UNIVERSITY OF GHANA

SUSTAINABLE FINANCING AND BUSINESS MODELS IN THE COOKSTOVES SECTOR IN GHANA

BY

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

…… **……..**

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CERTIFICATION

I, hereby certify that this thesis was supervised in accordance with the laid down procedures by the University.

…….. ……

DR. CHARLES ANDOH **DATE**

SUPERVISOR

DEDICATION

I dedicate this project work to the Almighty God and my parents in the persons of Mr Samuel Ablorh and Mrs Portia Deborah Williams.

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LIST OF ABBREVIATIONS/ACRONYMS

BCC	Behavior Change Communication
Endev	Energizing Development
GACC	Global Alliance for Clean Cookstoves
GIZ	German Agency for International Cooperation
HAP	Household Air Pollution
ICS	Improved Cookstove
IEA	International Energy Agency
KCIC	Kenya Climate Innovation Center
LPG	Liquefied Petroleum Gas
MNRE	Ministry of New and Renewable Energy
NISP	National Improved Stove Program
PAYG	Pay-As-You-Go
SACCOs	Savings and Credit Co-operatives
SETH	Social -Economic -Time and –Health
SE4All	Sustainable Energy for All
SNV	Department for International Development
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VLE	Village level Entrepreneur
WHO	World Health Organization

ABSTRACT

The purpose of this study was to propose sustainable financing and business models to tackle the financial and marketing/distribution barriers hindering the widespread adoption of improved cookstoves and clean fuels in Ghana. The study employed the mixed-method research approach through the use of questionnaires and interview guides for collecting primary data. Furthermore, desk review was undertaken with regards to financing and business models in the Cookstove sector.

Analysis of data was done through the use of descriptive statistics, with the results presented in frequency tables and graphs. From the findings, sustainable financing and business models on Promotion, Marketing, Financing and Pricing have been proposed for the development of the Cookstove Sector in Ghana. The study was necessary since sustainable financing models and market-based approaches are pre-requisites for achieving scalable dissemination of improved cookstoves and clean fuels in Ghana.

Keywords*: Improved Cookstoves, Clean fuels, Business Models, Sustainable Financing, Market development*

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter provides the general overview of the study. It presents the study background and statement of the problem. It outlines further the objectives of the study, research questions, study significance and scope of the study. The chapter ends by giving a preview of organization of the entire study as well as the summary of the chapter.

1.2 Background to the Study

Globally, 2.7 billion people mainly found in developing countries rely on solid biomass (woodfuel and charcoal) fuels and rudimentary traditional cooking systems to attain their cooking and heating needs (International Energy Agency (IEA), 2015, Ezzati, 2005). In Sub Saharan Africa, nearly 730 million people rely on the use of traditional biomass (mostly fuelwood, dung and charcoal) for their cooking and heating needs, usually with inefficient stoves or three-stone fires in less ventilated environments (IEA, 2014). The disadvantages of relying on these traditional biomass fuels are many: they are inefficient, produce greater amount of dangerous emissions, and contribute to forest deforestation. Furthermore, household air pollution (HAP) from cooking with "polluting" or "inferior" fuels lead to more than 4.3 million premature deaths per year around the globe (World Health Organization (WHO), 2016a).

Consequently, the adoption of improved cookstoves (ICSs) and cleaner cooking fuels is considered one of the simplest and most affordable ways of resolving this problem is to improve energy efficiency, remove smoke from indoor living space and lessen the drudgery of cooking duties (World Bank, 2011). According to Global Alliance for Clean Cookstoves (GACC, 2015b), improved cookstoves alone remain inadequate to capture fully the environmental and health

potential of clean cooking, hence clean cookstoves must be adopted along with cleaner fuels such as (liquefied petroleum gas (LPG), ethanol, briquettes, pellets, biogas, etc. According to Warwick & Doig, (2006), adoption of improved cookstoves (ICSs) and cleaner fuels such as LPG, ethanol, briquettes pellets, biogas in developing countries reduce health risks, alleviate poverty and empower women. Furthermore, Barnes, Openshaw, Smith & Van der Plas (1993) and Simon, Bumpus & Mann (2012) consider it a "win–win" development project due to the co-benefits that result from their use. Moreover, the World Bank in a research carried out in 2011, argue that the advantages of switching to these cleaner cooking technologies includes all three key components of sustainable development; that is the social, economic and environmental benefits.

Despite the many associated advantages of improved cookstoves and cleaner fuels, adoption rate continue to be low in Ghana, as well as in many developing countries despite several clean cooking programs and interventions by the Global Alliance for Clean Cookstoves (GACC), the World Bank, Sustainable Energy for All (SE4All), the U.S. Agency for International Development (USAID), German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit, or GIZ), Energizing Development (EnDev), Department for International Development (SNV), Nordic Environment Finance Corporation, etc. Additionally, funding from governments, donors, social impact and carbon finance investors have augmented financial flows to clean cooking interventions within Sub Saharan Africa in the past few years. (Watson, Byrne, Morgan-Jones, Tsang, Opazo, Fry & Castle-Clarke, 2012; Ray, Clifford & Jewitt, 2014; Rehfuess, Puzzolo, Stanistreet, Pope & Bruce, 2014). Researchers such as (Rehfuess *et al*., 2014; Levine, Beltramo, Blalock & Cotterman, 2012) have attributed the slow uptake to factors which include financial, socio-cultural, institutional, political barriers, etc.

According to Mobarak, Dwivedi, Bailis, Hildemann, & Miller (2012), financing serve as major hindrance for enterprise production, and explains the low demand for non-traditional cooking

technologies. Financial challenges for consumers particularly in developing countries to drive the adoption of these clean cooking technologies and fuels pose hindrance for effective development of the sector as most rural and several urban consumers cannot afford the cost of clean fuels and improved cookstoves technologies (Banerjee, 2001; Winter-Nelson and Temu, 2005). For instance, Beltramo, Levine and Blalock (2014) indicate that financial barrier poses a major limitation to the adoption of improved cookstoves and cleaner fuels in Uganda. Furthermore, Mobarak *et al*. (2012) identified issues of financing as a critical factor underpinning the slow uptake of modern cooking technologies in Bangladesh. Again, Mitchelleta (2011) posits that the dangers of financing low carbon programs also affect the availability of improved cookstoves technologies and cleaner fuels as they are perceived to be uneconomically competitive at current energy market prices, hence making them financially unprofitable for investors. According to the Global Alliance for Clean Cookstoves (GACC) (2016), aside the local capital source of finance, the global commercial investment funds for the sector was only $12 million in 2015. In addition, sustainable financing models to underpin most Small and Medium Enterprises (SME) in an attempt to secure a non-collateralized funds that is flexible and workable in real terms is elusive (Ray, Clifford and Jewitt, 2014) The mainstream private-sector led funding scheme and business models deployed is "unfriendly" and too expensive for startup local artisan enterprises (Mobarak *et al.,* 2012). Furthermore, larger private sector business players and banking institutions are disinclined to invest in the sector due to high perceived market and operational risks.

The Cookstove sector in Ghana began in the 1990s with the focus on promoting clean and efficient charcoal stoves such as the Ahibenso coalpot program.by the Ministry of Energy, introduction of subsidies on domestic LPG consumption by the Government of Ghana, free dissemination of LPG cookstoves and cylinders to rural areas under the Rural LPG programme (Ministry of Petroleum,

PR 2015), promotion of sustainable cooking fuels under the Bamboo and Rattan Development Programme, among others.

Ghana as a country faces enormous challenges in increasing and improving access to clean cooking energy services due to the lack of proper financing, marketing and distributional strategies for local cookstove entrepreneurs (Sedzro, 2018). Furthermore, the barriers of providing affordable consumer financing options for cleaner and more efficient stoves and fuels weakens our efforts to upscale (Brew-Hammond and Kemausuor, 2009).

1.3 Problem Statement

Globally, 2.7 billion people mainly found in developing countries rely on solid biomass (woodfuel and charcoal) fuels and rudimentary traditional cooking systems to attain their cooking and heating needs (International Energy Agency (IEA), 2015; Ezzati, 2005). The International Energy Agency (2016) estimates that the global population of 1.8 billion people will continue to depend on solid biomass fuels for cooking if we continue business as usual.

In sub-Saharan Africa, about 730 million people rely on traditional biomass cooking fuels (wood, charcoal and other agricultural residues (IEA, 2014). This number is projected to increase to 880 million due to population increase by 2020 (IEA, 2014). Furthermore, the World Bank (2014), estimates that the projected cumulative annual opportunity cost for continuous reliance on traditional fuels in Sub-Saharan Africa is 3 percent of the region's $32 billion annual gross domestic product as a result of time lost to fuelwood collection, household expenditures on wasteful fuels and stoves, as well as costs for treating smoke-related ailments, majority being women and children. Additionally, inefficient and "inferior" reliance on traditional cooking systems emit about 25% of global black carbon; coupled with forest degradation, loss of biodiversity, and localized deforestation resulting from their use (World Bank, 2011).

In Ghana, about 77 percent of the population continue to depend on traditional biomass for cooking. This result to severe negative health impacts including an estimated premature deaths of 17,000 people been recorded annually as a result of exposure to Household Air Pollution (World Health Organization, 2017). Switching to clean and efficient cooking solutions (improved cookstoves and cleaner cooking fuels) would provide solutions to many of these problems. However, significant barriers of financial, marketing, technological, socio-cultural, political, among other factors hinder the large scale penetration of clean cooking solutions (Banerjee, 2001; Winter-Nelson and Temu, 2005; Jan, 2012; Mobarak et al., 2012; Rehfuess *et al*., 2014; Levine, Beltramo, Blalock, Cotterman, 2012), thereby impeding efforts of policymakers and non-governmental organizations (NGOs), international development agencies and global institutions towards the promotion of clean cooking energy services.

Financing serve as a major barrier for the development of the Cookstove sector especially in developing countries (Banerjee, 2001; Mobarak *et al*., 2012; Ray *et al*.,2014). Clean cooking energy services are too expensive for many low income households. In Ghana, financing serve as a major challenge for the expansion of access to clean and efficient cooking energy due to the lack of proper financing schemes for local cookstove entrepreneurs, as well as lack of affordable consumer financing options, hindering market development (Sedzro, 2018). Additionally, appropriate marketing and distributional models to support the marketing, distribution and maintenance of cookstoves, and clean fuels is also a major challenge (Sedzo, 2018). The development and implementation of sustainable business models would hence provide solutions in tackling the business barriers to clean cooking energy services adoption.

Consequently, the overall objective of this study was to propose sustainable financing and business models for the cookstove sector in Ghana, as appropriate policy interventions underpinned by

research based financing and business models could help in shaping the Cookstove sector to upscale significantly.

1.4 Purpose of Study

The purpose of this study was to propose sustainable financing and business models for the development of the Cookstoves sector in Ghana.

Specific Objectives

The study was guided by the following specific objectives:

I. To investigate the barriers accounting for the low adoption of improved cookstoves and fuels in Ghana

II. To investigate the financial barriers facing actors within the Cookstove and fuel value chain in Ghana.

III. To assess the nature of current business models within the Cookstove sector in Ghana.

IV. To propose sustainable financing and business models for the development of the Cookstove sector in Ghana.

1.5 Research Questions

From the objectives above, the researcher sought to find answers to the following research questions:

I. What factors account for the low adoption of improved cookstoves/fuels in Ghana?

II. What are the financial barriers facing actors within the Cookstove and fuel value chain in Ghana?

III. What is the nature of current business models within the cookstove sector in Ghana?

IV. What sustainable financing and business models can be adopted to promote the Cookstove sector in Ghana?

1.6 Significance of the Study

The significance of the study lies within the dealing of a worldwide issue that implies severe environmental, health, social and economic problems generated through traditional cooking practices and also within the overall objective of the United Nations (UN), oriented to achieving sustainable development in its Sustainable Development Goal 7 of which Ghana is a signatory. With a growing recognition about the benefits of cleaner and efficient cooking technologies and fuels, inadequate resources for implementation of clean cooking projects such as startup cost, user financing, product development, etc pose huge challenge to the adoption of clean cooking technology (Lambe, Jürisoo, Lee & Johnson, 2015). A comprehensive approach in addition to innovative enterprise and consumer financing and business models would provide opportunity for upscale in production and increased adoption of these clean cooking technologies. Consequently, the study sought to propose effective and sustainable financing and business models for the private sector and end-user segments within the Ghanaian cookstove sector to scale up production and adoption of cookstoves and clean fuels technologies.

