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FACTORS AFFECTING THE ADOPTION OF FISH SMOKING TECHNOLOGY IN  
MOREE

BY

**PRISCILLA ATTA-PETERS**

**(10876990)**

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY SOCIOLOGY DEGREE.

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Except for formally stated references to other people's work, I, Priscilla Atta-Peters, declare that this work is the outcome of my research conducted under the supervision of Prof. Akosua Keseboa Darkwah and Dr. Fidelia Ohemeng of the Department of Sociology. To the best of my knowledge, this thesis has never been submitted in whole or in part for another degree in Ghana or elsewhere.

**PRISCILLA ATTA-PETERS**

**DATE**



30<sup>TH</sup> OCTOBER 2023

.....  
(STUDENT)

**PROF. AKOSUA K. DARKWAH**

**DATE**



30<sup>TH</sup> OCTOBER 2023

.....  
(PRINCIPAL SUPERVISOR)

**DR. FIDELIA OHEMENG**

**DATE**



30<sup>TH</sup> OCTOBER, 2023

.....  
(SUPERVISOR)



## DEDICATION

I first dedicate this thesis to God, then to my parents, Mr. Paul Atta-Peters, and Mrs. Victoria Atta-Peters for their unflinching support throughout this two-year academic journey. And to my siblings, Cornelius, Rhoda, Theophilus and Nana Mankrado Atta-Peters with love from your elder sister. I lastly dedicate this thesis to myself for the hard work and ‘sleepless nights’ to get this done.



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## ABSTRACT

The paper studied the underlying factors that had informed the adoption decision of the Chorkor smoker in the Moree community. Fish smoking is an affordable traditional fish preservation method that has been employed in most developing countries including Ghana. Smoked fish continues to be a major protein source in most Ghanaian diets. The contribution of technology can only be visible when and if the technology is widely used and diffused. Therefore, understanding the factors that affected this choice is beneficial.

The main study objective was to examine the factors that led to the adoption of the Chorkor smoker. This was achieved by using a qualitative approach. A semi-structured interview was the main tool used to collect data for the study. The instrument for data collection was the interview guide. Snowball and purposive sampling methods were employed to recruit participants for the research. The primary source of information was derived directly from the fish smokers and other stakeholders of the Chorkor smoker.

This study used Rogers' theory of diffusion of innovations to describe and understand the life experiences of fish processors. The theory helped to explain adoption, the different types of adopters and why some people acquire technology faster than others. It is asserted that although adopting a new technology can be extremely difficult, even in cases when there are clear advantages, the adoption process is greatly influenced by a number of variables, including education, awareness, cost of inputs and features of the technology. Academics and Non-Governmental Organizations can benefit from this study as they begin to theorize the dynamic and multifaceted role gender plays in fish processing. It is recommended that major stakeholders launch awareness campaigns to educate fish smokers about the benefits of adopting newer fish processing technologies. This study establishes a strong foundation for future research on fish smoking technologies in Ghana and beyond.

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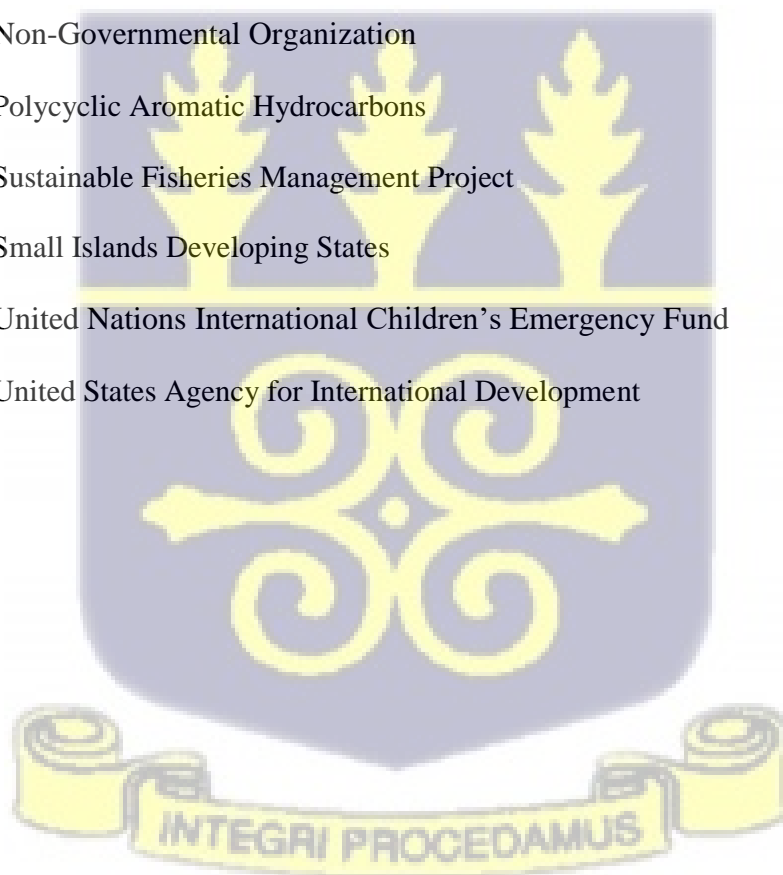
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## LIST OF ABBREVIATIONS

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BOG	Bank of Ghana
CEWEFIA	Central and Western Fishmongers Association
CSIR	The Council for Scientific and Industrial Research
FAO	Food and Agriculture Organization
FC	Fisheries Commission
FRI	Food Research Institution
FTT	FAO Thiaroye Technique
GDP	Gross Domestic Product
IAA	Impact Assessment Framework
MOFA	Ministry of Fisheries and Acquaculture
NGO	Non-Governmental Organization
PAH	Polycyclic Aromatic Hydrocarbons
SFMP	Sustainable Fisheries Management Project
SIDS	Small Islands Developing States
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development



## CHAPTER ONE

### INTRODUCTION TO THE STUDY

#### 1.1. Introduction

This chapter reviews the background of the study, the problem statement, the objectives of the study, the importance of the study and the organization of work.

#### 1.2. Background of the Study

Ghana according to Finegold et al., (2010) has West Africa's fifth-largest economic zone, a shoreline of 539 kilometres, and a continental shelf area of 20,900 kilometres. Ghana, is one of the most well-known fishing nations globally because of its large fish landing sites that are alongside the coast; its fish industry contributes about 12% to agriculture and to Gross Domestic Product, 4.5 % every year (Sakyi et al., 2019, 14). Ghana indeed has a long history of fishing with very experienced fishers relative to other African countries, which has been attributed to advanced traditions from the colonial era. Ghana has four administrative coastal regions: The Central, Western, Greater Accra, and Volta Region. Marine, inland fisheries, lagoon fisheries, aquaculture and Lake Volta according to the Ministry of Fisheries and Aquaculture (2003), are the five major sources of fish supplies in Ghana.

In fact, in 2008, Ghana's per capita fish and fisheries product consumption rate was roughly twice the average for the global market (Bank of Ghana, 2008). Additionally, the fishing industry collaborates with other economic sectors to supply raw materials, particularly to businesses that process fish, while utilizing the services and goods of other industries to run (Amarfio, 2010). According to estimates, Ghana's fish output accounts for around 3.9% of the country's GDP (Bank of Ghana, 2008). The fishing industry has been and continues to be one of the greatest sources of income generation for developing countries and a high economic contributor to global markets.

In West Africa, the artisanal fisheries sector is essential in providing food and employment to the increasing population.

In Ghana, the fishing industry employs quite a large number of individuals (fishermen, traders, processors, boat builders, and mechanics) (Nerquaye-Tetteh, 1999). Ghana is one of the most well-known fishing countries in the world due to its abundance of landing sites along the coast and on Lake Volta. Ghana has a yearly per capita fish intake of 25 kilogramme, which is greater than the predicted global and African averages of 18.9 kg and 10.5 kg, respectively (Onumah et al., 2020). Ghana's fishing industry makes a significant contribution to the country's economic development, goals of employment, poverty reduction, food security, and foreign exchange incomes.

Post-harvest losses in Ghana are usually instigated by inadequate storage facilities and poor fish handling. To reduce waste, fish is preserved using a variety of conventional processing processes (Nti et al., 2002). Fish is particularly perishable; thus, higher levels of processing are required to maintain and extend shelf life and expand sales and marketing potential. (FAO, 2016a). Fish preservation primarily inactivates germs and enzymes, extending shelf life and ensuring food safety. Fish processing uses maximum raw materials to produce value-induced products which are based on profitability. According to Davies and Davies (2009), the processing of fish ensures the highest market quality, guarantees product safety, gives good shape to the end product, uses the most appropriate processing techniques and minimizes waste as much as possible. should be reduced. According to Nerquaye-Tetteh (1979:2), methods of fish processing comprise modern (freezing and canning) and conventional methods (drying, smoking, frying, salting, and fermentation). Cold storage facilities are non-existent in rural areas as compared to big towns and cities. The lack of refrigerators, along with an inadequate transportation network, prevents the efficient distribution of fresh and frozen fish, making smoking the predominant and most pervasive fish processing method used in Ghana (Nerquaye-Tetteh et al., 2002). Till the late 1960s, the ovens most commonly used in Ghana for smoking fish were cylindrical or rectangular. (see Figures 1.0

and 1.1) and made of mud or metal (Avega & Tibu, 2017: 2). Such ovens had various flaws, including extensive fish handling during smoking.

**Fig 1.0: Round mud oven**



Source: Sakyi et al., (2019)

These ovens were inefficient in terms of fuel use, and could not handle the high amounts of fish landed during the bumper periods. (Avega & Tibu, 2017: 2). They were also unproductive, using more fuel for the smoking process than was necessary, which indirectly led to deforestation. Smokers of fish were also at risk because the smoke from the ovens reached their eyes and lungs directly. This issue was more severe in the smoking of tiny fish species like anchovies than larger species. The smoking process was time-consuming, resulting in inferior-quality smoked fish with a low market value.

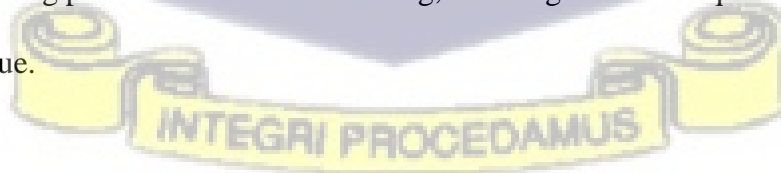
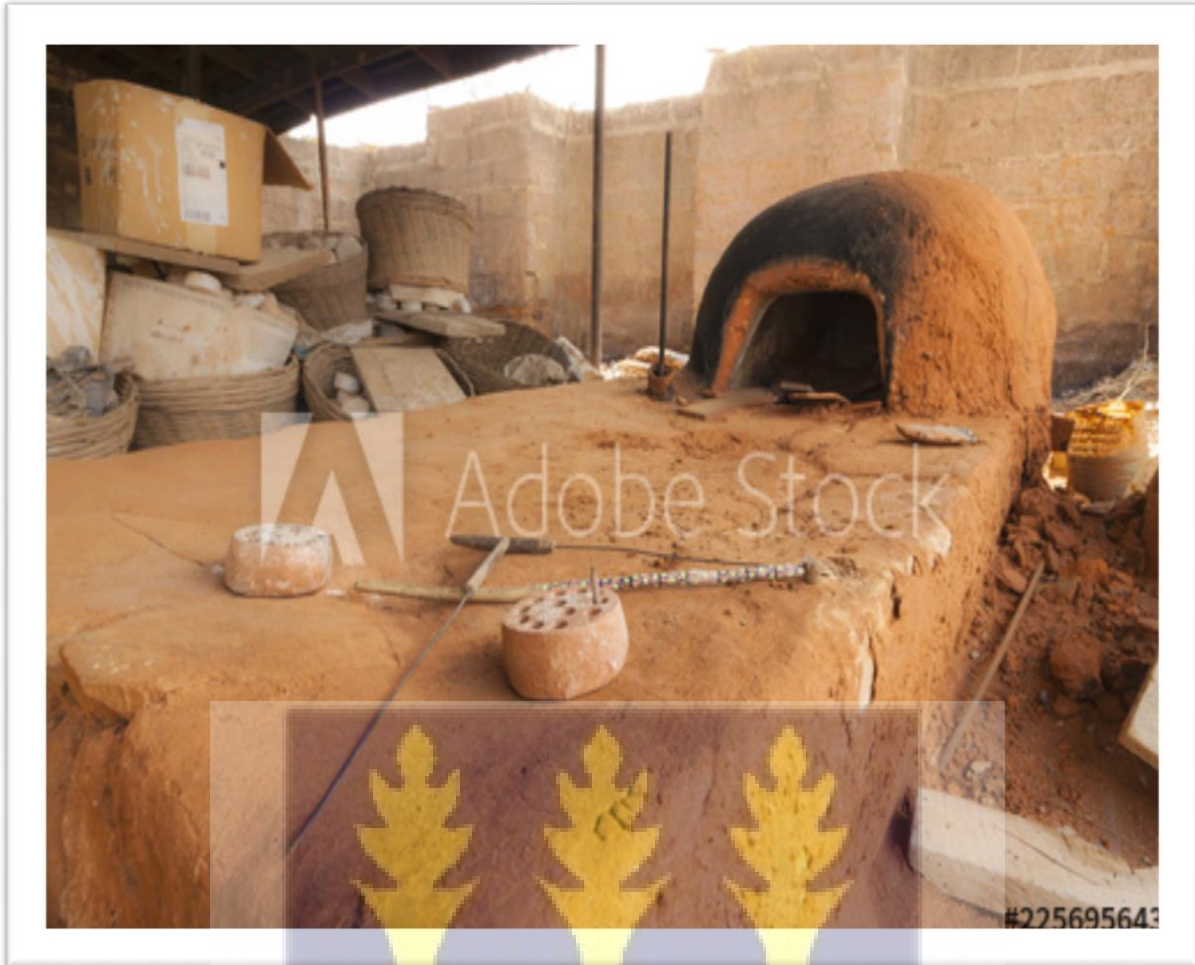


Fig 1.1 Cylindrical Oven



Source: Google Photos (2019)

In the 1950s, the consciousness of the inadequacies of primitive ovens stirred up developmental projects on improved smoking smokers, like the Nyegesi, Ivory Coast, Altona, and Adjetey. None was accepted in Ghana because they were too expensive to use (Adeyeye & Oyewole, 2016: 208-209). Considering the restraints and shortcomings of the traditional smokers, the Chorkor Smoker, (see Figure 1.2), in 1970 was developed and introduced. It was designed by Mr. B. Kagan (FAO Expert on Fish Processing Technology) with the assistance of Mrs. Gladys Nerquaye-Tetteh in alliance with some fish processors at Chorkor, a fishing community in Accra. This improved smoking technology contains combustion chambers and an area for smoking with tray sets that are normally rectangular (Nunoo et al., 2019). The combustion chamber, which serves as the smoker's foundation, is often made of mud, but burnt bricks and cement blocks can also be utilised. (Nerquaye-Tetteh, 1999). “The Chorkor Smoker is easy to operate as it alleviates drudgery

and is user-friendly” (Nerquaye-Tetteh, 1999:17). The smoker has a large capacity to reduce fuel-wood consumption and is also very efficient. The fish smoked from the Chorkor is of high quality. It is also amenable to adapt to gas fuel with a gas ring providing heat instead of wood. (Ajang et al., 2010) and has improved the working conditions of fish processors.

**Fig 1.2. The Chorkor Smoker**



**Source: Fieldwork, 2022**

### **1.3. Statement of the Problem**

Globally, fish is processed in so many forms. However, with the most pervasive processing method, smoking, there is a need for smoking technologies and ovens. A lot more processing technologies are used all along the coasts of Ghana but there have not been many discussions on the reasons for the adoption.

Studies concerning diffusion and adoption of technology by Mahajan & Peterson (1979) and Rogers & Shoemaker (1971) cited in Anane (2020) set these two processes (diffusion and adoption) apart. However, they are linked: Adoption without diffusion would be ineffective neither can diffusion exist without adoption. In addition to this, Roger's (1995) theory of diffusion which concerns itself with the spread of innovation within a population, does not incorporate socio-demographic characteristics or factors like age, culture, and economic factors in the adoption of technology but tends to focus solely on innovation or product characteristics. It is necessary to know the features of the adopters of the Chorkor smoker because it could influence an individual's ability to acquire knowledge or adopt a particular technology. My research seeks to do a more nuanced and holistic assessment of the varied ways in which these socio-demographic characteristics come together to explain the adoption of a particular technology.

In its research, the Council for Scientific and Industrial Research (CSIR) revealed unusually high levels of polycyclic aromatic hydrocarbons (PAHs) in fish smoked in the traditional "Chorkor" oven. These PAHs are recognised carcinogens (CSIR, 2018). Over the last few years, this information has resulted in the implementation of a variety of programmes to reduce the PAH level of smoked fish. Fish smoking technologies, like the FAO-introduced Thiaroye Processing Technique (FTT-Thiaroye) and "Ahotor" oven, have encountered a variety of challenges. None of these smoking ovens have been as popular as the Chorkor smoker.

Although there have been numerous studies on the adoption of fish processing technology, there is a dearth of knowledge on the adoption of the Chorkor smoker which was introduced more than 30 years ago. My interest then lies in the factors that instigated fish processors in Moree to adopt the Chorkor smoker. This is so because, understanding the design, functionality and the adoption process of the chorkor smoker can contribute to the development and improvement of smoking techniques for preserving fish. This knowledge can be valuable for communities that rely on fish preservation as a means of food security and economic sustainability.

## 1.4. Aims and Objectives

### 1.4.1 Main Objective

The principal goal of this study is to identify the factors that influenced the adoption of fish smoking technology, specifically the Chorkor smoker, in Moree in the Central Region of Ghana.

The specific objectives are summarized as follows:

1. To examine the factors that led to the adoption of the chorkor smoker
2. To examine the role socio-demographic characteristics played in the adoption of the chorkor smoker in Moree.
3. To identify the role of multi-stakeholders (NGOs, state, traditional leaders) in the adoption process of the Chorkor smoker.

### 1.5. Research Questions

In light of this, the study seeks to answer these questions:

1. What were the factors that influenced the adoption of the chorkor smoker?
2. What role did socio-demographic characteristics play in the adoption of the Chorkor smoker?
3. What were the roles of multi-stakeholders (NGOs, state, traditional leaders) in the adoption of the Chorkor smoker?

### 1.6. Significance of the Study

The study contributes to a more nuanced and renewed understanding of fish-smoking technologies and their discourses around practices in Ghana. As the data on the adoption of fish processing technology in Ghana is limited, this study adds to materials that already exist. This paper is also

beneficial to most academics and Non-Governmental Organizations to start theorizing about the dynamical and multidimensional role of gender for fish processors in Ghana.

Additionally, the results of this study are beneficial in providing feedback to non-governmental organisations (NGOs) about fish smokers' participation in NGO interventions focusing on fish-processing technologies in the Central Region. Adoption agents will also know the right approaches to use when developing new models of fish processing technologies.

This study also helps appreciate the historical journey of the Chorkor smoker and how it became the most widely used technology now amidst the introduction of other improved ovens for fish processing.

This study also provides a framework for evaluating the potential effects of governmental adjustments on fish technologies. The results will be a useful piece of knowledge for policymakers and any other program that seeks to encourage the adoption of approaches in settings similar to those in this research region. Therefore, far beyond Moree, the effects of the study's findings will be felt.

### **1.7. Organisation of the Study**

This work is organised into six major chapters. Each chapter has its sub-themes for easy comprehension. The first chapter provides an overview of the thesis. It covers the background, statement of the problem, research questions, objectives and goals, the significance of the study, and thesis organisation.

The second chapter includes a review of important literature on fishing in general and fishing in Ghana, fish nutrition, fish processing, fish smoking, the notion of innovation, innovation diffusion, the four fundamental aspects in innovation diffusion, and adopter classifications. The review also includes relevant papers on indigenous knowledge that can influence the use of traditional

technologies by fish processors, as well as demographic features of processors that influence their use of technology.

Chapter three centres on the research methodology. It justifies the use of the qualitative approach for this work. Chapter (three) also points to the discussion of how the study was conducted indicating data collection procedures and instruments, study population, sampling population, and the sampling methods and procedures. It further looks at how data collected was processed. Ethical considerations and field experiences were established and discussed in this chapter as well.

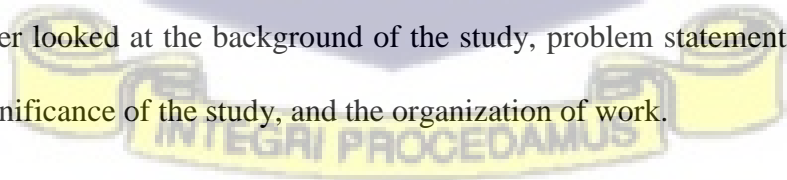
In Chapter Four, the idea of fish processing in Ghana is covered, along with a detailed explanation of the Chorkor smoker.

Chapter five presents a breakdown of the field data and a discussion of the results generated on the factors that affected the adoption of the Chorkor smoker. The data was collected from primary sources. This same chapter discusses the findings on the influence of stakeholders in the adoption of the chorkor smoker in Moree

The chapter six synchronizes the major findings of the study on the research questions and concludes the findings. It also suggests recommendations for consideration by policymakers.

### **1.8. Chapter Summary**

The above chapter looked at the background of the study, problem statement, the objectives of the study, the significance of the study, and the organization of work.



LITERATURE REVIEW

**2.1. Introduction**

This chapter's purpose is to review the available literature on the research subjects addressed in this study. This brings together theoretical and conceptual issues, as well as empirical studies that provide context and a necessary foundation for the study. Literature on the Ghana Fisheries Sector, fish nutrients, fish processing, fish smoking, the notion of innovation, dissemination of innovations, the four main aspects in innovation diffusion, and adopter types was evaluated.

The review also includes relevant papers on indigenous knowledge that can influence the use of traditional technologies by fish processors, as well as demographic features of processors that influence their use of technology.

**2.2. Ghana Fisheries Sector**

Ghana is situated close to Côte d'Ivoire and Togo in the Western Gulf of Guinea subregion. The nation has traditionally profited from abundant fisheries resources and a lengthy history of artisanal and deep-sea fishing, which is rather unusual among West African nations. The assertion made by Nyemah, Delhor, and Akakpo (2017, p. 66) is that "Over 24,300 square kilometers of the continental shelf and around 550 kilometers of coastline in Ghana provide for a thriving fishing business. The country also has a river, lake, and lagoon system that serves as the foundation for the inland fishing industry."

Ghana's population of 30.8 million has a high demand for seafood (Ghana Statistical Service, 2021). According to Koranteng and Pauly (2004), Ghana's fish stock is in decline due to pressure from overfishing, which has steadily harmed the ecology, just like in many other countries throughout the world. The FAO's 2016 report, which highlights how marine fisheries are the nation's main source of fish and that production has been dropping since 1999, from 420,000 tonnes

to 20200 tonnes in 2014, supports this assertion. The GDP contribution of fisheries to Ghana, which declined from around 6% in 1993 to 4.5% today, demonstrates this. Additionally, the fish landing has consistently decreased over time in relation to total output.

For many people in Ghana, fishing is a significant source of income. These efforts highlight the value-chain concept, which first appeared as an analytical tool for agricultural research in the 1960s (Raikes et al. 2000). Aquaculture, inland fisheries, and marine capture fisheries make up Ghana's fisheries industry. Aside producing animal protein, the fishing industry employs 2.7 million people, or 20% of the total labor force, primarily women who work in distribution and processing (Akpalu et al. 2018). Small-scale or artisanal, inshore or semi-industrial, industrial, and tuna fisheries are four marine fishing industry subsectors. The industrial sector includes trawl boats and shrimpers. All sectors' catches are dominated by small pelagic fish species, with the exception of the tuna fleets.

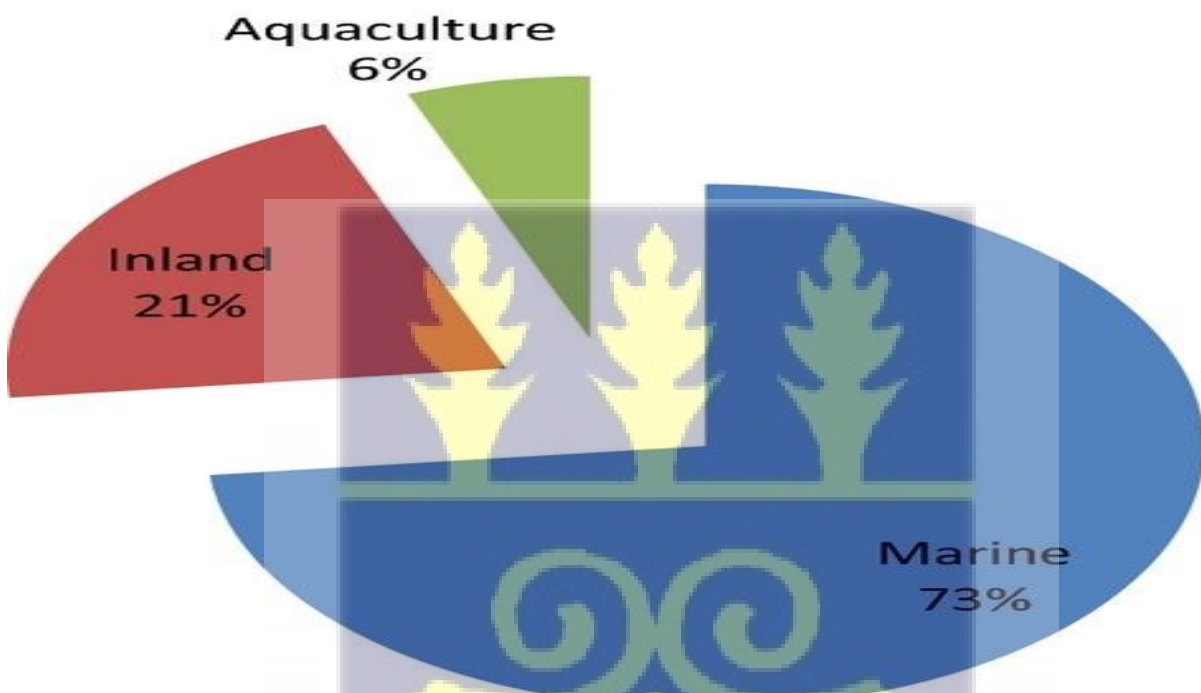
### **2.2.1. Marine and Inland Fisheries**

Ghana's economy is heavily reliant on marine fishing. It supports livelihoods and employment while also contributing to GDP. Marine fisheries primarily cover the sea, and some lagoons. The marine sector accounts for more than 80% of overall fish landings, including inshore and offshore fisheries and includes 25 crustacean species, 347 fish species, and 17 cephalopod types (Anon., 2008). Industrial, semi-industrial and small-scale (artisanal and subsistence) fishing all coexist. Because of its fish yields, the artisanal sub-sector is particularly important in the marine industry. It yearly contributes about 68-70% of the marine fish, with small pelagic fishes dominating. Small pelagics (approximately 70% of catches) include sardinella (round, flat), anchovy, mackerel, and other species such as tuna (FAO, 2016-2019). The artisanal sector is the biggest and most essential in the marine fishing sector since it employs a huge number of fishermen and processors, among other things. Total marine fish output in August 2018 was 152,132.05mt, valued at US\$2,067,734,077.77, according to the Medium-Term Expenditure Framework for the Ministry of Fisheries and Aquaculture 2019-2022.

