compliance measures and therefore reduce the level of risks to the importers. The impact of this is to exclude small producers from the supply chain.

Focusing on HACCP which is mostly applied in fishing industry for pathogen control, the cost elements can be associated with its main seven principles (Unnevehr, 2000). The cost in respect to the seven principles can be categorised into two,

(i) the costs on processing control (which include planning, training, monitoring, testing and record keeping); and

(ii) the costs on specific intervention to reduce pathogen which would be incurred in the process modification

Unnevehr (2000) identified additional compliance costs associated with HACCP implementation. These include the costs related to complexity of the HACCP plan which will be estimated based on the number of critical control points, time spent on HACCP preparation and implementation and corrective action. Table 4 provides details of the cost variables identified by Unnevehr.

The challenge of food safety to developing countries is based on the following facts (Unnevehr, 2002):

(i) The immediate food safety regulation needed is basic sanitation,

(ii) The cost of investing on food safety to meet international standards is very high;

The economies are heavily dependent on export earnings.

World Bank (2005a) provides two suggestions on the challenges. First, interacting safety regulation with other policy reforms on a case by case basis as opportunities to strengthen institutions and change regulatory approaches are identified. Second, relating case components to the overall progressive food safety regulatory system. This means investing in key infrastructures, capacity building and institutional building for greater stakeholders' participation.

This is what is seen in many developing countries where effort to comply with food safety is done on individual basis with participation of both the private and public sectors and; within and across countries.

Table 4: Description of HACCP costs variables

No.	Variable	Description
1	Complexity of the HACCP plan	Number of critical control points in the firms HACCP plan
2	Time and cost of plan design	Time needed and associated costs of HACCP plan design. It includes research, writing and rewriting and implementation of the plan
3	Cost of training, both external and internal training	Number of firms employees who went for training, cost of the course, travel, lodging expenses and productivity loss
4	Cost of control and record keeping	
4.1	Additional monitoring	Cost associated with additional time spent in monitoring
4.2	Additional lab analysis cost	Additional costs associated with external and internal lab work. It includes microbial or chemical tests.
4.3	Annualized equipment costs[19]	Cost of new equipment purchased calculated as annualized costs $A=V_0 * \{I / [1 - (1 + I)\text{-}n]\}$
4.4	Corrective action costs	Costs associated with the occurrence of critical limit deviations. The costs include labour, product destroyed or reworked and analytical tests of potential hazardous product
4.5	Cost of new employees hired for monitoring	Costs of eventual employees hired in order to cover the increase in time needed for control procedures
4.6	Review costs	Cost of daily reviewing the records and reviewing the whole HACCP plan.
4.7	Sanitation costs	Writing and implementation of sanitation standard operating procedures (SSOP) plan, microbial analysis such as swiping machinery, new cleaning equipment and material, hiring new sanitation personnel
4.8	Validation costs	Change in company costs in certifying their product.

Source: Unnevehr (2000)

19 Annualised cost according to Gittinger (1973), where V_0 is the cost of the equipment, n is years of life and I is the discount rate. The critical issue here is the choice of discount rate, (this will depend on the price used, if market price, then the discount is the cost of borrowing, if is economic price, then the discount is opportunity cost of capital in the economy).

Several studies that estimated cost of HACCP on seafood, meat and poultry suggested the estimates to be conducted at the industry level and firm levels (Cato *et al.*, 1998; Unnevehr, 2000). Variables of cost of training, plan refinement, sanitation audits, and cost of implementing critical control points, equipment cleaning, record review, eliminating pests and administration have been used in estimates conducted at industry level in seafood processing plants. Other direct costs to producers and exporters are major plant repair and renovation, re-packers and warehouses, rejected products at the fishing level, vessels and foreign processors. At firms' level, the variables used include, number of critical control points in the HACCP plan, raw material yield, final product prices and investment, daily capacity and labour productivity (Unnevehr 2000). This is important to determine economic factors associated with achieving improved level of product quality. A combination of industry and firm level assessment was conducted as the study covered individual actors along the export supply chain in the fishing industry.

Antle (1999) classify compliance costs into joint and non joint quality costs. The joint costs are those that are non separable between traditional quality attributes and safety quality, whereas non joint costs are the ones that can be separated. Whether joint or non joint, the costs are divided into variable and fixed quality-related costs. The setting of standard on performance may involve only the variable costs while process involved both variable and fixed costs.

The World Bank (2005a) correctly distinguishes between fixed and operational costs.. For example, for testing a product, there is a need for initial investment in equipment, training of laboratory personnel as well as the cost of accreditation. The operational costs include maintenance, salaries, and the cost of laboratory materials.

The literature cited above consider cost of compliance for an export product; but do not include the cost of necessary change in the organization of production for facilitating the compliance, which would eventually lead to the reduced unit cost of compliance. The above argument is also supported by .Shaffaedin (2007). Important costs such as delays in exportation (e.g. interest charges) caused by the procedures necessary for the compliance, export reduction due to compliance and loss of export earnings needs to be included. The secondary costs which can also be included are loss of income at the country and firm levels, as well as the loss of employment and household consumption (Shaffaedin, 2007).

2.5.2 Benefits of standards compliance

Compliance benefits can be described as gains associated with adherence to food safety standards. Benefits can be qualitative or quantitative, and can be sustained by individuals or community following compliance with specific standards. Jaffee (2003) contends that compliance to food safety standards can create new forms of competitive advantages, and therefore promote trade, growth and employment. Firms would normally aspire to keep costs low for realizing anticipated higher returns. This is however counter-challenged by the efforts to comply with quality and safety standards which are always likely to increase production costs. Conversely, Mazzocco (1996) and Henson and Jaffee (2007) argue that average profit per unit sold may also increase because of greater efficiency in the agri-food chain resulting from coordination and to a greater intra-firm efficiency of resource use. Furthermore, market scope could also increase compensating for per-unit profit decreases arising from costs incurred to meet the standards. Standards compliance may also enhance market access, realization of premium price, improvement and/or retention of industry's reputation/image and reduction of inspection hassles. According to Kadigi *et al.* (2007), standards compliance has also played positively for the Nile perch fishing community. The study shows that there was an increase in benefit in terms of gains in assets and income on the part of upstream chain actors.

2.6 Theoretical Framework and Empirical Methods

2.6.1 Theoretical framework

Food safety standards are aimed at overcoming market failures linked to information asymmetry (Buzby, 2003). Conformity to food safety standard is considered a general solution to the problem of information asymmetry between buyers and sellers. A seller will generally be aware of the attributes of a given food item while those attributes are hardly known to a buyer. This reality has lately compelled market mechanisms to change accordingly to overcome the above shortcomings. One of the actions has been a move from spot market transactions to more closely coordinated forms of market governance such as vertical co-ordination, joint ventures, contracts and strategic alliances (Hobbs *et al.*, 2001).

Other institutional economists such as Schmitz (1995) and Nadvi (1996), using maintain that firms' joint action is essential for coping with new challenges in food safety regulations. Henson and Mitullah (2004) contend that external economies on their own are not enough for realizing progress and growth. There is need for joint action which focuses not only on individual enterprise or incidental external effort, but also on the deliberate inter-firm linkages and networks. The social capital theory also supports network-relationships for enhancing feasible easier access to information, technical know-how and financial support (Omta *et al.*, 2001)[20]. However, negotiations and reaching agreement[21] especially on the level of safety and price premium brings in high transaction costs (Buzby, 2003). In this case a rational producer would choose a network that minimizes costs. Hobbs and Young (2001) contend that networks or chain re-organization to closer buyer-seller relationship is associated with transaction costs reduction in addition to improved information flow

2.6.2 Transaction costs and governance structure

Williamson (1979) defines a governance structure as the institutional framework within which the integrity of a transaction is decided. The concept of governance structure

20 The network relationship may also lead to social liability e.g. reducing the possibilities to relate the company to outside network, high co-ordination costs of the network relations etc.

21 Transaction costs such as cost of discovering what price should be used, individual contract negotiation costs

comes from institutional economics as developed by, amongst many other authors, Coase (1937), Klein *et al.* (1978) and Williamson (1973, 1979, 2000). Central in institutional economics is the notion that costless exchange between any two or more economic agents (persons, firms or organizations) does not exist. Any transaction comes with costs to the agent and that is what is referred to as transaction costs. Hobbs (1996), Williamson (1973, 1979) and Menard (2001) explain three major characteristics that exist to determine variation in transaction costs that cause emergence of various chains of governance structure. The characteristics include asset specificity, uncertainty or bounded rationality surrounding the transaction at stake and frequency or opportunism of that transaction. The asset specificity and exchange uncertainty conditioning becomes an issue because of opportunistic behaviour in business which brings high costs in enforcement and monitoring in spot market hence leading firms into contracting and vertical coordination as the best choice governance structure.

Hobbs and Young (2001) contend that vertical coordination may be used to accomplish several purposes including satisfying customer demand on quality food and in cost minimization. Processors may wish to control their supply chains more tightly to satisfy consumer demands for quality and safe food. Menard and Klein (2004.) argue that new regulations may impose new set of problems between retailers of safe food in importing countries and suppliers in exporting countries that might be alleviated through vertical coordination. Vertical integration is sometimes adopted as a measure to reduce information cost, in place of contracting, as in the latter; it is costly to verify whether contractual obligations are being met especially under credence goods (Williamson, 1973; 2000). Menard and Klein (2004) explain that contracting through the use of a variety of organizational arrangements (from vertical integration to production or marketing contracts to formal or informal negotiating arrangements) may generate efficiency gains by reducing transaction costs.

Transaction cost analysis has been used to provide explanation for the existence and structure of firms and for the nature of vertical co-ordination within a supply chain (Menard and Klein, 2004; Hobbs, 1996; Williamson, 1979). Transaction costs Economics assume that when transaction costs are low, transactions will be carried out in spot markets, and when transaction costs are high, it becomes efficient to set up an organizational structure hierarchy for carrying out transactions (Williamson, 1979). When transaction costs increase or decrease, a different governance structure between spot market and hierarchy may be chosen to carry out the transactions. In between the two extremes there are hybrid structures namely strategic alliances, formal written contracts, vertical integration, quasi-vertical integration and tapered vertical integration (Hobbs *et al.*, 2001) that may arise as need be.

2.6.3 Supply chain concept

Supply chain is now a commonly used term internationally and encompasses every effort involved in producing and delivering a final product and/or service from a supplier/producer to consumer (Wysocki *et al.*, 2003; Shaheen, 2005). Its primary focus is on cost and efficiencies of supply and flow of materials from their various sources to their final destinations. In recent literature there has been evolution of supply chains that synchronize the flow of value and supply. Feller *et al.* (2006) argue that supply chains focus upstream on integrating supplier and producer processes, improving efficiency and reducing waste while value chain focus downstream on creating value in the eyes of the customer. However, for supply chain to generate maximum value in the current dynamic environment of rapid shift in tastes, preference and demand, it must synchronize the flow of supply with the flow of value from customers (Feller *et al.*, 2006).

Supply chain management concept has been used to analyse performance of supply chains. However, there have been some similarities between the concepts of supply chain management and value chain. Hobbs and Young (2001) differentiate supply chain management from value chain by describing the former as the entire vertical activities from production on the farm, through processing, distribution, and retailing to the consumer regardless of how it is organized and how it functions while value chain is a vertical alliance or strategic network between numbers of independent business organizations within a supply chain, often encompassing the entire spectrum of the supply chain from consumer to producer.

Both supply chain management analysis and value chain focus on the relationships between members of the chain. According to World Bank (2005) the supply chain management is emphasising on the role of the lead firm in organising its supply chain. World Bank (2005) maintains that supply chain is a superior form of organising productive systems by emphasising the role of lead firms and stressing the positive outcomes of partnership linkages. This form of analysis privileges a single way of organising agribusiness supply chains. In contrast, the global value chain approach does not privilege one type of coordination and explicitly addresses the questions of power inequalities.

Thorpe and Bennet (2004) describe fish supply chain as a set of interdependent agents (fishers, processors, and distributors) that work together, consciously or unconsciously, to convey a fish derived product to the eventual consumer and argue that an action of one actor in the chain affects the livelihood of all actors in the chain. Consequently, the growth in trading relationships and supply chain will demand effective chain governance mechanism to ensure returns are maximized at the chain level. For example, food safety standards that affect fishing trade, demand new governance mechanism to ensure consumer protection. One effect of this supply chain once dominated by artisanal fishermen is that it may gradually be transformed and concentrated in fewer hands and become more vertically-organised (Thorpe and Bennet, 2004). Gibbon (2000) refers to the emergence of vertical organised chains as “chain shake-out’ following introduction of food safety standards in the Tanzanian Nile perch industry.

2.6.4 Review of empirical methods

2.6.4.1 Methods for assessing choice of governance structure

Recent studies using econometrics have shown that high level of asset specificity or uncertainty increase transaction costs which cause a shift to another contractual arrangement (Jaskow, 2003; Masten, 2000). Other studies using logical mathematical models have however shown circumstances in which several substantially different arrangements co-exist, without significant differences.

Menard (1996) using multinomial Logit model shows that different arrangements or governance structures with same performance co-existed in water supply in France. Masten and Saussier (2002) provide a general mathematical form that assist in assessment of factors that influence choice of governance structure. The general mathematical form represent the theory that transactors will choose a governance or contract if the expected gains are greater than those from other forms of organizing the transaction. The mathematical form presents the choice as a standard discrete choice problem as follows:

$$G^{*} = G^{C} \quad \text{if} \quad V^{C} > V^{a} \qquad \text{……………………………………}(1)$$

and

$$G^{*} = G^{a} \quad \text{if} \quad V^{C} \leq V^{a} \qquad \text{……………………………………}(2)$$

where

G^{*} represents governance form actually chosen

G^{C} represents contracting and

G^a represents alternative to contracting

V^C represents gains from contracting and

V^a represents gains from alternative to contracting

The general mathematical form is more feasible in solving relations that are affected by non-measurable cost such as transaction costs. The form is solved using logical mathematical methods where factors that influence costs are assessed.

2.6.4.2 Methods for quantifying compliance costs and benefits

Antle (1999) discusses three approaches used in estimating regulatory costs and benefits which include Accounting, Economic-Engineering and Econometric approaches. Selection of the approach depends on objective of the study. Details on the three approached is provided below.

(a) The accounting approach provides quantitative information about economic, environmental and social impacts that is intended to be useful in making decisions. An accounting method is thus a process of describing the effects of an action or decision. The approach uses data from pilot programs or from survey of plants that have adopted quality control systems to construct estimates of the components of the quality control system, such as additional labour in operating HACCP and additional capital requirements for process control. This method is operationally straight-forward; however it has some shortcomings including the following:

(i) The unlikeliness of the approach to identify all of the inputs required in safety quality because some are not observable,

(ii) The approach is unable to measure the effect of regulation on the overall operating efficiency of the plant; and

(iii) The problem associated with sample size. Use of small number of plants due to survey costs, make the approach unable to represent a large and diverse industry such as food industry.

Though the econometric method seemed to be more feasible in economics studies, the accounting method appears to have been used more widely. Henson *et al.* (2000), Jensen and Unnevehr (2000), Colatore and Caswell (2000) and Golan (2000) have applied the accounting method in assessing the use of HACCP in the livestock industry. Jaffee (2003) and Aloui (2004) have applied the method in primary agricultural production systems. An empirical study by Khatun (2004) provides reasonable results on costs and benefits of HACCP implementation on fish. Khatun (2004) conducted a study on fish trade liberalization in Bangladesh and examined the possible impacts of Sanitary and Phyto-Sanitary (SPS) measures and eco-labelling on shrimp exports from Bangladesh. The study identified three categories of costs which are upgrading, certification and training. The study also identified benefits based on environmental performance, economic and trade consideration, and corporate image. Though the study seemed to provide results on costs and benefits, the analysis could not provide details due to lack of data.

(b) Econometric approach can be used as alternative cost estimation method. The approach uses data sets that are representative of the industry to statistically test hypotheses related to behaviour and production structure e.g. whether a particular quality system technology is jointed in output and product quality (Antle, 1998b). Antle (2000) assesses compliance cost in beef using econometric equation in a form

$$c(y,s,q) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where:

y is output quantity,

s is product safety, and

q is a vector of other non-safety quality attributes.

The general functional form thus becomes;

$$C(y,s,q,w,k) = vc(y,s,q,w,k) + qc(s,q,w,k) + fc(k) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where: $C(y,s,q,w,k)$ is total cost,

$vc(y,s,q,w,k)$ is variable cost that depends on both output and product quality,

$qc(s,q,w,k)$ is a separate component of variable cost associated with quality control that is independent of y but dependent on s and q

$fc(k)$ is the conventional fixed cost

C component for capital k which is independent of both output and quality

(c)The economic-engineering approach was used prior to the development of duality based econometric models for production cost analysis. The approach uses detailed

engineering data combined with data on input costs to construct quantitative models of the production process. The approach is too costly and therefore like the accounting approach, it may fail to capture industry heterogeneity and may not provide information that is representative of the industry if a small number of plants are used (Antle, 1998b).

CHAPTER THREE

METHODOLOGY

3.1 Overview

This methodology chapter is divided into five sections. Section one discusses the conceptual framework of the study using a schematic illustration. Section two provides details on sampling and data collection methods. Section three provides explanation of methods used to analyse the data, data variability and means used to solve the variation. Section four provides explanation of study hypotheses, variables used in the analysis and mathematical models applied to test the hypotheses. Section five highlights limitations and difficulties encountered during the study.

3.2 Conceptual Framework

The conceptual framework in Fig. 2 depicts the linkage between costs of implementation of international food safety standards to changes in the organization of Nile perch industry in Tanzania. The framework identifies driving forces behind implementation of the standards and how different players react to these forces, which created conducive environment for market evolution or vertical coordination in the Nile perch export supply chain. Fig. 2 shows that, the export market in developed countries, notably the European market is the one that sends signals of food safety demands by consumers. In response to consumers demand for safe food products, international public and private organizations such as WTO, ISO, Codex, EU and British retailers association insisted and spearheaded the setting up of standards such as ISO 9000, ISO 22000, and traceability to assist exporting countries to adhere to them and ensure safe products for consumers (World Bank, 2005a; Unnevehr and Hirschhorn, 2000; UNIDO, 2003; Nanyaro, 2009). In addition to these voluntary standards, private international retailers such as EU fresh food retailers like British Retailers Consortium (BRC) responded to consumers concerns and the international regulatory changes by developing their own protocols and passing them upstream to developing countries exporters as private standards (Waniala, 2002). The retailers' protocols are often considered more stringent than regulatory requirements (Fulponi, 2006).

To secure the markets in Europe, the developing country exporters and their governments had to respond to the international standards requirements by setting up national standards and adhering to the stringent international standards. The adherence involved rigorous policy review, adoption of new regulations, skills upgrading for quality inspectors and auditors, improvement of public infrastructures such as roads, landing sites and laboratory facilities.

Another feature captured in Fig. 2 is enforcement of both international and national standards on fish. This is done by a legally established Competent Authority, which is the Fisheries Department (FD). The legal competent Authority sometimes fulfils its mandates using local and international entities or bodies (URT, 1999; FD, 1999; CEC, 2001). The mandate ensures certification of production systems and products, accreditation of laboratories, inspection and auditing of operational manuals of specific standards.

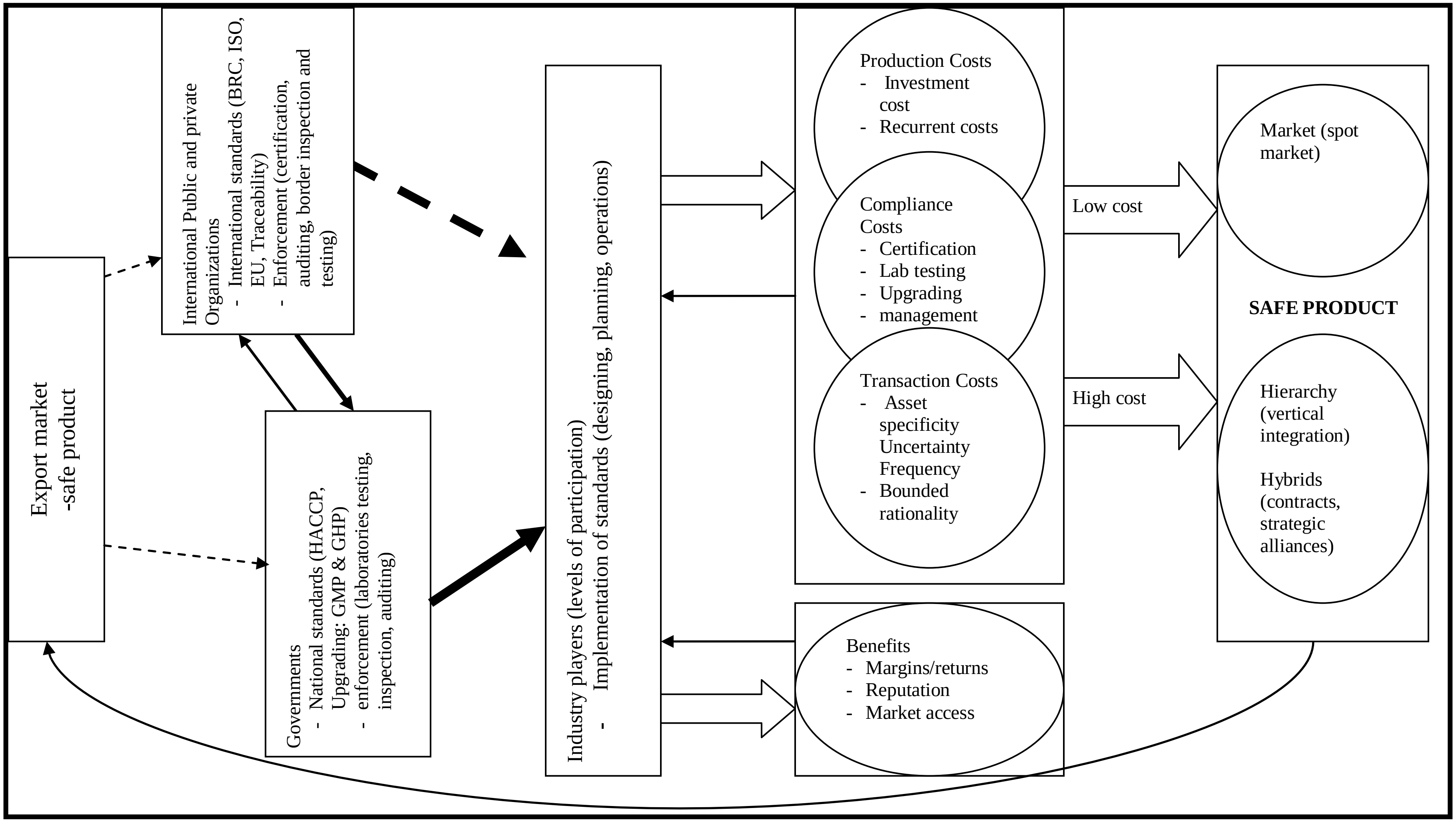

Figure 2: Conceptual framework for the study

Source: Conceptualized from Antle (1998), Williamson (1979; 2000), Hobbs and Young (2001) and Menard (1996).

All these have cost implications to the implementers of the standards. The implementers of the standards are the key players and they range from fishers, traders of raw fish to processors and exporters of safe product. The costs of implementation of standards which are referred to as compliance costs arise from investments on capital assets, production system certification and safety management practices that demand retraining of human resources and/or recruitment of new staff especially for quality and safety control. The management practices for product processing include product testing (both in-house laboratories for daily product testing and external laboratory testing), documentation, and supervision. For fishing and fish trading, it includes proper handling and transporting of fish.

Depending on the type of export products, some asset-specific investments might be necessary. These include investment in specific locations, specific assets and training in specific skills. In these circumstances hold up problems are likely in the industry thus contracts drawing is a sensitive area in this supply chain.

Implementation of international standards requires participation of the key industry players. This is yet another feature which is shown in the conceptual framework. The decision to participate in fishing for export will thus depend on the expectation of the supplier on the benefits that will be accruing from the activity. The benefits can be the margins and/or reputation which will enhance accessibility to the market for longer period. The reputation that a firm is certified for a particular standard enhances market accessibility and could be financially beneficial over a longer time perspective. If the expectation indicates that the benefits are higher, the supplier will engage in standard requirements activities related to the export product. Once participation is observed, the other issue is the level of meeting the international standards i.e. level of compliance. This is influenced by the cost incurred and benefit accrued because of compliance. When it comes to international food safety standards there are no levels of compliance however, the uncertainties involved may cause variations in meeting the requirements

3.3 The Study Area

The study was carried out in nine districts in Mwanza and Mara regions located around Lake Victoria on the Tanzania side of the lake. On the Tanzanian side, the lake is surrounded by three regions namely; Kagera, Mwanza and Mara. Mwanza region was selected because Mwanza City is the major centre for the Nile perch business. The first processing plant was established in Mwanza in 1992 and by 2000 a total of 7 plants had been established in Mwanza while only 3 and 2 plants had been established in Mara and Kagera regions respectively, (Mwanza office report, 2006). The initially established processing plants in Mwanza made it possible for the study to gather all necessary information required namely cost and benefits for both before and after compliance with food safety standards. The processing plants in Mara were established after import bans, hence they were constructed with approved compliance layouts. In this way Mara region was used to triangulate the analysis of costs and benefits of compliance. Kagera region could not be used because at the time of survey only one processing plant was in operation while the second one was under construction. The one in operation is a branch of a processing plant in Mwanza; hence no additional tangible benefits would have been obtained to include it in the survey.

The lake lies in the middle of a flat and gently rolling plateau, at a height of around 1100 m above sea level. Throughout the plateau are spectacular granite outcrops and close to Mwanza city these form cliffs around the shore. The majority of the population in this shoreline belong to the Wasukuma people. Other big tribes are Wakerewe, Wahaya, Wagita and Wakurya. The total population on this shore line was estimated at 8 million by the 2006 National Census (World Bank, 2005a).

There are several economic activities around lake Victoria including fishing, livestock keeping and crop farming, mining and trading. Fishing as a major economic activity involves several species, but only three main species namely Nile perch, sardine (*dagaa* in Kiswahili) and Nile tilapia (*sato)* are commonly traded. The trading shares for the three species are Nile perch (65%); *dagaa* (20%) and *sato* (15%). The major crops grown include maize, paddy, banana, sorghum, cassava, legumes, cotton and coffee. Other activities are mining and trading.

3.4 The Research Approach

Two approaches were used to determine the effect of food safety standards on the organization, costs, benefits and distribution of costs and benefits among actors in the

Nile perch supply chain. These approaches are the “before and after” and “with and without” conformity to standards for downstream and upstream actors respectively. A preliminary survey carried out in August 2005 was used to assess the justification of the “before and after” compliance or “with and without” compliance. The “with and without” approach was employed to assess effects upstream due to similarities between small scale operators in Nile perch. *Dagaa* fish made it feasible to compare the two chains given the fact that the chain is not subjected to food safety standards.

On the other hand, the “before and after” approach was applied downstream at the processing level in the Nile perch export supply chain owing to lack of industrial fish processing for *dagaa*. This was possible because some processing plants were willing to avail data covering the periods before and after implementation of the food safety standards (i.e. data from 1994 to 2007).

3.5 Sampling Procedure

The preliminary survey was used to identify actors involved in the Nile perch supply chain on the Tanzania side of Lake Victoria. An attempt was made to distinguish between actors at different levels of different supply chains. This was important as the study was interested in export supply chain. The survey was also used to identify the number of actors at different levels of the chain together with the scale of their business. The findings from the preliminary survey indicated that:

(a) Only Nile perch and *dagaa* are involved in export business. Fisheries regulations forbid exportation of Tilapia (*Sato*)

(b) The export supply chain for Nile perch consist of three main channels; supplying fresh fish to the European markets, Regional/African markets and the domestic market while the *dagaa* chain supplies dried fish to the Regional African markets and domestic markets. The latter chain is therefore not subjected to compliance to the EU food safety standards.

The chains involve various actors including fishers, boat owners, fish collectors/traders, industrial and artisanal processors and other service providers such as net menders, boat repairers and cooks just to mention a few. Though the actors are many, this study focused on export supply chain; hence an emphasis was on fishers, boat owners, collector/traders, industrial processors and exporters. Information obtained from District fisheries offices indicated that traders, non-fisher boat owners, non-boat owners / boat owner fishers comprise 1.0%, 9.9%, and 89.1% of the total population respectively. Whilst this is a sample composition the actual sampling was constrained with availability of actors at landing site during the field survey. Based on the findings of the preliminary survey, samples of fishers, boat owners, traders and processors for the study were drawn as described below.

3.5.1 Selection of fishers

A total of 19 landing sites that include 10 Beach Management Units (BMU) and 9 local villages (in case of BMU's absence) offices were used to identify fishers operating in a particular landing site. Random sampling using lists of names of fishers presented by the offices were used. However, fishers' availability at the time of interview sometimes rendered the given list invalid. In such situation, other fishers from a similar site were interviewed. The given lists of names were however important in ensuring that the alternative fishers interviewed were from the target landing site. The total number of interviewees for the study was 67 and 75 non-boat owner and boat owner fishers respectively.

3.5.2 Selection of boat owners

The importance of differentiating compliance to standards based on size or scale of business necessitated the need to categorize boat owners before sample selection. FD had categorized boat owners into 3 groups for tax/levy purposes. The first category is small scale owning 1 to 4 boats; the second is medium scale owning 5 to 8 boats and large scale group that own more than 8 boats. These categories were used in sample selection. Availability of boat owners on the day of interview and decline in fishing activities affected sample selection. For example, in some landing sites, boat owners who are considered large scale operators had been reduced to one, which means an interview for that category in that landing site was hundred percent.

3.5.3 Selection of traders

Traders were grouped into dealers, traders operating trucks/vehicles and traders with motorized boats also known as *karua*. The total number of interviewees was 58 including 44 Nile perch traders and 14 *dagaa* traders. The Nile perch traders comprise 14 dealers, 20 traders operating trucks and 10 operating motorised boats/*karua*. Selection of the traders was affected by their availability and willingness to be interviewed.

3.5.4 Selection of processors

During field survey in 2007 there were 10 processing plants operating in the three regions in Lake Victoria as two had been closed on non-conformity reasons. However, the study concentrated on five processing plants operating in Mwanza region which have been in operation since 1994 before the EU import bans.

3.6 Data Collection

3.6.1 Secondary data

The research reviewed various documents such as published data, reports, articles, papers and books to gather necessary information in relation to food safety methods applied in fish in Tanzania and fish production and processing in lake Victoria. These documents were sourced from the Internet, Fisheries Division Headquarter in Dar es Salaam, Mwanza Region Fisheries Office, Districts Fisheries Offices in Mwanza, Lake Victoria Fisheries Zone Office, Tanzania Fisheries Research Institute (TAFIRI), Tanzania Industrial Fish Processors Association (TIFPA), Tanzania Fishermen Union (TAFU) and Lake Victoria Environmental Management Program (LVEMP). The information collected from various sources is summarised in Table 5.

3.6.2 Primary data

Primary data were collected in four phases as described in the following sections.

3.6.2.1 Phase I: Preliminary survey

A preliminary survey was carried out in January and February 2006 in Mwanza region. During the survey, interviews with key fisheries agencies and focus group discussions were conducted. An interview with key fisheries agencies such as fish quality inspectors and laboratory agencies and BMUs was conducted. These aimed at understanding institutional arrangements in the industry identify standards requirements and assess the level of conformity to the standards.

Table 5: Secondary data collected and their sources

Source	Type of data collected
Fisheries Headquarter in Dar es Salaam,	(i) Nile perch export data from 1995 to 2005, (ii) Export market destinations for year 2007 and 2008 (iii) Role of Quality Control Division
Mwanza Region and District Fisheries Office	(i) Nile perch production from 1996 to 2005 Mwanza region
Lake Victoria Zone Fisheries Office,	(i) Role of the Zone Fisheries office and monitoring strategy (ii) Food safety standards implemented (iii) Laboratory services and costs (iv) Processing plants established and food safety standards requirements
TAFIRI research centre	(i) Researches conducted in respect to Nile perch fishing activities
TIFPA processors association,	(i) Objective of the Association (ii) Achievements and challenges
TAFU fishermen union,	(i) Objective of the Association (ii) Achievements and challenges

LVEMP	(i) Role of the organization in Nile perch fishing (ii) Their contribution and challenges in Nile perch activities

A checklist presented as Annex 3 was used to gather information from fisheries officers, fish quality inspectors, laboratory agencies and BMU officers.

The focus group discussions were aimed at obtaining information on supply chains arrangements in fishing activities in Lake Victoria, and actors' understanding on compliance costs and benefits. Identification of compliance cost was necessary because the initial visits prior to the study indicated that those costs were not well understood by the actors. The focus group discussions were conducted at Kayenze, Mchangani and Magu landing sites in Mwanza region. Kayenze was selected because of its magnitude of fishing business and the fact that it was among the first sites to be improved after the introduction of food safety standards in 1997/98. Mchangani is moderately improved while Magu is a seasonal landing site.

Focus group discussions were made with a group of 5 fishers, 6 collectors/traders (3 truck owners, 1 boat owners and 2 dealers), 8 boat owners (3 boat owners and 5 boat owner-fishers), 2 service providers (boat repair, fuel supplier). The discussions identified and separated compliance costs from other quality costs before preparing a structured questionnaire used in detailed interview. Selection of the participants in the discussion was influenced by the nature of fishing activities in the Lake. Hence a village leader was approached, and with his assistance the study identified different types of actors based on type and size of activities. Annex 4 provides a checklist that was used during focus group discussions to gather information on compliance costs knowledge from fishermen/boat owners and traders/collectors.

3.6.2.2 Phase II: Questionnaire survey

The questionnaire survey was conducted in October and November 2006 covering a total of nine districts in Mwanza and Mara regions. These include six districts in Mwanza region, (Sengerema, Ukerewe, Magu, Ilemela, Geita and Nyamagana) and three in Mara region (Musoma rural, Musoma urban and Rorya). During this survey, interviews were carried out using a structured questionnaire with separate questions for fishers, boat owners and traders/collectors. The questionnaire is presented as Annex 5. The questionnaire consists of questions on characteristics of the actors, production, contractual or governance structure, costs and benefits. A separate questionnaire was used to collect information from the sampled industrial processors (Annex 6). The questionnaires were prepared in English and administered in Kiswahili.

3.6.2.3 Phase III: Visits to fisheries office and laboratory agencies

The third phase involved visits made to the Fisheries Division Headquarters in Dar es Salaam in August 2007 to collect further information on new developments on standards, quality control and fish exports. During the visit, discussions were held with the officers in charge[22] of quality control and statistics sections. Visits were also made to the four main laboratory agencies located in Dar es Salaam in November 2007.

3.6.2.4 Phase IV: Follow-up survey

The follow-up survey was carried out in May 2008 for data validation and gap filling. During this visit, the same questionnaire was administered in six districts namely Ilemela, Sengerema and Geita in Mwanza region and Musoma urban, Musoma rural and Rorya in Mara region.

3.7 Data Processing

The data were processed using the Statistical Program for Social Science (SPSS) Version 11.5. In order to clean the data, summary statistics such as frequencies, means, maximum values, minimum values and standard deviations were computed to identify outliers and hence reduced the number of obvious misleading observations. In the data cleaning process four observations were deleted based on incomplete information and having numbers far below the average. At the end of the data cleaning process the data set remained with 234 observations that included 84 Nile perch boat owners, 25 *dagaa* fish boat owners, 44 Nile perch traders, 14 *dagaa* traders, 43 Nile perch fishers and 24 *dagaa* fishers.

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[22] Mr. Kumila Julius is the officer in charge of statistics section while Mr. John Makenya is a Principal Assistant Fisheries Officer who at the time of field survey he was acting as in charge of quality control section at headquarters office in Dar es Salaam

3.7.1 Computation of relevant variables

The relevant variables for assessment of effects of compliance on governance structure of supply chain were computed as described below.

(i) *Number of boats*

Total number of boats was computed by summing up quantity of boats owned and hired. The same method was used to compute total number of engines operated by actors.

(ii) *Size of business*

The number of boats operated was used to determine size of business for boat owners. This was categorized based on district government popular method of categorizing boat owners for levy/tax purposes. The categories were: (a) Small scale boats owners which comprise a group of those who operate 1 to 4 boats, (b) Medium scale boat owners who operate 5 to 8 boats and (c) Large scale boat owners who operate more than 8 boats.
This was adopted because it was seen as the best method as there was a decrease in number of boats operated by single actor in the Lake, to the extent that in some landing sites we could hardly get a single respondent with ten boats.

(iii) *Operational costs*

Total individual actor operational cost was calculated based on itemized costs provided by individual respondents during field survey. The computed costs were then compared to total costs provided by the same respondent. Where there was a large difference between the computed and given costs, the computed figure was taken assuming that they are more reliable because it is easy to remember individual costs than remembering total costs.