The contribution to literature and filling of knowledge gaps through this study would provide an essential platform for the cookstove sector policy influence. Additionally, the study would provide Governments, Development partners, investors, financial institutions and other stakeholders with rich insights into sustainable financing and business models for the promotion of improved cookstoves and clean cooking fuels.

1.7 Scope and Limitation of the Study

The study sought to propose sustainable business models for the Cookstove sector in Ghana. It also sought to investigate the financial barriers facing actors within the Cookstove value chain in Ghana as well as to assess the nature of current business models within the Cookstove sector in Ghana.

The study was narrowed down and limited to key actors within the Cookstove value-chain made up of manufacturers, retailers and end-users of improved cookstoves and clean fuels who participated in the study.

1.8 Definition of Key Terms

I. **Improved cook stove** (ICS): A cooking device constructed to increase combustion efficiency of biomass, and creates smokeless environment in the kitchen.

   Note: Improved Cookstoves are interchangeably referred to as cookstoves in this study.

II. **Clean Fuels**: The Global Alliance for Clean Cookstoves define clean fuels as fuels that meet Tier 3 specifications for indoor emissions as relating to health and environmental impacts**.**

III. **Sustainable Financing**: This refers to any form of financial services which provides lasting benefits for both clients and the society at large**.**

IV. **Business Models:** These refer to strategies involved for the successful operation of a business which includes: identification of sources of revenue, products, intended customer base, details of financing, etc.

1.9 Chapter Organization

The study was organized into six (6) chapters: Chapter one covered the general introduction of the study which included the background of the study, statement of the problem, study objectives, research questions, significance, study scope, definition of key terms, chapter organizations and chapter summary. Chapter 2 focused on reviewing relevant literature; both theoretical and empirical literature. Chapter 3 covered the research methodology. Chapter 4 presented and discussed the study results, presented the proposed business model suitable for promoting the sector and encouraging

business linkages, while Chapter 5 comprised of the summary, conclusions and policy recommendations.

1.10 Chapter Summary

From the above discussions, it is evident that the development and adoption of sustainable business models to tackle financial barriers to improved cookstove and fuel adoption is fundamental for the upscale of the sector. This led to the study objectives, research questions, significance of the study, scope and limitations, definition of key terms, chapter organization and summary of the chapter

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In the previous chapter, the research problem is presented together with the research objectives, research questions, significance and scope of the study. In this chapter, related literature was reviewed. The goal of the review was to ascertain gaps in the literature as a basis for developing the study's conceptual framework in order to address the research problem. This chapter was divided into 2 main sections. The first section presents the history of the cookstoves sector in Ghana, Benefits of Improved Cookstoves & Clean Fuels, Barriers Affecting Adoption of Improved Cookstoves &Fuels, Promotion of Clean Fuels, Financing Clean Cooking, as well as the Business Models in the Cookstove and Fuels Sector. The second section presents the empirical review of the research, with identification of gaps and conceptual framework.

2.2 History of the Cookstoves Sector in Ghana

The Cookstove sector in Ghana began in the 1990s, with the focus on promoting improved charcoal stoves and cleaner fuels such as the Ahibenso coalpot program.by the Ministry of Energy, introduction of subsidies on domestic LPG consumption by the Government of Ghana, free dissemination of LPG cookstoves and cylinders to rural areas under the Rural LPG programme (Ministry of Petroleum, 2015), promotion of sustainable cooking fuels under the Bamboo and Rattan Development Programme, among others. Additionally, efforts by development partners which includes UN agencies, the World Bank, the European Union, NGOs, as well as the Private sector have been instrumental in addressing efficiency of cooking energy in the country.

The Ghana cookstove ecosystem is promising, as the country is home to many improved cookstoves manufacturers, with total cookstoves production amounting to tens of thousands. Nonetheless, these

figure represent just about 5% of the total cookstove market today. According to the GACC Technical Report (2015a), improved cookstoves includes all cookstoves with improved fuel efficiency and reduced emissions compared with the baseline stoves (such as the three stone fire/ mud stove) as per the guidelines of the International Workshop Agreement (IWA). Table 2.1 below presents some examples of improved cookstoves in Ghana.

Table 2.1: Examples of Improved Cookstoves in Ghana (Domestic & Institutional)

Type of Cookstove	Type of Cookstove	Type of fuel
 Improved cookstove (Envirofit)	 "Gyapa", "Holy cook", "Toyola" model	Charcoal

 Improved charcoal stove 'CookMate'	 Improved woodstove	
 Gas Cooker	 Gas Cooker	LPG

Source: Author (2018)

According to the Global Alliance for Clean Cookstoves (GACC) (2015b), improved cookstoves alone remain inadequate to fully solve the environmental and health effects from the use of inefficient cookstoves and traditional solid fuels. Hence, the sector also focuses on the promotion of cleaner fuels such as Liquefied Petroleum Gas and alternative biofuels (such as ethanol gel, pellets, briquettes and biogas.

Table 2.2 below present some examples of clean fuels

Table 2.2: Some Clean Cooking Fuels in Ghana

 **Uncarbonized Briquettes**	 **Carbonized Charcoal**

Ethanol Stove

Ethanol Gel with stove

Source: Author (2018)

2.3 Benefits of Improved Cookstoves & Clean Fuels

According to Barnes, Openshaw, Smith & Van der Plas *(*1993) and Simon, Bumpus & Mann *(*2012), switching from traditional solid fuels and inefficient cookstoves to cleaner cooking fuels and improved cookstoves (ICS) is considered a win-win development agenda as a result of the associated co-benefits of health, socio economic and environmental impacts.

2.3.1 Health Benefits

Adoption of ICSs and clean cooking fuels promote the health of users. Studies by Asaduzzaman, Barnes & Khandker (2010) in Bangladesh, and García-Frapolli, Schilmann, Berrueta, Riojas-Rodríguez, Edwards, Johnson & Masera (2010) in rural Mexico reveal that switching to clean cooking fuels and clean cooking devices such as ICSs reduces health risks of Household Air Pollution (HAP) due to excessive smoke, with women and children being the most affected victims.

Furthermore, using the cost benefit analysis (CBA) framework in Sudan, Kenya and Nepal, Malla, Bruce, Bates & Rehfuess (2011) discovered the health and economic benefits of adopting improved cooking interventions through the reduction of illnesses, treatment costs, and productive time previously wasted from taking care of sick children.

2.3.2 Environmental Benefits

There are environmental benefits associated with the adoption of ICSs and clean cooking fuels. WHO (2006b) discover that the adoption of ICSs and clean cooking fuels are beneficial for both the local and global environment, and thus encouraged the need to invest in these clean and efficient cooking technologies. Again, Habermehl (2007,2008) indicate the significant environmental benefits such as forests preservation, and reduction in carbon dioxide ($CO_{2)}$ and methane ($CH_{4)}$ from ICS programs in Kampala, Uganda and Kampala. Furthermore, several researchers (Barnes et al, 1993; Venkataraman & Masera, 2004; Rehfuess, 2006; Bond, Smith & Haigler, 2008; Grieshop, Marshall & Kandlikar, 2011) have outlined the environmental benefits such as decreased pressure on forest resources, reduction of greenhouse gases (GHGs), and thereby mitigating climate change.

2.3.3 Socio- Economic Benefits

The use of ICSs and clean fuels delivers socio-economic benefits. For example, studies by García-Frapolli, Schilmann, Berrueta, Riojas-Rodríguez, Edwards, Johnson, & Masera (2010) revealed that ICS use in rural Mexico contributed to about 53% savings of fuelwood. In Sudan, Kenya and Nepal, Malla, Bruce, Bates & Rehfuess (2011) revealed significant economic benefits of cooking time and fuel savings. Similar results are reported by Habermehl (2007) in Uganda and Habermehl (2008) in Malawi. Furthermore, Thurber, Phadke, Nagavarapu, Shrimali & Zerriffi (2014) report of significant fuel savings by households from the use of "Oorja" ICS, using pelletized biomass in Karnataka and Maharashtra, India. Moreover, the African Development Bank (2009) in Northern Vietnam estimated annual savings of US$68 by households who switch from the use of traditional

solid biomass and coal to the use of biogas. In addition, the study revealed an average time savings of 1.8 hours per day through the use of biogas. Additionally, Wickramasinghe (2003), Patrick (2007), Matinga (2008) report of reduction in physical burden as well as risk related with fuelwood. Also, Christiaensen & Heltberg (2012) report that the use of biogas by smallholder farmers of rural China reduces their fuelwood usage and reduces time spent by women in collecting fuelwood. Using the cost benefit analysis (CBA) framework, Malla *et al*. (2011) discovered in Sudan, Kenya and Nepal the economic benefits of adopting improved cooking interventions through reduced hospital bills, in addition to reduced time in taking care of sick children.

2.4 Barriers Affecting Adoption of Improved Cookstoves &Fuels

In spite of the economic, health and environmental benefits of using ICSs, significant barriers hinder the effective adoption of these clean cooking technologies. According to Bailis, Cowan, Berrueta & Masera (2009) and Barnes, Kumar & Openshaw (2012) adoption has been remarkably slow in spite of efforts by governments, non- governmental agencies and civil society organizations which includes such as the Global Alliance for Clean Cookstoves(GACC), the Netherlands Development Organizations (SNV), Deutsche Gesellschaft für Internationale Zusammenarbeit, (GIZ), World Bank, etc.

Several authors have identified quite a number of barriers hindering the effective adoption of improved cookstoves. Examples of these barriers include: financial barriers, institutional barriers, socio-cultural barriers, technical barriers, political barriers, accessibility challenges, low level of awareness, etc.

2.4.1 Financial barriers

Researchers such as Adler (2010), Ekouevi &Tuntivate (2012), Ahiekpor, Ribeiro, Rockson, Bensah & Antwi (2014); Riley (2014), Kumar, Rao & Reddy (2016), among several others have outlined the financial barriers hindering the various actors in the cookstove value chain. These include manufacturers who face financial barriers through their inability to access funding for the expansion of their businesses as a result of unwillingness on the part of financial institutions to grant them loans (due to lack of awareness and confidence in the profitability of the cookstove sector, in situations where loans are obtained, interest rates are so high. startup or maintenance the development of the sector to include: exorbitant import duties on raw materials (steel plates) for the production of ICSs, Furthermore, several distributors are unable to access stoves due to their inability to pay upfront for ICSs, coupled with unfavorable financing models among others hinders the desired penetration of ICSs. Consequently, these financial barriers have the tendency to affect retail prices of ICS and alternate cooking fuels, leading to higher cost of ICSs hence making it difficult for low- income earners to purchase. For instance Pachauri, Van Ruijven, Nagai, Riahi, Van Vuuren, Brew-Hammond & Nakicenovic (2013) discovered that 99% of the population of Mali, Liberia, Burundi, Somalia and Madagascar are unable to access modern cooking devices simply because most of these households cannot afford them. Mobarak, Dwivedi, Bailis, Hildemann & Miller (2012); and Beltramo, Levine & Blalock (2014) identify financial constraint as a major barrier contributing to the low demand of ICS in Bangladesh and Uganda respectively.

Hiemstra-van der Horst & Hovorka (2008) established that middle-income households, mostly found in urban areas, have adopted ICSs more rapidly than households found in low income-rural communities. Again, the study by Smith, Shuhua, Kun & Daxiong (1993), found that one of the most important factor that led to the success of China's NISP was as a result of the higher income of rural households, fostering their purchasing capacity. Furthermore, Damte & Koch (2011)

discovered that higher income of women in Ethiopia significantly led to an increased adoption rate of the "Mirt" and "Lakech" stoves

Against this backdrop, several studies have purported that subsidies on ICSs and clean fuels remain an effective mechanism towards initial adoption, which most poor people would not have had access to them without these subsidies.