Inland fisheries are the rearing of fish in freshwaters like ponds, lakes, rivers, reservoirs, and many more. Yet, statistics from fisheries are only collected from aquaculture and Lake Volta.

Volta Lake is Africa's largest man-made lake (8700 km<sup>2</sup>). It accounts for 90% of total inland fishing production in Ghana, employing around 300,000 people: 80,000 fishermen and 20,000 fish processors/traders (NAFAG, 2004-2005). More than 130 fish species have been found in Lake Volta.

**Fig 2.0: Marine, inland (wild), and aquaculture in total fish production**



Source: Failler et al., 2014

### 2.3. Fish Nutrients

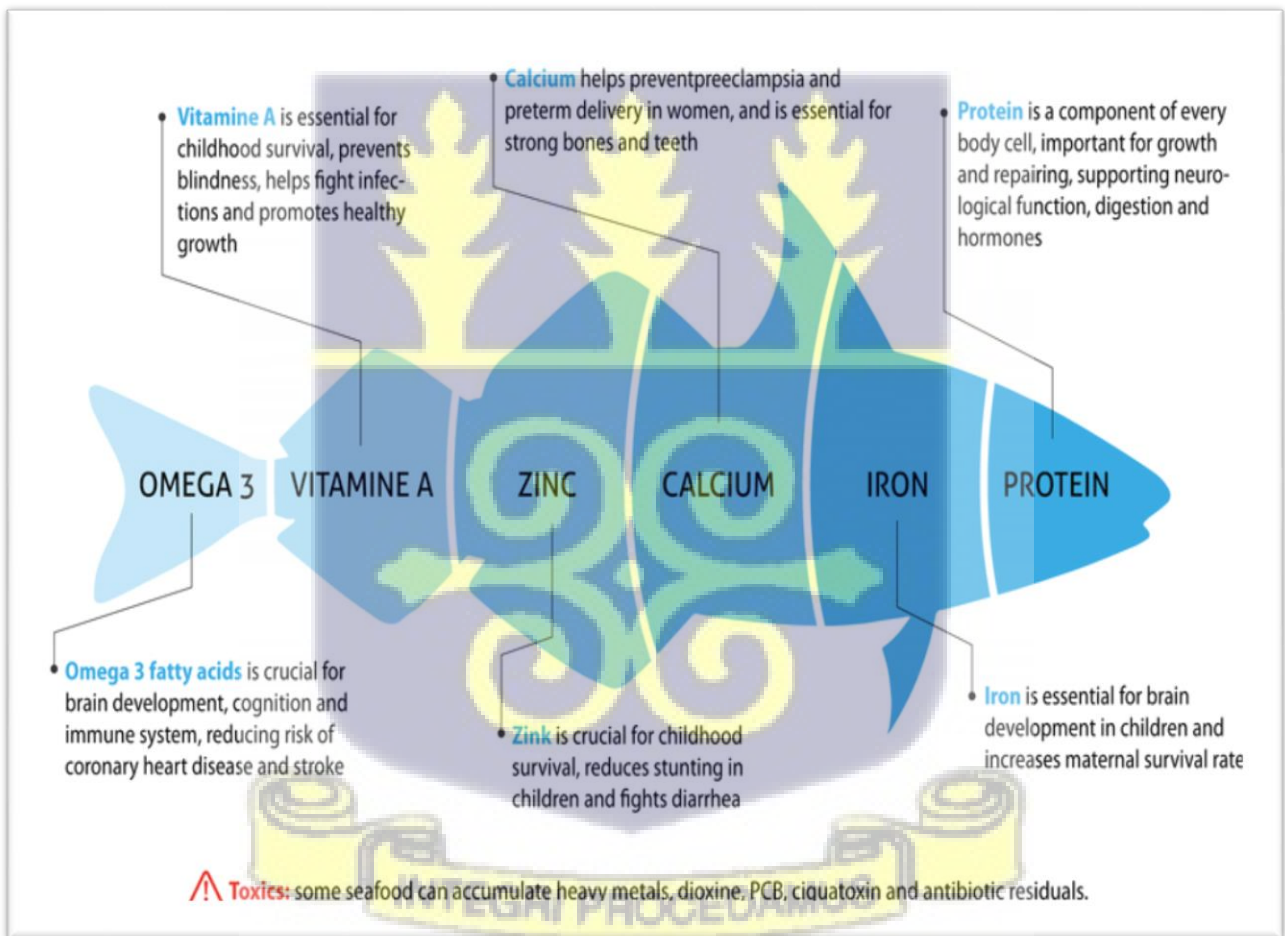
Fish is possibly the most abundant source of harvestable protein, and its unique nutrition is critical in addressing hunger, micronutrient shortages, and non-communicable diseases. For a well-balanced diet, most households in Africa and other continents include fish in their regular meals.

Fish contains nearly 15-24% protein, 0.1% vitamins A, B, C, and D, 70-84% water; 0.1-22% fat; 1-2%, 0.5% calcium and 0.25% phosphorus (Abraha, et al., 2018).

The Food and Agricultural Organization (FAO) emphasized that humans must make fish products as their primary source of protein in meals. Fish consumption has also been linked to a lower risk

of dementia, cardiovascular disease, inflammatory disorders, type 2 diabetes, psychiatric issues, and certain malignancies (Hosomi, Yoshida, & Fukunaga, 2015). Nonetheless, these characteristics are neglected and unacknowledged in the global food security debate. Development interventions associated with fish consumption and aquaculture have been targeted in some continents, such as Africa, to enhance household nutrient intake through direct food consumption, output, and an increase in income (FAO, 2020). Fish, according to Mayhew and Penny (1988), cooks faster and digests more quickly than beef. Sipe (1993) discovered a link between fish consumption and consumer longevity in his study. According to this scholar, the vast majority of Americans and Japanese who eat fish as their primary protein source have longer lives.

**Fig 2.1: Distribution of nutrients in fish**



Source: Troell, M., Jonell, M., & Crona, B. (2019).

## 2.4. Fish as Food

Fish has been a vital part of food since the era of hunting and gathering. It has been regarded as an important source of first-class protein amounting to about 17% of animal protein consumed globally and 7% of human protein consumption. (FAO, 2020). Global fish consumption has increased exponentially, culminating in a fluctuating trend in fish production since the 1970s. It is estimated that global fish production increased from 40 million tonnes in the 1970s to a record figure of 96.4 million tonnes in 2018 with marine capture contributing to 84.4 million tonnes (Tidwell and Allan, 2001; FAO, 2020). The increase in production parallels the increase in consumption, which has been largely linked to the growing population in many African countries (Tidwell and Allan, 2001) Many African, Asian, and South American countries are experiencing population growth. (Tidwell and Allan, 2001). The increasing dependence on fish as food is clearly expressed in FAO's (2020, p. 5) assertion that:

Globally, fish provided more than 3.3 billion people with 20% of their average per capita intake of animal proteins, reaching 50% or more in countries such as Bangladesh, Cambodia, the Gambia, Ghana, Indonesia, Sierra Leone, Sri Lanka and several small islands developing states (SIDS).

The great majority of African fishing communities rely on fish as their primary source of nutrient. (Gomna and Rana, 2007). This is due to the fact that fish, particularly small pelagic fish, is affordable and available in these areas. They add that many developing nations view fish as a replacement for animal protein that are inaccessible to the deprived, who make up the majority of the population. For instance, research conducted by Nti, Larweh, and Gyemfua-Yeboah (2002) on expecting mothers in Ghana found that nearly all of their participants named fish as their main source of animal protein, but that due to cost, their consumption level was insufficient to meet their health needs. This is critical because the availability and accessibility of fish to households are important in determining the health conditions of the household members in many cases, yet a household's consumption pattern of fish is mostly tied to the economic condition of the household members. This is so because according to Boatema et al. (2018), the price of food serves as

a major determinant for accessing food by low-income households. Low-income households mostly buy small pelagic fish because it is a cheaper option.

Fishing communities are mostly identified as being very poor and overcrowded, lacking most essential services, amenities and assets that allow for diversifying the livelihood of such communities (Gomna and Rana 2007). Despite the high levels of poverty recorded in fishing communities, Sousa, Martins and Hanazaki (2016) argue that fishing communities consume more fish, especially small pelagic fish. Consuming whole small fish is considered to be a better option than consuming parts of whole fish because small whole fish is much more balanced in nutrition (Gomna and Rana, 2007).

## 2.5. Technology and Adoption

Different authors describe technology in various ways. Technology according to Loevinsohn et al. (2013) is a means of generating products and services, which includes organisational strategies as well as physical procedures. Technology tries to raise a given status quo to a more appropriate level. It enables people to complete activities more successfully and efficiently than they would have in the absence of technology (Bonabana-Wabbi, 2002). Technology, according to Gershon and Umali (1993), is a factor that affects the factor of production and is subject to some degree of uncertainty, whether perceived or objective (or both). Uncertainty decreases with time as experience and information accumulate, and production functions themselves can change as users apply technology more efficiently.

Rogers (2003: 13) synonymously uses 'technology' and 'innovation'. Technology for him, is "the design for instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving the desired outcome". Rogers groups it into two: software and hardware. Software according to Rogers, (2003: 259) is "the information base for the tool", whereas hardware is "the tool that embodies the technology in the form of a material or physical object,".

Enos and Park (1988) studied the adoption of imported technologies in Korea and defined technology as the broad knowledge or information that allows some tasks to be accomplished, some services to be performed, or some products to be made. Although Enos and Park (1988) focused on non-agricultural technology, this term is applicable to agronomic technologies as well. Technology, according to them, is meant to make the task of the entity to which it is applied easier. Consequentially, the majority of technologies are labelled as capital and labor-saving. Economists see this as resource conservation.

**Adoption** on the other hand, is a personal process that details the processes one goes through from knowing about an innovation to actually adopting it. According to Bonabana-Wabbi (2002), adoption is a conceptual process that an individual goes through from first hearing about an innovation to its eventual use. A social system can become more open to innovation if people or groups accept it. Feder et al. (1985) defined adoption as the long-term incorporation of innovation into farmers' ordinary farming operations. Adoption, on the other hand, is not a persistent tendency, as Dasgupta discovered in 1989. This suggests that a person might decide to stop using a particular invention for a variety of reasons, one of which might be the existence of a different approach that is more effective at meeting their demands. Adoption rate and adoption intensity are the two main areas of interest among academics. The intensity of adoption pertains to the volume of use of a particular technology at any one time, whereas the rate of adoption refers to the relative speed with which people accept innovation. According to Cameron (1999), the dynamic process of adoption necessitates gradual technological education. Many innovations take a long time to propagate from the time they are released until they are widely accepted. According to Jones (1972), many improper decisions are made because people don't have a proper grasp of an issue, don't have enough information about potential solutions, or have too much information that is frequently contradictory.

Adoption is the choice to make complete and constant utilization of new technology, idea or innovation. By way of explanation, it is the larger scale of continuous use of a new technology until

a new one comes out. Adoption becomes easier when fish processors have access to facilities, inputs and other technological innovation, considered the factors associated with adoption into adopter characteristics, social system variables and innovation attributes, the adoption procedure is basically a process of decision-making. (Ekong, 2003).

## 2.6. Adoption of Technology

Technology adoption models are frameworks and philosophies that explain why individuals accept and use certain technologies. It also depicts how people use modern technologies in business and communication, and other sectors. Technology adoption is simply the acceptance and utilization of modern technology assuredly. Several technology adoption models explain the reasons for technology adoption. They also discuss important factors that motivate people to accept modern technology. Technology has consistently been a key player in global development and increases productivity in all spheres of work. It incorporates the factors that necessitate the change of its functions of production, taking into account potential uncertainty that could be either apparent or objective (Feder and Umali 1993). In this way, the adopters become much more capable and effective in applying and using the adopted technology.

With regard to this study, technology adoption entails adopting, as well as the application of more advanced technologies to increase adoption's productivity and standard of livings. Certain factors constantly impact technology adoption. In agriculture, favourable considerations for the adoption of production recommendations include compatibility, viability, and profitability of these technologies. The growth of fish processing has recently been significantly influenced by the application of new technologies produced by research & development. The factors that influence the adoption of new technologies have been carefully studied, whereas current technologies have received less attention.

The majority of diffusion theorists have studied technological adoption. However, the most useful is one by Rogers (1995). The growth of agriculture and fish processing industries has been significantly aided by the adoption of new technology created via research and development (Rauniyar and Goode 1992). However, fish processors are not obligated to adopt technologies merely because they exist and are available; rather, certain criteria impact their choice. It can be distressing for academics and policymakers when fish processors do not utilise the technologies that researchers and policymakers have developed. Social actors must evaluate a number of factors when deciding if technology adoption is in the best interests of the adopters because it is a complex topic.

## 2.7. Studies on Adoption

A concept, behaviour, or product that a person considers as new from a sociological perspective is called an innovation. Since the emphasis is on how an idea is perceived, the innovation just needs to be new to the specific adopter. This implies that adoption is a mental process that begins with learning about innovation and ends with opting to fully implement the new concept (Rogers and Shoemaker 1971). Due to their inaccuracy and inability to discriminate between an individual or aggregate adoption, Feder et al. (1985) suggested that sociological definitions of options are typically indicative of more thorough theoretical and empirical investigation.

Adoption has traditionally been seen from two angles, citing Yigezu et al. (2015). Each household decides whether to adopt and how intensely to adopt at the individual farm level. Farm-level adoption research focuses on the factors that influence the adoption decision, either statistically or dynamically by incorporating learning and experience. Since the objective of diffusion models is to identify specific trends in the diffusion cycle through time and space, they do not expressly refer to the invention process.

An innovation is a technological production element from an economic perspective, but there are subjective and/or objective doubts about how it will affect production. By learning from their

accomplishments, adjusting the idea, and refining its application, farmers were able to reduce uncertainty over time. The degree of use in long-run equilibrium has been defined by economists as ultimate farm adoption since the farmer is completely aware of the new technology and its possibilities.

## **2.8. Factors Influencing the Adoption of Fish Processing Technologies**

This literature explains investigations of factors that impact decisions to embrace new technology, as well as the technology diffusion process among individuals and across groups. As a result, more people choose to use new technology. It is extremely difficult to get a concept implemented, even when its benefits are evident. The history of innovations teaches us that proven concepts and programs usually take far too long to become part of a practice. Technology adoption is always influenced by several factors. Major factors have been identified by scholars in the literature on fish preservation technologies on the African continent.

In the aquaculture sector, Asche (2008) observed that modern-day technologies can aid growth in the following ways:

1. increasing farm productivity
2. increased fish supply and
3. decrease in consumer prices

In agreement with the above, Dey et al. (2006) also added that the adoption of the Impact Assessment Framework (IAA) as an improved technology in aquaculture-agriculture in Malawi improved fish commerce and exports, resulting in job creation that aided general development. He also asserted that IAA households as compared to non-IAA households were likely to have:

1. higher farm productivity
2. greater technical efficiency
3. greater human capital.

4. higher human capital and social capital result in higher efficiency for farmers.

The artificial spawn of significant species, for instance, has been shown to have launched aquaculture development in the shrimp, and tilapia industries, according to Kumar and Engle (2016). It is therefore prudent to say that the adoption of an innovation is accompanied by some advantages and benefits.

### 2.8.1. Education

In the literature on the adoption of fish processing technologies, one major factor was identified by these scholars and researchers on education (Kumar, Engle, and Tucker, 2018). Educational levels play a significant role in influencing respondents' choices since more educated people are more dynamic in responding to technology advances. In most cases, studies that have established the relationship between education and adoption relate it to formal education. Education is usually believed to create an advantageous intellectual and mental attitude for the approval of newer practices. Adoption literature (Rogers 1983) shows that the complexity of technology hurts adoption. Therefore, education ought to reduce the complexities that come with technology. The ability to read and understand sophisticated methods inscribed on technological packages is important to adoption.

For example, in Northwestern Nigeria, Bolorunduro, Adesehinwa, & Ayanda (2005) found that the adoption of the Altona Kiln which was positively and significantly related to educational attainment because of the complexity of the kiln required knowledgeable persons to use them. In addition to the above, Özçatalbaş (2014) cited in Alabi et al. (2020) affirmed that the central importance of education in every facet of life cannot be overemphasized because it gives room for innovation awareness and applicability for maximum productivity. Comparably in Ghana, Okorley et al. (2001) in their research on production constraints of women in the Central Region cited a lack of understanding about fish processing technologies as the cause for the low rate of adoption of fish processing methods. Caswell et al. (2001) conclude that adopting management

technology is likely to be influenced by high levels of farm operator education; however, Bonabana-Wabbi (2002) disagrees. In her research, she discovered that the amount of education had little bearing on the adoption of Integrated Pest Management in Uganda.

Individual's level of education, according to Umunna (2010), enables people to control the rate of message input and acquire the ability to retain and retrieve information for future use. Through education, individuals get the ability to seek and apply information in problem-solving. This is because the ability to read broadens their scope to include external printing of technology information.

### **2.8.2. Age and Level of Experience**

Age can also be highlighted as a factor in innovation uptake. It is believed that older people are better equipped to analyse technology information than younger ones since they have gained knowledge and expertise over time. Age, on the other hand, has been demonstrated to have a detrimental impact on technology uptake. Rogers (1995) classified the older generation as "technology laggards," who are skeptical of contemporary technologies. Younger farmers in Swaziland were more likely to use more modern farming techniques for the same level of capital and labour availability (Rauniyar and Goode 1992). The age of processors affects the adoption of the Burkinaabe kiln in Northwestern Nigeria, as examined by Bolorunduro et al. They came to the conclusion that older processors might be interested in using this kiln.

The age of adopters had a detrimental effect on the adoption of innovative aquaculture technology in Africa (Harrison 1995), and soft-shell crab farming in the United States (Caffey and Kazmierczak 1994). Older farmers in Bangladesh also had a lower degree of comprehension and awareness of changing aquaculture practices (Alam et al. 2012). In the majority of these cases, older farmers rejected innovations that were anticipated to yield better results. Alabi et al. (2020) found that 77% of their respondents under the age of 50 have the physical strength to do the strenuous duties required in fish processing. In line with the above, further investigations (Ake Assi et al.

2014; George et al., 2014) have also shown that individuals engaged in fishing activities are usually in their youthful stage. This justifies why Bolorunduro and Adesehinwa (2007) perceive this age group to be economically engaged and more likely to accept innovations.

Some studies have also related age to adoption decisions. It is more likely that the age of a fish processor will influence adoption in one or more ways. Older processors are believed to be experienced, have more resources, and authority, giving them more opportunities to experiment with newer technology. Poison and Spencer (1992) assume that younger farmers will accept innovations more readily than older farmers due to their understanding of new procedures and willingness to take risks. Panin (1988) discovered, however that, because these factors have a favourable influence on their experiences and decisions regarding the adoption of innovations, elders in African communities are viewed as superior.

**Level of Experience:** This is simply the number of years a fish processor has been in business. Older fish processors are assumed to have been working for many more years and are better able to evaluate the technology. Kebede et al., (1990) agree with the assertion above. They explain that experience enhances one's ability to make judgment calls about whether implementing technology will result in large profits or not, which influences one's desire to accept a particular invention. Even though Rogers (1995) categorized the older group as “technology laggards” who view newer technologies doubtfully, the case of Moree is different. Since the participants have fish smoking experience, it is anticipated that they will allocate resources well and adopt certain principles, which call for good management abilities for maximum production.

This is similar to Dankwa's (2001) finding of a high level of adoption of technologies in the Ashanti Region which he attributed to the long working experience of the cocoa fanners and contacts with front-line extension staff. It is widely acknowledged that a lot of information has been accumulated over the years of employment. Therefore, it is anticipated that fish processors' opinions of improved technologies will be positively influenced by their cumulative experience. Ex-

experience is probably a good indicator of how to fish processors will succeed in the future. Experience, therefore, has a favourable impact on adoption. Numerous studies backed up this claim. In their 1992 study in Ghana on the variables influencing the adoption of suggested cocoa production techniques, Asante and Seepersad discovered a strong association between the adoption of recommended practices and the success of the cocoa farm. The adoption of sweet potato varieties and agricultural experience in the production of sweet potatoes were found to be positively correlated, according to Geta, Dadi, and Adugna's research from 2005.

### **2.8.3. Social Actors**

The influence of social actors on technological adoption is another aspect that influences the adoption of fish processing technologies. With social actors, they refer to key informants or people with power in a given society who are key in the adoption of technology. They are key because they provide adopters with requisite information about the technology and its benefits. Information reduces certain uncertainties about technology and hence may change an individual's assessment over time (Caswell et al., 2001). Traditional leaders, public officials, and non-governmental organizations especially in Ghana are instrumental in the spread of information about an innovation. Through engagement, leaders in any social structure can influence their members. Potential adopters are more inclined to use an invention if their heads and leaders believe in it. Every social system has specific and vital roles for social actors. In Ghana specifically, subjects in rural communities are ruled and governed by customs and traditions therefore, traditional leaders in these areas are most respected. In this regard, innovation or technology adoption championed by these traditional heads is likely to be adopted by the subjects. In most cases, the higher-ups' adoption of technology is discussed before it trickles down to the main users of that particular technology. Furthermore, these social actors are of great influence, have contact with change agents, are experienced, and are exposed. They also have higher socioeconomic status and are very innovative.

Commonly, individuals are liable to adopt a way of life because of the kind of people who champion them. In this regard, adopters are more likely to accept a specific technology based on the type of information they acquire. The right information is needed at the beginning, during, and after the adoption process. This type of communication is a special one in that the messages concerning new ideas are created and shared with individuals.

#### **2.8.4. Level of Awareness**

Rogers saw the first stage in the adoption process as recognizing a need. According to Odediran and Ojebiyi (2017), a high level of awareness is a critical instrument for the adoption of technologies. In Nigeria, Alabi et al. (2020) also mentioned that in Epe, the awareness of the introduction of fish smoking ovens was noticeably high among fish processors because Epe received a lot of attention from agencies and non-governmental organizations as compared to other areas.

Likewise in Ghana, Buadi (1992: 9) in his study on adoption in Tema made it known that “potential adopters are likely to adopt innovations depending on the source from which they obtain information. They usually obtain information from different sources for their adoption decisions”. In his literature, he stated that at each stage of the adoption process, information is required. The information should be detailed enough to answer the questions asked by the adopters and also to enable the adopters to make the right decisions. In the same vein, Jones (1972:17) specified that inappropriate decisions may emerge as an outcome of a wrong analysis of a problem, or of failure to obtain appropriate knowledge (or because of contradictory information) on possible innovative solutions. Individuals or potential adopters are likely to reject an innovation when information about the innovation is not clear, precise, and relevant.

William, (1968) significantly stated the positive connection between the dependent variables and social participation variables. He asserted that extension agents are important information carriers because they have a significant impact on the adoption of recommended agricultural techniques. According to Pradesh, as described by Dasgupta, (1977), most information on new technology is transmitted by extension agents who prefer contact with the wealthier and larger farmers, and

further dissemination of this knowledge is limited to their relatives and friends. Certain features must be present for any innovation to be easily and broadly embraced. This study would look into some of these.

According to Alabi et al. (2020), Epe in Nigeria received more attention from agencies and non-governmental groups than in other places, therefore fish processors there were visibly more aware of the deployment of fish smoking ovens. In Ghana, Buadi (1992: 9) found that "possible adopters are likely to accept innovations depending on the source from which they acquire information" in his study on the adoption and proliferation of the Chorkor smoker in Tema. They typically get data for their adoption decisions from a variety of sources. He claimed in his writings that accurate knowledge is necessary.

#### **2.8.5. Cost and Availability of Inputs**

The adoption of technology can also either be enhanced or hindered depending on the cost of inputs. In Ghana, Nti et al. (2002) stated that fish processors did not adopt a technology due to their inability to purchase the inputs for the construction of the oven. In the same study, it was noted that 78 to 90 percent of respondents observed that lack of finance or credit, cost, and availability of inputs were paramount to the adoption of technology. Odediran and Ojebiyi (2017) writing about fish processors in Lagos State, Nigeria as well as El Oster and Morehart (1999) writing about farmers in Eastern Uganda have made similar arguments about the significance of credit in increasing technological adoption.

Adoption decisions are frequently financial ones. Additionally, this choice alters the investment possibilities available to fish processors. As a result, the cost of technology and whether fish processors have the necessary resources can be predicted to affect acceptance. Capital-intensive technologies are only accessible to wealthy individuals; thus their adoption is restricted to people with the resources. Additionally, small-scale modifications are adopted more quickly than large-scale ones, so the cost of technology may have an influence on both the rate of adoption and the extent.

### 2.8.6 Technological factors / Characteristics of Innovation

The term "innovation" covers thoughts on things an individual or group perceives as new. How potential adopters perceive an innovation influences their decision either reject or adopt it. An individual's perception of a specific technology may differ from that of extension agents or organisations championing the adoption perceive that same technology. Thus, while they see the innovation as a "compulsory- need", the adopters may have a different feel or view about the innovation. According to Rogers (1975), research on technology adoption has a "pro-innovation bias." This means everyone should embrace innovation because it is good. However, it has been recognized and noted that not all innovations are the "best course of action" available to people or groups.

The fact that it may be so challenging to have a new idea embraced, even when it has apparent benefits, is one reason why there is so much interest in how ideas spread. There is a considerable gap between what is known and what is being used in many fields. Many innovations require a large amount of time, often many years, from the moment they become available until they are widely embraced. As a result, how to accelerate the rate of innovation diffusion is a prevalent issue for many people. Innovation is an idea, practice, or product that a person or other adoption unit perceives as novel. Whether a concept is "objectively" new as determined by the amount of time that has passed since it was first used or discovered has no bearing on how people behave. The individual's response to the idea depends on how novel it seems to them. Innovation is a concept that the person perceives as novel and, in this case, the characteristics of the technology are very important in determining whether it will be adopted or not.

For example, Mignouna et al. (2011) discovered in their study of the adoption of imazapyr-resistant maize (IRM) technology in western Kenya that technical characteristics play an essential part in the adoption decision-making process. They contended that farmers who believe the technology meets their demands and is ecologically beneficial are more inclined to adopt it because they regard it as a good investment. Practitioners' perspectives heavily influence their decision to

adopt technology. Another study by Adesina and Zinnah (1993) found that farmers' perceptions of features of contemporary rice varieties influenced their decision to adopt it. The attributes of the technology itself, without a doubt, play a significant role in a fish processor's decision to embrace new technology. According to Rogers (2003), perceived characteristics of the innovation that can increase adoption are relative benefit, compatibility, trialability, observability, and complexity.

Rogers concluded that these five characteristics account for between 49 and 87 percent of the diversity in new product acceptance.