(iv) *Total revenue*

Total revenue from fish was computed by summing up the revenues from all household members involved in fishing related activities. The summing was done after computing individual household members revenue using volume of catch and selling price provided in the questionnaire. This was then compared with the given total fish revenue. When there was a difference the computed value was taken assuming that the price figures were more reliable and fish catch volumes are easy to remember. Using computed value of revenue reduced the possibility of using underreported revenues which is a common problem with primary data on income.

(v) *Education*

The variable education was also decoded from the grouping form to number of years. This was necessary because assessing influence of education in transaction costs require number of years. This was done using the knowledge on number of years for each certificate qualification.

(vi) *Inspection methods*

The variable inspection method was computed by counting the number of methods given in a multiple response question. This was done using multi-response formula in SPSS.

(vii) *Physical household assets*

Value of household physical assets was computed using number of household assets owned multiplied by the current value.

(viii) *Contracts*

The variables related to contract were decoded after running frequencies and establish common answers and group them to have a smaller number of codes.

After computing all the variables, a correlation test was run using a bivariate method in SPSS to establish variables that are related. More attention was given to the following variables:-

(a) *Age* and *duration* in fishing business because all are measured in terms of number of years and it is obvious that those with lower age would have less number of years in the fishing business.

(b) *Household assets* and *fishing income* because of the problem of endogeneity

In addition to the computed variables above the results of the preliminary survey shows that there are notable effects on governance structures resulting from shortage of fish supply rather than compliance hence some relevant market variables were identified. The variables include:

(i) *negot* which is ability to negotiate in fish market

(ii) *loanacc* which represent access to loan from a buyer and

(iii) *fbuyer* which represent the position of a buyer in a supply chain

3.8 Data Analysis

Statistical Program for Social Science (SPSS) and STATA programs were used during analysis depending on their strength in addressing a specific objective. The STATA software is stronger than SPSS in fitting categorical regression models hence was used in addressing objective three. The following sections describe in detail the analyses carried out to achieve the objectives of the study.

3.8.1 Level of compliance with food safety standards in Lake Victoria

A list of critical quality requirements that actors are supposed to meet was prepared and compared with their actual practices. Descriptive statistics were used to assess level of compliance by actors at different stages of the Nile perch supply chain.

3.8.2 Influence of food safety standards on governance structure

3.8.2.1 Model setting

A mathematical model that assesses emergence of various governance structures in supply chain was adapted. The theory assumes that when costs increase in certain market arrangements the actors choose the arrangement with minimum total cost. Implementation of food safety standards in Nile perch industry led to increase in total costs which include production costs, compliance costs and transaction costs. Thus a general form representing effect of compliance to governance structure or choice of arrangement or contract can be written as follows:-

$$GS = f\left(PC + CC + TC\right) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (5)$$

Where:

GS = governance structure or contractual choice

PC = total production cost

CC = total compliance costs

TC = total transaction costs

Because it is not easy to measure a transaction cost which is one of the variables in the mathematical model, a Logit model was used to assess its influence on emergence of governance structure. Thus variables related to sources of transaction costs were identified and subjected to the above governance structure function as follows.

$$GS = f\left[PC + CC + TC\left(x_i\right)\right] \quad \text{……………………………..…….. (6)}$$

$$TC = f\left(x_1, x_2, \ldots x_n\right), \quad \text{……………………………………………… (7)}$$

Where x_i are the variables related to sources of transaction costs

The above equation was then estimated using Categorical Regression Model (CRM) specifically Multinomial Logit Regression model. The model was selected because unlike Binary Logit Model, the Multinomial Logit Model does not impose constraints among coefficients that are implicit in the definition of the model. In this case a set of contractual choices identified under the study as dependent variables were estimated against a set of independent variables. Thus solving *K* equations, predicted probabilities can be computed using a formal Statement of Multinomial Logit model written as:

$$\Pr(y = m \mid x) = \frac{\exp(x\beta_{m|b})}{\sum_{k=1}^{K} \exp(x\beta_{k|b}} \quad \text{……………………………………. (8)}$$

Where:

m are the categories of nominal outcome which are the contractual choices identified

b is the base category or comparison group selected from the categories of the contractual choices.

3.8.2.2 Empirical model for assessing change in governance structure

The initial finding of the study on the relationship of actors along the supply chain indicated that there are two types of contracts; (i) fishing and (ii) trading. The two contracts necessitated separate model fitting as described below.

(i) Fishing contractual arrangements

In fishing activities, the contractual arrangements were initiated by the boat owners, that the fisher chooses an arrangement among available choices. In most cases, the arrangements are location specific thus fishers are compelled to join them for lack of options. While fishers were looking for contracts that were profitable because they only had labour to invest on, the boat owners would put on the table fishing contractual arrangement that has been influenced by uncertainty variables: *selling price, volume of catch and type of fish buyer*; and financial constraint variable: *value of all other non-fishing assets and access to loan*.

(ii) Trading contractual arrangements

In fish trading contractual arrangements, both agency and principal are concerned with their investment. The quality issues had strengthened the arrangements with more demand for investment to finance quality assets; hence in addition to the variables under fishing contracts, asset specificity variables were included under trading contracts.

(iii) Effect of transaction costs on fishing and trading contractual arrangements

Two more hypotheses were introduced to support hypothesis one in section 1.3.3. The two hypotheses were used to identify the determinants of choice of type of contractual arrangement based on asset specificity and uncertainty as sources of transaction costs. The hypotheses are:

(i) Hypothesis 1

Involvement in Nile perch activities requires specific investment to provide fish that comply with food safety standards. It is hypothesized that the higher the compliance with food safety standards the higher the probability of engaging in a more integrated market arrangement. Thus parties involved in Nile perch fishing needed to invest more in specific fishing assets as per standards which increases their likelihood of getting into a more integrated market.

(ii) Hypothesis 2

It is hypothesized that, the higher the uncertainty to supply, the higher the probability of engaging in a more stringent contractual arrangement. This hypothesis emphasises on the uncertainty created by degree of asset specificity, nature and frequency of the transaction. Fish being a highly perishable product that required complying with food safety standards can be a source of a hold up problem which is expressed in price and type of fish buyer. In addition to that, volume of catch that indicate frequency of transaction can influence level of uncertainty.

The two hypotheses assume that parties have a strong incentive to choose the most efficient type of contractual agreements however, the assumption is reasonable if the parties operate in a competitive market. Otherwise, other economic factors such as financial constraints and market power can influence initiation and choice of the contractual arrangements.

3.8.2.3 Variables for the fishing contractual model

Table 6 shows the dependent and independent variables included in the fishing contractual model. These variables are described below.

(i) Dependent variable *(Fcontracts)* was split into three groups' namely equal share of daily revenue (ER), equal distribution of fishing days/turnover (ET) and unequal distribution of fishing days/turnover (UT). More on these groups are discussed under results and discussions in chapter four.

(ii) Independent variables

(a) *Investment*

The investment variable was computed using data on value of boats and engines operated by fishers. It was expected that, acquisition of a large number of boats and engines would tie the transactor into specific asset that he would need to integrate into a higher cost minimization arrangement to ensure his investment.

(b) Sellprice

The selling price variable was used to reflect the characteristic of uncertainty. Uncertainty might create a room for hold up problem from any opportunistic partner transactors using price to facilitate his motive. For boat owner to put up a contract that hedge against hold-up problem the unit selling price needs to be stable and/or increasing. Thus higher/stable selling prices decrease preference to higher market integration.

(c) Fcatch

The fish catch variable expressed in kg per week was used to capture on the uncertainty and transaction frequency. It was assumed that the higher the volume of catch and higher frequency of transactions, the lower the level of uncertainty and the lower the level of market integration. Though one would have said that, for a perishable product, the larger the volumes the higher the level of hold up problem, but high frequency of transaction in a product that comply with standards increases trust level of supplier to the fish buyer, and therefore reducing the level of uncertainty to the supplier. Thus boat owners with high volume of catch would initiate contracts with fewer ties to fishers.

(d) Hhaset

Household asset variable was also used to assess access to finance. It was assumed that own funds were easily accessed by those who were engaged in non-fishing activities. Thus the higher the value of non-fishing assets/household assets the lower the market integration.

(e) Duration

Time period in fishing activities used to express influence of market power in the initiation of contractual arrangement. It was expected that a person involved for a long period of time in fishing activities would have more experience, more accumulation of assets and trust, thus the lesser the market integration.

(f) Unit cost

The unit cost variable was computed and inserted in the model to determine its effect on initiation of contract with an expectation that an increase in unit cost will lead to higher integrated market.

(g) Actor

The variable was used to differentiate fishers according to compliance with food safety standards. This was expressed as a dummy variable taking a value of 1 if involved in a fish product that comply with food safety standards and value 0 if otherwise. It is expected that those who are involved in fish products that comply would be engaged in more integrated markets.

(h) fbuyer

Type of fish buyer variables was used to capture market power. It is expected that those with more market power would influence choice of market arrangement that favour their interest. Also, it was expected that the furthest downstream actors or chain leaders would have power in the market such that they influence type of market arrangement for their interest.

(i) Loanac

Loan access variable was included in the model to reflect financial constraint. As the general financial system in the country is inadequate, accessing loan from buyers was used as a variable because in fishing activities, lending among actors in the fish supply chain is common and is considered the easiest way of accessing funds to finance fishing activities. Thus, access to buyer's loan is expected to increase probability of higher market integration.

3.8.2.4 Variables for trading contractual model

The dependent and independent variables included in the trading contractual model are presented in Table 7. A brief description of these variables is given in the following sections.

Table 6: Fishing contracts' variables for Multinomial Logit model

Variable name	Definition in fishing contracts
Dependent variable	ER= equal share of daily fish revenue
Fcontract	ET=equal distribution of fishing days/turnover
	UT= unequal distribution of fishing days/turnover
Independent variables	
Investment	Total value of fishing assets under fishing operations in TZS
Sellprice	Average unit selling price (TZS/kg) at the time of interview
Fcatch	Average total weekly catch volume in kg
Hhaset	Total value of non-fishing assets in TZS.
Duration	Years involved in fishing activities
Unit_cost	Unit cost of fishing (TZS/kg)
Actor	Type of fish involved where the variable taking value of 1 when Nile perch is involved and 0 when other type of fish are involved
Fbuyer	Variable was broken into four variables (i) *processor*=variable taking value of 1 when buyer is a processor and 0 otherwise (ii) *collector*=variable taking value of 1 when buyer is a boat owner and 0 otherwise (iii) *trader*=variable taking value of 1 when buyer is a trader and 0 otherwise (iv) *spot*=variable taking value of 1 when buyer is open market and 0 otherwise
Loanacc	Variable taking value of 1 when no access to loan from buyer and 0 otherwise

(i) Dependent variables

Three dependent variables *(tcontract)* were derived from four different marketing arrangements that existed for Nile perch, (a) Open or spot market (OM), (b) Contract where buyer provides loan for fishing activities (LFC) (c) Contract where buyer provides loan for fishing and non-fishing activities (LFNC) and (d) Contract where buyer provides fishing assets (FA). To avoid perfect prediction that would be caused by few respondents on the LFC contractual arrangement, the LFC contractual arrangement was combined with the LFNC arrangement to form only one variable LC where buyers provide loan.

(ii) Independent variables

The independent variables included in the trading contractual model were generally similar to those used to assess contractual choices in fishing contracts. The two models were different in the following aspects.

(a) Contrary to fishing arrangements, the variables here were used to assess choice of contracts and not initiation of contracts.

(b) *Negot:* A variable on ability to negotiate in fish market was included under trading contract to reflect on market power. The more the bargaining power the more probable to engage in less integrated market.

3.8.3 Assessment of compliance costs and benefits

3.8.3.1 Compliance costs

Quantification of compliance costs started with separation of traditional quality costs from compliance quality costs following Antle (1999) classification of costs based on joint and non-joint cost method. In addition to Antle's method, HACCP costs were identified using Unnevehr (2000) categories of cost variables.

The following sections describe how costs were assessed at the various stages in the Nile perch export supply chain:

(A) Processors' Compliance Costs

Additional costs incurred by processors after import ban in 1997 were considered to be processors compliance costs. These costs were obtained from records kept by accounts departments in the processing plants. These costs included costs associated with the additional machinery, building and activities carried out to meet food safety standards.

Table 7: Trading contracts' variables for Multinomial Logit model

Variable name	Definition
Dependent variable	
Tcontract	OM= open/spot market LC=buyer provision of loan in return for fish sale FA = buyer provision of fishing assets in return for fish sale
Independent variables	
Investment	Total value of fishing assets under fishing operations
Duration	Years involved in fishing activities
Sellprice	Average unit selling price (TZS/kg) at the time of interview
Sale_kg	Average annual total volume of fish sale in kg
Hhaset	Total value of owned non-fishing assets
Unit_cost	Total annual fishing costs
Fbuyer_dummy	Variable was broken into four variables (i) *processor*=variable taking value of 1 when buyer is a processor and 0 otherwise (ii) *collector*=variable taking value of 1 when buyer is a boat owner and 0 otherwise (iii) *trader*=variable taking value of 1 when buyer is a trader and 0 otherwise (iv) *spot*=variable taking value of 1 when buyer is open market and 0 otherwise
Loan_dummy	Variable taking value of 1 when access to loan from a buyer and 0 otherwise
Nego_dummy	Variable taking value of 1 when always negotiate and 0 when always accept price

However, it wasn't easy to identify all the costs related to compliance because as time passed, additional machinery or activity cost items were booked in the plants accounting books without differentiating between compliance and traditional costs. Using one plant, which was more willing to provide costs data, the study used the data to obtain the costs.

The plant is an average processing plant in terms of production capacity and location (which is neither in the City centre nor on the outskirts), which provide an advantage to the study in terms of providing an average assessment of compliance cost to processors. Assessment of compliance costs to processors was based on the following.

(i) Most of the data used were from a processing plant with an average installed capacity of 80 tons per day

(ii) Prior to comparison, the data were transformed into constant prices using 1992 as a base year based on the Bank of Tanzania (BOT) statistical reports

(iii) Estimation on loss in output due to slow down or stop production to allow plant rehabilitation was conducted based on amount of fillet produced before rehabilitation multiplied by number of months the plant was closed for rehabilitation

(iv) Estimations for laboratory tests conducted outside the processing plants were based on the following;

  (a) Testing fee for whole fish was estimated using a unit fee of TZS 70 000 per six parameters multiplied by 26 weeks as the testing was required after every 2 weeks

  (b) Total sample destroyed when conducting tests on whole fish was estimated using the average of 6 kg multiplied by 26 weeks times local market selling price for whole fish TZS 1800 per kg

  (c) Fillet testing was estimated in the same way as whole fish as the fee amount and frequency of testing was the same.

(d) Total amount of fillet sample destroyed was calculated based on 4kg required multiplied by 26 weeks times export fillet FOB price equivalent to TZS 3 600 per kg.

(v) Estimation on laboratory testing conducted in processing plants (using in-house laboratories) was estimated using TBS testing rates because figures on re-agents used in the in-house laboratory could not be established. The tests involved daily testing of fillet, weekly health checks of direct processing labourers, tests on wastes from cutting tables and personnel aprons. The costs were estimated as follows:-

(a) As most processing plants were carrying daily test on 3 key microbiological parameters, the study used the same to estimate test costs using TBS test fee of TZS 12 000 per parameter multiplied by 360 days in a year

(b) The value of sample damaged was calculated based on a 2 kg sample used per test multiplied by 360 days times FOB equivalent price of TZS 3 600

(c) Workers' health check cost was estimated using a rate charged by medical laboratories in Mwanza of TZS 1000 per test. The rate was multiplied by average number of 100 workers tested per week, times 52 weeks in a year

(d) Test on wastes on cutting tables and aprons were estimated as half the amount of the cost of checking workers health because the test was on randomly selected samples of aprons used by the workers and of the samples of wastes from different cutting and washing tables.

(B) Traders Compliance Costs

Traders' compliance costs were distinguished by comparing the current practices to what was the normal practice before the import ban. Gibbon, (1996) and Mitullah, (2004) also provided a clear background on transporters' practices before the EU import bans. Thus the current transporters operations were related to compliance to food safety standards hence compliance costs.

Computation of compliance costs to traders includes value of fish that rejects due to non-conformity to standards. This was computed using net loss price multiplied by the average amount of fish reject. The net price was computed as difference on the market price for quality and rejected fish. The market prices offered by processors to traders during the field survey were TZS 1800/kg and TZS 250/kg for quality and rejected fish respectively.

(C) Boat Owners' Compliance Costs

These were determined by comparing boat owners who are involved in Nile perch fishing and those who are involved in *dagaa* fishing. Though fisheries regulation cut across all types of fish from the lake, more emphasis is on Nile perch fishing which is exported mainly to Europe.

3.8.3.2 Benefits of compliance with standard

The assessment on compliance benefits considered both quantitative and qualitative benefits to individual actors in the export supply chain. Various factors were used as indicators of compliance benefits to the actors as summarised below.

(a) Compliance Benefits to Processors

Benefits to processors include guaranteed market, premium price, and sustainable production. These benefits were assessed using export volume trends and variation in FOB price since the uplift of EU import bans. Improved firms image and trust were used as criteria for benefits of compliance due to the fact that good image and trust among importers of Nile perch would sustain exports of Nile perch.

(b) Compliance Benefits to Traders

Benefits to traders include access/guaranteed market, price premium and gross margins. The guaranteed markets were assessed using real price and volumes of fish rejected by processors due to non-conformity since 1996. Price premium was calculated as net price of quality and rejected fish. The processors' price offered to Nile perch traders was used to calculate the net price. Gross margins were computed as difference between traders' total revenue and recurrent costs in TZS.

(c) Compliance Benefits to Boat Owners

The benefits to boat owners include guaranteed market, price premium and gross margin. However, the guaranteed markets were assessed using volumes of fish supplied by boat owners to processors and/or traders. The premium price was calculated as net price of quality and rejected fish using respective market prices offered at landing sites.

3.8.4 Limitations of the study

The main limitation of the study was accessing information especially from the industrial processing factories. The Nile perch industry is dominated by direct foreign investments with minimum interaction with private or non-business officials or individuals. This led to difficulties in obtaining data from them. It is also clear that as private business, giving out cost data means revealing processing plant's cost structure which is a strong business competitive strategy. It was also difficult to gather information from processors because at the time the Darwin's Nightmare film (a negative picture about Nile perch industry in Tanzania) was broadcasted internationally. This made the processors to be more cautious in providing information about the industry. However, a substantive amount of all necessary required data was obtained through various efforts including, inviting stakeholders into workshops organised by the SAFE project so that they could understand the objectives of the study; securing an introduction letter through the Fisheries Headquarters in Dar es Salaam and get into a verbal confidentiality agreement with the processing plants which led to reporting on the findings using letter codes for the plants instead of their actual names. Cooperation from one of the processing plant who was willing to reveal a lot of costs information is also highly recommendable. Thus most of the analysis conducted for processors was based on data from this processing plant. Thus the results should be interpreted based on the above mentioned research limitations.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents and discusses the results of the study. The chapter is organised in seven main sections including the overview. The second section describes the structure of the existing Nile perch (NP) supply chain, indicating the channels through which fish and fish products pass from fishermen to the different markets. Section three presents a detailed analysis of the actors and comparison of main characteristics, assets owned by the different actors and levels of investment in fishing related activities.

Section four describes various actions and activities undertaken by the government and different actors in the Nile perch supply chain to ensure compliance to food safety standards. The section also discusses the mandatory and voluntary standards in Nile perch processing and the extent of implementation to meet these standards. Section five provides a detailed assessment of the costs and benefits associated with compliance to food safety standards. Section six presents and discusses changes that have occurred in organization and governance of the supply chain because of the compliance to food safety standards. Different contractual arrangements amongst actors in the supply chain that have emerged after introduction of food safety standards are discussed in detail in this section. The chapter winds up with section seven that discusses the results of multinomial logit models used to analyse the different contractual arrangements.

4.2 The Nile Perch Supply Chain

Evolution of Nile perch supply chain can be traced way back from Nile perch boom and commercialization in the 1980s, later trade liberalization and export of Nile perch in the 1990s. However, the supply chain by then was less complex. The chain was dominated by artisanal fishers, traders/agents, fish mongers and artisan processors (Fig. 3). Most of the medium traders were agents to local processors and Kenya fish exporters as there were no large scale processing activities in Tanzania. Later in mid 1990s, the first processing plant was established in Tanzania, thus exports to EU and Asian markets.

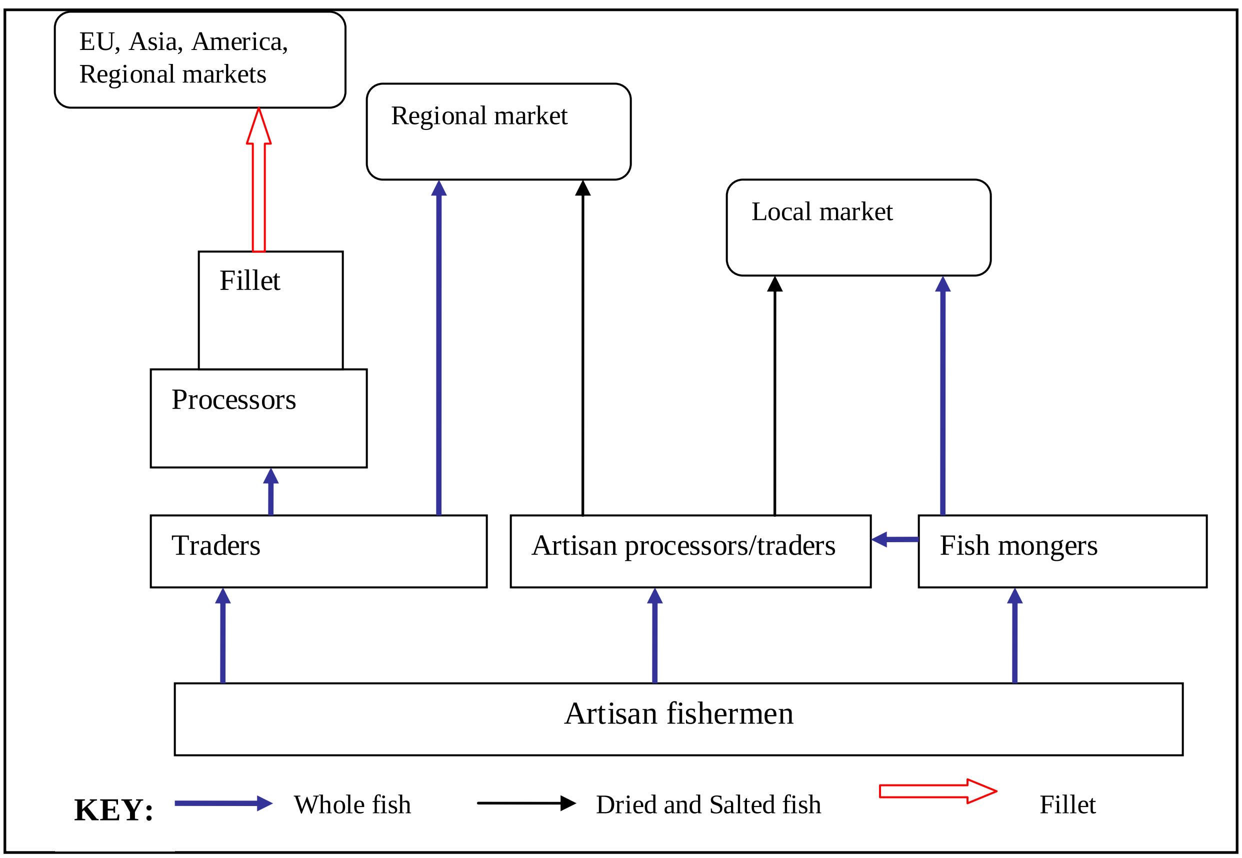

Figure 3: Nile perch supply chain before implementation of food safety standards

Figure 4 shows the existing Nile perch supply chain, which consists of a complex system of channels that have evolved over time. The chain operates at three main levels: (a) National level, which involves localized trading within Tanzania. (b) Regional level involving cross boarder trade between Tanzania and neighbouring countries of Kenya, DRC, Rwanda and Burundi and (c) International level involving exports to EU and other world markets. Below is a description of the channels.

Channel 1

This channel involves boat owners who sell directly to industrial fish processors. These fishermen/boats collectors own boats and have no obligations to traders or processors because they use own capital to run their business. That is, they grew out of the dependence to traders and processors. They are considered as medium to large scale operators with high price margins. Using boat collection, they move around in the lake more easily, collecting more fish estimated at 10 to 20 tons per day. The fish collected is sold directly to processors with few boat owners selling to processors through agents.

Channel 2

This channel is comprised of small scale fisher-boat owners who sell their fish catch to fish agents at landing sites. The fish is sold either to dealers (*machinga*) or to other boat owners who operates in a relatively large or medium scale or to agents. The small scale boat owners are obliged to sell through agents because of low volumes of fish catch. The low volumes do not provide economic justification for direct supply of fish to processors. In addition to that, processors preferred medium to large scale fish suppliers as a strategy to control fish quality and reduce transaction costs related to quality checking and monitoring. In this case, the processors discourage direct delivery by small scale suppliers through low price.

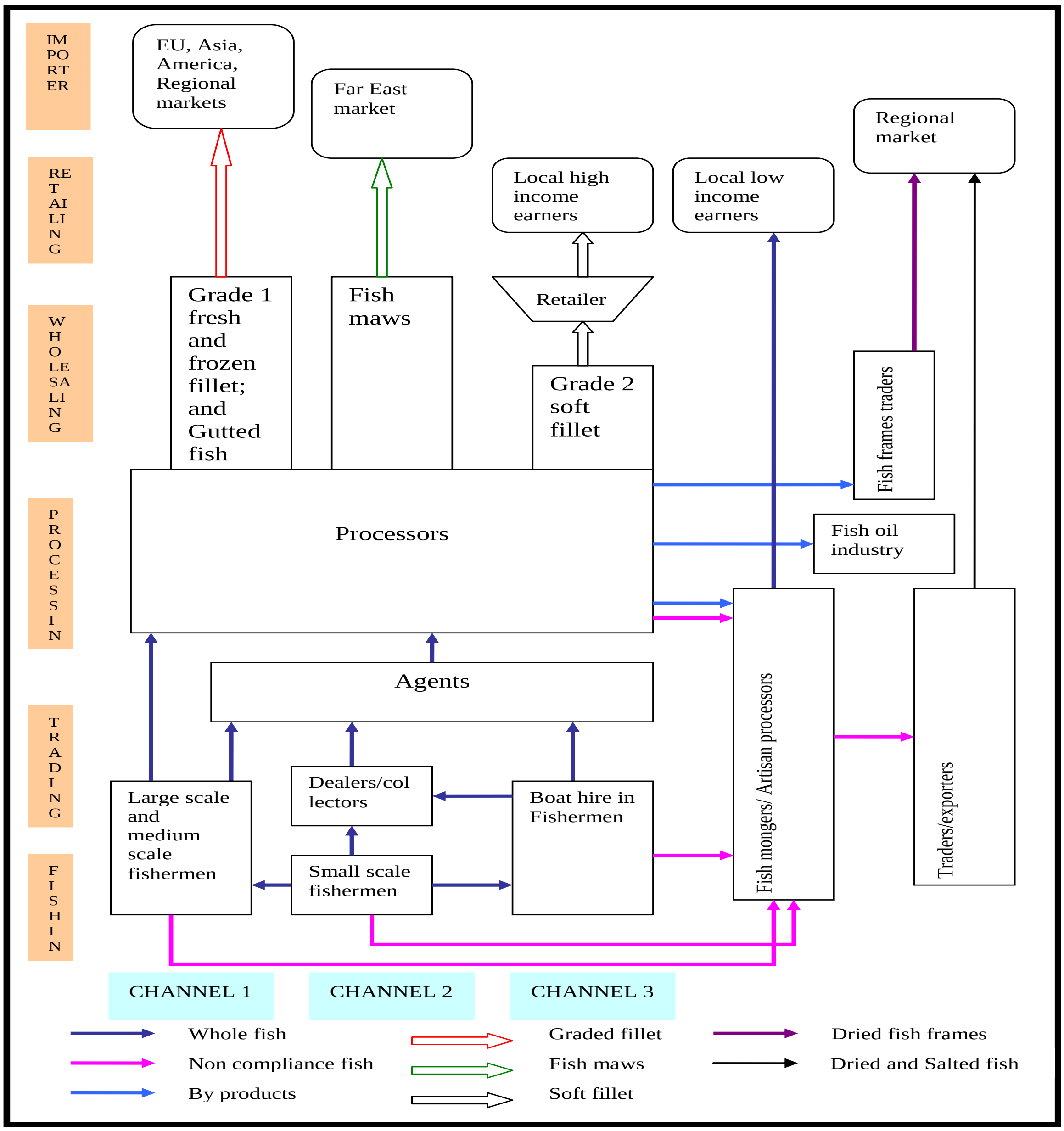

Figure 4: The evolved Nile perch export supply chain in Tanzania

Channel 3

The channel is comprised of boat owners accessing their assets under hire purchase or contracts from fish buyers. The contracts obliged boat owners to sell fish to their contractors. There are two types of these boat owners.

(i) Boat owners who obtained fishing assets either as loan or as hire purchase working assets from fish collectors in an agreement to sell fish to the boat collector who in turn sells to processors. The boat collector can agree to sell boat owner's fish and receive sales commission of TZS 50 to 100 per kg from the boat owner. Sometimes this happens when a boat collector receives higher price from the processor. This agreement benefits both sides as the boat collector is ensured of volume while boat owner receives higher price than the market price at the landing sites. This kind of arrangement was observed at Kibuyi, Nkome Mchangani and Chifunfu landing sites.

(ii) Boat owner financed by traders or agents, in agreement to sell fish to them. Agents in Nile perch industry receive commission and operate at landing sites with ice-cooled containerised trucks. Most of the agents acquired their equipment on loans from the processors after supplying them with fish for some time or being introduced by other agents who had built goodwill. The loans are provided for five tons trucks or 15 tons collection vessels. On top of this they pay a non refundable fee of US$ 200 and a guarantor who is well known to the processor. During high seasons, the agents collect up to 30 tons per day of fish and 0.75 tons a day in low seasons.

4.3 Key Actors in the Nile Perch Supply Chain

4.3.1 Fishers (*Wajeshi*)

Fishers in both Nile perch and *dagaa* fish are the people who get into the water to catch the fish. Fishers are a mixture of indigenous people living in villages close to landing sites and those coming from distant villages, districts, regions around the Lake and from other regions in the country. The majority of fishers (38.8%) are indigenous people operating from their villages of origin. Fishers originating from regions outside Lake Zone such as Kigoma and Rukwa are the minority (Table 8).

Table 8: Places of origin for Nile perch and dagaa fishers

Fishing location against place of origin	**Nile perch fishers**		***Dagaa* Fishers**		**Total**	
	n	%	n	%	n	%
Same village	16	37.2	10	41.7	26	38.8
Same district	7	16.3	2	8.3	9	13.4
Same region	10	23.3	5	20.8	15	22.4
Region around the lake	9	20.9	4	16.7	13	19.4
Region in the country with fishing activities	1	2.3	3	12.5	4	6.0
Total	43	100.0	24	100.0	67	100.0

It was observed during the field survey that most of the fishers found in the landing sites of Kibuyi, Nyang'ombe and Chifule/Malelema are local people and are engaged in sardines (*dagaa*) fishing. These sites are known to have high catch of Nile perch that attracts fishers from distant villages thus pushing locals into *dagaa* fishing. Other similar landing sites include Nkome-Mchangani, Lukuba, Chifunfu, Bihira Camp and Shoka.

The landing sites of Guta, Kibuyi, Nyang'ombe, Kayenze, Izunge, Bwai, Igombe, Kijiweni, Shoka and Chifule Malelema have moderate Nile perch catch and therefore attract only local people.

Fishers were of diverse socio-economic profiles on age, education and family status among other features. The findings in Table 9 show that most fishers were single young men (63 %) with mean age of 29 years.

Table 9: Comparison of features between Nile perch and dagaa fishers

Characteristic			**Nile Perch**	***Dagaa* fish**	**Total**
Education	None	n	2	2	4
		%	4.7	8.3	6.0
	Primary	n	37	20	57
		%	86.0	83.3	85.1
	Ordinary level	n	4	2	6
		%	9.3	8.3	9.0
	Total	n	43	24	67
		%	100.0	100.0	100.0
Marital status	Single	n	26	16	42
		%	60.5	66.7	62.7
	Married	n	17	8	25
		%	39.5	33.3	37.3
Age		n	43	24	67
		Youngest	15	17	15
		Oldest	52	61	61
		Mean	28.7 +_1.1	30.0 +_1.9	29.2 +_0.9

The young men found themselves in fishing because some had grown up in fishing families as reported by respondents. The majority of fishers (85%) were not well educated. They had only primary level education. They had no capital to invest in fishing business; and were thus contracted by the boat owners as fishers. When the features of low education, lack of capital, living single or coming from unstable family circles are combined together, they make the fisher groups vulnerable to any rent-seeking opportunists who take advantage of their "dis-advantaged" position; and exploit their labour to earn un-proportionate gains.

Lack of access to capital was a manifestation of poor saving mechanisms and poor financial systems. This was demonstrated by a commonly acceptable fact that fishers were good spenders because they had money as sited by one boat owner[23]

"*… these guys know how to spend their money, if you give them US$ 300 it will be gone in less than two hours. They normally land at 07:00 hrs in the morning and by 10:00 hrs they are finished with fish delivery. Between 10:00 hrs and 12:00hrs is their happy time and by the time they go to sleep at 12:00hrs the money is gone. They wake up again at 15:00hrs ready for another night in the lake. …This is their life cycle*".

This non-frugal spending behaviour contributes to their unstable relationships and families' breakdown.

The almost daily fishers' spending spree was confirmed by a fisher[24] who was asked why not bank his fishing income to buy a boat of his own and his response was:-

23 Mr Shinge Yeyema is a boat owner with collection boat at Nkome Mchangani landing site in Geita, interviewed on 8 May 2008 at Nkome Mchangani

24 Mr Celestine Mapengo a fisher at Kijiweni landing site in Sengerema was interviewed on 10 May 2008

'*….I don't have time to go to the bank, and I can't keep the money in my pocket because this water is terrible. When I go I am not sure if I will come back. I would rather spend the money than letting it be eaten by fish (i.e. dropped in the Lake)".*

Because of this fishers' perception, they do not save or bank their money for better plans. Over time the spending becomes the motive for more work and an opportunity for boat owners.

The main asset owned by fishers was their hard working culture and fishing skills that they learnt from their parents who were fishers. The skills involved knowledge of the lake, fishing areas, seasonal fluctuation and thus fish movement. It also involved skills in handling fishnets, setting them in the water and pulling them out for fish collection. However, hardworking culture was a key to all the skills and when someone was a hard worker; he could easily be accepted in fishers' team than one with skills but not hard working. Hardworking meant physical strength and perseverance and these are the main reasons for fishers' movement from one fishing area to another. A fisher's skills were communicated to prospective contracting boat owners by either other fishers or other boat owners. As Stated above, the fishers themselves would normally select themselves to ensure good delivery, which will in turn assure them of good returns as payment from the boat owner.

Notwithstanding the fishing skills as the main reason for fishers movement in the Lake, the majority of fishers were more or less permanently operating in the same area or fishing camps. Findings in Table 10 indicate that 83.7% of Nile perch fishers and 60.9% of *dagaa* fishers were permanently staying at the landing sites that they were found at the time of interview. A fishing camp was an island in the Lake. Most fishing camps were organised by boat owners who operated more than four boats commonly known as *tajiri* (singular) *or matajiri (plural);* literally meaning rich owner or rich owners respectively. Those who shifted did so when there was low fish catch and this was normally in the months of April to October and return during high seasons from December to end of March. *Dagaa* fishing was a bit different from Nile perch fishing hence dagaa fishers' movement was more frequent (39%) compared to 16% for Nile perch fishers. Fishing of *dagaa* is during high season from November to August. Thus, *dagaa* fishers take the months of September to October for visiting their families and relatives or resting in the fishing camps. For Nile perch, fishing is throughout the year, resting is possible with fishing turns or shifts.

Table 10: Fishers movement status in the landing sites or fishing camps

Movement status	**Nile perch**		**Other fish**	
	n	**%**	**n**	**%**
Permanent	36	83.70	14	60.90
Part time	7	16.30	9	39.10
Total	43	100.00	23	100.00

Movements of fishers influenced contractual arrangements. In landing sites that were close to Mwanza city such as Magu and Kayenze, the contracts favoured both sides. It acted as an incentive for fishers not to look for jobs in the city and therefore being available for fishing when required. In landing sites far from the city such as Nkome Mchangani, Kibuyi and Lukuba, the contractors set the terms in a way that benefited them more because the alternative to fishing was not easily available. In landing sites such as Bulongelo, which is not easily reachable by road but is close to Nkome Mchangani, contractual terms favoured both parties. This is because the landing site is like an island and therefore fishers can move around more easily. Movement is so flexible that mistreatment by a contractor could lead to a fisher moving to another contractor.