2.4.2 Institutional barriers

Institutional barriers pose a major challenge influencing the effective implementation of ICSs projects in many of the places they are being promoted (Barnes, Openshaw, Smith & van der Plas, 1993; Sinha, 2002; World Bank, 2011; GACC, 2011). This includes unavailability of institutional infrastructure such as Research and Development (R&D) centers, information & technology exchange, training venues, certification and quality control centers, promotional agencies, after sales support services, etc. Four (4) types of institutional structures are in existence among the ICS programs: Government-led institutions, semi-governmental structure, NGO/private partnership, and commercial private enterprises. Government engagement is necessary to achieve program objective, through favorable policy formulation, awareness creation, monitoring, etc. However, (Barnes *et al*., 1993; Sinha, 2002) is of the view that although governments' role in policy formulation is important, several ICSs programs were successful without government's intervention. The roles played by Non-Governmental Organizations (NGOs) and entrepreneurs through awareness, establishment of commercial markets, and provision of after sales support services are helpful for significant upscale of improved cooking technologies.

2.4.3 Unfavorable Government Policies and Regulations

Unfavorable government laws and regulations hinder significant uptake of ICSs. For instance, Ghana's regulations around taxes and import duties of raw materials for the production of ICSs does not facilitate progress of the sector. Furthermore, exorbitant import tariffs dissuade interested

investors from entering the ICSs market in order to meet the growing demand of Ghanaian consumers (Energy Commission, 2015, Ahiekpor, Ribeiro, Rockson, Bensah & Antwi. (2014).

2.4.4 Socio-Cultural Barriers

Several studies conducted mostly in Asia and Latin America argue that the failure of ICS designs to meet the functional, and social-cultural settings of users serve as a major barrier to their adoption. Improved cookstoves (ICSs) are usually unable to meet local needs as compared to traditional stoves such as lighting, heating, smoking of meat/ fish, repelling of insects, etc (Manibog, 1984; Yuntenwi, 2008). Hence ICSs are likely to be rejected when they are unable to satisfy these. In India for instance, the introduction of "Vikram" and "Harsha" although inefficient were highly adopted as a result of their features meeting existing cooking practices as compared to the "Oorja" and "Philips" stoves. Hence it is necessary to engage potential users, especially women prior to developing high-quality ICSs to achieve compatibility with local cooking practices so as to realize widespread adoption (Sinha, 2002; Malhotra, Neudoerffer & Dutta, 2004; Figueres, 2010).

2.4.5 Accessibility Challenges

First of all, the supply of various types of ICSs in all urban and rural areas is not readily available to meet the increasing demand (Ahiekpor *et al.,* 2014). In addition, poor road network and high transportation fares serve as a de-motivation (due to unattractive profit margins) for ICSs entrepreneurs from reaching available rural and peri-urban populations.

2.4.6 Technical and Quality related barriers

Absence of technical and quality standards as well as poor testing and monitoring mechanisms, affects the quality of cookstoves resulting in less efficiency and durability (Sanghal, Bhaskar, Pallavee & Arindam, 2016). For instance, a study undertaken in rural Mexico recommends, "The technology-centered approach" to produce quality stoves to achieve effective dissemination of ICSs (Troncoso, Castillo, Merino, Lazos & Masera, 2011). Furthermore, Nepal & Grimsrud, (2010) found that ICSs in Nepal do not yield reductions in firewood. In Peru, cookstove programs face

technical and quality related barriers (poor quality of stoves, stoves inability to meet expected benefits of fuel efficiency) hindering the achievement of effective results (Adrianzén, 2011). Again, a research undertaken in a rural district of Guatemala observed that about 67% of "Plancha stoves" developed structural defects (Boy, Bruce, Smith & Hernandez, 2000). In Ghana, there is limited technology transfer and diffusion of technical knowledge in the manufacturing of clean cooking technologies (Energy Commission, 2015). Furthermore, several researches conducted mostly in Asia and Latin America, contends that the failure of ICS designs to meet the functional, and social-cultural settings of users serve as a major barrier to their adoption (Ruiz-Mercado, Masera, Zamora & Smith, 2011; Bielecki & Wingenbach, 2014; Kshirsagar & Kalamkar, 2014; Rhodes, Dreibelbis, Klasen, Naithani, Baliddawa, Menya & Kennedy 2014; Wang & Bailis, 2015).

Several other examples have cited technical and quality problems (such as blocked chimneys, cracking of clay liners, mismatch with local cooking pots, as well as other manufacturing defects) contributory factors for the failure of ICSs dissemination (Dutta, Shields, Edwards and Smith, 2007; Gifford, 2010; Barnes *et al.,* 1993; Jetter & Kariher, 2009; Mukunda, Dasappa, Paul, Rajan, Yagnaraman, Kumar & Deogaonkar, 2010). Furthermore, another technical challenge is the absence of appropriate tools and devices to monitor the performance of these ICSs through objective, cost-effective and scalable means. In recent times however, monitoring of ICSs is getting easier with the introduction of new sensors as well as IT-based SUMs.

2.4.7 Lack of Information and low level of Awareness

As postulated by the "theory of technology diffusion", information dissemination is essential for widespread adoption of ICSs (Rogers, 2003; Ruiz-Mercado, 2011). A study conducted by (Troncoso *et al*., 2011) in rural Mexico, suggest a "people-centered close inter-action approach", as an effective information dissemination mechanism. Additionally, the low level of education, awareness creation and understanding on the health and environmental risks associated with the use

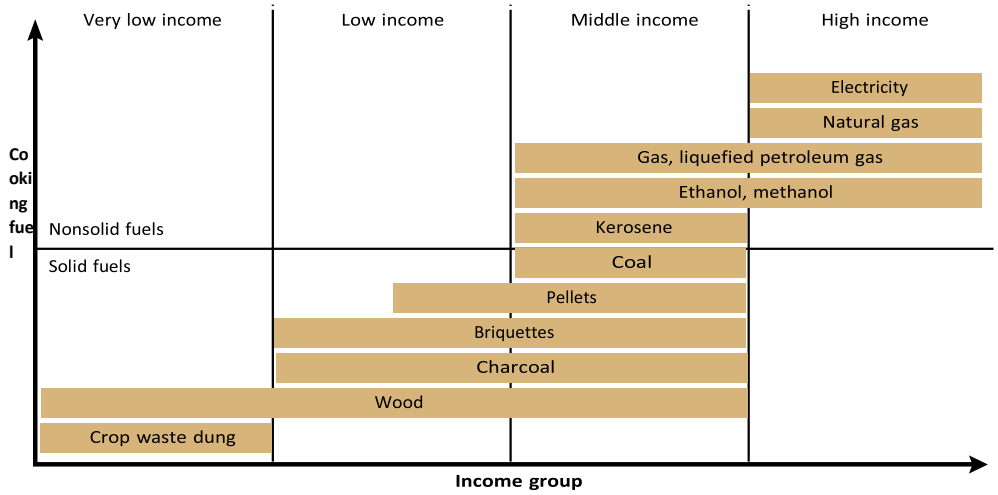
of traditional cookstoves pose a major barrier to ICS adoption (Lewis & Pattanayak, 2011; Fatihiya & Kenneth, 2015; Kumar, Rao & Reddy, 2016; Mobarak *et al*., 2012). For instance Lewis & Pattanayak (2012) and Mobarak *et al*. (2012) argue that the low level of literacy in many African countries, especially among rural women found in patriarchal societies, has the tendency to limit access to information on benefits of an innovation, thereby hindering its adoption Again, (Sinha, 2002) maintain that active engagement of women regarding their preference was one of the major reason for the success of the NISP in China. Moreover, studies by (Figueres, 2010) revealed that active participation of end-users and follow-up visits were influential for the success of ICS intervention in Guatemala.

2.5 Promotion of Clean Fuels

Several programs and organizations highlight the urgent need for truly clean and more sustainable fuels in addition to efficient cookstoves. As improved cookstoves (ICSs) alone are insufficient to fully capture the health and environmental potential of clean cooking, Hence, (GACC, 2015b) maintain that improved stoves must be distributed with clean or at least cleaner fuels, such as LPG; and alternative biofuels which includes: ethanol, processed biomass as briquettes or pellets, or biogas.

In Sub -Saharan Africa, however, access and adoption of these clean fuels remain limited. According to World Bank (2017), less than 1 million households in Sub- Saharan Africa depend on these fuels to meet their cooking and heating needs.

Figure 2.1: Schematic Illustration of the energy ladder hypothesis: Change in fuel with increasing income level



Source: **Adapted from WHO (2016a).**

Using the energy ladder hypothesis, Hosier & Dowd (1988) explain that as households' economic well-being increases, they are expected to move up the ladder to more sophisticated energy carriers. They further explain that consumers are more likely to move to less sophisticated energy carriers as economic status decreases through either a decrease in income or an increase in fuel price. Hence, households at lower levels of income and development tend to be at the bottom of the energy ladder, using fuel that is cheap and locally available but not very clean nor efficient.

Again, the energy ladder model further explains the technological improvement of a fuel to its fuel efficiency. For that reason, both stove efficiency and capital cost increase with energy sophistication, and the use of any type of energy is an indicator of household affluence. The end-use efficiencies of cooking technologies increase progressively in the following order: woodfuel-charcoal- kerosene- LPG-electrical power (Reddy, Williams & Johansson, 1997).

2.5.1 Barriers Hindering Widespread Adoption of Clean Fuels

Significant barriers hindering the effective adoption of clean fuels must be addressed to ensure significant upscale. These include barriers relating to affordability issues, policy barriers, low level of awareness, accessibility challenges,

2.5.1.1 Issues of Affordability

Affordability hinders the widespread penetration of clean fuels especially in developing countries. About 50 percent of poor households who rely on solid traditional fuels for cooking are unable to pay for cleaner fuels. Additionally, associated stoves remain unaffordable for most low income families. The cost of these fuels in addition to their cookstoves is unaffordable for most rural and many urban consumers. Furthermore, clean fuel entrepreneurs face huge financial barriers, with limited global investment capital in the sector, thereby affecting margins of both biofuel producers and distributors. (Mitchell 2011; Schlag & Zuzarte 2008; Ashwani 2012; Clough 2012; Ferguson 2012; GACC 2015b; UNIDO, 2015; World Bank 2015a). Nevertheless, a promising market for pellets, briquettes and ethanol is growing quickly, with several new entrants as well as rising interest of donors/investors. In addition, emerging innovative business models such as PAYG (Pay-as-you-go) have increased optimism for the sector's profitability and growth.

2.5.1.2 Policy Barriers

The supply side of the clean fuel sector experiences many challenges including policy barriers including the poorly regulated tax and tariff regimes, inhibiting the import of production equipment, fuels and biofuel stoves (to complement local supply) so as to meet demand. Additionally, clear endorsement of governments through favorable policies to create enabling environment is usually unavailable.

2.5.1.3 Low level of Awareness

Awareness of biofuels like ethanol is limited among consumers, raising safety concerns. Most households are oblivious of alternatives to traditional fuels, few who are aware are most often unwilling to switch from the use of these traditional fuels. In most cases, consumers are not fully informed about the dangers associated with using traditional fuels, and the associated advantages of transitioning to the alternatives. For instance, a survey conducted in Mozambique in 2012 shows that 55% of consumers are not aware of long-term associated health impacts of using traditional charcoal for cooking. Likewise, just13% of women surveyed in 2008 in Ethiopia were aware that smoke inhalation is a "cause for concern" (World Bank, 2014).

