

UNIVERSITY OF GHANA

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

**THE EFFECTS OF PLASTIC POLLUTION ON INSHORE MARINE
FISHING ACTIVITIES: INSIGHTS FROM ELMINA COASTLINE IN THE**



**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA LEGON,
IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD
OF MPhil GEOGRAPHY AND RESOURCE DEVELOPMENT**

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DECLARATION

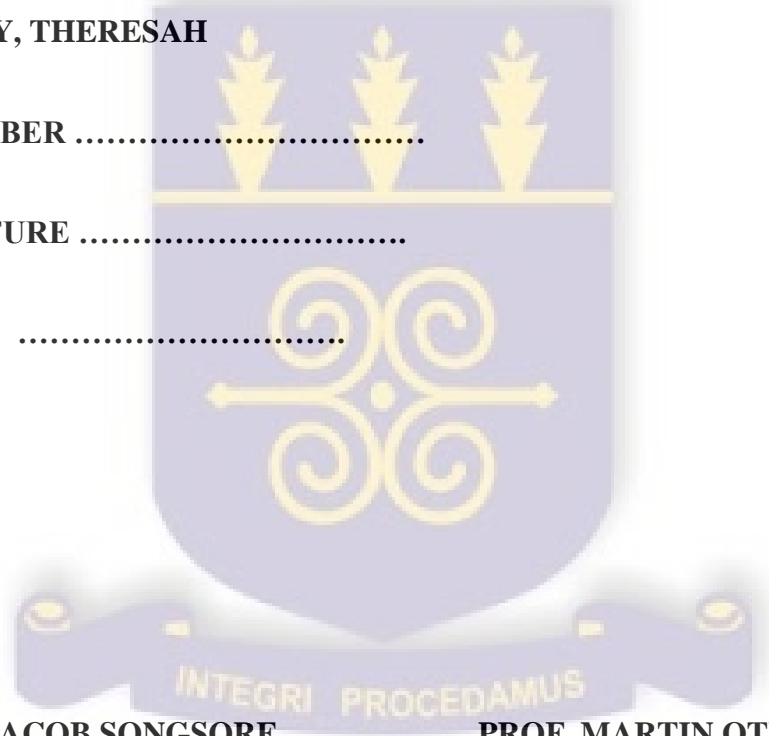
I, Theresah Larrey hereby declare that this research is my own work towards the award of Master of Philosophy in Geography and Resource Development and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree by this university or any other university, except where due acknowledgment has been made in the context.

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ABSTRACT

Elmina is one of the important inshore fishing areas in Ghana where fishing serves as a source of livelihood for about 75 percent of the residents and its environs. However, fluctuations in fishing output have been recorded in recent times. Though there are myriad of causes to these fluctuations, this research sought to delve into the role of plastic marine debris in the observed fluctuations, since plastic marine debris have been noted to have the potential to cause harm to marine animals. Elmina like most coastal settlements in Ghana, suffers from improper disposal of all types of waste including plastics which ranks top in all wastes found along the beaches. A total of 150 questionnaires were administered to fishermen; 3 focus group discussions were held for fish mongers; three in-depth interviews were held for 2 fisheries officers at the Komenda Edina Eguafu Abirem (KEEA) and Cape Coast Metropolitan Assembly (CCMA) fisheries department and an interview with a marine and fisheries expert.

The study revealed that plastic marine debris has no effects on fishes in the Elmina coastline, but hampers the smooth operations of fishing activities through clogging of pedals of outboard motors and the breaking of nets of fishermen in the Elmina coastline. It was also revealed that the plastic marine debris rather affect the artisanal and deep sea fleets instead of the inshore fleets. Thus, fishermen in the Elmina coast, who are inshore fishermen, had very little encounter with them.

The study recommends an intensive education of fishermen on the dangers that plastic marine debris can have on their source livelihood. Furthermore, the study recommends the placing of dustbins at vantage points at the various fish landing sites and the empowerment of the fisheries departments at the districts level through provision of infrastructure at the office, logistics and personnel

DEDICATION

I dedicate this piece of work to the memory of my late mother and brother.



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TABLE OF CONTENTS

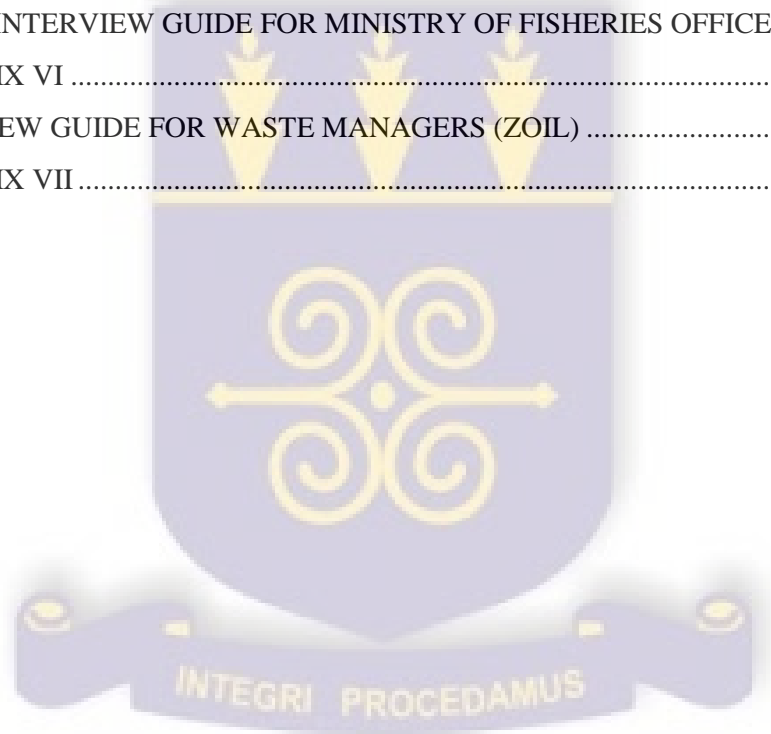
CONTENT	PAGES
DECLARATION	i
ABSTRACT.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS.....	v
LIST OF FIGURES	x
LIST OF TABLES.....	xi
LIST OF PLATES	xii
LIST OF ABBREVIATIONS AND ACRONYMS.....	xiii
CHAPTER ONE.....	1
GENERAL INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 The Problem.....	6
1.3 Goal and Objectives.....	8
1.4 Research Prepositions	8
1.5 Literature Review.....	8
1.5.1 Tragedy of the Commons.....	9
1.5.2 History of Plastics	11
1.5.3 Plastic Marine Debris.....	13
1.5.3.1 Entanglement	15
1.5.3.2. Ingestion.....	16
1.5.3.3. Introduction or spread of alien species.....	18
1.5.3.4 Damage to coral reefs.....	19
1.5.3.5 Introduction of chemicals into the marine environment.	19
1.5.4 Some suggested Solutions to the Plastic Marine Debris Menace.	20
1.5.5. Open Access Fisheries Resources.....	21
1.6 Conceptual Framework.....	22
1.6.1 Institutions.....	24
1.6.2 Policies.....	26
1.6.3 Market Forces	28

1.7 Research Methodology	29
1.7.1 Research Design.....	31
1.7.2 Target Population.....	31
1.7.3 Data Collection Methods	32
1.7.3.1 Sampling size and design for Questionnaire Survey.....	32
1.7.4 Qualitative research methods	33
1.7.4.1 In depth interview	33
1.7.4.2 Focus Group Discussion.....	34
1.7.5 Secondary Data Sources.....	34
1.7.6 Methods of Analysis	35
1.8 Limitations to the study	35
CHAPTER TWO	36
FISHING IN GHANA	36
2.1 Introduction.....	36
2.2 What is the UNCLOS?.....	38
2.2.1 Pre- UNCLOS Laws in Ghana.....	39
2.2.2 Post- UNCLOS Laws in Ghana	40
2.3 Contemporary Fishing Activities in Ghana	41
2.4 Inshore fishing Activities in Ghana	42
2.4.1 The trends in fish output over the last decade (2000-2010).....	43
2.5 Benefits Ghana derives from the fishing industry	44
2.5.1 Fishing as a source of livelihood.....	44
2.5.2 Fishing as a Source of Foreign Exchange, Food and Nutrition	45
2.6 Common Property Regimes in Fisheries Resources Management	45
2.7 Evidence of the presence of plastic waste in the marine environment of Ghana.....	46
2.8 Conclusion	48
CHAPTER THREE	49
THE ELMINA COAST	49
3.1 Introduction.....	49
3.2 The KEEA Municipality	49
3.3 Elmina.....	49

3.3.1 Fishing activities in the Elmina coastline in the Colonial era.....	51
3.3.2 The definition of Elmina Coastline.....	52
3.4 Physical Characteristics of the Elmina Coastline	52
3.4.1 Drainage.....	52
3.4.2 Vegetation.....	52
3.4.3 Population.....	52
3.4.4 Climate.....	53
3.4.5 Economic activities.....	53
3.5 Conclusion	56
CHAPTER FOUR.....	57
Contemporary Inshore Marine Fishing Activities in Elmina.....	57
4.1 Introduction.....	57
4.2 Demographic characteristics of Respondents	57
4.2.1 The Sex of the respondents	57
4.2.2 The age structure of respondents	58
4.2.4 Marital status and number of dependents	60
4.3 Changes in the output of fishermen in the Elmina coastline.....	61
4.2 Changes in the methods of fishing in the Elmina Coastline	65
4.3 Conclusion	70
CHAPTER FIVE	71
THE EFFECTS OF PLASTIC POLLUTION ON FISHING ACTIVITIES AND THE HABITATS OF FISHES IN THE ELMINA COAST	71
5.1 Introduction.....	71
5.2 Evidence of Plastic waste in the Elmina Coast.....	71
5.3 Effects of plastic wastes on fishing activities at the Elmina coastline	73
5.4 Effects of plastic wastes on the quantity and quality of fish caught in the Elmina coast line	77
5.5 Effects of plastic pollution on some activities related to fishing in the Elmina coastline..	80
5.5.1 Effects of plastic pollution on the fishing Equipment of fishermen in the Elmina coastline	80
5.5.2 Effects of plastic pollution on the incomes of fishermen within the Elmina Coast	82

5.6 Effect of plastic waste on the habitats of fishes within the Elmina Coastline	84
5.7 Conclusion	85
CHAPTER SIX	87
INSTITUTIONAL FAILURES AND COPING MECHANISMS OF FISHERMEN IN THE ELMINA COASTLINE.....	87
6.1 Introduction.....	87
6.2 Ministry of Fisheries and Aquaculture Development in KEEA and the CCMA	88
6.3 The work of the Ministry of Fisheries and Aquaculture development of Ghana.....	91
6.4 The work of the District Assembly in the KEEA municipal area.....	91
6.5 The CBFMC's and fishermen associations in the KEEA Municipal Area	92
6.6 Coping Mechanisms of the fishermen to the plastic waste menace in the Elmina coastline	93
6.7 Ways to handle the plastic waste menace	95
6.8 Conclusion	96
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	97
7.1 Introduction.....	97
7.2 Summary of Key findings.....	97
7.2.1 Plastic marine debris, fishing methods and changes in fishing output in the Elmina coastline	97
7.2.3 Plastic marine debris altering the habitats of fishes in the Elmina coastline.	98
7.3 The Effects of other factors affecting fishing activities and output in the Elmina coastline	99
7.3.1 Plastic Marine Debris and Other Activities related to Fishing in Elmina	100
7.3.2 Institutional Failures in addressing Plastic Pollution Problems and the Coping Mechanism of Fishermen to the Plastic Pollution Menace	100
7.4 Conclusion	100
7.5 Recommendations.....	101
7.5.1 Education on the harmful Effects of Plastic Waste on Marine Lives.	102
7.5.2 Regular Collection of Waste to avoid its entering into the Seas.....	102
7.5.3 Adequate Resources to Equip the Fisheries Offices at the District Level	102
REFERENCES	103

APPENDIX I	118
QUESTIONNAIRE FOR FISHERMEN.....	118
APPENDIX II	124
FOCUS GROUP DISCUSSION FOR FISHERMEN	124
EFFECTS GENERATED BY PLASTIC WASTES ON THE FISHING ACTIVITY	124
APPENDIX III.....	126
INTERVIEW GUIDE FOR FISH MONGERS	126
APPENDIX IV	128
KEY INFORMANTS INTERVIEW GUIDE.....	128
INTERVIEW GUIDE FOR MARINE BIOLOGIST	128
APPENDIX V	130
INDEPT INTERVIEW GUIDE FOR MINISTRY OF FISHERIES OFFICER.....	130
APPENDIX VI	132
INTERVIEW GUIDE FOR WASTE MANAGERS (ZOIL)	132
APPENDIX VII	133



LIST OF FIGURES

FIGURES	PAGES
Figure 1.1 Conceptual framework	23
Figure 3.1 Map of Study Area... ..	54
Figure 4.1 Changes in quality of fish caught along the Elmina coastline	61
Figure 4.3 Reasons for changes in Fish Output	64
Figure 4.4 Changes in methods of Fishing	65
Figure 5.1 Awareness of plastic pollution I the marine waters of the Elmina coastline	72
Figure 5.2 Effects of plastic waste on fish output	78
Figure 5.3 Changes in quality of fish caught	80
Figure 5.4 Effects of plastic pollution on fishing equipment	81
Figure 5.5 Effects of Plastics on Income	83
Figure 6.1 Coping mechanisms adopted by fisher folks	94

LIST OF TABLES

TABLES	PAGES
Table 2.1 The output of inshore marine fisheries in Ghana from 2000 -2010 ...	44
Table 4.1 Socio Demographic characteristics of respondents	57
Table 4.2 Cross Tabulation on age and length of years spent in fishing	59
Table 4.3 Cross Tabulation between changes in fish quantity and years spent in fishing.....	62
Table 4.4 Changes caused to Fishing Activities because of plastic marine debris	66
Table 4.5 Cross Tabulation between changes in fishing methods and changes in quantity of fish caught	68
Table 4.6 Cross Tabulation between changes in the fishing industry within the last five years and changes caused by plastic wastes	69
Table 5.1 Cross Tabulation between observation of plastic waste and number of years spent fishing	74
Table 5.2 Effects of plastic wastes on fishing activities	77
Table 5.3 Cross Tabulation between effects of plastic wastes on fishing activities and fish outputs	77
Table 5.4 Cross Tabulation between changes in quantity of fish output and evidence of plastics at sea	78
Table 5.5 Cross Tabulation between effects of plastics on income level and reasons for changes in revenue	85
Table 5.6 Changes to Habitat of fish due to plastic debris	85
Table 6.1 intervention from Municipal (KEEA and CCMA) Assembly	92

LIST OF PLATES

PLATES	PAGES
Plate 6.1 Landing Site in Cape Coast, showing plastic waste at the beach	89
Plate 6.2 some parts of the office of the Fisheries and Aquaculture Development at the Cape Coast Metropolis	90

LIST OF ABBREVIATIONS AND ACRONYMS

BOG	Bank of Ghana
CAADP	Comprehensive African Development Programme
CFC	Chlorofluorocarbons
CCMA	Cape Coast Metropolitan Assembly
CBFMC	Community-Based Fisheries Management Committees
CSIR	Council for Scientific Industrial Research
DDD	Dichlorodiphenyldichloroethane
DDT	Dichlorodiphenyltrichloroethane
DAA	Development Action Association
DESSAP	District level Environmental Sanitation Strategies and Action Plans
DDE	Dichlorodiphenyldichloroethylene
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Agency
EU	European Union
FAO	Food and Agricultural Organisation.
GPA	Global Program for Action
GESAMP	Joint Group of Experts on the Scientific Aspect of Marine Environment Protection

GSGDA	Ghana Shared Growth and Development Agenda
GYEEDA	Ghana Youth Employment and Entrepreneurial Development Agency
GNA	Ghana News Agency
IUCN	International Union for Conservation of Nature
IUU	Illegal Unreported and Unregulated (fishing)
KEEA	Komenda Edina Eguafo Abirem
MARPOL	International Convention for the Prevention of Pollution from Ship
MOFA	Ministry of Food and Agriculture
MMDA	Metropolitan, Municipal and District Assembly
MDG	Millennium Development Goal
NOAA	National Oceanic and Atmosphere Administration.
NEPAD	New Partnership for Africa's Development
NMFS	National Marine Fisheries Service
PCB's	Polychlorinated Biphenyls
PAH's	Polycyclic Aromatic Hydrocarbon
PNDC	Provisional National Defence Council
POP	Persistent Organic Pollutants
STAP	Scientific and Technical Advisory Panel
UNEP	United Nations Environment Programme

US EPA	United States Environmental Protection Agency.
UNCLOS	United Nations Convention on Law of the Sea.
UNESCO-IOC	United Nations Educational Scientific and Cultural Organisation
UNSD	United Nations Statistics Division

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

Population growth and urbanization are seen as twin processes simultaneously occurring within urban spaces. This growth however is noted to place increasing stress on the environment due to the inability of the available resources to support the growing population (Nunoo and Quayson, 2003). The situation has also led to the phenomenon of overcrowding in many cities that has seen a rapid increase in wastes generated, with an increase in the wider diversification of all types of pollutants (Zaman and Lehmann, 2013). This is because the type of wastes generated has changed due to industrialization and development, including components of marine debris (UNEP, 2011). According to Allsopp et. al. (2006), about 80% of all marine debris or litter originate from land, while the remaining 20 % is ocean - based (Allsopp et. al. 2006). For example, over the last three decades, the increasing proliferation in the use of synthetic products such as plastics has resulting in a proportionate increase in plastic wastes deposited into the waste stream (Yankson 1998 as cited by Ackah et al., 2012).

Marine debris as defined by the National Oceanic and Atmospheric Administration (NOAA) is “any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes” (NOAA, 2006). Studies on marine debris have shown that plastics consistently rank top of the component materials and make up 60 to 80% of all marine debris for the past 30 to 40 years due to the introduction of synthetics like plastics (Henderson, J.R. 2001; Derraik, 2002; Sheavly, 2005) which

hitherto was not the case. Undoubtedly, plastics in marine debris have fatal consequences on the functioning of marine species. Plastics and other marine debris have affected the survival and reproduction of species in most cases causing ingestion and entanglements of aquatic lives (Laist 1997; Baird and Hooker, 2000; Derraik, 2002; STAP, 2011; UNEP 2011). While mention can also be made of other effects such as the introduction of alien species into the marine environment, destruction of coral reefs among others (NOAA, 2005, UNEP, 2011; Allsopp et al., 2006).

In discussing the fatal consequences of plastic marine debris on marine lives, fish cannot be left out. For thousands of years, fish has remained a major nutritional source to human society (Lackey, 2005). Early men obtained fin fish, shellfish and other forms of aquatic life along the shores of rivers, lakes and seas. Archaeological data point to the use of fish spears from 90,000 BP (years before present), nets 40,000 BP and fish hooks 35,000 B.P. (Gartside and Kierkegaard, n.d). Kathlyn Stewarts, an Archaeologist, suggests that fishing activities was over looked in archaeological studies because it did not require specialized tools and therefore lacked artefacts for proper archaeological studies. He noted the use of materials such as wood, cloth, leather and fabrics which decay rapidly and thus loses every trace to their historical value. Even in recent times, fish is still caught using no specialized tools especially in low tides coastal zones (Gartside and Kierkegaard, n.d).

Globally, fish production has increased steadily from 19.3 million tonnes in the 1950's to 100 million tonnes in 1986 and reaching 134 million tonnes in 2002. Globally, marine fishing is known to be the largest contributor to the world fish production (Grainger, 1999). Within the last decade however, the relative contribution of marine fisheries to world's fish production has diminished with significant fluctuations in global marine catches (See Csirke, n.d; Brander, 2007; ICES, 2012;

Grainger, 1999). ICES (2012), states that the fluctuations in fish harvesting are probably as a result of destructive fishing methods adopted including over fishing and over exploitation of some fish species (ICES, 2012). The situation has worsened to the extent that fishers have migrated from the traditional fishing grounds into new areas for fishing. In recent times, deep water fishing has become a common practice with fishermen moving from distances of 500 meters to areas measuring up to 2000 metres below sea level. Again, the WWF (World Wide Fund) established that, the global fishing fleets are 2 to 3 times bigger than what the world's oceans can sustainably accommodate (WWF, n. d.).

Aside the unsustainable fishing methods adopted other geogenic activities including tsunamis and earthquakes have also contributed to the decline in fish population (MRAG, 2010). In recent times, climate change is noted to be a major contributor to decline in world fish production. Climate change has direct and indirect impacts on fish stocks that are exploited commercially. Direct effects include changes in the physiology and behaviour of the fishes which alter growth, development, reproductive capacity, mortality, and distribution. Indirect effects alter the productivity, structure, and composition of the ecosystems on which fish depend for food and shelter (Brander, 2007). The effects of increasing temperature on marine and freshwater ecosystems are already being felt worldwide. Rapid shifts in the distributions of fish and plankton in regions such as the North East Atlantic which has seen a more rapid temperature change, is one of the many examples of the negative effects of climate change on freshwater ecosystems. Again, these changes in water temperatures are expected because of the continuous increase in the earth's temperature. Some of the changes are expected to have positive consequences for fish production, but in other

cases, reproductive capacity is reduced and stocks become vulnerable to levels of fishing that had previously been sustainable.