1. **Relative Advantage:** This is the extent to which the innovation being presented is believed to be superior to the former or existing technology (Rogers, 2003). Technology will easily be adopted if an individual finds it more advantageous. According to Rogers (1961a), early adoption is preferred when an innovation has a comparative advantage over previous practices. Thus, in simple terms, the more advantageous the innovation, the faster it will diffuse through a social system. This feature will influence adoption, especially if it is more useful in terms of productivity, cost-effectiveness, or riskiness (Batz et al. 1999). Nutritionally balanced feed formulations have contributed to higher aquaculture production (Kumar et al. 2016). These innovations enhanced the availability of aquaculture goods, as well as the economies of scale and scope, while lowering production costs and consumer prices (Asche et al. 1999).
2. **Compatibility:** This is also another important attribute of technology adoption. According to Rogers (2003), compatibility is the degree to which a new idea is perceived to be compatible with existing practice or environmental conditions, socio-cultural objectives, and indigenous technology. Similarly, Kaasinen (2005) defined it as the level at which adopting technology is compatible with what people do. That is its conformity to adopter needs, norms, beliefs, and previous experiences. When something familiar is associated with in-

novation, it sets the setting for the mental reaction to its acceptance. Jones (1972), Santopolo (1961) and Yeracaris (1961) found that compatibility is important in determining technology adoption.

Also with compatibility, the technology is supposed to have something in common with the old mode of usage. Thus, there should be something about the old technology which can be identified in the new technology making its usage very easy for adopters. The innovation should not be totally different from the old one so much so that adopters will find it difficult to even understand its use.

3. **Trialability:** This is an individual's belief that he can experiment with innovation on his own. The trialability of innovation influences whether it will be adopted or rejected by prospective users. According to Abara and Singh (1993), rice farmers welcomed new varieties only after seeing significant production improvements on their farms. Trialability is strongly related to adoption rate and is a key factor influencing the adoption decisions of early adopters (Rogers 1995).
4. **Observability:** If a potential adopter sees an innovation's ability to create a financial benefit, the innovation is more likely to be embraced. When the consequences of practice are easily visible, this is referred to as observability. O'Connor (2007) discovered that the great visibility and demonstrability of online services drove more people to sign up for internet connections.
5. **Complexity:** Adopters are less likely to accept an innovation if it is complex and difficult to use. Complicated innovations pose a risk to potential adopters because they require complex abilities in order to comprehend the technical know-how of the invention. Kivlin (1960) also showed that with the exception of relative benefit, the complexity of inventions was more strongly associated in a negative way with their rate of adoption. Additionally, since educated farmers are capable of learning quickly and can read and comprehend farm

material better than other farmers, they appear to absorb more knowledge through interactions with extension personnel (Boahene, 1993). Therefore, education ought to reduce the complexities that come with technology. The ability to read and understand sophisticated methods inscribed on technological packages is important to adoption. However, it was very easy for fish processors to adopt the Chorkor smoker despite their low educational backgrounds. Some scholars (Khanna, 2001; Samiee, Rezvanfar, & Faham, 2009) agree with my assertion above that education has little or no impact on how quickly people accept new technologies. According to research on how education affects the acceptance of technology, formal education has a detrimental impact on the adoption of genetically modified crops (Uematsu & Mishra, 2010). The construction of the Chorkor smoker is also very easy as no special tools and fabrication methods are needed and some of the fish processors constructed it themselves.

Hence, innovations that are perceived to have a high degree of relative advantage, compatibility, and less complexity are more likely to be adopted than those that do not (Rogers, 2003).

### **2.8.7. Group Association**

The association with a group (fish processors association) is important for technology adoption. In general, it has been found that fish processors who belong to a group or an association and are active members use technology more frequently than non-members. Being a member makes it easier for them to receive information on new technology, material inputs like ovens, smoking trays and loans to pay for hired labor and input purchases. Belonging to a social group strengthens social capital and enables the exchange of trust, ideas and information.

Farmers in social groups communicate their expertise on the benefits and uses of cutting-edge technology. Uaiene et al. (2009) assert that social networks have a major influence on people's decision-making. Additionally, it is claimed that farmers collaborate and learn from one another in the unique environment of agricultural innovation. Katungi and Akankwasa (2010) looked at the adoption of the corn-versus-banana technology in Uganda and found that farmers who partic-

ipated more in community-based groups were more likely to participate in social learning. Although many researchers have reported that social groups positively impact technology uptake, social groups can also negatively impact technology uptake, particularly in the presence of free-riding behaviour. Bandiera and Rasul (2002) suggest that learning externalities have opposing effects. For example, the more individuals are experimenting with new technologies, the more beneficial it is to participate in and free-riding someone else's experiment.

## 2.9. Theoretical Framework

The study's theoretical framework adopted is the adoption and diffusion theory which fall under social change and modernization theory. This theory by Rogers has gained much recognition in the area of adoption of a technology or innovation. According to this theory, economic development encompasses the alteration of the social structure permitting the proliferation of innovation and technologies that would make impact (Musa, 2006).

Several theories and models have been proposed to investigate the factors influencing the adoption of new technology. Creswell (2009) argued that theoretical underpinnings are necessary and important for research. A theory helps to shape the research questions. It also explains how data should be collected and analysed, as well as provides a call to action. According to Hennink, Hutter, and Bailey (2010), a theoretical framework influences research design and data collecting. According to Creswell (2009), theory is an interconnected structure of beliefs or ideas used to explain behaviour and attitudes.

Many technology acceptance theories exist in information systems research, according to Oliveira and Martins (2011), however Rogers' diffusion of innovations theory is the best relevant theory for this research. Rogers published this theory in 1962, and it has since been widely used to uncover innovations that have been approved or rejected. The notion of diffusion of innovation explained how a new idea, product, or innovation spreads throughout society (Rogers, 1962). Many agricultural studies, both worldwide and locally, have used Rogers' diffusion of innovations theory as the theoretical underpinning.

### 2.9.1. Stages of Adoption

Rogers and Beal (1957) and Rogers and Shoemaker (1971) hypothesised five stages that innovation goes through before it is used by an individual:

1. The Awareness Stage: Rogers (1983) perceived this stage as the first step in an adoption process. At this stage, individuals may be exposed to the innovation and become aware of it but lack full detail of it. For instance, they may know only the name of the technology but not how to use it for production. The individual becomes aware either through a discussion with friends or relatives and also through numerous means of publicity like magazines, newspapers, the internet, and television amongst others. The major purpose of the awareness stage is to start the subsequent stages in a sequence that will eventually result in either the acceptance or rejection of the innovation.
2. The Interest Stage: Individuals at this level begin gathering specific and thorough information about the technology that will be used. The person wants to know how it works, the costs involved, qualities, features, and other relevant information. By Beal and others (1957) and Levidge and Steiner (1961), the interest stage was referred to as the “Information” stage, and by Levidge and Steiner as the “Knowledge” phase.
3. The Evaluation Stage: The individual at this stage determines the worth or value of the innovation and decides whether or not to test it.. He compares different aspects of innovation with the existing product to decide on whether the innovation should be tried out or not. The evaluation stage is perhaps the least distinct of the five adoption stages and one of the most challenging from an empirical standpoint to interview respondents. At this point, the person experiments mentally with new concepts or methods. He adapts the knowledge from the earlier stage to his own circumstance. The appraisal step has also been referred to as "application" (Bael and others, 1957; Bael and Rogers, 1960),” acceptance” (Copp and others, 1958), and “conviction” by other researchers (Rogers and

Yost 1960, Rogers and Pitzer, 1960). The evaluation stage, along with the trial stage to some extent, is essentially the same as the Lavidge and Steiner steps of “liking” and “preferred” (1961). All of these phrases suggest that at the evaluation stage, an affective component of behaviour—a pleasant or unfavorable feeling toward the idea—is present.

4. The Trial Stage: The individual at this stage tests the innovation. These are generally small-scale trials to test their effectiveness. The majority of people will not adopt an invention without giving it a trial run first. While the rejection of innovation may happen at any point of adoption; it occasionally happens when trial- stage results are perceived incorrectly.
5. The Adoption Stage: If the trial yields positive results, the individual will eventually adopt or buy the technology for successful use.

Even though the stages follow a sequential order, Singh (1965), affirmed that the stages of adoption are not static but dynamic. The same five steps do not occur with all adopters or practices. The order is not always consistent.

### 2.9.2. Diffusion

Rogers explained diffusion as, “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 2003, p. 5). It is also a peculiar form of communication whose messages are about a new idea. This new idea in the message content gives diffusion its specialty. “The newness means a degree of uncertainty is involved” (Rogers, 1995, p. 6). It is also arguable that diffusion is a type of social change because it can alternate the structure and functions of the social system.

## Elements of Innovation Diffusion

Rogers proposes four main elements as the means of influencing technology spread. The innovation itself, communication channels, time, and a social system are examples of these. He also argued that diffusion manifests itself differently in different cultures and fields, and that it is largely dependent on the type of adopters and the innovation-decision process.

- 1. Innovation:** This is an “idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers, 2003:12). It can also be an object of social change. If an old innovation that has been developed some years back is seen as new by potential adopters, then it may still be an innovation for them. Uncertainty is another major impediment to the adoption of new technologies. The outcomes of innovation may create some uncertainty. Rogers (2003) defines consequences as changes that occur in an individual or a societal system as a result of the adoption or rejection of an innovation. To reduce uncertainties in technology adoption, individuals must be well-versed about the imminent advantages and disadvantages of the innovation to make them aware of all its consequences. Furthermore, Rogers makes assertions that consequences could be categorized into anticipated versus unanticipated and desirable versus undesirable and direct versus indirect.
- 2. Communication channel:** This channel transfers information from one individual to another in a social system. Rogers (2003:5) explained communication as “a process in which participants create and share information to reach a mutual understanding”. It operates across channels between sources. Rogers also mentions that a source is a person or organisation that creates a message. “Channel is simply the means through which a message gets from the source to the receiver” (p. 204).

Rogers grouped communication systems into two categories: mass media and interpersonal channels. Although mass media disseminates information more quickly, Rogers argues that interpersonal channels are more vital for the dissemination of innovations or technology. Interpersonal channels involve communication between two or more individuals, whereas mass media channels include mediums such as television, radio, or newspapers. Typically, mass media channels are the most effective means of raising awareness about an idea. Interpersonal channels, such as one-on-one or face-to-face discussions between people, are more effective in persuading people to embrace a new notion. As a result, interpersonal channels are more powerful in shaping an individual's strong attitudes. This is why it is much easier for a fish processor to adopt an innovation from a colleague processor than from an extension office.

Communication channels are also classified as localised and cosmopolite, as they communicate between members of a social system and outside sources. Although practically all mass media channels are worldwide, interpersonal channels can be either local or global. As a result, at the knowledge stage of the innovation-decision process, mass media and cosmopolite channels are more significant, but and interpersonal channels are more relevant at the persuasion stage (Rogers, 2003).

3. **Time:** Time refers to how long it takes for people to accept a social innovation. Generally, it takes time for individuals to get used to new ideas and technologies. For instance, it took a while for the Chorkor smoker to be adopted after its introduction to the people of Chorkor.
4. **Social systems:** This is the last stage of the diffusion process. According to Rogers (2003), social systems are a collection of interrelated units that work together to solve problems in order to reach a common goal. Individuals, groups, and organisations are all compo-

University of Ghana <http://ugspace.ug.edu.gh>  
nents of social systems. When technology is not embraced by a social structure, it is use-  
less. As the diffusion of innovation occurs in a social system, it can then be manipulated  
by the social structure.

Diffusion also can be explained as to how technologies and innovations are spread. It is the prod-  
uct of a series of individual decisions to begin using the new technology, decisions that are typi-  
cally the result of weighing the unknown benefits of the innovation against the unknown costs of  
adopting it. Rogers (1995), as referenced in Anane (2020), defined innovation adoption as a life  
cycle with five types of adopters.

### 2.9.3. Adopter Categories

The breakdown is based on the population's tendency to accept a specific innovation. Innovators,  
early adopters, early majority, late majority, and laggards are the various classes.

According to Rogers (1995), **innovators** are people who are willing to take chances and attempt  
new ideas, who often serve as gatekeepers in their communities, and who are often slightly outside  
the local system and its associated constraints. Innovators are the first to accept an innovation, yet  
they account for only a small percentage of all adopters (2.5%).

**Early adopters** are individuals who are eager to acquire technology but do it cautiously and  
slowly. According to Rogers (1995), they are more rational and capable of working with abstrac-  
tions than late adopters, implying that they are more efficient at determining the most effective  
strategy to achieve a given goal. They do not need to see the innovation in action to recognise its  
value. Early adopters account for around 13.5% of total adopters.

There are also people who are cautious but open to change more quickly than the ordinary person.  
They are less likely to hold "opinion leadership" roles in their communities than early adopters,  
but they communicate with others in the system on a regular basis. They frequently spend more  
time debating whether to accept an invention before proceeding with it. The **early majority** ac-  
counts for roughly one-third of all system adopters.

**The late majority** is a group which is more likely to accept an innovation later than the average member of a local system. Members of this group's decisions are most likely influenced by peer pressure, and they maintain a socialise attitude. They mainly adopt an innovation because other people have already adopted it and are benefiting from it. They have low educational attainment and participation, and rely primarily on local information sources. The "late majority" accounts for around one-third of all adopters.

The last category, **laggards** are the traditional and old-fashioned people who are sluggish to revolution and analytical toward new ideas, and will only adopt or attempt them after the new ideas have become the order of the day. This group accounts for around 16% of all adopters. Diederer et al. (2003) define "laggards" as either "late adopters" or "non-adopters" of mature technology. When the laggards ultimately adopt an innovation, it may have already been surpassed by a more recent idea that the innovators are already employing.

Rogers further categorized these five kinds of adopters into two groups: early adopters and late adopters. Early adopters are innovators, early adopters, and the early majority, whereas late adopters are laggards and the late majority. The phrase "late adopter" refers to people who adopted an innovation but were not among the first 25% of potential consumers. Each group has its own "personality," at least in terms of its reaction to a certain innovation. According to Rogers (2003), a person's social position is generally positively connected with his or her level of innovativeness. This explains why those who are looking for a higher social position are more likely to adopt innovation, possibly even through the use of technology.

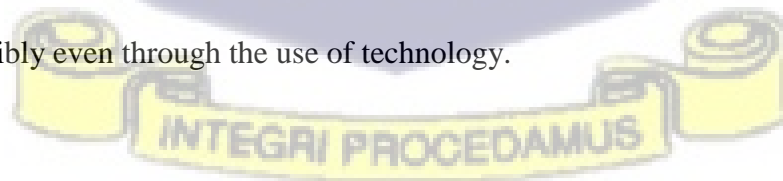
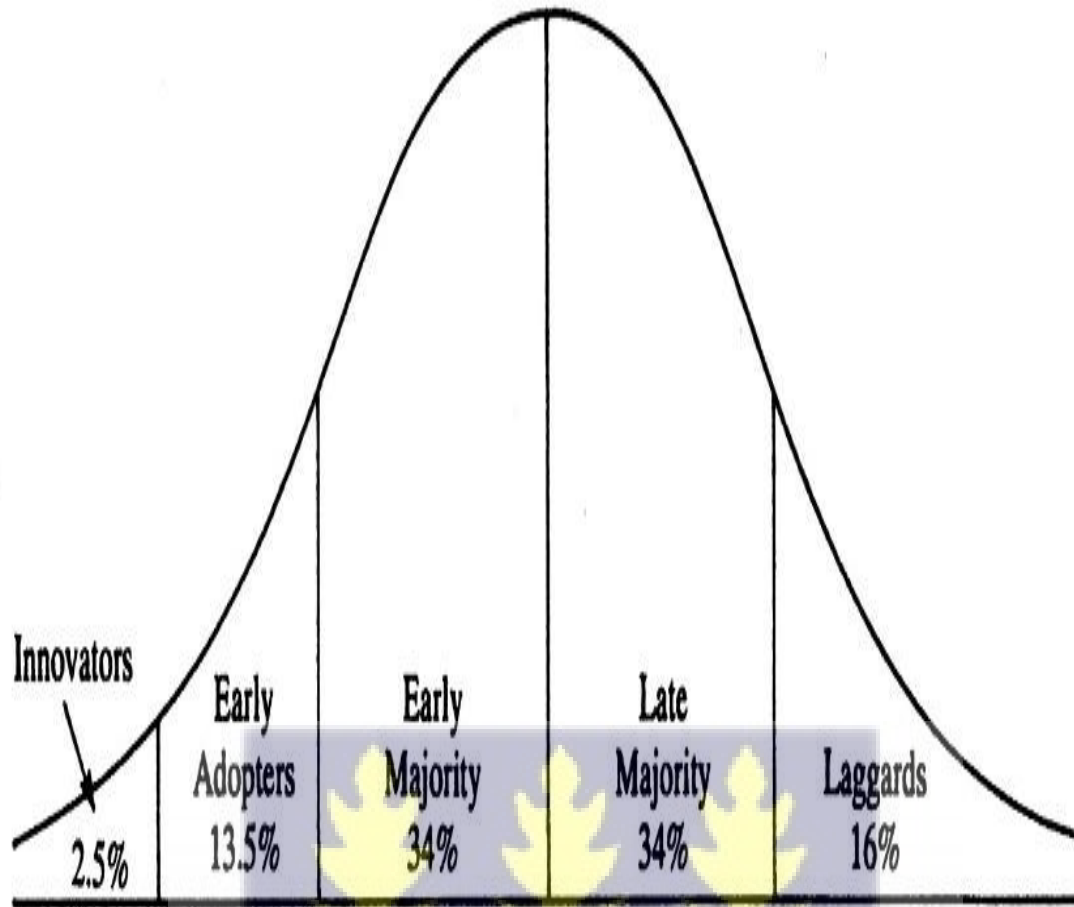


Fig 2.2: Diffusion of Innovations (Rogers, 2003)



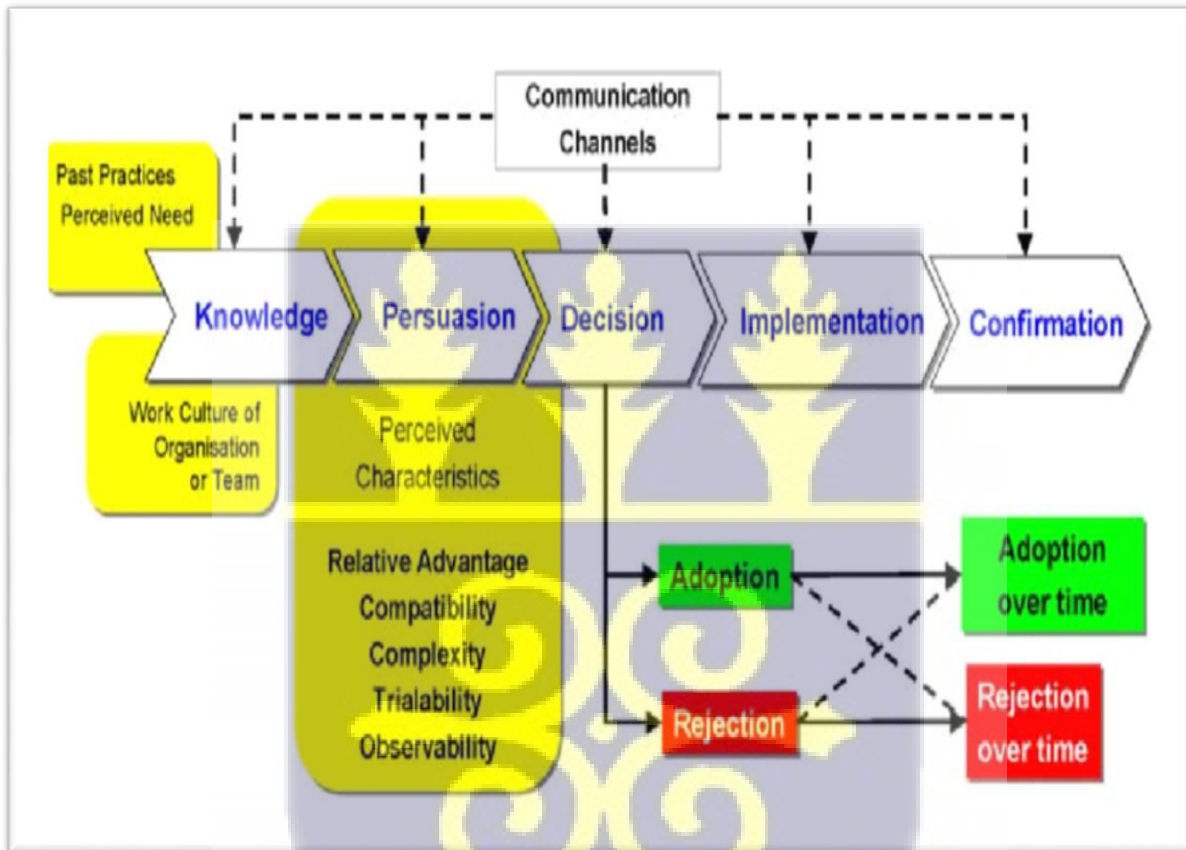
Source: Diffusion of innovations. Rogers (2003)

Morris and Doss (1999) discovered that the number of adult men in the farmer's home is substantially related to the adoption of agricultural innovations. Morris and Doss' findings refute Rogers' (2003) claim that adults (in the Ghanaian context) are those above the age of 18 who have the necessary means and a tendency to adopt innovations. Because they are afraid of taking chances, the elderly (those over the age of 60) are hesitant to accept new technologies (Rogers, 1995). Younger people (those under the age of 18) are adventurous, but lack the finances to accept advances like middle-aged adults. Perhaps this is why Rogers (2003) stated that there was no substantial difference between early and late adopters.

**2.9.4 The Innovation-Decision Process**

This process is defined by Rogers (2003:172) as “an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation”. This includes five stages: knowledge, persuasion, decision, implementation, and confirmation. These steps are generally arranged one after the other. This is shown in figure 2.3:

**Fig 2.3.: Five Stages of the Innovation-Decision Process**



Source: Rogers (2003)

***Knowledge Stage***

The knowledge stage is the first step in the innovation-decision process. Individuals learn about the existence of innovation and seek knowledge about it at this stage. “What?”, “How, and why?” are some of the questions asked. Individuals determine “what the innovation is about and how and why it works” during this stage (Rogers, 2003, p. 21). The questions, according to Rogers,

produce three sorts of knowledge: (1) awareness-knowledge, (2) how-to- knowledge, and (3) principles knowledge.

*Awareness-knowledge* reflects knowledge of the existence of an innovation. Individuals with this type of knowledge can learn more about the innovation and, eventually, adopt it. The operating principles that describe how and why an innovation works are included in principles-knowledge. Although an innovation can be implemented without this knowledge, its misuse may result in its discontinuance. How-to-knowledge includes instructions on how to use an innovation correctly. Rogers considered this knowledge as a critical variable in the decision-making process for innovation. An individual should have a suitable level of how-to-knowledge prior to the trial of this technology to boost the adoption possibility (Rogers, 2003). As a result, this information becomes even more important for reasonably difficult ideas, because individual attitudes influence whether the innovation is adopted or rejected.

Ignoring the knowledge step can cause issues in the change management process because important stakeholders may believe they were not properly informed or consulted. This can cause emotional dissonance during the persuasion stage and have an impact on the implementation stage later on.

### *The Persuasion Stage*

Individuals determine the worth of embracing new innovation at this level and further investigate its potential. When an individual (or another decision-making unit) develops a favourable or unfavourable attitude toward an innovation, this is referred to as persuasion. It is vital for a potential user to regard the invention as valuable. This can be accomplished through educating potential users on the benefits of the innovation, such as “saving time,” “lowering expenses,” or “increasing performance.” Positive testimonials are an excellent approach to persuade people to adopt a certain idea. Individual attitudes are formed after learning a great deal about the innovation. According to Rogers (2003), the knowledge stage is more cognitive- (or knowing-) based, whereas the

persuasion stage is more affective- (or feeling-) centred. Thus, individuals are more concerned with the innovation at the persuasion stage.

### *The Decision Stage*

The decision is made when individuals engage in behaviours that contribute to their decision to adopt or reject the innovation. Adoption is the decision to use an innovation fully as the best course of action available. Most people will not adopt an idea unless they first test it to see if it will work in their own situation. If innovation has at least some relative advantage, the individual will make an adoption decision. At this point, the individual can choose to accept or reject the innovation. While adoption refers to using an innovation fully as the best course of action possible, rejection refers to not using an invention (Rogers, 2003).

### *The Implementation Stage*

When someone uses an innovation, this is referred to as implementation. During this stage of implementation, the new idea is really put into action., which entails overt behavior change. At that stage, the new concept has institutionalized or become a regular part of the adopter's daily activities. An innovation is put into use during the implementation phase. But an innovation introduces novelty, and with novelty comes some unpredictability in the dispersion (Rogers, 2003). At this stage, uncertainties about the outcome of the innovation have the potential to be problematic. To reduce ambiguity about the consequences, the implementer may require technical assistance from change agents and others. Furthermore, the invention-decision process will come to a stop because the innovation loses its distinguishing quality as the new idea's autonomous personality (Rogers, 2003).

### *The Confirmation Stage*

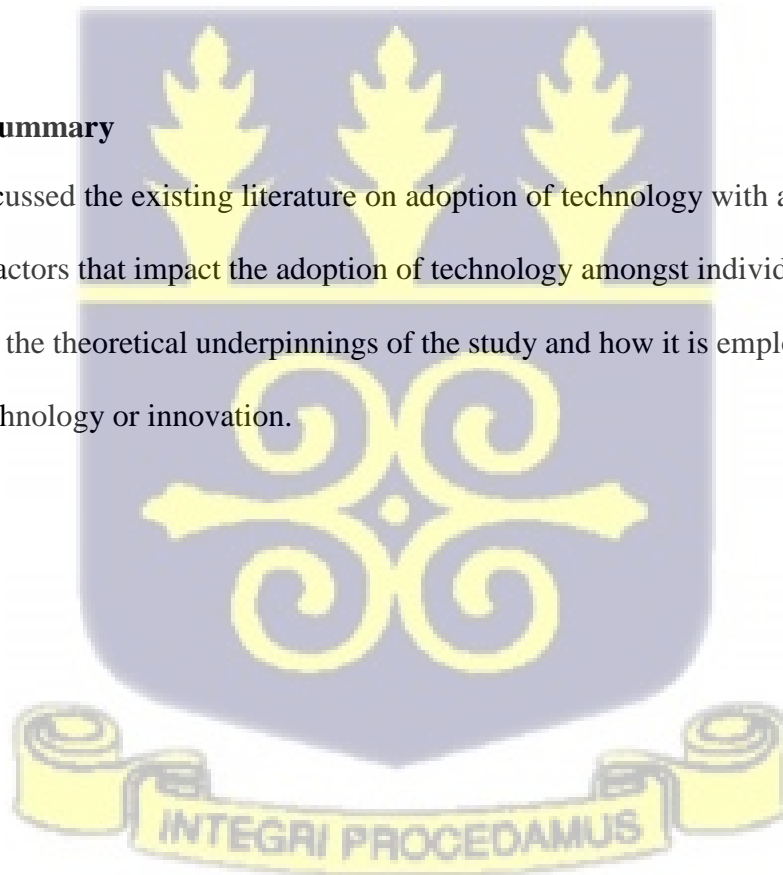
At this step, the individual has made an innovation decision and is looking for validation. According to Rogers (2003), this decision can be reversed if the individual is exposed to contradictory messages about the invention. If the individual wants to stick to their decisions, they must reject contradicting messages and seek affirming ones that reinforce their choices. As a result, attitudes

are much more critical at the confirmation stage. Depending on the degree of support for the acceptance of the technology and the person's mentality, later adoption or discontinuance occurs during this stage.