2.5.1.4 Accessibility Challenges

Accessibility remains a challenge for widespread uptake, as clean fuels are largely unavailable as compared to their traditional counterparts. For example, consumers of charcoal have to travel about 50–250 meters to buy charcoal for cooking, likewise rural and peri-urban users of charcoal travel 1–2 kilometers (Patel & Nyangena 2016; World Bank 2009). Clean fuels such as LPG, ethanol, pellets, among others are however not readily accessible, especially in rural communities. To this effect, huge investments is needed to improve distribution networks so as to achieve significant penetration. In Ghana for instance, adequate filling and distribution centers especially in rural and peri-urban areas have become a big challenge, whereas distribution outlets in regional capitals and major cities (particularly in Southern Ghana) are over concentrated. Thus according to Ruiz-Mercado, Masera, Zamora & Smith (2011), the distribution challenges of clean fuels can further promote the situation of 'stove and fuel stacking', a situation by which households tend to use ICSs alongside their traditional stoves rather than entirely replacing, mainly as a result of unreliable supply of appropriate fuels for their ICSs. In addition, poor road network and high transportation fares serve as a de-motivation (due to unattractive profit margins) for clean fuel entrepreneurs and

retailers/distributors from reaching available rural and peri-urban populations. Table 2.3 below presents the summary of market barriers hindering the effective adoption of Clean Fuels

Table 2.3. Summary of Clean Fuel Market Barriers

Factors	Barrier	Description
Demand side	Affordability issues- price competitiveness of clean fuels versus traditional solid fuels	Relatively higher cost of clean fuels may be unable to compete with traditional fuels such as charcoal.
	Affordability of clean fuel stoves	The consumer may be unable to afford cost of pellets or ethanol stove.
	Access to quality fuels/stoves (related to distribution barrier)	Clean fuels and stoves may be inaccessible at the market or may necessitate travelling long-distances to buy as compared with other alternatives such as charcoal or traditional stoves.
	Awareness of Consumers	Consumers may be unaware of associated health risks of using solid fuels or, most importantly, the existence or

		advantages of improved alternative fuels/ stoves
	Behavior change needed	Unwillingness of consumers to switch from current use of fuel, especially when the purchase of a new stove is required.
	Consumers perception about fuel safety/quality	Lack of consumers' confidence in the durability, or safety of alternative biofuels.
Supply side	High cost of distribution (reflects access barrier in demand section above)	High costs incurred by producers during distribution to last-mile customers; road infrastructure may also be underdeveloped
	Supply of fuel	Biofuels may be difficult to produce or import; large capital investment needed for production; high cost of

		electricity also impedes fuel production
	Supply of feedstock	Difficulty in obtaining constant feedstock in terms of quantity, quality, and price for fuel producers.
	Availability& quality of biofuel stoves	Available stoves and fuels may not function well together in terms of efficiency and consumer experience.
	Quality of Fuel (see perception of fuel safety/ quality barrier above)	Fuel safety and quality is variable, reflecting the perception of safety and quality barriers described above.
Enabling factors	Finance	Financing may be absent for supply chain actors. *W*orking capital for the production and distribution of alternative biofuels and cookstoves; and financing for market transformation

		programs, research and development are mostly unavailable
	Policy/regulation	Unfavorable policies like import barriers; poorly targeted subsidies; and absent or unclear regulatory frameworks inhibit the growth of the sector.
	Quality standards/testing	The limited adoption of uniform quality standards may increase the risk of actual and perceived market spoilage.
	Research and development	Lack of investment (finances and effort) into research and development could hinder needed progress to improve stove and fuel quality, and to

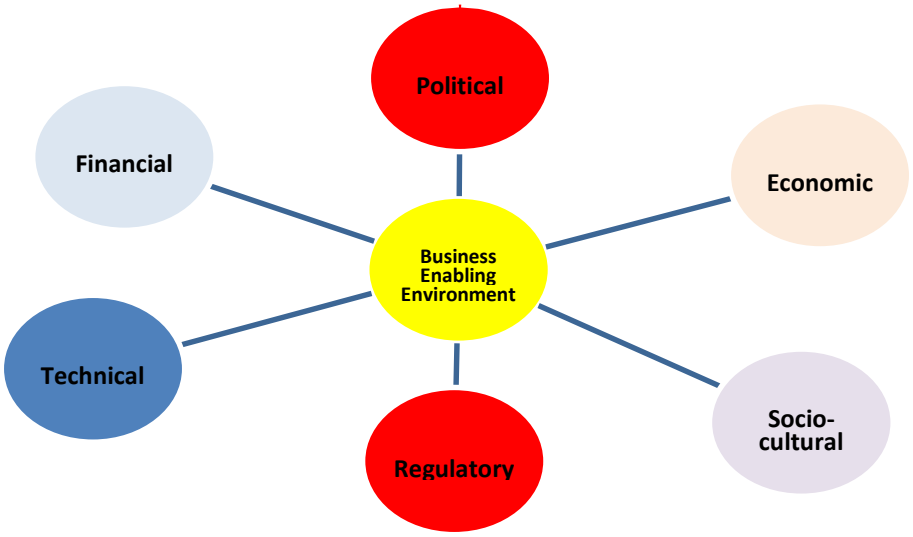
		better tailor them to the cooking experience desirable by customers.

Source: World Bank, 2017

2.6 Creating a Business Enabling Environment

According to Cordes (2011), adopting an enabling environment for a successful clean cookstoves and fuels market demands the development of proper structural conditions as well as empirical guidance. The business enabling environment (Figure 2.2) depends on six key control environments: political, economic, technical, socio-cultural, regulatory, and financial environments. These control environments are entangled, with strong interdependencies. Thus ensuring a balance between the control environments would help ensure sustainable businesses within the improved cookstoves and fuel market to upscale significantly.

Figure 2.2: Business Enabling Environment for Upscale of Improved Cookstoves & Fuels



2.7 Financing Clean Cooking

In spite of socio-economic, environment and health benefits of adopting ICS and clean fuels, the sector has witnessed low adoption of these improved technologies, particular in developing countries mainly due to financial barriers, as the costs, which include both capital and ICSs/fuel costs, are higher than the traditional cookstoves and fuels. (Banerjee, 2001; Winter-Nelson &Temu, 2005; Mobarak *et al.* 2012).

Examples of available financing mechanisms for promoting adoption of ICSs/ clean fuels include:

2.7.1 Subsidies

Subsidies remain a major financial mechanism for the promotion of ICS and clean fuels in developing countries. For instance, Ekholm, Krey, Pachauri & Riahi (2010) while examining the role of micro-financing and subsidizing of modern fuels in enhancing adoption discovered that subsidies can upsurge productivity since the time wasted for fuelwood collection can be profitably used. Similarly, Ouedraogo (2006) found that subsidization of LPG as well as LPG cookstoves could decrease significantly the utilization of fuelwood in urban Ouagadougou. Furthermore, Edwards & Langpap (2005) exploring how access to gas stoves on credit affects the use of fuelwood in Guatemala, concluded that credit access plays a significant role in influencing household adoption to gas stoves even though the effects are minimal.

However, several researchers (Zerriffi, 2011; Simon, Bailis, Baumgartner, Hyman & Laurent, 2014), have criticized this strategy on the grounds that it has not produced the expected outcomes, such as channeling of resources towards some groups at the detriment of targeted recipients. Granado, Coady & Gillingham (2012) argue that subsidies to fuels such as LPG usually used by high and middle income/ urban peri-urban households would only cause financial burden to public purse and would not benefit the intended income group, but rather those with high income who could well afford them without subsidies. For instance, in Ghana, subsidies on LPG by the

government which was originally intended to encourage household consumption of LPG, led to the unintended result of reducing costs of fuel for commercial vehicles such as taxis. Furthermore, empirical evidence reveal that increased adoption of ICS cannot be guaranteed even in cases where cookstoves are subsidized or even given out freely (Lewis & Pattanayak, 2011). An example is the case of Peru that recorded just 42% of beneficiary households who were effectively using ICS although subsidies were provided (Adrianzen, 2013). Consequently, the Ministry of New and Renewable Energy (MNRE) India report of 2010 recommends the concept of decreasing subsidies gradually as this practice ensures that stoves remain reasonably priced, but at the same time providing opportunities for commercialization. This model was successful in "Ethiopia's Cooking Efficiency Improvement and New Fuels Marketing Project" from 1989 to1995. Hence Governments could offer a small amount of continually decreasing subsidy to enable poor people purchase at the initial stage to be ended once ICS become more affordable and a successful commercial market is established. To make this strategy applicable, MNRE (2010) suggest region specific, user-income specific, model specific, flexible subsidy structure; with precise end date (for instance subsidy decrease of 10-20% every year after annual assessment.

Although some researchers Masera, Díaz & Berrueta (2005), Rai & McDonalds (2009) and Still, MacCarty, Ogle, Bond & Bryden (2011) have argued that financial incentives are indispensable for manufacturers and users, towards scaling up cookstoves adoption, the example of China's NISP, whereby government's financial support to the program was not up to 15% revealed that successful cookstove program can be achieved without subsidies. The literature in Asia, has emphasized how subsidies increase adoption of ICS and clean fuels (Dupas, 2014; Lewis & Pattanayak, 2011; Simon, Bailis, Baumgartner, Hyman, & Laurent, 2014). Nonetheless, huge subsidies can discourage households' long-term usage and repurchase of ICS. This is because after an ICS project has ended,

liquidity constraints among low-income households especially might discourage continued use of ICSs.

2.7.2 Carbon financing

Carbon financing provide an alternative means to upscale production of ICS and clean fuels. The Carbon market was established as a means to address climate change. The sale of carbon credits serves as a means of incentivizing the reduction of greenhouse gas (GHG) emissions whereby each credit represent reduction of 1 ton of carbon monoxide or its equivalent (Blunck, Griebenow, Rammelt & Zimm, 2011). In the situation of cookstove projects, carbon credits guarantee financial sustainability since it does not require end-users' ability to pay the total cost of ICS and hence serve as an enabling mechanism for promoting ICS penetration. Additionally, carbon credits guarantee longer timelines of projects through the integration of monitoring and stove maintenance for continued offsets of project duration (Simon, Bumpus & Mann, 2012). Carbon financing have gained popularity in the last decade as some stakeholders within the sector considers carbon financing as very crucial for facilitating household adoption of ICS and fuels. (Jeuland & Pattanayak, 2012). This funding is derived from the sale of carbon credits accumulated through the use of ICS and clean fuels. According to Sanghal, Bhaskar, Pallavee & Arindam (2016) out of the distribution of 8.2 million ICSs in 2012, 50% benefited from carbon financing. Recent estimates, posit that the Global Alliance for Clean Cookstoves (GACC) has so far acquired $265 million through carbon finance for the cookstove sector. In addition, carbon financing accounted for 36% of total source of funding in 2013 and was recognized as the "single largest financier of cookstove projects". Reflecting on these outcomes, Simon *et al*. (2012) highlight several opportunities and significant challenges of this developing mechanism in accelerating development of the cookstove sector. For instance, project leaders of the Qori Q′oncha Project in Peru reported that the inclusion of carbon funding contributed to massive scale-up in distribution of stoves (Simon *et al.*, 2012). Furthermore, through carbon financing, the Uga stove Project in Uganda witnessed significant

upscale, while securing affordability, quality of stoves and a guaranteed warrant system" (Simon *et al*., 2012). Moreover, other researchers such as Bumpus (2009) and Lambe, Jürisoo, Lee & Johnson (2015) acknowledge the significant contribution of carbon financing in facilitating the growth of the ICS sector in Honduras and Kenya respectively.

Carbon financing is however criticized due to its ability to cause unexpected financial consequences like distortion in price of local metals (Simon *et al*., 2012). This situation contributes to the wider subject of market interference, as explained by Simon *et al.* (2012) who argue that carbon finance has the potential to encourage "suppression of similar or competing businesses due to external capital injections", leading to non-competitiveness of local enterprises and damage to the economy and livelihoods. Moreover, ICS businesses who heavily rely on carbon finance are at risk to market price changes of carbon credits, and hence can affect their sustainability (Shrimali, Slaski, Thurber & Zerriffi, 2011).

2.7.3 Loans or Micro-credit from financial institutions

Financial institutions such as commercial banks microfinance institutions provide an alternative source of finance for the cookstove sector through the provision of credit facility. Microfinance institutions especially exist to alleviate poverty especially in low income countries through both individual and community based savings allowing consumers to access various financial products (Lapenu & Zeller, 2002; Ghate, 2007). Value chain actors (manufacturers, distributors, consumers) within the cookstove sector face huge economic barriers, decelerating the rate of adoption. Two types of financing are involved in this approach: Enterprise financing and End- user financing:

With enterprise financing, credit facility is usually given to manufacturers/ distributors to ensure continuous production and supply of products respectively. According to Shrimali *et al*. (2011), enterprise financing provides significant funding for development especially for start-up enterprises.

End- User/ Consumer financing is the direct provision of credit facility by financial institutions to end-users so as to access ICS or through the purchase of stoves on credit by end-users from manufacturers or stove retailers (Shrimali *et al*., 2011). Bailis, Cowan, Berrueta & Masera (2009) exploring the financial challenges faced by end-users in Mexico discovered that purchasing stoves on credit provide an effective solution to realizing desired penetration of ICS in low income households especially in this period of declined donor support.