In Ghana, the adoption of unsustainable fishing methods is widespread and has become one of most concern to industry stakeholders. According to the GNA (2008), pair trawling and bottom trawling are increasingly practiced in the Ghanaian marine waters. “Pair trawling involves dragging a huge net between two boats to catch fish” (GNA 2008). Even though the Ministry in charge denied that those vessels engaged in pair trawlers were not of foreign origin, but have local owners, there is still the fact that pair trawling is dangerous to aquatic habitats and species since the nets used drag everything in its way and destroys the very rocks that bear plankton, which also serves as home for many fish and other species and in some cases destroying an entire ecosystem, leading to loss of marine species and biodiversity.

Aside these unsustainable fishing practices coupled with other geogenic activities hampering the maximum development of the marine fisheries sector, Ghana has got a long and rich history of fishing dating as far back as the early 1700’s (BOG, 2008; Kwadjosse, 2009). According to Kwadjosse (2009), although fishing was basically made up of artisanal fishers, these fishers ventured into the coastal waters of neighbouring countries such as Liberia and Nigeria in the late 1800’s and early 1900’s. The Fantes are reported to have been fishing in Benin Republic and Cote d’Ivoire waters in the 1900’s (BOG, 2008) to serve the domestic market.

Ghana’s coastline and marine zone covers 200 nautical miles or 550 km extending from Aflao in the East to Half Assini in the West (Amalalo, 1998). The vegetation along the coastal strips reflects on of coastal shrub in the East and a semi - deciduous, deciduous and ever green forest along the western sections. The zone is endowed with

many resources and serves as home to about 80% of industries in the country. According to Amalalo (1998), the pressing challenges affecting the coastline of Ghana include domestic sanitation, fisheries degradation, wetland and mangrove degradation, industrial pollution of water resources and coastal erosion (Amalalo, 1998).

On domestic sanitation, one of the current challenges facing the marine environment in Ghana is the issue of indiscriminate disposal of plastic wastes (Nunno and Quayson, 2003). Many reforms have taken place in the fishing industry basically due to introduction of many borrowed technologies from other parts of the world. One of such technological invasions has led to the emergence of plastics into the fishing industry. Plastics, since its introduction by Alexander Parks at the Great London Exhibition in 1862 (Bellis 2006), has come to stay and has been used extensively in both food and water industry for packaging because of its innate properties such as low bulk densities and inertness that make them convenient carrier materials and low risk contaminants. Plastic bottles and sachets used to package ice water mostly sold to pedestrians and passengers in moving vehicles have become widespread in the country (Fobil and Hogarh, 2006). Currently, plastic wastes rank highest in post-consumer wastes in the country (UNCSD, 2011); with very few recycling centres, the majority of the wastes end up on the streets. According to Stoler et al. (2012), an estimated 270 tonnes of plastic wastes is generated in Ghana every day. Nunoo and Quayson (2003), conducted a research on management of litter accumulation on two beaches in Accra and revealed that plastic litter ranked highest in all litter collected at the two study areas (Nunno and Quayson, 2003). This attests to the fact that plastic wastes have become the most visible form of waste generated especially at the coastal

beaches of Ghana. This research therefore seeks to examine how these plastics found on the beaches/ shore affects fishing activities.

1.2 The Problem

Fishing activities in Ghana began as far back as the 1700's and Ghana is well-known in the West African sub- region for its long and rich tradition in fishing (BOG, 2008). Ghana's fishing history can be divided into two main eras, namely the pre-UNCLOS and the post-UNCLOS Laws. Ghana appended her signature to the convention in December 2009, but did not accept the procedures provided in the section 2 of Part XV of the Convention (Kwadjosse, 2009). The pre - UNCLOS era could also be called the "golden years" of marine fishing in Ghana as the industry recorded constant increase in fish landings. The prevailing perception at the time that fisheries resources were infinite also fuelled desires that led to the importation of many fishing vessels into the country for increasing fishing activities (Kwadjosse, 2009).

On the other hand, the post-UNCLOS laws or regulations sought to measure how to conserve and manage the fisheries resources of the country sustainably upon the realisation that fisheries resources were finite contrary to earlier views held that fisheries resources were infinite. Fisheries regulations ensured that fisheries were sustainably and well managed to avoid their depletion. PNDC law 265 of 1991 was accordingly enacted to protect and conserve the fisheries resources through the issuance of licenses to only registered vessels. The fisheries Commission Act of 1993 was given the mandate in the regulation and management of fisheries resources and the co-ordination of policies. Ghana has over the years reviewed its policies on fisheries. Currently, the fisheries management in Ghana is operating on the fisheries Act 625 of 2002 that has seen an integration of international fisheries resources management policies into the existing Ghanaian fisheries management policies and

frameworks and furthers acts to amend shortfalls that may be found in the Ghanaian policies (BOG, 2008; Kwadjosse, 2009).

Despite efforts by the Government to ensure the effective implementation of the frameworks and policies enacted over the years to regulate the Ghanaian fishing industry while improving efficiency and the influx of foreign industries coupled with advanced technology, the industry is still bedevilled with a number of challenges leading to fluctuations in the output of fishers. According to the Ministry of Food and Agriculture (2011), Ghana's fish production over the last decade has been fluctuating and most of the decreases are recorded in captured or deep sea fisheries. However, this gap has been filled by the advances in aquaculture and inland fishing activities (Asare-Antwi and Abbey, 2011).

Many factors have been adduced to explain such fluctuations in fish output (for instance see BOG, 2008; Mills et al., 2012 and Amarfi, 2010). However, current forms of litter found on Ghanaian beaches have remained largely plastic wastes (Nunno and Quayson, 2003) mostly found on the sea bed and on the surface of sea water forming marine debris (Allsopp et al., 2006). It is known that plastic wastes, when found in the marine environment becomes plastic marine debris and it is also known worldwide to cause harm to marine life and also alter many ecosystems in the marine environment (see Sheavly 2005; NOAA 2006; UNEP, 2011, STAP, 2011). In this direction, this research seeks to examine whether plastic wastes have had a role to play in the fluctuating fishing output recorded by Ghanaian fishermen in recent times and how it is affecting inshore or semi industrial fishing activities in Ghana, taking insights from Elmina, a prominent inshore fishing town in the KEEA Municipality.

1.3 Goal and Objectives

The major goal of this research was to analyse the effects of plastic wastes on inshore fishing activities at the Elmina fishing coastline in the KEEA Municipality.

The specific objectives were to:

- I. Analyse the trends in output of inshore fishing activities;
- II. Assess the effects of plastic wastes on the habitats of fishes;
- III. Assess the effects of plastic wastes on fish yields and other activities;
- IV. Examine the impacts of other factors on fish output;
- V. Assess the institutional frameworks and mechanisms for addressing the problem.

1.4 Research Propositions

- I. The presence of plastic wastes in the marine environment causes harm to fisheries.
- II. Other factors such as climate, algae growth etc. affects fishing activities.

1.5 Literature Review

This review delves into the history of plastic wastes, plastic marine debris and its effects on marine lives and fisheries resources in Ghana. Before that however, a brief review will be given on Hardin's tragedy of the commons and how this concept has had an influence on the fishing industry in the Elmina fishing area. Again, the use of common property (fishing sites), which is the main source of livelihood for the people in the community. A debate on common property regimes and open access property

regimes will also be discussed and finally, measures taken to curb the plastic waste menace will also be reviewed.

1.5.1 Tragedy of the Commons

In recent years, examining the fluctuations in total fish caught world over, fishermen seem to have fallen in to what Hardin calls the "Tragedy of the Commons" (Kraak, 2011). In Hardin's theory, "a common", is used to depict a natural resource, owned and shared by many people. 'Shared' used here means that each individual does not have a claim to any part of the resource, but rather, to the use of a portion of it for his/her own benefit. The tragedy occurs in the absence of regulations, where each individual has the tendency to exploit the commons to his/her advantage without any form of restrictions. Under this type of use, the commons is depleted and eventually ruined (Ponce, n.d).

Hardin's tragedy of the commons, which was originally propounded as an ecological interpretation of the problems of unrestricted human population growth, has been accepted widely as a general theoretical framework for analysing over-exploitation of natural resources (Latta, 2002). The theory, which shows how 'pasture' is used by herdsmen to feed livestock and how each thinks about the benefits to be derived from adding an extra animal to the herd, without consideration of the overall effect on the pasture. This eventually leads to the destruction of the pasture. This has similar patterns in the degradation of a much wider range of commons goods such as fisheries, grassland, forests, water resources, atmosphere etc. (Adhikari, 2001).

However, another school of thought has argued that, the tragedy of the commons only exists with open access resources where no property rights exist, and where ownership of the property is opened to all within a particular community. Swallow

(1990) as cited Cousins (1993) summarised the differences between common property and open access property. In a common property regime, firstly, no single individual has the exclusive rights to the use of the resource; secondly, group members have secured expectations that they can gain access to future use of the resource. Furthermore, there are functioning membership criteria. Also, there are communally defined guidelines for resource use and finally, there is an enforcement mechanism for punishing deviant behaviour. In an open access property regime, there are no social authorities that define and enforce the rights of individuals or groups to the use of the resource; also, each resource user ignores the consequences of his behaviour on others (Cousins, 1993). This school of thought argues that, the tragedy occurs when the institution, be it community or organisation in charge of the property, fails to control the access to that common resource by failing to enforce internal laws and regulations governing the commons for collective use (Adhikari, 2001).

With this scenario, the negative environmental externalities faced worldwide because of the plastic industry are a typical example of the tragedy of the commons (Akullian et. al., 2006). The producer gets his income from the manufacture and sale of the plastic products, individual consumers enjoy using the plastic products for their comfort, while the whole population bears the full cost of the impacts of its production and improper disposal of the plastic material after use. Lack of laws and policy enforcement, coupled with current improper disposal of plastic wastes and lack of recycling centres have led to its emergence in the world's oceans. Records have it that plastic wastes have consistently topped in the components of all marine debris in recent years (STAP, 2012).

The world's ocean covers 72% of the earth surface and its health is in no doubt directly related to the health of man as majority of the air we breathe originate from

the world's oceans (Project Kaisei, 2010). Again, the oceans do not recognize artificial boundaries set by the international laws such as the EEZ, therefore any misuse at one side can have a dire consequence on the entire oceans of the planet.

Some other anthropogenic activities are also known to be responsible for a major loss of the world's bio-diversity in the oceans. Marine lives are endangered in varied forms through overexploitation, dumping of both biodegradable and non-bio degradable waste, drilling of oil, land reclamation, dredging and global climate change. These, among others (see for instance Derraik 2002; Beatley, 1991). One disturbing and recent form of human impact that constitutes a major threat to marine lives is the pollution of the sea by synthetic materials such as plastic wastes.

1.5.2 History of Plastics

Before the invention of plastics, wood, stone, metals, clays, animal skin etc. were among the many materials man used in making his clothing in the earliest times (BTR Nylex Ltd., 2005). However, in recent times, plastics have become a necessary component of man's life ranging from his private to his professional life. Right from the break of day till sunset, man seems to depend almost entirely on plastics and its related materials for everyday survival (Sharma, n.d). One of the many experiments that led to the invention of plastics took place around 1835 when Regnault, a renowned French chemist created a chemical called Vinyl chloride which he turned into white powder. This white powder he created many years ago has been modified and is known today as the PVC (BTR Nylex Ltd, 2005).

Plastics were unknown until Alexander Parkes in 1855, publicly displayed it at the Great International Exhibition in London. Plastics, then called Parkesine, named after Parkes, were made by mixing Camphor (chemical used in mothballs) and

nitrocellulose (chemical used in many modern lacquers for motor car bodies) (BTR Nylex Ltd, 2005).

Major breakthroughs in the effort to manufacture plastic were recorded after Parkes in 1855. However, the acceptance of plastics as a useful material for use both at home and at work and the ever increasing demand for more goods, more chemicals, more steel and power led to the wider acceptance and growth of the plastic industry. In the 1900's, plastics became wide spread and more research was conducted into finding newer versions of existing plastics for improved uses (Mustalish, 2004).

Today, the UNEP (2009) defines plastics as a polymer, a very large molecule made up of smaller units called monomers which are joined together in a chain by a process called polymerisation. The polymers generally contain carbon and hydrogen with other elements such as oxygen, nitrogen, chlorine or fluorine (UNEP, 2009). Teye (2012), further explained that plastics are polymers and a polymer is an organic macromolecule composed of several hundreds and thousands of repeating segment called 'mers' linked together in chain-like form. Plastics are made from polymers and additives (Teye, 2012).

These polymers come together to form a useful versatile material (plastic) which has many uses and has been used extensively in the manufacturing industry in the last three decades. Plastics are durable, cheap, lightweight, strong, inert (STAP, 2011), which makes them more appropriate for the manufacture of a range of products. These same qualities make them a serious social hazard as form non bio-degradable products that rather fragment into smaller pieces known as plastic pellets (Derraik, 2002). The subject of plastic marine debris and its effects on the marine environment has be explained further in the next sub topic.

1.5.3 Plastic Marine Debris

Industrialisation has led to the discovery of many materials, most of which lack the recovery infrastructure and therefore end up as waste (Allsopp et al. 2006). One of such materials that have been useful in today's industrialisation is plastic, which has become a new form of waste generated within the last 3 to 4 decades (Sheavly, 2005). Human garbage now includes synthetics and plastics, which have inevitably found their way into the world's oceans.

An internationally agreed definition of marine litter, which is adopted by UNEP is any persistent, manufactured or processed solid material discarded, disposed or abandoned in the marine and coastal environment (UNEP, 2012; Butterworth et al., 2012). An inspection of most beaches in the world reveals the presence of plastic waste seen now as a menace. The world over, the statistics on plastic wastes on the beaches keep rising and the sizes of these plastics vary from large containers, fishing nets to microscopic plastic pellets and particles (Lytle, 2011). Same can be said about the beaches of Ghana (Nunno & Quayson, 2003).

The information on marine debris reveals that plastics make-up most of the marine litter worldwide (for instance see Derraik, 2002; Allsopp et. al., 2006; STAP, 2011; Butterworth et. al., 2012). Though the methods used to assess these cannot be justified by authors due to the fact that data on temporal trends vary between regions and are typically restricted to sampling at or near the sea surface in coastal waters or on the shoreline, the predominance of plastics amongst the other marine litter and its proportion consistently varies between 60% and 80% of the total marine debris (Derraik, 2002).

The properties of plastics which make them so perfect for the manufacturing of other products such as its lightweight, strength, durability, corrosion-resistance with high thermal and electrical insulation (Thompson et al., 2009) also makes them non-biodegradable. Therefore, the continued accumulation of this material in the marine environment poses a serious growing global problem. The flora and fauna of the ocean floor to the surface of the sea, and the whole marine environment is under attack from the effects of plastic accumulation (Baulch and Perry, 2014).

According to Galgani et al., (2012), the disturbances caused by marine debris, in this case, plastic marine litter to the marine environment can be broadly grouped into three categories. These are ecological, economic and social. In explaining these categories, Galgani et. al., proposed the following under each category. First, they noted under the ecological section that species such as plants and animals may suffer mortality or sub lethal impacts through entanglement, physical damage and ingestion among others. Also, the swallowing of micro plastics, accumulation of chemicals from plastic and facilitating the invasion of alien species or altering the benthic community may form other potential impacts on the ecological system.

Second, plastic marine litters have economic costs to the environment, which includes potential costs to tourism, damage to vessels, fishing gear and facilities, losses to fishery operations, cleaning and sanitation among others. Again, the social cost of plastic marine litters includes the reduction in aesthetic values of the environment and potential hazards to public safety are some immediate costs (Galgani et. al., 2012).

Again, a report by the Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel GEF in 2012, revealed that the impact plastic marine debris has on marine life, can be considered under four broad headings:

- I. Ingestion and entanglement
- II. Provision of new habitat; potential for debris to provide new habitats
- III. Dispersal via rafting, including transport of invasive species and
- IV. Ecosystem level effects

The effects or harm caused by plastic marine litter on marine life have been reviewed extensively, the following delves into some of the effects identified:

1.5.3.1 Entanglement

Entanglement in marine debris is one of the causes of widespread animal suffering, leading to the deaths of about a hundred to thousands of marine animals and birds each year (Butterworth et. al., 2012). Many of the species known to have suffered entanglement include 32 species of marine mammals, 51 species of seabirds and 6 species of sea turtles. Other species have large numbers of victims involved although the exact extent of the problem is difficult to quantify (Allsopp et. al., n. d).

Entanglement takes place when fishing gears made of plastic material are intentionally abandoned or unintentionally lost in the marine environment (including monofilament line, nets and ropes, as well as other types of ropes, nets and plastic packaging from consumer goods). Old or worn out fishing gear discarded in the oceans may continue to function as a fishing apparatus (Matsuoka et. al., 2005 as cited by Allsopp et. al, 2006), thus, trapping marine organisms such as fish and crustaceans as its gets carried away by the current and end up killing such trapped

species. The manner in which a marine animal is entangled and the type of debris involved differs by species; basically, the animal's body shape and behaviours may impact on the nature of entanglement (Butterworth et. al., 2012).

Entanglement may affect marine life differently. For example, plastic debris may restrict the ability of the animal to feed, leading to starvation. The additional materials trapped may exert undue weight over marine organisms whiles hindering its movement and inability to escape impending predators ultimately strangling them to death (Allsopp. et al, 2006). Rope and ligatures may cause amputation or severe wounds that leave sores and infections on marine organisms. Loops and hooks may cause deep cuts into the skin muscle. Butterworth et al (2012) noted that the non-biodegradable character of plastics gives it the potential to entangle more sea animals after the first is dead and decomposes.

1.5.3.2. Ingestion.

Over 260 species are already known to be affected by plastic marine debris through ingestion and entanglement (STAP, 2011). While the Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel – GEF (2012), reports that about 663 species have been affected by entanglement and ingestion alone, of the 120 marine mammals listed on the IUCN Red list as being endangered, 54% are known to have been entangled or to have ingested plastic marine debris (STAP, 2011).

Some marine animals eat marine debris either intentionally or unintentionally, when this debris is mistaken for food. Its effects on the animal will depend on the shape, size and volume of plastics ingested. In fewer cases, the plastics can go through the digestive tract without causing any harm to the animal, but in most cases, the plastic

becomes lodged in the throat or digestive system leading to strangulation, starvation, malnutrition and eventual death (Allsopp et. al. 2006.; Baulch and Perry, 2014). Again, ingested plastics cannot be digested and may lead to a sign of fullness of the stomach which blocks the intake of extra food leading to starvation and malnutrition. Further, plastics make the animal full leading to restricted ability to swim and dive (Butterworth et. al., 2012).

Though Cetaceans, Turtles and birds have been identified as being the most affected by ingested plastic marine debris worldwide (Butterworth et. al. 2012), fish of all types have also been identified to ingest plastic marine debris. Stevenson (2011) stated that

A recent study analysed the stomach contents of 141 fish from 27 species in the North Pacific Subtropical Gyre and found that 9.2% of the fish had ingested plastic particles. Based on these findings, the study estimated that the plastic ingestion by mesopelagic (that are fishes living primarily between 200-1000 meters depth) Fish in the North Pacific is between 12,000 and 24,000 tons a year, a weight equivalent to about 8-16,000 automobile. Another recent study focused on the effects of ingested plastic on a family of fish (Myctophidae) that are common throughout all the world's oceans. Of the fish sampled in the study, 35% had plastic in their guts, mostly in micro-sized (1-2.79 mm) fragments. The researchers who conducted this study hypothesized that if the fish are not able to pass the plastic from their guts, they may be at risk of malnutrition and the eventual starvation that has been observed in other species such as seabirds and other marine mammals. (Stevenson, 2011).

In addition, plastic debris ingested by marine animals, have the potential of transferring hazardous chemicals in the plastics into the animal's body (Allsopp et al (2006) which could potentially have lethal consequences on the animal.

1.5.3.3. Introduction or spread of alien species.

Anthropogenic activities have led to the movement of some species into regions where hitherto, they were non-natives. The movement of one species into another habitat is called a biological invasion, and these invasions may have devastating consequences for the ecosystems concerned (Allsopp et. Al., 2006). Such movements may result in the transfer of organisms or chemicals on organic materials that suspend in water within the marine environment such as seeds, tress, leaves etc. Recent studies focus on the fact that plastic litter floating on the surface of the ocean have increased the number of rafts that transport environmental pollutants (Stevenson, 2011).

Organisms ranging from *algae to iguanas* have been seen to raft on rubbish in the marine environment (Allsopp et. al., 2006). However, common organisms living on plastic waste in the ocean include barnacles, polychaete worms, bryozoans, hydroids and molluscs. It is known that organisms colonize marine debris especially in the tropics basically because of the favourable climate (Barnes and Milner, 2005). For example, in Florida, an exotic bryozoan species (*Thalmoporella* species) was found which was not from the region (Winston et. al., 1997).

In colder regions, several species of barnacle and bryozoan have been found on plastic litter whilst invasive exotic barnacles, *Elminius modestus*, were found on plastic litter in the Shetland Islands (Barnes and Milner, 2005). These signify the potential of drifting plastic to aid an alien species invasion that may cause imbalances to the ecosystems.