The fishers work in groups of three to four people in a boat and share daily revenue among themselves. During field survey in 2007, three main types of payments received by fishers were revealed;

(a) Payment based on the proportion of fish catch. This is performed after fish delivery at the landing site,

(b) Payment based on distribution of an agreeable amount of fish for home consumption. This is performed after fish selection at landing site where non-conforming fish (based on fish size) are distributed between fishers and boat owner. The distribution amount range from one to two kg per person.

(c) Payment based on two meals provided to fishers. The first meal is provided to fishers before they go in the lake and the second meal is carried to the boat and consumed during the night and/or on the day when they have to stay in the lake for more than one night. The meals are normally served with fish from daily catch, rice and stiff porridge (*ugali*) made from maize flour. The average amount of rice used is one kg per fisher costing about TZS 850 and maize flour amounting to 1.5 kg per person costing about TZS 600 per kg at the time of field survey.

4.3.2 Boat owners (*Matajiri*)

Boat owners commonly known as *matajiri* were categorized into three groups. First, are boat owners who solely own boats and engaged fishers to fish for them. They owned more than one boat. They organise the fishers to go to the lake and wait at the landing site to receive and sell the fish. Second, boat owner- fishers who own boats but also go into the water to catch fish. Most of boat-owner fishers operated one boat each. Third, boat owner-collectors who own more than four fishing boats and one or more fish collection boat(s). The largest boat collector had four collection boats with carrying capacity of 22 tons each. These were considered large scale operators, *matajiri*, and operated fishing camps (*kambi*) in the Lake's islands. All the three categories of boat owners operated boats of 8 m to 10 m long. Fishing boats longer than 10m long were prohibited by fisheries regulation. The common assets owned and capital investments by the three categories of boat ownership are described below.

4.3.2.1 Assets owned by Nile perch and dagaa boat owners

(a) Nile perch boat owners' assets

The assets owned were boats and sometimes engines; gillnet lines and paddle or sails. The boat was a planked canoe (Plate 1) with either an outboard engine normally with Horse Power (HP) 9.9 or 15 or paddle or sail. The use of paddles increased in recent years because of robbery of engines. The 40 HP engine was used mainly in fish collection boats. In Nile perch fishing the fisheries regulations provide specifications on gillnet sizes to be used to ensure fish resource sustainability. Recommended gillnets (*nyavu za makila*) were of 5 to 8 inches with ply 6, 9 or 12. Ply 9 is considered moderate and is mostly used. Ply 12 is very strong and can last longer but is expensive while ply 6 is the weakest but affordable by the majority of the fishermen. Ply 6 and 9 are commonly used because they are less costly considering theft of gillnets in the Lake. Other gears used include long-lines (*migonzo*), hooks and fishing lines (*ndoano*) of 10 mm size.

Plate 1: Fishing boats with an outboard engine parked at landing site

Planked canoe with out-boat engine parked at Lukuba landing site in Musoma Rural District

The carrying capacity of planked canoe is 0.5 to 1 ton. Boats of carrying capacity of one ton to 22 tons were used for fish collection and for delivery of fish to the fish processing plants. The collection boats were equipped with insulated ice bins (Plate 2).

Plate 2: Fish collection boat docking at Bulongelo Landing site, Geita District

Note the canoe size and insulated ice bin which is filled up with mashed ice to be used to transport fish directly to processors' jetties or to traders at landing sites.

(b) Dagaa boat owners' assets

Fishing assets owned by *dagaa* boat owners were planked canoes, engine of HP 15 and HP 9.9, paddle and sail. However, use of engine in *dagaa* fishing was less common compared to the use of paddle and sails. This could be explained by small scale level of operations whereby the largest scale boat owner operated a maximum of six boats. The common fishing gears used by boat owners for *dagaa* fishing were small meshed seine nets. Although the fisheries rules require use of mesh size between 6mm and 10 mm; it was observed during the field survey that seine nets had mesh size far below 6 mm. Mosquito nets were used in drying *dagaa* which indicated the possibility that they were also being used for fishing as sited by Minakawa *et al.* (2008).

4.3.2.2 Capital investment levels for Nile perch and *dagaa* boat owners

Mean comparison using t-test between small scale (those with 1 to 4 boats[25]) boat owners of Nile perch and *dagaa* fish in terms of number of boats operated indicated a significant difference at 6% significant level (Table 11).

Table 11 indicates that Nile perch small scale boat owners needed to invest about TZS 6 million while *dagaa* fish required only about TZS 5 million. According to Tanzania Small and Medium Enterprises (SME) development policy based on capital investment categories, the Nile perch small scale boat owners fall under the category of small enterprises while *dagaa* fishing fall under the category of micro businesses.

Table 11: Mean comparison for investment between Nile perch and dagaa

Variable	Fishing type	n	Mean	Std. Error Mean	t	Sig. (2-tailed)
number of boats operated	Nile perch	72	1.88	0.12	1.92	0.06
	Dagaa fish	23	1.43	0.20		
Number of engines operated	Nile perch	41	1.59	0.15	-0.37	0.72
	Dagaa fish	8	1.75	0.72		
Investment cost of boats and engine	Nile perch	72	6 141 527.78*	1 254 962.58	0.36	0.72
	Dagaa fish	23	5 075 043.49*	2 718 308.28		

* Mean exchange rate at the time of interview was 1 US$ to 1100 TZS

25 Local governments in the Lake Victoria, Tanzania side have categorized boat owners into three categories for levy/tax purposes. The three categories are small scale (boat 1 to 4), medium scale (boat 5 to 8) and large scale (boat 9 and above). Most other fish boat owners fall in the small scale category with very few in the medium scale category.

In Tanzania micro businesses are considered informal such that in most cases they don't need registration or business licence.

In fishing however, both small and micro enterprises are subject to formal registration and annual operational licence before being involved in fishing activities. All boats needed to be registered with business name. The business name registration was not mandatory in 1980s, but because of traceability especially in Nile perch fishing, now all boats must have a registered business name. Registration of fishing boats was done by the Fisheries Department (FD) of the Ministry of Livestock Development and Fisheries (MLDF) and under Surface and Marine Transport Regulatory Authority (SUMATRA) of the Ministry of Communication and Transport (MCT). This was considered by boat owners as double registration as pointed out by Kadigi *et al.* (2007).

In 2007 the FD charged between TZS 20 800 and TZS 40 000 for initial registration and licensing depending on the carrying capacity of the boat. Annual registration and licence fees ranged from TZS 10 000 to TZS 15 000. SUMATRA charge between TZS 30 000 and TZS 40 000 depending on number of boats owned. Per unit cost is lower for those with large number of boats which might be seen as an incentive for large boat owners to increase the number of boats owned. However, because of multiplicity of managerial cost in terms of number of supervisors; ownership cost becomes high such that it cancels the lower unit cost advantage. In the 1990s, there was a ban in trawlers in the lake that if one needs to expand one has to increase the number of boats hence an increase in management costs. Boat owners were legally required to pay landing sites maintenance levy ranging from TZS 500 to TZS 2000 per boat depending on respective landing sites regulations. These rates were set by Beach Management Units (BMU) which is a stakeholders' management system in landing sites or village governments if there is no BMU running a landing site.

4.3.2.3 Capital investment amongst categories of Nile perch boat owners

Analysis of investment levels was conducted amongst three groups, (small scale, medium and large) of Nile Perch boat owners. The three groups were based on categorization by local government in fishing areas for levy/tax purposes. The results of the nalysis show significant difference on number of boats and engines operated amongst the three groups of boat owners; hence the difference in capital investment levels as depicted in Tables 12 and 13. The large scale boat owners invested to the tune of TZS 220 million while medium scale and small scale boat owners invested TZS 82 million and TZS 6 million respectively.

Table 12: Total investments on boat and engine in Nile perch fishing

Business Size	n	Mean	Std. Error	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Small scale	72	6 141 527.78	1 254 962.58	3 639 203.46	8 643 852.09
Medium scale	9	81 907 777.78	33 195 257.01	5 359 377.83	158 456 177.72
Large scale	4	223 925 000.00	78 871 872.63	-27 080 499.63	47 4930 499.63
Total	85	24 412 470.59	7 247 590.94	9 999 841.18	38 825 099.99

Table 13: Comparison on the amount of capital investment among NP boat owners

Test	Sum of Squares	Df	Mean Square	F	Sig.
Amongst the three categories	213 007 959 993 676 400	2	106 503 979 996 838 200	53.9	0.00
Within categories	162 038 921 537 500 000	82	1 976 084 408 993 902		
Total	375 046 881 531 176 400	84			

Table 14 shows that large scale Nile perch boat owners had a minimum of 8 engines; the medium scale boat owners had 5 engines while small scale boat owners had about 2 engines. This ownership pattern was also depicted in the capital investment levels.

Table 14: Number of engines operated in Nile perch fishing

Nile perch ownership category	n	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Small scale	41	1.59	0.97	0.15	1.28	1.89
Medium scale	6	5.00	0.63	0.26	4.34	5.66
Large scale	4	8.50	2.38	1.19	4.71	12.29
Total	51	2.53	2.33	0.33	1.87	3.19

Comparison amongst Nile perch boat owners using anova indicated significant difference in number of boats and engines owned amongst the three categories of boat owners (Table 15).

Table 15: Mean comparison: No: of boats and engines owned in Nile perch fishing

Test results	Amongst the three categories in Nile perch boat owners		Within the three categories in Nile perch boat owners		Total	
	Boats	**Engine**	**Boats**	**Engine**	**Boats**	**Engine**
Sum of square	332.93	215.75	80.81	56.95	413.11	272.71
Df	2	2	82	48	84	50
Mean square	166.46	107.88	0.98	1.189		
F	170.24	90.92				
Sig.	0.00	0.00				

The magnitude of capital investment required in fishing is a barrier to entry for new investors in the fishing business. Respondents in the study area complained about accessibility to finance especially from the commercial banks which require fixed collateral and are bureaucratic with long procedures before releasing funds. Most banks have their branches located in towns and cities thereby constraining accessibility to the majority of boat owners in rural areas. Microfinance institutions (MFIs) provide loans but charging high interest rates of between 38% and 40% with weekly repayment schedules. Lack of access to loans frustrates boat owners. They only rely on buyers as credit providers as well. Credit from buyers depends on relationship built based on magnitude of business, period of exchange between parties and available guarantors.

4.3.3 Traders (*Ajenti*)

Traders (*ajenti*) of both Nile perch and *dagaa* buy fish from suppliers at the landing sites and sell to different markets. While *dagaa* traders sell fish to an open or spot market, the Nile perch traders sell through contractual arrangements. The arrangements depend on traders' means of operations which categorizes them into four types namely dealers, boat collectors, truck owners and factory agents.

(a) The factory agents are fish traders contracted by processors and live in commission. There are three types of agents. (i) agents that are provided with working tools (such as five tons truck with cooling box or collection boat with carrying capacity of 22 tons, gun-boots and aluminium trays), working capital and three assistants, (ii) agents that are provided with only working tools and two assistants and (iii) agents that are provided with working capital and two assistants. During field survey in 2007, there were claims that some of the agents are employees of the processors camouflaged as traders because it is not allowed by law for processors to engage in fishing activities. Becoming an agent one needs to have a guarantor who is a long-term supplier to the processor and pay a non-refundable fee of TZS 200 000. When accepted, the agents get into written binding contracts with the processors. The contract requires that, the agent to supply fish only to the contractor, however, the contract is silent on selling price. The empirical evidence from the study shows that, the agents receives a relatively lower selling price (TZS 2214/kg) when compared with private business traders who owns trucks (TZS 2300/kg) and those who owns collection boat (TZS 2400/kg).

(b) Boat collectors are private or independent traders who own a collection boat (*karua)* of 22 kg carrying capacity with an insulated cooling box. Some of the private boat collectors had previously being agents and managed to accumulate enough capital to operate their own business. Boat collectors receive relatively higher selling price and sometimes they get into short term supply contract with processors. The contract specifies selling price and live for a maximum of one week. This kind of contract has both positive and negative effect on fishing activities. The positive effect is that it encourages suppliers to provide working tools to fishers while the negative effect, is that it encourages fishing along the lakeshores which is considered illegal by law.

(c) Truck owners are also private or independent traders owning five tons trucks with cool boxes. Some of them, like boat collectors, they were previously operating as agents. Unlike, boat collectors, truck owners do not get into selling contract with processors mainly because of the inconsistence in amount of fish supplies although claimed that they prefer to sell to any processors who offer higher selling price at the time.

(d) Dealers are small business Nile perch traders who purchase fish from fishermen in small quantities and sell to the other three traders. Though selling to other traders, dealers do not have contracts with them. Using small capital they enjoyed selling to any fish buyer who offered better price. Dealers owned an average operating capital of US$ 100 for fish purchase and resale. Some dealers (15%) owned one or two fishing boats, which were used for fishing or hire-out to other fishermen. Most dealers were young men aged between 15 and 30 and were normally found in landing sites when the fishermen dock at landing sites. Their source of fish was from own boats; from fishing areas that were inaccessible by roads; and from fishing labourers who exchange their fish received as food share to cash.

In general, both Nile perch and *dagaa* traders have some similarities and differences, which can be depicted from their demographic characteristics, ethnicity group, and experience in fishing business, markets served, product sold and assets owned.

4.3.3.1 Demographic characteristics and experience in fishing business

Although Nile perch traders were different from *dagaa* fish traders in terms of asset ownership and activities carried out, there are some similarities. Table 16 indicates that traders of both groups were in the mean age of 36 years which is an active age group. The groups were engaged in the business almost throughout the year with a mean of 10 months.

The results in Table 16 indicate significant difference in fishing experience between the two groups at 3% significant level using Leven's test of equality of variances in an independent sample. This shows how recent Nile perch fishing activities are compared to *dagaa* fishing. Despite this finding, it was astonishing that there was low level of business operations in *dagaa* compared to Nile perch as reflected by boats and engines owned. One would have expected that the longer the period one stayed would increase investment in fishing assets otherwise move to Nile perch fishing. This may be explained by the anthropologist associating fishing activities and fishing tribes.

Although it was believed that fishing is a clan based business, Nile perch attracted people from all tribes around the Lake and changed the norms on specificity of the business. The tribes that were considered fish traders in the Lake were Wasukuma, Wakurya or Wangorime.

Table 16: Mean comparisons on age, time and duration in fishing business

Variable	Fish type	n	Mean	Std. Deviation	Std. Error Mean
Age	Nile perch	44	35.25	7.32	1.10
	dagaa fish	14	36.86	11.79	3.15
Months of business operation/year	Nile perch	38	10.82	2.26	0.37
	dagaa fish	13	10.62	2.75	0.76
Experience in fishing activities (years)	Nile perch	44	6.62	5.82	0.88
	Dagaa fish	14	11.46	11.61	3.10

The other tribes of Wahaya, Wazinza, Wasubi, Wakerewe, Waluli, Wakwaya, Wajita and Wajaluo were all considered to be fishermen. However, the increase in fishing costs and depletion of fish forced the fishing tribes to join trading tribes. Table 17 shows that only 47.7% of traders in Nile perch came from the fish trading tribes. The remaining 52.2% of the traders belong to fishing tribes as mentioned above and non-fishing ethnic groups such as Tanzanians of Arab and Asian origin. The movement of fishing tribes into fish trading business was also seen in *dagaa* fish. The reason might be the decline in fishing income and that people were finding trading more profitable and less risky in terms of capital cost.

Table 17: Distribution of fish traders by tribe

Tribe	**Nile perch**		***Dagaa* fish**	
	N	**%**	**N**	**%**
Fishing tribe	21	47.7	9	64.3
Trading tribe	21	47.7	5	35.7
Non fishing tribe	2	4.6	0	0.0
Total	44	100.0	14	100.0

4.3.3.2 Markets served and products sold

While traders of *dagaa* sold their fish to the domestic village markets, district and region markets and/or exported to markets in the neighbouring countries, most of the Nile perch traders sold raw fish to plant processors who are the key suppliers of fresh and frozen fillet to the international markets mainly in Europe. Rejected[26] raw fish is sold to artisanal processors who process the fish and sell in domestic markets and regional markets such as the Democratic Republic of Congo (DRC), Rwanda, Zambia and Malawi. Trading of processed Nile perch fish to international markets is dominated by Nile perch processors. Contrary to the market for *dagaa* fish, traders of Nile perch were more focused to ensure delivery of fish that meet quality standards of buyers. In this

[26] Rejected Nile perch fish is the fish that does not meet food safety standards and other standards such as size, weight and freshness

case the activities they performed and quality assets they owned differ with those of *dagaa* traders.

In *dagaa* fishing, processing was limited and mainly related to drying either by smoking, sun drying and salting. Quality in terms of scent and level of moisture were determined by a mere experience on the product dryness status. Contrary to Nile perch, the FD did not emphasise adherence to food safety standards in *dagaa* fishing.

4.3.3.3 Assets owned

Depending on the activities of the *dagaa* trader, the common assets owned were plastic buckets or drums, drying nets and gunny bags. The plastic buckets or drums were used for fish collection at landing sites, carrying fish to the drying places especially on rocks around the landing sites. This was observed at Kibuyi and Lukuba landing sites in Musoma. At Chifunfu and New Igombe/Kayenze Ndogo landing sites, the drying is on wooden tables with solar panels, nets and on sand. The solar panels were provided by EU funded project on Implementation of Fisheries Management Plan (IFMP) for Lake Victoria. The project ended on 30 August 2008 (Mairi, 2008, personal communication).[27]

Gunny bags were used to transport dried *dagaa* fish to the local and national markets and export to regional markets. Kirumba market in Mwanza was the main market where

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[27] Personal communication with Mr. Julius Mairi, the Fisheries Officer at Ilemela District in Mwanza Region in May 2008

traders especially exporters buy dried *dagaa* fish for export. The Kirumba market was constructed with the support from Japan on efforts to improve the quality of dried fish.

Contrary to *dagaa* fish, Nile perch traders served buyers that demand fish of high quality standards. For this reason they were required to use equipment that enabled them to meet these quality standards such as insulated trucks (Plate 3), boats with an insulated collection box (Plate 2), fish trays, ice bins, protective gears such as gumboots, overcoats, gloves and head covers. The trucks and boats were inspected by fisheries officers more frequently; sometimes every month. If a truck is found with any defect it would be grounded until the defect is corrected and re-inspection of the truck conducted. The fisheries regulation requires the carrying vessels to provide space for non-fishing tools and should not be used to carry anything else except fish. Trucks were required to write the words “fish only (*samaki tu*)” on both sides of the truck.

Plate 3: Insulated trucks with label on its body saying fish only (samaki tu)

Note: The labels on the truck side "*samaki tu*" that indicate that the truck should not be used to carry anything else except fish. Also note the words in the fish shading wall. The words prohibit random people from sitting or leaning on the wall and restrict the shade to fish traders with required protective gears.

Most (90%) of the trucks used by Nile perch traders were provided by the processing plants on agreement to sell fish to them. The plants' trucks were labelled with processing plant's name on both sides of the truck to minimize the risk of dishonest traders to sell fish to other processors.

Fisheries regulation requires all trucks to park at gazetted landing sites which have floating bays for fish off-loading, shed for fish weighing and other sanitary and BMU office facilities as shown in Plate 4. The fish weighing shades have labels indicating that no one was allowed to stand or sit on the shed without protective gears. The words in Kiswahili as seen on Plate 3 on the wall of fish shed are " *Ni marufuku kukaa au kuegemea banda. Usiingie ndani ya banda bila* sare" which means "*Sitting or leaning on the shed walls is prohibited. Don't get inside the shed without uniform and/or protective gears*". This indicates efforts made by Nile perch actors to meet food safety standards. However, it was observed that, in most cases the conditions were not observed. Fishers had neither uniform nor any protection gears when off-loading fish from their boats or when weighing it at the scale shade. In some landing sites, the sheds are rarely used as they were located close to off-loading floating bays which were broken.

The improvement of the landing sites is shared between FD and fish processors and their maintenance is left to BMUs or village government management. Traders and boat owners indirectly contribute to landing sites maintenance through levies charged per kg of fish collected or per trip. The amount charged differs from one landing site to another as they are set by authorities of the respective BMU.

Plate 4: Floating bay at Mchangani BMU improved landing site in Geita District

The levies that prevailed during the survey in 2007 varied from TZS 30 to TZS 80 per kg or TZS 20 000 to TZS 30 000 per trip. The levy per trip was considered fairer than the levy per kg. There were complaints among traders interviewed during the field survey in 2007 on the per kg levy which created challenges to both traders and management of landing sites.

For traders, the per kg rates creates shortage of fish supplies to them as most boat owners take their fish catch and sell it at landing sites with low levies. The divergence of fish catch to landing sites with low levies also creates shortage of revenue to the management of landing sites. As a strategy to collect the levies, management of different landing sites with the help of FD decided to involve processing plants to collect the levies on their behalf. This decision is seen as a challenge to the processing plants as it might affect their long term relationship with their suppliers. During the time of field survey some discussions were going on between managements at landing sites and processors on how best they could handle the levy collection issues.

4.3.4 Processors

As indicated above, *dagaa* processing is limited to drying and there are no stringent quality requirements that have to be observed. In Nile perch processing there are several requirements that should be put in place to meet food safety standards of the export market especially the EU. These requirements can be categorized into processing plants and infrastructure requirements as described below.

4.3.4.1 Nile perch processing plants requirements

Processing of Nile perch involved washing; scaling, cutting, skinning, trimming; chilling or freezing to required temperatures before packing ready for export. The activities are carried in processing plants that were reconstructed to abide to food safety standards. The majority of the processing plants were established in the 1990s. There are currently

12 Nile perch processing plants in the three regions around Lake Victoria but only 10 processing plants are operating (Table 18). Most of the plants were more than ten years old with only one new plant which was three years old during the time of field survey in 2008. The new plant is a branch of the oldest plant Vicfish Ltd. The two processing plants that are not in operation were closed down in 2000 due to non conformity to standards.

High investment costs associated with food safety standards requirements were claimed to be the main reason for failure to rehabilitate old plants to meet the stringent requirements. The high investment costs and poor financial system in the country also explain why most plants are owned by foreigners. Four of the processing plants were under direct foreign investment. Out of five plants visited during the field survey, three (60%) were owned by foreigners and two (40%) were owned by Tanzanians, of which, one is owned by a Tanzanian of Indian origin and the other one by an indigenous Tanzanian.

Table 18: Processing plants established in Lake Victoria and their current status

Name of factories	Location	Year established	Ownership	2008 status
Vicfish Ltd	Mwanza	1992	Sole proprietorship	Operational
Tanzania Fish processors Ltd	Mwanza	1992	Partnership	Operational
Mwanza Fishing Industries Ltd	Mwanza	1994	Sole proprietorship	Operational
Omega Fish Ltd	Mwanza	1997	Venture capital	Operational
Nile perch Fisheries Ltd	Mwanza	1992	Sole proprietorship	Operational

Tan-perch Ltd	Mwanza	1992	-	Not operational
NICO Ltd	Mwanza	2008[28]	Sole proprietorship	Operational
Prime Catch (Exporter) Ltd	Mara	1999	-	Operational
Musoma Fish Processors Ltd	Mara	2000	Sole proprietorship	Operational
Mara Fish Packers Ltd	Mara	1999	-	Not operational
Kagera Fish company ltd	Kagera	2003	Sole proprietorship	Operational
Vicfish Bukoba Ltd	Kagera	2005	Branch of Vicfish	Operational

Source: Extracted from Lake Victoria Zone Office Reports, Nyegezi, Mwanza (2007)

4.3.4.2 Infrastructure requirements

Airfreight is crucial when it comes to food safety standards especially if the good is consumed in other areas different from where it is produced. Several Nile perch processing plants were established in Mwanza because of its accessibility to airport facilities and to Dar es Salaam City for shipping of frozen fillet to Europe, the United States of America and Asian countries. However, recently more Nile perch fillets were air freighted via Nairobi airport because of inadequate airfreight facilities in Mwanza airport. The airfreight facilities problem in Mwanza airport was raised with processors to the FD, but not much had been done. The air-freighting via Nairobi was believed to cause financial loss to the government as there were some processing plants with Kenya sister companies that were taking Nile perch fillet from Tanzania, repacked in Kenya and re-exported as Kenyan products. No evidence was obtained in terms of quantities of

[28] NICO processing plant was established in 1997 as Food Chain International Ltd and closed in 2000 due to non-conformity. Later in 2005 the plant was bought by NICO Ltd, reconstructed and started operations in July 2008 after being approved by FD.

fillet transported to Kenya across the border though a truck filled with fillet crossing to Kenya was observed during the field survey.

Analysis of Tanzania Nile perch fillet export statistics of 2007 shows that Kenya imported about 275 tons of frozen fillet and 196 tons of fresh fillet from Tanzania but at the same time paid a royalty amount which was the same as exporting to other countries such as Japan and the Netherlands (Table 19).

Table 19: Percentage of royalty charges on FOB fillet consignment value in 2007

Product	Kenya	Japan	Italy
	% of royalty paid	% of royalty paid	% of royalty paid
Frozen fillet	0.90	0.30	0.30
Fresh/chilled fillet	0.03	NA	0.03

Source: Fisheries Headquarters, Dar es Salaam (2008).

NA: Not applicable as there is no chilled fillet exported to Japan because of distance

4.4 Extent of Compliance with Food Safety Standards in Nile Perch Industry

Adherence or compliance to food safety standards in Nile perch depended on different actions or activities undertaken by the government through the FD of the Ministry of Livestock Development and Fisheries (MLDF) and the actors at the various nodes in the Nile perch supply chain (fishermen, traders and processors). The following sections describe actions or activities undertaken by the government to ensure compliance to the quality standards and critical areas of quality assurance at the different nodes in the supply chain.

4.4.1 Government or fisheries department

The specific conditions for import of fishery products from Tanzania are laid down in Commission Decision 98/422/ EC[29]. To achieve implementation of the standards as stipulated in the Decision, the FD improved the fisheries institutional capacity in terms of review of fisheries policy, rules and regulations; improved enforcement of the rules and regulations, improvement of infrastructure, human skills and technology. The fisheries policy was reviewed in 2000 and the result was the Fisheries Act 2003 which incorporated the Commission decisions by incorporating EU fish and fish products requirements as stipulated in EU Directive 91/493/EEC. Fisheries regulation following the amended Act 2003 came out in 2005. Under the Commission Decision 98/422/EC the EU and Tanzania agreed to appoint FD as a Competent Authority (CA) to guarantee compliance with food safety standards as required by EU.

The appointment was in 1998 where FD personnel had to undergo vigorous training before being accepted by EU that it could guarantee the import conditions though with some minor weaknesses (European Commission Reports, 2006). Besides personnel

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29 The decision laid down special conditions governing imports of fishery and aquaculture products originating from Tanzania. The agreement was temporary upon appointment of Competent Authority (CA) and guarantee by CA that special conditions governing imports of fisheries product into EU following Commission Decision 98/422/EC of 1998 was respected. The guaranteeing was provided after consecutive inspections conducted by the EU Commission in (i) August 1999 with view to considering the removal of import ban imposed by the Commission Decision 1999/253/EC; (ii) October 2000 aimed at assessing the measures taken regarding pesticides contamination in the Lake and assessment of conditions of fishery products production stipulated in Council Directive 91/493/EEC of July 1991, Commission Decision 98/422/EC of June 1998 and Commission Decision 2000/127/EC which was an amendment of Commission Decision 1999/253/EC and (iii) October 2006 with the objective to assess whether the Competent Authority was capable of guaranteeing special conditions governing imports as laid down in the decisions mentioned above.

training, the FD was restructured, equipment and laboratory testing standards were improved especially in the Lake Victoria Zone where Nile perch fish comes from.

(i) Restructuring of Fisheries Department

Prior to being assigned the responsibility of CA, the fisheries policy and regulation were reviewed aiming at streamlining agencies and ministries involved directly in governing, setting and enforcement of standards. In this case the regulatory framework to assure food safety and quality control functions in the country were mandated to four ministries[30] instead of seven. The FD was organized into zonal and sub-zonal offices. While the headquarters of the FD remained at the Ministry responsible for fisheries in Dar es Salaam, three zonal offices were established namely Coastal zone, which was responsible for marine and aquaculture fishing; Southern Highland zone, which was responsible for water bodies in the southern highlands of Tanzania; and Lake Victoria zone office which was responsible for Nile perch fishing. The zonal offices were given the responsibilities of quality control, standards and marketing[31]. The regions were set

30 The ministries involved are Ministries of Health, Agriculture and Food Security, Ministry of Livestock Development and Fisheries, and Ministry of Industries and Trade. These ministries have been empowered by laws, which include: Food (Quality) Control Act, a Plant Protection Act, a Fisheries Act, a Radiation Control Act, a Standards Act and a Tropical Pesticides Research Institute Act (1979).

31 The zone fisheries office conducts an assessment of HACCP program of processing plants which involves:-

(i) Checking, verification and approval of HACCP manual. This is conducted by checking on the design and appropriateness of the documented HACCP system to processing conditions of the operating plant using approved food safety checklist prepared and approved by the competent authority.

(ii) Daily supervision of the processing to ensure compliance.

(iii) Independent inspection of products, factory facilities and critical control points. This is sometimes carried together with a team from fisheries division headquarters in Dar es Salaam.

(iv) Auditing is carried in two levels, the internal audit which is prepared and conducted by the HACCP team manager with section managers in a plant and external audit conducted by FQCSM, fisheries as sub-zonal offices with responsibilities of monitoring fishing environment and ensure sustainable fishing in their respective regions. The district fisheries officers implement activities assigned by zonal officers. The district officers were then trained to become district fisheries inspectors (DFI) for quality and fishing activities control.

The CA through zonal officers approve exports through issuing certificates and conduct inspection or checks at all stages of the supply chain. The CA also ensured establishment of quality landing sites and issued public health certificate for export of fish products. Thus CA was given power to enter into fish product premises, inspect them and take action in case of non-compliance. These actions were legally supported under the Fisheries regulation 2005, Articles 54 to 57. In two incidences during the field survey, a fisheries inspector was observed closing down plant E for 10 days as action against the plants' inadequate action on repairing a leakage close to production conveyor belt and destruction of packaging materials that were not according to specification. These actions by the fisheries inspector indicated that, the fisheries inspectors go beyond food safety. The inspectors monitor traceability and other quality aspects as long as the plant agreed to abide by the standards.

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division headquarters. The FQCSM and headquarters conducts auditing quarterly using the auditing checklist. The EU commission also carry out auditing, the first audit was on 2000 and the second was on 2006. The gap of EU auditing is big because of the complying efforts that put Tanzania in group one as per EU directives.
(v) Certification of products for export.

(ii) Training

Formal long term and short term training were conducted to impart knowledge and skills in quality assessment among the CA personnel. A total of 62 personnel, with 38 officers from Zonal offices and 21 from the headquarters have Masters Degree in Food Science and Fisheries. At the district level, there were 331 officers with a degree or Diploma in Fisheries. In addition, short term training to district and zonal officers was conducted annually. The short term training covered areas of (a) awareness on food safety standards requirements, possible important deficiencies and how to detect them, HACCP auditing, inspection of fishing boats and gears; fish transporting trucks and landing sites; and enforcement of regulation to ensure fish resource sustainability.

(iii) Laboratory testing standards and critical limits

FD in collaboration with the Tanzania Bureau of Standards (TBS) provided improved national standards which incorporate the EU Directive and some international standards as shown in Table 20. The major improvement on the standards was modification in testing methods.

Table 20: Tanzanian national critical limits for microbiological hazards in fish

Test Parameters	Test methods	Units	Critical limits	Remarks	
				Standards	Test Methods
Total plate count/g	TZS 118:2002	*Cuf/g*	1×10^5	Old	New
Total coli form/g	TZS 119:2002	*Mpn/g*	4×10^2	Old	New
Salmonella/shigella sp/25g	TZS 122:2002	*P,A/25g*	Absent	Old	New
Vibrio cholerae/25g	FDA-BAM:1995	*P,A/25g*	Absent	New	-

Staphylococcus aureus/g	TZS 125:2002	*Cuf/g*	1×10^{3}	Old	New
Enterobacteriaceaea/g	ISO 21528(part 2)	*Cuf/g*	1×10^{3}	New	-
Escherichia coli	TZS 731:2002	*Mpn/g*	1×10^{1}	Old	New

Source: Fisheries Division, Nyegezi, Mwanza (2007)

Though the national standards were believed to incorporate EU directives on fish products, the implemented standards required comprehensive implementation of Pre-requisite procedures (PRP), Operational pre-requisite procedures (OPRP), approved Hazard Analysis Critical Control Point (HACCP) and product testing before export. This sounds more of US standards though said to be EU's. In other words, the National standards became more stringent than the EU Directives by trying to incorporate as many standards as possible so as to avoid future economic disaster as the one caused by the import ban imposed by EU on Nile perch in 1997 due to non-conformity. Before the first import ban, the national standards in fisheries processing were emphasising on Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP). The two practices are now part and parcel of PRP and OPRP.

Microbiological critical limits which were the standards set to show the minimum allowable levels of harmful microbiological bacteria in food were in Tanzanian fishery standards since early 1980. However, inadequacy in enforcement resulted into high levels of *salmonella spp* in fish exported to EU (Commission Report, 2006). According to the report, Rapid Alert System for Food and Feed (RASFF) since 2002 indicated that fish products from Tanzania had high levels of *salmonella spp*. This meant that, though the standards were there, their enforcement was inadequate either due to laxity of the market and/or enforcers, or shortage of qualified personnel or inadequate facilities to carry out the assignment. However, the standards were improved and enforcement tightened immediately after the first import ban in 1997.

In addition to microbial critical limits, the test for pesticides contamination was also required. Continuous improvement of national standards could be observed with the enforcement of additional conditions such as testing for Polycyclic Aromatic Hydrocarbons (PAH) and dioxin which was enforced in 2007. Laxity in enforcement was associated with the fact that, there was low possibility of contamination with specified hazard due to environmental nature of fishing activities. For example, there was no possibility of having smoke in Nile perch fillet as there was no activity producing smoke in processing plants. Another example was the test for sensitivity for histamine formation. This was associated with poisonous fish and according to the Principal Assistant Fisheries Officer[32], there were no such species in Lake Victoria. Such species are only found in the ocean.

CA collected samples for pesticides and Poly Chlorinated Binpheyls (PCB) and conducted year quarterly tests. According to the acting zonal fisheries officer in-charge in Mwanza during the field survey, the samples always came out with negative results. Frequent tests for heavy metals including lead, mercury and cadmium were also conducted. The EU critical limit for heavy metal was 0.2 mg/kg while the critical limit

[32] Mr. John Makenya is a Principal Assistant Fisheries Officer, at the Headquarters Dar es Salaam, 14 December 2007

used in Tanzania to ensure conformity was far below (0.4 mg/kg). The limits are subject to change depending on new testing technology and new scientific reference that could be availed.

Monitoring for pesticides was carried out by the Food and Veterinary Office where samples of water and sediments from the lake, processing plants and plants bays were sent once every six months for testing. The tests were on organochlorine pesticides, organophosphorous pesticides and PCBs. The results had been negative since 2002.

(iv) Laboratory structures and equipments

Another critical area for the CA to perform its responsibilities lies with access to laboratory testing equipments. Since 1997, fish products, water and soils were sent abroad for testing as per standard requirements because of low capacity in domestic laboratories. Initially, samples were sent to the accredited and EU approved laboratories in the Netherlands and South Africa Bureau of Standards (SABS). The domestic laboratories of TBS, Government Chemist Laboratory Agency (GCLA), Tanzania Industry and Research Development Organization (TIRDO) in Dar es Salaam; and Nyegezi Fish Quality Control Laboratory (NFQCL) in Mwanza were used for quality control though not accredited. Immediately after the import ban in 1997, the Nyegezi old laboratory was renovated and more equipment were purchased for microbial tests. Construction of a new laboratory designed to conduct both microbial and chemical tests commenced in 2000 and the laboratory received its accreditation certificate on 17

December 2007. The laboratory was accredited for analysis of six microbiological parameters namely total microbial count, total *caliform*, *streptococcus spp*, *vibros spp*, *salmonella*, *E Coli*, *Entrobactreious* and *thermatory caliform* (Plate 5).

Plate 5: New building of the NFQCL and its accreditation certificate
Note: new laboratory building that received accreditation certificate in December 2007, Mwanza

The FD as an acceptable CA by the EU oversees the implementation of quality and food safety standards and now all operations of actors in the Nile perch export supply chain. To adhere to required quality standards, fishermen are obliged to use mashed ice in fish handling, partition boat to separate fish from other non fish tools and use of trays when off-loading fish at landing sites. Traders are obliged to use insulated trucks or collection boats for those using boats to collect fish and use protective gears. Though the regulations were for fisheries sector, the enforcement seemed to be more on the Nile perch which was exported mainly to the EU.