Nonetheless, the effectiveness of this financing model to achieve promotion of clean cooking technologies has been criticized, as the model is yet to achieve the expected production and dissemination of ICS. In addition, microfinance institutions whose mission is to support poverty alleviating activities have been subjected to criticisms of amassing wealth for themselves, at the expense of the poor, thereby displacing the poor into further indebtedness (Roy, 2010).To this effect, Winiecki, Cortiglia, Morris & Chowdhary (2008) and Gautam (2011) suggest that microfinance institutions especially should be flexible, with various loan schedules, while at the same time expressing willingness to provide unconventional products to increase both supply and demand for improved cooking technologies.

The challenges with this financial mechanism lie in the fact that microfinance institutions mostly invest in income generating-assets, but not on consumer goods, even though ICSs generate some form of savings due to their fuel efficiency features (Bailis *et al.*, 2009), thereby limiting end-users' ability to access funds to purchase clean cooking technologies. Furthermore, Singh & Pathy (2012) argue that financial institutions such as commercial banks and microfinance institutions may be unwilling to extend loan facilities to an individual for the acquisition of ICS because of the low profit. Moreover, the guarantee that an individual will be able to pay back the credit remains a challenge, as majority these end-users are poor. For instance, Bailis *et al*. (2009) report that

Mexico's attempt to institutionalize credit- based solutions to improve access to ICSs in some cases led to default by consumers.

2.8 Business Models in the Cookstove and Fuels Sector

According to Shrimali *et al*. (2011), achieving long term sustainability of benefits from the use of improved cookstoves and fuels, requires the development of market-oriented business models in order to ensure continuous production and supply of quality products, even beyond timelines of donor funding/support. Thus Shrimali *et al*., (2011) identification of six (6) independent variables such as: target customers, financial model, marketing strategy, channel strategy and organizational characteristics are necessary for influencing scalability and financial sustainability of improved cookstove and fuel businesses. Furthermore, Porter's (1998), Diamond Model maintain that an effective and viable business models necessitate the recognition of all major actors within the improved cookstove and fuels value chain, in this case, the manufacturers/ producers, suppliers, end-users, financial institutions, development partners as well as the government in bridging the gap between demand and supply, and to ensure the creation of an enabling environment for increased access to ICS and fuels, and at the same time ensuring sustainable businesses. In addition, the model outlines the specific roles of Development partners, and civil society organizations in bridging the gap between the demand and supply through the government and financial institutions. For a successful upscale, the model acknowledges the distinctive internal and external factors such as; inclusive policy formulation on improved cookstoves and fuels, coordinated national standards and protocols, regulations to enforce adherence to standards, as well as access to credit facilities for end-users as well as cookstove and fuel enterprises.

2.8.1 Financing Models

According to Shrimali *et al*, (2011), developing effective financing strategy is necessary for the growth of the sector. Thus commercially viable enterprises dealing with low-income populations should find appropriate means of making their stoves and fuels affordable to their customers. ‘‘Consumer’’ financing to assist customers who are unable to make upfront payment of stoves/ fuels, reducing the barrier of acquisition, and enterprise’’ financing in reducing the cost structure of stove enterprises for the generation of substantial revenues at a lower price point for the cookstoves and fuels. End-User financing is critical for ensuring affordability in the acquisition of improved cookstoves and reducing the entry barrier of acquisition.

2.8.1.1 Enterprise Financing

Enterprise financing is necessary for both manufacturer and distributor links within the supply chain. With enterprise financing, credit facility is usually given to manufacturers/ distributors to ensure continuous production and supply of products respectively. According to Shrimali *et al.* (2011) enterprise financing provides significant funding for development especially for start-up enterprises. For manufacturers/ producers, enterprise financing provides working capital for business expansion, logistics/ transport, etc. purchase of equipment/machinery, etc. Enterprise Financing for manufacturers can be accesses through commercial loans (local banks, Deutsche Bank, subsidized loans (GIZ), Grants/ seed funding for upscale of businesses (GACC, Ashden, USAID, World Bank). For distributors/ retailers, credit facility is usually provided by microfinance institutions to finance their business as well as other inventory costs. Microfinance institutions may also partner with them as distribution channels. Nonetheless, access to enterprise financing is limited due to challenges of collateral requirements, high interest rates on loans, lack of expertise in loan applications procedures, among others (World Bank, 2011).

2.8.1.2 End- User/ Consumer Financing

End- User/ Consumer financing is the direct provision of credit facility by financial institutions (banks/ micro-finance institutions) or from manufacturers to end-users so they can access ICSs (Shrimali *et al*., 2011). Bailis *et al*. (2009), exploring the financial challenges faced by end-users in Mexico discovered that purchasing stoves on credit provide an effective solution to realizing desired penetration of ICS in low income households, especially in this era of declined donor funding. Consumer financing thus become very necessary to achieve uptake of ICS due to users' inability to afford upfront costs especially among low-income households. Examples of current financing schemes for the consumer/ end-user include: PAYG Plans (that is: Installment systems to avoid upfront costs); Carbon finance (where cost of stove is subsidized for end-users due to expected carbon credits to be derived from the usage of the stoves); Employer payroll deductions (where cost of stove is deducted by an employer from employee's paycheck over a scheduled period); community savings groups and Savings and Credit Cooperatives(where members save in groups towards the disbursement of goods or services) ; Small Loans /Credit from microfinance institutions; Mobile Payments (that is payments for clean energy products through mobile phones, ie Kenya's use of M- Pesa, a leading mobile money service provider for payment of clean energy products, Equity Bank's Equitel platform, an online energy loan known as EcoMoto is available for payment of clean energy products such as ICS).

However, the challenge of small loan sizes hinders consumer access to credits for the purchase of ICS. According to Singh & Pathy (2012) financial institutions such as commercial banks and microfinance institutions may be unwilling to extend loan facilities to an individual for the acquisition of ICS due to low profit, those financial institutions that are willing charge high interests, thereby making the ICS more expensive for the poor end-users/consumers. Moreover, Shortcomings of the PAYG or installment system is that purchase of cookstove can be for

distributors/ retailers with limited working capital, offering cookstoves on credit may tie up limited working capital needed for the purchase of new stock or to meet other business obligations.

2.8.2 **Marketing and Distribution Models**

Creating the demand for ICSs/fuels is necessary for ensuring significant adoption. In view of this, common marketing and distribution models include:

I. Village level Entrepreneur (VLE) model: That is partnering with local entrepreneurs (especially women self-help groups and women-run businesses who serve as village –level entrepreneurs in selling the stoves to consumers in rural communities.

II. Piggyback model**:** That is collaborating with supermarkets, community based organizations, hardware stores, microfinance institutions, or other networks who are already having access to consumers.

III. Proprietary sales network**:** That is setting up a new proprietary distribution channel, including direct delivery, to serve the target market.

Table 2.4: Distribution channels

Channel Type	Details	Examples (Project developers)
Direct sales	Sell directly to consumers via sales staff, proprietary store network or branded commission-based agents	Up Energy, Ezy stove, CookMate, Envirofit, Gyapa
Retailers and Private Dealers	Sell to third-party: retailers and dealers	Envirofit, Gyapa, Impact Carbon, CookMate, Geres
Social Enterprises	Run sales via microfinance institutions, government extension agents, or NGO workforces.	Impact Carbon, BioLite, Microsol
Institutional/ Corporate Sales	Bulk purchase and redistribution by institutional clients, (eg: relief agencies, hospitals, schools, and government Programs	International Lifeline Fund, Envirofit, CookMate

Source: Gold Standard Report, 2016

2.9 Empirical Perspectives

Shrimarli *et al.* (2011) conducted a study to assess the adoption rate and business opportunities of improved commercial stoves operations among 12 cookstove enterprises in India. The findings revealed that the most successful among these enterprises relied on both enterprise funding as well as management expertise. In addition, the construction of well- designed cheaper and readily available stoves, suitable for meeting their consumers' preferences with efficient supply networks contributed to the scale up of cookstoves distribution of several hundred thousand.

Another study was conducted by Levine, Beltramo, Blalock and Cotterman (2012) with the aim of examining the factors behind the low rate of ICSs adoption in Uganda. By exploring different distribution methods of disseminating cookstoves to low income consumers, the fieldwork conducted in the urban centre of Kampala and rural Mbarara, Levine et al. (2012) found that ICSs offered with regular payments, in this case, four equal weekly payments delivered without interest significantly increased the adoption rate by consumers as compared to upfront 'payment in full' option. Furthermore, the study opposed the notion that low adoption rate of ICSs was largely motivated by lack of interest by consumers, but however emphasized significant uptake when the terms of sale were modified.

Furthermore, a study was conducted by the Kenya Climate Innovation Center (KCIC) in 2016 with the aim to provide an overview of the cookstove sector in Kenya by focusing on technologies, actors, financial and business models, and regulatory framework found that most preferred distribution model was the manufacturer-distributor-end user model, used by 56% of Kenyans, whereas payment by cash at the sales point was the mode of payment mostly preferred, standing at 88.4%, whereas sales on credit were catching on through the Mkopa system and SACCOs.

Another study conducted by Brodbeck (2016) with the objective of identifying critical factors and barriers faced by cookstove distributing enterprises in India recommended the above-the-line

(ATL) and below-the-line (BTL) marketing channels, where ATL methods such as TV can be used to increase brand legitimacy, and the BTL product demonstrations where existing networks can be utilized. Furthermore, the study suggested that enterprises create a working balance of internalizing and outsourcing distribution activities, regular communication with partners as well as prioritizing customer-centric product design.

2.10 Gaps in Literature

From the perspective of the current study, the following gaps were identified in the literature:

The first was the limited empirical evidence in the Ghanaian context with respect to the project topic. Hence by this study, the researcher sough to provide an empirical evidence of sustainable financing and business models for the improved cookstove and fuels sector in Ghana. Consequently, the current study would make a significant contribution to knowledge of sustainable financing and business models in the cookstove and fuels sector.

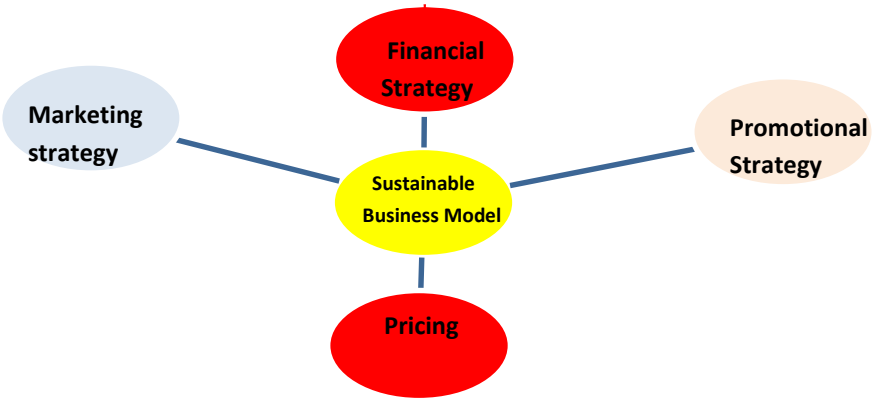
Secondly, most of the limited empirical studies adopted a qualitative research approach. In contrast, this study employed a mixed-methods research approach as it provides an elaborate framework of data collection and analysis procedures that fully address a research problem (Creswell, 2003).

2.11 Implication for the study

The prevalence of the above gaps in the literature leaves some implication for this study. It is essential that more studies be undertaken in Ghana to validate more evidence on sustainable financing and business models for the development of improved cookstove and fuels sector in Ghana.

2.12 Conceptual Framework

Figure 2.3: Conceptual Framework



Source: Adapted from USAID, 2016

In analyzing the empirical literature, the purpose was to identify sustainable financing and business models for the improved cookstoves and fuels sector. Consequently, the development of sustainable business models based on United States Agency for International Development (USAID) (2016), four (4) independent variables which includes: Financial Strategy, Marketing strategy, Promotional strategy and Pricing Strategy are postulated to influence scalability and financial sustainability of improved cookstove and fuels businesses. The adoption of these variables to enhance scalability and financial sustainability hence formed the bases for the researcher's data analysis and discussion.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Generally, the credibility of a research is influenced by the measures taken in conducting the research (Creswell, 2003). A credible research is one that offers a reliable and valid findings and conclusions. This chapter dealt with the discussion of the methodology used in conducting the study. The research approach, sample and sampling techniques, data collection and data analysis methods were explained. Furthermore, ethical considerations were also treated in this chapter.