1.5.3.4 Damage to coral reefs.

Old and abandoned fishing gears, especially lobster trap, are known to be a source of destruction to coral reefs (Butterworth et. al., 2012). Ligatures and lines become entangled with coral reefs and eventually break off at the point of entanglement. Once the debris is freed, the process continues until the debris becomes part of the whole structure of the coral reefs (Allsopp et al. 2006).

A study conducted on the impacts of marine debris on corals on the North western Hawaiian Islands identified that debris causes damage or death to many invertebrates including sponges and coral (Allsopp et al. 2006).

1.5.3.5 Introduction of chemicals into the marine environment.

Recently, researchers found that about 50% of polyethylene plastic fragments in the North Pacific Gyre contained PCBs (Polychlorinated Biphenyls), 40% carried organic chlorine pesticides such as DDT (Dichlorodiphenyltrichloroethane), and 80% also carried PAHs (Polycyclic Aromatic Hydrocarbon), (Stevenson, 2011).

In yet another study in 2003-2004, pre-production thermoplastic resin pellets and post-consumer plastic fragments were collected and analysed for POP's (Persistent Organic Pollutants) from water samples in the North Pacific Gyre, Hawaii, Mexico, Los Angeles and California. PAHs were detected in almost all the samples, with the highest concentrations found in the plastic collected near industrial and urban areas around Los Angeles. The only pesticide detected was DDT and its metabolites i.e. broken down products such as DDD (Dichlorodiphenyldichloroethane) and DDE (Dichlorodiphenyldichloroethylene) (Stevenson, 2011). These studies discovered a correlation between the concentrations of pollutants and the age that is the brittleness and discoloration of the plastic litter. The longer the litter floats on the ocean, the

darker and more polluted the raft becomes, signifying a higher number of accumulated species. This may affect marine scavengers, such as seabirds, known to be colour-selective in feeding.

1.5.4 Some suggested Solutions to the Plastic Marine Debris Menace.

Many Organisations have come up with measures for reducing or halting the indiscriminate disposal of litter especially that of plastics and other synthetic materials into the world's oceans. Many of these Organisational Initiatives can be grouped into Global, International and National Initiatives (for instance see Butterworth et al., 2012; STAP, 2011; Allsopp et. al., n. d). The Convention on Biological Diversity's report in 2012, stated that marine debris could be reduced through eco-labelling, green procurement, extended producer responsibility; deposit return progress; fees charged on single use plastic bags; education to promote the viewing of wastes as a resource for recycling; engaging with corporations and industry associations on sustainability; encouraging reuse and reduction through green chemical; encouraging better product and packaging design and lastly, supporting marine debris awareness (Allsopp et al. n. d).

The international Convention for the Prevention of Pollution from Ships (MARPOL) is also one of such global negotiations working around the clock to ensure the reduction of plastics and other synthetics from entering the sea (Allsopp et al. n. d). MARPOL's 1988 legislation aimed at preventing ships from disposing their garbage over board. The Annex V of the MARPOL legislation restricts the dumping of plastics over board and also urges all member states to maintain garbage receptors at the various sea ports to discourage ships from disposing wastes over board.

The Global Program for Action (GPA) for the protection of Ocean from Land base activities is also a UNEP collaborated program with other intergovernmental oceanographic Commissions of the United Nations Educational Scientific and Cultural Organisation (UNESCO-IOC) on strategies on monitoring Marine litter from entering the sea from land based sources since it forms about 80% of all marine debris (Butterworth, et al. 2012).

In Ghana, Zoomlion, a private company in charge of waste management has adopted some measures to help curb the ever increasing waste problem in the country. According to Anarfi (n. d), these measures include the formation of zoom kids club, which is a club in basic schools responsible for inculcating into children the knowledge of waste management. Aside this measure, other form of education are being given to the general public on waste management and more importantly to prevent plastics from entering the sea, since most beaches in Ghana also serve as dump sites. Insert a picture of beach refuse dump site in Ghana. These dump inevitably have some consequences on fishing activities; therefore, it is in place to examine fishing in Ghana.

1.5.5. Open Access Fisheries Resources

In open access fisheries resources, the resources are considered as equal to “res nullius”, meaning a thing that has no owner. In this type of fisheries, no person or group of persons have the right to use the resources. Therefore, open access fisheries resources are rather based on privileges instead of possessions (Stewart, 2004). Just as mentioned earlier, when common property which is jointly owned by a local community and the state lacks the attention of one of the owners, then the property becomes an open access one. According to Aheto et. al. (2012), the Ghanaian fishery industry is characterized by the open access system.

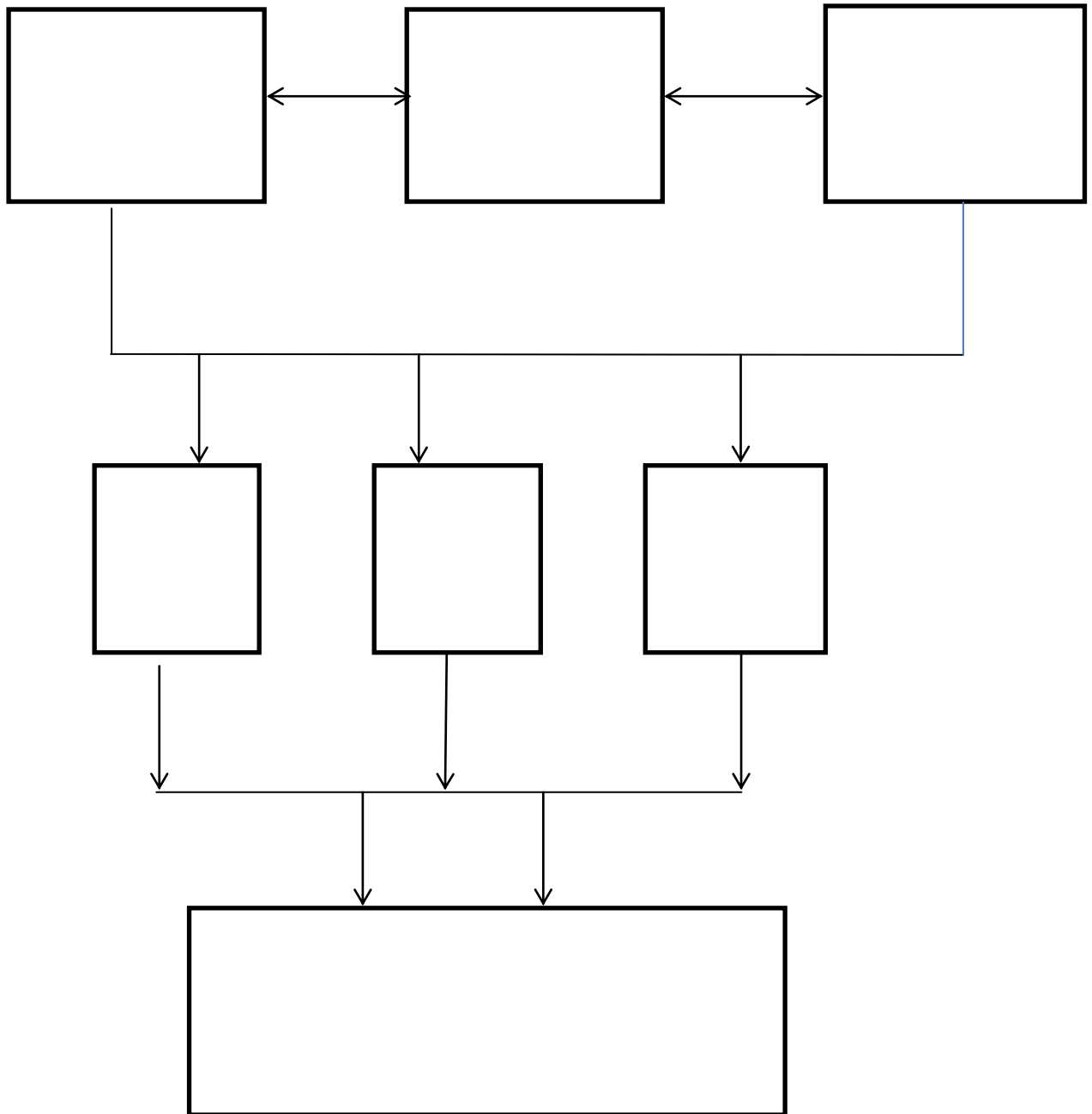
With this form of fisheries, the individual receives all of the economic benefits accruing from the fisheries, while the resulting stock depletion is shared among all resource users. This eventually results in the tragedy of the commons. The consequence of such a system is that fishermen will continue to enter the fishery sector as long as revenues minus costs remain above zero, until ultimately the net revenue of the entire fleet is zero (the bionomic equilibrium). At this equilibrium, the resource is depleted as far as economics will allow and fishermen will move to alternative fisheries, resulting in the sequential depletion of fish stocks (Aheto et. al., 2011).

1.6 Conceptual Framework

This conceptual framework looks at the relationship between Institutions, Policies and Market forces that have led to the emergence of plastic pollution leading to debris of such kind in the marine environment. This framework helps to identify the loop holes in the activities of these organisations that have brought about the issue of plastic marine debris.

The framework was constructed by the author, looking into the activities of institutions (formal and informal), Policies and market forces, which have interplayed to cause some form of pressure in the fishing industry.

Figure 1.1 Conceptual framework showing the effects of pollution on inshore marine activities



Source: Author's Own Construct, 2015.

1.6.1 Institutions

An institution is an organisation founded for a particular purpose such as educational, religious etc. Institutions can also mean an established law or practise. In Ghana, several institutions are required to research, formulate and co-ordinate all the activities in the fisheries sector of the country. An example is the fisheries commission founded under the Fisheries Act 2002 (Act 625). The commission is mandated to regulate and manage the utilization of the fisheries resources of Ghana and to coordinate the policies in relation to them (Fisheries Act, 2002). In addition, the commission is tasked with the following functions

- I. Prepare and keep under continual review, plans for the management and development of fisheries in waters under the jurisdiction of Ghana.
- II. Establish priorities for the utilization of fishery resources which will provide the greatest benefit to the country.
- III. Ensure the proper conservation of the fishery resources through the prevention of overfishing.
- IV. Strive to minimise as far as practicable, fishery gear conflict among users.
- V. Ensure monitoring, control and surveillance of fishery waters.
- VI. Promote co-operation among local fishermen and advance development of artisanal fishing.
- VII. Promote sub regional, regional and international co-operation in fisheries management.
- VIII. Carry out research and survey work for the assessment of stock of the fisheries resources.

- IX. Correlate fisheries with other water uses and environmental protection particularly with respect to the fish resources and food chain in the rivers, lagoons, lakes and the continental shelf along the coast.
- X. Hear and determine complaints from persons aggrieved in respect of matters arising from or related to fishing activities and the fishing industry.
- XI. In consultation with the competent authority, establish requirement for manning fishing vessels and boats, safety for crew and vessels for fishing gears in use to avoid damage by other vessels.
- XII. Establish standards for fish quality, weight and the basis for fish pricing in consultation with any other agency that has responsibility for fish quality.
- XIII. Make recommendations to the minister on grant of licenses of fishing.
- XIV. Perform any other function conferred on it under this Act or any other enactment in collaboration with District Assemblies with fishing communities to ensure enforcement of the fisheries laws including bye-laws made by the relevant District Assembly.

Despite these functions stated in the fisheries Act, the commission is reported to be faced with challenges including funds, qualified personnel and logistics among others.

However, according to Ghana Shared Growth and Development Agenda GSGDA, 2010-2013, fisheries sector made strategies to identify and strengthen intra – sectorial and inter-ministerial coordination through joint planning among stakeholders to ensure the development of the sector.

In dealing with institutions in charge of fisheries resources in Ghana, the informal/unofficial institutions cannot be overlooked. Fishing groups, ethnic groups etc. play a major role in fishing activities. In each landing site, there are set of rules governing the activities at the particular point. In the case of Elmina, the indigenes have set up rules which governs their activities, these rules include

- I. No fishing on Tuesdays.
- II. No fighting, cursing etc. at the landing sites.
- III. No Child Labour at the landing site

However, it was very clear that these local rules were not being adhered to. On one of my visits to the landing site on a Tuesday afternoon, most of the fishers were preparing their canoes to set sail. On questioning one of the fishermen, he revealed that, per the revised rules, fishing was now permitted on Tuesdays, but only in the late afternoon. Clearly, this goes to show that local institutions are no longer holding. The fisheries officer of Elmina, clearly stated that, the uncooperative nature of fishermen to lay down rules and regulations have led to some of the problems being experienced in the fisheries sector. Therefore, a component of this conceptual framework looks at the role of the institutions, including their shortcomings towards the downward trend in fish caught in recent times.

1.6.2 Policies

The fisheries Act 625 of 2002 spells out the rules governing the activities of fishers in Ghana. The law provides for

- I. Regulations and management of fisheries.
- II. Development of fishing industry.
- III. Sustainable exploitation of the fishery resources.

From these broad categories, the fisheries regulations talks about the following:

- I. License for canoes and qualification for licence (Regulation 27)
- II. Establishment of zones and prohibition of fishing inside zones (section 81)
- III. Destruction of fishing gears of artisanal fishermen within the IEZ (Section 81)
- IV. Submerged stationary fishing gear (Section 86)
- V. Prohibited fishing methods (Section 88)
- VI. Protection of gravid and juvenile lobsters, crustacean and juvenile fish (Section 89)
- VII. Fishing for marine mammals(Section 90, R17)
- VIII. Fisheries Impact Assessment (Section 93)

Establishment and functions of the monitoring, control and surveillance and enforcement unit (Section 93)

- I. Authorized officers (Section 95)
- II. Policing and other powers of authorized officers (Section 96)
- III. Possession of prohibited fishing gear (section 135)

Under these regulations, both the fishers and fishery resources are protected. But why are fishermen refusing to follow these regulations intended to ensure their safety and safeguard their source of livelihood. From the report of the Coastal and fisheries Governance, fishermen flout the rules because

- I. There is no enforcement of the law and regulation.
- II. They act according to the canoe owner/net owner's instructions even if it contravenes the law. If one decides to do what is right but goes contrary to the owner's instruction, that person is sacked.

Aside these formal policies set by the government to govern fisheries resources, local policies also exist. It was revealed in the above discussions that fishermen flout these policies too. This section of the conceptual framework looks at policies in the fisheries sector, and whether it has contributed to the current trends identified.

1.6.3 Market Forces

The concept of a market involves the whole relationship between demand and supply. Thus, it represents what consumers want and can pay for (demand) and what producers are willing to supply at different prices (supply). Market forces are the effects of aggregate supply and demand in a market environment on the prices of goods and services. It causes price to increase when supply decreases or demand increases, and price to fall when demand decreases and supply increases. In Ghana, determining the price of fish is one of the many responsibilities of the fisheries commission. However, due to some challenges faced by the commission it has failed in performing this task. Therefore, locally, the price of fish is according to its season, that is lean season and the bumper season.

Fish is more expensive during the lean season especially from January to March, while it is cheapest in the months of August, September and October which is the bumper season. During the lean season, fishermen use many unauthorized methods of fishing to increase catch and make higher incomes since the demand for fish is high due to seasonal scarcity. This leads to overfishing.

On the international scene, National Marine Fisheries Service (NMFS) a line office of NOAA in 2013 identified 10 countries worldwide involved in illegal, unreported and unregulated fishing (IUU) in which Ghana was a part. The IUU fishing activities may occur or affect all types of fishing ranging from small scale to industrial, shipment,

processing, landing, and sale of IUU fishes. These activities amount to accruing wealth through illegal business. The demand for fishes leads to the involvement of IUU which is nationally and globally undesiring (NOAA, 2013).

Harvesting of corals comes about as a result of sea floor dredging by pair trawlers. Though these corals have medicinal properties, the chief fisheries officer of KEEA, lamented that these corals harvested are abandoned at the Tema fishing port. Corals serve as home to fishes, so when they are removed, it displaces fishes and cause distortions to the natural habitats of fishes.

Breakdown in policies, rules and regulation enforcement, institutional breakdown and market forces have led to the indiscriminate disposal of waste in and around beaches. Also, the use of the beaches as places of convenience has had some effects on the general activity of fishing. The current issue of plastic waste pollution on our beaches is a vivid example of the break down in our governing systems. This section of the conceptual framework looks at waste, especially that of plastic. Have these wastes contributed to the decline in the volume of fish caught recorded in recent times?

In a nut shell, this research will analyse the current trends in the fishing output in the inshore fishing with insights from Elmina fishing coastline.

1.7 Research Methodology

The study made use of the Concurrent Triangulations Strategy, which is when both quantitative and qualitative methods are used at the same time in an attempt to confirm, cross-validate, or corroborate findings within a single study. Mixed Method is known to provide a wider and more convincing understanding of the research problem than the traditional quantitative and qualitative approach. Also, it can be said that, quantitative data can cross-validate the qualitative data, while the reverse is true

around a common reference (Tashakkori and Teddlie 2003; Fitzpatrick and Boulton, 1994 as cited by Teye, 2012). However, this research was more skewed to the qualitative nature than the quantitative nature. Johnson and Onwuegbuzie (2004) summarized five importance of using mixed methods in a research. The five importance are stated thus:

- I. It is used for seeking convergence and corroboration of results from different methods.
- II. It is used for complementarity.
- III. It is used for initiation that is discovering contradictions that can lead to a reformation of the research problem.
- IV. It is used for development of methods that is using the finding from one method to help improve the other method.
- V. It is used for the purpose of expansion, which is expanding the breadth of the research by using different methods to investigate different components of the research problem.

This research intends to make a contribution to the global research on plastic marine debris and its effects of marine lives, in this case fishes. Thus, it will be wise to get a deeper understanding of what is happening in the fishing industry. To this end therefore, a mixed method strategy (triangulation) than a pure qualitative or quantitative strategy is deemed more appropriate for this study. This method is necessary for this work because most of the findings from the fisher folks are narratives from their experiences and perceptions, thus having a quantitative finding from records from fisheries departments will help validate the qualitative findings from the fisher folks. Triangulation as used in this research involves the use of

multiple methods and data sources in order to strengthen the interpretation and conclusions that will be drawn from this research (Teye, 2012; Bryman, 2006).

1.7.1 Research Design

The study adopted the case study approach. This approach entailed detailed and intensive analyses of a case under study, in this case, plastics pollution in the marine environment. This allowed me to conduct research into the complexity and peculiar nature of the Research problem.

1.7.2 Target Population

The target population for the study included fisher folks with more than 5 years' working experience in the fisheries sector in Elmina selected from semi- trawlers, dugout canoes, those who fish in the lagoon and finally those who use line and sinker along the shore. The fishermen were grouped into these categories because the fishing area had all these fishermen working there, therefore to get a comprehensive understanding of the effects of plastic waste on fishing activities that goes on in the fishing area, all these categories of fishermen needed to be included in the study.

The next target group were the officials of Ministry of Fisheries and Aquaculture in the KEEA Municipality. This group served as the experts to give information to validate the narratives from the fisher folks. A marine biologist at University of Ghana fisheries and marine science department was also contacted

Waste Managers (Zoil, GH.) which is organisation in charge of cleaning the fishing area. However, because of the closing down of GYEEDA, the Zoil cleaners could not be contacted. Therefore, this research could not elicit their views on the problem under investigation.

1.7.3 Data Collection Methods

1.7.3.1 Sampling size and design for Questionnaire Survey

The non-probability sampling technique, particularly the purposive sampling technique was used for this study. This sampling technique also known as judgmental sampling is a procedure whereby the researcher selects sample elements on the basis of judgement derived from experience. Respondents are selected on the basis of the nature of information being sought (Teye, 2012). Sampling units or respondents for this study were selected based on the knowledge possessed on the subject matter as fishermen with more than five years' experience in the field of fishing.

To arrive at the sample size, I asked for the total number of fishermen at the Elmina Fish landing site. However, I must add that, the fisheries department at the KEEA Municipal did not have in their records, the total number of fishermen that land their catches on the harbour, thus, the number of fishermen working within the coastline were unknown due to poor record keeping. Therefore, the head of fisheries department in the KEEA Municipality, one Julius estimated that the Fishing Harbour receives an average of 800 fishermen in a day. Based on this figure, the sample size for the study was calculated.

I used Cochran's sample size calculation to determine the sample size of the respondents. (For full calculation of the sample size, please see Appendix VII) Because of time and resource constraint, the sample size was reduced to 150. In selecting respondents from each group of fishermen, the purposive sampling technique was employed, respondents were selected from each group based on a criterion of five years working experience in the field of operation.

1.7.4 Qualitative research methods

Qualitative research is basically conducted to find people's meanings, perception, description and understanding of a social phenomenon (Boeje, 2010). To better understand the findings of the quantitative survey, the following qualitative methods were adopted for the study

1.7.4.1 In depth interview

According to Boeje (2010), "an interview is a form of conversation in which one person restricts himself to posing questions concerning behaviours, ideas, attitudes and experiences with regard to social phenomena to one or more participants or interviewee who limit themselves to providing answers to these questions" (Boeje, 2010 pg. 61).