Besides the Nyegezi laboratory in Mwanza, TBS laboratory received accreditation certificate on the same date as NFQCL but for analysis of only three microbial parameters. *Salmonella spp* which is a critical parameter was not one of the accredited parameters thus TBS depends on NFQCL for that test. Having two accredited laboratories in the country might reduce the testing costs especially costs associated with transport of samples abroad. However, for pesticides and metals, samples are still sent to Chemipher Laboratory in Uganda which is accredited and approved by the EU. The approval by EU is one of the grey areas when it comes to standards. According to the directives, the emphasis was on the use of accredited laboratories, but, when it comes to implementation the accredited laboratory has to be approved by EU. The approval is based on knowledge of EU on the performance of the accredited laboratories. The EU knowledge on performance of the laboratories is based on familiarity of the laboratory to EU in terms of being working with entities known to EU or through results of inter-laboratory proficiency[33] tests (personal discussion with TBS officer, 2007[34]).

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[33] The proficiency tests are conducted to assist in verification of testing methods because some of testing methods are not internationally acceptable.

[34] Ms Agnes Mneney, the Principal Quality Assurance Officer at TBS, conversation was held on 12 December 2007 at TBS Laboratory building, Dar es Salaam

Laboratory equipment were a challenge to the CA. New modern equipment and qualified personnel were required. Several donor communities assisted in the process, for example, accreditation was sponsored by DANIDA; and technical assistance was provided through a project known as Strengthening Fishery Products (SFP) under ACP/OCT countries and EU. Through this project, necessary equipment such as biological safety cabin, *prioclave*, *stomatcher and* sterilizer were procured (plate 6).

Plate 6: Biological safety cabin that was procured by NFQCL in 2007
Note: Biological safety cabin is important laboratory equipment for analysis of *salmonella*.

In addition to microbiological analysis, the NFQCL is being prepared for accreditation on pesticides and heavy metal analysis. The laboratory has already procured some equipment. If the accreditation is granted, the laboratory will be in full operation. According to the Laboratory head, Mr. Kiliani, most of the equipment were in place by the time of the field survey in May 2008. They were in the process of assembling them before testing them ready for accreditation.

4.4.2 Quality requirements and methods of quality assurance at fishing stage

Boat owners are required to follow fisheries regulation, which emphasise in use of small boats mainly not more that eleven meters long, with pens separating fish from other non fish materials. Large boats were banned early 1990s to ensure sustainability of the fish resources in Lake Victoria. It was observed during field survey that all boat owners operated boats of required length of not more than 11 metres. The boats are licensed and inspected by the FD as Competent Authority[35] in fishing activities in the country. The license is issued according to landing site though delivery of fish could be in any gazetted landing site. The register of the licensed boats and names of boat owners are kept by the FD at the BMUs or village government offices at landing sites. Though renewal of registration and licensing is required annually, it was observed that on average only 90% of boat owners renewed their registration. Boat partitioning as another requirement for ensuring fish quality was adhered to mainly by large scale boat owners (Table 21). None of the small scale boat owners and only 20% of medium scale boat owners adhered to boat partitioning as quality requirement.

35 FD was appointed as Competent Authority as part of agreement between Tanzania and EU during import ban in 1998 through Commission Decisions 98/422/EC (Commission Report, 2009)

Table 21: Proportion of boat owners adhering to CA quality assurance requirement by size of fishing business

Requirement	Size of business based on number of boats in operation		
	Small scale (%)	**Medium scale (%)**	**Large scale (%)**
Boat length (5-11 metres long)	100.0	100.0	100.0
Renewal of registration and licence	80.0	90.0	95.0
Boat partitioning	0.0	20.0	100.0
Training on quality aspects	8.3	40.0	73.0
Attaining knowledge on inspection methods	63.0	80.0	100.0

Table 21 indicates that training by fisheries officers on quality issues were more directed to large scale boat owners. This can be associated with high level of interaction amongst large scale boat owners, processors and fisheries inspectors due to reasonable magnitude of fishing business. However, almost all boat owners had knowledge on fish inspection methods. Fisheries regulation requires knowledge of about 10 fish organoleptic inspection methods. But during the field survey it was noted that the majority of boat owners were aware of a maximum of only six methods. When the level of knowledge were categorised into low knowledge (knowledge of 1 to 3 inspection methods), average knowledge (knowledge of 4 to 6 inspection methods) and high knowledge (above 6 inspection methods), the majority were found to be aware of a maximum of 6 methods with over 63% of small scale fishermen having average knowledge on inspection methods. This suggests that the amount of fish rejected due to non-conformity could be reduced if knowledge on the inspection methods is imparted.

In addition to partitioning of boats, fisheries regulation requires boat owners to use mashed ice for preserving fish. Differences were observed among boat owners on adherence to this requirement. The level of adherence increased with the size of fishing business. Whilst all interviewed large scale boat owners used mashed ice, only 40% and 4.2% of the medium and small scale boat owners respectively used ice. The large scale business operators used ice not only because of the magnitude of their business, but also because most of them operate collection boats that in most cases deliver fish to processing plants on contract. As part of the contract they are provided with ice according to the amount of fish delivered.

Instead of using ice, most of the medium and small scale boat owners used alternative methods to ensure quality of fish which include early morning delivery and frequent commuting to the collection boat that docked in the Lake (Table 22). Early delivery meant spending less time in the Lake to ensure fish delivery early in the morning before sun rise. This was associated with loss of dawn catch; but interviewed boat owners indicated that no fish catch loss was incurred especially with the decrease in fish stock.

Table 22: Alternative fish handling methods used by Nile perch boat owners

Size of fishing business	Early delivery at landing sites (%)	Frequent commuting to collection boat in the lake (%)	Total (%)	Pearson Chi-square value	Asymp. Sig (2-sided)
Small scale business	91.30	8.70	100.00		
Medium scale business	66.70	33.30	100.00	2.43	Ns
Large scale business	0.00	0.00	0.00		

ns means not significant

Frequent commuting in the lake underscores the importance of collection boats in reducing operational costs. As much as fish stock is decreasing, it becomes expensive for boat owners to commute frequently to collect fish. Frequent commuting is common among boat owners who stay in the lake fishing for more than one night, normally 3 nights. During the survey, it was observed that, fishers went fishing with one extra boat carrying food and fuel.

4.4.3 Quality requirements and methods of quality assurance at trading level

Traders as key transporters of raw whole fish from the landing sites or from the lake to the processing plants are supposed to adhere to food safety standards and traceability. As indicated in section 4.2.3.3 above, the boats and trucks operated by the Nile perch traders required approval by CA before commencement of operations and were under scrutiny throughout their use. The traders were required to send applications to CA who carried out inspection of trucks or boats using a checklist. Upon satisfactory inspection the CA approved the application by providing a certificate. The approval was renewed annually. Table 23 indicates the quality requirements to fish traders. The most challenging requirement is associated with time spent in collection of fish at landing site. Truck operators spent more time at landing sites which create a demand for more mashed ice to preserve fish for long time periods or risking high amount of spoiled fish. Thus conformity in Nile perch could be challenged by depletion of fish stock in the lake.

Table 23: Quality requirements and adherence by fish traders in Nile perch

Requirement	**Unit of measure**	**Truck operators**	**Boat operators**
Acquire approved certificate	%	100.0	100.0
Last time the certificate was renewed	Year	2007	2007
If spent less than 3 days collecting fish at landing site	%	45.0	100.0
Own protective gears	%	100.0	-
Own fish trays	%	90.0	-
Own a collection ice bin at landing site	%	90.0	-
If received training in the last one year	%	95.0	100.0
Average number of Inspection methods known	Number	8	6
Use of insulated trucks/boats	%	100.0	100.0

The inadequate fish supply created strong links between traders and boat owners on one side and traders and processors on the other side. On the first side, the relationship is based on boat owners as fish suppliers to traders and on the second, is the relationship based on processors as fish buyers. On suppliers' side, the traders obtained mashed ice from processors and provided it to contracted boat owners to ensure adequate fish supply. The amount of ice given was equivalent to the amount of fish supplied. If fish supplied was less than 80kg ice was not offered. On the other hand, processors as fish buyers extended loans or working assets such as insulated trucks and working capital to traders with long-term fishing business relationship.

4.4.4 Food safety standards and their implementation at the processing level

All sampled processing plants were found to abide to food safety standards which include national standards and private/voluntary standards. The sections below provide a summary of standards implemented in Nile perch processing and their status as observed during the field survey.

(i) Standards applied in Nile perch processing

(a) National or Mandatory Standards

Most Nile perch processing plants have been implementing HACCP since 1997. Only one of the five sampled processing plants had HACCP in place two years after its establishment in 1992 (Table 28). However, with the first EU import ban all plants were required by CA to approve their operationalised HACCP after going through a complicated procedure as shown in Annex 7. All plants are required to form HACCP team before application for approval of plants' systematic planning and operational HACCP manual. The planning and operational manual is designed and produced by the plants' HACCP team that comprises of production manager, quality controller and other two personnel from the management. The team undergoes rigorous periodic training on food safety with the assistance of CA. The HACCP team is responsible for operationalization of the manual in its plants; inspection and in-house auditing which in most plants was conducted quarterly and reports documented.

HACCP teams from all processing plants required training on HACCP implementation. Initially FD provided the training using qualified trainers from Tanzania Bureau of Standards (TBS) and Small Scale Development Organizations (SIDO). Thereafter each plant is required to provide continuous training to its own team using trainers from their own sources. The teams of most of the sampled plants were initially trained by trainers from TBS and further training by South Africa Bureau of Standards (SABS) from South Africa. The whole process of HACCP program implementation takes about five to twelve months. Most of the sampled processing plants spent about twelve months before their operational HACCP systems being approved by CA. However, the approval time for processing plants established after 1997 was not that much long due to their advantage of being constructed following HACCP requirements.

In addition to assurance of hygienic conditions, the HACCP is also used for monitoring microbial hazards, where regular testing of products, testing of waste from critical control points in production layout and workers health is conducted. Four main critical areas mentioned by most of the plants visited during the field survey include fish reception area; fish washing area; fish filleting; and freezing or chilling areas. In the reception area, fish is sorted out using organoleptic method, thereafter fish dissection is carried out after washing the fish using pressurized water to check the inside parts of the fish. Microbial tests on whole raw fish are conducted using in-house laboratory. Any fish detected with problem is put in a conveyor belt directly to the waste place. At the waste place, fish offals are removed and the fish is sold together with other fish by products to artisanal processors. The offals from rejected fish and processed good fish are processed for export to Asian countries. At filleting areas, control tests are carried out to ensure that there is no contamination from the fish or human beings handling the fish. Temperature control in freezing and chilling areas is critical hence close supervision is carried out by HACCP team leader to ensure constant temperature in the areas. The water used in the processing plants is tested for microbial and chlorine. The tests for microbial are carried once a month while tests for chlorine is carried out daily and all test results are documented.

Product testing is conducted in two levels, namely, in-house testing to control for microbial hazards and testing in public accredited laboratories before product export. Whether in-house testing or using accredited laboratory, the critical limits as set by the national standards have to be met. Results of testing by the processing plants are in most cases negative except during rainy season when some positive results are obtained. Therefore more stringent checks are conducted during the rainy season. The fish suppliers interviewed during the field survey complained that the stringent checks are a deliberate move by processing plants to benefit from high fish catch season in using compliance as an excuse. The high level of spoiled fish during the rainy season is probably caused by contaminated water with debris carried by rain water into the Lake. In addition to microbiological tests, the EU requires testing for parasites and contaminants as mentioned earlier. In 2006, EU required additional check on PHA and dioxin in Nile perch. The requirement was part of directives but was not enforced until 2007. The sampled processing plants visited during field survey reported to have conducted these tests using an accredited laboratory in Uganda.

(b) Private and Voluntary Standards

In addition to national standards, individual plants implemented private or voluntary standards such as British Retailers Consortium (BRC), International Standard Organization (ISO) 9000 and ISO 22000 so as to hedge against further stringent standards and/or loss of market. Out of the five sampled processing plants only two implemented BRC and were certified after 12 months. The certification aimed at improving plants image, quality of fish product, increase plant efficiency and reduce product liability. Only one plant reported implementation of ISO 22000 and it is in the process of implementing Eco-labelling. The quality controller of plant C[36] narrated that, "*Implementation of additional voluntary and private standards increases the costs in terms of additional machinery, tools and training, but is less complex if one has HACCP in place and the benefits can be observed through plants image, improvement in production efficiency and reduction in product liability which guarantees plants investment".* The processing plants that are not implementing private or voluntary standards indicated that, it was important to have the standards in place; however, they did not see the incentive to invest in implementation of additional standards when they are experiencing shortage of fish.

(ii) Level of implementation of standards in processing plants

Most of the processing plants have met the standards of design and construction specified in fisheries regulations that adopted EU hygiene directive (91/493/EEC). Old

[36] The sampled processing plants were coded from A to E as part of confidentiality verbal agreement between the author and owners of the plants

processing plants had to undergo renovation and reconstruction to meet the standards. This was observed during visits made to the sampled processing plants. Table 24 shows that processing plants have made several structural changes to meet the improved national standards that incorporate international standards.

Table 24: Plants structural change to achieve compliance to food safety standards

Plant Code	Build new plants to HACCP specification	Changes plant layout	Build new in house lab	Upgrade lab	Changes water supply system	Upgrade or build chilling and freezing facilities	Upgrade temperature control	Upgrade/build storage facilities	Acquire/rehabilitate own landing site	Acquire/upgrade own insulated trucks	Construction of a separate by-product freezing area	Construction of a new upgraded and closed drainage	Procure metal detector
A		x	x	x	x	x	x	x		x	x	x	
B		x		x	x		x						x
C			x		x	x	x	x	x	x	x	x	x
D		x		x	x		x				x		
E	x	x											

Note: x indicates change

Three main requirements that were implemented by the plants as indicated in Table 24 were; change in water supply system, upgrading of temperature control system and upgrading or construction of in-house laboratory. The three main requirements were associated with critical control points in the processing plants. The change in water system was to assure availability of portable water for production in the processing plant and for producing mashed ice supplied to fish suppliers. Upgrading of temperature control system involved improvement in freezing and chilling areas, purchase of temperature control devices and training on the use and control of the devices together with documentation of temperature data. Three out of the five sampled processing plants visited during the field survey have upgraded their in-house laboratories to ensure compliance to ISO 17025, which is the standard for setting up a laboratory. The laboratories are for control of microbiology contaminants through testing of workers health, raw fish and fillet. Workers are normally tested weekly while raw fish and fillet testing is conducted for each batch. The in-house laboratories are used for control only; and further product testing is conducted using accredited laboratories in Uganda and/or South Africa. Testing costs reported by the plants are enormous, ranging from US$ 10 to US$ 12 per parameter.

Some plants such as plants A and D constructed new in-house laboratories in addition to up-grading their old laboratories. These extra construction activities were observed where extra plant capacities and fancy buildings were built. The improvements in the plants buildings were driven by scare for more stringent food safety standards in the future. According to by then quality control officer, Mwanza sub-zone[37], the maximum plant installed capacity before food safety standards in 1998 was 80 tons a day. During restructuring most plants increased their installed capacity to a maximum of 140 tons a day but most of the plants were operating at an average 50% of the installed capacity as

37 Personal discussion with Mr. Steven Lukanga, by then quality control officer, Mwanza sub-zone at Nyegezi Fisheries Institute, Mwanza, January 2006. Currently, Mr. Lukanga is the Acting Zone Officer in-charge in Lake Victoria Zone

shown in Table 25. The officer claimed that, the extra capacities were a result of plants trying to avoid additional investment cost if need for expansion arises in the future.

Table 25: Plants capacity before and after re-construction

Plant Code name	Year Established	Initial installed Capacity (tons/day)*	Capacity after re-construction (tons/day)	Utilized capacities in 2007			
				Low season		High season	
				(tons/day)	%	(tons/day)	%
A	1994	50	50	20	40	30	60
B	1992	50	120	30	25	70	58
C	1992	140	100	30	30	55	55
D	1992	70	80	50	63	70	88
E	1997	60	75	15	2	40	53

* Data on initial installed capacities was obtained from FD, Nyegezi, Mwanza (2006)

(iii) Machinery requirements by processing plants

Besides restructuring of buildings, processing machines and equipment are crucial in meeting requirements for food safety standards. All the five processing plants visited during the field survey had to purchase additional equipment before being allowed to export fish. According to Mr. Mondoka (2007)[38], the processing plants started with few advanced equipment. Most of the activities such as skinning were done by hand. After the import ban, the plants purchased modern machines and equipment such as fish de-boners, automatic ice machines and standby generators, strapping power machines, ice plants and plate freezers, cooling towers, flake ice machines and caterpillar. Specific

38 Mr. Mondoka is the Sub-Zone Fisheries Officer, based in Nyegezi, Mwanza. Several discussions and visits to processing plants were conducted with his assistance in 2006 and 2007.

equipment for food safety standards requirements purchased included, metal detector, water purification plants, dosing pump, dolce salt dosing pump and washing machines. All these machines and equipment were imported from South Africa and Europe.

(iv) Human skills/manpower

Conformity is not an easy task according to the management of the processing plants visited during the field survey because it requires manpower training on issues of quality and quality control. Table 26 shows that the plants used external and internal trainers. External trainers such as TBS and SABS were used to provide training to processing plants' HACCP teams. The training focused on implementation of HACCP program, and other food safety standards applied in the plants, auditing procedures and control measures. Training using external trainers focused on the HACCP teams so that they become trainers of the in-house trainings.

Table 26: Training provided to plants personnel

Plant Code	Means of Acquiring knowledge	Type of informal training	Training provider	Number of personnel trained
A	In-housel and external	GMP, GHP, HACCP, ISO 9001:2000, ISO 22000	(i) Quality control Manager (ii) TBS	4
B	In-house	GHP, HACCP, ISO, BRC quality requirements	(i) Quality Control Manager (ii) Fisheries Department (iii) TBS	4
C	In-house and external	HACCP, ISO 9001:2000, ISO 22000, Ecollabelling	(i) Quality Control Manager (ii) Fisheries Department (iii) TBS (iv) SIDO	5
D	In-house and external	GHP, HACCP, ISO 9001:2000, ISO 22000	(i) Quality Control Manager (ii) Fisheries Department (iii) TBS	4
E	In-house and	GHP, HACCP, ISO	(i) Quality Control Manager	3

external	9001:2000, ISO 22000	(ii) Fisheries Department (iii) TBS

In-house training is provided to all processing workers both permanent and casual labourers. Permanent workers are provided with details on GHP while causal labourers are trained on how to ensure quality of their body, uniform and working tools. The in-house training is provided weekly at the plants' premises. The plants have mini-training rooms with all necessary documents on quality issues. Of the five processing plants visited during the field survey, three plants had training rooms with adequate training materials on quality issues. Much as the training was provided, the HACCP concept was left to the top management.

In addition to training, monitoring of plants' activities and suppliers is crucial to processors. In- house monitoring is conducted by the processing plant HACCP team. Quality control and monitoring involved daily inspection of production layout and quarterly annual in-house audits. The audits are carried out by the HACCP teams and results documented after being discussed with the top management and section supervisors. Corrective measures in case of default are carried out by section supervisors under the HACCP team. Inter-plant assistance was also provided through technical committee formed by the processing plants quality control managers. The committee normally meet and discuss when there is a new standard to be enforced, or when there is a major concern on some operations related to quality. According to quality controller of plant C, the committee is very helpful and is working very closely with the zonal office in Mwanza.

4.5 Costs and Benefits of Compliance at Different Stages in the NP Supply Chain

4.5.1 Costs and benefits for boat owners

3.5.1.1 Investment cost

The main assets owned by boat owners include fishing boats, which are 5 to 10 meters long and with carrying capacity of 500 to 800 kg, collection boats of 7 to 11 meters long with carrying capacity of 6 to 22 tonnes, engines and ice bins for fish collection. The boats are made of either soft wood or hard wood. The life span of soft wood ranged from 2 to 3 years while that of hard wood boats is 5 to 10 years if properly maintained. The soft wood boats are not widely preferred because of frequent breakdown, which increases the possibility of fish spoilage as water passes through into the boats. However, it was found out during the field survey that the majority of boat owners did not use hard wood because of two main reasons: (i) hard wood is expensive due to its shortage caused by deforestation around the Lake Victoria Zone. For example, Ukerewe district used to be a major source of hard wood but currently most wood comes from Tabora region, which is about 700 km away; and (ii) increase in theft of gillnets and depletion of fish resource in the lake makes it unprofitable to invest in hard wood fishing boats. Consequently, most boat owners use soft wood to construct fishing boats and hard wood is used for construction of collection boats, which need to be strong for carrying large quantities of fish. Table 27 provides a summary of assets used and their average costs. Most of the assets are used by both Nile perch and *Dagaa fish* boat owners except fish handling assets, such as collection boats, boat partition/pens[39] and ice bins. These assets are required to ensure quality of fish to meet food safety standards.

Table 27: Cost of fishing assets owned by Nile perch and Dagaa fish boat owners

Type of asset	Unit	Size	Average cost of asset in TZS as at 2007	
			Nile perch	*Dagaa* fish
Fishing boat	Kg	500 – 800	200 000	200 000
Boat partition (pens)			40 000	NONE
Collection boat	Tonnes	6 – 22	1 400 000	NONE
Engine	HP	9.9/15	2 500 000	2 500 000
Engine	HP	40	3 500 000	3 500 000
Ice bin	tonnes	6 – 22	700 000	NONE
Gillnets	Ply	9 – 12	35 000	NA
Dagaa seine	Ply	4-6	NA	25 000

NONE = the asset is not required. NA =Not applicable

The collection boat and ice bins cost Nile perch boat owners a total of TZS 2 100 000 more compared to *dagaa* fish boat owners. If Nile perch boat owners would follow the quality requirements to the letter by using boat partitions with galvanized sheets insulated pens their costs would have increased by TZS 40 000. However, during the field survey it was observed that, most fishers were using plastic sheets commonly known as *kavero* instead of insulated pens. The plastic sheets are accepted as a substitute to insulated pens although they do not guarantee quality.

39 Quality requirements demand partition of fishing boats to provide pens that separate fish from other fishing equipment

Boat owners with collection boats use ice boxes which are insulated with galvanized sheets as seen in Plate 2. At the time of the field survey, the average cost for a complete collection boat with an outboard engine was reported to range between TZS 6 million and TZS 10 million. This cost is likely to increase following FD intension to introduce fibre-insulated boats as food safety standards requirement. When asked about that, the quality inspector Mr Mondoka[40] indicated that the issue has been shelved due to the current concern of fish depletion, which might affect most stakeholders in Lake Victoria. However, considering the current fish export trend, with no fish being returned due to non-conformity, such kind of quality requirement may not be enforced in the near future.

Although fishing boats and engines are considered the main assets in fishing activities, it was observed during the field survey that gillnets are the most important assets that determine the sustainability of the investment. Some fishing boats were found dumped in landing sites because of lack of fishing gears especially gillnets. About 60% of the sampled Nile perch boat owners reported incidences of gillnets thefts in the last five years. About 79% of them were compelled to slow down fishing activities while 21% abandoned some of their fishing boats due to lack of gillnets. A complete gillnet ready for use required to be fixed with 15 floating buoys. Once completed, a gillnet cost about TZS 40 500 to TZS 60 000. Nile perch boat owners use gillnet of 9 to 12 ply with about 40 gillnets per boat while *dagaa* fish boat owners use 4 to 6 ply of the beach seine with one seine per boat. During the field survey Nile perch boat owners complained

40 Personal communication with Mr. Mondoka E., a quality inspector, Mwanza zone office, Discussion was held at Nyegezi office, Mwanza in 2006

about increase in fishing costs resulting from fisheries regulation requirements on the use of more than 5 inches gillnets to ensure fishery resource sustainability. Table 28 indicates that there is statistically significant difference between Nile perch and *dagaa* fish in number of boats owned at 1% significant level. This shows that Nile perch fishing requires significantly more investment in assets than *dagaa* fishing. The reason for this might be the tendency of Nile perch processors or traders to get into favourable selling contracts with boat owners with large quantities of fish catch in order to reduce transaction costs.

Table 28: Mean comparison: assets owned by Nile perch and dagaa boat owners

Variable	Fishing type	n	Mean	t	Sig. (2- tailed)
Number of boats operated	Nile perch	84	3 +_ 2.0	3.209	0.00
	Dagaa fish	24	2 +_ 2.0		
Number of engines owned	Nile perch	50	3 +_ 0.3	1.531	0.14
	Dagaa fish	8	2 +_ 0.4		

Although fishing assets are costly, having a large number of fishing assets ensures favourable contracts with fish buyers. The results in Table 29 show that Nile perch boat owners require twice as much (TZS 18.29 million) the amount of investment required by *dagaa* fish boat owners (TZS 6.29 million). The high investment cost to both boat owners is associated with ownership and operation using outboard engines. Table 29 indicates that, the quality assets increase investment costs to Nile perch boat owners by

14.2% with an overall increase in handling costs by 30.6% which is almost the same as the cost of fishing gears (31.1%).

It can be generalized from the results in Table 29 that quality issues substantially increase investment costs to the extent that they can be a barrier to entry in Nile perch fishing investment. To avoid these costs, alternative or option indicated by Nile perch boat owners during the field survey was to sell fish to boat collectors rather than owning a collection boat. Though the option seems to increase commuting costs to boat owners they considered it cost effective because with the shortage of fish, they have no choice but to stay in the lake for more than one night to catch more fish.

Table 29: Share of the cost of total assets owned to total investment

Variable	**Nile perch**		***Dagaa* fish**	
	Mean cost (TZS)	**% share to total investment**	**Mean cost (TZS)**	**% share to total investmen t**
Boat owned	878 690	4.8	609 040	9.7
Engine owned	6 126 078	33.5	5 188 889	82.4
Gears owned (gillnets and seine)	5 688 204	31.1	497 476	7.9
Collection boat with engine and ice bin	5 600 000	30.6	None	0.0
Total investment cost	**18 292 972**	**100.0**	**6 295 405**	**100.0**

4.5.1.2 Boat owners' recurrent costs

(A) Description of recurrent costs

Boat owners' total recurrent costs comprise traditional fishing cost items and costs of items associated with quality assurance. Based on Antle (1999) categorization of costs, this study describes the traditional cost as costs borne by both boat owners in relation to fish catching and fish delivery whereas cost of items associated with quality assurance are costs incurred to meet traditional quality standards (i.e joint quality costs) and to meet food safety standards requirements (i.e. non-joint costs). Details on the traditional fishing costs and costs associated with quality assurance are summarized below.

(I) Traditional Recurrent Fishing Costs

The traditional recurrent fishing costs can be categorized as annual costs and daily costs as shown in Table 30. The annual costs are considered as recurrent costs because of their very short term in nature. Some of the peculiar annual and daily recurrent costs are described in the sections below.

(i) Annual traditional costs

(a) Plastic gallons and buoys:

These are necessary tools to ensure floatation of gillnets in the water. The gallons are used more than buoys because the latter seem to be more expensive. A buoy is sold at TZS 600 and 20 buoys are required per gillnet while a plastic gallon is sold at TZS 400 and 15 gallons are used per gillnet. However, buoys are more efficient and stay longer if they are not destroyed by other fishing boats. For gallons a keen tying of the gallons to gillnet and tighten of gallon lid is crucial otherwise the gallons are lost. On average, inadequate skills in tying the gallons to gillnet can result into its replacement every month while buoys are replaced once a year. Tying of 15 gallons or 20 buoys required a single bundle of nylon rope, which cost TZS 500 during the field survey.

(b) Replacement of gillnets

High rate of replacement of gillnets results from theft of gillnet and poor fishing methods. About 60% of the boat owners interviewed during the field survey reported to buy gillnets to replace stolen ones. The theft rate is so high that fishermen have formed fishermen unions such as Tanzania Fishermen Union (TAFU) and Mara Fishermen Union (MAFU) that among other things to assist in combating theft in the lake. Also the fishing method referred to as double or triple joined gillnets to fetch more fish using stones to submerge gillnets destroyed the nets and therefore increased the frequency of replacements; sometimes after every three months.

(c) Net repair or net mending

This is done on daily basis where an average cost per net is TZS 1000 if 30 nets are repaired. However, it was observed during the field survey that net mending for the *matajiri* was done by the fishermen as part of their job.

(d) Paddles replacement

This depends on type of wood used to make them. Some paddles last for 2 to 3 years if made of hard wood while others last for 4 to 6 months if made of soft wood. The majority of boat owners (78%) use soft wood not only because of inadequate access to hard wood but also hedge against risk of loosing the paddle in the lake.

(e) Anchor and anchor ropes

Anchors are categorized as annual cost item because the commonly used anchors are large structured stones or piece of hard wood *(jisiki*) which is replaced annually. During the field survey, the structured stones or *jisiki* were sold at a price of TZS 16 000 to TZS 20 000 while the iron made anchor was sold at TZS 28 000 though not readily available.

Anchor ropes are either made of sisal or nylon. One anchor requires one bundle of anchor rope which cost about TZS 7000 to TZS 8000 for sisal rope and TZS 10 000 for nylon rope during the field survey.

Table 30: Annual and daily traditional cost items in Nile perch and dagaa fishing

Type of cost	**Cost items**	**Unit cost (TZS) range**	
		Nile perch	***Dagaa* fish**
Annual cost items	- engine repair	15000	15000
	- anchor (*nanga*)	16000 – 28000	16000 – 28000
	- anchor ropes (price per bandle)	7000 – 10000	7000 – 10000
	- knife	500 – 1000	500 – 1000
	- water scoop (*sabujo/mbehe)*	300	300
	- fish scoop *(katangazi)*	NA	500 – 800
	- plastic sheet *(kavelo)*	2000	2000
	- floating gallons/buoys (*dumu dogo/boya*)	400 – 600	400 – 600
	- ropes for gallons (per piece)	500	500

	- hooks	80 – 100	NA
	- hooks line (timber)	1300 – 3000	NA
	- gillnets (complete with reddish buoys)	40500 – 66000	NA
	- gillnet (ply 6 x 5”, 9 x 5.5” to 12 x 5.5”)	18000 – 35000	NA
	- *dagaa* seine	NA	25 000
	- paddle	1500 – 5000	1500 – 5000
	- sail	20000 – 30000	20000 – 30000
	- lamp	NA	30000 – 35000
	- camps rent	120000	60000
	- cooking facilities	20000 – 40000	NA
	- boat registration and licensing	10000 – 40000	10000 – 30000
	- district council levies	20000 – 30000	
	- Landing sites levies	1500 – 4500	500 – 1000
Daily cost items	- Engine fuel and oil	1750 – 2200	1750 – 2200
	- Baits (*chambo*)	80 – 200	NA
	- Net mending	1000 – 2000	1000
	- Boat repair	1000 – 3000	1000 – 2000
	- Food for fishers (supper per fisher)	1000	800
	- Food fish share (2-3 kg or 1 kg *dagaa*)	3600 – 5400	450 – 600
	- Fishers fishing cost	See contracts	See contracts
	- Cook	9000 – 15000	5000
	- Security guards	30000 - 40000	NA

(f) Knife

This is a tool used to collect fish if caught in gillnet by cutting a string on the net. The knife is crucial as it eases fish pulling from the gillnet which could otherwise get destroyed by staying long on the net or pulled hence broken into pieces. Each fisherman normally carries one knife. The knife is also used for protection against robbers in the lake.

(g) Water scoop and fish scoop

Water scoop commonly known as *sabujo* or *mbehe* is used to remove water from the boat. This water scoop is another crucial tool as it reduces the amount of fish destroyed by water from the lake. Normally there are 2 to 3 scoops per boat. *Dagaa* fish boat owners complained about high rate of fish spoiled caused by boat leakages. To reduce cost, boat owners used cut-open plastic gallons that look like big scoops. The study observed few fishermen using plastic bowls which were not commonly used as they are perceived to be expensive. A bowl costed between TZS 800 and TZS 1200.

Fish scoop is commonly known as *katangazi*. The scoop is made of plastic gallon cut into half or big plastic bowls. It is used by dagaa boat owners to remove fish from the boat to and put in plastic drums.

(h) Hook and hook liner

These fishing gears are used for Nile perch fishing. Most fishermen use hook liners to fish during the day whereby a range of 500 to 4000 hooks are used. They cost about TZS 80 to TZS 100 per hook depending on size. About 100 hooks require one bundle of timber rope which cost between TZS 1300 and TZS 3000 depending on the strength of the timber.

(i) Sail and lamp

These are commonly used by *dagaa* fishermen. The cost of sail ranges from TZS 20 000 to TZS 30 000. Kerosene lamp is critical for *dagaa* fishing as it is used to attract *dagaa* fish during the night. During the field survey, the lamp costed TZS 30 000 to TZS 35 000 and could last for 3 years. However, theft causes frequent purchase of lamps sometimes every season.

(j) Rent for fishing camp and cooking facilities

Most boat owners rent a house at landing sites, which is used, as an operation office during fishing season. For *dagaa* the camps are temporary while for Nile perch the camps are permanent. The camps are located within 400m from the Lake which is considered fisheries area or landing site. During the field survey, the boat owners claimed to be charged an annual rent of TZS 120 000 for the camps[41] by nearby residents. As per fisheries regulation, 400m width lake shore belongs to FD. However, inadequate enforcement of the regulations led to misappropriation of the shores by nearby residents. Since 1999 the residents were required to move away from the Lake shores as part of food safety standards requirement for landing sites improvement. Though the residents had moved away, they retained ownership of the grounds because they were not compensated by FD.

(ii) Daily traditional costs

These include cost of engine fuel, live baits, boat repairs, food, cook and security guard. On average, a boat consumes a mixture of oil and petrol at about 15 to 40 litres per trip at a cost of TZS 1750 to TZS 2200 per litre depending on the location of the landing site. Fuel-oil mixture consumption normally increases with the age and status of the engine.

41 The camps are equipped mainly with cooking facilities and mats for beds. Boat owner is the overseer of the fishing camp who hired a lady as a cook paid by selling food to fishers and boat owners.

As most engines have been operating for more than 5 years, the fuel consumption reported of 15 to 40 litres per day seems to be on the higher side.

Live baits are used by fishermen using lines, whereby 2000 baits can fish about 400 to 600 Nile perch fish per day. The live baits commonly used are *furu* and young cat fish known as *kambale*. The two types of baits are used because they are readily available in the fishing season. There is a belief amongst fishers that they get more fish with *kambale* baits. This has compelled most of them to initiate *kambale* farming in areas around Mwanza City.

Boat repair using blankets to fix holes in fishing boats is done daily. One blanket is required to repair a single boat. The blanket is cut into long pieces and squeezed in between holes. During the field survey one blanket costed TZS 3000

Cost of food for fishers is borne by boat owners. They provide two meals[42] to fishers when on duty. In addition to food, Nile perch fishers and boat owners share 2 to 3 kg of fish each while *dagaa* fishers and boat owners share 1kg each of *dagaa to take* home. Nile perch fishers and boat owners normally share fish that has been rejected by buyers

42 Two meals were served for fishers on duty. One was served before going to the Lake and two was food taken to be eaten at night when in the Lake. Normally, a common staple food *ugali* made of maize meal was prepared with Nile perch as afternoon meal. The food was shared with boat owners and the time was crucial as was used to plan for the night work, reprimand the mis-behaved fishers, loan repayment and a general report concerning fishing activities of the previous night. A second meal was normally made of rice and fish.

because of not meeting required standards such as size. Fish of below 50cm in size is normally rejected and this is what is taken home by fishers and boat owners.

Cooks are either paid on daily or monthly basis. The cooks are hired by boat owners who operate fishing camps. They are paid about TZS 9 000 to TZS 15 000 per cook per month depending on the number of fishers served in the fishing camp. *Dagaa* fishing camps paid monthly wage of TZS 5 000 for cooking service.

Security guards cost about TZS 30 000 to TZS 40 000 per month. Instead of security guards, most boat owners engage fishers to take care of the engines and gillnets as part of their job.

(II) Cost associated with quality assurance

Based on classification by Antle (1999), the quality assurance cost items are categorized into joint and non-joint costs as shown in Table 31. The joint cost items are associated with quality even before enforcement of food safety standards. The non-joint cost items are associated with food safety standards requirements.