Discontinuance might happen in this stage in one of two ways, according to Hasin (2006) First, the individual rejects the innovation and substitutes it with a better one. This type of discontinuance choice is referred to as replacement dis-continuance. Disenchantment discontinuance is the inverse of discontinuance selection. In the latter situation, the individual rejects the innovation because they are dissatisfied with its performance. The invention not meeting the individual's needs could also be a cause in this type of discontinuance decision. As a result, it lacks the first feature of innovations that determines adoption rate—a perceived comparative advantage (Hasin, 2006).

## 2.10. Chapter Summary

This chapter discussed the existing literature on adoption of technology with a focus on the various interacting factors that impact the adoption of technology amongst individuals and groups. It further looked at the theoretical underpinnings of the study and how it is employed to explain the adoption of a technology or innovation.



## RESEARCH METHODOLOGY

### 3.1. Introduction

The most essential source of information for this research was working on the field. Fieldwork enabled me to form my own interpretation/understanding of Moree's social ties. I witnessed numerous people's regular interactions. I asked pertinent questions on the history of fishing in Moree and other random questions per the interactions with indigenes of the town. I could also discuss fish-smoking ovens in detail because the people were kind enough to educate me on them. It also made it feasible to gain a better picture of Moree's social activities.

Concurring with Patton (2002), the objective of a study directs its technique. The study's overarching purpose was to examine the factors that influenced the use of the Chorkor smoker in Moree. This chapter describes and justifies the research methodologies used in this study. It also provides an overview of the research approach, sampling and sampling techniques, data sources, inclusion and exclusion criteria, data analysis, study area, and ethical considerations.

### 3.2. Profile of Moree

Moree, a popular Fante fishing town in Ghana is situated along the shore, 8 kilometres east of Cape Coast (Overa, 1998:113). It is located at a latitude of 5° 7' 60N and a longitude of 1° 11' 60W (Falling Rain, 2006). On the Accra-Cape Coast highway, Moree is located on the left-hand side. One must board a taxi at Moree junction to enter the main town. Moree is famous particularly for its artisanal fisheries. Moree is the largest and the only fishing town in the Abura-Asebu-Kwamankese district, a district in the Central Region. It is classified as an urban community based on its population of 20,000 people (Marquette et al, 2003: 328).

Fig 3.0: Sign Post at Moree Junction



Source: Fieldwork, 2022

It is believed that Moree was founded by a giant Egyptian hunter (Asebu Amanfi) and fisherman Farnyi Kwegya (Overå, 1998:116) therefore making fishing the most predominant occupation there. Oral historians have averred that *Farnyi Kwegya*, the mastermind behind fishing in Moree settled on the coast due to the abundance of Stingray (*Morol3*) in the rivers and hence adopted the name, Moree. Due to the numerous successes attributed to him, his statue has been erected at the centre of Moree.

A person's matrilineage (ebusua) is immediately added to when they are born in Moree. Even with significant limitations, the traditional lineage system continues to work and bring people together in kin-based connections (Salm, 2002:142). Each lineage's unique status and identity within society are expressed through property rights and certain symbols. An individual's ebusua determines his or her inheritance, degree of power, and standing in the community. In their mothers'

families, men often hold the majority of the traditional leadership positions, while women typically receive property (Ansah-Koi, 2008). The people of Moree identify themselves as Fantes and are primarily found along Ghana's coastland in the Central Region. Their territory extends from the Pra estuary in the west to the Accra boundary in the east. The Dutch first settled there in 1632 and the presence of the Fort Nassau proves foreign presence in the colonial period (Overå, 1998:114). However, according to oral tradition, the Fantes arrived in their current position from the north before the 17<sup>th</sup> century (Fynn, 1987). They performed certain roles as trade intermediaries for domestic and foreign merchants.

Inhabitants of Moree engage in fish processing, distribution, and marketing of fish products. People of Moree who do not engage in fishing activities provide services for the fisher folks. Some of these services are net mending, preparing food for fishers, and some trading activities usually along the coast. Fish processors in Moree are largely women who buy their fish from the Moree shore and sell to neighbouring towns like Mankessim and Kotokouraba. Many individuals travel to Moree to find work in the fisheries because it is a busy fishing community. Similarly, some native fishmongers relocate to neighbouring towns and nations to find work during the lean season. During my fieldwork, respondents verified that they would travel for days, weeks, or months to other fishing regions in search of a larger fish catch.

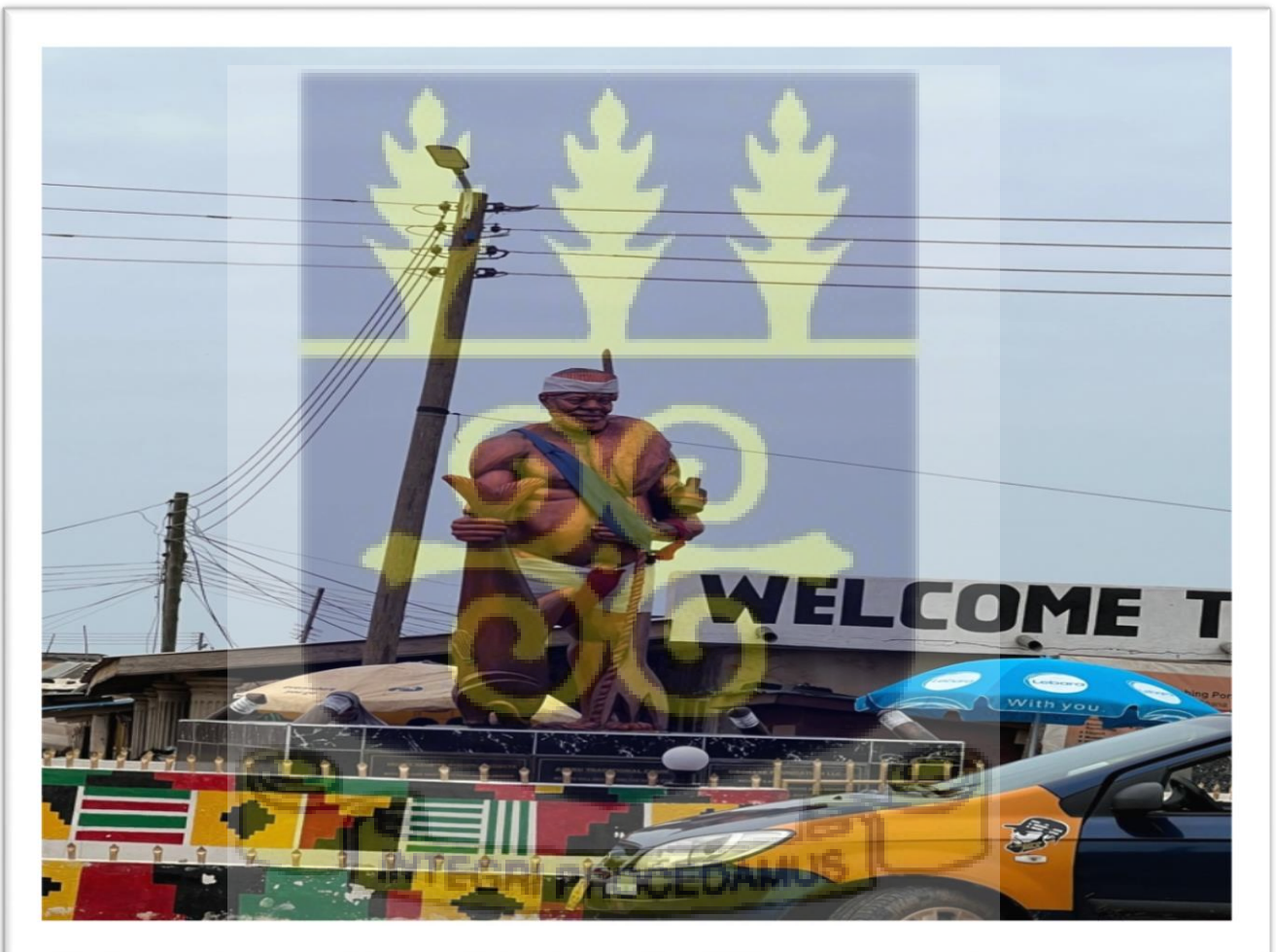
### **3.2.1. Fishers Hierarchy in Moree**

In Moree, the head of all fishers is called the Chief Fisherman (Pofohen). This Chief Fisherman oversees all activities on the sea and settles disputes among fishermen. He also acts as a liaison between the town's fishermen and other external entities. In this regard, the chief fisherman is the first point of call in Moree on issues regarding fishing. He also levies fees to fishermen from neighbouring towns who come to Moree to land their catch. According to the one of the employees of the Chief Fisherman, the 7 clans in Moree select the chief fisherman based on his skill and knowledge of fishing and not hereditary. These clans rotate the position and title as deemed fit. According to Odotei (1999:24) to be designated as a chief fisherman, one should belong to the

eligible group and must own a canoe and fishing equipment. The chief fisherman also has a linguist. He is the chief fisherman's spokesperson and also represents the chief fisherman at several major functions.

Moree has a Konkohemaa (ruler of all fish traders), a middle-aged woman in charge of the town's fish trade activity. She is expected to work hand in hand with the chief fisherman in the town. In Moree, the konkohemaa ensures the well-being of all fish traders by resolving fish trade issues such as fish transportation to neighbouring cities. Unlike the Apofohene, this post is chosen based on physical traits (such as how intellectual she is) as well as merit of service.

**Fig 3.1: Statue of the first fisherman in Moree**



Source: Field work, 2022

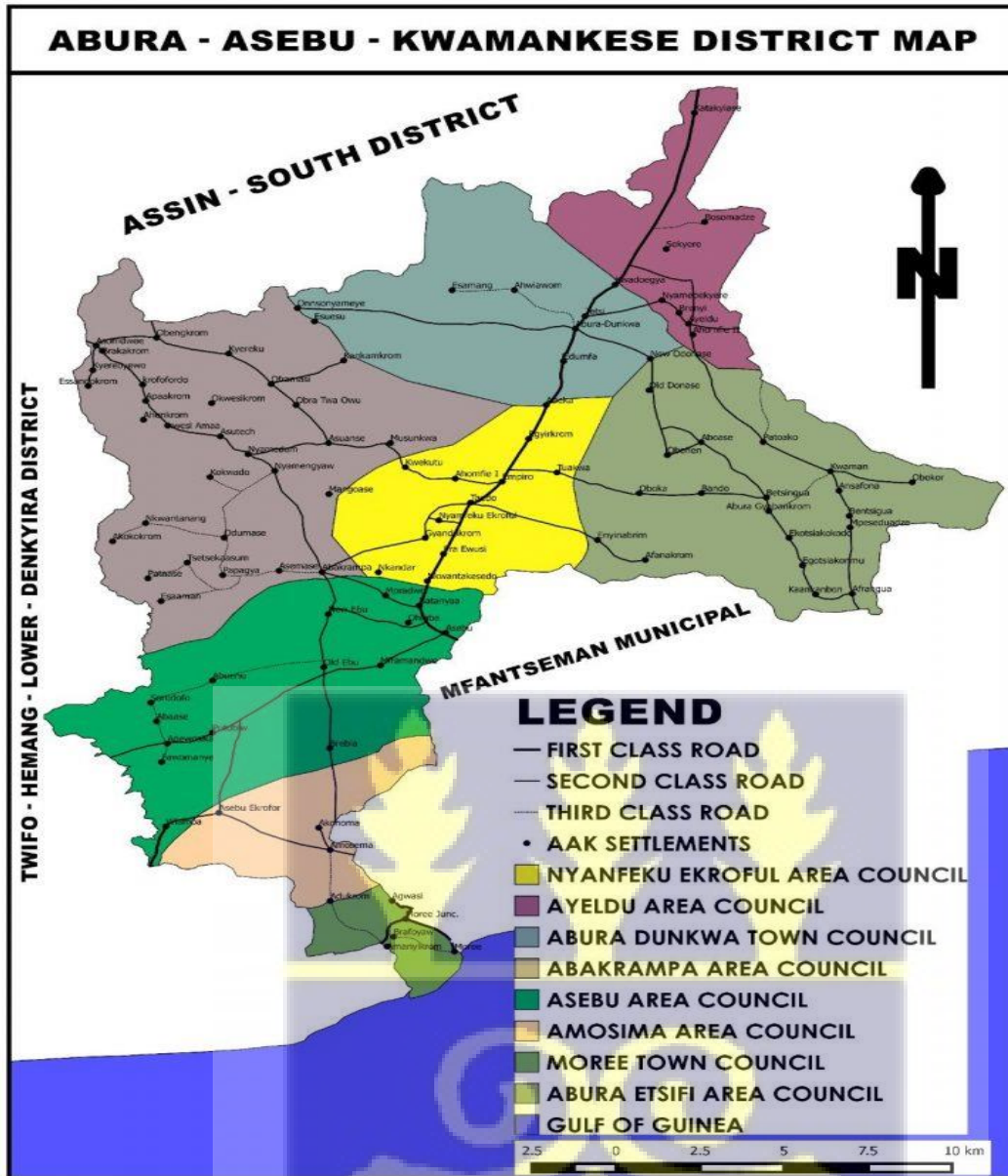
### 3.2.2. Physical Characteristics of Moree

Moree features a rocky coastline with landing areas at the base of a conspicuous cliff that overlooks the sea (Koranteng, 2002). Despite its rocky terrain, erosion looks to be a problem at Moree. The village is situated in a low-lying area with loose quaternary sands up to 80 metres above sea level (Districts of Ghana, 2006). Moree already has physical infrastructure, such as primary schools, public toilets, and a beach resort. Even though most of them look dilapidated, they still provide inhabitants with the needed services. It also has a very neat hospital, post office, police station, local restaurants, churches, a rural bank, and some drinking bars.

Moree is a town with many old structures, the majority of them being family homes. These structures are close to the beach and the market. Drainage is a major problem across the town. People dispose off liquid waste in any way; gutters are not particularly common. Water is available in the town, even though it isn't always accessible. As a result, households who are without water must travel to Moree Junction to get water. The community is connected to electricity even though not all the homes are. There have also been some new developmental projects such as the construction of the Kwame Nkrumah University of Science and Technology (KNUST) Central Region campus and the Community Library facility built by the Rebecca Akufo-Addo Foundation.

There are suburbs (*brono*) in the town namely: Apese, Abokum Ano, Twuwiiim (mostly Ewe migrants), Bentsir, Abrofo Mpoano, Court dan ho, Anan Enyim, and Mfa Ano. The main road from Moree Junction to the main town is tarred and of high quality, however there are no asphalt roads within the town. Most of the houses are extremely close to each other, and it is possible that one will have to travel through someone's compound to go to their destination. Along the shore of Moree, there is a sea defense wall that protects the land from being flooded by the sea.

Fig 3.2: Map of the Abura Asebu Kwamankese District



Source: Google Maps

### 3.3. Research Approach

To achieve the research aims, a qualitative technique was used in the study. According to Creswell (2014), the qualitative approach is a means of analysing and comprehending the meaning attributed to a social or human phenomenon. Qualitative research permits researchers to make sense of social phenomena and to give meaning to them (Denzin & Lincoln, 2000a). Qualitative research also includes an in-depth understanding of social phenomena in their natural setting, as well as a method of exploring and gaining insight into the meaning that individuals or groups of people attribute to a social phenomenon or human problem, as well as attempting to understand

the subject's perspective on the social problem. This method was more appropriate for gathering and analysing data in order to meet the study's objectives. It was accomplished through observations, listening, documenting, and interpreting accounts of fish processors, as well as their lived realities and experiences.

According to Creswell (2009), a qualitative study gives a variety of information sources that are highly interactive and humanistic. Its adaptability allows researchers to respond instantly to what participants say by tailoring subsequent questions. Its flexibility gives researchers the ability to react quickly to what participants say by adapting to questions about the participant's specifics (Mack et.al. 2005).

### **3.4. Study and Target Population**

Population as defined by Onwuegbuzie, Leech, and Collins (2011) is the collection of objectives and events of groups of people who are subjects of research about which the researcher seeks to determine specific characteristics. Population can also be explained as a group of persons who share common traits. The study population was mainly fish smokers in Moree. However, the target was primarily fish smokers who have been in business for more than 15 years and are either the first generation of fish smokers who adopted the chorkor smoker or their daughters. Rogers (1962) classifies them as innovators and early adopters. In addition, representatives of various institutions associated with fish smoking such as fishermen, NGOs, and district assembly officials were participants in the study.

### **3.5. Sample Size**

Statistically, a study with a large number of participants may not give a representative sample for findings. However, that is not the goal of a qualitative study. According to Mason (2010), qualitative studies have substantially smaller samples than quantitative research. As a result, this research is not intended to provide broad conclusions. Furthermore, the small number can benefit the researcher by allowing for the study of the diversity and richness of the data collected. Given,

the above, 22 people ranging from the three age classifications of 30-39, 40-49, and above 50 who lived in Moree were selected. Of the twenty-two respondents selected for the study, there were 18 females and 4 males. Out of the 22 participants, 17 were fish processors, 1 carpenter of the smoking tray, 1 employee of the chief fisherman and 3 members of an NGO- CEWEFIA.

### **3.6. Sampling Techniques**

According to Neuman (2014), in a qualitative study, research participants are selected based on their value to the study rather than their representativeness. This study used non-probability sampling approaches such as purposive sampling and snowball sampling to gain participants for the research. This was done by first identifying the number of fish processors in Moree. The purposive sampling method provided the opportunity to get the specific individuals who assisted with the needed information regarding the objectives of this study. It also helped gain knowledgeable participants who provided in-depth information on my study. Because of the exploratory nature of the research, the purposive sampling method was adopted. In purposive sampling, the researcher chooses cases or participants with a detailed objective in mind. This strategy enabled the researcher to select participants who were knowledgeable and met the inclusion criteria of my study. Three participants were selected using purposive sampling. In order to gather the necessary characteristics or life experiences for the study, the researcher relied on her judgement to select three people from CEWEFIA to be interviewed. The researcher scheduled an interview session with them after obtaining their phone numbers from the CEWEFIA website.

Snowball sampling begins by identifying people who fit the criteria that have been determined useful for inclusion in the study and then uses their referrals to discover people with the same exact range of skills (Mack, 2005). Snowball sampling was employed to identify participants who had used the technology for a long time (innovators and early adopters). Snow-ball sampling occurs when the researcher finds the initial participants for the study and then asks them to connect him or her to others who meet the criteria (Van den Hoonaard, 2015). Nineteen participants were selected using snowballing. Snowball sampling was adopted in this study because the researcher

found it challenging to find the study's sample frame. The person with whom the researcher comes into touch will act as a referrer for the study's remaining sample. The researcher identified the *konkohemaa* for this study through the help of a family member. The *konkohemaa*, also known as the queen fishmonger is the leader and mouth piece of women in the fishing communities. The *konkohemaa* being in this business for long recommended additional fish processors to the researcher. Even though most women were fish processors, snowball sampling was needed to identify the participants who have used the technology for a long period (innovators and early adopters). This benefited me as a researcher to utilise community knowledge about those with the necessary information for the study.

### **3.7. Data Collection Process**

Interviews that were semi-structured were employed to collect data for the study. Responders discussed the issues openly when this tactic was employed. A qualitative technique was chosen because it permits the researcher to pay close attention, interpret, and assess events from the interviewee's standpoints, which have been established through their experiences (Bryman, 2015). Due to the qualitative technique's versatility, researchers can respond to what participants say right away by changing the questions that follow to take into account the information they have provided (Mack, 2005).

#### **3.7.1. Interviews**

Interviews are a vital means of acquiring detailed data yet they may also be costly and time-consuming. The interviewer's relationship with the participants can vary based on the uniqueness and quality of the responses gathered (Kumar, 2005). The majority of participants elected to have the interviews conducted in their homes, where they felt more at ease and so were able to speak freely on the subject. Some of the participants worked while the interview was being conducted. The researcher sometimes had to assist in the smoking of fish to have a feel of how it is done. Other participants, specifically members of the Central and Western Fishmongers Improvement Association (CEWEFIA) were interviewed at their workplaces.

According to Bryman (2004), The interviewer is free to investigate and explore further questions in response to what is deemed noteworthy, while also allowing a bond to form between the researcher and the participant. I also permitted participants to take breaks when they needed to. It allowed me to modify the interview method if necessary. They also let me witness their daily lives. Despite having prepared a semi-structured interview guide, I permitted the participants to express themselves.

Key informant interviews were also conducted with key informants (employee of the chief fisherman, head of CEWEFIA) alongside the research. This was done because these informants know the issues of interest to the researcher. Through discussions with such experts, the researcher gathered rich data on fishing in Moree and other information that was of great help to this study.

### **3.7.2. Observation**

According to Cohen and Crabtree (2006), observation is a technique that enables researchers to connect with participants while both observing and participating in the social environment. Additionally, it provides information on participants' regular activities and increases the field data's richness (Patton, 1990). I used an observational checklist as a guide when I was out in the field. My goals for this checklist guided me in gaining knowledge about the lifestyle of people living in the research area. In the course of my study, I observed some fishing activities at the landing sites, including women receiving fish from fishermen for processing, male children swimming in the sea, mending nets, women fighting over fish acquisition, and other non-fishing traders. Fish smokers offering me a firsthand encounter with their natural environment gives me the chance to observe and participate in their social interactions rather than relying solely on participant narratives. I got the opportunity to watch some of the actions going on at the landing site while the data was being collected. I also observed the local community and noted their attitudes and mannerisms.

Fig3.3.: Non-fishing traders rendering services to individuals at the landing site



Fig 3.4: Moree Fishermen mending nets



Source: Fieldwork, 2022

It was also observed that fishing in Ghana is still done in the traditional way. This is because traditional sea-related beliefs are still transmitted and ingested in fishing communities. Those fishing activities are still influenced by such beliefs, despite the introduction of Christianity and Islam by European colonialists to change the traditional belief systems along the coastal settlements of Ghana. For instance, even though Christians forbid praying to the gods (pouring libations), most fishermen still do so before a fishing expedition because they believe that if they don't, the gods won't protect them while they are at sea. Many handcrafted fishing canoes also have vibrant paintings, inspirational verses, and witty sayings like "God dey", and "Ghana Boys" among others for identification.

**Fig 3.5: Some boats and canoes in Moree**



Source: Fieldwork, 2022

### 3.7.3. Audio Recordings and Field Notes

According to Tessier (2012), one of the greatest ways to capture qualitative data is to record and write field notes. The memories captured will ensure validity, credibility, and accuracy after the meeting. The field notes, audio, and visual recordings in this study ensured efficiency and transparency. Fieldnotes because of its simplicity were the primary ways of keeping records from the field until technology introduced recording devices. Field notes are essential for a qualitative researcher whose primary goal is to fully comprehend the phenomenon under study or the participants' lived experiences. In this study, field notes were handwritten in a book to assist the researcher with memories from the interviews. Recorded interviews permitted the researcher to assess respondent responses before and after transcription which was of great help to the researcher. This study's researcher believes that a qualitative interview is a great tool necessary for understanding participants' lived experiences.

### 3.7.4. Access to field and participants

I must admit that gaining participants for my study was not an easy task. There are lots of fish smokers in Moree, however, my work is centered on early fish smokers, people who have worked for more than 15 years. As Reeves (2010) noted, in such cases, it is advantageous for researchers to use "gatekeepers," or individuals or organisations who can assist in the recruitment of informants. With this idea, I carried out my fieldwork with the assistance of the head fish smoker who was also an early adopter of the Chorkor smoker, I was finally able to get in touch with them. Some participants also demonstrated negative attitudes toward the research. This was mostly because they had taken part in so many unproductive interviews. They saw this research as an opportunity to gather their thoughts on the subject without presenting a concrete solution to their financial problems. These participants were hesitant to be interviewed and needed to be persuaded that, while the research will not directly benefit them financially, their concerns will be addressed. After this explanation, individuals who were still doubtful were not interviewed. One participant said, "*Me ba, m'ay3 m'adwen d33 menye oibara nkasa biom osiand3 w)nye h3n kasa wie a h3n*

*te hwee biom, nso w anyim s3 afraba pa*” which translates as, “Despite my choice to forgo any future interviews, I would still grant yours because you seem like a good girl.”

### **3.7.5. Demographic Characteristics of Participants**

This section analyzes the socio-demographic background of the participants of this study. This section examines their age, sex, educational background, marital status, ethnic group, and occupation. The demographics of participants are very important because it is believed that these variables can influence the perceptions, knowledge, and attitudes of individuals. Out of the 22 participants that were interviewed, 17 were fish smokers, 1 employee of the chief fisherman, 1 carpenter of the smoking tray, and 2 members of the Central and Western Fishmongers Improvement Association (CEWEFIA) and the founder of CEWEFIA 1. The other participants who were not fish processors have accumulated enough knowledge and experience on the adoption of the chorkor smoker in Moree.

This session also considers how participants’ social backgrounds influence their adoption of a particular technology. It is very important to consider the demographics of participants in research because it allows you to better understand certain background characteristics and provides information needed for research syntheses and secondary data analyses (Bein, 2009).

#### **3.7.5.1. Gender of participants**

Out of the 22 participants that were interviewed, 18 were women constituting a large percentage. Out of the 18 women, 17 were fish processors who were early adopters of the Chorkor Smoker and had been in business for more than 15 years. These fish processors were all females. This is because, in Moree, the indigenes place much regard on gender dynamics and the division of labour. It is their belief that men are to go fishing because the first person who made fishing an occupation and brought it to light in Moree was a man. They also believe that men engage in precious jobs like fishing and not women. This is consistent with earlier claims that women are

primarily involved in the processing and marketing of fish captured in artisanal fisheries while men predominated in fishing operations, especially in Africa (Sakyi et al., 2019).

### 3.7.5.2. Age and Experiences

Age is a crucial socioeconomic factor in the fisheries industry because it has an impact on output, productivity, and innovation adoption (Olaoye et al., 2016). The age of the participants gives a fair idea of the age groups in the study. Because the researcher was looking for a specific group, the age of the participants was taken into consideration. That is people who have been using the fish-smoking technology in the community for at least fifteen years. Participants were often met with shyness when the question of age was asked. Some respondents wanted to share their true age, while others preferred to remain anonymous. The researcher noticed that people's ages were cloaked in mystery. Most of the women were unsure of their ages and relied on historical events in Ghana to identify themselves. As a result, the ages of several of the participants, particularly the elderly, were estimated.