3.2 Research Approach

The study employed the mixed method approach. Creswell (2012) defines mixed method as the procedure for collecting, analyzing, and 'mixing' both qualitative and quantitative method in a single study to understand a research problem. According to McKerchar (2010), a blend of diverse approaches in one study may provide interesting results from different viewpoints. Furthermore, Morgan (2007) recommends that all researchers share their beliefs through mixed-methods approach so as to strengthen the methodological issues, as the strengths of one method can counterbalance the weaknesses of the other.

3.3 Study Context

Ghana is a country situated in West Africa, just above the Equator. The Greenwich Meridian passes through its main industrial city, Tema. Ghana shares common boundaries with Togo in the east, Burkina Faso in the north and Cote d'Ivoire in the West. The Atlantic Ocean is in the south. It covers an area of 238,537 square kilometres. Ghana is divided into 10 administrative regions and 216 district assemblies. The population of Ghana, according to the 2010 Population and Housing Census, was 24,658,823, with relatively more females (51%) than males (49%) (Ghana Statistical

Service, 2012). One of the major economic activity is Agriculture, accounting for about 45 percent of Gross Domestic Product and employs about 60 per cent of labor force.

About 77 percent of Ghana's population rely on traditional biomass for cooking, in addition to cooking on simple inefficient stoves in poorly vented kitchens. This practice result to severe socio-economic, health and environmental impacts. In mitigating the above, Ghana has over the last three decades been involved in energy programs focused on improving access to cleaner technologies for cooking and heating. One of such programs is the introduction and marketing of improved cookstoves and clean fuels to reduce reliance on biomass use, and to alleviate the impact on our forest resources and on the climate. Nonetheless, barriers such as financing and marketing are major significant challenges hindering effective penetration of clean cooking solutions (Sedzro, 2018).

3.4 Sampling and Sample Size

Barreiro & Albandoz (2001) indicate that sampling in research may be required when the population of participants is too large to be conveniently surveyed. Additionally, sampling is necessary as the researcher does not have the time and resources to cover the entire population. For this reason, one hundred and fifty (150) end-users of improved cookstoves and clean fuels who have used the various types of cooking technologies for at least 24 months were purposively sampled. This was to ensure that respondents had enough experiences about their cooking technologies and hence could respond appropriately to the questionnaires administered. From the total of one hundred and fifty (150) end-users, eighty (80) end-users from Greater Accra and seventy (70) end-users from Ashanti Region participated in the study.

For manufacturers, a total of fifteen (15) manufacturers of both stoves and fuels; nine (9) from the Greater Accra Region and six (6) from the Ashanti Region participated in the study.

For retailers, a total of forty (40) manufacturers; twenty-five (25) from the Greater Accra Region and fifteen (15) from the Ashanti Region participated in the study.

Furthermore, questionnaires were distributed to three (3) officials from three (3) financial institutions to also get their perspectives and also to ascertain the financial support been provided by their respective Bank for the development of the Cookstove Sector.

Additionally, an interview was held with a key informant from the Energy Commission.

All these respondents were selected as they are the main key stakeholders involved in the promotion of the Cookstove Sector, furthermore, they were believed to have more experience, and hence rich information would be provided.

3.5 Sources of Data

Data was primarily collected from key stakeholders in the sector; made up of end-users, manufacturers/ producers, retailers of improved cookstoves/ clean fuels. In addition, financial institutions and Energy Commission (representing the Government) were involved in the study.

This category of respondents were considered in line with the Diamond Model as developed by Porter (1998) who maintain that an effective and viable business models necessitate the recognition of all major actors within the improved cookstoves and fuels value chain, in this case, the manufacturers/ producers, end-users, financial institutions, as well as the government so as to bridge the gap between demand and supply, and to ensure the creation of an enabling environment for increased access to improved cookstoves and fuels, and at the same time ensuring sustainable businesses.

In addition, secondary data through desk review was obtained from research reports and journals with regards to financing and business models in the Cookstove sector.

3.6 Data Collection Techniques

The study utilized both quantitative and qualitative data collection techniques. Data for the study was primarily obtained through questionnaires administered to respondents to be completed, made up of end-users, manufacturers/ producers, retailers of improved cookstoves/ clean fuels; financial institutions. Additionally, an interview was held with a key informant from the Energy Commission. The questionnaires were designed with guidelines and instructions that allowed respondents to answer even during the researcher's absence.

3.6.1 The Study Questionnaires

3.6.1.1 End Users of Improved Cookstoves (ICSs) and Clean Fuels

Questionnaires were administered to end-users of improved Cookstoves (ICSs) and Clean Fuels. In all, one hundred and fifty (150) end-users were sampled for the study. The questionnaire items were developed based on the study objectives, and captured data based on: the socio-demographic characteristics of respondents, the degree of adoption of improved cookstoves/ clean fuels, as well as financing of improved cookstoves and fuels; and their associated challenges.

3.6.1.2 Retailers of Improved Cookstoves (ICSs) and Clean Fuels

Questionnaires were also administered to retailers of improved cookstoves (ICSs) and clean fuels. In all, forty (40) retailers were sampled for the study. The questionnaire items were developed based on the study objectives, and captured data which included: background information of the company, financing of the business and its associated challenges as well as distribution channels and marketing strategies adopted by retailers. In addition, respondents' opinions were sought on the appropriate financing and marketing schemes to aid in the analyses and developing of a viable business model so as to address the research problem.

3.6.1.3 Manufacturers/ Producers of Improved Cookstoves/ Clean Fuels

Questionnaires were administered to manufacturers/ producers of improved cookstoves (ICSs) and clean fuels. In all, fifteen (15) manufacturers/ producers were sampled for the study. The questionnaire items were developed based on the study objectives, and captured data which included: background information of the company, financing of the business and its associated challenges as well as the distribution channels and marketing strategies adopted by the manufacturers/ producers. Furthermore, respondents 'opinions were sought on the appropriate financing and marketing schemes to aid in the analyses and developing of a viable business model in order to address the research problem.

3.6.1.4 Financial Institutions

Questionnaires were also administered to three (3) officials from three (3) financial institutions to seek their perspectives and also to ascertain the financial support been provided by their respective Bank for the development of the Cookstove Sector.

3.6.2 In- depth Interview with Key Informant

According to Bryman (2008) interviews provide excellent means of accessing individuals' perceptions and definitions of situations. Furthermore, interviews are helpful in gathering opinions, beliefs and thoughts of participants. To this effect, an interview was held with a key informant from the Energy Commission

In view of this, an interview guide was employed to guide the researcher, as well as monitor the process of interview with the official from the Energy Commission.

3.7 Data Analysis

All data collected from the study through questionnaires and in-depth interview were analyzed. Quantitative data collected was processed, coded and analyzed through the use of the Statistical

Product for Service Solution (SPSS) software. Frequency tables, percentages, and graphs among others were used to present the results. Furthermore, analysis of the qualitative data obtained through interviews was done by hand to determine the themes and were presented as they emerged. During the analysis process, important statements were quoted verbatim. In addition, the research guiding questions were continuously displayed to assist the researcher focus on the study and stay within the scope of the research questions.

3.8 Ethical Considerations

Ethical issues are very important since human beings were at the center of the whole study. For this reason, the study was carried out in accordance with basic research ethics. Respondents' consents were sought prior to collection of data.

Furthermore, confidentiality of respondents was upheld by the researcher. Respondents were informed about the confidentiality of their identity and were also assured that their responses would be used only for academic purposes. In summary, confidentiality, respect and safety of participants were highly maintained and adhered to in this study.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

While the preceding chapter provided the procedures employed for collection of the data, this chapter presented, summarized, and analyzed collected data from the field. It focused on the interpretation of data collected through both quantitative and qualitative means (mixed methods research) by way of questionnaires in addition to interview guide instruments so as to answer the research questions highlighted in Chapter One of this study.

4.2 Analysis of Quantitative Data

In this part of the dissertation, questionnaires were collected data was collected through questionnaires from respondents made up of end-users, retailers, manufacturers/ producers of improved cookstoves and clean fuels, and officials of selected financial institutions.

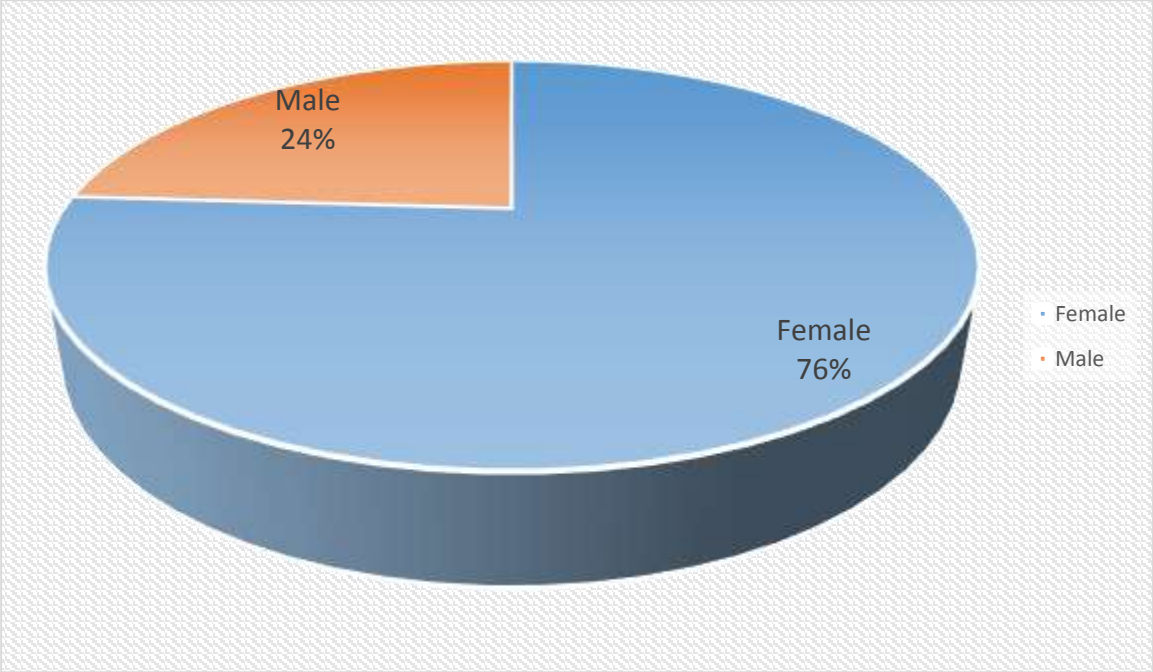
4.2.1 Demographic Characteristics of Respondents (End-Users)

In this part of the dissertation, data was collected on the demographic characteristics of end-users of improved cookstoves and clean fuels which included: the sex of respondents, age, marital status, education and income levels.

4.2.1.1 Gender of Respondents

From the total number of 150 end-users who participated in the study, data collected revealed, as summarized in Figure 4.1, that one hundred and fourteen (114), representing 76% were females; whereas 36 (24%) of the respondents were males. From the statistics provided it is evident that females dominated in the study and this is due to the fact that when it comes to domestic cooking in Ghanaian homes, females are mostly the ones who undertake such duties. The statistics is summarized in Figure 4.1.

Figure 4.1: Gender representation of respondents



Source: Field Data (2019)

4.2.1.2 Ages of respondents

From the data collected, it was revealed as summarized in Table 4.1, that twenty-four (24) respondents, representing 16% were 29 years and below; sixty-six (66) respondents, representing 44% were between the ages of 30 to 39 years; those that were between the ages of 40 to 49 were thirty-three (33) representing 22%; twenty-one (21) respondents representing 14% were between 50 to 59 years, whereas those from age 60 and above were six (6) representing 4%. The statistics is summarized in Table 4.1.