Matthews (2005) stated that, interviews are not used to elicit answers to specific questions, instead, it makes it possible for participants to express their understanding about the subject matter in their own words (cited by Boeje, 2010). This tool (in depth interview) allowed me to get an in-depth response to the problem. Three in depth interviews were conducted basically for the key informants who were related to the problem under study. Three in depth interviews were conducted for the head of Fisheries department in the KEEA Municipality, a Marine Biologist from the Department of Fisheries and Marine Sciences of the University of Ghana and lastly the Head of fishermen in the Elmina Fishing Harbour ("apofofhen") because of the vast knowledge they had on the subject matter. The main idea was to gather information that may have been ignored by the researcher from the vast knowledge the respondents had on the issue being discussed. Therefore selection was basically purposive.

1.7.4.2 Focus Group Discussion

This is a qualitative interview with a number of participants at a time, mostly ranging from 8 - 10 members. Focus groups are organised to promote group interaction since it serves as a social platform for the group to better explain the research problem in a social setting.

Five Focus group discussions were conducted. Two for fishermen from different canoes, based on canoe sizes and group and three were conducted for fish mongers. For the fishermen, the criteria for selection were based on minimum of 5 years working experience, members from different canoe groups, some members from bigger vessels were selected and joined with members of smaller canoes and fishermen who showed interest in the problem being discussed generally. In all two focus groups comprising of ten members in each group were conducted. Threats posed by plastic wastes to the fishing activities were discussed.

Fishmongers mostly sat according to the type of fish they sold, therefore, selection was based on type of fish sold, ethnic groups they belonged to and finally those who showed interest in the problem being discussed. Three focus group discussions were held for the fish mongers, the first group had eleven members, second group was made up of nine members and the final group had eight members.

1.7.5 Secondary Data Sources

The research made use of the vast array of information in the internet. Other Journals were also reviewed. Print as well as online books were also used.

1.7.6 Methods of Analysis

The quantitative section was analysed using SPSS version 20.0, graphs, tables and charts were generated to have a pictorial projection of the various variables. The qualitative data was analysed manually.

1.8 Limitations to the study

The following factors hindered the smooth completion of the study

- I. The closure of the Zoil cleaners which was a subset of the GYEEDA (the Ghana Youth Employment and Entrepreneurial Development Agency) due to the termination of the GYEEDA project, hindered the smooth completion of the study. This unfortunate development thwarted the researcher's desire to interview some of the workers on their observation on the type of litter they clean from the beaches
- II. Lack of logistics at the fisheries departments both at The KEEA Municipality and The Cape Coast Metropolis served as a hindrance to the smooth completion of the research. There were no office computers in any of the offices I visited, and no data whatsoever were available on the daily activities of the fishing Harbour.

CHAPTER TWO

FISHING IN GHANA

2.1 Introduction

This chapter talks about fishing activities in Ghana, according to Ghana's Fisheries Aquaculture Sector Development Plan (2011 to 2016), fisheries generate up to one billion dollars each year. Ten percent of Ghana's land surface is covered with water, which provides a great resource for the fishing industry in the country (Antwi-Asare and Abbey, 2011). With a marine coastline of five hundred and fifty kilometres, the fishing industry provides a major form of sustainable livelihood and poverty reduction strategy for several households and communities in the country (BOG, 2008). Fishing in Ghana plays a significant role in contributing to national economic development in the spheres of employment, livelihood support, poverty reduction, food security, foreign exchange earnings and resource sustainability (MOFA, 2013).

The Ghana Shared Growth and Development Agenda indicates that the fisheries sub sector provides the country's fish need, a rich and much needed cheap source of protein that enhances Ghana's food security (National Development, Planning Commission 2010). The per capita fish consumption in Ghana is 40kg/ annum, which is higher than that of the world's average. It is also believed that the fishing industry employs about 10% of the country's total population, spread out in the various components of the industry (Gordon et. al., 2011).

The marine fisheries sector in the country is grouped into three major subsectors. These are the small scale or artisanal, semi-industrial or inshore, and industrial/tuna subsectors (FAO, 2016). The artisanal or small scale fishery sub sector is mainly identified with the use of several simple fishing gears, which include purse seine nets,

beach seine net, set nets, drifting gillnets, hook and line, and simple dugout canoes (FAO, 2016). In spite of this, the small scale or the artisanal subsector is the most vibrant and important contributor to Ghana's landed weight of fish as it accounts for approximately 70 to 80% of the total national marine fish production (Quatey, 1997; Amador et al., 2006 as cited by "Ghana", 2007).

The semi-industrial or inshore subsector mostly uses built wooden vessels fitted with inboard engines mostly outboard motors and may have lengths ranging between eight and thirty seven meters (MOFA, 2013). The vessels can also be used for artisanal fisheries as well (FAO, 2016) specifies that:

They operate as purse seiners during the upwelling periods and switch to bottom trawling for the rest of the year. The purse seiners target the sardinellas, chub mackerel and other Carangidae species. They fish in the same coastal waters as the artisanal fleet during the upwelling seasons. The small-sized trawlers target gery triggerfish (*Balistes capriscus*), while the others exploit seabreams (mainly *Pagellus bellottii*, *Pagrus caeruleostictus* and *Dentex canariensis*), snappers (*Lutjanus fulgens* and *L. gorensis*), red mullet (*Pseudupeneus prayensis*), cassava fish (*Pseudolithus senegalensis*), burrito (*Brachydeuterus auritus*) and groupers (*Epinephelus aeneus*) (FAO, 2016).

The industrial subsector on the other hand is currently operated from Tema and Takoradi fishing Harbours where the water is deep. The trawlers used normally range between 35 and 43 meters in length. Ghana has a long and rich tradition of fishing in the West African sub region (BOG, 2008; Kwadjosse, 2009).

In order to better and fully understand the developmental stages of fisheries governance in Ghana, it is important to identify a milestone to serve as a standard for

indicating progress. For this purpose, UNCLOS was selected because it represents an important milestone in international fisheries law, as well as a source of various important instruments that have served to shape the way fisheries is governed worldwide. Hence, this section examines fisheries governance in Ghana by examining legislation in two eras: the pre-UNCLOS and the post-UNCLOS eras.

2.2 What is the UNCLOS?

The United Nations Convention on the Laws of the Sea (UNCLOS) as explained by the Oceans & Laws of the Sea of the United Nations (2013) lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the ocean and their resources. It also enshrines the notion that all problems of ocean space are closely related and need to be addressed as a whole (Oceans & Laws of the Sea of the United Nations, 2013). However, before the UNCLOS, all oceans of the world had been subjected to the freedom of the sea doctrine in the 17th century (Oceans & Laws of the Sea of the United Nations, 2012). The doctrine of the freedom of sea allowed countries to have rights over a narrow stretch of land adjoining its coastlines, and the larger oceans were free for the use of everyone, which resulted in misuse of the ocean resources. Nearly after a century, the canon shot rule followed, this set jurisdiction over three nautical miles of the ocean to the coastal states. This three nautical mile ownership became widely accepted (Hollis, 2013).

However, advances in technology, increased use of powerful ships and pressure on fish stocks, as well as pollutions from travelling ships. More so, the exploitation and its resultant tensions over sea resources such as oil, precious minerals and other valuable seabed and surface resources gradually increased conflicts between states. However, disputes over who owns the sea started many centuries ago when in 1494,

two years after Christopher Columbus discovered the Americas, the two super powers of the oceans at that time, that is Spain and Portugal had a dispute over who owned and controlled which part of the world's oceans. Thus, to resolve that dispute, the then Pope drew a line along the Atlantic Ocean and Spain owned everything to the west of the line while Portugal owned everything to the east of the line. In similar vein, the Ambassador of Malta, Arvid Pardo in his speech delivered on the 1st of November to the UN, spoke of the super-Power rivalry that was spreading to the oceans, and of the conflicting legal claims and their implications for a stable order concerning the rich potential that lay on the seabed (Oceans & Laws of the Sea of the United Nations, 2012).

Thus, the Exclusive Economic Zone (EEZ), which is one of the features of the convention, gives a legal right to coastal states to exploit, develop, manage and conserve all resources found in the waters, in the ocean floor and the subsoil extending 200 miles from its shores. Though the UNCLOS has given coastal states rights over the two hundred nautical miles of the sea adjoining their coastlines, which has helped in the development of such states, the Convention has had some shortcomings.

2.2.1 Pre- UNCLOS Laws in Ghana

The Pre-UNCLOS laws included Fisheries Regulations LI 364 of 1964; NRCD 87 of 1972 (Fisheries Decree 1972); Fisheries (Amendment) Regulations 1977; and AFRD 30 of 1979 and the accompanying regulation, Fisheries Regulation 1979 LI 1235 (Kwadjosse, 2009). An examination of the pre-UNCLOS legislation reveals that this period was basically dedicated to the building of fishing craft without any means of conservation, because the mind-set of the people was that fish resources were infinite (Kwadjosse, 2009).

2.2.2 Post- UNCLOS Laws in Ghana

The post UNICLOS laws were much concerned with the sustainable use of fisheries resources. They included the Fisheries Regulation 1984 LI 1294; Maritime Zones (Delimitation) Law, 1986; PNDC Law 256 of 1991; Fisheries Commission Act of 1993; and Fisheries Act 625 of 2002. These legislations were tilted towards an awareness of the need for conservation, after the passing of the Maritime Zones (Delimitation) Law, which led to the enforcement of the EEZ.

The PNDC Law 256 of 1991 was passed to commence the conservation of fisheries resources. Efforts were made to license all vessels engaged in fishing. This was a medium used to check the exploitation of the fisheries resources. The Law was to manage or conserve the fishery resources by controlling access through licensing, establishment of fishing zones and restrictions on fishing gear to be used within and without these zones and in the industry as a whole. It was also established as a means of Monitoring, Control and Surveillance.

The Fisheries Commission Act of 1993 directly followed the PNDC Law 256 of 1991, this Act was established to provide a regulation for the management and utilization of the fishery resources in Ghana, with its sole responsibility of regulating and managing the fisheries resources and co-ordinating policies in relation to them. The Commission had duties, which included fostering international co-operation and collaboration in fisheries for the benefit of the nation within the framework of Ghana's foreign policy and international commitments, and advising the sector Minister on the importation of fish to supplement the local fish production. This law is considered as a major step in the efforts to manage the fisheries resources (Kwadjosse, 2009).

The next regulation was the Ghana Fisheries ACT 625 of 2002. This regulation is what is used currently to govern the fisheries sector. According to Kwadjosse, its main purpose is to Amend, consolidate and attempt to streamline all the existing fisheries laws to address chronic and emerging issues whilst conforming to national and international fishery resource development and management strategies. By its very definition, the Act sets out to integrate international fisheries agreements into Ghanaian national legislation. It emphasizes the importance of the Fisheries Commission by strengthening the legislation establishing the Commission' (Kwadjosse, 2009: 24).

2.3 Contemporary Fishing Activities in Ghana

The coastline of Ghana measuring about five hundred and fifty km long gives a combining scene of a sandy beach dotted with rocky shores, estuaries and lagoons which serve as breeding grounds for many marine fish and crustaceans (Kwadjosse, 2009). The fishing industry in Ghana is mostly carried on in the marine and freshwater zones, with artisanal fisheries being the most important contributor of landed marine fisheries, while the Volta Lake serves as the largest lake for fresh water fish landing (BOG, 2008). There are a wide variety of fish species in Ghana and these can be grouped under Small Pelagic Species including (*Clupeidae [sardinellas]* and *Engraulidae [anchovies]*), Large Pelagic Species (*Scombroidae [tuna-like fishes]*), and Demersal Species of the families Sparidae, *Lutjanidae*, *Mullidae*, *Pomadasyidae*, *Serranidae*, *Polynidae* and *Penaedae* ("Ghana", as cited by FAO, 2007).

Just like most developing countries around the world, Ghana's fishing industry is not free from challenges. Most of the challenges stem from mismanagement at the policy enacting level and at the grassroots by the fishers themselves. Some of the challenges include improper fishing contracts with foreign investors, over-exploitation of

fisheries resources, high fishing pressure, high incidence of illegal fishing, open access for artisanal fisheries, low economic returns, low value addition, underdeveloped aquaculture and lastly, high demand for fish (Mills et al., 2012). Again, oil exploration and its effect on fishes cannot be downplayed. Recent incidence of dead whales being washed ashore the beaches of Ghana is a clear indication of the threat posed to the fishing industry by the oil exploitation (Amarfio, 2010).

To promote the fishing industry, policy objectives enacted by the GSGDA under this area include: promoting the general principles of responsible fishery with emphasis on the enforcement and compliance with maximum allowable fish catches that will enable the resources to renew themselves; promoting private investment in aquaculture; developing aquaculture infrastructure including fish hatcheries; and promoting the improvement in fish husbandry practices and health management.

The key indicators selected to monitor progress towards the attainment of these policies objectives include: Fisheries contribution to Ghanaians protein intake; total fish supply (metric tonnes); quantity of fish produced by hectare of pond per year (tonnes/ha/yr.); total surface water area under fish farming (excluding cages) ha.

2.4 Inshore fishing Activities in Ghana

The term “inshore”, according to the Concise Oxford dictionary, is an adjective, which means at sea but operating at the coast. Again, according to NOAA’s fish glossary (2006), inshore waters refer to a shallower part of the continental shelf. Antwi-Asare and Abbey (2011) added that inshore refers to the portion of the sea where vessels measuring between 9 and 12 meters long operate both as trawlers and purse seines operators in Ghana.

2.4.1 The trends in fish output over the last decade (2000-2010)

To understand the trends in fishing outputs in contemporary times, a decade's production was analysed to give a clearer picture of what is happening in the fishing industry. Trends analysis serves as a platform to provide relevant information for assessment, programme planning, programme evaluation and policy development activities (Rosenberg, 1997). The inshore fishing industry in Ghana comprises of the purse seine and the small semi-industrial trawlers, which accounted for 1.86%, 2.08% and 1.96% of all fishing fleets in the country in the years 2000, 2005 and 2009 respectively (Fisheries commission as cited by Antwi-Asare & Abbey, 2011). Although inshore fishing provides the smallest quota to the gross national marine captured fisheries, its contribution to the overall fish output and national development cannot be over looked. It is estimated that it contributes 2.8% to the total marine captured fisheries in Ghana (Antwi-Asare & Abbey, 2011). Table 2.0 illustrates the output of inshore fisheries over the last decade (2000-2010).

Table 2.1 The output of Inshore Marine fisheries in Ghana from 2000 – 2010

Year	Output in metric tonnes
2000	380,000
2001	366,000
2002	290,000
2003	331,412
2004	352,405
2005	322,790
2006	315,530
2007	293,398
2008	343,967
2009	318,300
2010	319,331

Source: Ministry of Food and Agriculture, 2008

2.5 Benefits Ghana derives from the fishing industry

2.5.1 Fishing as a source of livelihood

According to the Population and Housing Census (2010), 41.5% of Ghanaians are involved in agriculture, forestry and the fisheries industry. Out of the 41.5%, 45.5% are males while 37.7% are females. The fishing industry serves as a source of employment for both rural and urban populace especially those living by water resources. It has been estimated that about 10% of the population are employed in the fishing industry, with women being the key players in post-harvest activities.

The post-harvest sector alone serves as a form of livelihood not only for fishermen but women who range from fish processors and traders to those employed in the various stages of the post-harvest process. These include those employed as labourers who

pack, store, load, unload and transport fresh and processed fisheries products on foot or by trolley for short distances. It also includes people providing transport and storage services, export processors, cannery workers, fishmeal manufacturers and those engaged in the production of packaging for different types of products.

Again, another group of people who depend primarily on the fishing industry as a source of livelihood are the boat builders, mechanics, timber and fuel wood providers, food vendors, drinking bar operators and many other supporting activities. The livelihood opportunities provided by the post-harvest sector range from full-time employment to seasonal, occasional involvement in the different stages of the post-harvest chain (BOG, 2008).

2.5.2 Fishing as a Source of Foreign Exchange, Food and Nutrition

Fishery and fishery products have steadily become the country's most key non-traditional export, recording for over 50 per cent of earnings from non-traditional export (BOG, 2008). In another report for Ghana National Commission for UNESCO, it was recorded that the fishery sector provides the country with foreign exchange through the country's non-traditional export commodities and make up 20% of such ("Ghana", 2007). Fish also provides its consumers with about 60% of animal protein intake. Ghanaians have a per capita fish consumption estimated to be around 40kg, which is higher than the world's average of 13kg.

2.6 Common Property Regimes in Fisheries Resources Management

Stewart (2004) defines "right" to be the capacity of the claimants to call upon others without such claims, to acknowledge their duty to honour the claim without any violation of such a duty sanctioned by the state or by an authority. It is a capacity of controlling with the assent and assistance of the state the actions of others (Stewart

2004). In common property regimes, local community or communities, instead of an individual hold the exclusive right to harvest fish in a particular geographical area. These rights come in diverse forms such as right to harvest particular species of fish stock in a particular area and again, the right to use fishing vessels or gears of a particular kind in exploiting the resource.

In terms of ownership, the state retains the power to devise regulations while the local community within which the resource is located enacts the local rules where individuals are expected to obey in the exploitation of the resources. When commitment from either the state or the local community towards the sustainable exploitation of the fisheries resources is not maintained, leading to lack of enforcement of rules by both parties, then the resource will be opened to all as an open access fisheries.

2.7 Evidence of the presence of plastic waste in the marine environment of Ghana

The production of plastic products soared after the Second World War. The awareness of the presence of plastics in the marine environment became widespread after a Norwegian explorer, Thor Heyerdahl crossed the Atlantic Ocean in 1970, and reported to the United Nations Conference on the Human Environment (held in Stockholm in 1972) about the quantity of filth that had engulfed the sea. Since that time, a swell of reports, government actions and specific studies have revealed that the marine environment is gathering a large volume of human-originated debris. Estimates of the volume of waste vary, but some reports indicate that up to “*300,000 items of litter and waste can be found per sq. kilometre of ocean surface*” (National Research Council [NRC], 2008 as cited by Butterworth et al., 2012).

Worldwide, as many as 8 million items of litter may enter into the world seas on a daily basis (Benton, 1995 as cited by Tsagbey et al., 2009). Nunoo and Quayson (2003) estimates that the weight of rubbish that enters the sea is three times bigger than the weight of fish that is caught from the world's oceans annually.

In Ghana, a research on the beach litter deposited at the two tourist beaches in Accra by Tsagbey et al. (2009:7) revealed that the beach litter consisted of the "32 individual items of which six are on the list of the world's "dirty dozen". These litters are believed to originate from different sources such as tourists litter, household litter and other land-based sources. Plastic materials ranked top in all litter collected at the study area, which was in line with the discovery made in several places around the world (Jeftic et al, 2006; Topping et al., 1997; Hoagland & Kitte-Powell, 1997; Nunoo & Quayson, 2003). Again, the findings of Tsagbey et al. (2009) also falls in line with the findings of Nunoo and Quayson, (2003), which revealed that plastic waste rank top in all beach litter found on the Ghanaian beaches. Tsagbey et al. indicated that:

In the study, plastics formed about 66% at Korle and 53% at La of the total number of litter found, which is not significantly different from that of the beach litter survey of Sakumono Beach and Centre for National Culture Beach by Nunoo and Quayson (2003), which recorded between 46% and 58% (Tsagbey et al., 2009:1).

These litter left at the beach is carried into the sea through run offs and the action of the wind. Again, fishermen use plastic carrier bags to keep food items such as "gari" and sachets of water used at sea. All these plastics are dropped into the sea after their contents are emptied which has a potential of causing harm. Another interesting aspect about the use of polythene bags by fishermen is the fact that, the plastic bags are used

to share fish caught among them. Therefore, after sale, these plastic bags are left unattended to which leads to it entering into the marine environment.

2.8 Conclusion

The Ghanaian fishing industry has gone through phases of development to what is currently being practiced. The UNCLOS periods in Ghana mark important milestones in the historical developments of fisheries management in Ghana. The policies that accompanied the UNCLOS have helped shape the fishing industry in contemporary times.

Ghana's fishing outputs have recorded fluctuations over the years and several reasons have been given for it. Undoubtedly, the fluctuations recorded have not stopped the fishing industry from its numerous benefits to the Ghanaian economy. Mention can be made of employment, foreign exchange earnings, source of food and nutrition to the people of Ghana etc.

CHAPTER THREE

THE ELMINA COAST

3.1 Introduction

This chapter looks at the history of the fishing industry in Elmina in the KEEA Municipality. This historical account of the industry will be captured as well as a discussion on the profile of Elmina, looking at its ecological background.

3.2 The KEEA Municipality

Komenda-Edina-Eguafo-Abirem Municipal area is one of the Twenty (20) Metropolitan, Municipalities and District Assemblies in the Central Region of Ghana. The Municipal Assembly has Elmina as its administrative capital. It is bounded on the south by the Atlantic Ocean (Gulf of Guinea), on the east by the Cape Coast Metropolitan Area, on the north by the Twifo-Hemang-Lower-Denkyira District and on the west by the Mpohor-Wassa East and Shama Districts. It is located between longitude 10° 20' West and 10° 40' West and latitude 5° 05' North and 5° 15' North. The Municipality covers an area of 452.5 square kilometres (from the assembly portal). The municipality has a population density of 3.9.8 person per square kilometre.