The information showed that most of the participants were below the age of 50 and had been very productive. It means that most fish processors were quite young (between ages 15-20) when they adopted the Chorkor smoker. That is why the researcher agrees with Rogers (2005) that most adopters of innovations are young and enterprising people, who are daring and would like to try new things. Because fishing-related activities involve a lot of energy, previous studies have indicated that the majority of those who engage in them are often between the ages of 20 and 50, when they are still young, productive, and economically active (George et al., 2014; Odediran & Ojebiyi, 2017).

The research also solicited different data on years of processing experience and years of using the Chorkor smoker. This was to ascertain the actual period of the existence of the Chorkor smoker in Moree. Fish processors have worked with the Chorkor smoker for more than 15 years and are very experienced on the job. Better performance is typically connected with more experience. The

majority of the fish processors in the sample would have had a proper understanding of fish processing techniques and would have been able to understand business trends such as seasonal availability of harvested fish, changes in operating conditions, and price fluctuations of inputs and fish products, which could have guided their decision-making. This result is in line with the findings of the report of Odediran and Ojebiyi (2017), which asserted that they would be able to make logical and rational decisions regarding the adoption or rejection of a technology based on their extensive knowledge of existing technologies in comparison to recently introduced ones. This is because the majority of fish processors worked with their mothers or family members at a tender age before starting their own businesses.

### **3.7.5.3. Marital Status**

Marriage is crucial for numerous reasons, claim Lamanna and Riedmann (1994). Companionship, emotional stability, the desire to parent and raise children, peer pressure, and love are a few of them. Nearly all societies, including Moree, share these reasons. Information gathered from the participants showed that 19 were currently married with children, and 3 were widowed with children. This is possibly due to the fact that local communities value the contributions of family labour. This is evident in a large number of spouses and children that families have. It is customary for family members to actively assist in the processing and marketing of fish, particularly if they are independent adults.

### **3.7.5.4. Education**

The study's participants' educational backgrounds showed a significant percentage of illiteracy: Three of the CEWEFIA members had formal education, while the other seventeen fish smokers, and the carpenter did not. This is likely to have an impact on how they participate in adoption activities in that written materials cannot be read and understood by them. Educational levels have substantial functions to play in influencing participants' choices since educated people are more likely to react quickly to technological advances. In most cases, studies that have established the relationship between education and adoption relate it to formal education. Education is usually

believed to create an advantageous intellectual and mental attitude for the approval of newer practices.

Adoption literature (Rogers 1983) shows that the complexity of technology hurts adoption. Therefore, education ought to reduce the complexities that come with technology. The ability to read and understand sophisticated methods inscribed on technological packages is important to adoption. Education plays a crucial part in many facets of life as well as in running a successful business since it increases the likelihood that people will be aware of, persuaded by, accept, and use new or enhanced technologies for maximum productivity (Zçatalbaş, 2014). According to Adeyeye et al. (2016), education level is also positively correlated with access to household amenities and facilities, such as those related to biosecurity and hygienic precautions as well as environmental health during fish processing, is inevitably influenced by one's employment and money.

#### **3.7.5.5. Ethnicity of Participants**

The population of Moree is diverse however, the vast majority of participants revealed that the majority of Moree's residents are Fantes. The Chorkor smoker is used predominantly by Fantes, and all the adopters are Fantes and had lived in Moree for more than 30 years. All participants were Fantes and spoke the Fante language fluently. Aside their native language, three of the participants (3 CEWEFIA members) could speak English.

#### **3.7.5.6. Fish Processing Association**

Social organizations assist their members in pooling their funds so they can access loan facilities (Olaoye et al. 2012). Additionally, it offers an enhanced platform for gaining an understanding of crucial fish smoking concerns including price regulation, fish sharing, and/or the use of smoking ovens in times of excess or scarcity. One of the main issues that fish processors deal with is a lack of funding and/or the inability to obtain loans or credit to grow their business (Sakyi et al., 2019).

15 fish processors out of the 17 in Moree were members of the fish processors' association. Despite admitting to being members, most participants did not attend most meetings because they believed the association was prejudiced, particularly when it came to providing services like loans. The majority also failed to show up for meetings and seminars because they had personal grievances against the association's leaders.

### **3.8. Data Collection Instruments**

The primary data for this study consisted of first-hand information gathered from my interviews. In-depth interviews were the main source of obtaining primary data to develop a keen understanding of the area. It enabled me to probe to know more about the technology and why participants prefer to use the Chorkor smoker. Three interview guides were used to gather information from fish smokers, one employee of the chief fisherman, and the members of CEWEFIA. The questions on the interview guide were developed in accordance with the research goals.

The guide for fish smokers had three parts; a section on socio-demographics, the role of multi-stakeholders in the adoption of the chorkor smoker, and the technological factors that led to its adoption.

The guides for the other participants: members of the Central and Western Fishmongers Improvement Association (CEWEFIA), a Non-Governmental Organization, and linguist to the chief fisherman also had sections on socio-demographics and the adoption of the chorkor smoker

### **3.9. Data Analysis**

In order to I the data obtained from the conducted interviews; a thematic analysis method was also used. Precise notes from audio recordings were included in the data. The recorded audio data was afterwards written down and translated into English. Based on the predetermined study objectives, participant information was entered into Microsoft Word and organised into tables to look for similar themes and patterns. The themes were identified from the responses to the interview questions. For instance, a theme on economic factors was derived from one of the answers

given from the question asked on the factors that influenced the adoption of the Chorkor smoker.

One of the responses given was, “When one does not have enough money, one cannot construct the oven because she will have to buy the smoking trays, pay artisans, pay labourers and many more. Some even want to be fish smokers but because they do not have enough money to even buy the smoking trays let alone pay artisans”.

The phenomenological analysis was suitable for this research because it acknowledges the value of human experiences and is concerned with the subjectivity, interpretation, description, and agency of the persons involved in the phenomena. (Creswell, 2009; Denscombe, 2007).

### **3.10. Inclusion Criteria and Exclusive criteria**

Fish smokers of either gender have an equal chance of being recruited. Fish smokers who have been working in the Moree community for more than 15 years and have been using the Chorkor smoker were included in my study. Fish processors who have been working for less than 15 years and/or have not used the Chorkor smoker were excluded from the study. This is because the Chorkor smoker is the most predominant fish smoking technology in Ghana, and it is also the primary technology for my study.

### **3.11. Ethical Consideration**

Regulations, norms, and unwritten standards that govern the duties of researchers are among the ethical considerations in research (Creswell, 2014). The Ethical Committee of Humanities of the University of Ghana gave its approval before beginning the data collection. As part of the requirements to receive ethical approval, a comprehensive project description, including the project proposal and the proposed interview guide, an introductory letter from my head of department, a cover letter from the principal investigator, and curriculum vitae, among other pertinent files, were all submitted. This ensured that ethical standards are not violated.

The researcher ensured anonymity by using pseudonyms rather than the names of the participants. Information about participants' identities was neither collected nor retained. There was no information provided that would have allowed participants to be identified in a report that could be published. They were informed that every piece of information requested was only used internally by the research team for academic purposes. The local fish smoker's association's and community leaders' approval was sought by the researcher.

The leaders were then invited to a meeting to review the study's objectives. This study ensured that respondents were at free will to choose whether they wanted to take part in the study or not. They were not forced or coerced to take part in the study. The researcher also ensured that participants adhered to Covid-19 protocols even though the wearing of mask was no longer mandatory. She ensured that there was social distancing between herself and the participants. The information obtained from the participants was kept confidential by being available to only the researcher and her supervisors. The researcher gave participants peculiar identifiable codes to aid in easy tracking.

I have to admit that adhering to the ethics committee's requirements and maintaining the highest academic standards has been a tremendous learning experience for me. It helped me to comprehend the distinction between field research and research conducted on paper. I must admit that although I was first anxious about going to Moree, it turned out to be a positive experience. Being in the field and not knowing how the locals would react to me bothered me. However, having a common language and cultural background with them helped me.

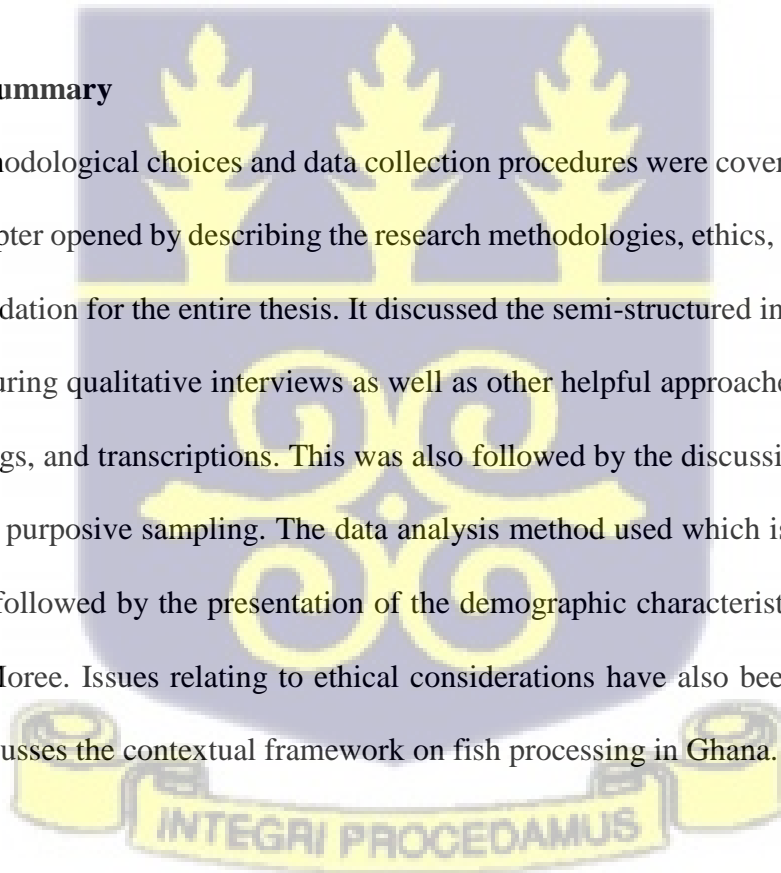
### 3.12. Reflexivity

It is vital for a researcher to record his or her thoughts and feelings during the research because they are the main tool used to interpret, I, and summarize the study's conclusions (Chilisa, 2012). The way researchers and study participants engage may have an impact on the information gathered. As a result, the researcher must be open about their perspective. To do this, one must assert reflexively that they are either insiders or outsiders.

An “insider” according to Olsen (2016), is one who studies the behaviour of individuals within a particular cultural system, while an “outsider” does that from outside a cultural system. For me, reflexively, being an ‘insider’ – that is being a Fante made it easy to communicate with my participants and also enabled me to understand the people and the society. This is because I share a cultural bond with the Fante people. I am from the Central Region of Ghana with a matrilineal succession and had grown up in a fishing village hence, my status as an insider. This made it easy for me to connect with the people and the environment. Months before I started the research work, I first called the secretary of the Central and Western Fishmongers Improvement Association (CEWEFIA) in Moree to let him know about it. He personally escorted me to the konkohemaa, who extended a warm welcome to me. The Fante language gave them a sense of attachment to me, which was very helpful.

### 3.13. Chapter Summary

The study’s methodological choices and data collection procedures were covered in length in this chapter. The chapter opened by describing the research methodologies, ethics, and reflexivity that serve as the foundation for the entire thesis. It discussed the semi-structured inter-views used for gathering data during qualitative interviews as well as other helpful approaches including observations, recordings, and transcriptions. This was also followed by the discussion of the sampling method which is purposive sampling. The data analysis method used which is thematic analysis which was also followed by the presentation of the demographic characteristics of the research participants in Moree. Issues relating to ethical considerations have also been discussed. The next chapter discusses the contextual framework on fish processing in Ghana.



## FISH PROCESSING

### 4.1. Introduction

Women dominate the economic activities of the fish processing sector in Ghana (Koranteng, 1993). Almost all women in the coastal areas of Ghana are fish processors. According to Okorley et al., (2004), the rapid population increase in Ghana of approximately 3% which considerably surpasses the food production growth rate of about 2%, has made the role of women in food production, processing, and marketing more crucial. This chapter describes the entire fish processing process in Ghana.

### 4.2. Forms of Fish Processing

In Ghana, fish processing can be categorized into two types traditional and modern. Traditional fish processing methods include smoking, salting, sun-drying, frying, and fermentation (Okorley et al., 1998), whereas modern fish procedures include canning and freezing. By lowering the temperature (e.g., freezing), applying heat treatment (e.g., smoking, boiling, frying, and canning), reducing the amount of water available for microbial attack (e.g., salting, drying, and smoking), and altering the storage environment (e.g., packing and refrigeration), food can be protected from microbial attack (FAO, 2016a). Traditional processing processes conserve large quantities of varied species of fish landed during the peak season to reduce waste. Traditional fish-processed items such as smoked fish and dried and salted fish are popular among Ghanaians.

#### 4.2.1. Freezing

Fish marketing in Ghana has grown in importance as people become more aware of the health benefits of eating fish. To prevent fish from deteriorating, freezing is one of the methods used by Ghanaian marketers and consumers. This is one of the most effective ways to keep fish fresh. Some marketers, such as importers, trade or sell fresh fish by deep freezing it to increase its shelf life. According to FAO (2002), the temperature in a freezer corresponds to the temperature in which most fish live. Frozen fish keeps longer than unfreeze ones. This is done by either covering

fish with layers of ice or keeping them in refrigerators. Fishes like redfish, salmon, sardinella, and mackerel can be frozen. When seafood is correctly handled and frozen at a very low temperature, it is practically "locked" in time, preserving freshness and quality. The use of refrigerators is a modern way of preserving fish since there were no refrigerators in pre-colonial Ghana.

Still, not many fishmongers in Moree freeze their fish before selling it. This is as a result of their ready market. However, the small percentage of people who store their fish in freezers do so because they utilize them for household needs.

**Fig: 4.0. Frozen fish**



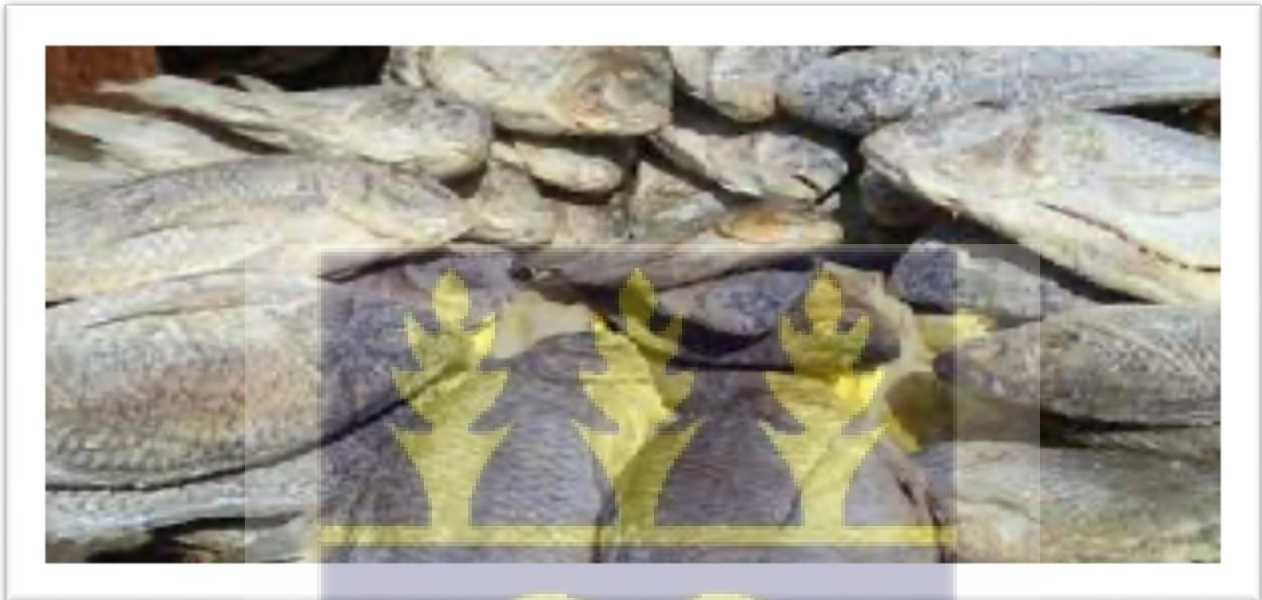
Source: Google Photos

#### **4.2.2. Salting**

Salting is one of the oldest and most traditional methods of preserving fish. Salting is a physical and chemical process that occurs as a result of salt penetration of the fish's body with moisture forces leaving the muscles, resulting in a weight change and is designed to preserve the fish (Al-Rubai et.al 2020). Salting is done simply with salt, and sometimes water, as the only ingredients. Often, salting is used in combination with drying. If the process is carried out inappropriately, the fish can get spoilt. Salt is a valuable item that prevents fish spoilage. It preserves fish by extracting

water from it to make it dry. In the salting process, preservation is done by reducing fish's moisture content and removing bacteria not to live and develop again. In Ghana, salted fish (tilapia) is called "koobi". Other examples of salted fish are kako (a whale-like fish) and momoni (all other salted fish). According to FAO (2005), salting is in two forms: dry salting and wet salting. Dry salting is rubbing the salt directly in the fish while wet salting is simply keeping the fish in a solution of salt and water for a long time. Fish is typically salted dry rather than wet in Ghana.

**Fig 4.1: Salted tilapia "koobi"**



Source: Google Photos



**Fig 4.2: Dry Salting of Fish**



Source: Google Photos

**Fig 4.3: Wet Salting of Fish**



Source: Google Photos

### 4.2.3. Fermentation

The fish sector has been steadily expanding over the years, producing massive volumes of by-products. Fish heads, skin, bones, thorns, and viscera are among the byproducts. Although some

of them are processed for feed, collagen, and oil production, as well as to a lesser extent for bio-fuels and fertilisers, many other high-value bioactive chemicals can be extracted. Fish fermentation has long been used to extend the shelf life of fish. Fermented fish products have a niche market due to their capacity to deliver a distinct feature, particularly in terms of scent, flavour, and texture.

Fermentation of fish for preservation was commonly paired with salting or drying in Africa (El Sheikha et al., 2014). One of the most well-known fermented fishes amongst the Akans is “*momoni*”, “*looshala*” and “*lafifi*” amongst the Ga and Ewe respectively in Ghana. Different types of freshwater fish, such as catfish, and barracuda can be used. They are allowed to ferment for 1–5 days (El Sheikha et al., 2014). The production of Momoni is based on traditional knowledge of fermentation and practical experience. Before fermenting, the fresh fish can be scaled and gutted, and the gill and gut regions are heavily salted (30%). Fermented fish can be identified from a distance because of its ‘stinky’ scent which cannot be hidden.

Mansur et al., (2004) found out that, a protein which is the most important nutrient in fish was 33.7% in wet fermented fish and 61.32% in dry fermented fish. The processing influences the outcome or quality of fermented fish, and nutrients might be lost when the processing gives room for more bacteria. Koffi-Nevry and Koussmon (2012) in support opined that fermented fish could be contaminated if not processed under hygienic conditions. Hence a contaminated fish product indicates a reduction in its quality or attributes.



Fig 4.4: Fermented fish “*Momoni*”



Source: Google Photos

#### 4.2.4. Drying

Fresh fish can rapidly deteriorate unless preserved. Drying is one of the most common methods of fish preservation. In Ghana, fish is dried on racks or the bare floor and directly exposed to the sun for some time to allow the water in the fish to evaporate. Small fish is mostly sun-dried on mats. When it rains the fish has to be kept dry by covering or transferring them under shelter. In Moree, some fishmongers dry fish on the ground and others on the fish rack. Fish kept on above-ground racks are less likely to get contaminated by sand or dust. Additionally, raised racks keep wandering animals away from the drying fish. If it rains unexpectedly, the fish can be covered with a plastic sheet. The racks in Moree are constructed with wood on the outside but with metal stands on the inside raised about one metre from the ground. The mesh size should be small so the fish do not fall through.

**Fig 4.5: Fish drying on the ground**



Source: Fieldwork, 2022

**Fig 4.6: Fish dried on racks**



Source: Fieldwork, 2022

Smoking is undeniably one of the oldest fish processing methods. The practice of fish smoking has been in existence for over a thousand years. It was one of the ancient methods for preserving fish. The Ghana Standards Authority defines smoked fish as fish that has been exposed to smoke to defer spoilage. Fish smoking explains the process where harvested fish are dried and ‘smoked’ on racks. In Ghana, fish smoking is one of the most widely used traditional fish processing methods employed to preserve quantities of fish landed in the season of glut. The smoking process reduces water activity and can result in the deposition of beneficial antimicrobial and antioxidant compounds like phenols and carboxylic acid (Arason, Nguyen, Thorarinsdottir, & Thorkelsson, 2014). The smoking process exposes fish to heat and smoke that is produced by the combustion of biomass (wood, sawdust, coconut husks, etc) which gives colour and a range of tastes appreciated by consumers.

Smoking can be categorised as traditional or modern, depending on the smoke deposition into the food products. In the traditional technique, an oven is used to produce smoke formed by burning wood or sawdust wood (Visciano et al., 2008; Stolyhwo & Sikorski, 2005). In the modern method, an electric field acts on ionised smoke particles which quickens the smoke deposition or the use of commercial liquid smoke flavorings (Martinez et al., 2007; Duffes, 1999). In West African countries like Nigeria and Ghana where national statistics indicate consumption of about 24.6 grams per person per day (FAO, 2008). The products of fish, either fresh, dried, or smoked are traditionally used in soups and sauces (UNDP/TCDC, 2001). Asiedu et al., (2018) indicated that smoked fish is generally consumed due to its better taste, higher nutrient quality, and its availability in rural, domestic, and international markets.

The smoked fish sector in Ghana is known for employment creation, income generation, food security, and foreign exchange earnings helping in the sustainability of the Ghanaian economy (Asiedu et al., 2018). The smoked fish sector has also become an unconventional means of employment for most girls in rural areas who could not be enrolled in formal education (Brownell et

al.,1983). A large number of these girls enter into the smoked fish sector either to assist parents or for their upkeep. Smoking fish extends shelf life, enhances flavor, increases soup consumption, and reduces wastage that could have occurred during bumper seasons, thereby allowing storage for the lean season (Akande & Adeyemi, 2016).

#### 4.2.5.1. Some Smoked Fish Species in Ghana

Practically all species of fish sold in Ghana can be smoked and it has been estimated by Adeyeye & Oyewole (2016) that, 70-80 percent of the domestic marine (sardines, anchovies, chub, and horse mackerels) and freshwater fish (mostly tilapia and catfish) is consumed in smoked form (Essuman, 1992). Common smoked fishes like sardinella (*Amane/ eban*), and (*tuna/ opoku*)”, amongst others are popular in Ghanaian markets.

**Fig 4.7: Smoked Tuna**



Source: Field work, 2022

**Fig 4.8: Smoked Sardinella**



Source: Google Photos

**Fig 4.9: Smoked Salmon**

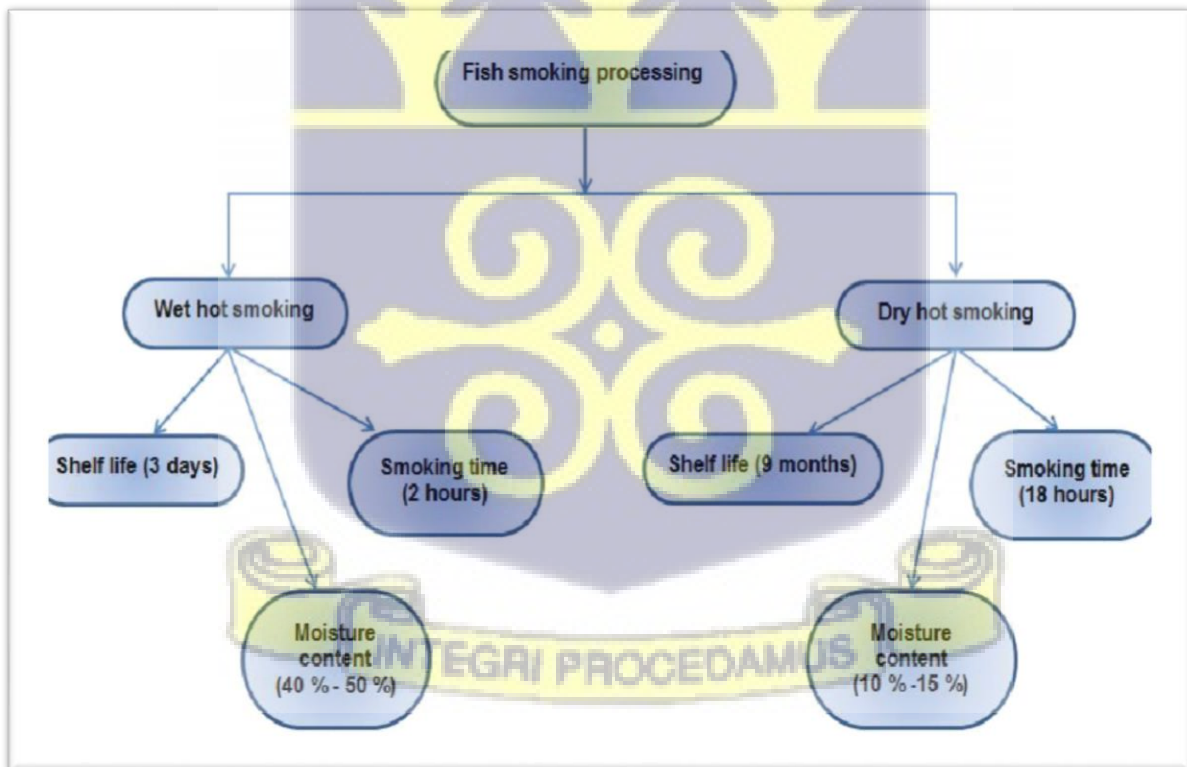


Source: Google Photos

**4.2.5.2. Forms of Fish Smoking**

The smoking procedure can be done in one of two ways: “wet” hot smoking or “dry” hot smoking, depending on the type of fish being smoked, its intended use, and storage method. Both procedures are performed at temperatures greater than 80 °C, which is enough to cook the fish. Wet hot smoking normally lasts 1-3 days and takes 1-2 hours to complete. Prior to the former, dry hot smoking typically takes 10 to 18 hours and on occasion even days. Fish smoked in this way has a shelf life of 6 to 9 months when properly stored. This is by far the most common way because it might take a while to sell and distribute smoked fish, and traders commonly keep it for many months as they wait for a better opportunity. Smoking has an impact on the weight, protein composition, pH, flavour, and texture of fish muscle. (Arason, Nguyen, Thorarinsdottir, & Thorkelsson, 2014). According to the FAO (2007), smoked fish can be considered a high-quality protein source, yet some fish samples have high levels of PAHs (Hasselberg et al., 2020).