Table 31: Quality recurrent cost items in Nile perch and dagaa fish fishing

Type of cost	**cost items**	**Unit cost (TZS) range**	
		Nile perch	***Dagaa* fish**
Joint Quality cost item	- Plastic sheets (*kavero*)	15 000 – 20 000	15 000 – 20 000
	- Fish trays	5000 – 10 000	NA
	- wooden bar (*vigomezo*)	1000 – 2000	1000 – 2000
	- plastic bucket (*madumu*)	NA	800 – 2500

	- drying nets	NA	3000 – 18 000
Non-joint Quality cost items	- Boat partition (pens)	15 000 – 20 000	NA
	- Ice bins (renting cost)	70 000	NA
	- frequency of commuting	10 000 – 15 000	
	- rejected fish (loss to boat owner (TZS/kg))	3600	

(a) Joint quality costs

These costs include plastic sheets (*kavero),* fish trays, wooden bars, plastic buckets and drying nets. *Kavero,* the plastic sheets are used by both Nile perch and *dagaa* fish boat owners to reduce fish spoilage. During the field survey, an adequate piece of *kavero* cost about TZS 15 000 to TZS 20 000. The plastic sheets are not recommended in quality assurance because they maintain fish odour and are not easy to clean and dis-infect.

Fish trays are used when delivering fish at landing sites or collection boats in the Lake. These are either galvanized or plastic fish carrying trays. The fish trays cost about TZS 5000 to TZS 10 000. The wooden bars, plastic buckets and drying nets are used in *dagaa* fishing and their costs are as shown in the Table 31.

***(b)* Non-joint quality costs**

The non-joint costs include partition of boats, ice bins, commuting in the lake and amount of fish rejected because of not meeting the required standards. *Partition of boat* by boat owners is to ensure separation of fish from other fishing tools because food safety standards require separation of fish from fishing tools. *Dagaa* fish boat owners used wooden bars (*vigomezo*) to prevent fish from spreading in the boat.

Ice bins are either owned or rented-in from buyers by few Nile perch boat owners at an average monthly rent of TZS 70 000. *Commuting cost* is considered as daily quality cost because it involves the frequency of taking fish to the collection boat located in the Lake. The commuting cost is estimated on the basis of fuel cost. The experienced boat owners provide estimates on amount of engine fuel used to move from their fishing points to the location of collection boats. The amount of fuel was then multiplied by the average price of oil mixed with petrol fuel, (at landing sites, the fuel sold to boat owners is a pre-mixture of oil and petrol claiming that it increases the density of fuel). The volumes of fish rejected due to non-conformity to standards were considered non-joint cost because rigorous fish selection was one of the requirements of food safety standards.

(B) Comparison of boat owners' recurrent costs

(a) Unit costs amongst Nile perch boat owners

Analysis of unit costs by size of business scale amongst Nile perch boat owners shows a significant difference at 1%. This result negates the study's expectation that larger businesses will have lower per unit cost of compliance due to economies of scale (Fig. 5). Though unusual, the anomaly is explained by the dominance of artisanal fishing in Nile perch, which brings in the indivisibility of managerial costs to large scale boat owners.

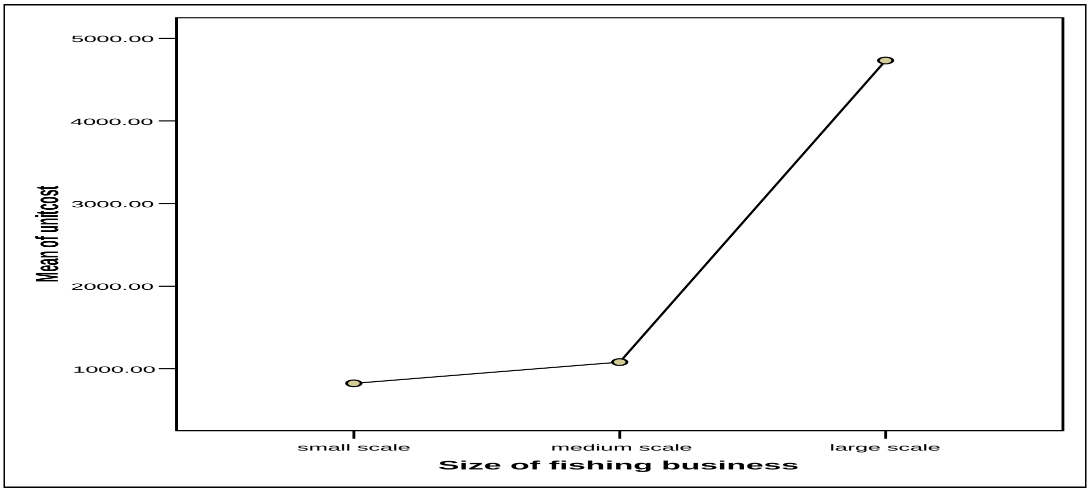

Figure 5: Comparison of unit cost by size of business amongst NP boat owners

(b) Unit costs between Nile perch and dagaa boat owners

An individual boat owner using a boat operated by an outboard engine was used as a representative in the comparison of Nile perch and *dagaa* boat owner's annual recurrent costs. The calculation of the annual costs for the two types of boat owners was based on the values as indicated in table 32.

Table 32: Assumption used in estimation of recurrent cost between Nile perch and Dagaa boat owners

Description	**Unit of measure**	**Nile Perch**	***Dagaa***
Average operating months in a year	days	300	192
Gallons used to float one fishing nets	number	15	15
Number of nets used in fishing per single boat	number	40	1
Rope	Bundle	1	1
Employees/fishers	number	3	4

Table 33 summarises the annual recurrent costs for individual Nile perch and *dagaa* boat owner estimated using the above information. The results in Table 33 indicate that Nile perch boat owners' incurred significantly higher annual recurrent costs (TZS 33.0 million) than *dagaa* boat owners (TZS 17.6 million) with a large share of the cost being fuel for the engine followed by cost of fish rejected by buyers or used for home consumption. The comparison indicate that quality costs for Nile perch fishing are higher accounting for 16.87% of its total costs compared to the *dagaa* fish quality costs which accounts for only 0.24% of its total cost.

In addition to the quantified costs shown in Table 33, Nile perch boat owners incur additional costs emanating from monitoring fishing activities to ensure compliance. Contractual agreements with fishers and traders normally increase quantifiable and non-quantifiable costs to boat owners. These are incurred during relationship establishment, loan acquisition and repayment. These costs are discussed in detail in the following section.

4.5.1.3 Transaction Costs to Boat Owners

The transaction costs to boat owners are associated with searching for a partner with whom to exchange; screening potential trading partners to ascertain their trustworthiness; bargaining with potential trading partners to reach an agreement; packaging and transferring the product; monitoring the agreement to see if the agreed conditions are fulfilled and; enforcing the exchange agreement. The following sections describe costs for boat owners in the fishing and fish trading contractual agreements.

(a) **Transaction costs in fishing contractual agreements**

(i) Boat owners verbally contract three fishers to carry out fishing activities at an agreed form of payment. Contracting two fishers and a supervisor who ensure collection and delivery of adequate quality fish is a challenge to boat owners. The recent trend of selling fish by fishers in the Lake and appropriate the money claiming low catch led to boat owners dependence on hard working, strong and skilful relative or old friend who command respect from other fishers.

(ii) Searching for qualified fishers to engage in the fishing contract is another cost to a boat owner. Though in most cases, fishers are identified by fishers' supervisor, an approval of the boat owner is necessary. The approval requires knowledge of boat owner on fishers located around the lake. It was found out during the field survey that fisher's movement in the lake was common, with those being expelled by other boat owners being high. Thus a boat owner's relationship with other boat owners is crucial for sharing information on fishers' conduct in different landing sites or fishing camps. The information sharing is forged through (a) selling fish to large scale boat owners, which means accepting what ever price offered to them; (b) forming informal co-operations where small scale boat owners agreed to assist each other in case of emergence such as accidents and robbery in the Lake, and (c) lending of fishing gear amongst themselves.

Table 33: Comparison of average annual recurrent cost between Nile perch and dagaa boat owners

Cost item	Annual recurrent costs for Nile perch fishing				Annual recurrent cost for *dagaa* fishing			
	Quantity	Frequency of incurring the cost in a year	Unit price	Total cost	Quantity	Frequency of incurring the cost in a year	Unit price	Cost for dagaa fish
Gillnets/*dagaa* seine	40	2	26 500	2 120 000	1	2	25 000	50 000
Plastic gallons with ropes	400	10	450	1 800 000	15	6	460	41 400
Paddle	3	2	2 500	15 000	4	1	2 500	10 000
Anchor with rope	1	1	25 000	25 000	1	1	25 000	25 000
Knife	3	1	500	1 500	4	1	500	2 000
Water scoop	2	2	300	1 200	2	2	300	1 200
Kerosene lamp				-	1	2	35 000	70 000
Kerosene				-	3	192	980	564 480
Fishing camp rent	1	10	10 000	100 000	1	5	10 000	50 000
Cooking facilities	1	1	30 000	30 000	1	1	20 000	20 000
Boat maintenance and repair	1	10	3 000	30 000	1	6	3 000	18 000
Engine repair and maintenance	1	10	15 000	150 000	1	6	15 000	90 000
Net mending/repair	40	10	1 000	400 000	1	6	1 000	6 000
Engine fuel and oil	35	300	1 975	20 737 500	40	192	1 975	15 168 000
Food for fishers	3	300	1 000	900 000	4	192	800	614 400
Fish taken for consumption					5	192	800	768 000
Registration/license/levies				44 000				29 000
total traditional costs				**26 354 200**				**17 527 480**
Quality costs								
Boat partition/wooden bar (vigomezo)	1	1	15 000	15 000	4	1	1 000	4 000
Fish trays/scoop	2	1	12 000	24 000	3	2	700	4 200
Plastic sheet (*kavelo*)	2	2	2 000	8 000	2	2	2 000	8 000
Plastic drums				-	3	1	2 500	7 500
Drying nets				-	1	1	18 000	18 000
Commuting costs	1	100	12 000	1 200 000				-
Fish reject/home consumption	4	300	3 600	4 320 000				-
total quality costs				**5 567 000**				**41 700**
Grand Total Cost				**33 001 200**				**17 569 180**
Traditional cost (%)				**83.13%**				**99.76%**
Quality cost (%)				**16.87%**				**0.24%**

(iii) Monitoring of fishers activities. Though recruitment and negotiation between boat owners and fishers is conducted by the supervisor, monitoring is largely done by boat owners. With the current declining trend in fish catch in the lake where fishers are required to move far in the Lake at an average of 3 hours travelling time instead of 1 hour as it was five years ago, risk of cheating on fish catch volume by fishers has increased. To combat this, boat owners are compelled to:

(a) Provide monitoring gadgets such as expensive mobile phones to supervisors for them to be in contact with the boat owners while in the Lake. During the field survey a mobile phone cost about TZS 70 000 to TZS 100 000. Though the mobile phones benefited boat owners, the device outperform fisheries surveillance in the Lake hence increased violation of fisheries regulations. The boat owners use mobile phone to alert fishers in case there is a patrol heading to the Lake.

(b) Forge relationships with each other through convoy fishing. The convoy fishing seem to be successful, however, invisible costs associated with assistance to pull partners sailed or paddled boat are not recorded.

(c) Introduce fishing patrols to deal with robbery in the Lake. This is normally done by large scale boat owners. About 40% of the sampled large scale boat owners used a 40HP out-boat engine to monitor own fishing boats in the Lake.

(iv) Enforcement of the agreement with fishers increase costs to boat owners through follow up on registered offence with the village government or police. The cost refered to as *usumbufu* (inconveniences) led to changes in punishment methods by boat owners. About 83.5% of the sampled boat owners instantly fired mis-behaved fishers after paying their dues. Interestingly 8.2% of the interviewed fishers, which comprised only small and medium scale fishers, reported that they could not foresee breaching of their contracts with boat owners. This shows that trust between small scale boat owners and fishers is higher than between large scale boat owners and fishers. High competition on skilled fishing labour might be the reason for this. High competition may lead to high cost hence investment on trust might be the best option for small and medium scale boat owners to compete in the labour market.

(b) **Transaction costs in fish trading contractual agreements**

(i) Three main conditions were mentioned as necessary for a boat owner to get a contract with traders. First, provide an acceptable guarantor who is a large scale boat owner. Second, supply fish to the trader for two to three years. Third, pay specified amount of money as commitment. The amount of money ranges from TZS 30 000 to TZS 200 0000 depending on the terms of contract.

(ii) A loan repayment procedure is another source of transaction costs to boat owners. Most boat owners who received loan from traders, tend to (i) agree on lower unit price than the market price, normally TZS 200/kg lower, (ii) offer a certain amount of fish as appreciation for being provided with a loan (iii) cheat on fish weight by using tempered weighing scales

4.5.1.4 Benefits of compliance with standards for boat owners

The benefits of standards compliance for boat owners are related to access/guaranteed markets, price premium and high net revenues. The access/guaranteed market is assessed by examining the real fish price offered to Nile perch fish suppliers since 1996 and volumes of fish rejected because of not meeting the standards. Real price is normally adjusted to remove the effect of changes in the purchasing power of any currency in reference and expressed in constant value relative to the base year (http://www.teachmefinance.com/scientific_terms). Data on fish catch by Nile perch fishermen since 1996 was compiled from four district fisheries offices in Mwanza and used to compute real price using 1992 as base year following Bank of Tanzania index. The computed real price indicates that the unit price offered to fishermen has been increasing since 1999 after the uplift of EU import ban. The decline in price between 1997 and 1999 as shown in Fig 6 is associated with the intermittent import bans whereby fish exports were limited to low value markets in Asia and Africa.

The average fish catch reported by Nile perch boat owners was about 35 tons a year of which only 1.5 tons were rejected due to non-conformity to the required standards especially fish which is smaller than the minimum size. During the field work no single case was reported where boat owners could not get a market for quality fish. However, this is not only because of compliance to quality standards but also current shortage of Nile perch fish being experienced in the Lake (Fig. 6)

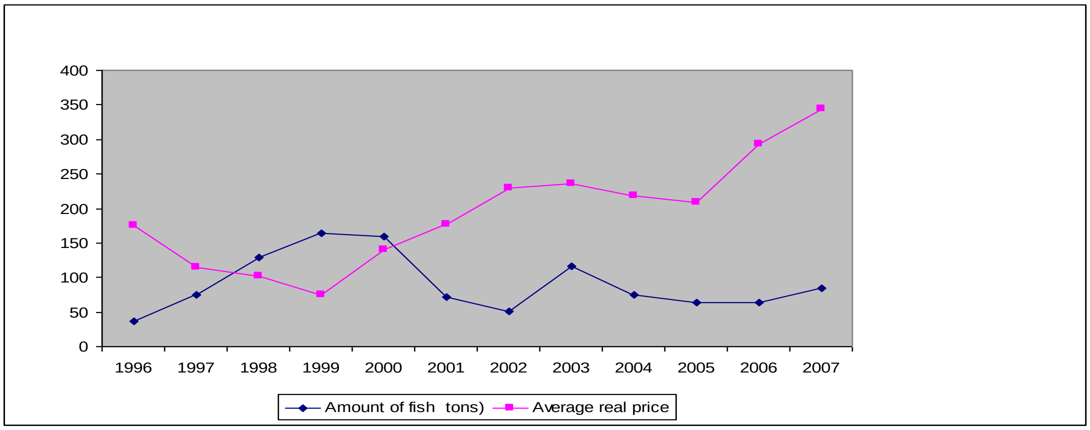

Figure 6: Trend in NP fish catch (tons) and real price (TZS) in Mwanza 1996-2007

Source: Compiled data from Mwanza district offices, 2006 and addition of field survey data, 2007

Premium price is assessed by comparing the market price of quality Nile perch fish to that of non-conformity or rejected Nile perch fish. At the time of the field survey, boat owners reported the highest price of TZS 600 per kg offered for rejected fish. The price is equivalent to 33% of the market price for quality fish. This implies that, by selling quality fish, boat owners enjoy premium price.

The other benefit to boat owners is high net revenue from sale of fish. Despite similar volumes of fish catch, the Nile perch boat owners receive high average annual net revenue resulted from higher unit selling price and lower unit cost. The computed average annual fish catch for Nile perch and *dagaa* boat owners shows no statistical significant difference in their volumes of fish catch (Table 34). Mean comparison however, shows a significant difference in the average unit selling price (TZS/kg) and unit fishing costs between Nile perch and *dagaa* boat owners at 1% and 10% respectively. The table also shows a significant difference in annual net revenues between the two categories of boat owners. This confirms Kadigi et.al (2007) findings that Nile perch fishing (with compliance to food safety standards) pays more than dagaa fishing (without compliance to food safety standards).

Table 34: Mean comparison: fish volume, unit cost, selling price and annual net revenues between Nile perch and dagaa boat owners

Variable	**Type of boat owner**	**Independent test**		
		Mean	**T test**	**Sig. (2-tailed)**
Unit fishing cost (TZS/kg)	Nile perch	1041	3.37	0.00
	Dagaa fish	334		
Unit selling price (TZS/kg)	Nile perch	1 783	26.34	0.00
	Dagaa fish	717		
Annual fish catch (kg)	Nile perch	57 230	1.19	0.24
	Dagaa fish	25 445		
Annual net revenue (TZS)	Nile perch	26 002 073	2.71	0.01
	Dagaa fish	8 157 838		

4.5.2 Cost and benefit of compliance to standards for Nile perch traders

4.5.2.1 Investment costs for traders

The current investment required by Nile perch traders seemed to be much higher than before compliance. Prior to food safety standards, traders were transporting Nile perch fish using simple means of transport such as bicycles, wheel barrows, pick-ups and fishing boats with no ice bins. It was easy to enter into business as long as one had capital to buy and transport to fish to processing plants. In 1997 new fish handling methods such as use of ice were introduced in the NP industry. An analysis using weighted average indicated that the average amount of investment required by Nile perch traders to enter into Nile perch fish trade before compliance was half (TZS 4.3 million) of what was required after compliance (TZS 8.6 million) as shown in Table 35.

Table 35: Assets owned by Nile perch fish traders and their costs at current price

Type of trader	n	Before compliance		After compliance		Additional cost
		Assets owned	**Cost (TZS)**	**Assets owned**	**Cost (TZS)**	**%**
Dealers	14	Bicycles or w/barrow	90 000	Weighing scale-analogue	6 000	
		-	-	Bicycles	90 000	
		-	-	Cool box	40 000	
Total			**90 000**		**130 600**	**45.1%**
Traders own trucks	20	Pick-ups	7 500 000	5 tons insulated truck	15 000 000	
		Weighing scale	12 000	Weighing scale-digital	20 000	
		-	-	Fish carrying trays	10 000	
		-		Ice bin	700 000	
Total			**7 512 000**		**15 730 000**	**109.4%**
Traders own boat	10	Collection boat	700 000	Insulated collection boat	2 100 000	
		40HP engine	3 500 000	40HP engine	3 500 000	
		-	-	Ice bin	700 000	
Total			**4 200 000**		**6 300 000**	**50.0%**
Weighted average			**4 397 727**		**8 623 373**	**96.1%**

Compliance with food safety standards emphasised on use of modern means of transporting fish such as insulated trucks or insulated boats equipped with ice bins full of mashed ice instead of block ice. Five-ton trucks were recommended to reduce loading time spent in landing site, which might cause fish spoilage. The small amount of average investment required by traders in Table 35 compared to boat owners as shown in Table 29 explained the movement of boat owners from fishing activities to fish trade or combining the activities of fishing and trading. Of the surveyed Nile perch fish traders, 23.3% were boat owners who moved from fishing to trading activities.

4.5.2.2 Recurrent costs for traders

Compliance increased traders recurrent cost tremendously through introduction of new activities such as provision of quality approved certificate, annual renewal of the certificate, transport vessel inspections, techniques and use of mashed ice. Table 36 compared traders' average costs incurred before and after compliance with food safety standards.

Processing plants provide factory agents with single truck of 5 tons, fuel, maintenance, and registration and quality approval certificate. The factory agents incur labour cost (hire 3 labourers for fish sorting and packing), and cost on additional fuel of about 70 litres per trip as factory agents claimed that the amount provided by processing plants was not enough.

Most boat collectors operate own fish trading businesses which means they had previously obtained loans from processors and grew out of it. Only 15% of the surveyed boat collectors had loans from processors at the time of the field survey. Boat collectors operated a maximum of 2 collection boats and consumed about 370 litres of fuel per week equivalent to 3 trips.

Table 36: Comparison of traders recurrent cost before and after compliance

Cost item	Units	Dealer	Factory agent	Boat collector	Truck owner
Before costs					
Fuel amount	litres	-	3 640	19 344	29 120
Fuel cost	TZS	-	45 864 000	35 726 600	58 240 000
Wages	TZS	-	6 552 000	2 5891 684	26 742 820
Fish share as food	TZS	312 000	-	8 658 000	20 748 000
Cooking	TZS	-	-	390 000	1 170 000
Camp/house rent	TZS	-	60 000	120 000	-
Licence	TZS	-	-	162 448	252 096
Levy	TZS	-	520 000	780 000	2 340 000
Sub-total	TZS	**312 000**	**52 996 000**	**71 728 732**	**109 492 916**
After cost					
Boat/vehicle inspection	TZS	-	-	101 036	359 996
ice loading	TZS	-	-	520 000	520 000
Fish sorting/packing	TZS	-	-	260 000	260 000
Protective gears	TZS	-	720 000	-	720 000
Fish trays/trolls	TZS	4 000	16 000	-	16 000
Allowances	TZS	-	520 000	624 000	468 000
ice bin at landing site	TZS	-	840 000	-	840 000
Sub-total	**TZS**	**4 000**	**2 096 000**	**1 505 036**	**3 183 996**
Grand total	**TZS**	**316 000**	**93 783 640**	**95 821 112**	**148 976 032**
Percentage increase		**1.3%**	**4.0%**	**2.1%**	**2.9%**
Fish rejected	Kg	-	24 960	14 560	23 400
Fish reject cost	TZS	-	38 688 000	22 568 000	36 270 000
Non-conformity cost	**%**	**0.0%**	**70.2%**	**30.8%**	**32.2%**

The annual recurrent cost for truck owners is higher than for the other traders (Table 36). This might be a result of using old vehicles that require frequent maintenance and consumes more fuel. The high recurrent costs incurred by truck owners might be a result of a small number of respondents. The sample was represented by 8 traders who owned an average of 2 trucks operating in the remote landing sites at Nkome-Mchangani, Geita, Lukuba and Nyang'ombe in Mara region.

Table 36 shows that the after compliance costs varied with type of traders. Dealers who are small scale traders in Nile perch business incurred 1.3% additional cost associated with acquisition of trays or trolls for carrying fish. The factory agents, boat collectors and truck owners incurred additional cost of 4.0%, 2.1% and 2.9% respectively. However, both traders incur higher compliance cost due to non conformity to standards which is represented by the amount of fish rejected by processors. During field survey, the net loss price was TZS 1550 per kg. (Initially the rejected fish were retained by processors based on safety quality standards requirements to ensure safe disposal of unsafe fish). In that case the quality cost to suppliers was equivalent to the total amount of fish rejected. However, through Tanzania Fishers Union (TAFU) the government intervened and since then processors are required to pay for the rejected fish.

The non-conformity cost seems to be higher for factory agents at 70% compared to boat collectors and truck owners which is about 30%. During the field survey, traders claimed that the non-conformity cost was higher when one received a loan from a fish buyer. In general, all traders who supplied fish directly to processors complained of high levels of rejects and contended that processors are benefiting from fish rejects using food safety standards as an excuse. The amount of fish rejects normally decrease immediately after finalizing loan repayment. Thus the price differential on the rejected fish might be interpreted as compliance cost to fish suppliers and loan monitoring cost which means a cost of acquiring a loan.

4.5.2.3 Transaction costs to traders

Transaction costs to traders arise from loan provisions and selling price. Provision of loans creates market power to processors who bear a greater proportion of risks and therefore indirectly retain ownership of the fish by offering low price to fish traders. Exercise of market power such as price setting and loan repayment methods create conflicts along the supply chain.

In the Nile perch industry processors retained the power over purchases of whole Nile perch by setting price on individual basis. Those with large capital are in a better position to negotiate for higher prices. However, lack of transparency creates mistrust among chain actors. One of the mistrust in Nile perch is cheating on fish weight and quality. Weight cheating is through tempering with weighing scales. During the field survey it was observed that this kind of cheating is done by almost all actors along the supply chain. Cheating based on quality excuse is mainly done by processors at the fish receiving point. Again this is an issue of transparency in fish selection process at the processing plant using food safety standards as an excuse.

Following HACCP, there is a separation between raw material entry point and exit point. In this case, when fish are received at the processing plant, the selection is done at the reception but on the other side of the counter, the owner of the fish (trader) is not allowed on that side. So what ever selection method is used by the processor cannot be verified by the fish owner. Some efforts were made by TAFU to increase transparency in fish selection at the processing plant. In late 2005 TAFU through mediation by the Regional Government Authorities, managed to influence their presence in the fish selection process. However, the presence of fish suppliers was later forbidden on food safety grounds. This again reflects the use of food safety standards as an excuse to exercise market power.

4.5.2.3 Compliance benefits for traders

The benefits of compliance with standard vary with type of trader. The small size business traders enjoy market access with no or minimum amount of fish rejects. Handling small quantities of Nile perch fish, dealers who operate around shore-line, select quality fish and deliver them to traders in a short span of time or in rare cases they use small containers filled with mashed ice. Dealers' benefits are associated not only with compliance with the standards but also shortage of fish. The shortage of fish compelled traders to engage dealers who move around the Lake, even in areas that are not accessed by collection boats, looking for fish supplies; hence increase their trade volumes.

Premium price is assessed using net market price for quality fish and rejects. The computed net market price indicates that all traders enjoy price premium (Table 37). A comparison of average annual net revenue within the Nile perch chain (amongst Nile perch traders) shows a skewed distribution of revenue with those (factory agent) closely related to downstream chain actors (processors) enjoying higher revenues. Table 37 shows that net revenues for collectors using boats (*karua)* are three times greater than those of dealers, while net revenues for factory agents using fish trucks are twice more than those of collectors using own trucks and twenty times greater than revenue obtained by boat collectors. Kadigi *et al.* (2007) reports similar differences in net revenue amongst Nile perch traders. The report shows that annual net revenues for boat collectors are three times higher than those of dealers while those of truck owners and factory agents are four and ten times higher respectively. A comparison between Nile perch and *dagaa* traders indicate that there is no significant difference in their net annual revenue. This is contrary to the findings by Kadigi *et al.* (2007). However, this difference might be a result of little number of respondents in *dagaa* traders' category.

Table 37: Comparison of Nile perch and dagaa traders' net prices and gross margins

Variable	**Nile perch traders**	***Dagaa***

	Dealer	Factory agent	Boat collector	Truck owner	Traders
Selling price for quality fish	1 919	2 214	2 400	2 300	900
Selling price for rejected fish	600	250	250	250	-
Net price	1 319	1 964	2 150	2 050	-
Annual net revenues	2 756 704	148 746 185	7 591 126	67 941 100	41 263 350
Comparison between Nile perch and *Dagaa* traders				**Nile perch**	***Dagaa***
Mean comparison between Nile perch and *dagaa*					ns

4.5.3 Standards compliance costs and benefits for processors

Contrary to boat owners and traders, processors are the key players in implementation of food safety standards that include HACCP, ISO 22000 and BRC. Thus the costs were grouped into investment and recurrent costs as discussed in the sections below.

4.5.3.1 Investment costs to processors

The investment costs for processors include establishment of fish processing plants that meet food safety standards. This kind of investment on specific assets is related to sunk costs because of no or low value in alternative use. Total investment costs by Nile perch processors around the Lake are location specific investment therefore sunk cost. The analysis on processors investment was conducted using a scenario of "before and after" compliance with food safety standards. The costs are itemized under seven groups: (a) preparation costs, (b) construction/rehabilitation costs, (c) production system set up, (d) process and product certification, (e) machinery and equipment costs (f) setting of in-house laboratory and (g) recording and documenting equipment (Table 38).

In general, compliance increased investment cost by 16.0% with higher cost being restructuring or plant construction according to the standards. The additional investment cost of about TZS 7 billion can be a barrier to entry for most citizens due to inadequate accessibility to credit especially from the local financial institutions. Details on changes in cost items due to compliance are discussed below.

Table 38: Summary of total investment cost for fish processors before and after food safety standards (TZS)

Investment costs	Before compliance	Additional cost for	% increase in
Preparation costs	6 200 000	8 134 513	0.12
Plant construction/restructuring	43 327 006 824	5 782 159 304	83.25
Production system set up*	-	45 100 000	0.65
Product and process certification*	-	84 000 000	1.21
Machinery and equipments*	-	1 000 000 000	14.40
In house laboratory*	-	18 500 000	0.27
Recording/documenting	3 100 000	8 000 000	0.12
Total	**43 336 306 824**	**6 945 893 817**	**16.03**

* Before compliance costs could not be established hence processors were asked to provide estimates on additional cost that was incurred immediately after introduction of food safety standards.

(i) Preparation costs

These are costs incurred before starting any production but are necessary for the establishment of a plant. The necessary preparation costs include information search, communication and staff travel. Though the cost items are the same for plants, their structure changed with implementation of standards. In the assessment of the preparation costs, data from two processing plants which were established in 1994 and 2000 were used. Prior to comparison, the data were transformed into constant prices using 1992 as a base year based on Bank of Tanzania (BOT) statistical reports. Fig. 7[43] shows an interesting pattern on the preparation costs before and after compliance with food safety standards. The figure shows a tremendous decrease in travel costs and emergency of new costs elements such as consultancy/technical assistance and relationship establishment with certifiers. Below is a detailed discussion on the cost items under preparation costs.

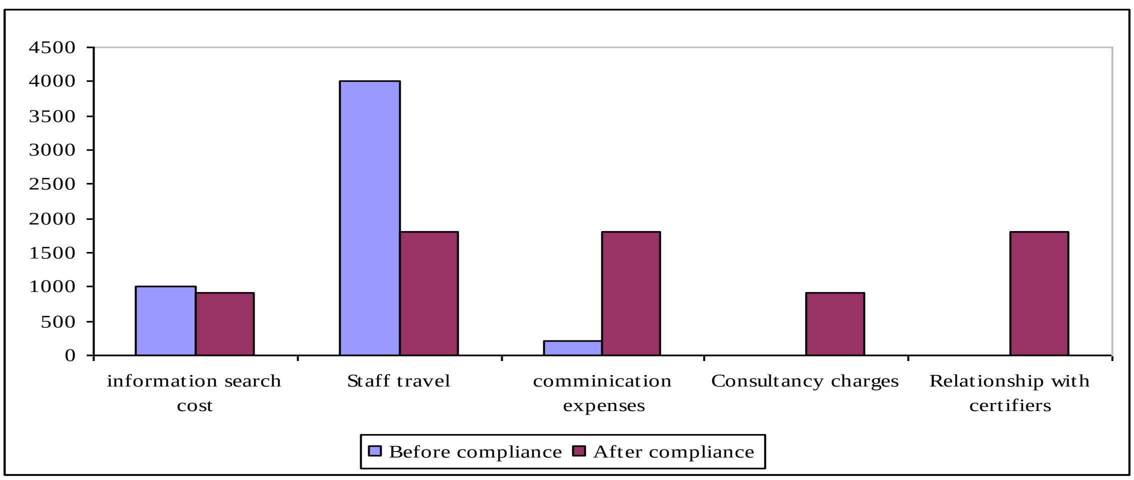

Figure 7: Preparation costs "before and after" compliance with standards (TZS)

(a) Information search costs

43 Comparison was conducted after transforming the data using constant price index with 1992 as base year.

Fish processors are required to adhere to fisheries regulation and standards imposed through FD, TBS and TFDA. These requirements were there even before import ban in 1997 but more emphasis was initiated after the EU import ban. Prior to establishing a processing plant, investors have to consult with the three government entities to ensure compliance with the standards. TBS offers four standards which have an average of 20 pages each at a cost of TZS 1 000 per page. The standards included TZS 402:1988 (microbiological standards), TZS 93:1980 (industrial water), TZS 186:1983 (fresh fish handling and processing-code of hygiene), and TZS 345: (Frozen fish). In addition to acquisition of standards, investors pay for initial laboratory test on six microbiological parameters at a cost of TZS 12 000 per parameter. Initially, the standards were provided to investors. However, inadequate government budgets to its entities led to commercialization of some activities. TBS as a government entity decided to commercialize the activities under the standards unit. This raised the cost on information search though relaxed its accessibility compared to the pre- commercialization period.

In addition to TBS, the Tanzania Food and Drug Authority (TFDA) requires an investor in processing plants to be licensed, registered and inspected for food hygiene under the TFDA Act, 2003, Part (ii) section (c) paragraph 20 – 27, Part (iii) section (a) paragraph 28-36 and section (e) paragraph 44 – 46 respectively. Under these sections in the TFDA Act, TBS and FD are respectively recognized as a standards maker and Competent Authority in fishing activities in the country. Information search costs are relatively reduced through coordination of fishing activities by FD. The FD costs on information provided to fish processors is covered through royalty[44] paid by processors every time they export. Frequent visits by the fisheries officers or fish inspectors to fish plants provide room for discussion and delivery of fish and fish products-related information availed to fisheries division by the EU.

(b) Staff travels costs

The analysis showed that staff travel costs decreased by almost 50%. The decrease in cost can be explained on a new trend of employing technical consultants to conduct much of the initial activities prior to establishment of processing plants rather than engaging permanent personnel.

(c) Communication costs

The study findings show that communication costs after compliance increased eight times the original costs (Fig. 7). The costs involve telephone calls, faxes and exchange of documents prior to production process. Before compliance, much of the communication was within the country as the information required focused on country requirements. However, after implementation of international food safety standards, investors in fish processing started to solicit prior information from EU or fish buyers in Europe in addition to information provided by the FD.

44 Royalty is a 2% to 3% charge on each Nile perch export value that processors pay in recognition to exploitation of fish resources from Lake Victoria

(d) Additional preparation costs

Two new costs were introduced as a result of compliance needs; (i) cost of employing consultants and/or technical assistance and (ii) relationship establishment with certifiers. Before compliance much of the activities were conducted by investors themselves. This changed after introduction of the standards. Recently, the investors are involving more of technical or expert services from within and outside the country. The involvement of experts, especially from abroad, is argued on the need to adhere to proper certification procedures to avoid re-doing things in case of inadequacies if carried out otherwise. The interviewed processors employed consultants or technical assistance from different professional entities such as TBS, SGS-Tanzania and SABS.

(ii) Plant Construction/rehabilitation Costs

The study could not establish initial construction costs for the fish processing plants that were established before 1996. Most of the plants were initially cotton ginnery warehouses which were sold to fish processing investors who renovated them with emphasis only on GMP. During the field survey, the processing plants were not ready to release information on purchase value of the warehouses. Rather the study was provided with information on rehabilitation costs after the import ban in 1997. This was the period when HACCP was introduced as mandatory requirement to all fish processing plants. Table 39 shows the estimated investment cost for plants rehabilitation activities using constant price with 1992 as base year.

Table 39: Fish processing plants rehabilitation cost in TZSS as at 2007

Cost item	Average Value in TZS
Plant rehabilitation/restructuring	4 332 700 682
Water and pollution system	14 442 335
Litter and waste facilities	2 888 467
Changing rooms-	57 769 342
By product processing plant	722 116 780
Waste water treatment plant	13 890 463
Pest control and environment protection	14 442 336
Loss in output during rehabilitation	623 908 898
Total rehabilitation cost	5 782 159 304

The cost of incorporating HACCP requirement in the buildings differed across processing plants depending on the original State of the plants. During the field survey, it was found out that, for plants with an average installed capacity of 80 tons per day, they spent about TZS 5.4 billion during the ban to uplift the face of their processing plants.

In addition to that loss in output due to closure of plant to allow rehabilitation was estimated at about TZS 600 million. The rehabilitation cost continued to increase as during the field survey, most of the old plants were conducting further improvements. For example, plant A spent TZS 60 million in 2005 for wall claddings using fibre plastic. In 2006, the plant floor was changed by applying epoxy which cost about TZS 120 million in total. Thus in general by the year 2007 the total average rehabilitation costs was about TZS 6 billion. This rehabilitation cost is 10% of the total cost of constructing a new medium processing plant which costs about TZS 56 billion. The 10%

figure however is lower than the rate provided by a processor in Mara region. During the field survey in Mara, one processor claimed that plant restructuring cost was more than the cost of a new establishment. For him, safety standards have increased construction costs by 30% considering implementation complexities. Looking at the costs figures above, the argument can be validated and confirmed that food safety standards increased investment cost. However, the level of compliance costs depends on the original status of the investment.

(iii) Production System Setup and Certification

(a) Production/HACCP system set up

In system set up the major cost is on training followed by manual design, development and approval process. Processors are required to implement HACCP which requires individual plants to go through a process of training its management staff. The process starts with formation of HACCP team that oversees HACCP programs implementation in the processing plant. The team designs HACCP manual, operationalises it and undergoes manual approval by CA before commencement of operations. Cooperation of private firms (processors) and government (FD) is necessary to ensure food safety standards because the EU import bans affect revenues to both[45]. In the Nile perch industry, the EU and FD contributed on HACCP training, inspection and approval of the operationalised HACCP manual. The processing plant covered some training costs such

45 The government had incurred cost to ensure conformity to food safety standard. However, because of inadequate data, the study could not conduct much analysis on the cost to the government

as travel and accommodation and manual design and development. In general the government contributed 31.06% of the total HACCP implementation cost (Table 40).