3.3 Elmina

Fishing activities in Elmina date as far back as the 1400's where fishing activities were basically for domestic purposes and to feed slaves (Aheto et al., 2012). The Elmina fishing harbour is situated along the Benya River and is mostly used by inshore vessels and canoes. Elmina became an important town in the 1470's, when the Portuguese explorers discovered the rich gold land on the shores of the West African

coast. King Alfonso named the town previously known as “Anomansa” as el mina: the mine (The Elmina 2015 Strategy).

Elmina is basically a cosmopolitan area because it receives migrants from other places who migrate in search of job opportunities in the fisheries industry (Koranteng, 2012). This important historic town boasts of the third largest fishing harbour in Ghana, and the most important inshore fishing harbour as well (Aheto et al. 2012e). Aside her fishing potentials, it also serves as an important ancient city, which is popular for its role in the famous slave trade and served as home to the largest slave castle in the country (Asiedu-Addo, 2013).

The Elmina coastline also known as “atekyem” (muddy place) was re-established in January 1986 by a group of young advocates in Elmina called the Zion Mobisquad (Enninful, 2009). The fishing area was built to facilitate the fishing industry in the community to improve the lives of the people. After the establishment of a proper fishing ground, migrants from other fishing communities around the country moved in, to join the fisher folks in the Elmina community. This injected life into the once dead community after the abandonment of the Portuguese, the Dutch and finally the bombardment of the town into ashes by the British in June 1873 (Enninful, 2009). Today, Elmina serves as a vibrant inshore fishing port for many vessels of varying shapes and sizes that operate in the country. According to KEEA’s report in 2006, many programs have been put in place to help boost the sector. Amongst them are the fishing continuation school for first cycle school graduates and the establishment of the Paul Isert Centre to update fishermen on the latest technology in the fishing industry.

The fishing sector in Elmina mostly experiences two fishing seasons namely the peak season and the off peak season. The peak season mostly spans from July to September, this season is characterised by bumper catches and some fishermen even go to sea on Tuesdays, which is customarily a resting day for the sea and the fishermen. The off-season, which normally spans between January and June is also characterised by lower and normal catches (Koranteng, 2012). During this period, most fisher folks migrate to other fishing harbours in search of higher catch. The fish caught in the Elmina harbour alone contributes about 15% of the total fish production in Ghana (Aheto et al., 2012), which is a major contributor to the Nation's fisheries GDP (Asiedu-Addo, 2013). The Elmina strategy (2015), also reveals that about 75% of the total population of the town depend on fishing and its related activities as their source of livelihood.

3.3.1 Fishing activities in the Elmina coastline in the Colonial era

The people living along the coast of Ghana since time immemorial have always practised fishing. According to Pacheco Pereira, Elmina has always had an abundance of fish, which was the major food for the Negros (Odatei, 1991). It is believed that fishing activities existed before the arrival of the Europeans because the craft used were manufactured using local materials and local technology. The fishing crafts used were machetes and it was normally sixteen feet long and one and half feet wide. With the presence of the Portuguese in Elmina, the traditional socio- political activities in Elmina were strengthened. With trade in slaves, gold and ivory, the Elmina merchants became wealthy and powerful. It is recorded by Herstein (2014) that the basic indigenous activities in Elmina were cultivation, fishing and salt making which were for domestic sustenance.

3.3.2 The definition of Elmina Coastline

For the purpose of this thesis, Elmina coastline is defined to be the shoreline along the whole of Elmina Township including the harbour, and the many landing sites used by fishermen outside the harbour. This gives room for the fishers who do not normally use the harbour for their day-to-day activities.

3.4 Physical Characteristics of the Elmina Coastline

3.4.1 Drainage

Along the coastal zone are a series of lagoons and wetlands, which include the Benya, Brenu, Susu, Abrobi and Ankwanda lagoons. These lagoons support a vibrant salt industry. In between the hills are valleys with various streams, which drain into the coastal lagoons and the Atlantic Ocean. These streams include the 'Iture' and 'Ante' in the west and the 'Udu' and 'Suruwi' in the east (KEEA, 2006).

3.4.2 Vegetation

The vegetation found in the Elmina coastline varies according to the rainfall pattern. There is the coastal scrub and grassland type with scattered trees, which is mainly characterised by mangrove and palm fronds. The KEEA Municipality on which Elmina is, is generally humid with a 30 kilometre coastline which forms part of the littoral anomalous zone of Ghana and experiencing less rainfall than the interior (Statistical Service, 2014).

3.4.3 Population

Elmina is the fastest growing town in the KEEA and the most populated town in the municipality, mainly because it is the centre of an important economic activity, which is fishing. According to Aheto et al. (2012), Elmina's population is 32,819. Again, the

Castles, which are major tourist attraction sites in the town, receive about 100,000 tourists annually of which 50,000 are foreigners (Elmina Strategy, 2015).

3.4.4 Climate

Climate change affects fisheries in a number of ways. Firstly, rise in sea temperature has the potential of destroying coral reefs which serves as a source of food and home for some species of fish and also as a source of protection for various coastlines. Though the rise in the temperature of the sea may be seen to be an advantage to the growth of some fish species, the obvious disadvantages it has on total fish species is gross and the poor fishermen are left to build general adaptive capacity to the current trend of events. In Elmina, it was recorded that herrings which was mostly caught in July/ August were being harvested in October. Informal interviews with fishermen revealed that the fishermen attributed this change in harvest to the change in weather patterns. Although they did not have knowledge on the impacts of climate change on their fishing activities, they were able to determine that the changes in the seasons of fish harvesting seasons was due to changes in weather conditions. Again, Paintsil (2010) revealed that most of the fishermen could not predict seasons and times for the harvest of particular species of fish because of the change in weather conditions as a result of climate change.

3.4.5 Economic activities

Elmina does not boast of large industries but rather has small and medium scale enterprises located throughout the township and the municipality. These small and medium scale enterprises include boat making, oil extraction, barbering and hairdressing. Salt making is also an important aspect of the economy of Elmina. Elmina used to be the centre of trade (import and export) in the colonial era, but has lost its trade status in contemporary times (KEEA, 2006).

Now, Elmina serves as an important trade town for fish and salt. Elmina also hosts two of the UNESCO world Heritage protected sites: the castle of St. George d'Elmina and Fort Coenraadsburg on St. Jago Hill. These two sites receive over 100,000 tourists annually. The private informal sector employs 87% of the population of the municipality followed by 6.9% by the public sector. The Employees in the informal sector is made up of 28.3% males and 9.1% females (Statistical service, 2014).

Figure 3.1 Map of study Area showing Elmina fishing coastline



Source: GIS lab of the University Of Ghana, 2015.

3.5 Conclusion

Elmina is an ancient town that has seen many economic activities ranging from gold trade to slave trade in the pre-colonial and the colonial era. However, it still serves as an important trading centre for fish and salt. Fishing alone serves as an economic backbone of the town employing about 75% of the population of the township.

Tourism also serves an important economic activity to the people of Elmina and its environs. The two UNESCO world Heritage protected sites found in the town, together, brings an average of 100,000 tourists to the town annually, leading to a boom in economic activities.

CHAPTER FOUR

Contemporary Inshore Marine Fishing Activities in Elmina

4.1 Introduction

This chapter is divided into two sections; the first section discusses the socio demographic characteristics of respondents. This is to provide background information of respondents and also help in understanding subsequent sections of the analysis. The second section also seeks to find out the changes that have been recorded in the current output of fisher folks in the inshore marine fishing industry in Elmina and the causes of these changes. Before that however, a brief discussion will be held on fishing activities in Elmina in terms of output of the fishermen. KEEA's annual report on Agriculture in 2006, stated that fisheries output has been fluctuating in the fishing industry in Elmina in recent times (KEEA, 2006). Therefore, looking at the contemporary fishing activities in Elmina in recent times will help in analysing the effects plastic wastes/ pollution has on fishing activities in the Elmina coastline.

4.2 Demographic characteristics of Respondents

To achieve the set objectives, a total of 150 canoe fishermen operating in the Elmina coastline were sampled. The following sub-section presents some of the demographic characteristics of the sample as a prelude to the discussions on the dynamics of fishing activities in the study area.

4.2.1 The Sex of the respondents

The results of the sample survey (see Table 4.1) revealed the dominance of males in the fishing profession, as only one female was recorded to be part of a fishing crew on

a canoe. This can basically be attributed to the vigorous nature of fishing and the high risk involved. The study however revealed that, females played a major role in the post-harvest activities such as selling, processing into roasted fish, salted fish or dried fish, and lastly the preservation of fish.

4.2.2 The age structure of respondents

In terms of the age structure of the study respondents were within the age range of 20 to 25 years and 25 to 30 years, both accounting for 54 percent of the total respondents. This goes to explain that the fishing activity is a vigorous one that needs manual labour; hence able young men are better preferred. In addition, high dropout rate among the school going pupils in Elmina and its environs (Elmina Strategy, 2015) leaves them vulnerable without any form of employable trade. Therefore, the alternative work that uses very little skills but high manual abilities serves as a ready employment for the untrained, thereby increasing the number of young men in the fishing trade. A cross tabulation of respondents Sex and Age was conducted to examine the relative distribution of male population by age groups. It was clear from Table 4.1 that, a larger number of respondents involved in fishing were very youthful and belongs mostly to the school going age of 20 to 25 and 30 to 35 years, spend longer years in fishing (29.9%) and (26.30%) respectively. Older fishermen beyond 40 years spent longer years in the fishing activities. This implies that, as most young men join the fishing profession, the likelihood of remaining active until they get aged is high. The longer a fisherman stays at sea, the more experienced he becomes. Therefore men with experience are also needed to apply their rich experience in terms of difficulty at sea. Table 4.1 shows that, with a chi-square value of 136.084 and a P-value of 0.000 reveal a significant relationship between the age of fishermen and the length of years they spent in fishing.

Table 4.1 Socio - demographic characteristics of respondents

Socio-demographics	Category	Freq	%
Sex	Male	149	99.3
	Female	1	0.7
	Total	150	100
Age	20-25	41	27.3
	26-30	40	26.7
	31-35	9	6
	36-40	16	10.7
	40+	44	29.3
	Total	150	100.0
Years spent fishing	Less than 1 year	1	.7
	1-3	26	17.3
	4-6	24	16
	7-10	36	24.0
	10+	63	42.0
	Total	150	100.0
Ethnicity	Akan	115	76.7
	Efutu	3	2.0
	Other	10	6.7
	Ewe	22	14.7
	Total	150	100.0
	Level of Education	No education	45
Primary		73	48.7
JHS/Middle		22	14.7
Vocational/Tech		10	6.7
Total		150	100.0
Marital status	Single	27	18.0
	Married	67	44.6
	Living together	36	24.0
	Separated	20	13.3
	Divorced	10	6.7
	Total	150	100.0
Number of dependents	1	52	34.7
	2	38	25.3
	3	20	13.3
	4	9	6.0
	5	31	20.6
	Total	150	100.0

Source: Field Data, 2014.

4.2.3 Level of Education of Respondents

Table 4.1 further shows that most of the respondents (48.7 percent) had only primary education and 30 percent having no education. This goes to confirm the high dropout rate recorded in the Elmina. Lack of educational skills leave most people unemployed forcing them into the fishing sector. There were few (14.7%) who had J.H.S education and either dropped out due to financial problems or non-performance at the B.E.C.E level. The educational structure of the fishermen portrays the level of education within the Elmina coastal stretch, because the fishing industry alone employs about 70 percent of the people of Elmina and its environs. It can be inferred that the fishing industry per the data is made up of participants with very little education and this findings resonate with other observations (Elmina Strategy, 2015; Attah-Mills et al., 2004).

4.2.4 Marital status and number of dependents

Table 4.1 also shows that, majority of the respondents were married (44.6%), while many others were living together with women who are not their wives and had dependants to cater for ranging from one to five. Also, significant is 27 percent of respondents who indicated they were single with the remaining either separated (20%) or divorced (10%).

Table 4.2: Cross Tabulation on Age and Length of years in fishing of Respondents

Length of Years in fishing						
Age	< 1 year	1 to 3	4 to 6	7 to 10	10+	Total
20-25	0	78.80%	92.30%	16.70%	9.50%	29.90%
31-35	100%	25%	0	72.20%	4.80%	26.30%
36-40	0	4.20%	7.70%	5.60%	19%	11.70%
40+	0	0	0	5.60%	66.70%	32.10%

Source: Field Data (2014) $X^2 = 136.084$ $df = 12$ $P\text{-value} = 0.000$

4.3 Changes in the output of fishermen in the Elmina coastline

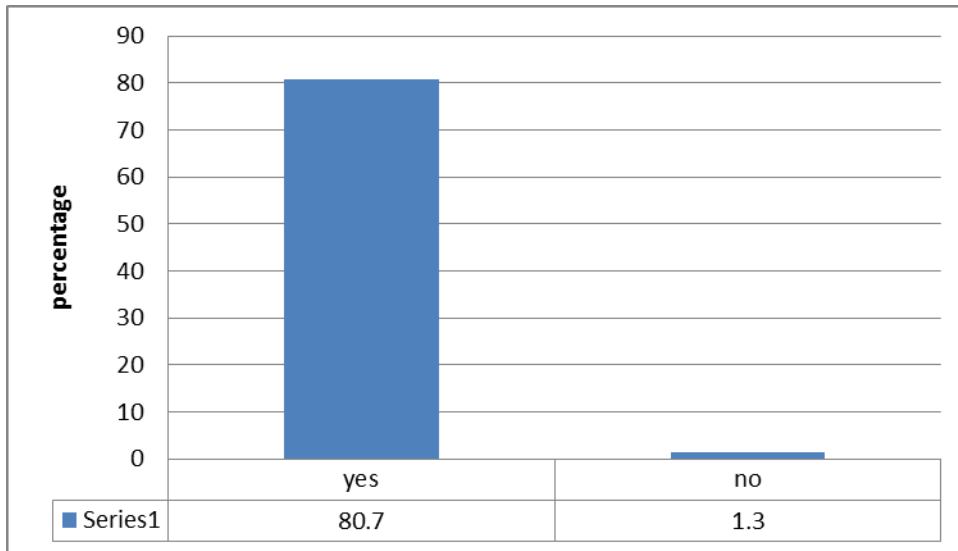
Due to lack of data on the quantity of fish caught within the Elmina coastline, the fishermen were asked the quantity of fish caught, this was used because a report by the fisheries and aquaculture sector development plan from (2011 to 2016) states that the best source of information for fisheries management and trend analysis is from the fishermen. The report proves that after obtaining licenses for operation, it becomes necessary for license issuers to collect information from fishermen for timely analysis (MOFAD, 2011).

With this knowledge, respondents were asked if there had been changes in the output of fish caught in the coastal stretch within the last five years. From the analysis of their responses (80.7%) making 115 of the 142 respondents admitted to some changes in output. Only 2 respondents (1.3%) of the total respondents agreed that output has not changed in the last five years. During a discussion with one of the chief fishermen in the area, he noted;

“these days we always go fishing early and come home late but with almost an empty basket. We have been casting our nets wide but only catch ‘air’.

Perhaps we need Jesus to direct us once again as He once did in the bible. It is really bad”.

Figure 4.1 Changes in quantity of fish caught along the Elmina coastline



Source: Field Data, 2014

The study further sought to ascertain if fishermen’s perceptions on the quantity of fish caught varied with the number of years spent in the profession. Table 4.3 showed that fishermen who spent more than 10 years in fishing (55.4%) were able to report on notable changes in quantity on fish caught over the years. This was followed by fishermen who spent between 7 to 10 years agreed that quantity of fish caught over the years has changed. A chi-square test conducted to reveal whether the relationship between number of years spent in fishing and the quantity of fish harvested was significant. A chi-square value of $X^2 = 18.224$ and a P-value of 0.001 reveal a significant relationship between the number of years spent fishing and the quantity of fish caught.

Table 4.3: Cross Tabulation between Changes in fish quantity and years spent in fishing.

Number of years spent in fishing	Changes in quantity of fish caught		Total
	Yes	No	
1-3 years	1.8%	50.8	2.6%
4-6 years	11.6%	0.0%	11.4%
7- 10 years	30.4%	0.0%	29.8%
Over 10 years	55.4%	50.0%	55.3%

Source: Field Data (2014). $X^2=18.224$ $df=4$ $P\text{-value}=0.001$

The Figure 4.3 further attempted to examine respondents perceptions on the possible causes and reasons for the notable changes in the quantity of harvested. An important issue adduced as the major cause of the changes in output of fishermen was overexploitation (68%). Fishermen noted that as fishing remain the dominant occupation in the area, it has become lucrative due to the cash rewards after trips. This has led to an upsurge in the number of fishing canoes that sail daily for fish. This observation was a critical point noted in an interview session with the fisheries officer of the KEEA Municipal area, who revealed that;

“the uncooperativeness of the fishermen to rules and regulations set to govern their activities has led to an influx of many canoes into the area that has further lowered the catches of individual fisher groups”.

Coupled with the concern of the fisheries officer is the non-adherence to the Municipals regulations on fishing. This observation falls in line with Aheto et al.

(2011) who revealed that the Ghanaian fishing industry is characterized by the open access system of property rights and regime. With this type of property regime, the property is a public good and all members of the community are entitled to the use of the property without any form of restrictions. Thus, the continuous use of the property leads to its depletion, a situation that can be likened to the Hardin's tragedy of the commons.

Additionally, fishermen also noted that wastes of varying types especially that of plastics that has engulf the coast and waters could account for the changes in fish quantity over the years. Twenty four percent (24%) of respondents (Figure 3), agreed that large volumes of wastes in water has the ability to drive away fishes into deep seas, out of reach to the inshore fishing fleets. This view however was contested by the Secretariat on the Convention on Biological Diversity and STAP report in (2012), which stated that wastes especially that of plastics have the potential to harden and solidify and form an extension to the habitats of fishes, leading to more species in a given location boosting fish catch (Secretariat on the Convention on Biological Diversity and STAP, 2012). The current findings therefore does not resonate well with the Secretariat on the Convention on Biological Diversity and STAP report in (2012) and seeks to conclude that this view should be subjected to further research.

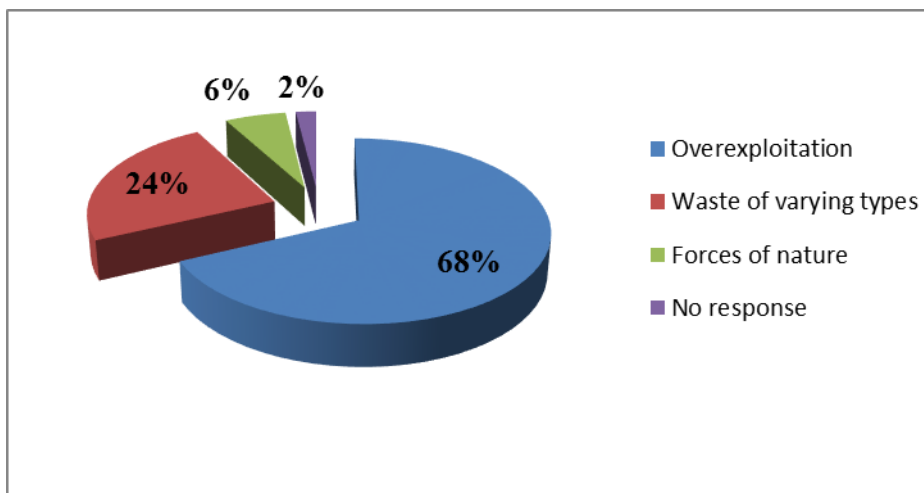
On the other hand, some respondents (6%) also believed that fishes have declined due to forces of nature. Some believe that the sea has many spirits residing in it, therefore fishermen are mindful of the presence of spirits. In an interview with Kweku, he revealed that

“The sea is a god called “bosompo” and she is a god of purity. In a bid to have bumper catches, some groups of fishermen resort to using charms. The

sea god is against such practices and as a punitive measure, sometimes withholds catches from the fishermen”.

Even though this perception by portion of the respondents has no scientific claim to it, fishermen believe in the existence of spirit at sea and their power to affect productivity.

Figure 4.3: Reasons for Changes in Fish Output



Source: Field Data (2014)

4.2 Changes in the methods of fishing in the Elmina Coastline

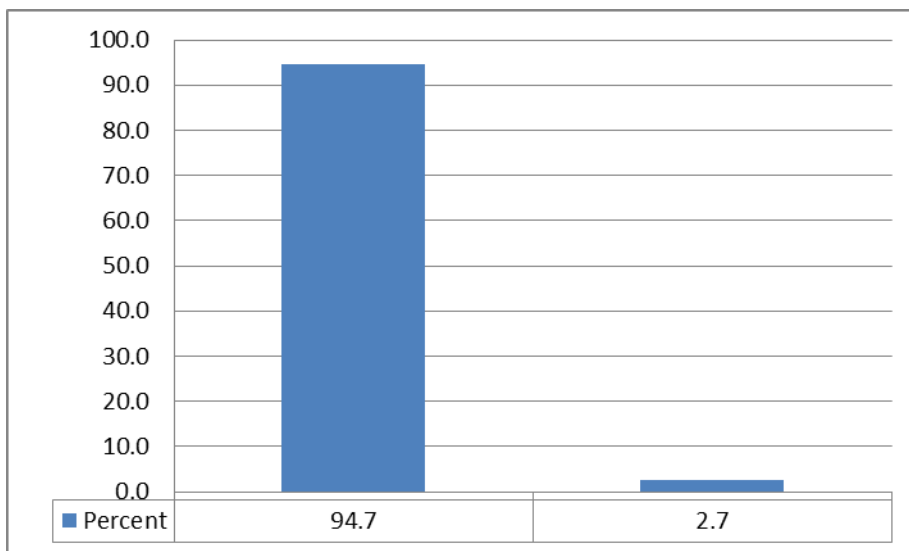
To find out if there had been changes in methods of fishing, respondents were asked if they had witnessed any changes in the method of fishing. From figure 4.4, majority of respondents (94.7%) agreed to the fact that changes have occurred in the methods used in fishing during the past five years under review. However, a fewer percentage of respondents representing (2.7%) indicated otherwise, that the methods of fishing have not changed within the last five years.