**Fig 4.10: Fish smoking forms**



Source: Sakyi et al., (2019)

Indeed, the Ghanaian government has recognised since the 1950s how fish smoking jeopardises the health and safety of fish smokers (Ndiaye et al., 2015:67). Heart disease, lung cancer, cataracts, anaemia, and miscarriage are all documented health problems among Ghanaian fish smokers (Gordon et al., 2011). As a result, new fish-smoking ovens, such as the Chorkor Smoker, have been developed to limit fish smokers' exposure to smoke. The major and most common source of energy in smoking fish is the use of wood as fuel. It should be noted that different woods affect the quality of the smoked fish differently, which tends to affect the flavour. Wood smoke is made up of gases and particles that are easily absorbed by moisture on the skin.

#### 4.2.5.3. The Fish Smoking Procedure

In Ghana, the smoking process usually consists of the following steps:

- After the purchase of fish from the sea shore, the fish processors wash and sort in either seawater or freshwater twice.
- Washed fish is then loaded onto drying racks to allow it dry for some time in an open environment depending on the fish type.
- Fish is then transferred onto the smoking racks to the smoker for cooking. This step requires a lot of heat.

According to Jong et al. (1992), smoked fish should not be consumed right away after smoking; instead, the heat should be allowed to settle at a temperature of 2°C and be kept there until the fish is subsequently consumed. The smoked fish is quickly packaged in Ghana, depending on the season, for storage or marketing. Smoked fish can become infected throughout the packing, storage, and marketing processes. This is especially true when the fish is uncovered and shown in the open market, as is common in Ghanaian markets. The degree of contamination is mostly determined by smoking, drying, packaging process, and storage temperature (Cyprian, 2015). Again, fish storage at the appropriate temperature and the use of proper packaging materials can ensure that nutrient-rich products are delivered to the consumers.

#### 4.2.5.4. Processed Fish Storage and Packaging

The principles of storage and packaging of smoked fish is very essential in the fish smoking business. This is because smoked fish can easily go bad when it is not stored well. This is also extremely important for the commercial sale of smoked fish.

Fig 4.12 shows how smoked fish is packaged for storage. This is usually done when fish are abundant in the market. Fish is wrapped in paper and kept in a cool place for 3-6 months. The particular choice of a preservation process is largely dependent on the geographical area, food habits, and some socio-economic factors of the local people.

**Fig 4.11: How smoked fish is packaged for storage**



Source: Field work 2022

#### 4.3. The Introduction of the Chorkor Smoker

For a long time, Ghana relied heavily on traditional fish-smoking equipment. The majority of traditional ovens are made of clay mud. Each oven has a side stoke hole for lighting the fire and removing the wood ashes. Sticks are used to separate each layer of the fish from the next after it is placed in layers on wire mesh or sticks. Smoking fish in traditional ovens is time-consuming and wasteful. As a result, traditional ovens are inefficient.

Nerquaye-Tetteh (1999) asserts that extensive research was conducted in Ghana prior to the design and construction of the Chorkor Smoker to assess different fish processing techniques, types of smoked goods, persons working in the smoking industry, and product marketing. The creation of the Chorkor Smoker involved fish processors. It was very much important to involve them because they were experienced. These processors understood the processes and the kind of modifications that will better work for them. The technology was constructed on existing systems familiar to users.

The Chorkor Smoker used for fish smoking takes its name from a fishing area in Ghana called Chorkor. With the assistance of Mrs. G. Nerquaye-Tetteh, who worked with the Council for Scientific and Industrial Research (CSIR) in collaboration with several fish processors at Chorkor, Mr. B. Kagan, an FAO expert on fish processing technology, created this smoker. This smoker was developed to also address the issues of post-harvest losses because it can smoke large quantities of fish at the same time. This technology is currently in use in several sub-Saharan African countries. There were over 120,000 traditional and Chorkor smokers operating in Ghana in 2015. (Okyere-Nyarko, Aziebor & Robinson, 2015). Between 1969 and 1971, the Freedom from Hunger Campaign (FFHC) assisted in the construction of more Chorkor Smokers and offered them at a subsidized price to Chorkor smokers.

The usage of the smoker spread gradually throughout the Chorkor Community and beyond. Because of the evident benefits of the smoker, more processors were eager to implement it. The fish smokers began preparing plans for the construction of the “Smoker” as well.

#### 4.3.1. Features of the Chorkor Smoker

There are four parts to a Chorkor Smoker. The first part is a rectangular combustion chamber. This chamber is twice as long as the previous one and has two openings in the front. The combustion chamber is separated by a central wall. According to Nerquaye-Tetteh (1999), the usual standard length of the combustion chamber is 90ins (228cm); 45ins (112.5cm) in width; and 24ins in height (60cm). The combustion chamber, which serves as the smoker’s foundation, is typically made of bricks, mud, or cement blocks. Because it is highly expensive to build with bricks and cement blocks, many people choose to build with mud.

The second component is a smoking unit consisting of a set of trays. The smoking unit consists of a collection of smoking trays that vary in size and quantity based on the size and quantity of fish to be smoked. However, for tiny and medium fish species such as anchovies and sardinellas, 10 trays are often used per oven. An average of 5 trays can be used for large species such as tuna.

The third component is a sheet of plywood that serves as a cover as well as regulating smoke and heat in the smoking unit. The wire mesh is stretched over the bottom of the frames to accommodate about 20kg of fresh fish per tray without the tray dropping (Nerquaye-Tetteh,1999).

The Chorkor smoker is available in single or double units. The treatment of pre-salted fish with smoke from incomplete combustion of wood at high temperatures is included in the use of this oven for fish smoking. Idah and Nwankwo (2013), on the other hand, stated that very high smoking temperatures can impact the nutritional content of smoked fish and emphasized the importance of assessing the nutritional qualities of fish smoked in ovens that create high temperatures, such as the Chorkor smoker. Furthermore, when utilizing this smoker, large levels of Polycyclic Aromatic Hydrocarbons (PAHs) might be released from direct contact of fish with combustion fumes.

**Fig 4.12: Block Chorkor Smoker**



Source: Fieldwork, 2022

**Fig 4.13: Chorkor Smoker constructed with mud**



Source: Fieldwork, 2022

Major advantages of the Chorkor smoker over the original traditional round/rectangular ovens include the following:

- a) Low construction cost (Brownell and Lopez, 1985).
- b) The Chorkor Smoker is easy to operate as it alleviates drudgery and is user-friendly (Nerquaye-Tetteh, 1999:17)
- c) It also has a large capacity that is, up to 10 trays of fish can be smoked at a time.
- d) High fish quality and uniformity due to the usage of a sheet of plywood as a cover, the heat, and smoke required during the smoking process.
- e) The smoking process could be controlled to some extent.
- f) The Chorkor Smoker operates with less time and effort
- g) Fuel consumption is greatly reduced (6 -10 times less firewood than with the traditional ovens)
- h) The smoked fish is also of good quality.
- i) Fish handling is greatly reduced (Nerquaye-Tetteh, 1999:17).
- j) Materials used for the construction of the smoker are largely and locally available
- k) The Smoker has proven to be a helpful innovation in both marine and freshwater fisheries since it is easily changed by processors to meet their specific demands and conditions.
- l) The Chorkor Smoker has led to an increase in economic activity and a positive impact on processors' household income and food consumption patterns.
- m) The introduction of the Chorkor Smoker has resulted in a reduction in post-harvest losses in the fish processing business.

#### **4.3.2. Dissemination of the Chorkor Smoker**

The acceptance of the Chorkor smoker in Chorkor made it possible for the dissemination into other communities in Ghana. According to Nerquaye-Tetteh (1999), various techniques were used to reach out to other communities. Examples are the following:

- a) Local carpenters and masons in different communities were taught how to construct the smoker
- b) UNICEF (Ghana) in 1982/83 sponsored a Chorkor Smoker manual entitled, “A Practical Guide to Improved Fish Smoking in West Africa” which was published in English and French as part of the activities to disseminate information on the smoker.
- c) Local individuals who contributed to the construction of the Chorkor smoker by providing materials such as mud and water were allowed to own smokers on their own.
- d) Food and Research Institute and the Food and Agricultural Organization in 1986 produced an educational video cassette on “ Improved Fish Smoking in the Tropics” for fish smokers, extension officers, and students in Ghana to orient the fish smokers on the Chorkor Smoker.
- e) In promoting the transfer and use of the Chorkor Smoker in the Volta, Western, Greater Accra, and Central Regions, UNICEF Ghana, UNESCO, UNDP, and some organizations financed numerous collective and cooperative projects.
- f) As part of the dissemination process, a Technical Cooperation Programme carried out by FAO in 1986 assessed the performance of various ovens including the Chorkor Smoker. It was further observed that other smokers or ovens had some variations in temperature distribution. Nevertheless, the Chorkor performed well in terms of cost, capacity, ease of operation, product quality, and fuel efficiency (Stroud,1986).
- g) From 1988 to 1998, a six-week regional training programme for extension officers was organised as part of the Ghana/Netherlands Training and Applied Research Project for Artisanal Fish Processing in Africa to contribute to reducing post-harvest losses of fish and improving the availability of high-quality fish in rural areas.

#### 4.4 Fuel Woods in Fish Smoking

In prehistoric times, wood was the primary source of fuel for heating, lighting in the dark, and cooking. For long years, humans relied solely on wood for energy. Although rising industrialization has resulted in the substitution of fossil fuels such as petroleum, coal, and even electricity for wood, it remains a key source of energy for the population in developing countries (Sepp, 2014). Fish smoking in Ghana cannot be investigated without the use of fuel wood. The major source of energy for fish smoking is fuel wood. In Ghana, as in many other regions of Africa, fuelwood accounts for approximately 70% of total energy use (Ghana Energy Commission, 2006).

Even though many different types of wood can be utilised, fish smokers pay close attention since the qualities of the wood can affect the smoked fish result (Asiedu & Okeke, 1994). The use of different types of wood influences the quality of the smoked fish differently and brings out distinct colours. The colour could be black, dark brown, golden brown, light brown, or filthy white. The colour of smoked fish varies by location. For example, consumers in Southern Ghana prefer golden brown smoked fish for immediate consumption, but dark brown for storage or transit (Obodai et.al. 2009). To get certain hues, fishmongers utilise specific types of fuel wood.

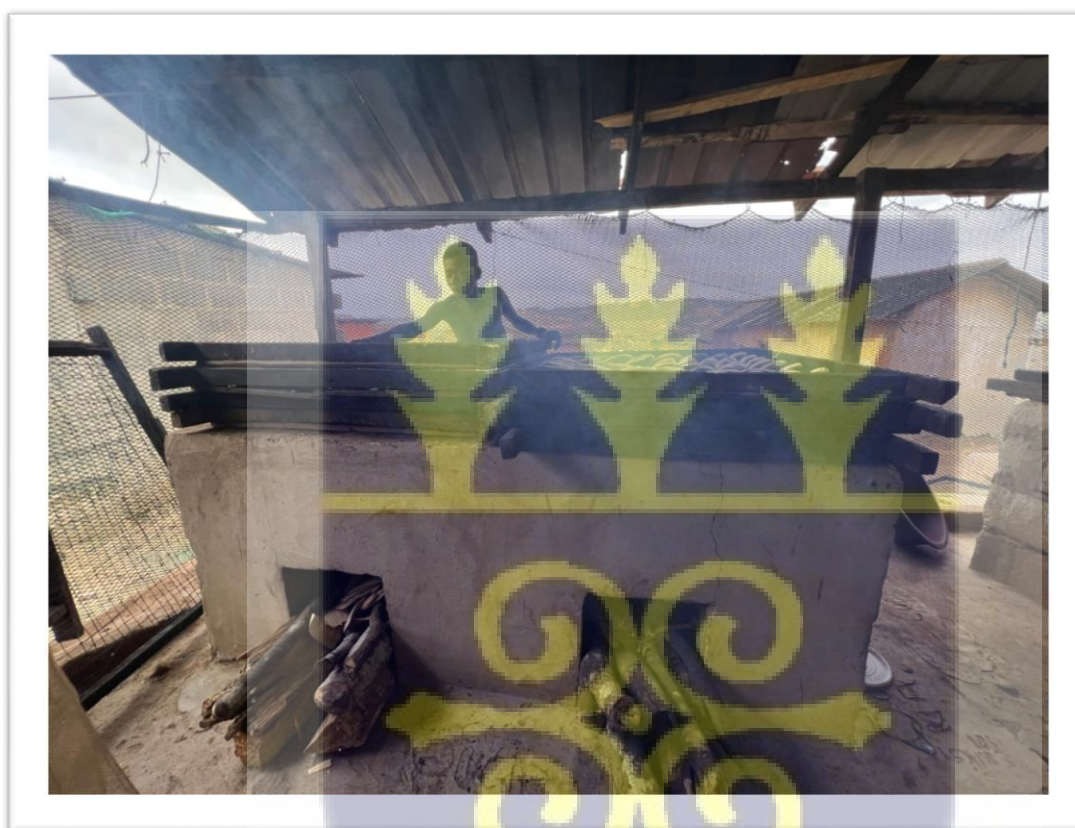
Fuel wood is useful as a sustainable energy source for generating power in places with easy access to forest products and byproducts. Over two billion people worldwide use fuelwood (FAO, 2005). While fuel wood is less expensive and more generally available than fossil fuels, exposure to smoke from its combustion has been a major public health concern, particularly in developing countries. This practice of utilising wood as a fuel to prepare or process food by smoking has been linked to high levels of carcinogenic compounds known as polycyclic aromatic hydrocarbons (PAHs).

#### 4.5. Health Risk Faced by Fish Smokers in Ghana

Fish smokers are faced with some occupational hazards posed to their working environment. The fishing sector is a socially constructed gendered sector where women face the highest risk. Despite the fact that smoking helps to preserve fish by exposing it to smoke from smouldering wood or

plant materials (FAO/WHO, 2012), the method of smoking in Ghana exposes fish smokers to dangerous and harmful levels of Polycyclic Aromatic Hydrocarbons (PAH) which are found mainly in wood smoke. Fats dripping from the smoked fish to the fire also causes this. Fish smoking has been connected to the presence of PAHs in smoked fish (Olabemiwo et al., 2011; Palm et al., 2011). Ghanaian fish smokers breathe in the smoke from the smoking process and also eat the smoked fish most times. Their skin comes into direct contact with the smoke as well.

Fig 4.14: Smoke emitted from a traditional oven



Source: Fieldwork, 2022

According to the Codex Alimentarius Commission CAC (2009), PAHs are long-lasting organic environmental toxins that can be found in raw fish as a result of tainted water or the lignin pyrolysis of biomass fuels like firewood during fish smoking. The concentration of lipids in the fish, the duration of smoking, the kind and composition of fish fuel utilised, the direct or indirect smoking method, the distance between the fish and the heat source, and the design of the smoking

chamber are all factors that influence the level of PAH in smoked fish (Codex Alimentarius Commission CAC, 2009). PAH in smoked fish is capable of causing cancer for consumers and processors especially breast cancer among older women (Essumang et al.2012). If smoked fish is a big component of one's regular diet, it may significantly increase PAH intake. Because smoked fish is the predominant protein source in most households, it is critical to investigate the various types and quantities of polycyclic aromatic hydrocarbons eaten by Ghanaians through smoked fish consumption.

#### **4.6. The Division of Labour in the Fishing Industry**

In Ghana, the bedrock of the fishing industry is coastal communities that have been in existence for several generations. The activities of fishing are generally handed down from generation to generation. There is therefore no gainsaying that fishing is an ancient occupation. In the stir of the changes in many sectors of Ghana, most fishing communities like Moree have preserved their culture and tradition. Because of their early involvement in the fish trade, Fante women in Ghana have been regarded as having strong entrepreneurial skills (Walker, 2002). The strong gender segregation of labour is a particular feature of fishing communities. Gender roles for both men and women are traditionally established in community institutions, and no one dares to question them. (Odotei, 2003). The issue of women's participation came out strong in my interviews. Although gender roles complement each other to make fishing easier in Moree, men outnumber women in decision-making. As a result, the women complained about concerns of gender imbalance, particularly in decision making.

Studies on the fishing industry in Ghana place much importance on the economic aspect referencing the technical and entrepreneurial skills of individuals who have developed the industry and have spread their tentacles to other West African countries. These acquired skills have created the required environment for the industry's development. Notably, both men and women play important roles in the fishing business; however, gender dynamics in the African context favour

either the man or the woman in the value chain. The roles that men and women play in the fishing business are socialised differently by their parents and the community.

The organisation of fishing activities becomes interdependent in the fishing sector, which is a classic example of male and female teamwork and collaboration, according to Schultz and Haines (2005). Without the other, neither gender would be able to survive (Williams, & Choo, 2006). Women play an important role in the fishing industry all over the world (Nadel- Klein and Davis, 1988); they sell and process fish, manage fishing households and finances (Sinclair and Felt, 1991; Felt, Murphy, and Sinclair, 1995), knit heads and repair nets (Thiessen, Davis, and Jentoft, 1992), and so on. According to Over (1992), women's activity in getting fish to consumers involves a chain of production, processing, and distribution. Because of the assistance they provide, women might be considered direct participants in the production process. After a long fishing expedition, exhausted fishermen always require the assistance of women in post-harvesting activities.

According to some authors, women in agricultural households are in charge of processing and marketing agricultural goods (Amakye, 2019; AmosWilson, 1999; Williams, 2001). The Food and Agriculture Organization of the United Nations (FAO) has produced a number of documents and reports on the dangerous role of gender in the worldwide fishing sector. These materials highlight trends in which women in most developing countries play a 'invisible' role in the business (FAO, 2013, p.xi). According to the FAO (2016), this is exacerbated by the widespread belief that fishing is a male-dominated industry in which women have a supportive but non-active role. Women's roles begin at the shore, where they purchase seafood from fishermen to process and sell. Women can be grouped based on their role in distribution and marketing. According to Odotei (1991), they are wholesalers and retailers. Because they deal directly with the fishers, wholesalers are major and well-known processors and distributors who have direct access to bulk fish. Retailers, on the other hand, purchase fish from wholesalers in smaller quantities for resale to individual houses and consumers.

Odotei (1999) claimed that along the coast of Ghana, fishing societies had a public authority structure headed by the chief fisherman: *Dotorwofia* (Anlo), *Apofohen* (Fante), *Woleiatse* (Ga-Adangme), and assisted by a Council. The absence of women in this structure raised numerous issues about its representativeness since the industry was supposed to be characterized by the representation of men and women with balancing gender roles. Overa (1993: 110) simply puts it as “men fish and women exchange, process and distribute fish”. Women are equally important in fish processing activities as males are in catching fish from bodies of water (Megbowon et al., 2010; Okorley & Kwarteng, 2000).

The smoked fish business is mostly dominated by women, whose economic activities in the fish processing sector have grown in importance in light of the low-income levels of many women in Ghana (Koranteng, 1993). According to Adeyeye and Oyewole (2016), more than 56% of women in Lagos State, Nigeria, work as fish processors. According to George et al. (2014), the majority (97.9%) of fish processors in Ibeju-Lekki Local Government of Lagos State were women. Alabi et al. (2020) expand on this in their study on “Awareness and acceptance levels of better smoking oven among fish processors in Lagos Lagoon, Nigeria.” In their analysis, they discovered that practically all of the processors (99.4%) were female. This is consistent with the arguments made above that females are generally involved in the marketing and processing of fish.

Women make over half of the total employment in the fishing sector globally (Pomeroy and Andrew 2001). Regardless of this, in African cultures primarily, how gender is constructed affects the roles and responsibilities assigned to women and men resulting in either of them dominating one element of the value chain. ‘Constructing Gender and Occupational Segregation: A Study of Women and Work in Fishing Communities,’ by Yodanis’, stated that occupational sex segregation explains women do not fish. Commonly seen in fishing communities, women engage in fish processing procedures while men (fishermen) engage in the dangerous and exciting pursuit of fishing by catching fish with a canoe from the water bodies. Fishing is usually restricted to men since it involves risk and also requires considerable strength (Oliver, 1989). Similarly, Gordon, Pulis, and

Owusu-Adjei (2011) argued that women are mostly responsible for post-harvest activities, which include fish trading and processing in the developing countries as well as the Ghanaian fish value chain, with male fish traders dominating or controlling offshore inputs such as vessels, motors, nets, and decisions about how, when, and where to fish. Generally, men dominate fisheries inputs (boats, engines, nets) as well as decisions about when, where, and how to fish in West Africa.

According to FAO (2016), despite the fact that women play a major role in the Ghanaian fisheries value chain, they are frequently confronted with less access to finance and institutional assistance than their male counterparts. A substantial number of women who work as fish processors and traders earn poor earnings, making it difficult for them to process fish. As noted earlier, Ghanaian women are repeatedly restricted from most fishing practices due to the strict taboos that exist in their vicinity. Pregnant women and women who are menstruating are specifically restricted from these activities—to the extent that they are not even allowed to come to the landing sites or the seaside. This has generally been attributed to the fact that women could contaminate the sea which could cause the sea gods or spirits to flee. For most women in these fishing towns, their work is a tradition that must be preserved, as the trade was largely passed down to them by their mothers and great-grandmothers and has become a way of life. The cash generated by women's fish production, transformation, and selling is critical for the overall fishing industry (Britwum, 2009). As a result, there is an incentive for women to be active change agents in the fishing sector.

#### **4.7 Chapter Summary**

An overview of fishing and fish processing in Ghana is provided in this chapter. It briefly discusses fish smoking, focusing on the Chorkor smoker and its spread as well as the health risks that smokers of fish confront. The division of labor in Ghana's fishing sector is finally explained.

## THE CHORKOR SMOKER ADOPTION

### 5.1. Introduction

This chapter discusses the primary topics and draws on the findings from the interviews and subsequent data analysis. These findings have been discussed in relation to the study's objectives. This section begins by addressing the underlying elements that have aided the acquisition of the Chorkor smoker '*dadze fono*' and finishes with the roles performed by various stakeholders in the oven's adoption.

### 5.2 Factors affecting the adoption

Result from the study revealed that the factors influencing adoption of the Chorkor smoker in Moree are age, level of education, social actors, level of awareness among others. These have been grouped into socio-demographic, technological and individual characteristics.

#### 5.2.1. Socio-demographic characteristics

The major socio-economic characteristics of the participants are presented in Table 5.1. The characteristics are gender, age, level of education, marital status, level of experience, group association.

**Gender:** Out of the 22 participants that were interviewed, it was found that 4 were men and 18 (82%) were women constituting a large percentage.

**Occupation:** 17 out of the 22 participants were fish processors, 3 were members of a major fish association (CEWEFIA), 1 worked with the Chief Fisherman in Moree and the other was a carpenter who made fish smoking nets. The study focused on the 17 fish processors because they had used the fish processing technology.

**Age and experience:** The findings showed that 8 (36%) of the 17 fish processors were between 30-40 years, 10 (45%) were between the ages of 41-50 years old while the others were aged 51 years and above. This indicates that when most fish processors adopted the Chorkor smoker, they were rather young- between the ages of 15 and 20. For this reason, the researcher concurs with Rogers (2005) that young, ambitious individuals who are bold and willing to try new things make up the majority of innovator adopters.

When I was a child barely 8 years, I watched my mum smoke fish with the round mud oven. That was the oven they used at that time. So, my mother usually made me wash the fish and sometimes remove the guts. Other days she would make me put the fish on the smoking tray. She would sometimes also tell me to light up the fire with the firewood. So as time went by, I basically knew how to smoke fish. And because I was not able to attend school, it has been my daily source of income. Most women involve their children especially female children in the smoking of fish. If she is of age and wants to continue the business, it makes it easy because she already knows what to do.

*(MaaPee, 37 years, Fish processor)*

The thirty-five-year fish processor also said:

I have been in the fish processing industry for about twenty (20) years. I learnt the trade from my mother.

The early adopters of the Chorkor Smoker had been in business for more than 15 years. These fish processors were all females. This is because in Moree much emphasis is placed on gender dynamics and the division of labour. This is consistent with earlier claims that women are primarily involved in the processing and marketing of fish captured in artisanal fisheries while men predominated in fishing operations. The researcher observed same on the field as well.

According to the employee of the Chief Fisherman,

“mbasiafo ntum ny3 mbanyinfo dwuma”

This translates as, “women are not capable of performing the tasks performed by men”. Therefore, in Moree and most coastal areas in Ghana, men go fishing while women process and sell the fish largely.

**Marital Status:** Information gathered from the participants showed that 86% were married with children, and 14% were widowed with children. This could be because the labour contributions of family members are valued in the local communities. This is evident in a large number of children that families have. It is customary for family members to actively assist in the processing and marketing of fish, particularly if they are independent adults.

**Level of Education:** The level of education attained by the participants varied. Of the 22 people in the sample, 86% had never attended formal schooling. 14% had attended secondary school and tertiary. The intricacy of technology hinders adoption, as adoption literature (Rogers 1983) demonstrates. Education should therefore lessen the complexity that accompany technology. Adoption requires the capacity to read and comprehend complex procedures written on technology packages.

Table 1.1: Distribution of Participants by their Socio-economic Characteristics

Socio-demographic characteristics	Frequency	Percentage (%)
<b>Gender</b>		
Female	18	82
Male	4	18
<b>Total</b>	<b>22</b>	<b>100</b>
<b>Marital Status</b>		
Married	18	82
Divorced	4	18
<b>Total</b>	<b>22</b>	<b>100</b>
<b>Age</b>		
30-40	8	36
41-50	10	46
51 and above	4	18
<b>Total</b>	<b>22</b>	<b>100</b>
<b>Level of Education</b>		
Non-Formal Education	19	86
Formal Education	3	14
<b>Total</b>	<b>22</b>	<b>100</b>

It was found out that 88% of fish processors in Moree were members of the fish processors' association. Membership of social organization helps fish processors to have access to inputs, loans and other resources that enhanced level of productivity. It was found out that the highest number of fish processors belonging to these organizations have gone through some form of sensitizations and education.

One of the workers of an NGO stated that:

We empower them through trainings, sensitization and train them through hygienic fish handling, packaging, storing, preservation. We do all these things and also train them on value addition. Value should be added to the fish as time goes on. As I told you earlier, we give them loans but some of them find it difficult to repay and that is the more reason why we advise them to be part of the Village savings and loans scheme so that there it will be flexible for them. This is because you contribute your own money so it makes it easy to take it as a loan from the association. It's just like the bank just that all the interest will come to the group. We are still training them in the safe fish and the licensing certificate, and we want them to get it so that when they have it they will be able to take their fish to the malls, markets and even do exports.

Mr. Man, CEWEFIA, 49 years

NGOs like CEWEFIA came in to take us through a series of training on the use of the chorkor smoker properly. They also showed us how to bargain on the market because the fish smoked on the Chorkor is of high quality. They also showed us how to properly wash fish before smoking on the Chorkor. In fact, they educated us very well on the chorkor.

Fish Processor 1, 50 years, Female

Association with a group (fish processors association) is important for technology adoption. In general, it has been found that fish processors who belong to a group or an association and are active members use technology more frequently than non-members. Being a member makes it easier for them to receive information on new technology, material inputs like ovens, smoking trays and loans to pay for hired labor and input purchases. Belonging to a social group strengthens social capital and enables the exchange of trust, ideas and information.