Table 4.1: Ages of respondents

Ages	Frequency	Percentage
29 and below	24	16
20-39	66	44
40-49	33	22
50-59	21	14
60 and above	6	4
Total	**150**	**100**

Source: Field Data (2019)

4.2.1.3 Marital status of respondents

The study also took into account the marital status of the respondents. From the total of 150 respondents, seventy-two (72) respondents, representing 48% were married; thirty-seven (37) respondents, representing 25% were single; eleven (11) respondents, representing 7% were divorced; two (2) respondents representing 1% of total respondents were separated; while the remaining twenty-eight (28) respondents representing 19% were widowed. The statistics is summarized in table 4.2.

Table 4.2: Marital status of respondents

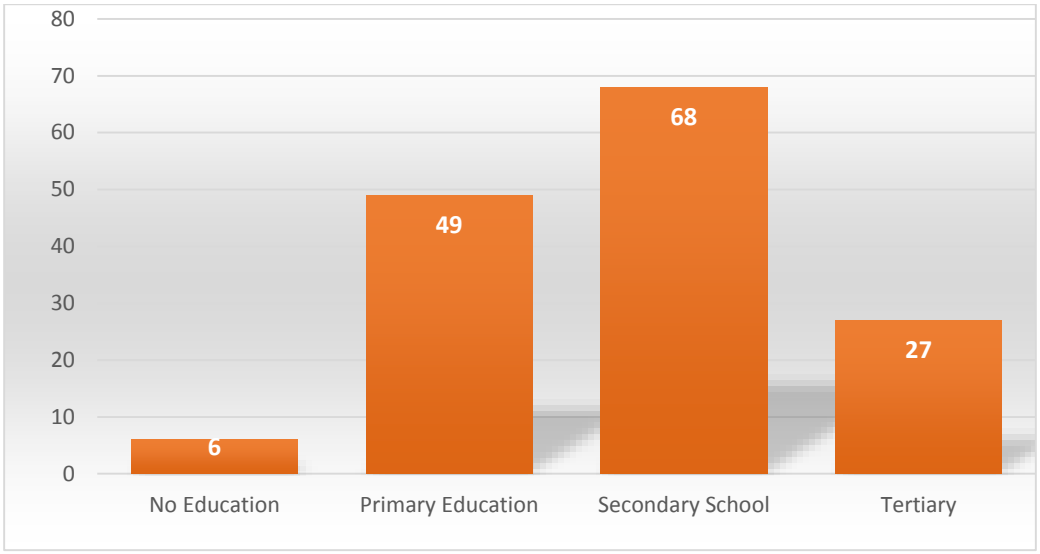
Marital status	Frequency	Percentage
Married	72	48
Single	37	25
Divorced	11	7
Separated	2	1
Widowed	28	19
Total	**150**	**100**

Source: Field Data (2019)

4.2.1.4 Educational background of respondents

Data on the educational background of respondents were collected. It was revealed that out of the total number of 150 respondents, one hundred and forty-four (144) respondents, representing 96% have some form of formal education, whereas six (6) respondents, representing 4% have no formal education. Of those who have formal education, (144); twenty-seven (27) of them representing 19% were those with tertiary education; sixty-eight (68) representing 47% were those with secondary education; whereas forty-nine (49) representing 34% were those with primary education. The statistics is summarized in Figure 4.2.

Figure 4.2: Education representation of respondents



Source: Field Data (2019)

4.2.1.5 Estimated monthly income

Data concerning the estimated monthly income of respondents was also collected. The results revealed that thirty-two (32) of the respondents representing 21% have an estimated monthly income below GH¢500; fifty-two (52) respondents, representing 35% have an estimated income between GH¢500 to GH¢800; forty-four (44) of the respondents representing 29% earn between GH¢800 to GH¢1000; with the remaining twenty-two (22) respondents, representing 15% earning an estimated monthly income above GH¢1000. The statistics is summarized in Table 4.3.

Table 4.3: Estimated monthly income of respondents

Monthly income (GH¢)	Frequency	Percentage
Below 500	32	21
500-800	52	35
800-1000	44	29
Above 1000	22	15
Total	**150**	**100**

Source: Field Data (2019)

4.2.2 Adoption of Improved Cookstoves and Clean Fuels

Respondents were questioned regarding the type of improved cookstoves used; data collected revealed that fifty four (54) respondents representing 36% use Gas Cooker only; users of Gyapa cookstove were thirty-seven (37), representing 25%; CookMate users were nine (9) representing 6%; six (6) of the respondents representing 4% use envirofit cookstove; ethanol users were five (5) representing 3%; while eleven (11) respondents, representing 7% use other type of improved cookstoves that were not included in the list. In addition, the data revealed that twenty-eight (28), representing 19% of the respondents use both Gas Cooker in addition to other type of charcoal stoves simultaneously. - a practice known as 'stove-fuel stacking', to meet all their cooking needs, and also in periods of shortage of LPG. This study findings confirmed the study by Ruiz-Mercado, Masera, Zamora, & Smith (2011) which found that distribution challenges of clean fuels can further promote the situation of 'stove and fuel stacking', thus a situation by which households tend to use

their improved cookstoves alongside their traditional stoves, instead of replacing them entirely. The statistics is presented in Table 4.4

Table 4.4: Usage of Improved Cookstoves

Type of Improved Cookstove	Frequency	Percentage
Gas Cooker	54	36
Gyapa	37	25
CookMate	9	6
Envirofit	6	4
Ethanol stove	5	3
Other improved Cook stoves	11	7
Gas Cooker and Other Charcoal Cookstoves	28	19
Total	**150**	**100**

Source: Field Data (2019)

Also, respondents were asked about the types of fuels used for their stoves. the data collected, revealed that charcoal was the highest type of fuel used by respondents with 47% of them using it; liquefied petroleum gas (LPG) was the second highest type of fuel used with 45% of total respondents using it; wood was the next with 5% using it; with the remaining 3% of respondents using it. The statistics is presented in Table 4.5.

Table 4.5: Usage of Fuels

Type of Fuel Use	Frequency	Percentage
Charcoal	70	47
Liquefied Petroleum Gas	68	45
Wood	7	5
Ethanol	5	3
Total	**150**	**100**

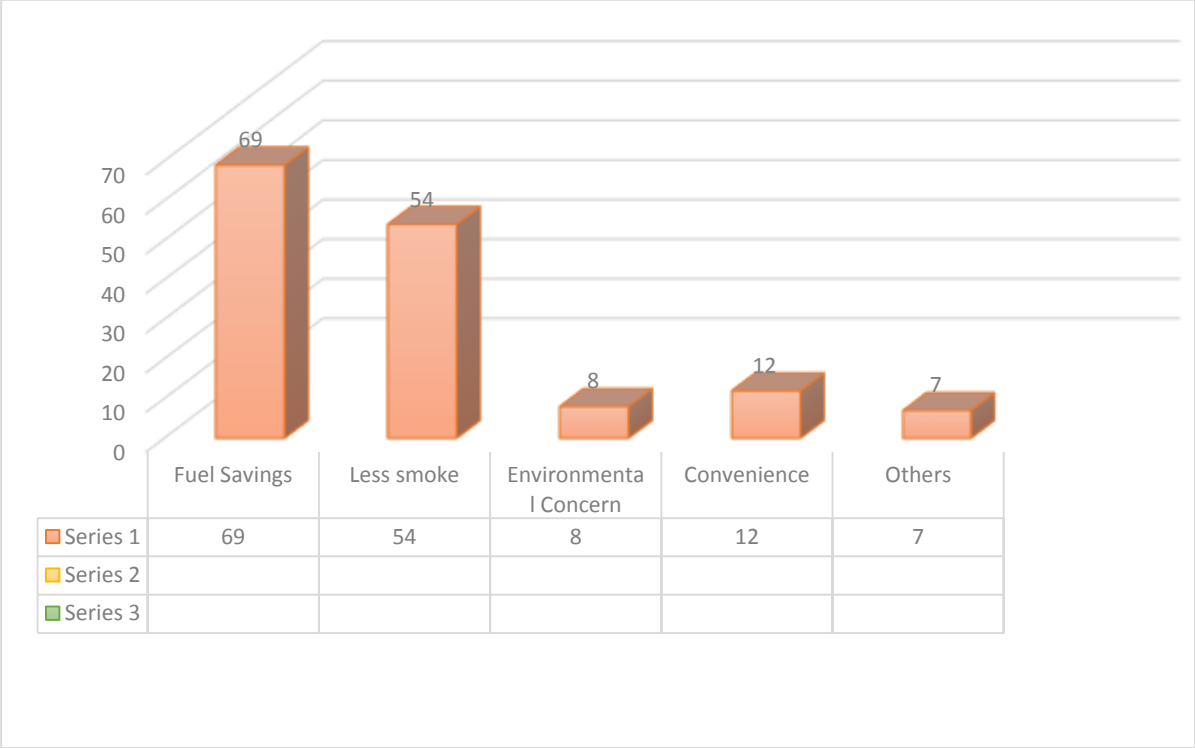
Source: Field Data (2019)

In terms of how long respondents have used their improved cookstoves, ninety-three (93) of respondents representing 62% have used their stoves for 2-3 years (24-36 months); while fifty-seven (57) respondents representing 38% have used their stoves for over 3 years (36 months).

On what factors influenced respondents' choice of their improved cookstoves, the data collected revealed as summarized in Figure 4.3 that sixty-nine (69) respondents, representing 46% were influenced by Fuel Savings benefits associated with the use of improved cookstoves; fifty-four (54) respondents representing 36% were influenced by smoke reduction characteristics of improved cookstoves; eight (8) respondents representing 5% were influenced to use improved cookstoves as a result of their concern for the environment; twelve (12) respondents representing 8% where influenced by the convenience/ easy to use characteristics of improved cookstoves; whereas the remaining seven (7) respondents representing 5% were influenced by other factors such as attractiveness of improved cookstoves. Thus, the study findings affirmed the study conducted by Garica-Frapolli, Schilmann, Berrueta, Riojas-Rodríguez, Edwards, Johnson & Masera (2010) who

revealed that the use of improved cookstoves in rural Mexico contributed to about 53% savings of fuelwood. Additionally, the findings confirmed Malla, Bruce, Bates & Rehfuess (2011) study conducted in Sudan, Kenya and Nepal which revealed significant economic benefits fuel savings from the use of improved cookstove and its associated fuel. Figure 4.3 presents the Factors Influencing End-Users' Choice of Improved cookstoves.

Figure 4.3: Factors influencing End -Users' choice of Improved Cookstoves

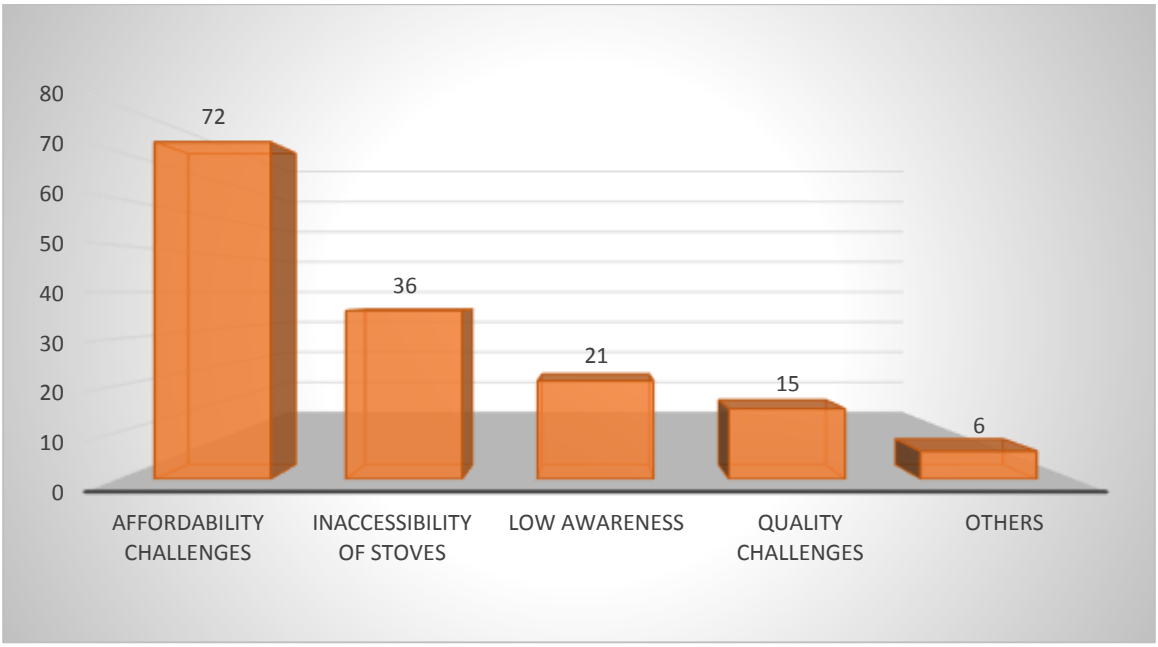


Source: Field Data (2019)