Table 40: HACCP implementation costs incurred by processors and FD (TZS)

Cost item	Estimated cost (TZS)	
	Processors	**FD**
Training of HACCP team	40 000 000	20 000 000
Manual designing and development	5 000 000	
Manual production	50 000	
Initial approval of the operationalised HACCP	50 000	320 000
Total HACCP implementation	**45 100 000**	**20 320 000**
Percent of contribution to HACCP implementation cost	**68.94%**	**31.06%**

Source: Computed average from data provided by processing plant A and plant C, Mwanza, 2007

Processing plants are required to train a minimum of 3 management staff to form plant's HACCP team. The team is responsible for manual designing, development and supervision of HACCP implementation. Interview with sampled processing plants indicated that HACCP implementation requires initial training of not less than 3 months to ensure understanding on designing and development of the manual. Additional training is conducted annually with more staff being trained on new standards requirements and maintenance strategies to hedge against proliferation of new standards and staff turn-over. The annual training costs are described under section 4.5.3.2 below.

TBS, SIDO and FD provided assistance in manual design and development with major activities conducted by the HACCP teams. The developed manuals were/are classified documents on the part of individual plants. This confidential treatment of the manuals restricted knowledge sharing between plants and is adopted for fear of divulging competitive strategies to rival firms. However, the non-sharing of information contributes to complexity in manual design and development. Hence the time required to design, develop and operationalise HACCP manuals varied among individual plants, though the complexity of the process is the same. In the sampled processing plants, the time spent ranged from 5 to 12 months and an average total cost of TZS 65 million was incurred per plant.

(a) Process and Product certification

In addition to HACCP manual, product certification which involves testing of products according to national and international standards are carried out by individual plants before being certified as qualified fish processors and exporters into the EU market. The testing involve mainly microbiological analysis with seven parameters of *salmonella/shigella sp; Escherichia coli; staphylococcus aureus; Enterobateriaceaea; vibrio cholerae; total plate count and; total coliform.*

The testing costs increase with amount of time spent in identifying accredited and EU acceptable laboratory. In the sampled processing plants, certification was initially conducted by TBS after being approved by EU and later by recognised private bureaus such as SGS-Tanzania and South Africa Bureau of Standards (SABS) in South Africa. Delays in the process, especially on releasing testing results, caused a move away from

TBS services. Whilst abroad laboratories released the results in 5 days, TBS took 8 to 16 days for the same tests hence the necessity for Nile perch processors to shift.

Two of the surveyed processing plants implemented ISO 9000 hence incurred costs associated with ISO process certification. The process, as in HACCP, involved manual development, inspection and certification following successful operationalization of the respective manual. Processing plants contend that once HACCP is successfully implemented, ISO certification becomes less expensive as it involves the same procedures with more focus on traceability. However, the time between applications for certification to actual certification took about ten months. The ten months period was for both process and product certification as they are normally carried out simultaneously. Much time was spent on writing and re-writing checklists for the manual, travelling and documentation. This increased plants' costs in terms of loss in output. Table 41 indicates that the loss in output was the highest cost (85.7%) followed by the procedures involved (8.3%).

Table 41: Process and certification cost to processors

Cost item	Cost in TZS	% to total cost
Procedures involved (preparation, testing, inspection)	7 000 000	8.3
Process certification	3 000 000	3.6
Product certification	2 000 000	2.4
Loss in output during certification process	72 000 000	85.7
Total	**84 000 000**	**100.0**

Source: Average figures computed from data provided by processing plant A and C, Mwanza, 2007

(iv) Machinery and equipment costs

The cost of machines and equipment is mainly joint costs with few machines that are specifically for quality issues such as metal detectors. For the case of Nile perch, many processing plants started with few advanced equipment with most of activities, such as skinning, performed manually. After the EU import ban plants employed modern machines and equipment such as de-boners, fish automatic ice machines and stand-by generators. Other machines and equipment include strapping power machines, ice plants, and plate freezers, cooling towers, flake ice machines, caterpillars, sabro-plate, ice plants and freezers. All these equipment are required for fish processing. However, there was minimum installation of them because of less emphasis in food safety standards prior to EU import bans. The emphasis was more on GMP whereby the traditional quality tests such as smell, freshness and piece sizes were used.

Food safety standards brought requirements for additional equipment such as metal detector which is used to detect physical substance in fillets. Water purification plant, dosing pump, dolce salt dosing pump and washing machine were other equipment required. The cost of the machines and equipment differed from one plant to another depending on the sourcing. Most machines are imported from Europe, Japan, India and South Africa. The imports increase cost of machinery since most accessories and spare parts need to come from abroad as well. The empirical findings show that an average processing plant with installed capacity of 80 tons per day employ additional new machinery worth TZS 1 billion. This is 50% of the initial machinery cost.

In-house laboratories became mandatory after introduction of food safety standards for enhancing product monitoring. The laboratories are equipped with necessary equipment to conduct microbiological tests. Some of the equipment that were observed in plants' laboratories during the field survey and their cost are shown in Table 42.

Table 42: Laboratory equipment purchased by processing plants and their cost

Laboratory equipment	Quantity	Average Cost in TZS
Stomacher	1	4 000 000
Incubators	3	7 500 000
Autoclaves	2	4 000 000
Oven	1	1 500 000
Fridge	2	500 000
Deep freezer	1	1 000 000
Total average cost		**18 500 000**

Source: Processing plant C, Mwanza, 2007

Food safety standards regulations require proper documentation to enhance trace-back in the event of non-compliance. The requirement led processing plants to acquire additional computers to assist them in record keeping and documentation in soft and hard copies. The survey found out that the average processing plants with installed capacity of 80 tons a day almost tripled their documentation in acquiring new additional equipment for temperature recording, data processing and storage (Table 43).

Table 43: Average number and cost of additional recording equipment purchased

Item	Before compliance		After compliance	
	Quantity	Cost (TZS)	Quantity	Cost (TZS)
temperature loggers	5	1 000 000	5	5 000 000
desk top computer	3	2 100 000	-	-
Laptop computers	-	-	3	3 000 000
Total		**3 100 000**		**8 000 000**

4.5.3.2 Recurrent costs for processors

The compliance recurrent costs to processors are assessed using HACCP as the main source of quality costs to processors where both production system and testing are considered. A general assessment indicates that HACCP increases annual recurrent cost for average processing plant of 80 tons per day installed capacity by TZS 130 million. Table 44 indicates that the main compliance costs are related to skilled personnel responsible for quality supervision (27.21%) followed by laboratory testing (25.15%) and training (10.95%). Details on individual compliance recurrent cost are discussed below.

Table 44: Processors additional recurrent costs as a result of compliance- 2007

Cost item	Cost in TZS	% of cost to total cost
HACCP manual update and approval	450 000	0.35
Internal audit	1 360 000	1.05

External audit	220 000	0.17
Annual certification fee	4 000 000	3.07
Training (in-house and external)	14 250 000	10.95
Loss in output during training	10 000 000	7.69
Laboratory testing	32 725 580	25.15
Documentation	1 000 000	0.77
information access	1 200 000	0.92
Record keeping	9 500 000	7.30
Personnel/quality supervisor	35 400 000	27.21
Export requirement	20 000 000	15.37
Total	**130 386 380**	**100.00**

HACCP implementation costs include manual updating and approval, internal and external audit and product certification (Table 45). The sections below provide a summary of the costs.

Table 45: HACCP manual and audit costs: Processors and Fisheries Department

Activity	Cost item	Cost in TZS processor	FD
Manual update	Time spent	400 000	-
	Approval fees	50 000	320 000
Sub-total		**450 000**	**320 000**
Internal audit	Time spent	640 000	-
	Material used	720 000	-
Sub-total		**1 360 000**	**-**
External audit	Time spent	160 000	640 000
	Travel cost	10 000	1 200 000
	Materials used	50 000	100 000
Sub-total		**220 000**	**1 940 000**
Product certification	Annual certification fee	4 000 000	-
Grand total		**5 670 000**	**2 260 000**

(i) HACCP manual updating and approval

As much as the HACCP manual is designed and approved, the regulations require re-approval of the manual after every three years. In addition to that, plants are required to update the manual every time they introduce a new activity or equipment in the plant. This can be expensive especially to the restructured plants in Mwanza. During the field survey, plant C reported up-dating of its HACCP manual five times between 2003 and 2006 because of continuous renovations and purchase of new equipment for the plant. On average, HACCP manual update required about 80 man-days costing about TZS 450000. Manual update and approval cost to FD was estimated at TZS 320 000 which included inspection costs prior to its approval.

(ii) Internal and external audit

HACCP team is responsible for plants internal audit using checklist provided in the manual. The internal audits are carried out quarterly whereby team members inspect all critical control points and all key areas such as fish receiving points, conveyor belts, cutting tables, freezing area, waste disposal areas and water treatment plants. The audit is carried out for 3 days and a report submitted in the 10th day. Audit reports are presented to section supervisors with recommendations or suggestions on areas for improvement. In Nile perch processing, the estimated average cost involved was TZS 1.4 million. The cost includes time spent by the team members and the material used.

While the internal audits are carried out by plant's HACCP team, the external audits are carried out by FD. The external audits are conducted by Fisheries Inspectors from

Headquarters in Dar es Salaam with assistance from Zone fisheries office in Mwanza. The audits are carried out once in a year and the FD covers 90% of the cost. The estimated external audit cost to processing plants is TZS 220 000. The cost include local travel costs, material used during auditing and time spent by the plants' personnel involved in the auditing.

(iii) Certification fee

Annual product and certification fees are paid after satisfactory re-inspection of the production process/system and testing of products for microbiological hazards using the seven parameters (*salmonella/shigella sp; Escherichia coli; staphylococcus aureus; Enterobateriaceaea; vibrio cholerae; total plate count and; total coliform)*. Though the certifications ensure access to market, it creates additional cost to processing plants. The sampled processing plants estimated the cost at TZS 4 million as annual fee.

(iv) Training

Training costs have been exorbitant after introduction of food safety standards as it was not clear how much training was required. Some processing plants trained their personnel using local and foreign trainers just to ensure adequate training. Implementation of HACCP together with other voluntary standards requires documents to be signed by trained personnel. This led to a need for plants to train section supervisors on the standards. The empirical evidence from the field survey carried out in 2007 shows that the processing plants trained up to 7 management personnel through

TBS short courses of three to five days in Dar es Salaam. The training cost per person was TZS 750 000 exclusive of transport and accommodation. However, the training provided through local trainers is sometimes subsidized by the FD (i.e. plants are required to pay for travelling to and from Dar es Salaam and accommodation while FD pays for tuition). In addition to the training cost, the sampled processing plants estimated time lost/loss in output during training at an average of TZS 10 million per annum.

Some processing plants incurred higher training costs through contracting trainers from South Africa. The costs involved trainers training fees, air tickets, in-country travel expenses, training materials and food during the training sessions at an average cost of TZS 12 million per session. Though expensive, the rigorous training lasts for only five days with a maximum of 5 participants. Follow up training using local trainers was therefore important. The quality assuarance manager for plant A referred to the t raining by foreign trainers as important reference training for local follow-up trainers.

(v) Laboratory testing

The major cost associated with food safety standards is laboratory testing. The tests include microbiological and chemical analysis. Microbial tests for product monitoring are conducted using in-house laboratories while tests for process monitoring and prior to exports were carried out abroad because there was no accredited laboratory in the country. It was not until December 2007, that two laboratories in the country were accredited. The laboratories include NFQCL which was accredited for testing six microbiology parameters (*salmonella/shigella sp; Escherichia coli; staphylococcus aureus; vibrio cholerae; total plate count and; total coliform*) and TBS which was accredited for three parameters (*Escherichia coli; total plate count and total coliform*). Though the two laboratories were accredited, lack of accreditation on chemical tests hinder smooth operation to fish processors as they have to send samples abroad for chemical tests. Estimation on the testing costs conducted abroad and using in-house laboratories are shown in Table 46.

In most cases processors conduct tests abroad prior to exports. However, sometimes they request tests to be done abroad for monitoring chemical hazards. The costs for test done abroad prior to exports are covered through royalty paid to FD while processors cover costs related to loss in samples and monitoring requirements which was estimated at TZS 9 million.

Table 46: Costs for laboratory testing for microbiological and chemical hazards

Laboratory testing	Cost item	Cost in TZS
Abroad tests/outside the plants tests	Whole fish testing fee	1 820 000
	Sample damages	280 800
	Fillet testing fee	374 000
	Water testing fee	3 160 140
	Mud testing fee	750 000
	Chemicals & pesticides testing fee	2 684 800
	Transport, customs and bank charges	303 840
Abroad total testing costs		**9 373 580**
In-house laboratory tests	Fillet testing fee	12 960 000
	Sample damages	2 592 000

	Personnel health checks	5 200 000
	Cutting surfaces and aprons tests	2 600 000
In-house total testing cost		**23 352 000**

Microbial tests for monitoring activities are solely on processors with minimal assistance from FD. The study findings show that plants HACCP teams are the key monitoring agents who performed the exercise on daily basis. Monitoring by key buyers or certifiers is crucial in setting up the systems. Once they are satisfied with the initial compliance efforts, the monitoring activities are reduced to occasional frequencies as deemed necessary as shown in Table 47.

Table 47: Plants' quality monitoring agent and frequency

Plant code name	**Monitoring frequency by agent**			
	FD	**Key buying firms**	**Certifiers**	**In house personnel**
A	Daily	Occasionally	When necessary	Daily
B	weekly	None	None	Daily
C	daily	Occasionally	When necessary	Daily
D	Always	Occasionally	After 2 years or when necessary	Daily
E	daily	None	None	Daily

(vi) Skilled personnel for quality control

Quality supervision and control are considered by Nile perch processing plants as the main factor in compliance with food safety standards. Employment of skilled personnel as quality supervisors at each critical control point is thus imperative. Supervisors are placed at different locations starting from the landing sites to the point of final product delivery. In this case processing plants employ or train plant inspectors, record keeping and documentation officers, laboratory supervisors and renovators. The sampled processing plants estimated an increase in recurrent cost of TZS 35 million led by requirement for additional skilled personnel.

(vii) Export requirements

Estimation of compliance costs under export requirements could not be easily established because these are joint costs. Estimation by processing plant indicates an additional cost of TZS 500 per kg to the final exported product. The additional cost is a result of employing out-stationed staff, processing of special export documents, laboratory testing prior to export and certification of packaging materials.

4.5.3.3 Compliance benefits for processors

Compliance benefits to processors were assessed by looking at revenues, access to/guaranteed markets and price premium. As revenue data prior to food safety standards from the surveyed processing plant could not be obtained, the analysis used data from FD. These data comprise total Nile perch export volumes and values from 1998 to 2007 with the exception of 2003 and 2004. It is only data from 2005 to 2007 that include exports by each processing plant. Thus the trend in export volumes and values by processing plants from 2005 to 2007 was compared with total exports data prior to food safety standards (1998 to 2002).

(a) Increase in revenue

The analysis on Nile perch export revenues shows that conformity to food safety standards increases revenues. The revenues for large processing plants are more than doubled despite low volumes of exports (Fig. 8).

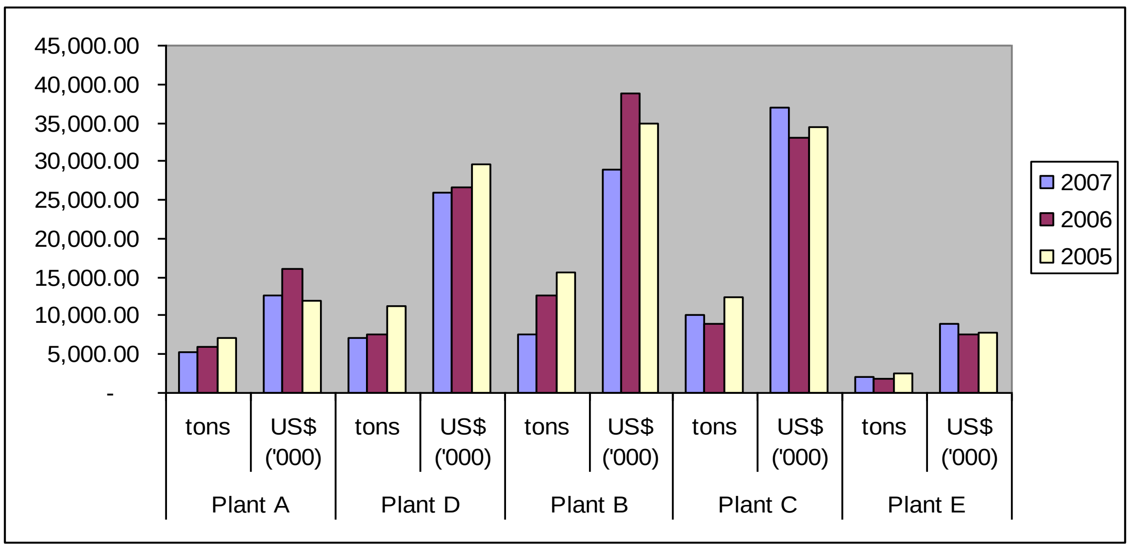

Figure 8: Trend on NP export volumes (Tons) and values US$ ('000) by processing plant

The analysis evidently shows that the high rate of increase in export revenue started after the successful implementation of food safety standards that enabled the uplift of Nile perch import bans by the EU in 2002 (Fig. 9).

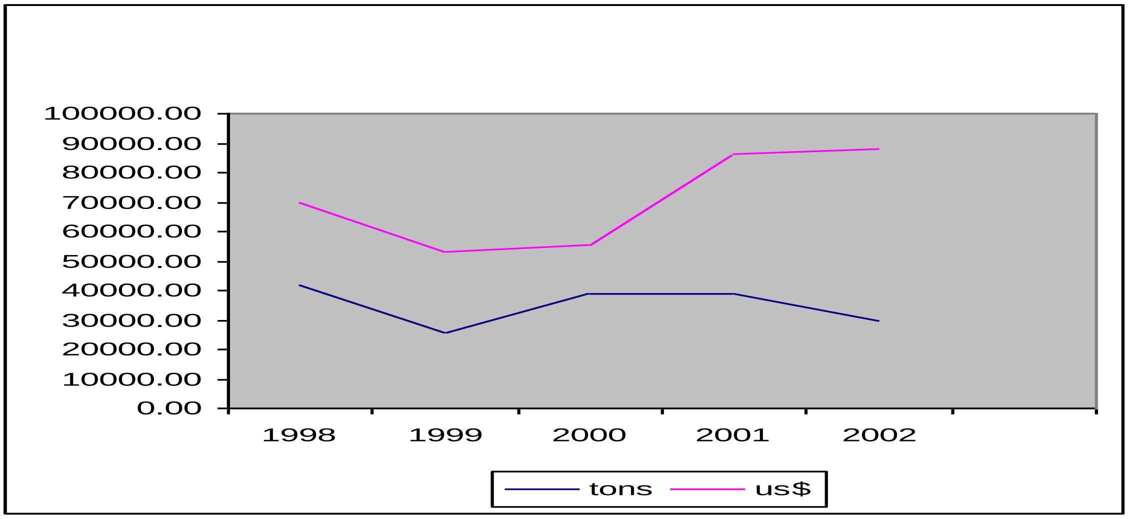

Figure 9: Nile perch export volumes (tons) and value (‘000 US$) from 1998 to 2002

(b) Access to or guaranteed markets

According to national statistics,[46] Nile perch exports have been fluctuating since 1997 because of a number of reasons including the EU import bans, and lately the depletion of fish resources in Lake Victoria. Fig. 10 shows fluctuation of Nile perch fish export from 1996 to 2007. It can generally be said that market accessibility due to compliance has been strong given that there has not been other import bans since 2002 nor any report on rejected exports due to non-conformity by EU since 2004. However, this market access cannot only be associated with compliance. Other factors, such as fish shortage as discussed in CBI (2007) report, may have influenced it. The report contends that Nile perch as other freshwater species from tropical waters have been successful in retail sales and the market share is expected to continue to grow due to shortage of traditional EU fish species.

46 *Hali ya Uchumi* wa Taifa katika mwaka 2006, 2007 is a National Economic statistic book published annually.

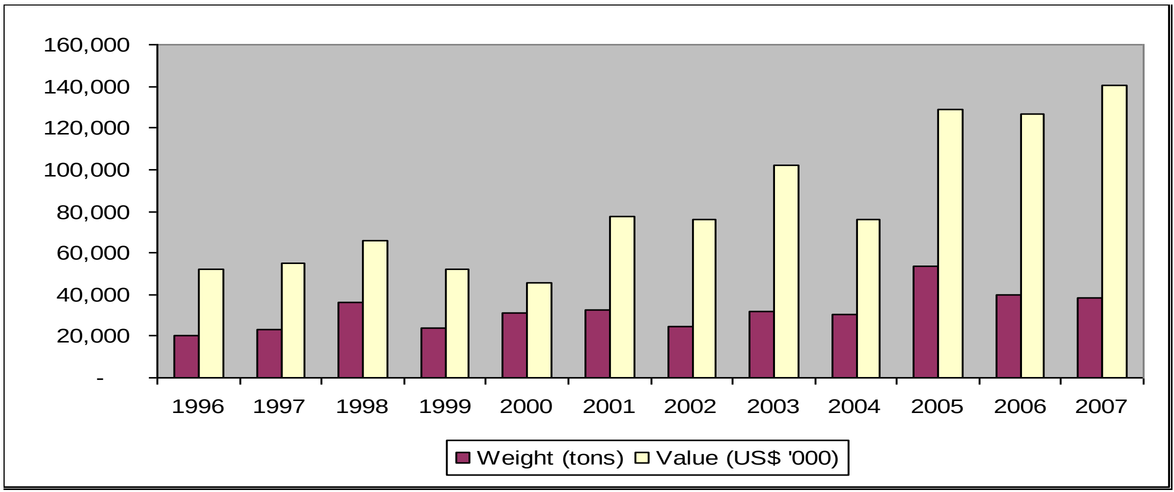

Figure 10: Trend on NP export volumes (Tons) and values in US$ (‘000), 1996-2007

(c) Price premium

Fig. 10 shows that while fish volume has been decreasing, the absolute FOB value has been increasing. This indicates that price premiums were sustained by processors. However, increase in value might be contributed to shortage of fish in the EU market.

4.6 Effects of Compliance with Food Safety Standards on Organization of the Nile Perch Export Supply Chain

The organization and governance of the Nile perch export supply chain has been evolving since 1990 when direct processing and export of Nile perch fillet from Tanzania started. Government prohibition of export of un-processed Nile perch initiated establishment of processing plants in Tanzania and by 1997 there were 12 plants around Lake Victoria on the Tanzanian side. However, as mechanized industrial fishing was prohibited in the country in 1994,[47] fishing activities continued to be dominated by artisanal fishers. The increase in demand for fish export from the Lake led to movement of people from outside the Lake to join fishing activities by becoming boat owners who lend boats to artisanal fishers on contract (Mitullah, 2004). The contracts allowed provisions of outboard engines and fishing gears such as gillnets and long lines to fishers in agreement to share fish catch or a certain percentage of future fish catch. The emerging relationships (contracts) eased stakeholders access to capital hence increased the number of fishing boats, fishermen, use of outboard engines and use of gillnets and beach seines (Fig. 11).

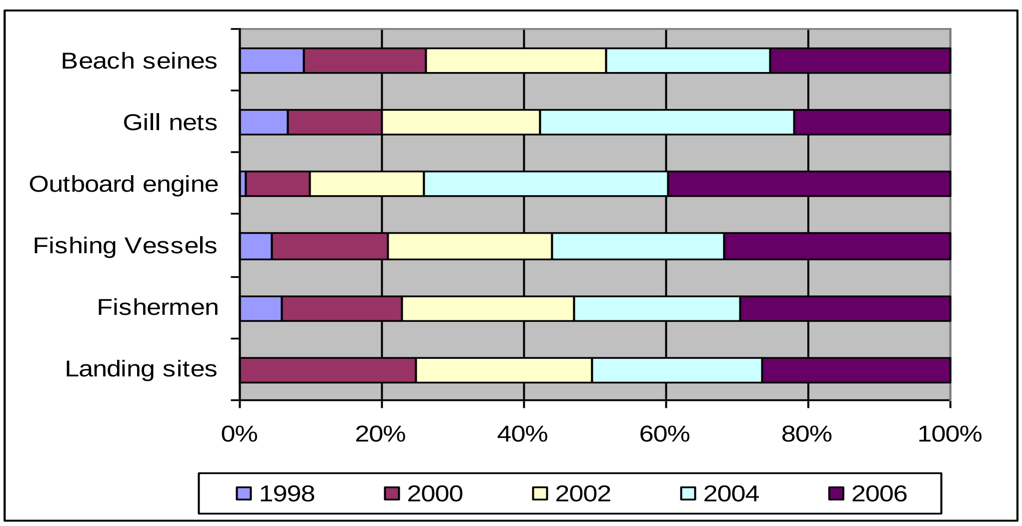

Figure 11: Changes in fishing efforts in Lake Victoria in Tanzania- 1998 to 2006
Source: Extracted from Tanzania Fisheries Annual Survey Report 2004 and LVFO, 2006

47 The trawlers prohibition Act was enacted in 1991, however, final enforcement of the ban was in 2002

Further changes occurred in the supply chain after enforcement on complying with food safety standards. The changes include, increased coordination of fishing activities, increased use of equipment that ensure quality of fish (i.e. establishment of quality production layout and laboratory testing), high movement of non-fishing tribes into fishing activities, concentration of fishing activities in few improved landing sites, concentration of fishing activities to few fishing actors and emergence of different contractual arrangements among actors of the supply chain. Although there had been many changes in the fishing activities led by compliance with standards, this study is interested on changes in governance structure. Hence the sections below dwell more on contractual agreements that had emerged or changed after the introduction of food safety standards.

In general the study findings show that emergence of the contractual agreements cannot be associated with only the demand for assets required to ensure fish quality which are costly but also decline in the availability of the fish. These reasons are reflected in different contractual agreements amongst the actors in the export supply chain. Contractual agreements (CoA) that existed in fishing activities in Lake Victoria are described as “mutual relationships between parties based on an agreement to perform an economic activity given specified terms”. Two main CoA that exist in the Lake were identified during the field survey. These are the fishing and trading arrangements which are clearly identified on the basis of the nature of activities undertaken and actors involved in each of them. The salient features of the two CoA are described in the subsequent sections below.

4.6.1 Fishing contractual agreements

Fishing contractual agreements involved mutual agreements between two parties namely fishers and boat owners or fishers and boat owners who are also fishers. In contractual agreements there are terminologies that were used and their meanings are described below:

(i) *Parties* referred to contract partners whereby in fishing contractual agreement the parties are fishers and boat owners

(ii) *fishing turns* referred to agreed fishing days in which contract parties rotate in retaining fishing sales

(iii) *non-fishing turn* referred to the days a contract party is fishing without retaining fishing sales as agreeable in the contract

(iv) *informal written contracts* referred to written contracts without lawyer support

(v) *Formal contracts* referred to lawyer assisted written contracts

The fishing contractual agreements were initiated by boat owners who had ownership power. There were normally minimal negotiations because of this power asymmetry and also the widespread and generally accepted modes of operation. The purpose of engaging in the contracts for fishers was to sell their labour (manpower) as source of their income while for boat owners this varied with the type of fish. Most Nile perch boat owners entered in contractual agreements mainly because they needed to increase their fish volume (77.6%) followed by sharing costs and benefits (10.6%) as shown in Table 48. Sharing of costs and benefits could be interpreted as risk transfer to partners, where the boat owners will not have to incur loss wholesomely. In general this main purpose could be associated with shortage of fish experienced by the actors in lake Victoria. For *dagaa* fish, sharing of costs and benefits was the main purpose of entering into contracts (41.7%) followed by easy cash constraint (29.2%). This reflects the small investment involved with *dagaa* fishing activities. Efforts to ensure reliable fish suppliers especially with seasonal fishing were indicated in the purpose of contractual agreements amongst Nile perch (4.7%) and *dagaa* (8.3%) fishermen respectively.

Table 48: Boat owners' purpose: Comparison between Nile perch and dagaa fish

Purpose of the contract	Nile Perch		*Dagaa* fish		Chi-square test	
	n	%	n	%	Value	Asymp. Sig. (2-sided)
Increase volume of collection	66	77.6	5	20.8	27.76	0.000
Easy initial cash constraints	6	7.1	7	29.2		
Get reliable fish suppliers	4	4.7	2	8.3		
Sharing cost and benefit/risk	9	10.6	10	41.7		
Total	27	100.0	5	100.0		

The findings in Table 49 show differences in the purpose of entering into fishing contracts across landing sites. Landing sites in areas far from the processing plants such as Nkome Mchangani and Bulongelo in Geita district; Lukuba and Kibuyi in Musoma district favoured contracts that ensure adequate fish supply. This assured boat owners reduced transport and collection costs due to economies of scale. In Ng'wanching'wa seasonal landing site in Magu district the contractors entered into contractual arrangements that ensure reliable fish suppliers due to seasonality and shortage of fishers. The shortage of fishers during fishing seasons between April and October is created by flow of labour from Magu to Mwanza city for alternative employment opportunities. Boat owners are therefore compelled to enter into contracts with fishers to ensure availability of fishing labour at the time needed.

Table 49: Comparison of agreement purposes between landing sites location

Contract purpose	Location			
	Close to city	Close to processing plants	Far from processing plants	**Total**
Increase fish volume	5	22	39	**66**
Easy initial cash constraint	2	3	1	**6**
Reliable suppliers	2	0	2	**4**
Share costs and benefits	1	2	6	**9**

Three main types of contractual agreements as presented in Table 50 and elaborated in Table 51 were identified during the field survey.

(A) Daily Revenue Sharing

Revenue sharing involved distribution of daily fish turnover after selling the fish. This normally occurs at landing sites with concentrated fish buyers. The daily revenue sharing agreement can be divided into three different agreements as described below.

(A.1) Fish revenue divided into three equal shares for boat owner, fishers and boat expenses

In this type, the daily revenue was divided equally into three thirds. One third each for boat owner and fishers and the remaining one third for boat expenses such as fuel and oil for the boat, food for fishers, maintenance of the boat, net repair, boat repair and purchase of other tools such as floating gallons. In this agreement both boat owners and fishers motivated by equal share of revenue select hardworking partners to ensure higher fish catches.

Table 50: Main type of fishing contractual agreements in Lake Victoria

Main type	**Sub-type**		**Sample size**	
			Nile perch (N=85)	***dagaa* fish (N=24)**
(A) Share of daily fish revenue (*passu)* **(ER)**	(1)	Fish revenue shared among three parties (boat owner, fishers, boat expenses) (catch revenue 1:1:1)	3	11
	(2)	Fish revenue shared after deduction of cost (share 50%:50%)	8	11
	(3)	Fish revenue shared with one day fished for fishing costs	15	2
(B) Equal distribution of fishing days turnover *(kichwa*	(1)	Equal fishing days distribution between boat owner and fishers under the 3:3:1 days arrangement	26	0
	(2)	Equal fishing days between boat owner and fishers. Each party to cover its own		

kichwa) **(ET)**		fishing costs. The “non fishing “party receives cash living allowance of US$ 1.5 - US$ 2 per landing boat during every non-turn day	3	0
(C) Fishing turns with unequal distribution of days **(UT)**	(1)	Unequal distribution of fishing days in a week between boat owner and fishers. Boat owners are given more days of fishing to take care of the boats' operation expenses	23	0
	(2)	Unequal distribution of fishing days in a month between boat owner and fishers. Boat owners are given more days of fishing to take care of the boats' operation expenses	7	0

This agreement relied on fishers' trust as a team because supervision by boat owner is low. If one fisher misbehaves, the other fishers drop him and suggest a replacement to the boat owner for his approval; and thus reduced search and negotiation costs to the boat owner. Although there is little involvement of the boat owner in terms of searching and employing fishers; assets supervision and control; the agreement was practised only in few landing sites that are located on islands such as Kibuyi and Bulongelo. Boat owners for *dagaa* fish also use this fishing contractual agreement. The reason for this might be high risk averse tendency of small capital investors that trusting their assets in the hands of trusted people is more important. This is a common trend with small investors who would prefer to take risks over time to ensure accumulation of profit rather than following the market behaviour. The small investors tend to accumulate small profits over long period of time and not trying to profit without considering the market direction as traders do. Liquidity problem is another issue among boat owners especially those small scale boats owners. Thus the agreement of dividing fish revenue into three shares eased their liquidity problem. In general this kind of agreement gave both sides an opportunity to decide on the fishing business. While the fishers have labour power, the boat owners rendered part of their assets ownership powers to fishers so that they could compete with other large boat owners in getting fishing labour.

(A.2) Fish revenue shared after deduction of boat expenses (share 50%:50%)

Equal sharing of fish returns after deducting boat expenses was another type of agreement used in fishing of both Nile perch and *dagaa* fish. In this agreement the revenue is shared after deducting all boat expenses. The agreement seemed to be fairer because the deduction of boat expenses is based on the actual expenses known to boat owners and fishers. The agreement was favoured by fishers in both Nile perch and *dagaa* fish and was observed in more landing sites than agreement A.1.

(A.3) Fish revenue shared with one day catch for boat expenses

This contractual agreement involves sharing of fish revenue with one day sales turnover set aside to cover boat expenses. The agreement is normally on three days turnover for boat owner, three days turnover for fishers and one day's returns for covering boat expenses. This contractual agreement provides room for another one day catch to compensate for low catch day. The provision for compensation is sometimes misused by a boat owner who is a custodian of money for boat expenses to appropriate rent from fishers. A boat owner is the one who knows about boat expenses and therefore he can claim for more compensation days. The agreement is used by both Nile perch and *dagaa* fishers, and was observed in 90% of the landing sites visited during the field survey.

(B) Equal Distribution of Weekly Fishing Turnover

This contractual agreement is based on distribution of weekly fishing turnover between boat owner and fishers. In equal sharing of weekly fish returns, fishers are engaged in fishing activities while boat owner is waiting at the landing sites to ensure adequate servicing and maintenance of the fishing assets. In this contractual agreement the party in fishing turn provides an agreeable small amount of money as living allowance to the party in non-fishing turn. Fish selling is always conducted in the presence of boat owner. This contractual agreement can be decided into two different agreements as described below.

(B.1) Equal distribution of fishing days between boat owner and fishers under 3:3:1 day's arrangement

In this agreement weekly fishing turns are distributed equally between boat owner and fishers with one day fishing turn set aside to cover boat expenses. Unlike contractual agreement type A, there is more involvement of boat owners in supervision and control of fishing activities in this contractual agreement. The involvement of boat owners' arises from the tendency of unscrupulous fishers trying to appropriate more by claiming low fish catch which allow for extra day to compensate for the low fish catch. The unscrupulous fishers tend to sell fish while in the lake and claim low harvest. Boat owners use two common means to control this kind of cheating. First, is through selection of fishers where one of the fisher is well known to the boat owner and in most cases is a relative or a long time fisher who has built trust with the boat owner. Second, is through forced resting days for fishers after every week by having two or more fishing teams depending on the number of boats that take turns. This method was observed in all landing sites except in Magu where fishing is seasonal.

(B.2) Equal fishing days between boat owner and fishers

In this agreement, weekly returns are shared by dividing fishing days equally between boat owner and fishers. Each party covered its own fishing costs while the "non fishing party" received cash of TZS 1500 to TZS 2 000 per landing boat as living allowance during every non-fishing turn day. In addition to the cash payment, the non-fishing turn party received his share of fish as food for the day. This agreement is not widely used especially when the boat owner is not a fisher as it provides obvious loophole for fishers to exaggerate fishing costs which affects returns of the boat owner.

(C) Fishing Turns with Unequal Distribution of Days

The agreement involved unequal distribution of days' turnover on weekly or monthly basis. The distribution of days depends on the relationships built between boat owners and fishers. This contractual agreement can be divided into two different agreements as described below:-

(C.1) Unequal distribution of fishing days in a week between boat owner and fishers

Boat owners are given more days of fishing to cover boat operation expenses. The distribution of days depends on the relationships that exist between the boat owner and fishers. Partners who have built a long term relationship distribute the week in a four days for boat owner and 3 days for fishers. This pattern of distribution also applies for hard working fishers and normally happens after the first or second agreement with the boat owner. This agreement is more practiced in areas with more fish catch and with boat owners who have large capital outlays that they entrusted fishers with fishing gears commonly referred to as "*kuwezeshwa*". *Wezeshwa* could loosely be explained as hire purchase or equipment leasing possibility of ownership transferred to the lessee in case the lessor is satisfied with returns on his assets. Most boat owners with collection boats provided fishers with boats, engines, gillnets and working capital in agreement to sell fish to them. The agreements provide for extension of financial help in case of other social problems. This attracted fisher–boat owners whose motive is access to financial assistance for fishing and non fishing activities. The non-financial assistance was for incidences such as accident in the lake or theft. The agreement ensured fisher-boat owners with quick accessibility to finance for new equipment or funds for taking care of the injured fishers or funeral agreements if there was death in the accident. In returns the boat owners with collection boats gain loyalty and price discounts. Though the agreement seems attractive, complaints about cheating using weighing scales were very common. The cheating could be considered as capital charge or price for the assets offered to fishers. The agreement allows for ownership of assets if one has worked for longer period and paid for the asset. This had been difficult for fishers as most of them were complaining on failure to finalise payment for the assets. The failure was contributed by three main reasons, (a) cheating on the weight of catch when delivering fish to boat owner; (b) agreement to sell fish at 10% to 20% lower than the market price as appreciation for being provided with fishing asset. The deduction was not part of the payment for the asset; (c) exaggeration of value of fishing assets loaned to fishers by boat owners.