### 5.2.2. Technological Factors

The attributes of the technology itself, without a doubt, play a significant role in a fish processor's decision to embrace new technology. The thesis has adopted the characteristics given by Rogers (2003). He perceived that characteristics of the innovation that can increase adoption are relative advantage, compatibility, trialability, observability, and complexity.

### *Relative Advantage*

This measures how much the technology being discussed is thought to be superior to current or earlier technologies (Rogers, 2003). If people consider technology to be more advantageous, they will adopt it more readily.

A fish processor stated that:

I chose to adopt the Chorkor smoker because it can smoke fish faster. I can smoke more than 10 trays per day.

(Aba, 49 years, Fish processor)

In conjunction with the above, a fish processor also said:

I adopted the Chorkor smoker because when I first used it at Tema, I saw how the fish came out very heavy and how it made my smoking very fast.

Another woman stated:

I decided to acquire the Chorkor smoker because it has a smoking tray upon which the fishes are loaded. The smoking tray makes it easier to turn the fish when one side is sufficiently cooked. The tray generally makes handling during the smoking process easier. This makes the entire process of fish processing much faster than the previous smokers.

(Adwoa, 35years, Fish processor)

A representative from CEWEFIA said:

The women realized they could put about 5 trays on one chorkor oven and they could smoke more fish and could also use less time to smoke more volumes of fish. Even the laggards also came in to adopt the chorkor oven.

From the above responses, we can state clearly that innovation will spread more swiftly in a social system if it is more advantageous. If this trait is more useful in terms of productivity, cost-effectiveness, or riskiness, it will have an impact on adoption (Batz et al. 1999). In agreement with

Rogers, all participants of the study admitted that one of the advantages of the Chorkor smoker is that it is able to smoke large volumes of fish at a time. That is very crucial in the harvest season as it prevents post-harvest losses. The use of the Chorkor smoker according to fish processors also does not require much time for smoking. According to fish processors at Moree, the maximum time for smoking fish which is also dependent on the species of fish is 40 minutes to 1 hour. This is in alignment with Ewusie (1990) who stated that the quantity of fish smoked on the Chorkor is 4 times greater than the load handled in a traditional oven.

As productivity has increased, new technologies have been extensively embraced. Productivity modifies the production function by increasing output from a given level of input usage or decreasing input use for a given level of output (Mansfield 1961). This means that if fish processors expect the benefits of adopting a new production system to outweigh the costs, they are more likely to do so, and vice versa.

### *Compatibility*

How well a technology is regarded to satisfy the needs of potential consumers is very crucial in adoption. If a technology is compatible with what people do, it makes it very easy to adopt. That is its conformity to adopter needs, norms, beliefs, and previous experiences. The traditional ovens had numerous disadvantages and did not meet the needs of the fish processors, thus the introduction of the Chorkor smoker.

The difference between the Chorkor and the round mud oven is simply the introduction of the smoking trays. The round mud oven did not use a smoking tray in the smoking process, nonetheless, there was a holding tray for the fish; a metal mesh and brooms.

(Adwoa, Fish Processor, 49 years)

One fish processor also explained that:

I adopted the Chorkor smoker because it was very easy for me to use it. It was almost like the round mud oven we used those days.

Adopters find it easy to use the new technology if it has certain characteristics of the old technology. The innovation shouldn't deviate from the original one so drastically that users will struggle to comprehend how to use it. Even though the positions may differ, the Chorkor smoker has a place to fix firewood, just as traditional ovens.

### *Complexity*

Adoption of innovation negatively correlates with an innovation's complexity, or how easy or difficult it is to grasp and use it (Rogers 1995). Individuals often choose to adopt less complex innovations over more complex ones since technologies are adopted more quickly if they are simple to understand and utilize. Also, depending on how much the traditional technology or management needs to alter, complexities can occur.

A fish processor said:

This oven is very simple and easy. I did not teach my daughter how to use it but she does sometimes because it is not complex.

Concurring with the above, a 46-year-old fish processor also said:

“This Chorkor smoker is also very easy to use since we just have to load the fish on the smoking tray and put it on the smoker and start smoking. It is not complicated at all”.

Another fish processor claimed that:

“The Chorkor smoker is so easy to use and understand and we know what to do at a particular time when using it and we don't need anyone to teach us how to use it”.

Adoption literature (Rogers 1983) displays that the complexity of technology hurts its adoption. The most potent element among fish processors' qualities that may enhance the adoption and use of technology is anticipated to be years of schooling.

### *Trialability*

An innovation may be adopted by a potential adopter if it is testable or scalable. This describes how much a person believes he can experiment with a new idea on a small scale on his own

property. However, there could be unforeseen factors that make it challenging for someone to perform a trial. Many of these aspects were summarized as capital, developing relationships with others to gather input, and infrastructure. Some fish processors who first noticed the technology at Tema stated that they had to pay for the usage of the Chorkor smoker to determine its difference from the traditional ovens they were using. An innovation that is testable represents less uncertainty to the individual who is considering it. And this is because the adopter is able to get the needed results and answers the moment, he or she uses the technology and can easily decide whether to adopt or not. According to Rogers (2003), an innovation that is more visible will easily stimulate communication amongst adopters and often lead to great adoption.

The first woman to use the Chorkor smoker at Moree opined that:

I first heard about the Chorkor smoker around the 2000s at Tema when I went to trade. Fish processors were already using it at Tema and testified that it was very good for fish smoking. During those times, Tema had a fish processing site where the fish smokers were constructed, I even paid to smoke my fresh fish on one of them and saw the difference between using that and using the round mud oven. I came back home and also heard fish traders at Mankessim talking about the same Chorkor smoker. So, I first heard it from fish processors in Tema, I even saw the chorkor smoker there for the first time in my life. But I had not seen that in Moree since we were all using the round mud oven.

From the above response, a technology can be easily adopted when it is tried and tested by the adopters.

### *Observability*

The term "observability" describes how easily an activity and its outcomes can be observed. It is also the degree to which an innovation is noticeable to other people. Increased visibility of an innovation will encourage conversation among the person's personal networks and peers, which will lead to an increase in either positive or negative responses. This plays a significant role in the adoption of technologies.

A fish processor added that:

I realized that it (the chorkor smoker) made work easier and saves lots of time because of the multiple smoking trays used so I decided to adopt the new Chorkor smoker. I was at Takoradi at the time. I returned to this town and discovered lots of people had acquired

Many prospective adopters believe that "seeing is believing". When fish processors use innovation and see or observe its results, they are more likely to adopt it. Many of the early adopters of the Chorkor smoker at Moree observed the benefits of the Chorkor smoker and then decided to adopt it.

### 5.2.3. Economic/ Financial Factors

An innovation's adoption is also influenced by socioeconomic factors, such as anticipated profits, input and output pricing, the availability of investment and operating capital, and labour availability. Financial stability was cited as one of the main stimulators of technology adoption by the majority of research participants. Access to finance facilities was a major key factor in determining the adoption of the Chorkor smoker. According to the information provided, the vast majority of respondents obtained their credit through personal savings. The fish processors could not give me the exact cost or estimate for the construction of the oven but they mentioned paying for clay, smoking trays and the services of artisans. This may be explained by the fact that the majority of fish processors lacked the necessary collateral that banks required in order for borrowers to obtain loans. This outcome is consistent with the findings of Mohamed and Temu (2008), who showed that access to credit and loans encourage the use of technology. They opined that for a fish processor to adopt a technology, she must be financially stable. This is because technology adoption comes with its own costs and fish processors must have a strong financial system capable of managing financial problems, analysing and allocating resources effectively. According to them, money can facilitate the purchase of inputs and enhance their capacity.

#### *Costs of Inputs*

The adoption of technology by fish processors can also either be enhanced or hindered depending on the cost of inputs. Depending on the magnitude of the initial capital expenditure necessary and

whether the new technology predominantly affects annual fixed or variable costs, new technologies have a variety of effects on costs and cost-effectiveness. The high cost of inputs is also detrimental to the adopters. Adoption rates for technologies with large upfront costs are often lower. Their purchasing decisions were influenced by market conditions, pricing levels at the time, and the state of infrastructure development. In general, technologies with large initial capital costs have extended payback periods and are frequently thought to have fewer overall benefits (Pannell et al. 2006). Reduced startup costs made it easier for developing nations to introduce and spread new technologies. As a result, the adoption of the improved fish processing technology requires more than just the availability of funding; it also depends on other elements such as access to materials and knowledge of how to use the upgraded technologies.

The majority of respondents noted that since the technology was advantageous, money should be sought out to assist adopters in purchasing inputs. Early adopters of the upgraded technology were able to purchase inputs on credit and also raise money over a lengthy period in order to be able to buy the inputs. It was noted that the establishment of a successful credit scheme would speed up the widespread acceptance of the new technology.

Faster technology dissemination is strongly correlated with the low pricing of inputs, which are frequently used by adopters. This is in relation to Nti et al. (2002) who reported that fish processors in Ghana failed to adopt technology because they were unable to afford the materials needed to build the oven. According to the same study, between 78 and 90 percent of participants believed that the expense of adopting new technology, the availability of inputs, and the lack of funding or credit were the main barriers. In my study, most participants also believed that cost of inputs was a great hurdle for them. They mentioned that no matter how available the inputs are, their financial status determines whether they will purchase them or not. The construction of the clay Chorkor smoker was very easy for fish processors in Moree because the inputs were less expensive. However, the construction of the brick Chorkor smoker has been a great hurdle for them because its inputs like cement are relatively very expensive.

A fish processor mentioned that she has constructed the clay Chorkor smoker and has been using it for years and the switch to the block Chorkor smoker has been her headache. She said it was so because the inputs needed such as the cement was very expensive. According to fish processors in Moree, the block Chorkor smoker made with cement is durable and can last for many years, unlike the mud Chorkor smoker.

She mentioned that:

I have been using the clay Chorkor smoker for more than 10 years now and cannot construct the modern one that is the brick Chorkor smoker. The cement used is very expensive to buy and has made me stick to the clay Chorkor smoker. Even though it's not as strong as the brick Chorkor, I have no option but to keep maintaining it for use.

Another smoker of fish stated:

When one does not have enough money, one cannot construct the oven because she will have to buy the smoking trays, pay artisans, pay labourers and many more. Some even want to be fish smokers but because they do not have enough money to even buy the smoking trays let alone pay artisans

The level of living standard a person achieves is largely influenced by his financial situation. The majority of fish processors agreed that their financial position made it easy to adopt the chorkor smoker. Generally, as income increases, it makes it easier for individuals to adopt a particular innovation because they can purchase input and equipment that comes along with the innovation. On the other hand, fish processors mentioned that colleagues with low incomes are likely to reject an innovation no matter how beneficial it is.

One of the interviewees stated that she delayed adopting the chorkor smoker because of low income. She also added that even though the chorkor smoker was not very expensive to adopt, it still needed some level of income from fish processors before its adoption. This implies that wealthier fish processors adopted the choker smoker at a faster rate than other fish processors.

The construction and adoption of the Chorkor smoker can be either income-friendly or not. This is because the construction of the clay Chorkor smoker was quite an income friendly to the fish processors. After all, they easily accessed the inputs for purchase. On the other hand, the brick

Chorkor smoker was problematic for them since most of them complained about the cost of the inputs like cement for the construction.

The participants noted that the price of inputs played a significant role in how widely they were adopted. The wide variation in oven ownership among processors amply demonstrated this. Fish smokers in society who possessed more than two ovens had sufficient financial means. The others who had just one blamed their predicament on the high cost of inputs and turned to the more traditional, less expensive round metal ovens because they were more cost-effective.

#### *Availability of Inputs*

Fish Processors in Moree mentioned that their adoption of the Chorkor smoker also depended on the availability of inputs. They explained further that the inputs needed for the construction of the technology included clay, blocks, wood, and nets among others. Clay is a substance that is accessible everywhere thus building a clay bail smoker is not a challenging task. However, the processors mentioned that one would need at least a week to build the clay smoker and put it in use because clay takes so long to dry out. Therefore, its construction should be done in the dry season when there is enough sunlight. The clay chorkor smoker can last for about three years with continuous maintenance. The bricks or cement used for the chorkor smoker is also easily accessible by fish processors. It also has a good appearance and can endure longer than a clay smoker. It can be constructed in a matter of days, at most. The fish smokers specifically mentioned the fish inputs used to make the trays as being pricey. The smoking tray is one of the necessary pieces of equipment needed to use the chorkor smoker. A former fisherman, now a builder of smoking trays in Moree mentioned that without the smoking trays one couldn't use the Chorkor oven. The inputs play vital roles in adoption, however, the costs involved in purchasing these inputs reduce the rate of adoption of the technology.

Another participant added:

“The adoption of the mud chorkor smoker was very easy for me since the mud was readily available”.

One woman also noted:

“The items for the construction of the oven were available. We have clay, water, firewood, wood and others at our disposal, so when one wants to get one of the ovens, she will just get these items ready and call on an artisan to construct the oven for her. For me, I made my uncle construct it since that is what he does for a living”

### *Land Availability*

The availability of land for the construction of technology is a key factor in how quickly innovation is adopted. It is apparent from the interviews conducted that fish-smoking technologies could be adopted when land is available and that the lack of land ownership can discourage fish-processing technology adoption. Fish processors with land either for them or inherited by them are more likely to adopt new technologies because they can afford to set aside a portion of their land for the construction of the Chorkor smoker.

One of the fish processors disclosed that even though she has land on which the chorkor smoker is constructed, the owner of the land can claim ownership at any time. She further added that it is very important for a fish processor to own land in her name before constructing the smoking oven. She also said one can have all inputs available but without land for the construction of the technology, all is in vain. Fish smokers in need of land would have to contact landowners and pay an initial amount to show their seriousness in acquiring the land for work. Sometimes, the fish smoker would have to take a percentage of the fish smoked to the land owner to show appreciation.

Another fish smoker mentioned that land is not only needed for the construction of the Chorkor smoker but also for keeping smoking trays and other work equipment. She added that for a fish smoker to be productive, she needs over 10 smoking trays and these trays must be kept well to be used another time. The underlying argument made by some fish processors was that the lack of landownership before the adoption of Chorkor smoker usually reflected land rentals which preclude tenants from future benefits due to the risk of eviction. In Moree, before one could construct

an oven for smoking, she should have land, specifically, land on her own. Some fish processors admitted that having one's land is very important.

A fish smoker also affirmed that:

“It is best for a fish smoker to build the Chorkor smoker on her land because once payment is due, land owners would not hesitate to break the ovens and take their lands”

Another woman also said:

Madam, how do we work if we don't have land to construct our ovens? If one is lucky, she will have available land from her parents, if not one would have to look for land which comes with an extra cost.

Madam Victoria Churchill Koomson, the founder of the Central and Western Region Fishmongers' Improvement Association (CEWEFIA) also affirmed that the availability of land is a very important factor in the adoption of fish smoking technology. She shared her experience with fish processors at Takoradi. She said that Takoradi's fish processors were forced out of their workplace because the government claimed the area was needed for the construction of railroads. It was a very sad experience for the fish processors because their smoking ovens were broken by government officials during the ejection period.

#### *Higher Market Value for Fish Product*

The goal of every trader is to increase profit marginally for goods and services. Participants of this study who were fish traders were no exception. The adoption of the Chorkor smoker by fish processors meant that they were able to sell their fish at relatively higher prices. Fish products with high-quality attributes can sell faster in the markets.

Fish processors at Moree revealed that one of the reasons they adopted the Chorkor smoker was that fish smoked had higher market value than those smoked on traditional ovens. This was a result of how uniformly smoked the fish product looked with better quality in terms of colour, shape and taste produced. Before the adoption of the Chorkor smoker in Moree, fish smoked from

traditional ovens were not as valued on the market. Fish processors can sell fish at a higher price because they were smoked on the Chorkor.

All fish processors in the study area agreed that the fish market was readily available and they had to travel to other towns and cities far and near to sell their fish. They could not travel to sell unattractive fish products, thus the chorkor smoker gave them high value for their fish. Even though income and profit varied from one fish processor to another, they all attested that the fish smoked on the chorkor was profitable when sold. Before the adoption of the chorkor, most fish processors said that they had to pay a considerable price for the chorkor smoker's services in other Ghanaian towns and cities like Tema and Nyanyano only to tell the difference, because of the high market value placed on the smoked fish from the chorkor smoker. This directly leads to enhanced incomes, living standards and nutritional status of individuals.

A Moree fish processor who is 62 years old mentioned that she started using the chorkor smoker because the smoked fish had a high market value due to its bright and brown appearance. Customers from the market would constantly purchase vibrant, eye-catching fresh fish.

#### **5.2.4. Individual Factors**

One major individual factor that determines adoption is level of awareness of a technology. A high degree of information and awareness, according to Odediran and Ojebiyi (2017), is a crucial instrument for the adoption of technology. Individuals seek information from various sources which suggest social networking either in or out of the community. This is crucial because once one network member adopts an innovation, others will be compelled to learn more about it and eventually embrace it as well. This is likely to speed up the adoption process.

##### *Level of Awareness*

Individual access to information is also very relevant. Information is an indispensable factor in the adoption of any technology. Technological adoption relies heavily on technology distribution.

Reliable information and technical direction are necessary to efficiently disseminate technology news. The relevance of the technology diffusion process for reviving the agriculture sector is demonstrated in the literature (Rogers, 2003). Fish processors who want to stay current on new fish processing technologies have access to a variety of information sources. Fish processors must be aware of technology's existence, benefits, and uses in order to use it. The process of learning about new technology also has an impact on how it is adopted. Fish smokers are better equipped to absorb technology because it helps them learn about it and how to use it successfully. Fish processors will only use technologies that they are familiar with or have heard of.

Access to information reduces the degree of uncertainty surrounding a technology's performance, which may eventually lead to a person's assessment being more objective. A decrease in technology adoption could also be caused by increased information accessibility. For instance, where there is little familiarity with a certain technology among the broader public, more information results in negative sentiments towards its adoption, perhaps because more information tends to discourage the adoption of that technology. This is most likely because additional knowledge indicates a wider information gap, increasing the risk involved. Therefore, it is essential to guarantee that the data is reliable, consistent, and accurate.

A processor opined that:

I first heard about the Chorkor smoker at Tema when I went to trade with some friends. Tema is industrialized, so we went there to buy fish and there were lots of Chorkor ovens on the land. That was where I saw and heard of it first. Tema fish processors spoke so highly of it and even allowed some of us who had money to smoke fish on it at a fee. After smoking, I saw many differences in the smoked fish compared to using the mud oven. I also realized it was so fast. If I can recall, I did not even spend more than an hour beside the oven.

Diverse opinions regarding how the fish processors learned about the chorkor smoker were expressed. Most women said they went outside Moree to get fresh fish and discovered that many processors were using the Chorkor to smoke fish. After paying for the same service and realizing the differences between utilizing the round oven and smoking on the chorkor, the decision was

made to use it. This implies that, rather than using modern sources like computers, mobile phones, the internet, or television, the majority of Moree's fish processors obtained their knowledge about the Chorkor smoker through conventional sources.

Low computer literacy among fish processors may be to blame for the extremely low usage of the internet as a source of knowledge or information about fish processing methods. This result is comparable to that of Ofuoku et al. (2008), who said that the majority (70%) of fish farmers in Delta State, Nigeria, learned about the most effective techniques from other farmers and paid consultants. Agbamu (2006) asserts that the amount of education, innovation sources, and degree of modernity in the area all have an impact on the information sources that farmers in developing nations utilize most frequently.

### **5.3. The Role of Multi-Stakeholders**

#### **Introduction**

In Ghana, the adoption of fish processing technology has gone through several processes before finally being accepted by the end users. Marine artisanal fishing is one of the profitable pursuits that is a part of a larger and more intricate economic supply chain. The artisanal fishing sector's economic and social advantages are sustained by various stakeholders from the various segments and stages of the supply chain. This complex web of stakeholders and their diverse stakes in the management and governance of fisheries resources should thus be given full consideration to impact the governance and tenurial ties within this fishing industry sector.

Any individual, group, or organisation that has an interest in a region's natural resources and/or that may be affected by project operations and has something to gain or lose if conditions change or remain the same is referred to as a "stakeholder," in accordance with Golder and Gawler (2005). Ghana's fishing industry's stakeholders have historically done a decent job of managing the deployment of fish technologies. These parties include the Ministry of Fisheries and Aquaculture

Development, the Food and Agriculture Organization (FAO), the Council for Scientific and Industrial Research (CSIR)-Food Research Institute, and the United Nations Children Fund (UNICEF).

The role played by social actors in the adoption of technology is another aspect that influences the adoption of fish processing technologies. Social actors are essential because they give potential users the necessary knowledge about the technology and its advantages. As a result of information reducing some technological uncertainties, a person's opinion may alter over time (Caswell et al., 2001). In Ghana, in particular, traditional leaders, government representatives, and non-governmental organisations play a crucial role in the dissemination of knowledge about innovations. Leaders can connect with their followers in every social structure to influence them. A potential adopter seems to be more likely to use an innovation provided their leaders and superiors support it. In every social system, social actors play distinct and crucial functions. Rural communities in Ghana, in particular, are regulated and governed by conventions and traditions; as a result, traditional leaders in these areas are highly revered. In this way, the subjects are apt to adopt any innovation or technological adoption promoted by these traditional chiefs. Before a new piece of technology reaches its primary users, it is frequently discussed how the higher-ups would use it. These social actors also have a lot of influence, interact with change agents, have exposure to many situations, and have experience. They are also more inventive and have higher socio-economic standing.

The dissemination of information around the coastal fishing communities is heavily influenced by local and international Non-Governmental Organizations (NGOs). These NGOs have worked to support initiatives that can provide resources like ovens, boats, and nets for various players throughout the value chain of fisheries. They have also helped in the adoption of the Chorkor smoker in Ghanaian fishing communities. The Central and Western Fishmongers Improvement Association (CEWEFIA), Development Action Association (DAA), H3n Mpoano, and a number of other organizations fall under the category of non-governmental organizations (NGOs).

The Ghanaian government has acknowledged since the 1950s that fish-smoking ovens can jeopardize the health and safety of fish smokers (Ndiaye et al., 2015). Heart disease, lung cancer, cataracts, anaemia, and miscarriage are just a few of the health issues that fish smokers in Ghana have been linked to (Gordon et al., 2011). The Ghanaian government has thus focused their efforts on creating and disseminating innovative fish-smoking oven technology to reduce the harmful health hazards associated with the practice. New fish-smoking ovens have been developed to lower the amount of smoke the fish smoker is exposed to, the amount of fuelwood required during the smoking process, and the amount of heat the fish smoker is exposed to throughout a "smoking session."

### 5.3.1. Food Research Institute (FRI)

The Food Research Institute played a significant role in the commercialization of the Chorkor smoker (FRI). With special reference to product safety, quality, and presentation, their mission is to be recognised as an institution that plays a significant role in the transformation of the food processing industry to be globally competitive. The Council for Scientific and Industrial Research's Food Research Institute (FRI) carries out market-driven applied research in the area of food science and technology and offers the country of Ghana's food industry technical services and goods. FRI deals with post-harvest handling issues in the fishing sector because it is Ghana's primary post-harvest research and development organisation.

By the early 1950s, the shortcomings of the conventional stove had been recognized, stimulating work to develop new and improved smokers such as the Adjetey, Altona, Ivory Coast, and Nyegesi models. However, for various reasons such as costs of inputs, none of these were adopted in Ghana. The Food Research Institute then met with fish processors in various regions to listen to their complaints about the drawbacks of using conventional round ovens. The Chorkor smoker, according to Mr. Stephen Nketsia, Food Research Scientist at Council for Scientific Innovation and Research (CSIR) -Food Research Institution (FRI), was created to alleviate the concerns of

post-harvest losses and to regulate the usage of firewood. He went on to say that the creation of the Chorkor oven was more directed toward the volume of fish since there was a glut during the early years and fish processors lost quantities of fish because traditional or outdated ovens could not smoke large quantities of fish at a go.

In 1969, the Chorkor, an improved traditional fish smoker, was developed and introduced as a result of the lessons discovered regarding the shortcomings and downsides of these early ovens. The Council for Scientific and Industrial Research (CSIR) of Ghana's Food Research Institute and the Food and Agriculture Organization (FAO) of the United Nations developed this novel technique. It has since taken advantage of the potential of technologies fulfilling users' standards. It was spearheaded by Madam Nerquaye-Tetteh, a food scientist who worked with Food Research Institute. The Chorkor oven had many advantages: It was easy to construct and may be put together with readily available materials in the area. Additionally, it is simple to use, has a sizable capacity, uses little fuel, smokes fish quickly, and produces high-quality smoked fish (Nerquaye-Tetteh, 1999). Through a number of training programmes and participatory marketing strategies, this easy-to-learn and highly efficient fish smoking technology was made popular in Ghana. As a result of the fish processors' early involvement in the implementation process, there has been a high level of acceptance and adoption.

In 1969, the Chorkor neighbourhood of Accra West saw the construction of the first set of the Chorkor Smoker in cooperation with fish smokers, hence its name. It was given to two fish smokers who worked together and expressed their willingness to accept and use the Smoker as well as to provide feedback to the Food Research Institute (Nerquaye-Tetteh, 1999). This was done to get other fish smokers to see how the smoker worked. The ultimate goal was to pique their curiosity about the novel concept. Mr. Stephen Nketsia stated that it was first commercialised in Chorkor since it was the nearest fishing town to the Food Research Institute, and they could always follow up with the fish processors for input on the new oven. After 6 months, the fish smokers from

Chorkor brought positive feedback to the Institute on the Chorkor smoker. The usage of the technology gradually extended throughout the Chorkor Community as more fish smokers became willing to adopt it in light of its obvious advantages. The processors started developing their own designs for the smoker (Nerquaye-Tetteh, 1999). Following the Chorkor community's quick acceptance of the technology, several methods were employed to disseminate it to other fishing communities through effective linkage procedures.

A six-week regional training course on artisanal fish processing and extension methods was offered annually from 1988 to 1998 as a part of the Ghana-Netherlands Regional Training and the Applied Research Project on Artisanal Fish Processing in Africa activities. The National Council on Women and Development, the University of Ghana, and the Ministry of Food and Agriculture provided their mid-level extension officers with this training. This project's major goals were to decrease post-harvest fish loss and increase rural people's access to high-quality fish and fish products. The Chorkor Smoker played a key role in these courses. FRI has been consistently working tirelessly to design and construct ovens to the advantage of the fish processors and allows them to smoke fishes without problems.

### **5.3.2. Food and Agriculture Organisation (FAO)**

The Food and Agriculture Organization was another contributor in the campaign to promote the Chorkor Smoker (FAO). One of the UN organisations that promotes the worldwide initiative to eradicate hunger is FAO. They work toward achieving food security for all people and guaranteeing that everyone has continual, equal access to nutritious food. In Ghana, where it has long-standing operations, the FAO has both national and regional offices. It offers crucial support for fisheries and aquaculture, including stock assessment, the development of data collection capacity, and policy advice.