Respondents were further asked to state the observed changes in the methods of fishing that have occurred over the last five years. From the table 4.4, 44% of respondents believed that the use of light in fishing is the major change that has

occurred in the methods used in fishing within the last five years. In an interview with a fisherman he explained that

“Our fishermen believe the use of lights during fishing activities seeks to attract fishes and this increases the quantity of fish harvested. We have warned our colleagues severally but most of them still do it in secret”.

Figure 4.4 changes in the methods of fishing in the Elmina coastline



Source: Filed Data, 2014.

This finding however does not resonate well with Bannerman and Quartey (2004), who argued that the use of light has not had any significant change in fish landing as he examined the quantity of fish caught before and after the use of light. They argued for lesser restrictions on the use of light in fishing since the differences in the quantity of fish caught remain insignificant. However, the question that needs to be answered is that, does the use of light conform to the policy regulations of Ghana? Is the method sustainable? This leaves room for further research to be conducted on the use of light in the study area and Ghana at large.

Aside the use of light in fishing, respondents (13%) noted that the use of canoes with outboard motors have caused a change in their methods of fishing. Though the use of outboard motors have aided fast movement of the canoes with fishermen virtually free from the struggles of manual paddling, some thought its use have made some fishermen redundant. However, most fishermen during informal interviews noted that traditional method of pulling net from the sea has ensured that the positions of less influential parties in fishing groups or canoes were still maintained.

Additionally, number fishermen (23%) believed that the use of dynamite is one of the many changes that have been recorded in the methods of fishing along the Elmina coastline whereas others making up 20 percent and 13 percent share the view that, the acquisition of improved vessels and the use of outboard motors were notable changes respectively.

Table 4.4 Changes caused to fishing activities because of plastic marine debris/pollution

Variable	Categories	Freq	%
If yes what caused changes	The use of light	65	44
	The use of outboard motors	19	13
	The use of dynamite	34	23
	The use of improved vessels	30	20
	Total	148	100

Source: field data, 2014

A cross tabulation was conducted to find out the relationship between fishermen perceptions on changes in fishing methods and the changes in the quantity of fish caught over the years. Table 4.5 revealed that 48.4% of the fishermen believed that

there is a relationship between the use of light in fishing and the quantity of fish caught. Also relevant was 21.1 percent and 17.1 percent of fishermen who expressed the view that there was a relationship between the uses of dynamites and improved fishing vessels and the quantity of fish caught respectively.

Notwithstanding these perceptions, the study further tested for the significance of the relationship between the changes in fishing methods and the quantity of fish caught. From Table 4.5, a chi-square value of 4.401 and a P-value of 0.354 shows no significant relationship between the changes in fishing methods and the changes in quantity of fish caught since P-value is less than 0.005 significant at which the test was conducted. The study concludes that, the findings of Bannerman and Quartey (2004) above could have some merit as the chi-square test conduct resonates well with their findings.

Table 4.5: Cross Tabulation between changes in fishing methods and changes in quantity of fish caught

Changes in Fishing methods	Changes in quantity of fish caught		Total
	Yes	No	
Use of light	48.9%	0.0%	48.4%
Use of outboard motors	1.1%	0.0%	1.1%
Use of dynamites	21.1%	0.0%	20.9%
Use of improved vessels	17.8%	100%	18.7%
Others	11.1%	0.01%	11.0%
Source: Field Data (2014)		Total	100%

$$X^2 = 4.401$$

$$df = 4$$

$$P\text{-value} = 0.354$$

Table 4.5 reveals the effects plastic waste/pollution has had on fishing activities. According to the table, 75.9% of respondents indicated that there has been drastic decrease on the amount of fish caught overtime while 23.0% reveals that plastic waste has increased the yield in fishing. About 1.1% however indicated that plastic waste has neither increased nor decreased fish catch. With respect to how these plastic materials affect fishing, the study identified that plastic wastes drive fishes into the deep sea as majority of respondents (85.7%) alluded to this fact. In addition, plastic wastes were also identified to pollute the sea making it dirty. This disrupts visibility during fishing activities. Consequently, examining the pace at which fishermen complain about decreasing yield in fishing, it is prudent to introduce healthy plastic waste management practices to curb dumping in the sea.

Table 4.6: Cross tabulation between changes that have occurred in the fishing industry in Elmina within the last five years and changes plastic wastes have brought to fishing activities in the Elmina.

Changes that have been brought on fishing activities	What changes have taken place			Total N=150
	Increasing	Decreasing	Don't know	
It drives the fishes into the deep sea	3.8	85.7	10.5	100.0
It kills fishes even before we catch them with our nets	40.0	50.0	10.0	100.0
It makes pulling of nets difficult especially when it adds up to our catch	27.3	60.0	12.7	100.0
It makes the sea dirty and disrupts visibility	28	75.0	7.0	100.0
It does not affect fishing in any way	38.0	52.0	10.0	100.0
They contain food the fishes feed on, hence the closeness of the fish to the shore	23.0	50.0	27.0	100.0
Total	23.0	75.9	1.1	100.0

Source: Field Data (2014)

4.3 Conclusion

This chapter reviewed the demographic characteristics of respondents, looking at the age, sex, marital status of respondents etc. this chapter also investigated into the changes that have occurred in the inshore fishing industry in Elmina over the past five years. The level of education of the respondents revealed why very little information was known about the effects of plastic marine debris on the activities of fishermen. Again, the changes in output recorded in the Elmina coastline was investigated by exploring changes in the method of fishing. It was revealed that changes such as use of light, carbide, improved vessels etc. were among the many changes that have occurred within the last five years. It was also revealed that over exploitation was one of the major causes of the fluctuations recorded in the output of fishermen in the Elmina coastline.

CHAPTER FIVE

THE EFFECTS OF PLASTIC POLLUTION ON FISHING ACTIVITIES AND THE HABITATS OF FISHES IN THE ELMINA COAST

5.1 Introduction

This chapter discusses the actual effects plastic wastes have on fishing activities and the habitats of fishing. It delves into the complex relationship between plastic marine debris and the fishing activities along the Elmina coastline. It also looks at the effects of plastic marine pollution on the habitats of fishes along the Elmina coastline.

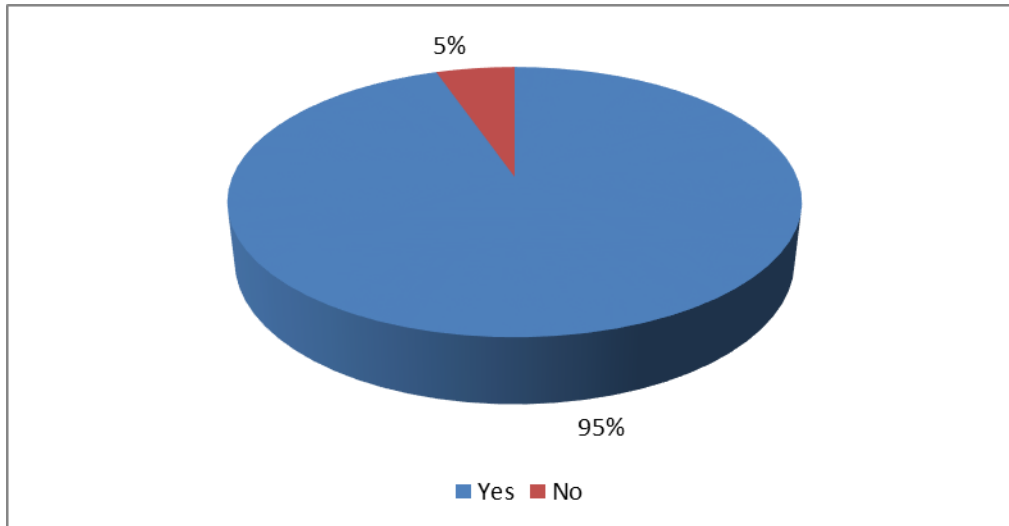
5.2 Evidence of Plastic waste in the Elmina Coast

To assess the extent of changes brought into the fishing activities in the Elmina coast by the presence of the plastic debris in the marine environment, fisher folks were asked if they had ever encountered plastic materials as they went about their fishing activities. As many as 95 percent of the total respondents agreed that plastic wastes are present in the marine environment, which was in line with the findings of STAP (2011) and Nunoo and Quayson (2003).

The remaining 5 percent of fishermen who had not encountered plastic marine debris in their line of work, however, through informal interactions revealed that, they had seen such on Television, heard about it on radio, from younger colleagues and through training programmes organised by NGO's for fishermen from time to time. However, it became difficult to get names of such NGO's from the fishermen basically because of illiteracy and forgetfulness. However, it is known that an NGO named "Hen Mpoano Initiative", an initiative by the U.S Agency for International Development (USAID) and other development partners including World Fish Centre,

SustainaMetrix and Friends of the Earth funded initiative (Robadue and Kankam, 2013) organise training seminars for the fisher folks in the Elmina coast from time to time

Figure 5.1 Awareness of plastic pollution in the marine waters of the Elmina coastline



Source: Field Data (2014).

In an interview session with Bob, a fisher man in his middle 40's who had spent more than 15 years in the fishing profession at Elmina, he revealed that

“We see it every day but it is deep in the sea, so we pass by it so it does not stop our outboard motor”

The study therefore concludes that there is ample evidence which indicates that plastic marine debris is present along the Elmina fishing coastline.

The study sought to find out if there was any relationship between the number of years of spent in fishing and fishermen's ability to see plastics at sea during fishing activities. From Table 5.1, it is evident that fishermen experiences with plastics during fishing activities increases with the number of years spent in the profession. Majority of fishermen with over 10 year's experiences (48.1%) confirmed the presence of

plastics in the sea over the years. Similarly, fishermen who have spent between 7-10 years and 4-6 years fishing recorded 26 percent and 9.2 percent respectively. The study further tested for significance between the two variables. The results (see Table 5.1) showed that with a chi-square value of 12.705 and a P-value of 0.13, there was a significant relationship between the number of years a fisherman spent fishing and the encounter with plastics at sea during fishing.

Table 5.1: Cross tabulation between observation of plastic wastes and number of years spent in fishing.

Number of years in fishing	Presence of plastics on sea		Total
	Yes	No	
Less than 1 year	0.8%	0.0%	0.7%
1 to 3 years	16.0%	62.5%	18.7%
4 to 6 years	9.2%	12.5%	9.4%
7 to 10 years	26.0%	25.0%	25.9%
Above 10 years	48.1%	0.0%	45.3%
Source: Field Work (2014)		Total	100%

$\chi^2 = 12.705$

df = 4

P-value = 0.13

5.3 Effects of plastic wastes on fishing activities at the Elmina coastline

An introduction of a material into a new environment always has some form of impact on the new ecosystem (Allsopp et al 2006). Therefore, the presence of the plastic wastes in the marine environment may have some consequences on the marine ecosystem that can also affect fishing activities.

Thirty (30) out of the 150 respondents representing (20%) (see Table 5.1) believed that the presence of plastic waste in the marine environment have driven fishes further back into the deep seas which has led to a decrease in fish catch in recent years. This view was contested during an interview session with the chief fisherman of Elmina who revealed that; “the activities of pair and bottom trawlers have rather swept away the sea bed rock which serves as home and also as a plankton bearing rock. This has forced the fishes to move further down into deep seas for food and shelter, reducing the availability of fish stock for fishermen to fish leading to a decrease in fish catch”.

Disruption to visibility on sea was another issue raised by a group of fishermen making up 8.7 percent of total respondents. According to a fisherman, the commonest type of plastic waste identified by the fishermen were the black polythene ‘take away’ bag and sachets of purified water mostly called “pure water” during fishing activities. The presence of these waste materials prevents the fishermen from seeing through the water. Though there have not been much empirical data to support this point raised by the fishermen, it was one of the findings of this study.

A much higher percentage of respondents (63.3%) answered that they have not seen any changes in their fishing activities since the introduction of plastic waste/debris into the Elmina fishing waters. This view contrasts the findings of many researches such as Allsopp et. al., (2006) and STAP (2011), confirm cases of ingestion and entanglement of fishes and other marine animals by plastic debris in the marine environment worldwide. The overarching question therefore is whether our policy formulators should wait until the menace of plastic debris become very evident in our fishing waters before any form of remedy is applied?

However, in the course of discussions with the fishermen at the Elmina fishing harbour, some shared the view that the plastic wastes/pollution within the coastal stretch affects the artisanal fishermen who do not move deep into the sea but fish relatively close to the shore. It was also revealed that the plastic wastes/debris are either at the immediate coast or are found on the high seas which is not within the reach of the inshore fleets. This explained why the fishermen in the Elmina coastal stretch, basically inshore fishermen, do not have much encounter with the plastic marine debris.

While a larger percentage of the respondents believed that the presence of plastic waste has not had any effects on their fishing activities, again from Table 5.2, 6 respondents (3.3%) revealed that the presence of plastic wastes in the fishing area sometimes kill fishes before the net catches them thereby causing fish harvested to give off bad odour few minutes after they are landed for sale. This nonetheless causes financial loss to them as the catches are sold out quickly at cheaper prices. In an interview with Kwame Tawiah, a fisherman in his early 30's he shared a thought on his encounter with a fish throat clogged with polythene;

“Seeing plastic bag clogged around the throat of a fish was scary, we nearly thought it was a bad omen, until we were told that fish eats plastic debris at sea and what we saw was the result of such. But it is very uncommon to see a fish with plastic clogged in the throat”.

The last issue raised was that plastic wastes found in the coastal stretch add up to the catch, making it difficult to pull out net. 3.3 percent of the respondents agreed to this issue.

Table 5.2 Effects of plastic wastes on fishing activities in the Elmina fishing coast

Effects	Freq	%
It drives the fishes further back into the deep sea	30	20.0
No changes	95	63.3
It kills fishes before they are caught	6	4.0
It makes pulling of nets difficult because it adds up to our catch	5	3.3
It makes the sea dirty and disrupts visibility	13	8.7
The contain food in which the fishes feeds on	13	8.7
Total	150	100

Source: Field Data (2014).

The study further sought to find out if there was any relationship between the effects of plastics on fishing activities and the output of fishing (whether outputs were increasing or decreasing). The cross tabulation in Table 5.3 reveals that majority of respondents (75.9%)who noted that outputs were decreasing also believed that plastics were having effects on fishing activities (STAP, 2011). To test the significance of this relationship a chi-square test was further conducted. From table 5.2, the study found out that at a chi-square value of 24.897 and a P-value of 0.000 shows a strong significant relationship between the effects of plastic wastes on fishing and output of fishing.

Table 5.3: Cross tabulation between effects of plastics wastes on fishing activities and fish outputs.

Effects of plastic wastes on fishing activities	Outputs in fish caught	
	Increasing	Decreasing
It drives the fishes further back into the deep sea	14.3%	85.7%
No changes	3.8%	96.2%
It kills fishes before they are caught	50.0%	50.0%
It makes pulling of nets difficult because it adds up to our catch	40.0%	60.0%
It makes the sea dirty and disrupts visibility	27.3%	72.7%
The contain food in which the fishes feeds on	100%	0.0%
Total	24.1%	75.9%

Source: Field Data (2014) $\chi^2 = 24.897$ df. = 6 P-value = 0.00

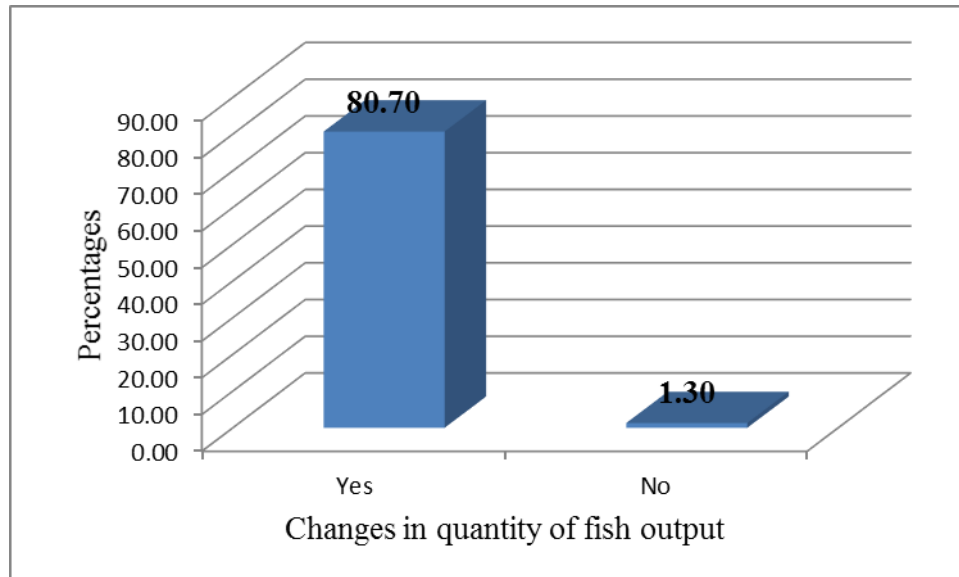
5.4 Effects of plastic wastes on the quantity and quality of fish caught in the

Elmina coast line

From Figure 5.2, 80.7 percent of the respondents agreed that there had been changes in the quantity and quality of fish and attributed it to the presence of plastic pollution in the marine waters. However, from earlier findings, it became evident that the changes in output recorded are due to many other factors and not mainly because of the presence of the plastic waste/ pollution. The remaining respondents (1.3%) were of the view that the presence of plastic pollution in the Elmina coastal stretch has not had any effects on the quantity and quality of fish caught. This is because; they hardly

encounter plastic wastes/pollution in the inshore area. The only encounter with plastic marine debris is in the artisanal area when the canoes are being taken into and from the inshore zone.

Figure 5.2 Effects of plastic waste on fish output



Source: Field Data, 2014.

The study again sought to ascertain whether there was any relationship between fishermen quantity of fish harvested and evidence of plastic wastes on the sea. The cross tabulation revealed that an overwhelming majority of fishermen (99.2%) perceived a strong relationship between the changes in the quantity of fish caught and evidence of plastic wastes on the sea. Subsequent chi-square value of 29.742 and a P-value of 0.000 reveal that there is a significant relationship between fishermen perceptions that the evidence of plastic waste pollution has significant effect on the changes in the quantity of fish harvested over the years.

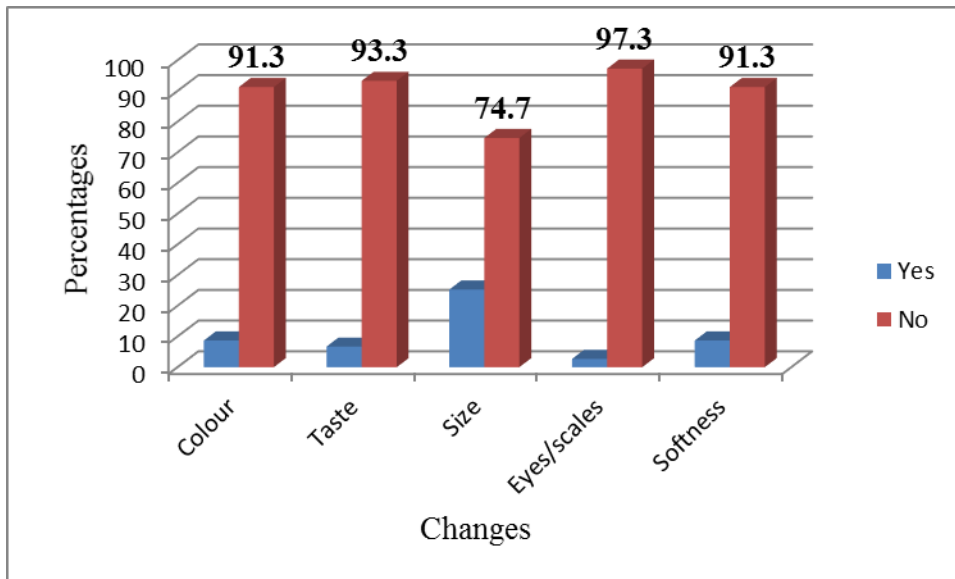
Table 5.4: Cross tabulation between Changes in quantity of fish output and evidence of plastics on the sea.