(C.2) Unequal distribution of fishing days in a month between boat owner and fishers

The agreement was similar to C.1 except that the terms are on monthly basis. Thus distribution of number of days in a month depended on built relationship and perseverance of fishers. The agreement is common in areas with high fish catch and medium or large scale boat owners such as at Nkome-Mchangani and Kibuyi landing sites. The main feature in this agreement is forced resting period for fishers after a month fishing and punishment for disobedient fishers. Using their decision power based on large investment, the boat owners force fishers to go for a rest for at least half of their fishing days. For example, if they had fished for 10 days as their fishing turns, then they are forced to rest for five days without working for any other boat owner. This is done to ensure that they use all the money they earned and therefore become desperate to work hard again and obey their contractors. If a fisher decides to work before finishing his resting time, it becomes difficult for him to go back to his contractor. The most possible solution was to move to another island. Control and supervision in this kind of agreement is very strict. Instant removal from fishing activities is the most common method of punishment. If a fisher misbehaves, he is paid his dues and fired instantly. This is contrary to what was reported in Gibbons, (1997) where fishers were fired without being paid their dues. For those who received leased equipment "*wezeshwa*" they have to return the fishing assets.

However, in some landing sites the fired fishers had to pay their dues in addition to returning the fishing assets while in some landing sites such as Nkome Mchangani, fishers just return the assets. The reasons for fishers being not obliged to pay their debts may not be a favour to them by boat owners. During the field survey, fishers claimed that boat owners have some ulterior motives when giving them credits. The motives are; (a) boat owners think that the longer the money stays with fishers the greater the interest boat owners might get, (b) through cheating boat owners manage to recover their money invested in the assets offered to fishers. Settling disputes related to breach of contracts between boat owner and fishers is through the village executive officer in the fishing areas.

4.6.2 Fish trading contractual agreements

A fish trading agreement is described as mutual binding agreement between two fish exchange partners specifying roles and responsibilities of each party. The agreement could either be verbal or informal written. The trading agreement differs with type of fish. While in *dagaa* fish, the agreements are verbal, in Nile perch both verbal and informal written agreements are applicable. An informal written agreement is necessary in Nile perch because of the value of fishing assets and diversity of people involved.

The activities involved in Nile perch fishing trading included transporting of raw fish from the lake or landing sites to the processing plant. Transportation of fish is either directly to the processing plant or through another actor in the upstream chain to the plant. Either way any transported fish is supposed to adhere to food safety standards. In this agreement, prices, time of delivery and quality of fish are specified in the contract especially if the buyer is a processor. In most cases price of fish is pegged to three days or weekly delivery time. Penalties through low price on delayed delivery are common. If the delivery time is not met, the price that takes effect is determined by the price on the transaction day but normally the price is lower than the formally agreed price.

The penalty of lower price compelled suppliers to deliver fish early as per contract. To reduce delay in fish delivery, which is caused by inadequate fish from boat owners, traders extended fishing resources to upstream actors to ensure adequate fish supply. Direct involvement of processors in fishing is illegal in Tanzania. The regulations were imposed as measures to ensure fish sustainability in the lake and income to the majority of people around the lake whose lives depend on fish. During the field survey boat owners reported that processors were engaged in fishing activities under the cover of support to fishers. However, this could not be confirmed during the survey.

Quality assurance is amongst the main aspects in the contractual agreements. Activities to ensure qualities are conducted during fishing, at landing sites and at processors doors. Buyers provide ice bins and mashed ice to suppliers with large volumes. The amount of ice provided depends on the amount of fish delivered at a ratio of one kg of fish to one kg of mashed ice. However, it was revealed during the field survey that the ice to fish ratio was observed mainly during low fish catch season as both boat owners and traders have to wait for long periods of time before getting adequate amount of fish.

Fish quality assessment at selling points in the lake or at landing sites is conducted using organoleptic method while at the processing plant an addition method of fish dissection is performed. The organoleptic method include fish smell, colour of the skin, eye brightness, flesh tightness, shape of the anus, bleeding in the eyes and mouth, colour of the gills and scales tightness. The dissection performed at processing plants is to check internal flesh tightness. However, the internal flesh tightness check has more to do with quality of the fillet and not related to food safety. During off-loading of fish from the boat to the weighing scale, parking in the truck or collection boat and during transportation, the quality of fillet could be destroyed through throwing, squeezing and bumping. All these aspects are taken care of by the contractual agreement through provision of loans, fishing assets and knowledge of fish handling that reduces the amount of rejected fish.

Trading in *dagaa* fish is on open or spot market, that there are no markets or trading agreements in that matter. Compared to Nile perch, this could be associated with high cost resulting from food safety standards requirements that force actors to engage in some agreements so as to minimize the costs. Quality assurance requires use of assets or equipment that are expensive and therefore demand high investment capital which is not easily accessed from the financial institutions in the country. Thus entering into contracts with fish buyers who are willing to extend loans is the immediate solution for traders. Four main reasons for getting into the trading contractual agreement were identified during the field survey. These include access to market; access to loans, access to fishing assets and cash that caters for non fishing activities. Differences exist in the reasons for entering into contracts between boat owners and traders. Access to loan and market was a common reason for both boat owners (43.8%) and traders (52.4%). Access to loan that covered fishing and non-fishing activities was ranked second by boat owners (25.0%) while for traders, access to fishing assets was ranked second (Table 52).

Table 51: Summary of main features of the identified fishing contractual agreements in Lake Victoria

Contract type	Method for covering fishing cost	Sharing of fish returns/revenue	Methods of Negotiation/monitoring/coordination	Remarks: Boat owner	Remarks: Fishers
A.1	- One third of daily revenues is set aside to cover for fishing costs - custodian of the money is boat owner	The remaining two thirds of daily revenue is shared equally between boat owner and fishers	- selection of fisher is conducted by fishers with an approval of boat owners - in some cases the boat owners is also a fisher hence less monitoring costs	- there is an incentive for boat owners to engage in this kind of contract as it provides him with room for sharing risks - Boat owner can appropriate more as custodian of money fishing cost	- it is a disincentive to fishers as the amount set aside for fishing costs is not equivalent to the actual cost
A.2	- Actual daily cost is deducted from daily revenue	The daily net revenue is shared equally between boat owner and fishers	- selection of fisher is conducted by fishers with an approval of boat owners - in some cases the boat owners is also a fisher thus less monitoring cost	- Incentive to boat owner due to cost sharing on daily basis	- There is incentive for fishers to engage in this kind of contract because of fair distribution of daily revenue
A.3	- One day fish revenue is set aside to cover for one week fishing costs - Boat owner is the custodian of the money	Sharing of daily fish revenue of the remaining 6 days in a week	- selection of fisher is conducted by fishers with an approval of boat owners - in some cases the boat owners is also a fisher thus less monitoring cost	- Incentive as boat owner will appropriate more as a custodian of money for fishing cost	- Fishers incentive to fish on the one day for fishing cost is low because they will be predicting the amount of cost and relate to amount of fish catch
B.1	- One day fish catch is used to cover one week fishing cost - Boat owner is the custodian of money for fishing cost	Three days fishing catch for the boat owner and three days fish catch for fishers	- Boat owners employ a relative or friend as supervisor - Use of forced resting for fishers after every month - Use fishing shifts for fishers normally for one month - Relatively higher monitoring cost	- Appropriate more from fishing cost - Use of compensation day for low catch as a strategy to ensure performance/reasonable catch -	- Less incentive to fishers on the fishing days for the boat owner -
B.2	- Cost is paid on actual amount - Costs are covered daily by the party in turn	The party receives all fish catch for three consecutive days meanwhile paying the other party a daily allowance of TZS 1500 to TZS 2000 per landing boat	- Boat owners employ a relative or a friend as supervisor - Use of forced resting for fishers after every month - Use fishing shifts for fishers normally for one month - Relatively higher monitoring cost	- Not very attractive to boat owner because of overstating of fishing cost by fishers if the boat owners is not involved in fishing, - Use of compensation day for low catch as a strategy to ensure performance/reasonable catch is commonly practiced to ensure more appropriation of fish returns by boat owner	- Less incentive to fishers on the fishing days for the boat owner -
C.1 and C.2	Cost is covered by boat owner	Boat owners are given more fishing days	- Boat owners employ a trusted relative or friend as supervisor - Provide financial assistance and or working tools to fishers - Use of forced resting for fishers after every month - Use of corporal punishments - Hire and fire is a common phenomenon	- Boat owners needs to be very strong in coordination and monitoring - Use the financial assistance as a tool for loyalty and price discount from fishers and boat owner-fishers	- Working hard pays more as the payment are fixed on fish catch - More secured when in the Lake because of the respect to boat owner by other stakeholders in the Lake

Loan for non-fishing activities to boat owners is important because of the risky nature of fishing activities. Theft and death in the lake is common hence access to loan in case of emergence is crucial as discussed in detail below.

Table 52: Traders' purpose for engaging in trading contracts

Purpose for engaging in contract	Nile perch boat owner		Nile perch trader		Total	
	n	%	n	%	n	%
Ensure market/increase sells	7	14.6	3	14.3	10	14.5
Ensure market and loan for fishing assets	21	43.8	11	52.4	32	46.4
Ensure loan for fishing and non-fishing activities	12	25.0	1	4.7	13	18.8
Accessing fishing assets	8	16.6	6	28.6	14	20.3
Total	48	100.0	21	100.0	69	100.0

Three main contractual agreements in fish trading were identified during the field survey as shown in Table 53. All three types of contractual agreement involve provision of fishing assets from buyers despite the form in which the assets are provided. The contractual arrangements have features which are common to all and features which are specific to each contract as described below.

Table 53: Types of trading contractual arrangements in Nile perch business

Contract terms	Nile Perch Actors				Total	
	Boat owner		Traders			
	n	%	n	%	n	%
Buyer provides fish transporting assets as working tools in return for fish supplies	30	62.5	8	38.1	38	55.1
Buyer provides loan in return for fish supplies	3	6.3	9	42.9	12	17.4
Buyer provides loan for both fish and non-fish related activities in return for fish supplies	15	31.3	4	19.0	19	27.5
Total	48	100.0	21	100.0	69	100.0

(A) Common Features Across all Types of Trading Contract

The common features are of two categories namely accessing loan and features related to mode of loan repayment as highlighted below.

(a) The common features in accessing loans were:-

(i) The supplier works with the buyer for a certain period of time normally more than two years before being approved by the buyer. The time period is used to establish working strength and trustworthiness of the supplier.

(ii) The supplier must own assets and willing to expand his business through either increasing fishing gears, number of engines, fish collection boats or trucks. A large number of assets owned by a borrower is not enough to guarantee loan if the supplier is not trustworthy. Breaching of contractual agreement by supplier is punished through confiscation of given assets or equipment.

(iii) The supplier is required to have a guarantor who is accepted by the fish buyer. This assists in reducing screening problem to fish buyers and is also used as a strategy for dealing with many individual debtors in case there is a problem.

(iv) In addition to a guarantor, some fish buyers especially processors require written evidence from a guarantor. This is not very common especially with the shortage of fish.

(v) A payment of non-refundable deposit of TZS 200 000 is also required. This is common to suppliers who want to be provided with insulated trucks from processors.

As pointed by Gibbon (1997), the guarantee conditions are many but they are set purposely as processors strategies to reduce the number of small fish suppliers to a manageable size, and at the same time to remove large fish suppliers who might demand higher favours such as higher prices.

(b) The common features in loan repayment are:-

(i) In most cases the mode of loan repayment and its timetable is not specified. During the field survey, both positive and negative responses were provided on this issue. Unspecified amount of money and time frame provide room for suppliers to repay their loans as per their fish catch revenues. If the returns are low, repayment is postponed to the next fish catch. This is a relief to boat owners especially the small scale boat owners. On the other hand, the unspecified repayment mode and time frame provide room for buyers to benefit from the supplier through, (i) favours such as buying fish at lower prices than the market price as part of agreement or as appreciation for extending loan to the supplier and; (ii) cheating using weighing scales whereby the scales are tempered with using salt to create rust on the scales springs.

(ii) Extending ties between fish buyer and fish supplier. It was observed during the field survey that all loans that were extended with agreed repayment time period were paid on time. During the field survey, about 70% of the borrowers were still paying loans that were extended two years ago without repayment time period. However some suppliers who were aware of the lenders' tricks repay their loans even if the repayment period is not specified. Table 54 shows that 10% of suppliers repaid their loans in one month though repayment period was not specified and 20% repaid within six months. All this could be interpreted as transaction costs to suppliers associated with loan servicing.

Table 54: Loan Actual repayment time against agreed repayment period

	Actual repayment period					**Total**
Agreed repayment period	**One month**	**Three months**	**Six months**	**One year**	**Still paying**	
One month	100%	0	0	0	0	100%
3 months	0	100%	0	0	0	100%
One year	0	0	0	100%	0	100%
Not specified	10%	0	20%	0	70%	100%

(iii) Loan repayment mode has changed since 1996. Instead of repaying fish as was observed by Gibbon (1997), most borrowers are now repaying their loans in monetary terms. About 60% of the interviewed suppliers repaid their loans in cash. The borrowers indicated that deduction of certain amount of fish revenue on each sale as part of loan repayment is disadvantageous because they end up paying more than the actual amount of loan received if they repay using fish. However, some of them reported that there was room for negotiation if the difference in fish selling price was significantly higher at the time of loan repayment compared to the time the loan was granted. The room for negotiation is provided by all fish buyers except processors.

(B) Specific features for each type of trading contractual agreement

Despite the common features outlined above each type of contract has its specific feature as described below:-

(a) Contracts with agreement for buyers to provide fish transporting assets as working tools in return for fish supplies is common among Nile perch boat owners and traders. About 63% of the sampled boat owners and 38% of traders were in this kind of arrangement. The boat owners were provided with engines, collection boats and sometimes fishing gears as working tools without being charged fee on the use of the assets. The only requirement in the agreement was to supply the buyer with fish. However, for someone to access the assets he was required to have a guarantee as discussed above. In agreement between processors and fish suppliers, processing plants provide fish suppliers with a truck, truck inspector, fuel and cover the costs of truck maintenance. The role of the inspector is to assist in sorting fish at the landing sites. In most cases, however, the inspector ended up being surveillance to the truck and driver. The inspector monitors the amount of fish loaded in the truck and ensures that the truck does not deliver fish to any other place than to the contracted plant. The agreement also involves payment to the inspector where the processor paid salary and trader/driver paid daily allowance ranging from TZS 3000 to TZS 5000. Some suppliers were also provided with collection boats with ice bins of 10 to 25 tons carrying capacity. A supplier normally specifies the type of asset or working tools he needed. However, switching from trucks to boats and back to trucks or vice-versa is not allowed. Therefore a supplier has to make informed decision on what kind of working tools will give him maximum returns before approaching a lender.

(b) Contracts with agreement that buyer provided loan for fishing activities in return for fish supplies. The main feature of this agreement is that the relationship is based on loan and working tools provision contrary to the first type of trading agreement where one is provided with working tools only. The loan extended could be in kind or in cash. However, there are two different arrangements under this contractual agreement. The first arrangement involves provision of truck, fuel, truck maintenance, inspector and working capital. Most of the suppliers interviewed during the field survey were in this type of arrangement because it gave them adequate access to truck and cash. Cash is extended to boat owners through purchase of some fishing equipment and extended to boat owners as working tools or loan in kind in return for fish supplies. The second arrangement involves provision of working capital to suppliers with trucks or boats. This type of arrangement is used by suppliers who own trucks or collection boats and only require working capital. These suppliers are normally provided with inspectors. This suggests that the inspectors are not only provided for quality assurance but also to ensure that the borrowers/suppliers adhere to the contractual agreements. This obviously increases processors monitoring costs.

(c) Contracts with agreement that buyer provided loans for fishing and non-fishing related activities in return for fish supplies. Unlike the above two contractual agreements which involve processors, only traders and boat collectors extend this kind of contractual agreement. The arrangement has the potential of creating friendly relationships between suppliers and buyers because loans are also extended for personal matters that are not related to fishing activities.

4.7 Results of Multinomial Logit Analysis

4.7.1 Estimation results for fishing contractual model

The analysis is on fishing contractual choices on Nile perch supply chains based on a sample of 109 individual actors involved in fishing activities in the Lake Victoria. Of the total sample, 85 were involved in Nile perch fishing while 24 were involved in *dagaa* fishing. The fishing contractual agreements as dependent variables were merged from 7 into 3 main categories because of the problem of response which produce less strong statistical results. Merging the categories of contractual agreements led to convergence of the *dagaa* fish group into one type of contractual arrangement namely equal sharing of fish revenue. Thus multinomial logit regression analysis was only carried out for the Nile perch fishing contractual agreements. The *dagaa* fishing contractual agreements were not subjected to multinomial logit analysis because of perfect prediction. The following multinomial logit regression equation was used to analyse the contractual choices.

$$\Pr(y = m \mid x) = \frac{\exp(x\beta_{m|b})}{\sum_{k=1}^{K} \exp(x\beta_{k|b})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

the nominal outcome of fishing contracts (*fcontract)* was analysed as *y* with three categories *m=3* and *x* as eight independent variables as shown in Table 6. UT was used as *b*, the comparison group/base category. The descriptive tests indicated that the observations were evenly distributed over the three types of contractual agreements as shown in Table 55.

Table 55: Distribution of Nile perch boat owners by type of fishing contract

Type of contract	Number	Percentage
Equal share of fish revenue (ER)	26	30.59
Equal share of fish turnover (ET)	29	34.12
Unequal share of fish turnover (UT)	30	35.29
Total	85	100.00

The descriptive statistics for the variables and the prior assumptions used to assess initiation of types of contractual agreements with upstream chain actors in Nile perch fishing are shown in Table 56. The prior assumptions on the results indicate the effect of the variable in influencing a boat owner to initiate a certain type of contract.

The study findings show that boat owners were the initiators of the contractual agreements hence the agreements were location specific which made fishers vulnerable to boat owners' cost minimization strategies.

Table 56: Variable descriptive and prior assumptions on choice of fishing contracts

Variable	Unit	Mean	Std	Min	Max	Prior assumption
Fcontract	1 to 3	2.05	0.82	1	3	
Investme	Continuous	15.13	1.48	11.97	17.78	-
Duration	Continuous	2.05	0.63	0.69	3.96	+
Sellprice	Continuous	1783.53	224.99	1000	2500	+
Fcatch	Continuous	16.93	1.37	13.54	20.99	+
Hhasset	Continuous	13.95	1.19	11.53	18.10	+
Unit_cost	Continuous	0.45	0.29	0.004	0.96	-
Fbuyer	1 to 3	2.64	0.65	1	3	+
Loanac	0 or 1	0.31	0.46	0	1	+

The continuous variables were subjected to different transformations prior to model run because of uneven distribution. The continuous variables on level of investment, duration in fishing activities, volume of fish catch and value of household assets were transformed using log as they would have affected the model due to large variation. The dummy variable on type of fish buyer (*fbuyer*) represented three types of buyers namely processors, boat collectors and truck traders. The type of fish involved (*actor*) as another dummy variable was dropped because the *dagaa* fishing group was not included in the equation. The estimated parameters of the multinomial logit model do not lend themselves easily to a direct interpretation. A parameter considered positive indicated (anything being equal in addition), that an increase in the respective independent variable makes the event less probable (yi=1) and more probable (yi=3).

Table 57 presents the results of maximum likelihood estimation of the model. The likelihood ratio test statistic indicated that the hypothesis of all slope coefficients being zero can be rejected at the 1% significant level. The likelihood ratio of 0.28 and the model's ability to correctly predict 52.15% of the observations suggest a satisfactory goodness-of-fit.

Table 57: Multinomial logit model for fishing contractual agreements

Variable	Estimates	
	Parameter	Parameter
Investme	1.20	1.69*
Duration	1.44	0.73
Sellprice	0.99**	0.99*
Fcatch	0.48*	0.41**
Hhasset	3.75***	3.18***
Unit_cost	1.19	4.08
Fbuyer- collector	0.23	2.53***
-trader	0.25***	4.19***
Loandumy	0.73	0.37

Comparison group: unequal share of fish returns (UR)

*, **, *** represents significance at the 10, 5 and 1 percent significant levels

The marginal effects from the equation are given in Table 58. The variable unit selling price significantly decreases the possibility of initiating a contract on equal share of revenue (ER) and significantly increased the probability of initiating a contract on unequal distribution of fishing days or turnover (UT). This was expected because higher prices reduce uncertainty to boat owners hence preference to less integration with upstream actors. The selling price variable has no influence on the probability of initiating a contractual agreement on equal distribution of fishing days or turnover (ET).

Table 58: Multinomial logit model marginal effects for fishing contracts

Variable	Marginal effect		
	ER	ET	UT
Investme	0.021	0.386	-0.600
Duration	0.115	-0.045	-0.606
Sellprice	-0.001**	-0.000	0.001**
Fcatch	-0.141	-0.046	0.187*
Hhasset	0.275***	0.043	-0.318***
Unit_cost	-0.020	0.118	-0.098
Loandumy	-0.036	-0.067	0.103
Fbuyer- collector	-0.577***	0.997***	-0.420***
-trader	-0.925***	0.950***	0.025

*, **, *** represents significance at the 10, 5 and 1 percent significant levels

As expected, the increase in volume of fish catch (*fcatch*) significantly increased the probability of initiating a contract on unequal share of fish returns (UT). It appears that large volume of fish catch increases frequency of transaction hence reduces uncertainty which then causes less preference to integration. The asset specificity which was represented by the variable on value of investment in fishing activities (*investime)* and the variable on unit costs *(unit cost)* of fishing did not influence the probability of initiating any type of contractual agreement. This is explained using a test of Analysis of Variance (ANOVA). The test shows that there is no significant difference in unit fishing cost amongst categories of Nile perch boat owners (Table 59). The insignificant difference can be explained by the multiplicity of management costs. In fishing activities in the lake, boat owners are not allowed by law to practice industrial fishing hence, business expansion means increase in number of the operating artisan boats which increases management costs in terms of more boat crews and boat supervisors.

Table 59: Analysis of Variance test on unit fishing cost amongst Nile perch boat owners

	Sum of Squares	df	Mean Square	f	Sig.
Between Groups	2342282.32	2	1171141.16	0.722	0.489
Within Groups	132987489.52	82	1621798.65		
Total	135329771.83	84			

Contrary to the expectations, the value of household assets which was used as proxy for access to financial resources indicates a significant increase in probability of initiating equal share of revenue (ER) contractual agreements and a significant decrease in initiation of unequal share of fish returns (UT). The interpretation of these results needs to be taken with some caution because the household assets might have included assets obtained after engaging in fishing activities.

The variable on access to loan from buyer (*loandumy)* did not have significant effect on initiating any contractual agreement. The *fbuyer* dummy variable shows an interesting finding indicating fishing strategies by boat owners. If the fish buyer belongs to the middle part of the supply chain as boat collector/trader, the boat owners initiated a contract which is probably less integrating. Thus selection of a contract to be initiated includes strategies to minimize costs by using a mixture of parameters related to market integration.

4.6.3 Estimated results for the trading contractual model

Since the *dagaa* fish traders had only one choice of selling to open/spot market, the Multinomial logit model was run to analyse choice of different contractual agreements amongst Nile perch traders. In this case a total of 118 observations were used. Table 60 provides statistics on distribution of the observation across the four types of trading contractual agreements amongst Nile perch fish traders. A large number of the sampled traders fall under spot market followed by those who received fishing assets from the buyer. The spot market was dominated by the shore-bond artisan Nile perch traders or dealers.

Table 60: Distribution of NP traders by type of trading contractual agreement

Type of contract	**Number of observations**	**Percentage (%)**
Spot/open market (OM)	53	44.9
Buyer provides loan in return for fish sale (LC)	21	17.8
Buyer provides fishing assets in return for fish sale (FA)	44	37.3
Total	118	100.0

Descriptive statistics carried out for the nine independent variables included in the model show a large deviation from the average level of investment, duration in fishing activities, amount of fish sold and value of household assets (Table 61). The deviation was a result of combining all types of Nile perch traders from very small to large. Most dealers invested nothing; they only required working capital to buy and sell fish at landing sites, low volume of fish sales and therefore low value of household assets. The variables were transformed using log and square roots to improve their distribution. The dummy variable for fish buyer was collapsed into three values instead of four. The processors were combined with traders because processors were few in sample. Combining the two groups makes sense since processors are also involved in trading Nile perch. Descriptive statistics for the transformed independent variables and prior assumptions are shown in Table 61.

Table 61: Variables descriptive and prior assumption on choice of trading contracts

Variable	Unit	Mean	Std. dev	Min	Max	Prior assumption
Tcontract	1 to 3	2.30	1.37	1	4	
Investme	Continuous	218.97	72.45	57.78	389.23	+
Duration	Continuous	2.60	1.04	0	6.25	-
Sellprice	Continuous	184.07	284.14	1000	2600	-
Sale_kg	Continuous	9.76	1.58	5.99	13.63	-
Hhasset	Continuous	14.05	1.31	11.42	18.11	-
Unit_cost	Continuous	45.13	13.31	3.76	94.08	+
Fbuyer	1 to 3	0.34	0.47	0	1	+
Loanac	0 or 1	2.46	0.82	1	3	-
Negotiate	0 or 1	0.31	0.46	0	1	-

The positive effect under trading contractual model indicated more probable toward buyer provision of fishing assets (*yi=3)* which is more integrated and less probable towards open or spot market (*yi=1).* Thirteen variables with zero value of investment were dropped as their removal improved the model estimation. Table 62 presents the results of the estimation. The maximum likelihood estimation ratio tests indicate that the hypothesis of all slope coefficients being zero can be rejected at the 5% significant level. The likelihood ratio of 0.23 and the model's ability to correctly predict 51% of the observations suggest a satisfactory goodness-of-fit.

The marginal effects computed are summarized in Table 63. The value of investment variable (*investme)* indicates that, high asset specificity significantly increased (0.05***) the probability of choosing a highly integrated market (FA) and significantly reduced (-0.06***) the probability of choosing spot/open market.

Table 62: Multinomial logit model for choices in trading contracts

Variable	Estimates	
	Parameter	Parameter
Investme	1.02**	1.03***
Duration	0.91	0.87
Sellprice	1.00	1.00
Sale_kg	0.82	0.70
Hhasset	0.91	0.97
Unit_cost	1.00	0.98
Loandumy	3.41	2.05
Nego_dumy	0.25*	0.23**
Fbuyer- collector	9.84*	12.89*
-trader/processor	2.56	9.54**

Reference category/Comparison group: Spot/open market (OM)
*, **, *** represents significance at the 10, 5 and 1 percent significant levels

Table 63: Marginal effects on choice of trading contract in Nile perch

Variable	**Types of trading agreements**		
	OM	**LC**	**FA**
Investme	-0.06***	0.001	0.05***
Duration	0.03	-0.006	-0.024
Sellprice	-0.00	0.000	-0.000
Sale_kg	0.07	-0.009	-0.065
Hhaset	0.01	-0.013	-0.002
Unit_cost	0.00	0.001	-0.004
Loan_dumy	-0.22	0.162	0.061
Neg_dumy	0.34***	-0.012	-0.221**
Fbuyer-collector	-0.46***	0.125	0.332
-trader/processor	-0.39**	0.373	0.348***

*, **, *** represents significance at the 10, 5 and 1 percent significant levels

Despite the transaction costs effect on the choice of contract, market power also indicates its influence on the choice of trading contract. The ability to negotiate (*Neg_dumy)* in fish market which was used as a proxy for supplier's market power indicates a significant decrease in the probability of choosing a highly integrated (FA) contractual agreement over spot/open market (OM). This implies that, an increase in suppliers' ability to negotiate in the fish market increases probability of moving from highly integrated contractual agreements to less integrated ones such as LC and OM.

The variable type of fish buyer (*Fbuyer)* which was also used as proxy for market power indicates interesting results. The results indicate that selling directly to downstream actors in the supply chain influence the probability of choosing highly integrated contractual agreement over spot market. This might be associated with issues of quality control because processors would want to buy fish from suppliers who ensure compliance and therefore enter into firm contracts with them.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

This study analysed benefits and costs associated with conformity to food safety standards and effects of the compliance on the organization and governance of the Nile perch export supply chain. Specifically, the study analysed levels of compliance with standards by actors at each stage of the Nile perch export supply chain, identified and analysed costs and benefits associated with conformity to food safety standards and examined the effects of compliance with food safety standards on the organization and governance of Nile perch export supply chain.

Data for the study were collected from secondary and primary sources. Secondary sources include the Department of Fisheries, laboratory agencies, associations in Nile perch fishing related activities and records kept by fish processing factories. A large part of primary data was collected using a structured questionnaire administered to a total of 239 Nile perch chain actors including processors, traders, boat owners and fishers. Checklists were used to gather information from key informants including Fisheries officials and leaders and members of Beach Management Units.

The data were analysed using a combination of methods including descriptive statistics, accounting method and logistical regression model. Descriptive statistics such as frequencies, mean comparisons and percentages were used to determine demographic characteristics and levels of compliance with food safety standards. The accounting method was employed to determine costs and benefits associated with compliance to food safety standards while categorical logit regression model was used to analyse effects of compliance on organization and governance of the supply chain. This chapter presents conclusions and recommendations emanating from the major findings of the study.

5.1 Conclusions

5.1.1 Implementation of food safety standards and level of compliance

The empirical evidence in this study shows that the Nile perch industry conformed to EU food safety standards through successful implementation of HACCP, ISO 9000, ISO 22000 and BRC standards despite existence of gaps between documented standards and actual implementation of the different standards. However, analysis on level of compliance amongst actors along the Nile perch supply chain shows variation in the level of compliance depending on capital endowment. High levels of compliance have been achieved by downstream chain actors (processors) who are closely integrated to fish buyers than upstream actors (fishers).

5.1.2 Costs and benefits associated with compliance to food safety standards

The analysis of benefits and costs has shown that standards are associated with high costs resulting from the required initial investment (restructuring of processing plants and machinery), maintenance of the quality standards that needs continuous training and laboratory testing. However, the benefits associated with compliance to the standards including increased revenue, access to market and premium price outweigh the costs associated with compliance. The costs and benefits of compliance were found to vary along the supply chain. Downstream chain actors were found to incur significantly higher costs but also obtained higher benefits than upstream chain actors.

5.1.3 Effects of compliance to food Safety standards on organization and governance of the Nile perch supply chain

The findings of the study show that several changes have occurred in the organization and governance of the chain since the implementation of food safety standards following the EU import bans in late 1990s. Major changes that have occurred include increase in investments, expansion in fishing activities and emergence of contractual arrangements between actors. Although most of these changes can be attributed to compliance with food safety standards, they cannot be wholly attributed to the compliance. The decline in fish stock in the lake might have influenced the changes in organization and governance of the supply chain. The results of the multinomial logit analysis suggest that the changes in governance of the supply chain built on contracts are influenced by business location, scale of investments and negotiation power.

5.2 Recommendations

5.2.1 Enforcement of food safety standards

According to the findings of this study compliance with standards constitutes a major way of avoiding import bans and promoting access to global fish markets. This suggests that it is worth supporting the continuation of efforts to maintain compliance in the Nile perch supply chain to avoid the loss of export markets for

Nile perch, which in turn may have a negative impact on the livelihoods of the primary actors in the value chain and on other beneficiaries. Continuous enforcement of food safety standards can be achieved through increased support from the government and development partners and the private sector, strengthening standards bodies in accredited laboratories, and technical skills; and quality monitoring agencies such the Fisheries Department and BMUs in infrastructure such as patrol boats and operating funds. Funds for enforcing regulations and strengthening BMU in all lending sites can be raised through establishment of measures that allow retention of adequate amount of fishing revenue by the Fisheries Department.

5.2.2 Improving access to financial services

Poor access to financial services among actors in the Nile perch supply chain especially actors upstream the chain was found to be a major constraint to compliance to food safety standards. Consequently, upstream actors depend on downstream actors for credit, leading to unfair distribution of benefits along the chain. These actors are compelled to enter into agreements with downstream actors because the current terms of credit in formal credit system are not favourable. Provision of credit or financial services at favourable terms of repayment would encourage upstream actors to borrow from financial institutions rather than depending on loans from downstream actors in the Nile perch supply chain. This should go together with efforts to promote establishment of Savings and Credit Associations among fishers and small boat owners.

5.2.3 Training

It was evident from the findings of the study that current knowledge in food safety standards is critical for the fishery industry to successfully comply to emerging new standards and therefore continue access global fish markets. This suggests that actors in the Nile perch supply chain should continue to undertake training in order to get prepared for the frequent amendments in and emergency of new food safety standards. Legally, competent agencies like national standard bodies such as TFDA, TBS in Tanzania should be encouraged to facilitate continuous training to fishery stakeholders so as to meet the frequent changes in standards. Instead of depending on government funding, efforts to encourage development partners and non-governmental institutions to finance training of various players in the Nile perch supply chain should continue to be made.

5.2.4 Involvement of developing countries in setting standards

Participation of exporting countries in standard setting is important for higher compliance level in this era of frequently amended and generation of new food safety standards. There is however inadequate participation of Nile perch exporting countries such as Tanzania in setting the food safety standards relevant to fisheries. The government needs to be more proactive in pursuing dialogue with EU on how to implement necessary changes in a manner that benefits both exporting and importing countries. There is also need to facilitate formation of national qualified standards auditing bodies and certified professionals who can fully participate in standard setting and monitoring.

5.2.5 Ensuring sustainability of fishing

Although the findings of the study show that the benefits of compliance outweigh the costs associated with compliance to the standards, efforts to ensure compliance to the food safety standards make sense if there is fish to export. The increase in the use of fishing gears and in the number of Nile perch fishers have raised concerns, particularly on the sustainability of the fish stock. It is therefore worth supporting the continuation of efforts to maintain compliance with EU food safety standards, while at the same time ensuring that sustainability measures are put in place to preserve the resource from over exploitation.

Measures that ensure sustainable fishing should be geared towards emphasis on self regulation and joint efforts amongst the riparian States. The on going efforts by Nile perch fish processors in the three riparian countries on the introduced self policing measure to counter depletion of fish stock in Lake Victoria should be maintained, strengthened and supported by the riparian States. This has to go together with the enforcement of existing regulations and strengthening of the monitoring systems. Future research on fishing regimes and compliance effects on Nile perch fish stock in the Lake would be appropriate to provide recommendations on improved regulatory and monitoring systems. Development partners and relevant academic institutions need to be involved in financing and conducting this kind of research respectively.

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ANNEXES

Annex 1: EU-SPS approval and/or certification requirements

(i) Exporting Approved procedures

Despite of the implementation of risk and/or hazard analysis, exporting countries cannot export to EU unless their systems are certified using competent authority approved by EU or third party country that is recognized by EU. As this is not enough, border inspections are carried with different intensity depending on product origin and country approved List Status.

(ii) Certification:

The Directive 91/493/EEC48 key feature is that all fishery products (whether fresh, chilled, frozen, canned, salted, smoked or dried) imported from third countries into the European Union must come from a preparation, processing, packaging or storage facility which is approved by the competent body in the country concerned. The EU delegates the control of food safety to a Competent Authority in each country, who in turn ensures that exporting vessels, processors and transporters are producing safe food under a system equivalent to that in the European Union.

Once the competent authority is approved by EU, the exporting country national laws are harmonized with the EU and the systems to monitor and control fish processing are established with principles of equivalency before the exporting country is approved for export to the European Union. Once the country is approved to export

48 Append the Directives article

the individual companies are checked by the Competent Authority and, if deemed appropriate, are listed as approved in a national register, with a certification number. This register is passed to the European Commission (EC) who makes the information public via its website. The countries that have passed are called List I countries. Other countries that are in the process of gaining approval but are deemed to be producing safe foods are shown in List II49. The draw back in this process is that processing plants even if established to have met the international standards of safety and quality; they only export if the country in which they operate is recognized and certified by the EC on List I or List II.