In 1969, after the people of Chorkor had accepted the chorkor oven, the Food and Agriculture Organisation received a grant from the Freedom from Hunger Campaign (FFCH) to promote awareness of the problem of hunger and malnutrition, as well as potential remedies. The campaign served as a conduit for the dissemination of research findings generated by FAO and other agencies and organisations. The Campaign under the FAO aided in the global dissemination of information and promoted development education activities in both developed and poor countries. Since the Chorkor smoker was already in existence, the grant also helped to construct and sell more Chorkor Smokers and smoking trays at a subsidized amount in Chorkor (Nerquaye-Tetteh, 1999). According to Nerquaye-Tetteh (1989), the construction and selling of the Chorkor smoker at a reduced price continued in Chorkor up until 1971.

Following the Chorkor community's rapid adoption of the technology, the FAO planned to expand its use to other fish processing towns throughout the country (Nerquaye-Tetteh, 1989). However, the removal of FAO's material and financial assistance significantly hampered activities in this sector. Ten years after it was initially presented at Chorkor, the oven was still relatively obscure outside of this area. However, Nerquaye-Tetteh (1982) observed that while there was a reasonable amount of enthusiasm for its potential adoption in other places, fish processors had attained great experience in the usage and building of the Chorkor Smoker in the region where it had been introduced. Proposals to extend the adoption to other communities sprung up.

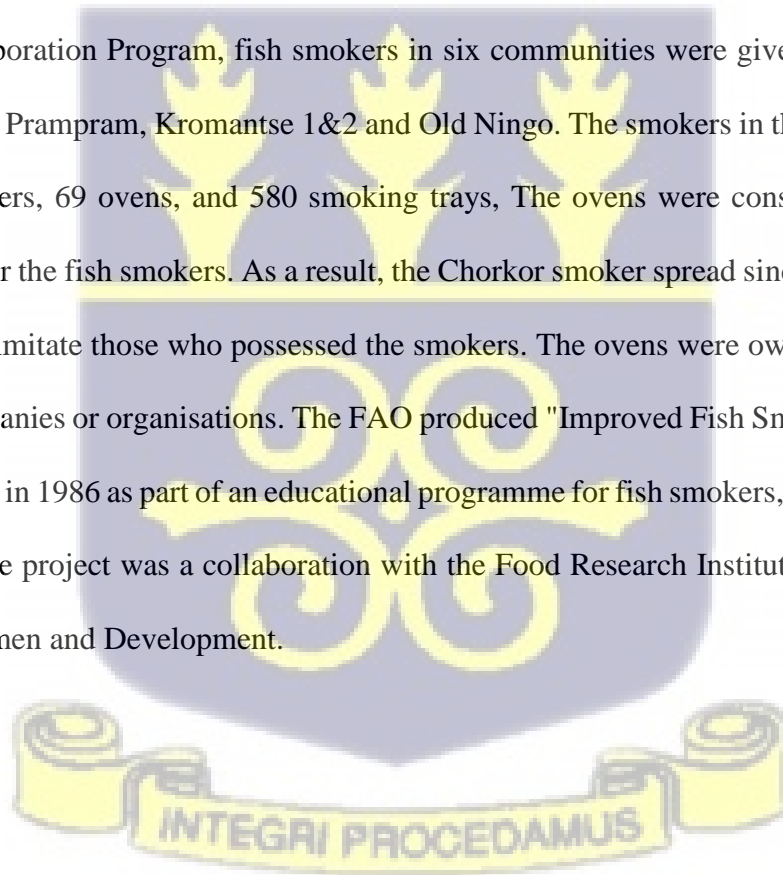
The Food Research Institute carried out an FAO Technical Cooperation Programme (TCP) project in 1986 that assessed the technical performance of various types of conventional and modified smoking ovens, including the Chorkor Smoker. The main objectives of TCP were to:

- To collect data on temperature distribution, smoking time, humidity, amount of fuel wood used, etc. as well as to give fish processors hands-on instruction in the usage of the Chorkor Smoker.

- Create a training/demonstration unit for fish smoking and pick various building materials to test for durability.
- Develop additional fish smoking training materials.

The study found some variances in temperature distribution across all types of ovens. Moving the layers of fish or putting out the fire with fuel wood were two other necessary controls for the smoking and drying rates. Contrarily, the Chorkor oven fared well in terms of price, capability, use, product quality, and fuel efficiency (Stroud,1986).

The FAO's interest in the Chorkor smoker gradually led to the continuous use of the technology which became widespread in Chorkor and other surrounding communities. As a result of the FAO Technical Collaboration Program, fish smokers in six communities were given Chorkor Ovens: Ankaful, Kpone, Prampram, Kromantse 1&2 and Old Ningo. The smokers in these areas received 57 plywood covers, 69 ovens, and 580 smoking trays, The ovens were constructed and put in strategic areas for the fish smokers. As a result, the Chorkor smoker spread since other fish smokers could easily imitate those who possessed the smokers. The ovens were owned by individuals rather than companies or organisations. The FAO produced "Improved Fish Smoking in the Tropics," a video tape in 1986 as part of an educational programme for fish smokers, extension officers, and students. The project was a collaboration with the Food Research Institute and the National Council for Women and Development.



### **5.3.3. United Nations Children's Fund (UNICEF)**

The *United Nations Children's Fund (UNICEF)* from 1982-1986 funded a project undertaken by the National Council for Women and Development (NCWD). In order to increase women's

productivity and lessen the tedium and burden of rural women's activities, the project sought to encourage the use of the Chorkor Smoker in communities outside of Chorkor as well as identify, develop, and promote technologies for creating income and employment through food preservation, food processing, and home-based businesses in Ghana (Nerquaye-Tetteh, 1989). This project covered the fishing regions (Greater Accra, Volta, Western and Central). Participatory and demonstration extension strategies were used. Women contributed in a variety of ways, including contributing mud and water, and physically helping in the oven's construction. At least one mason, one carpenter and artisans were taught in each town to build the oven. Individual fish smokers contributed to the expense of the Chorkor smoker construction by supplying mud, water, and labour.

The Chorkor smoker was introduced to local fish smokers, and 10 processors were chosen to provide the required amount of mud and water and assist in the construction of the stove base. Each of the 10 processors had a Chorkor smoker created for them and one of their own, maintaining the separate operational samples.

A handbook on the Chorkor smoker, titled, "A Practical Guide to Improved Fish Smoking in West Africa" was also published in French and English as a component of expansion exercises. According to Nerquaye-Tetteh (1989), it was financed by UNICEF in 1982-83 and distributed to provide end users with useful information on the Chorkor smoker.

#### **5.3.4. The International Labour Organisation**

The International Labour Organization began a partnership with the NCWD in 1985 thanks to large funding from the Dutch government. Its goal was to ascertain, develop, and launch income-generating solutions for home businesses, food processing, and food preservation in Ghana, with the goal of improving women's productivity and lowering the drudgery and burden of rural women's activities. This project also included the distribution of a modified version of the Chorkor Oven in various fishing settlements. The Central Region communities were Kokrobite, Nyanyano,

Apam, and Mumford. The introduction used a slightly different strategy than in previous projects. The smokers were given the ovens on credit. The smokers were given credit for the ovens. This spurred many more fish processors to use the technology.

### 5.3.5. The Role of Traditional Leaders

Chieftaincy, like other forms of authority, arose from a basic feeling of self and local area security. Among various human social orders, the most important reasons for assembling are protection and insurance against outside adversaries or enmity, as well as the requirement for an administration that drives and inspires people. In today's society, the chieftaincy establishment has advanced beyond security and insurance, and other similarly important jobs are expected (Dankwa, 2004).

Where the balance should be and how responsibilities should be distributed between traditional and modern fisheries management organisations are clear questions in a region like the Central Region. While traditional authorities have gradually decreased over time, traditions and beliefs have remained strong and are crucial to both fishing and communal life in general. Although it is obvious that these institutions are crucial to fisheries management, it is not always clear what their exact purpose should be. Additionally, combining traditional structures with more contemporary ones is not without its difficulties.

Traditional authorities are organizations or individuals who carry out their "jurisdiction and decision-making" duties "in accordance with traditional standards of governance" (Ubink 2008). These could be local chiefs and elders, Kings, traditional religious leaders, development chiefs, and family heads. Traditional leaders make a substantial contribution to the socioeconomic development of the state in various jurisdictions where they exist. The institution of traditional leadership has played a key role in day-to-day local governance in rural areas since the pre-colonial era. The traditional leaders were in charge of administration, politics, culture, and religion. Specifically, a chief should assist with satisfying the expectations and goals of the local area (Dankwa 2004). The simple definition of these goals is development, and it has been discovered that a

chief's success is determined by how well they do in terms of the level of development they are able to bring to their region. Therefore, the chief should be infused with wisdom, power, dynamism, and respect for having the option to be the expert in improvement that his community demands.

One of the employees of the Chief Fisherman in Moree stated that, while the Chief Fisherman is in charge of all fisheries activities, he lacks the authority to reject a technology that benefits fish processors. He went on to say that the chief fisherman has complete control over technologies used by fishermen but not by fish processors. He claims this is due to fish processors' ability to select which technology is best for them. One would agree that these leaders have a part to play in the adoption of technology. However, in Moree the case was different. Fish processors in Moree are self-motivated and ready to adopt technologies that work for them and not rely on external forces.

One fish processor opined:

Moree didn't have a chief back then and even now. Anytime individuals came from outside Moree to talk to us about something, they came with people we were familiar with to help them convince us to understand whatever they came with. Even though we didn't have chiefs, we had clan heads and association heads. They do not have the authority to decide what we should use for our work. So, I do not think they had a hand in the adoption of the chorkor smoker even though I am not sure about it.

Another fish processor said:

The issue of chieftaincy in this town is one that cannot be discussed. We did not have chiefs but had leaders of clans who could influence our adoption. However, as fish processors we know what's best for our kind of work and no leader can influence us to adopt something we do not want to. CEWEFIA introduced us to the Ahotor oven and the chief fisherman agreed that we adopt it, but we did not because we felt it was not good enough for us.

### 5.3.6. Central and Western Fishmongers Association (CEWEFIA)

CEWEFIA is a non-governmental organisation, a non-profit, women-oriented organization with its main office at Bronyibima Estate, Elmina. CEWEFIA was founded by Mrs. Victoria Churchill Koomson who is a former educationist. It was founded and launched in March 1990 after 54 fishmongers were evicted, destroying their mud ovens, in the bid to restore the Sekondi, Western Region, station of the Ghana Railway Corporation. The fishmongers promptly asked Mrs. Victoria Churchill Koomson who regularly stopped by the group at the processing center for assistance. She provided support in many forms to both the fish processors and their kids. Because she had an idea for a solution, she did not think twice to present it. She planned for their potential removal and had a place set aside for them. She passionately appealed to the late Nana Nketsia IV, the paramount chief of Essikado in the Western Region of Ghana, in an effort to obtain the appropriate piece of land. Nana accepted the plea and added further plots to the already-designated land right away. He claimed that if the land was extended from the valley to the historic Essikadu Cemetery, all the underprivileged ladies would be able to own a portion of the plots. She also made an effort to give the ladies access to clean water (a standpipe), a bathroom, and electricity so they could work efficiently and in a safe setting. She was called to help the fishmongers in the Central Region (Moree, Ekon, Ayisa, and Bantoma) because of her commitment to the Sekondi ladies. Mrs. Victoria Churchill Koomson responded by building Chorkor ovens, fish drying sheds, a kindergarten, and a centre for fishmongers' skill development. The Central and Western Fishmongers Improvement Association (CEWEFIA) of Ghana was formed as a result of the collaboration and exchange of ideas and experiences between the two fishmonger groups in Western and Central Regions.

More than 4000 fishmongers, vendors, men and women, adolescents, kids, and traditional leaders have been involved with CEWEFIA so far. It has also transformed the bad social practices of more than 2000 rural people, especially adolescents, in Ghana's Central and Western Regions.

CEWEFIA operates in two regions: Central and Western and has a total membership of 750 organized fishmongers in the Central and Western Regions of Ghana. CEWEFIA networks and collaborates with organizations such as Ghana Aids Network (GHANET), the Environmental Protection Agency (EPA), the Association of NGOs in Central Region Ghana (ANCER), Ghana AIDS Commission amongst others.

### *Finance*

Credit is required not just for the purchase of fishing boats and equipment, fish processing, and marketing facilities, but also, and perhaps more importantly, daily catch, processing and for commercial purposes. Women's socioeconomic roles in fishing areas require substantial credit support as well. As a result, there is a need for a functional credit and lending system that takes into account the fishermen's current socioeconomic conditions. This system must be linked to technology, production processes, and output prices to drive growth and development in this area. The majority of fish processors obtain bank loans for capital and operating costs and are unable to repay them on time. This has lasted for a long time and has made it difficult for women to receive finances or loans from formal institutions who view them as extremely risky. Women sometimes struggle to understand the terms and circumstances of these banks and are sometimes unable to meet deadlines, making payment of their loans difficult. This is where CEWEFIA stepped in to help the women secure loans and repay them when it was convenient for them.

One of the aims and objectives of CEWEFIA according to the founder, Madam Churchill-Koomson is to improve the financial management of fishmongers. CEWEFIA's social change actions have been recognised by the Ghana government. As a result, CEWEFIA has been implementing the Government's Micro Finance Loans Scheme to its organised and reinforced women organisations in eleven (11) rural areas including Moree. This will aid in the reduction of poverty in the area.

Most fish processors admitted that CEWEFIA has helped improve their finances by giving them access to small loans from the association and setting up Village Savings and Loans Association (VSLA). This VSLA constitutes only fish smokers who contribute 10 cedis every week to the coffers of the association. This is to help loan each other in dire times. The women save in a box which is kept by one person. The box has three padlocks with three keys kept by different persons. Each member knows how much money is in the box for the sake of transparency. When a member obtains a loan, she is given a maximum of three months to pay it back to the association. Most women obtained the loans to take care of their families and also to start side businesses in addition to their fish business. They also mentioned that these loans helped them to get some income to transition from the clay chorkor smoker to set up the block chorkor smoker.

According to the project manager for CEWEFIA,

The organization gives the fish processors loans but realized some of them found it difficult to repay and that is the more reason why we advise them to be part of the Village savings and loans scheme so that there it will be flexible for them. This is because you contribute your own money, making it easy to take it as a loan from the association. It's just like the bank just that all the interest will come to the group.

One of the processors also opined:

CEWEFIA is a group that helps fish processors. They educate us, and help us financially, by giving us loans. They also help us set up VSLA so we are able to give loans to each other without having to go to the bank.

Another fish processor pronounced that:

The loan I took from CEWEFIA's VSLA helped me acquire some inputs for the construction of the block chorkor smoker. I have always wanted to construct the block Chorkor smoker but I was hard-pressed with finances, but CEWEFIA came through for me.

### *Training Sessions*

According to the participants, CEWEFIA empowers them through training, sensitization, and

hygienic fish handling, packaging, storing, and preservation. CEWEFIA has also been educating women on occupational and vocational skills as well as credit utilisation. For illiterate women, organising reading and writing seminars help them engage in more productive social and economic activities. Training sessions are always well received by the participants. They were encouraged by CEWEFIA to put their newly acquired abilities to use in their own businesses. After the adoption of the chorkor smoker, they received several trainings on its usage from CEWEFIA. They also train the fish processors on value addition to help them get access to the licensing certificate to sell their products to the malls, markets and even do exports. CEWEFIA educates them on personal hygiene, family planning, and rights (fundamental human rights, human rights, and children's rights). For the people of Moree, CEWEFIA is more than just an NGO but a family.

This is what a fish processor said about the training sessions received from CEWEFIA.

As at the time we adopted the Chorkor smoker, there was no help from any NGO. But after we adopted it some NGOs like CEWEFIA came in and took us through a series of training on the use of the chorkor smoker properly. They also showed us how to bargain on the market because the fish smoked on the Chorkor is of high quality. They also showed us how to properly wash fish before smoking on the Chorkor. In fact, they educated us very well on the chorkor.

Another processor added that:

“CEWEFIA has been very good to us as fish processors. They have taken us through series of trainings on fish storage, handling and many more. They also trained us on how to smoke fish on the chorkor smoker”.

From the above, it is noted that stakeholders of the Chorkor smoker worked tirelessly to get the oven disseminated in the fishing communities in Ghana. Ghana issued postage stamps featuring a variety of Chorkor Smoker operations in honour of its crucial role in lowering post-harvest losses in the fish processing industry. This greatly assisted technological transfer (Nerquaye-

Tetteh, 1989). The commercialization of the Chorkor smoker in Moree largely depended on training and sensitizations given by CEWEFIA. Fish processors developed a considerable skill for the adoption and dissemination of the Chorkor oven largely because of its benefits.

Although certain international NGOs were very helpful in spreading the Chorkor oven outside Chorkor, the primary stakeholder in the town of Moree was CEWEFIA. CEWEFIA worked to educate fish processors on the benefits of the smoker and has assisted in the replacement of the old traditional ovens with the chorkor oven.



**SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

**6.1. Introduction**

This chapter provides an overview of the findings, as well as the study's conclusion and suggestions. The summary of findings highlights the conclusions reached based on data collected from research participants in Moree regarding their adoption of the Chorkor smoker.

**6.2. Summary of Findings**

The study's overarching goal was to find the factors that affected the adoption of fish-smoking technology in Moree. The specific goals were:

1. To examine the factors that led to the adoption of the chorkor smoker in Moree
2. To examine the role socio-demographic characteristics played in the adoption of the chorkor smoker in Moree.
3. To identify the role of multi-stakeholders (NGOs, state, traditional leaders) in the adoption process of the Chorkor smoker.

The following findings were reached based on participant replies in Moree regarding their adoption of the Chorkor smoker:

It was discovered that technologies needed to be appropriate for the local, environmental, and cultural environments in which they were being used. In this way, the Chorkor smoker supported the town's standing as one of Ghana's major fishing towns rather than challenging the customs and values of the residents of Moree. The study also indicated that if an innovation is tested or scalable, a potential adopter may embrace it.

The study found that the adoption rate of the Chorkor smoker was influenced by several monetary or economic aspects. The price of inputs can help or hinder how well fish processors use technology. New technologies have a wide range of impacts on costs and cost-effectiveness, depending on the magnitude of the initial capital investment required and whether the new technology primarily affects annual fixed or variable expenses. The high price of inputs is harmful to adopters as well. Adoption rates for high-cost technology are frequently lower. Their purchasing decisions were influenced by current pricing, conditions of the market, and infrastructure growth. High initial capital cost technologies typically have longer payback periods and are thought to have less overall advantages.

Moree fish processors stated that the availability of inputs influenced their decision to use the Chorkor smoker. They went on to say that the materials needed to build the device included clay, bricks, wood, and nets, among other things. Because clay is a readily available material, creating a clay bail smoker is not a difficult task.

The study also showed that the availability of land for technological construction is a critical element in how rapidly innovation is accepted. According to the interviews, fish-smoking technologies can be implemented when land is accessible, but a lack of land ownership can impede the development of fish-processing technologies. Fish processors who own or inherit land are more likely to adopt new technologies because they can afford to set aside a portion of their land for the construction of the Chorkor smoker.

On the socio-demographics of the participants, it was found that the majority of them were females because of the emphasis placed on gender dynamics and division of labour in Moree. It is their belief that men are to go fishing because the first person who made fishing an occupation and brought it to light in Moree was a man. They also believe that men engage in precarious jobs like fishing and not women. This supports previous reports that women are largely involved in the processing and marketing of fish caught in artisanal fisheries, although men predominated in fishing operations, particularly in Africa (Sakyi et al., 2019).

According to the data, it was also discovered that the majority of the participants were above age 40 and had been extremely productive. It suggested that most fish processors used the Chorkor smoker when they were young (between the ages of 15-20). As a result, the researcher concurred with Rogers (2005) that the majority of innovators are young and entrepreneurial people who are brave and want to try new things. Because fishing-related activities require a lot of energy, past research has found that the majority of persons who participate are usually between the ages of 20 and 50, when they are still young, productive, and economically active (George et al., 2014; Odediran & Ojebiyi, 2017).

The study also gathered information on years of processing experience and years of using the Chorkor smoker. This was done to determine how long the Chorkor smoker had been in Moree. Fish processors have been using the Chorkor smoker for over 15 years and are quite experienced. More experience is usually associated with better performance. The majority of fish processors would be proficient in fish processing techniques and would be knowledgeable of industry trends including price changes for inputs and fish products, all of which might affect their decision-making. This result was compatible with Odediran and Ojebiyi (2017)'s findings which said that they would be able to make clear and reasoned decisions about whether to adopt or reject a technology based on their broad understanding of existing technologies as opposed to newly presented ones. This is because the majority of fish processors started their enterprises with their mothers or family members at a young age.

It was also discovered in the study that some stakeholders of the Chorkor smoker like CEWEFIA organised training workshops for fish processors on financial stability, loan applications, and other topics that were beneficial for their business. The fish processors were educated on how to maximize profits by using the Chorkor smoker, and also how to bargain for prices with their customers to their advantage.

### 6.3. Conclusions

The acceptance of the Chorkor smoker in Moree can be attributed to three factors: technological, financial/economic, and personal. Overall, technological factors were the primary elements that prompted Moree's fish processors to adopt the Chorkor oven. It was found that the majority of the respondents were scared to take loans from the banks because of some harsh conditions given by the banks. They therefore resorted to loans from their local units (CEWEFIA). This facilitates access to vital information and credit facilities mostly by NGOs.

All of the fish processors were above the age of 40 and had been using the Chorkor smoker for at least 15 years. Because the Chorkor smoker has been in existence for more than 20 years, the researcher needed fish processors who had been using it for a while. This indicated that fish processors adopted or began using Chorkor smoker at a younger age and can be classified as early adopters and innovators because they are comfortable embracing new ideas and technologies.

Given the importance of education in technology adoption, Moree's instance has led me to believe that informal education is just as important as formal education in technology adoption. This is because the fish processors in Moree had no formal education but were able to adopt and use the Chorkor smoker. According to the adoption literature (Rogers 1983), the complexity of technology hinders adoption. As a result, education in all forms should aim to lessen the complications associated with technology. The ability to read and comprehend intricate procedures written on technological packages is critical for acceptance.

Although several stakeholders contributed to the spread of the Chorkor smoker, the Central and Western Fishmongers Association (CEWEFIA) was the primary stakeholder who influenced the smoker's acceptance in Moree. Fish processors acknowledged CEWEFIA's significant assistance in enabling them to adopt the smoker and work productively.

#### 6.4. Recommendations

Based on the findings of this study, the following recommendations have made.

1. It was discovered that most participants had low formal education. Although this had no effect on the acceptance of the technology, fish processors should nonetheless receive pertinent and suitable education and training. This may not always entail attending classes in a formal setting, but it does require periodic training on the use and maintenance of new technologies. Because the ability to understand and follow complex processes stated on technology packages is vital for adoption.
2. Adoption of the technology was found to be hindered by financial constraints of the adopter. Based on this, the Government and fisheries commission should take the needs of fish processors into consideration and subsidize bank rates for easy loan acquisition. This will in the long run encourage fish processors to adopt new technologies at a faster rate.
3. Associations that are seemingly owned and whose values all embraced by members have a greater influence on members behaviour. Therefore, it is encouraged that members find themselves attached to such organizations.
4. Improvements in processing technologies should be developed in collaboration with the processors and traders in an including manner, building upon their practical experience-based skills and contextual knowledge so that they can offer quality nutritious fish products that are not only affordable but also safe.
5. It is also recommended that extension officers of an improved technology should set up the technology at a more convenient place to allow the adopters try and test it for some time. This will relay the benefits of the technology to the adopters directly and will aid in its adoption.

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## APPENDICES

### APPENDIX I: INTERVIEW GUIDE

#### FACTORS AFFECTING THE ADOPTION OF FISH SMOKING TECHNOLOGY IN MOREE.

Dear Participant,

I am a final year master's student at the above-mentioned University. I am carrying out academic research on the above-mentioned topic, and I would be very grateful if you could respond to all the questions, providing as much detail as you can. Responses given will be used solely for academic purposes and respondents are, therefore, assured that the information provided would be treated with absolute/utmost confidentiality.

Please do you consent to be engaged in this study? [a] Yes [b] No

Participant Number ..... Date of Interview.....

Time start..... Time end.....

*To describe the socio-demographic characteristics of the adopters of the chorkor smoker in Moree*

I would like to find out a few demographic details about you. Kindly provide information on the following:

1. Age .....
2. Gender .....
3. Marital Status .....

4. Highest Education Level .....
5. Ethnicity .....
6. No. of years in the community .....
7. No. of years in this business .....
8. Social Status .....

*Knowledge on the chorkor smoker*

1. How did you hear of the Chorkor smoker in this community?
2. How did you acquire your Chorkor smoker?
3. Why did you choose to acquire the smoker? (Probe if there were dissenting voices and how they overcame that).
4. How long have you been using the Chorkor smoker?
5. Which fish-smoking technology were you using earlier?
6. Who are those who made you aware of the new technologies?

*To elaborate on the role of multi-stakeholders (NGOs, state, traditional leaders) in the adoption process of the Chorkor smoker*

1. What role did any NGO play in the adoption of the smoker?
2. How did the state play a role in the adoption of the Chorkor smoker?
3. How did your traditional leaders help in the adoption of the Chorkor smoker?

*To examine the factors that led to the adoption of the smoker*

1. What was the difference between the Chorkor smoker and the traditional ovens?
2. What factors influenced you to adopt the smoker?

3. How has the adoption helped you
4. What limited you to adopt the technology?



## APENDIX II: ETHICAL CLEARANCE



### UNIVERSITY OF GHANA ETHICS COMMITTEE FOR THE HUMANITIES (ECH)

*P. O. Box LG 74, Legon, Accra, Ghana*

My Ref. No...ECH 358/ 21-22 ...

1<sup>st</sup> August, 2022.

Priscilla Atta-Peters  
Department of Sociology  
University of Ghana  
Ghana

#### ETHICAL CLEARANCE (ECH 358/ 21-22)

The protocol title below has been reviewed and approved by the ECH Committee.

**TITLE OF PROTOCOL: FACTORS AFFECTING THE ADOPTION OF FISH SMOKING TECHNOLOGY IN MOREE**

**PRINCIPAL INVESTIGATOR: PRISCILLA ATTA-PETERS**

Please note that the final review report must be submitted to the Committee at the completion of the study. Your research records may be audited at any time during or after the implementation. Any modification of this research project must be submitted to ECH for review and approval prior to implementation.

Please report all serious adverse events related to this study to ECH within seven (7) days verbally and in writing within fourteen (14) days.

This certificate is valid till July 19, 2023. You are required to submit annual reports for continuing review.

Please accept my congratulations.

Yours Sincerely,

**Professor C. Charles Mate-Kole**  
**ECH Chair**

Cc: Prof. Akosua Darkwah, Dept. of Sociology, UG  
Dr. Fidelia Ohemeng, Dept. of Sociology, UG

Tel: +233-303933866

Email: [ech@ug.edu.gh](mailto:ech@ug.edu.gh)