Changes in quantity of fish output	Evidence of plastic waste on sea		Total
	Yes	No	
Yes	99.2%	50.0%	98.4%
No	0.8%	50.0%	1.6%

Source: Field Data (2014) $\chi^2 = 29.742$ $df = 1$ $P\text{-value} = 0.000$

Additionally, the study analysed data on the quality of the fishes caught in the Elmina fishing coast in the advent of the plastic marine pollution, majority of fishermen responded that there had not been any changes in the colour of fishes (91.3%) caught, changes in tastes (93.3%), changes in size (74.7%), changes in the brightness of the eyes and scales (97.3%), and no changes in softness (97.3%) caught now and before the plastic pollution. This view contracts the findings of Stevenson (2011), which hypothesized that if a fish ingests a plastic pellet and is not able to pass the plastic from their guts, it may be at risk from malnutrition and eventual starvation that has been observed in other species such as seabirds and other marine mammals (Stevenson, 2011).

Figure 5.3: Changes in quality of fish caught



Source: Field Data (2014)

5.5 Effects of plastic pollution on some activities related to fishing in the Elmina coastline

After analysing the effects that plastics pollution has on fish stocks, in terms of the quality and the quantity of fish caught, it is also prudent to also look at the major threats posed by plastic pollution on some activities related to fishing. The proceeding sub-headings discuss some of the major effects of plastic pollution on other fishing activities.

5.5.1 Effects of plastic pollution on the fishing Equipment of fishermen in the Elmina coastline

Figure 5.4 reveal that, 49 percent of the respondents revealed that the clogging of the pedals of outboard motors was the major problem faced due to the plastic pollution menace sometimes leading to a total breakdown of equipments. One fishermen during casual interactions opined that

“most times we spend productive hours at sea, untangling plastic wastes especially the black polythene bags from the pedals instead of fishing which goes a long way to affect productivity”.

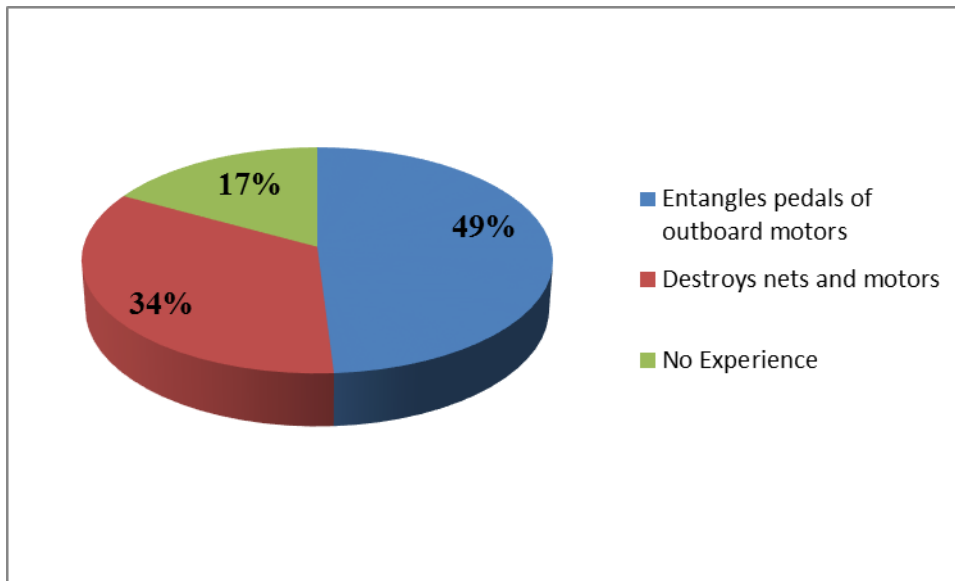
In another interview with Donkor, a fisherman from Mumford in the Central Region he also narrated that

“when the plastic waste gets stuck in the pedals, we remove them with care; otherwise it can break the pedals or cause serious problems to the machine”.

This finding resonates well with Global Environment Facility (2005) which reported of massive amount of plastic bags and other waste products flowing into the Jakarta bay has led to the clogging of outboard motors of vessels in the Indonesian seas. Aside the clogging of pedals of outboard motors by plastic wastes, some plastic wastes can enter into smaller holes in vessels, which lead to the enlargement of such holes causing leakages in the vessels.

Again 43 respondents (34%) of respondents also revealed that plastic wastes add up to their catch and makes the net heavy, breaking them in the process. The mending of broken nets take much time and money which leads to loss of productive hours. However, 26 respondents making 17 percent of the total respondents had no view on this question perhaps due to no previous experience.

Figure 5.4 Effects of plastic pollution on fishing equipment in the Elmina fishing coastline



Source: Field Data, 2014.

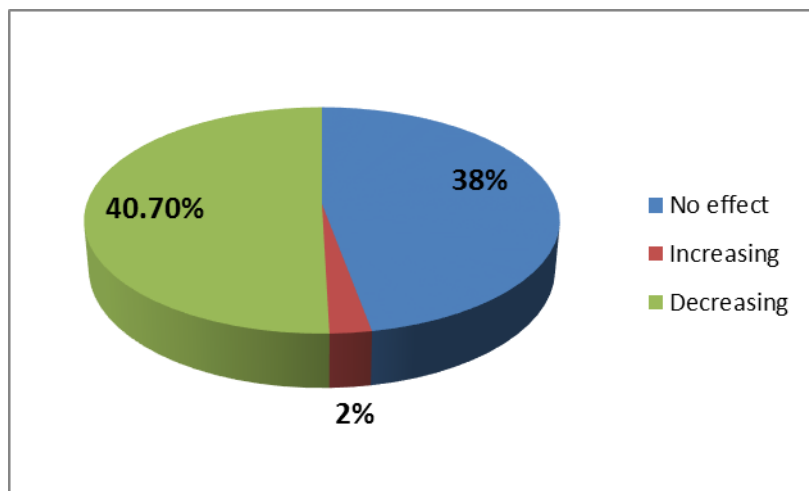
The study further analysed the data to establish whether there was any relationship between the effects of plastics on fishing equipments and the evidence of plastics on the sea. From Table 5.5, an overwhelming majority of respondents (96.8%) were of the view that there was a strong relationship between the two variables whereas only 3.2 percent of respondents stated they could not relate the effects of plastics on fishing equipment and the evidence of plastics on the sea. A statistical test for significance on the variables also reveals that, a chi-square value of 2.888 and a P-value of 0.089 shows a significant relationship between the effects of plastics on fishing equipments and the evidence of plastics on the sea.

5.5.2 Effects of plastic pollution on the incomes of fishermen within the Elmina Coast

Discussing the changes plastic pollution have brought to the income of the fishermen in the Elmina coast, 40.7 percent of the total respondents answered that plastic pollution has caused a decrease in their income level, basically the income derived

from fishing activities have decreased. Elaborating on the reasons for the decreased revenue, the fishermen mentioned extra expenditure brought on them such as repair cost, fuel cost, labour cost among others. A small percentage of the respondents representing 1.3 percent, revealed that the presence of plastic pollution has rather increased their income base mainly because fishes feed on the substances being carried in such waste materials, therefore, they believe, the plastic pollution rather brings the fishes forward within their reach. Again, this revelation by the fishermen does not have any scientific backing. However, STAP (2011) revealed that plastic marine debris have the potential to solidify and form an extension to the habitats of fishes in a particular area, increasing the bio diversity of fishes in a particular location (STAP 2011).

Figure 5.5: Effects of Plastics on Income



Source: Field Data (2014)

The study sought also to establish the relationship between the fishermen perceptions on the effects of plastics on their income levels and some reasons assigned to the changes in income levels. The Table 5.5 reveals that majority of respondents who were of the view that plastics have had a decreasing effects on their incomes noted a

strong relationship with the reasons assigned for the decreasing changes (63.5%). Further statistical test also reveals that with a chi-square value of 45.954 and a P-value of 0.000, the relationship between the effects of plastics on fishermen income levels and their perceived reasons for the change was very significant.

Table 5.5: Cross tabulation between effects of plastics on income levels and Reasons for changes in revenue

Reasons for changes in revenue	Effects of plastics on income levels		
	No Changes	Increasing cost	Decreasing cost
Repair cost	12.8%	2.6%	84.6%
Fuel cost	8.3%	8.3%	83.3%
Labour cost	22.2%	0.0%	77.8%
General cost	66.7%	0.0%	33.3%
Others	93.3%	6.7%	0.0%
Total	33.3	3.1	63.5

Source: Field Data (2014) $X^2 = 45.954$ $df = 8$ P-value = 0.000

5.6 Effect of plastic waste on the habitats of fishes within the Elmina Coastline

The respondents did not have adequate knowledge on the effects plastic marine debris have on the habitats of fishes within the Elmina fishing coastline. Therefore, the information given on this subject is solely from secondary sources. Plastic marine debris is known to persist in the marine environment because it does not break down but rather, fragments into smaller pieces called plastic pellets. These pellets have the ability to harden and form an extension to the natural habitats of the fishes. (Convention on Biological Diversity and STAP, 2012).

Table 5.6 shows that 29.3 percent of the respondents believed that plastic marine debris had altered the habitats of fishes while the majority of fishermen (67.3%) believed no changes has occurred to the habitats of fishes due to plastic debris. Out of those who responded yes to the question, no one was able to give reasons or evidence of change to the habitats of fishes within the coastline.

Table 5.6: Changes to habitat of fish due to plastic debris

Changes to habitat of fish due to plastics	Frequency	Percentages
Yes	44	29.3
No	106	70.7

Source: Field Data (2014)

Aguilera (2012), reports that marine debris has caused changes in the habitats of marine animals, not only on the sea floor but also the surface of the sea. *Halobates sericeus*, a marine insect which laid its eggs on flotsam (floatable objects) on natural surfaces of seashells, sea bird feathers, tar lumps and pumis, now lays eggs on plastic waste because of the abundance of plastic wastes in the north pacific subtropical gyre. This leads to an increase in the insert's egg density which may have consequences on the marine food web (Aguilera, 2012).

5.7 Conclusion

The fluctuations in the output of marine captured fishes recorded in Ghana can be said to be the interplay of so many factors. Mention can be made of the changes in the methods of fishing which have promoted the use of some unsustainable means of fishing such as light fishing and the use of explosives among others which have

contributed to these fluctuations. Again, plastic wastes/pollution in the marine environment has the potential to alter the habitats of fish through rafting of alien species into the environment. This is possible because of the buoyant nature of the plastic materials making it easier for these animals to travel on them with ease.

CHAPTER SIX

INSTITUTIONAL FAILURES AND COPING MECHANISMS OF FISHERMEN IN THE ELMINA COASTLINE

6.1 Introduction

This chapter is divided into two sections. The first session talks about the failures in regulations of the institutions in charge of fisheries management in KEEA Municipal Area. The second segment then looks at how the fisher folks are coping or adapting to the problems that these failures in regulations have brought about.

The management of fisheries resources in Ghana falls under many governmental and non-governmental institutions. The Fisheries Commission which is one of the major governmental institutions was established under the Fisheries Commission Act 457 and has continued to operate under Act 625 till date. The Commission was specifically set up to see to it that fisheries resources are sustainably exploited, to settle all forms of conflicts that may arise among fish operators both locally and internationally; serve as an adviser to the government in all matters related to fisheries, and to advocate on issues which tends to protect, promote and develop the fisheries industry (Antwi- Asare and Abbey, 2011).

Although other institutions such as the Water Resources Commission, the Environmental Protection Agency, the Volta River Authority, Water Resources Institute, Ghana National Association of Farmers and Fishermen, Ghana Co-operative Fisheries Association, Community-Based Fisheries Management Committees (CBFMCs) in various districts etc. all form part of the management institutions or play a pivotal role in the management of Fishery resources in Ghana, two institutions

were selected: the Ministry of Fisheries and Aquaculture Development offices at KEEA where Elmina is located and Cape Coast Municipal Assembly (CCMA) which is very close to the study area. Again, Community Based Fishing Management Committee (CBFMC) in Elmina was also visited. For the purposes of this research, the Ministry of Fisheries and Aquaculture Development's offices in the KEEA and CCMA (Cape Coast Metropolitan Assembly) were visited to find out the measures put in place to help the fisher folks overcome the challenges of fluctuating fish catch and the plastic waste pollution that is beginning to adversely affect fishing productivity in Elmina.

6.2 Ministry of Fisheries and Aquaculture Development in KEEA and the CCMA

In an interview with the chief fisheries officer of the KEEA Municipality which is where the Elmina coastline is located, Mr. Ephraim Essuman, said that although the plastic pollution exist in the seas, it was sent there by the fishermen themselves, who go out into the deep seas to fish. He explained that these plastic wastes accumulated through the buying and carrying of food and water at the shore. He further stated that though the problem exists, the plastic wastes are not that much on the deep sea but rather, they are found at the shore. The same view was shared by some fishermen, who explained that plastic wastes do not abound in the inshore fishing grounds, but abound in the artisanal and the deep seas areas.

The explanations provided by the authorities at the Ministry of Fisheries and Aquaculture Development were insufficient in effectively dealing with the plastic menace and the dwindling quantities of fish caught along the Elmina coast. The inability of the Ministry at the local level to strictly implement the regulations

appeared to be lacking, a situation that has the potential to exacerbate the current trends in fishing.

The case was almost similar at the CCMA Fisheries office. This office was visited to find out other measures being adopted by different Municipalities to curb the marine plastic debris menace. Again, interacting with the head of CCMA, it appears there were no measures put in place to control the use of plastic polythene bags at sea and also the indiscriminate throwing away of rubbish at the shore. Field observations and casual interviews also revealed that the CCMA office was abysmally staffed with unbecoming and inadequate infrastructure. These factors could be a major reason to the inability of CCMA to effectively perform its duties hence becoming functionally inept. The picture below was taken at the beach very close to the fisheries office of the CCMA and the Cape Coast castle which is located close to a fish landing site.

Plate 6.1: Landing site in cape coast, showing plastic waste at the beach in between the ministry of fisheries office and the cape coast castle



Source: Fieldwork, 2014

There was evidence of the presence of sachet waster packs littering the floor of the beach. If these plastics are not swept or cleaned, they get washed into the sea whenever there is a down pour, thus, increasing the number of plastic wastes already existing in the sea (Plate 7.1).

This second picture shows parts of the office complex at the CCMA Fisheries office, showing lack of infrastructure for staff (Plate 7.2).

Plate 7.6 Some parts of the office of the Fisheries and Aquaculture Development at Cape Coast Metropolis.



Source: Fieldwork, 2014

The first picture shows an office in the CCMA fisheries building, and the second picture shows the reception area where visitors are received and attended to. It was therefore not surprising that no data were kept on fishing activities and no measures were put in place at the district level to help address some of the problems fisher folks face in their day to day fishing activities.

The fisheries officer at the CCMA, who was a fisherman himself, lamented that although there have been numerous public educations on the dangers of

indiscriminate disposal of plastic wastes, more education and sensitization needs to be carried out especially to the fishermen, fish mongers, beach users and boaters.

6.3 The work of the Ministry of Fisheries and Aquaculture development of Ghana

The Ministry of Fisheries and Aquaculture Development is an institution set up to manage the fisheries resources of the country. Initially, fisheries were under the Ministry of Food and Agriculture but were made an autonomous body in 2011. The Ministry in partnership with the Fishery Commission looks at the day to day activities of fishers. These activities include licensing, registering, monitoring of fishing activities and settling disputes at the local and international levels among others.

6.4 The work of the District Assembly in the KEEA municipal area

The Ghana Districts Assembly system was considered in 1988 as a reformed decentralization of Local Government in Ghana. Its initiatives were to spearhead local initiatives in terms of planning, delivery of social services and also to ensure a broad participation and inclusive representation of the people at the local level in the governance of the nation (“In brief”, 2010).

To find out the role the Metropolitan Municipal and District Assemblies (MMDA) were playing in the fight against the plastic waste menace in the sea in the KEEA Municipal Area, the respondents were asked if there had been any intervention program from the KEEA and CCMA offices in the bid to fight the plastic waste menace. Out of the 137 respondents who answered this question, 135 respondents, making 98% of the respondents, indicated that there has not been any form of help/ intervention from the MMDA offices. While 1.3% of the respondents explained that

the Zoil cleaners, which was a part of the GYEEDA program, was the only intervention from the MMDA offices.

Table 6.1 Intervention from Municipal (KEEA and CCMA) Assembly

Have there been any help from the Municipal Assembly? percent	Frequency	
Yes	2	1.3
No	135	90

Source: field work, 2014.

From these findings, the study found that the municipal assembly office in the KEEA had very little influence on the activities of the fishermen in the study area. Contrary to the functions of the office as stated in Ofori- Aboagye (2008) “Introduction to Ghana’s Local Government Systems”, which includes the provision of basic infrastructure and services, promotion and support of productive activity and social development etc. were all not visible in the study area.

6.5 The CBFMC’s and fishermen associations in the KEEA Municipal Area

The CBFMC stands for local fisher folks committee mandated to mobilizing support for local fisher folks in resolving some of the problems facing the fishing industry. It was an initiative by the Government of Ghana to bring policy formulation close to the indigenous fisher folk population.

In order to find out what fishermen associations and the CBFMC’s are doing about the present problem of plastic waste menace in the study area, majority of the respondents making 87.3% of the total respondents, claimed that no measures have been taken by fishermen associations and the CBFMC to help fight the plastic waste menace. However, the remaining 12.7% of the respondents revealed there have been teachings on the use of dustbins instead of the open and indiscriminate dumping of waste being practiced. At one landing site within the Elmina coastal stretch, one

fisherman revealed that dustbins were placed at vantage places and were emptied regularly. However, this phenomenon is absent in many places which encourages open dumping. In the Elmina fishing harbour, the lack of dustbins leads to the dumping of waste into the lagoon which flows directly into the sea.

In finding out what has caused the low performance of fishing groups and the CBFMC from performing their responsibilities well, the issue of indiscipline, and uncooperative nature of the fisher folks and the lack of well-organized structures to issue commands are some of the reasons why these fishing groups are performing below their capacity. The question that rises is how to curb the indiscipline among the fisher folk population.

6.6 Coping Mechanisms of the fishermen to the plastic waste menace in the Elmina coastline

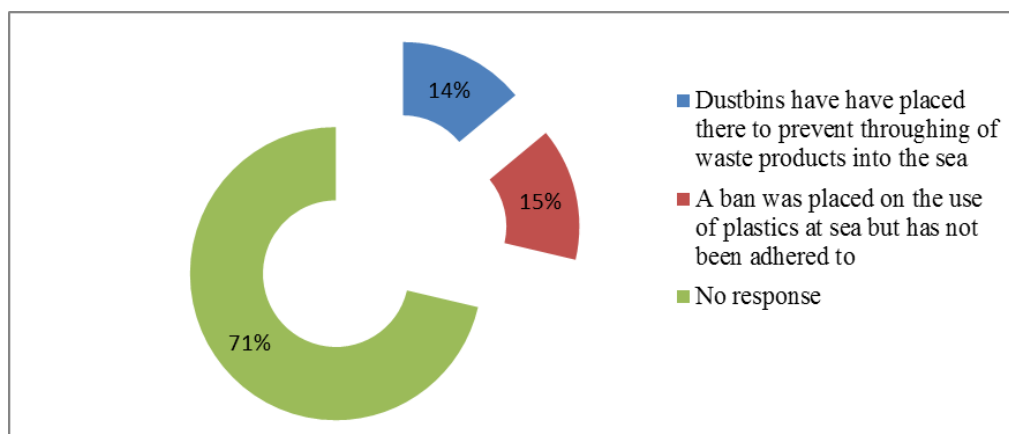
The second section of this chapter looks at the coping mechanisms of the fisher folks to the increasing number of plastic litter found in the sea. It is no news that the presence of plastic waste/pollution in the marine environment has had some devastating effects on the activities of fishermen. In the absence of any meaningful intervention from the fisheries and aquaculture development office, municipal assembly, the CBFMC etc. the fishermen have no other means but will have to cope with the situation until some sort of intervention is released from the Municipality. Understanding the coping mechanisms of the fishermen through the use of indigenous technology as well as borrowed technology is a huge step towards addressing the problem.

Majority of the respondents making 71 percent revealed that they have no coping mechanism for dealing with the problem (plastic waste/pollution). While 14 percent

of the respondents said that, dustbins have been provided at vantage points for proper waste disposal, another 15% of the respondents said a ban had been placed on the use of plastic products at sea but less success was recorded. The chief fisheries officer at the KEEA Municipality lamented about the uncooperative nature of some of the fishermen to the rules and regulations set out by the ministry to help regulate the indiscipline in the industry. He added the fisher folks curse and insult them whenever they introduce some form of rules or regulations.

In the world over, many intervention programs are being put in place to help manage marine pollution. The UNEP, the US EPA among many other known international organizations have put in measures to help curb this global problem. Examples of such measures include International Convention for the Prevention of Pollution from Ships (MARPOL), Zero waste Strategy, Education etc. Therefore, many intervention programs can be adopted by the local institutions to help solve the plastic pollution which is gradually taking over the fishing waters in Ghana.

Figure 6.1 Coping Mechanisms adopted by fisher folks against the plastic waste menace in the marine environment.



Source: Field Work, 2014.

6.7 Ways to handle the plastic waste menace

To find out from the respondents ways to help solve the plastic pollution problem, 32% of the respondents believed that if bins are provided at the beaches, they will use it for its purpose. While some 10.0% of the respondents believed that arresting people who throw rubbish at the beaches will serve as deterrent to others, another 8.7% of the respondents reasoned that, laws should be enacted on waste disposal. Another group making 6.7% believed that fishermen association should be strengthened to serve as a unified force in dealing with the plastic wastes problem and any other problem that may confront the fishing occupation.