(iii) Third part certification

Third part certification is another option provided by the EU Commission. This has to be a recognized official controlling body in a third country with certain standards of control procedures. The official counterpart is held responsible for monitoring and checking that operators within the exporting country are correctly implementing the procedures of internal control. Using the third part, an exporting country will be authorized to export to the European Union when the third country has selected and submitted to the European Commission a list of all the establishments that comply with the EU Directives and then issued with an EU official number by the commission.

49 Shipments from List II countries are, however, subject to 100 percent border checks.

Annex 2: Compliance cost centres identified using SSOP

Critical Point	Equipment required	Activity	Frequency of carrying the activity
Water source and treatment	• Borehole • Water tanks • Chlorine dozer sensory alarm bell • Sensory bulbs • Lovibond comparator for chlorine check • Plastic water tank seal • Aluminium water tank cover	Construction of borehole	Once
		Construction of deflouridation unit	Once
		Sand filtration	Daily
		Chlorination	Daily
		Carbon filtration	Daily
		Ultra-violet (u.v.)	Daily
		Cleaning and checking of tanks for chlorine residual	Twice a day
		Cleaning and checking of chlorine dozer sensory alarm	Weekly
		Repair of fluoride unit valves	Every 6 months
		Check u.v. wiring	Every 6 months
		Replace u.v. valve and tubes	Every 6 months
		Replacement of carbon sand	Every 3 months
		Checking of water tank seal and cover	Weekly
Portable water for production	• Flake ice manufacturing unit • Ice flake unit shade • Ice holding containers • Stainless steel chutes and templates • Sanitized gunny bags • Carrying ice bins • Detergent containers	Water tanks labeling	Once/when necessary
		Water quality monitoring (WQM) at source	Daily
		WQM after passing deflouridation unit	Twice a day
		WQM in water tanks	Twice a day
		WQM at production/processing area	Daily
		WQM at ice plant	Daily
		Gunny bags cleaning using detergents and chlorinated water	Daily
Water quality (Microbial and chemical analysis)	• Cloth • Blow lamp/gas torch • Groove glass stopper sample bottle • Water marker pen • Aluminium foil	Internal lab analysis for water	Once a month
		External lab analysis for water from the source	Once a year
		External lab analysis for water in the tanks	Twice a year
		Physical checks on water PH, turbility and organic mater	More than twice a year
Fish quality (microbial and chemical analysis)	• Sterile containers • Polybags • Test tubes • Insulated cool box • Refrigerator	Internal lab analysis for whole fish/raw material	On arrival
		Test of fish samples from various points along processing line	Once a week
		Test of fish samples for export	Prior to shipment
		Cultural examination for microbiological parameters	Once a month
Surface and personnel cleanness	• Sterile test tubes • Swabs sticks • Insulated cool box • refrigerator	Stores cleaning and disinfection	Weekly
		Test on swabs from workers' hands and aprons during processing	Weekly
		Cleaning and sanitization of Tables, utensils, floors, walls and cold stores	Twice a month
		Test on swabs from tables, utensils, floors, walls and cold stores	Weekly
		Test on swabs from packaging material	On arrival

Critical Point	Equipment required	Activity	Frequency of carrying the activity
	• detergents such as Nobla powder, Nobla liquid, Tiket, Vim, Oxonia, Chlorine	Test on swabs on cleaned surfaces	Four times a year
Workers health and personal cleanness	• Protective clothing • Head covering • Mouth mask • Gumboots • Water proof dressing as bandages • Signs and signboards	Medical examination	Every six months
		Report on any health problem	Daily
		Hands disinfection	Start working, after bell ring, after handling spoiled fish and after using a toilet
		Training on GHP	Yearly internal training
		Sign and signboards reminding of unhygienic behaviour	Always
		Record and documentation of workers health	
Pests control	• Pest proof containers for refuse	Construction of sealed potential breeding sites, holes and drains	Once
		Maintenance and repair the sealed potential breeding sites	Every 6 months
		Exterior and interior plant treatment	Twice a month
		Inspection after treatment	24 hours after treatment
		Documentation of plant treatment	Twice a month
Temperature in ice plant and fish	• Electrical thermometer with sensing element and battery checking device	Temperature recording	Four times a day
		Internal calibration of the temperature device	Regularly
		Fish fillet temperature check at processing line	Every 15 minutes
		External calibration of the temperature device	After expire of certificate
Waste disposal	• Waste/refuse trough • Refuse containers	Construction of the refuse trough	Once
		Construction of drainage systems	Once
		Cleaning and disinfecting drainage system and containers	After each disposal
Documentation	• Computers	Design HACCP manual and checklists	Once
		Update HACCP manual and checklist	When necessary
		Secure all documents (HACCP manual, laboratory manual, GMP and GHP manuals.	Always up to 2 years
Visitors	• Protective clothing • Mouth mask • Head and shoe covering	Fill in health declaration form	On the visit day
		Wash and disinfect hands	Any time entering the production area
		Use protective clothing, mouth mask, head and shoe covering	Any time entering the production area

Annex 3: Checklist for institutions dealing with food safety standards

General picture of

(1) institution objective and roles in relation to fishery activities

(2) Institutional understanding in international standards: profile (standards forming process), TZ participation, how much are local standards aligned to major importers.

Lab/policy

1. Technical committees: how are they formed, criteria, roles
2. Type of tests conducted
3. Basic requirements for microbial test lab in terms of equipment, personnel and materials
4. Accessibility/source of the equipments, personnel's skills and materials and their costs.
5. Financiers: govt/donor/loan
6. Standards tested/used by the laboratory: local and international standards
7. Accreditation status/process/costs/challenges
8. Responsibility of the laboratory in fisheries
9. Fish sample testing procedures/costs
10. Any test on water/mud? What is the testing process

11. Laboratory competency and challenges
12. Testing equipment potential
13. Relationship between ISO and the laboratory
14. Participation level in formation of standards
15. Level of cooperation :inter and intra

Training

1. When preparing training needs, what are the indicators of the needs?
2. Are you aware of each international market standards? How do you obtain them/cost/process
3. How is your competence in agricultural/raw products standards
4. Who finance your training? How do they finance? Do they State type of training? Or are they financing through busket funding? What are the rates?
5. Apprenticeship training/what are the costs/to whome is the training offered?
6. What is your consultancy competency area? Who are your clients? Are there clients who implement voluntary standards?
7. What is the level of cooperation in training?
8. What is the trainee profile?
9. Has there been any moment where there had been major safety standards requirements that demanded reorganization of the agency

Annex 4: Checklist on compliance knowledge to actors in Nile perch fishing

General information

1. When has Nile perch fishing started?
2. What were the quality requirements?
3. What were the costs related to the quality requirements?
4. What do we know about food safety standards in fishing activities?
5. Who are involved in implementation of food safety standards?
6. What are the requirements for adherence to food safety standards requirements?
7. How do we record the costs for fishing activities?
8. What are the main costs items?
9. Are these costs items distinguished between those related to food safety standards and those related to conventional fishing?
10. Are there benefits to compliance with food safety standards?
11. If yes, what are they?

Annex 5: Structured questionnaire for fishers, boat owners and traders

STANDARDS AND AGRO-FOOD EXPORTS (SAFE) FOR DEVELOPING COUNTRIES PROGRAMME:

PhD STUDIES

FORM A1: GENERAL INFORMATION

Date of interview ____________________________ Name of interviewer ______________

Respondents name ___________________________ Actor category ___________________

Locality:____________________________________ District: ________________________

Duration in this activity (yrs)____________________ Area of origin___________________

Ethinic group ________________________________ Current residence ________________

Staying with family (yes/No) ____________________ Parmanet/part time ______________

Parmanet/part time ____________________________ Shifting? (0=No/1=yes)____________

Months in operation (if not always)_________________ Frequecy of visit to family __________ (if not staying with family)

Actors categories: Codes
1 Nile perch fisher
2 Tilapia, dagaa and other species fisher
3 Boat owner for Nile perch
4 Boat owner for other species
9 Factory agent
12 Assistant of factory agent (other than the driver)
13 Independent Nile Perch collector with own fish van
14 Independent Nile Perch collector with hiring fish van
15 Shore-bond small scale Nile Perch collector
16 Independent Nile perch collector with motorised karua

FORM A1: BASIC INFORMATION ON THE ACTOR'S FAMILY

A1: Members of the family staying with him/her

ID	Name	Age (years)	Sex		Realtionship		Education level		Main Occupation	
			1=Male 2=Female		1= Head 2=wife/husband 3=child 4=other relation		1=none 2=primary 3=0 level 4= A level/certificate 5=Diploma 6=Degree&above		1=Child 2=School 3=Fisher 4=Artisanal processor 5=Crew 6=Farmer 7=Private sector employee 8=House 9=Government employee 10=house helper 11=Business 12Other specify	
			code		code		Code		code	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

If more than 10 resident family members, continue on a second for A

A2: Total resident members ______________________

A3: Members of the family left in the area of origin/other areas

ID	Name	Age (years)	Sex		Realtionship		Education level		Main Occupation	
			1=Male 2=Female		1= Head 2=wife/husband 3=child 4=other relation		1=none 2=primary 3=0 level 4= A level/certificate 5=Diploma 6=Degree&above		1=Child 2=School 3=Fisher 4=Artisanal processor 5=Crew 6=Farmer 7=Private sector employee 8=House 9=Government employee 10=house helper 11=Business 12=Other specify	
			code		code		Code		code	
11										
12										
13										
14										
15										

If more than 5 family members left in the area of origin/other areas, continue on the second form

A4: Family members left in the area of origin/other areas (same people as for the previous question) (remmittance–IN)

ID	Current place of residence		Years not staying with him/her	Sending money? To:				How often?		How much each time?	Year total
	1=in this district 2=in Tanzania (place) 3=in Dar es Salaam 4=Abroad (country)			Curr.resid 1=yes 2=no		Area of origin 1=yes 2=no		1=Each week 2=Each month 3=Few times a year 4=Occassionally		Amount each time	Calculate amount for the year
	Code			code		Code		code			
11											
12											
13											
14											
15											

A5: Total Estiamted Remittance (IN) for the past Year (period from _________ to _________)   TZS____________

FORM B1_1: FISHERMEN, BOAT OWNERS: FISHING ASSETS AND SOURCE OF FUNDS

B1_1:1 Fishing assets (owned, rented by the responendt or family member)

Asset type 1=dugout canoe 2=planked canoe 3=engine HP 9.9 4=engine HP 15 5=paddle 6= other (specify)		Solely Owned assets					Jointly owned assets	Renting in assets		Renting out assets	
Code		Size	Qty	Year purch ased	Asset cost	Life span (years	Quantity	quantity	Renting in price per mon	Qty	Renting out price per mon

B1_1:2 Fishing gears (owned, rented by the responendt or family member)

Gear type 1=line, 2=trap <u>Net types</u> 3=cast, 4=gill, 5=seine, 6=lift				Year purchased and current cost of the gears			Renting in gear		Renting out gear	
Code		Qty	Ownership 1=owner 2=joint 3=rent	Year purchase d	Asset cost	Life span (years)	quantity	Renting in price per mon	Qty	Renting out price per mon

B1_1:3 Source of funds for fishing activities

Loan received			Loan repayment terms			Actual repayment experience	
Loan source 1=buyer 2=bank 3=Non-financial instit 4=Other (specify)		Loan amount	Repayment amount	Repayment mode	Repayment period	Actual repayment time	Reasons for delay in repayment
Code							

If different sizes of boats-provide current cost for each asset size

Asset type	Size		Current cost
	Unit		

FORM B1_2: FISHERMEN, BOAT OWNERS: FISH QUALITY

B1_2:1 Did you have to buy/use additional assets/equipments to improve and ensure quality of fish since 1997?
Yes ________ No ________

B1_2: 2 If not what are the main reasons for not buying/using additional assets to improve and ensure quality fish?
____

____

____

B1_2:3 If Yes, please give details of the additional assets employed to improve fish quality

Type of asset/equipment	Solely Owned assets				Jointly owned assets	Renting in assets	
	Qty	Year purchased	Asset cost	Life span (years)	Quantity	Qty	Renting in price/mon

B1_2: 4 What additional activity did you do to improve and ensure fish quality? (*Any new activity initiated from 1997_ e.g. use of ice, training, employ quality inspector, selling in the lake, purchase collection boat etc*)

Type of additional activity to ensure fish quality	year started	Activity cost per month

B1_2:5 Have you had any consignments of your fish rejected by the buyer? 1=Yes, 2= No ______

B1_2:6 If yes how frequent? _________________________

B1_2:7 What is the average amount of fish rejected per month in kg ______________

B1_2:8What was the specific problem? 1= Size, 2=Weight, 3=Rotten/soft flesh _____________

B1_2:9 What measures have you taken to make sure that the problem won't happen again?
____

____

____

B1_2:10 How much did you invest in fishing activities to ensure quality fish (scale 1 to 5) ________

1=no investment, 2=low investment, 3=average investment, 4=high investment, 5=very high investment

B1_2:11 What is your perception on increasing dependence to the buyer after investment __________
1=none, 2=low dependence, 3=average dependence, 4=highly dependent

FORM B1_3: FISHERMEN, BOAT OWNERS: FISH PRODUCTION AND INCOME

B1_3:1 Estimated fish production

Name	Fishing work		If owner or renter				If labour	*Annual fishing income
As given in Form A	1=owner 2=labourer (crew) 3=renter 4=other (specify)		Average fish catch per week	Value of catch per week	Operating costs per week	Net value per week	Cash or equivalent per week	Calculate from number of weeks below
	code							
					Total income from fishing			

B1_3:2 Has the average fish catch changed over time? Yes ___ No ________

B1_3:3 If yes, give average fishing trend for the last 10 years by filling in the table below.

Item	Now	Five years ago	Ten years ago
Fish catch (kg/week)			
Distance to fishing areas (km)			
Fishing hours (hrs)			
Fish handling method			
Fishing method			

NB: Note any other major activity change and the reason for the change_write the change in the space below or overleaf

B1_3:4 Please provide information concerning the people you employ in fishing activities

Type of labour	No. of employee	Relationship to boat owner 1=same ethinic group 2=same village 3=relative 4=family member 5=Other (specify)		Status of employment 1=full time 2=employed when needed		How long have the employee stayed with boat owner (months)
		Code		code		
Fishers 1						
Fisher 2						
Fisher 3						
Fisher 4						
Cook						
Net menders						
Boat repair						
Security						

B1_3:5 Operational costs

Cost item	Qty/week	Cost per week		
Fuel				
Oil				
Wages				
Wages -fish share cash equivalent				
Food-fish share cash equivalent				
Net repairs				
Maintenance (gallons etc)				
Fishing baits (chambo)				
Ice loading				
Licence				
Landing site levy				
Boat inspection levy				
Other (specify)				

Weeks fishing per year _______________ * annual income = weekly income x number of weeks

FORM B2_1: COLLECTORS, RENTERS, ASSISTANTS: FISHERY ASSETS, LOANS AND INCOME

B2_1:1 Fish collection assets (owned, rented by the responendt or family member)

Asset type 1=fish van 2=collector boat 3=other crafts (specify) 4=other asset (specify)		Solely Owned assets					Jointly owned assets	Renting in assets		Renting out assets	
Code		Siz e	Qty	Year Purchase	Asset cost	Life span (years	Qty	quantity	Renting in price per mon	Qty	Renting out price per mon

B2_1:2 Source of loan for fishery activities

Loan received			Loan repayment terms			Actual repayment experience	
Loan source 1=buyer 2=bank 3=Non-financial instit		Loan amount	Repayment amount	Repayment mode	Repayment period	Actual repayment time	Reasons for delay in repayment
Code							

B2_1:3 Estimated income from fishery activities

Name	Fishery work		Cost and benefit				If labour	*Annual fishing income
As given in Form A	1=factory agent 2=indepe.collector 3=assistant (specify) 4=other (specify)		Average fish collected per week	Value of collecion per week	Operating costs per week	Net value per week	Cash or equivalent per week	Calculate from number of weeks below
	code							
					Total income from fishing			

B2_1:4 Operational costs

Cost item	Qty/week	Cost per week		
Fuel				
Oil				
Wages				
Allowances				
Maintenance				
Ice loading				
Licence				
Landing site levy				
Other (specify)				

Weeks fish collection per year _______________ * annual income = weekly income x number of weeks

FORM B2_2: COLLECTORS, RENTERS, ASSISTANTS: FISH QUALITY

B2_2:1 Did you have to buy/use additional assets/equipments to improve and ensure quality of fish since 1997?
Yes ________ No ________

B2_2: 2 If not what are the main reasons for not buying/using additional assets to improve and ensure quality fish?
____

____

____

B2_2:3 If Yes, please give details of the additional assets employed to improve fish quality

Type of asset/equipment	Solely Owned assets				Jointly owned assets	Renting in assets	
	Qty	Year purchased	Asset cost	Life span (years)	Quantity	Qty	Renting in price/mon

B2_2: 4 What additional activity did you do to improve and ensure fish quality? (*Any new activity initiated from 1997_ e.g. use of ice, training, employ quality inspector etc*)

Type of additional activity to ensure fish quality	year started	Activity cost per month

B2_2:5 Have you had any consignments of your fish rejected by the buyer? 1=Yes, 2= No ______

B2_2:6 If yes how frequent? ________________________

B2_2:7 What is the average amount of fish rejected per month in kg ______________

B2_2:8What was the specific problem? 1= Size, 2=Weight, 3=Rotten/soft flesh _____________

B2_2:9 What measures have you taken to make sure that the problem won’t happen again?
____

____

____

B2_2:10 How much did you invest in fish collection activities to ensure quality fish (scale 1 to 5) ________

1=no investment, 2=low investment, 3=average investment, 4=high investment, 5=very high investment

B2_2:11 What is your perception on increasing dependence to the buyer after investment __________
1=none, 2=low dependence, 3=average dependence, 4=highly dependent

FORM C1: MARKET AND CONTRACTS

B1_4:1 What are your major markets?

Type of market	Customers/ buyer name	Average amount supplied (kg/week)	Average selling Prices (TZS/kg)	Number of Years supplied the customer	Ability to negotiate price? 1=always accepting price 2=always negotiating	Do you have contract with buyer (1=yes, 2=No)	Type of contract 1=formal (lawyer assisted) 2=informal written 3=informal verbal	Purpose of the contract
Plant processing								
Fishermen-trader								
Trader								
Other (specify)								

B1_4:2 Contract with other chain actors

Type of chain actor 1=fish crew 2=fish supplier	Type of contract 1=formal (lawyer ass) 2=informal written	When was your first contract in fishing	What promted you to get into contract	Purpose of the contract	What are the terms of the contract	What happens when one does not meet the terms in the contract

FORM D1: OTHER ASSETS 1 –LAND, LIVESTOCK AND HOUSING

D1:1 Land owned and operated by the family: shambas and garden

Field ID		Area		Ownership		Rent in land	Rent out land	Use of field	Field cultivated by
Location 1=current residence 2=area of origin		Area of each field/plot		1=owned-idle 2=owned-used 3=owned-rent out 4=rent in		Amount paid TZS	Amount received TZS	Crop, crop mixture, idle etc	1=jointly 2=women 3=men
code			unit	code					
			Sub-totals (rentals) TZS						

Total number of plots _______ Total area owned _______ Total area used for farming: ______________

(=sum codes 1-3) (including land rented in or borrowed)

D1:2 Numbers of Livestock

Livestock type	Number now	Number year ago	Number born	Number died	Number bought	Number sold	Number gift in	Number gift out	Number eaten home	Current price*
Cattle										
Goat										
Sheep										
Pigs										
Chicken										
Turkey										
Others										

*adult animal or bird, price that could be obtained by selling now

D1:3 house construction (separate this as for the current residence and/or at the area of origin)

Wall construction ___________________________ (concreate, brick, wood, mud and wattle etc)

Roof construction ___________________________ (tiled, corrugated iron, asbestos, thatch etc)

Piped water? Y/N _________ Drinkable water? Y/N ________ Main electricity? Y/N _____

FORM D2: OTHER ASSETS 2 –HOUSEHOLD ASSETS, CREDIT AND SAVINGS

D2:1 Selected family assets (*this is meant for familly assets not listed in the preceding forms)*

Item	Number owned	Current price*
Hoe or spade		
Axe		
Bush knife (panga)		
Water container		
Cooking pot		
Bowl		
Bucket		
Hurricane lamp		
Torch		
Bed		
Watch		
Clock		
Radio		
Cassette/radio		
Television		
Telephone		
Refrigerator		
Sewing machine		
Bicycle		
Motorbike		
Tractor		
Car or jeep		
Pickup or truck		
Other (specify)		

* if known, current typical purchase price of item from shop or store

D2:2 Savings and credit

Does anyone in your family belong to a credit group or scheme? Y/N _________

If yes, give names and residence

Name	Residence	Name of scheme	Type of scheme (e.g SACCOS)

Last amount borrowed

Purpose of the loan

Interest rate

Loan repayment period

Grace period

Does this scheme also allow for savings? Yes/No

If yes, is this a regular savings? Yes/No

Savings amount (and how often?)

Apart from the scheme, do any member of your family have savings with a credit organization or bank? Yes/no

(Optional) estimate total amount of savings at the time of interview

FORM E1: CROP OUTPUT AND INCOME

Crop name (all major & minor crops)	Quantities					Total produce	Average price	Gross income	Variable costs	Net total income	Net cash income
	Unit	Consumed A	% B	Sold C	% D	E= A+C		G=ExF	H	I=G-H	J=IxD
							TOTALS				

WORKING SPACE (VARIABLE INPUT COSTS)

(This table is for working out the variable input costs i.e. cash costs for each crop)

Crop name	Name of input	Quantity used	Price per unit	Cost of input	Total costs for ech crop
		K	L	M=K x L	(sum of M values)

FORM E2: LIVESTOCK AND OTHER NR OUTPUTS AND INCOME

Milk cattle number _______ total days milked per cow ______ Average daily milk yield: ________

Crop name (all major & minor crops)	Quantities					Total produce	Average price	Gross income	Variable costs	Net total income	Net cash income
	Unit	Consumed A	% B	Sold C	% D	E= A+C		G=ExF	H	I=G-H	J=IxD
						Sub-total livestock					

Other NR*

							TOTALS				

* income generating NR-based family activities such as beer brewing, handicraft manufacture, pot making, charcoal making, other forest products and other NR based activities covered in the preceding Forms shoukd be listd here and calculations made about their contribution to family income.

===

WORKING SPACE (VARIABLE INPUT COSTS)

(This table is for working out the variable input costs i.e. cash costs for each crop)

Crop name	Name of input	Quantity used	Price per unit	Cost of input	Total costs for ech crop
		K	L	M=K x L	(sum of M values)

FORM E3: NON FISHERY/NON FARM INCOME RECEIVED BY MEMBERS OF THE FAMILY
(*Incomes obtained outside the fishery & farm related activities, incl. wages, salaries, self-employment, pension OR other income not covered in the previous forms)*

Each family member who has earned outside income during the past year should be interviewed using this form. For example, if there are 3 family members who have earned wages, salaries, self employment incomes (i.e own business income), or have received pension payment during the year, then fill in this form 3 times (one for each person). Own business refers to business not associated/created by fishery.

Name of the family member ________________________________ sex ________

Type of work		Amount earned last month (Enter here earnings for past month. For regular weekly pay this should equal weekly x 4)	Amount earned past year (Enter here earnings for year up to date of interview. For regular earnings, this should equal monthly x 12)	Place of work 1= nearby, 2=district 3=town (name), 4=city (name)	
Code				code	
1	Wages-seasonal				
2	Wages-regular				
3	Salary-private sector				
4	Salary-govt sector				
5	Own business income (net personal income from business i.e. gross income minus costs)				
6	Pension payment				
7	Other (specify) e.g property rents other than land and fishery related property, insurance payments etc.				
		YEAR TOTAL:			

Number of Form E3 completed for this family: ________________

Total non-fishery/non-farm income earned by family members ______________________________
(sum of year totals for all Forms E3 completed for this family)

Own business income i.e non fishery/non farm self employment (code 5 above) Additionaldetails

Type of activity ____ (e.g. brick making, shop keeping, etc)

Number of employees (how many people do you employ) _______________________________

FORM F: TRANSFERS, SHOCKS, COPING & CHANGES IN GAINING A LIVING

F1 Physical transfers and payment in kind (incl. gifts to relatives e.g. food, clothes etc)

Description (incl.units)	How often (times/year)	Amount each time	Total amount	Approx value per unit	Approx total value	Approx Value all items (past year)

F2 Shocks and response to shocks (3 last years) e.g theft of outboat engine, illness or death of family member etc.

Event (describe event)	When happened (date event occurred)	Effects of events* (give details)	Response to events* (how did household recover from the event?)

* try to write down accurate details in these places e.g 4 millions lost, 6 cattle sold to raise new working capital etc

F3 At present members of your family gain a living by (the purpose here is to reconfirm the main activities reported in the previous Forms)

____

F4 Has this pattern of activity changed over the past five years or sor? Yes/No _________

F5 If yes, what were the main activities for gaining a living five years ago?

F5 Regular food consumption of household (main foods eaten during past week)

Main food (last week)	Number of days	Amount eaten per day		Current price per unit	Cost of main foods	
		units	quantity		Per day	Per week
Fish						
Maize flour						
Other (specify)						

Annex 6: Structured questionnaire for industrial processors

COSTS AND BENEFITS OF COMPLIANCE WITH FOOD SAFETY STANDARDS: THE CASE OF NILE PERCH EXPORTS FROM TANZANIA

PhD RESEARCH

Questionnaire for processors

Processors status

1. Name of interviewee: ______________________________
2. Name of organization: ________________________________
3. When was it started: (year) ______________________________
4. Factory capacity (tons per day): _____________________
5. Utilized factory capacity: (i) Low season (tons/day): ________ (ii) High season (tons/day): ________
6. Type of Ownership:
   i. sole propriatership ii. Venture capital iii others ____________
7. If partnership, venture, who is the other partner:
   1. retailer of the products abroad
   2. wholesaler of the product aboad
   3. other (specify) ____

Quality and food safety standards

Type of safety standard	When certified	When started implementation	Length of time taken to achieve compliance

8. Structural changes in processing plant as a result to achieve HACCP compliance
   a. Buld new plants to HACCP specification
   b. Changes plant layout
   c. Build new lab
   d. Upgrade lab
   e. Changes water supply system
   f. Upgrade or build chilling and freezing facilities
   g. Upgrade temperature controls
   h. Upgrade/build storage facilities
   i. Acquire/rehabilitate own landing site
   j. Acquire/upgrade own insulated trucks
   k. Other (specify) ____
9. Structural changes in processing plant as a result to achieve Other food safety standards (such as BRC, SMC etc) _____________________
   l. ______________________________________
   m. _______________________________________
   n. ____
   o. ____
   p. ____
10. What other strategies do you use to cope with food safety standards?
   a. ____
   b. ____
   c. ____
   d. ____

MARKET

11. Selling:markets and sales percentages

Type of product	Market location (local market, south african, Asia, Europe, USA etc)	Parcentage of total sale	How long have you supplied the buyer?

12. Do you have contracts with your customers? i. Yes ii. No
13. Do the buyers you supply change some times? i. Yes ii. No
14. If yes how frequent do the buyers you supply change?
    Very frequently [ ] Frequently [ ] Less frequently [ ]

15. If yes what are the main reasons for these changes?
    1. ____
    2. ____
    3. ____

16. If it happens that you loose the current buyer, what alternative markets are there for you?

Name of customer	Cost incurred to access the market	Would the returns be as well good? 1= Yes; 2= No
1.		
2.		
3.		
4.		

TECHNOLOGICAL CAPABILITIES:

17. Do your staff have adequate knowledge of the food safety standards applied?
    Yes [ ] No [ ]
18. If yes how did they acquire the knowledge?
    ____
19. Have the owner and employees received any relevant training in fish processing? YES ___ or NO _____________
20. If yes, please specify the type and duration of training received:
    a. What type of informal training:
    ____
    ____
    ____
    b. Duration: (years) ___________________________
    c. What type of formal training:
    ____
    ____
    d. Duration (years) __________________________

RESOURCE CAPABILITIES:

21. How many employees do you have/use? Casual ____ Permanent _____
22. How many of your employees are skilled? _______ and how many are unskilled? _________.

23. For those who are skilled, what skills do they possess? ______________________________; ________________________; __________________; _____________________.

SETTING OF STANDARDS AND CONTRACTING:

24. What specific requirements/conditions do you have to meet when supplying your buyers?

1. ____
2. ____
3. ____
4. ____

.

25. Do you have a contract with your buyers?

Yes		No	

26. If yes what is the nature and purpose of the contract?

Nature of contract:	Tick	Purpose of the contract
Formal (lawyer assisted)		
Informal (written)		
Informal (verbal)		

27. What are the contents of the contract?

Contract terms	Yes/No
Time of delivery	
Payment mode	
Delivery mode	
Quality	
Price	
Conformance to specification	
Packaging	

28. Do you have a contract with your suppliers?

Yes		No	

29. If yes what is the nature and purpose of the contract?

Nature of contract:	Tick	Purpose of the contract
Formal (lawyer assisted)		
Informal (written)		
Informal (verbal)		

30. What are the contents of the contract?

Contract terms	Yes/No
Time of delivery	
Payment mode	
Delivery mode	
Quality	
Price	
Conformance to specification	
Packaging	

MONITORING OF STANDARDS AND CONTRACTS:

31. Are your products and operations inspected/monitored or audited?

Yes		No	

32. Who monitors your production process and products?

Type of a monitor	Frequency of monitoring	Aspects that are monitored
Government		
Key buying firms		

Certifiers		
Others (specify)		

IMPLEMENTATION OF STANDARDS AND CONTRACTS

33. Do you get assistance in meeting the standards requirements from the following?

Agent	**Yes/No**	**Type of assistance**
Customers		
Other exporting companies		
Trade organisations		
Private consultants		
Specialised consulting firms		
Non government organisations		
Government agents		
Other (specify)		

34. Have you had any consignments of your products rejected by the buyer?

Yes		No	

35. If yes could you give me a specific example? ________________________
____
____

36. What was the specific problem? __________________________________

37. What eventually happened to the consignment? _____________________

38. What measures have you taken to make sure the problem won't happen again? ____

39. Do you work together with the suppliers (producers) to enhance food safety capacity?

Yes		No	

COSTS AND BENEFITS OF COMPLIANCE

Preparation costs

40. In the following table indicate the important preparation costs for compliance activities.

Cost item	**Estimated cost**
Obtaining initial information	
Travel cost for staff (if any)	
Other costs incurred (stationary, photocopy, phone calls)	
Opportunity cost for time spent (hours spent)	
Consultancy or Technical charges	
Establishing relationship with certifiers	
Other (specify)	

Management costs

41. How many full time employees do you have in your processing plant indicating their monthly salaries and fringe benefits?

Employees' category	Number of employees	Average monthly salary cost	Average fringe Benefits/month

42. Among the employees how many are additional workers employed to build the standards compliance capacity indicating their monthly salaries and fringe benefits?

Category of additional employees'	Number of employees	Average monthly salary cost	Average fringe Benefits/month

43. How much compliance cost do you incur regarding marketing, account management and follow-up costs.

Cost element	Before compliance		After compliance	
	Travel (if any)	Communication	Travel (if any)	Communication
Marketing				
Account management				
Market follow-up				

Costs of certification and annual inspection

44. Please indicate the costs you incur in certification and inspection in the table below.

Cost item	Cost in TZS	Annual fee TZS
Process Certification		
Product certification		
Inspection cost		
Procedure involved (preparation, testing etc)		
Time spent		

Cost of monitoring production

45. How much costs do you incur in montoring production and technical assistance to suppliers in the past season.

Type of monitoring	Before compliance		After compliance	
	Travel	Communication	Travel	Communication

Monitoring own production				
Monitoring agents				
Monitoring fishermen				

Cost of conforming to export requirement

46. Please indicate in the following table the costs that you incurred on the following:

Cost item	**Do you incur this cost (yes/no)**	**Cost**
Wage costs of out-stationed staff (at port or airport)		
Cost of special export documentation		
Consumables needed to conform to export requirements		
Cost of renting dedicated storage in port/airport		
Cost of collection and analysis of laboratory tests locally		
Cost of analysis of laboratory tests abroad		
Amount spent on certified packaging material		
Taxes/levies/duties		

Record keeping

47. Please you are requested to supply information in the following table regarding record keeping costs.

Cost element	Cost before compliance	Cost after compliance
Wages and salaries		
Cost of consumables (stationery, etc)		
Training of staff		
Technical services		
Time cost		

48. How much of equipment do you have on the factory for record keeping? (Investment in IT, After Sale Follow-Up And Product Development)

Type of equipment	**Unit**	**Quantity**	**When acquired**	**Per unit cost/price**	**Use life**

49. How much have you spent on additional improvements in record keeping systems for compliance purposes?

Type of additional investments	**Unit**	**Quantity**	**When acquired**	**Per unit cost/price**	**Use life**

DIRECT COSTS: Plant/factory Establishment

50. How much cost did you incur for plant/factory establishment?

Cost element	Cost before compliance	Cost after compliance
Land acquisition		
Inspection cost		
Construction cost		
Training of staff		
Technical services		
Time cost		
Fuel and maintenance cost		
Other		

51. How much of the plant/factory machinery and equipment do you have?

Type of equipment	**Unit**	**Quantity**	**When acquired**	**Per unit cost/price**	**Use life**

52. In case you have made improvements in meeting compliance requirements how much did you spend on additional improvements or investments?

Type of additional investments	**Unit**	**Quantity**	**When acquired**	**Per unit cost/price**	**Use life**

53. How much have you spent on initial training and technical service plant/factory establishment for compliance?

Cost element	**Cost**
Staff training	
Technical services	

BENEFIT

54. In your opinion, what benefits do you think are important for compliance with standards? (1=not important; 2= moderately important; 3= important; 4= very important; 5= extremely important).

Benefit element	**1**	**2**	**3**	**4**	**5**
Improved management and greater efficiency					
Improved corporate image					
Improved fish quality					
Market access (assured market, stable prices, higher prices, etc)					
Reduced product liability					
Support services (inputs, credit, access to lab reagents, information)					
Improved environment					
Improved worker welfare					

Health and safety					
Community relations					

Thank you for the time and effort to complete this survey.

Annex 7: A Summary of processors HACCP approval procedure

HACCP Task	**Responsibility**	**Description**
Training of fisheries officers and processors	Fisheries office, processors, TBS	Training of fisheries officers and processors was important so as to understand the importance and implementation of HACCP.
Commitment of the management	Processors	The management has to show commitment in terms of moral, and financial. They also have to show awareness and expertise in HACCP
Mobilize HACCP team	Processors	Mobilize a team with a leader who has power to make decision and team up qualified members in the factory
Design and Development of HACCP manual	Processors and sometimes hired Consultants	Designing all the components of HACCP based on its 7 principles
Testing of HACCP manual	Processors	Required when HACCP is first developed to verify that it complies with requirements and is capable of achieving its outcomes
Checking of HACCP	Processors and Local Competent Authority	Processors to apply to the Director of Fisheries to check on the operating HACCP manual
Verification of HACCP	Processors, consultant and Local Competent Authority	On-site assessment to recognise the validity of the developed HACCP with the intent of recommending approval
Approval of HACCP	Processors, Local Competent Authority	HACCP stamped by the Zonal Fisheries Inspection Division.
Operation of HACCP • Specific operational duties (e.g. sampling/testing, record-keeping) • Ongoing verification activities • Independent verification • Amendments to HACCP when there are major changes in the production process • Updates and notification of minor amendments to HACCP • Re-approval of HACCP after 3 years	• Processors • Processors to do internal audit once every month • Competent authority to verify once every three months • Processors to apply for amendments from competent authority and get approval of amended HACCP. • Processors to update HACCP annually and inform the competent authority • Competent authority	Processors in general are responsible for HACCP operational tasks such as monitoring, testing or record-keeping. They are also in charge of ongoing verification activities such as internal audits or reviewing of monitoring records. When there are major changes in their production process such as changes in the infrastructure, equipments, handling or processing procedure that modify product outcomes, processors must apply for the approval of amendments.

[1] The basic HACCP principles include:

1. Identify the safety hazards that are reasonably likely to occur, including natural toxins, microbiological contamination, chemical contamination, pesticides, drug residues, decomposition, parasites, unproved food and color additives, and physical hazards;
2. Identify the critical control points for each of the identified hazards;
3. Identify the critical limits that must be met at each of the critical control points;
4. Identify the procedures that will be used to control and monitor each of the critical control points to ensure compliance with the critical limits; such procedures shall include calibrations of process control instruments, validation of software, and the use of consumer complaints;
5. The regulation prescribes corrective actions which must be taken by processors when any deviation from an identified critical point occurs. Specifically, the company must segregate the affected product and undertake a review by trained individuals to determine whether the deviation may have rendered the product either injurious to the public heath or adulterated.
6. Establish verification procedures to verify that HACCP is working correctly.
7. Provide for a record keeping system that will document the monitoring of the critical control points. Such records shall include the actual value obtained during monitoring and consumer complaints that relate to the operation of critical control points