Again, 5.3% of the respondents also suggested that cleaners should be employed to clean the beaches, while 4.7% of the respondents believed that plastics products especially the plastic carrier bags should be banned and replaced with paper bags. Another 2.7% of the respondents believed that if fishermen are educated on the dangers that plastic materials pose to the fish and other marine species on which their livelihoods depends, most of them will not dispose of plastics into water bodies. 1.3% of the respondents said that Plastic carrier bags should be banned from the country and lastly 0.7% of the respondents believed that security should be provided and strengthened around the shore to prevent people from dumping refuse haphazardly.

Many organizations have researched into measures to take to reduce the amount of plastic waste that enters the sea. According to the Allsopp et al (2006), the first step to addressing the problem of marine litter is by knowing the sources of such litter. It has been established that about 80% of all marine litter originates from land base sources. These litter end up in the environment through intentional and unintentional means.

Therefore, proper waste management around beaches, water bodies as well as domestic and industrial wastes is crucial.

6.8 Conclusion

The institutions in charge of fisheries management in Ghana are numerous and play divergent roles to ensure the sustainable use of the fisheries resources of the country. In terms of institutional frameworks at the grassroots to check the adverse effects of plastic waste/pollution on fishing activities, little success has been recorded. District assemblies, fishermen association as well as CBFMC's have done very little in helping curb the problem of plastic waste on fishing activities.

In the bid to survive in the global contemporary problem of marine plastic pollution, fisher folks have developed coping mechanisms and adaptation methods to this problem, by consciously avoiding areas of plastic waste/pollution so it does not clog the pedals of outboard motors and other equipment used at sea.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

Increased population growth and rapid urbanization has led to the production of more plastic products to keep up with the demands of the populace. With increased production, more plastic waste are being generated which have led to their emergence in the marine environment. The major objective of this research was to find out how the presence of these plastic materials/wastes in the seas has affected fishing activities in the Elmina coastline and the institutional frameworks that exist to help curb the problem. The following were the key findings

7.2 Summary of Key findings

7.2.1 Plastic marine debris, fishing methods and changes in fishing output in the Elmina coastline

The fishing sub sector in Elmina has witnessed some changes in the methods used in fishing through the years, mainly by adopting techniques used elsewhere. The major change in method of fishing that was recorded was the use of light in fishing which accounted for 44 percent of the answers given by the respondents. However, the use of light in fishing is illegal in Ghana because of the many disadvantages that come with it. Other changes recorded were the use of explosives such as dynamite, and the introduction and use of improved and powerful vessels aiding in fishing activities. The assessment of the changes recorded in the method of fishing was to have a basis to judge why fluctuations in fish production have been recorded. It was realized that, the fluctuating output of fish being caught in recent times is a combination of many factors; including the changes in fishing methods, the over exploitation of fishing

resources, the use of unauthorized fishing equipment, and other geogenic factors. These have contributed to the current trend of fishing output being recorded.

Again, the effects of plastic marine litter on fish output was investigated. It was surprising to find that plastic marine debris contributed very little to the output of fishermen. About 80.6 percent of the respondents agreed that, the change in output was due to over-exploitation and not because of plastic marine debris. This revelation was because the fishermen reasoned that plastic pollution is less in the inshore fishing area, while it abounds in the deep seas and the off shore areas. Therefore, plastic marine debris contributed very little to the fluctuating fish catch being recorded by the inshore fishermen on the Elmina coast.

It is interesting to note however, many organisations such as the UNEP, US EPA, STAP etc. have revealed plastic marine debris cause harm to marine organisms, which has lethal consequences. The questions that arise are: are the fishermen not seeing signs of deaths caused by plastic litter? Secondly, has the consequences of plastic marine litter on marine life not reached the waters of Elmina and that of Ghana yet? Third, should we wait for the consequences of plastic marine debris to manifest in our marine waters before any vigorous action will be taken? These questions leave room for more research to be conducted on the subject.

7.2.3 Plastic marine debris altering the habitats of fishes in the Elmina coastline.

Though there have been reports on the consequences of plastic marine debris on marine lives, respondents revealed that they have not noticed any appreciable changes in the habitats of fishes because of the presence of plastic marine debris in the Elmina coastline. This revelation was basically because the plastic do not get into the inshore fishing area to affect their activities.

7.3 The Effects of other factors affecting fishing activities and output in the

Elmina coastline

From the findings of the research, it was revealed that the fluctuating fishing output was as a result of the interplay of many factors. Some of these factors include algae growth, climate change variability on fish stocks, waste of varying forms and unstained and illegal fishing practices. Algae growth has the potential to increase biodiversity because of some plankton which may be carried in them. However, most algae tend to be poisonous or introduce harmful chemicals into their environs, thus making them harmful to marine species. However, in the Elmina coastline, the algae get caught in nets dirtying the catch, adding extra weight which leads to the breaking of the net.

Climate change also has the potential to directly affect fisheries resources through influencing fish stocks and the global supply of fish for consumption; or indirectly, by influencing prices of fish or the cost of goods and services required by fishermen and fish farmers. The fishermen in the Elmina coastline are suffering from the effects of the climate change on fishing activities in different ways. The changes in the season of catching particular species of fish, for example, the change in season for catching herrings have changes from July to October.

In the study area, the respondents revealed that, the use of pair and bottom trawlers by the Chinese was the major problem they faced. The sweeping of plankton bearing rocks in the habitats of fishes makes it very difficult to catch fish. Again, illegal and unsustainable fishing practices by all fishing fleets have led to the decline in fish stocks. The use of light and other explosives by inshore fishing fleets have contributed to the decline in fish stocks leading to the decline in fishing production.

7.3.1 Plastic Marine Debris and Other Activities related to Fishing in Elmina

To assess the effects of plastic pollution on other activities related to fishing, the income and equipment of respondents were taken into consideration. It became clear that, plastic marine debris affects the equipment used such as outboard motors, nets and wooden vessels which in turn affect the incomes of fisher folks through the cost of repairs and replacement.

7.3.2 Institutional Failures in addressing Plastic Pollution Problems and the Coping Mechanism of Fishermen to the Plastic Pollution Menace

It became evident from the findings that the Ministry of Fisheries and Aquaculture development offices in the KEEA and CCMA have done very little especially at the local level to address the challenges of the fisher folks, especially in the area of plastic marine pollution. The research revealed that the uncooperative nature of fishermen coupled with unavailability of staff, logistics and proper office space all contributed to the failure of the ministry to perform its task to the fullest.

7.4 Conclusion

The research sought to achieve a set of objectives. Therefore, based on the key findings of this research, the following conclusions have been drawn. The first objective was to analyse the trends in output of inshore fishing activities. This objective was achieved by noting that fish caught have been fluctuating because of a myriad of factors which included cost of fishing inputs, unprotected and deteriorated landing beaches, unfavourable weather conditions and indiscriminate use of carbide and other explosives in fishing, the use of light in fishing, unregulated fishing activities by the artisanal fishers etc. all have contributed to decline in fish caught. However, plastic marine debris had a very negligible effect on the decreasing output

of fishers. Therefore, it can be concluded that the fluctuating output of fishermen in the inshore fishing industry at Elmina is not due to the presence of plastic pollution in the sea.

Assessing whether plastic marine debris has altered the habitats of fishes, it was revealed that plastic marine debris has no effect on the habitats of fishes in the study area, however, it came to light that the plastic marine debris have the potential to harden and form an extension to the natural habitats of the fishes, thus increasing the number of fishes in an area.

The third objective was to assess the effects of plastic wastes on fish yields and other activities. This objective revealed that plastic waste affect fish yield through the equipment used such as the outboard motor and nets of fishermen but has little influence over the fish stock itself.

The last objective was to assess the institutional failures and the coping mechanisms of the fisher folks to the plastic marine debris. In conclusion, the Ministry of Fisheries and Aquaculture had very little influence over the activities of the fisher folks due to many factors such as indiscipline on the part of the fishers, lack of required logistics and enforcement. Therefore, it was concluded that the Ministry of fisheries needs to be equipped with the necessary logistics to work more effectively and efficiently.

7.5 Recommendations

Based on the finding of this research, the following are recommended to help prevent adverse effects of plastic waste on fishing activities.

7.5.1 Education on the harmful Effects of Plastic Waste on Marine Lives.

Though fishermen have agreed that plastic marine debris have not had any significant impacts on fishes caught, the evidence of harm caused to marine lives worldwide by marine debris is well known. Therefore, fisher folks must be educated on the problems that plastic marine debris pose to marine lives including fish stocks. Most fishermen have little knowledge on the issues of plastic waste and how it can affect their livelihoods; therefore, occasional visits of the fisheries management institutions and teachings through role play and other media will help sensitize the fishing community about the dangers of plastics marine debris.

7.5.2 Regular Collection of Waste to avoid its entering into the Seas.

Extant literature shows that 80% of all marine debris originates from land. To this effect, waste generated especially along the beaches by tourists and also indiscriminate dumping of refuse should be collected at all-times to avoid them being washed into the seas. Again, fishermen should be educated not to dispose the plastic products used at sea into the sea but to bring it ashore and properly dispose them into bins and properly managed landfill sites.

7.5.3 Adequate Resources to Equip the Fisheries Offices at the District Level

Visits to the offices of the KEEA and CCMA fisheries offices revealed that, the offices lacked the needed infrastructure to function efficiently. The absence of data keeping materials, books and other equipment are responsible for non-compliance of some fishermen to the regulations and rules set by the offices. Therefore, it is recommended that fisheries officers should be given refresher courses from time to time to keep them updated with the new technologies. The offices of the Fisheries Ministry should be upgraded so that it can get the needed respect from the fisher folk.

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SECTION B: TRENDS IN OUTPUT OF INSHORE FISHERIES

9. Have there been changes in the style of fishing within the last 5 years?
a. Yes [] b. No []
10. If Yes, what has caused these changes? a. the use of light in fishing []
b. the use of outboard motors [] c. the use of dynamite in
fishing [] d. the use of improved vessels in fishing [] e. other(s)
specify.....
11. If No, why hasn't the style changed in the age of technology
.....
12. Have there been changes in the quantity of fish caught over the years,
preferably the last five years? a. Yes [] b. No []
13. If yes, is the output increasing or decreasing?
14. What has caused these changes in output
a. nature has reduced the fishes itself [] b. overexploitation []
c. more fishers are putting pressure on fish stock [] d. migration of
fishes due to plastic waste [] e. other(s) specify
.....
15. If No, what is causing the stagnation of fish yields
.....

**SECTION C: AWARENESS OF PLASTIC WASTES ON THE BREEDING
GROUNDS OF FISHES**

16. Have you ever found plastics in the sea as you go about your fishing
activities? a. Yes [] b. No []

17. If No to Question 16, Are You Aware of the emergence of plastic wastes in the sea? a. Yes [] b. No []

18. If Yes to Question 17, how did you become aware of the current problem facing our seas? a. television announcement [] b. local announcement through the PAS [] c. district assembly announcement [] d. from colleagues [] e. other(s).....

SECTION C: THE EFFECTS OF PLASTICS ON FISHING

19. What are some changes plastic wastes have brought to fishing activities?
.....

20. Have there been changes in the quantity of fish caught over the years because of plastic wastes? a. Yes [] b. No []

21. Have there been changes in the quality of fishes caught over the years because of plastic wastes? a. Yes [] b. No []

Please indicate the changes in quality by ticking Yes or No

Change in quality	Yes	No
Colour		
Taste		
Size		
Brightness of eyes and scales		
Softness		

22. Have there been changes to the habitats of fishes because of plastic wastes? a. Yes [] b. No []

23. If Yes, please indicate the type of changes

a. introduction of alien species [] b. destruction of plankton []

c. temperature variation [] d. competition for space []

e. other(s) specify.....

24. Have plastic wastes caused any changes to the behaviour of the sea?

a. Yes [] b. No []

25. If Yes, please indicate the changes

.....

26. Have you ever found worms, insects etc. floating on plastic wastes on the sea

before? a. Yes [] b. No []

27. Were these organisms found on sea before the emergence of the plastic waste

menace? a. Yes [] b. No []

28. If Yes to Questions 27, what did they float on

Please Tick where appropriate

Object	Tick
Leaves	
Dresses	
Footwear	
Seeds	
Glass	

29. What is the major threats plastic wastes have introduced to fishing activities

.....

SECTION D: EFFECTS OF PLASTIC WASTE ON ALL OTHER ACTIVITIES RELATED TO FISHING

30. What effects have plastic wastes have on your income level?

- a. no effects [] b. increasing income [] c. decreasing income []

31. How have plastics changed your income level?

- a. repair cost [] b. fuel cost [] c. labour cost []
d. general cost [] e. other(s) specify

32. Has the emergence of plastic wastes affected prices of all other fish products?

- a. Yes [] b. No []

33. What effects do plastic wastes have on the equipment used in fishing?

.....

34. Aside the equipment used, has plastic waste affected any other activity related to fishing activities?

- a. Yes [] b. No []

35. If your answer to Question 34 is Yes, please specify

.....

SECTION E: COPING MECHANISMS OF THE FISHERMEN

36. What measures have you adopted to prevent the effects of plastic waste from affecting your fishing activities?

.....

37. Are the measures adopted in Question 36, effective?

- a. Yes [] b. No []

38. If your answer to Question 36 is No, what sought of help do you need?

.....

39. Has Government intervened in the situation?

a. Yes []

b. No[]

40. If your answer to Question 39 is Yes, what intervention was given?

.....

41. Have there been any help from the Municipal Assembly?

a. Yes []

b. No[]

42. If your answer to Question 41 is Yes, what help was given?

.....

SECTION F: MECHANISMS FOR ADDRESSING THE PROBLEM

43. What measures / rules have been taking by fishermen associations to help fight the plastic waste menace?

.....

44. What will you do in your small way to help curb the problem of plastic wastes?

APPENDIX II

FOCUS GROUP DISCUSSION FOR FISHERMEN

EFFECTS GENERATED BY PLASTIC WASTES ON THE FISHING

ACTIVITY

1. How has plastic wastes affected your fishing activities
 - Output/ Fish yields (quantity)
 - Quality
 - Taste
 - Size
2. Has plastic wastes affected your equipment used for fishing?
 - Nets
 - Canoes
 - Outboard motors
3. Has plastic waste caused injuries or harm to you as you about your fishing activities?
4. What has the government done about the plastic waste problem?
5. Were you involved in any intervention /remedy programme?
6. What do u do as fishermen to reduce the impact of plastic waste on your fishing activities?
7. Do you have local rules and regulations restricting the throwing of wastes in to the sea?
 - Rewards for best fishing group?
 - Sanctions for default?
8. What kind of help do you need from stakeholders in order to fight the problem effectively?

9. What has the government done to help you fight the plastic waste menace?
10. Any recommendations on how to solve the problem?

APPENDIX III

INTERVIEW GUIDE FOR FISH MONGERS

RESPONDENT DEMOGRAPHIC BACKGROUND

1. Name
2. Number of years spent as a fish monger?
3. Are u married?
4. Number of dependents?
5. Are you the sole bread winner of the family?

AWARENESS OF PLASTIC WASTE MENACE

6. Have you heard about the plastic waste menace in the sea?
7. From which medium did you get that information?

EFFECT OF PLASTIC WASTE ON FISHING

8. Has plastic waste affected your trading activities, in terms of
 - Cost
 - Quantity
 - Quality
 - Durability
 - Taste
 - Appearance
9. What are the threats plastic waste has brought to you as go about your business?

INSTITUTIONAL FRAMEWORKS TO HELP SOLVE THE PROBLEM

10. What measures have the mongers associations done to solve the plastic waste problem?

11. What has the District Assembly done to reduce the impact of plastic waste on your activities?
12. Have you educated on the effects of indiscriminate dumping of plastic waste in to the sea by any stakeholder?
13. What do you think can help remedy the situation in your own way?

APPENDIX IV

KEY INFORMANTS INTERVIEW GUIDE

INTERVIEW GUIDE FOR MARINE BIOLOGIST

SECTION A: PERSONAL INFORMATION OF RESPONDENT(S)

1. Position and rank of respondent
2. Number of years served as a marine specialist?
3. Sex of respondents
4. Qualification

SECTION B: AWARENESS OF PLASTICS

5. What makes up the Marine Environment?
6. What are the main components of Marine Debris?
7. Do changes in the constituents of Marine Debris have an effect on the habitat of fishes?
8. How have plastic wastes caused changes in the biological states of the sea?
9. Does the chemical constituent in plastics have effects on the chemical composition of the sea water?
10. If yes, how does it affect living species in the sea?
11. Has plastic wastes introduced other non-native species into the marine environment.

12. If yes, judging from the salinity of the sea water, how are these non-native species able to survive/cope?

SECTION B: EFFECTS ON FISHING

13. How has the menace of plastic wastes affected fish live/stock?
14. Do plastics wastes have any effects on the health of fishes?
15. Have there been reports on plastic wastes to your outfit?
16. If yes, what were the major complaints?

SECTION C: COPING MECHANISM

17. How best can fisher folks cope with the plastic wastes menace using indigenous technology available to them
18. What measure have your institutions taken to reduce the influx of plastic waste into the marine environment?
19. Any recommendations for the sea users?

APPENDIX V

INDEPT INTERVIEW GUIDE FOR MINISTRY OF FISHERIES OFFICER PERSONAL INFORMATION OF RESPONDENT

1. Name
2. Position and rank of respondent
3. Number of years served as fisheries expert?
4. Qualification

AWARENESS AND EFFECTS OF PLASTIC WASTES MENACE

5. Have there been complains to your outfit concerning plastic waste menace in the seas?
6. For how many years have plastic wastes posed a threat to the fishing harbour?
7. Have there been reports of decreasing yields due to the presence plastic wastes menace?
8. Has the presence of the plastic wastes affected the quality of fish caught?
9. Have there been reports of inquires or death of fisher folks due to the presence of the plastic waste?

INSTITUTIONAL MECHANISMS AND FRAMEWORKS FOR ADDRESSING THE PROBLEM

10. What measures have been put in place to address the problem?
11. Have there been collaborations from other stake holders?
12. Are local fishermen involved in any intervention program to help remedy the problem?

13. Have fishermen been well educated about the effects of indiscriminate dumping of wastes in to the sea?
14. What has been the main source of funding for the fight against plastic wastes in the sea?
15. What measures have been put in place to strengthen the people's livelihood strategies after the plastic waste menace?
16. What measures have been put in place to ensure sustainable fishing by the local fisherman?
17. What measures have been put in place to ensure sustainable fishing by the local fisherman in order not to compound the problem posed by the plastic waste?
18. How involved are the various stakeholders in the fight against plastic wastes menace?

APPENDIX VI

INTERVIEW GUIDE FOR WASTE MANAGERS (ZOIL)

1. Level and office of respondents
2. Number of years spent at place of work
3. Sex.
4. What are the major constituents of wastes along the sea shore?
5. When did plastic wastes became a major aspect of wastes or rubbish along the shore. (Time period)
6. How has it affected the activities along the shore?
7. What problems has the emergence of the plastic wastes brought to your daily work activities?
8. In your own way, what will you do to help solve the plastic wastes problem?
9. What kind of assistance will you require in your quest to help remedy the situation?
10. Any recommendations for shore users?

APPENDIX VII SAMPLE SIZE CALCULATION

Using Cochran's (1977) sample size calculation, I arrived at my sample size. Cochran suggested that if the proportion is larger than 5% ($n/N > 0.05$) with a finite population, the following formula was appropriate in choosing the sample size.

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1) + Z^2P(1-P)}$$

Where, n' = sample size with finite population,

N = Population size of fisher population

Z = Z statistic for a level of confidence, 5% CI= 1.96

P = since I could not get P from a prior work a conservative value of 0.5 was taken and

d = Precision is 0.05.

With this formula in mind, the sample size was

N = 800 (the population given to me by the head of fisheries)

Z = 1.96

P = 0.5

D = 0.05

Therefore,

$$\frac{800 \times 1.96^2 \times 0.5(1-0.5)}{0.05^2(800-1) + 1.96^2 \times 0.5(1-0.5)}$$

$$\frac{800 \times 3.8416 \times 0.5(0.5)}{0.0025(799) + 3.8416 \times 0.5(0.5)}$$

$$\frac{3,073.28 \times 0.9604}{1.9975 + 0.9604}$$

$$\frac{768.32}{2.9579} = \mathbf{260}$$

To get the sample sizes for the various fishing groups

Table 1.0 Sample sizes for the various fishing groups

Fishermen Groups	Population	% Of the 260 Respondents	Sample Size
Semi-trawler vessels	120	20	39
Dugout canoes	400	66.6	195
Lagoon fishers	50	8.3	16
Line & Sinker	30	5	10

Source: field data, 2014.

Table 1.2 New Sample Size for the various fishing groups

Fishermen Groups	Population	% Of the 150 Respondents	Sample Size
Semi-trawler vessels	120	20	30
Dugout canoes	400	66.6	100
Lagoon fishers	50	8.3	12.5
Line & Sinker	30	5	7.5

Source: field data, 2014