The study also sought to find out from users the factors that account for the low adoption of improved cookstoves in line with objective one (1) of the study. From the data collected it was found as summarized in Figure 4.6 that out of one hundred and fifty (150) respondents, seventy-two (72) respondents, representing 48% responded that affordability challenges accounted for the low adoption; thirty-six (36) respondents, representing 24% responded that inaccessibility of the improved cookstoves poses a challenge; twenty-one (21) respondents representing 14% responded

on low level of awareness; fifteen (15) respondents, representing 10% responded on Quality challenges; whereas six (6) respondents, representing 4% responded on other challenges. Thus affordability challenge as a major barrier to widespread adoption of improved cookstoves affirmed the study findings by Pachauri, van Ruijven, Nagai, Riahi, van Vuuren, Brew-Hammond & Nakicenovic (2013) who discovered that 99% of the population of Mali, Liberia, Burundi, Somalia and Madagascar are unable to access modern cooking devices simply because most of these households cannot afford them. Again, Mobarak, Dwivedi, Bailis, Hildemann & Miller (2012) and Beltramo, Levine & Blalock (2014) identify financial constraint as a major barrier contributing to the low demand of ICS in Bangladesh and Uganda respectively. Figure 4.4 presents the Factors Influencing Low Adoption of Improved Cookstoves.

Figure 4.4: Factors Influencing Low Adoption of Improved Cookstoves

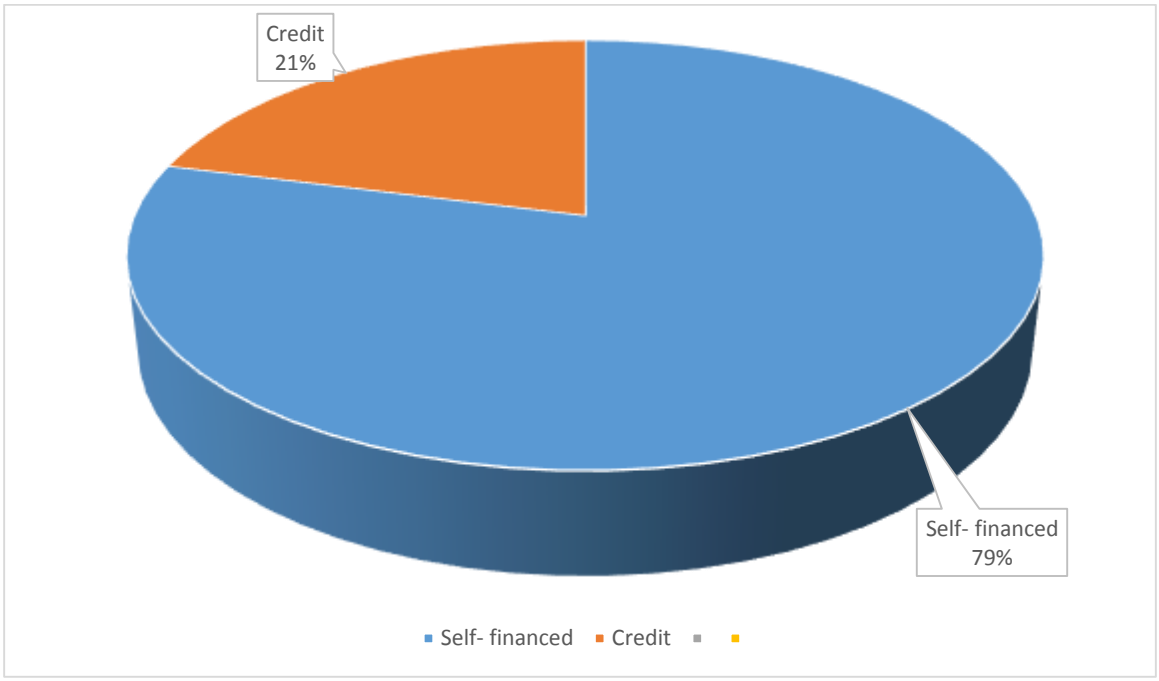


Source: Field Data (2019)

4.2.3 Financing of improved cookstoves

The study also investigated the financial barriers of improved cookstoves in line with objective two of the study. To begin with, respondents were asked on how they see the price of improved cookstoves, Eighty-one (81) representing 54% of total respondents consider the price of improved cookstoves to be expensive; thirty-six (36) representing 24% consider the price to be moderate, whereas eighteen (18) representing 12% consider prices of improved cookstoves to be low due to their benefits. Respondents were also asked on how they financed the purchase of their improved cookstoves. Whereas one hundred and eighteen, representing 79% of total number of respondents self-financed the purchase of their stoves, thirty-two (32) representing 21% purchased their stoves through credit. Figure 4.5 presents the Financing Options for Improved Cookstoves

Figure 4.5 Financing Options for Improved Cookstoves



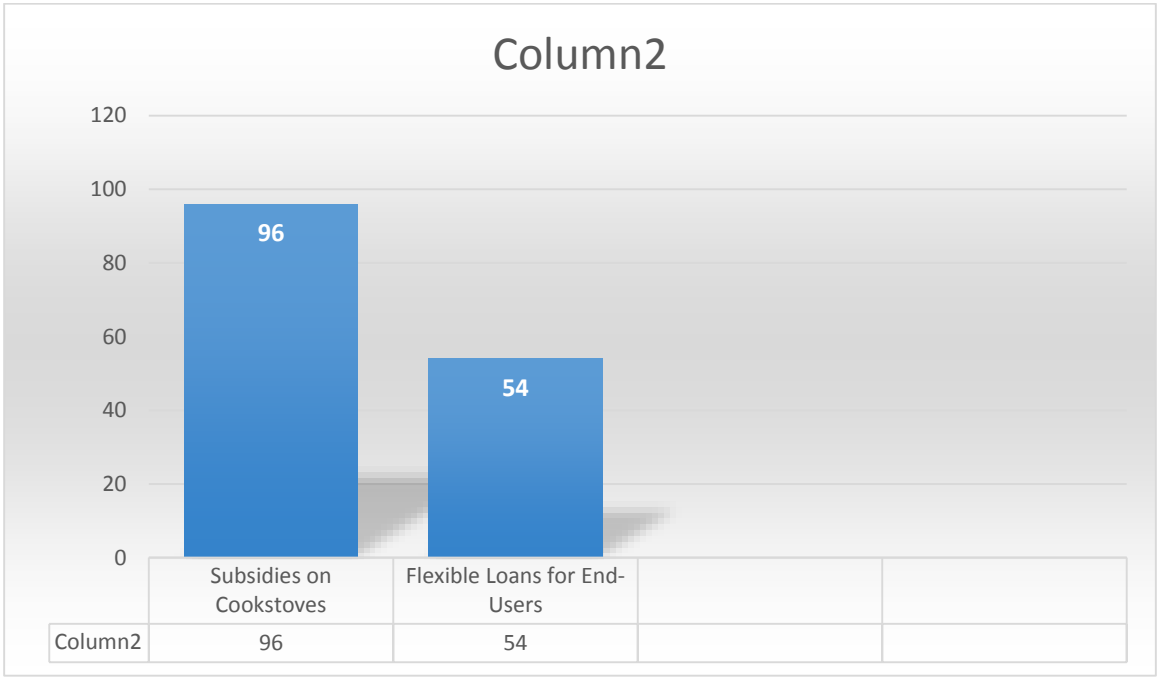
Source: Field Data (2019)

From the total number of thirty-two (32) respondents who purchased their stoves through credit, nineteen (19) of them, representing 59% were able to finance the purchase of their stoves through

credit from their families, whereas thirteen (13) of them received credit from their local credit groups for the purchase of their stoves. Some challenges encountered through credits includes high interest rates and bureaucratic procedures involved in accessing the credit.

Finally, respondents were asked about the financing schemes to be adopted so as to increase affordability and promote adoption. From the data collected, ninety-six (96) representing 64%, responded on subsidies on stoves whereas the remaining fifty-four (54) representing 36% responded on flexible loans for end-users to facilitate the purchase. Findings of study affirmed the study of Ouedraogo (2006) who found that subsidization of LPG as well as LPG cookstoves could decrease significantly the utilization of fuelwood in urban Ouagadougou. Figure 4.6 presents the recommended Financing Schemes by End-Users.

Figure 4.6: Recommended Financing Schemes by End-Users



Source: Field Data (2019)

4.2.4 Retailers of Improved Cookstoves/ Clean Fuels

4.2.4.1 Background Information

Data was also collected on retailers of improved cookstoves and clean fuels. Background information about the names of their companies/ enterprises was collected. In all, forty retailers responded to the study. Of these forty (40) retailers, six (6) of them representing 15% have been in the business for less than 2 years; eighteen (18) of them, representing 45% have been in the business between 2-5 years; ten (10) of them, representing 25% have been in the business between 6-10 years; whereas the remaining six (6) representing 15% have been in the business for over 10 years. The statistics is summarized in Table 4.6.

Table 4.6: Number of Years in the Cookstove / Fuel Business

Number of Years	Frequency	Percentage
Below 2 years	6	15
2-5 years	18	45
6-10 years	10	25
Over 10 years	6	15
Total	**40**	**100**

Source: Field Data (2019)

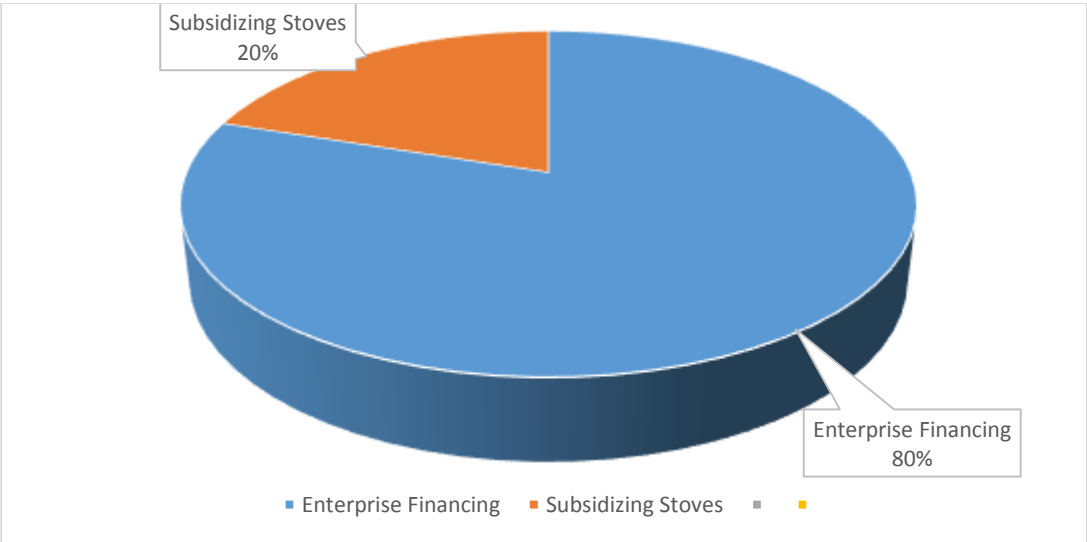
4.2.4.2 Financing of the business

In the area of financing, retailers were asked on how they finance the purchase of the improved cookstoves/ clean fuels. From the total number of 40 respondents, twenty-eight (28) of them, representing 70% self-finance the purchase, whereas twelve (12) of them get the stoves on credit

from manufacturers they deal with. The Data collected revealed that no respondents access credit from finance institutions.

Again, respondents were asked whether they face any financial barriers in their business. From the responses, all forty (40) respondents encounter financial barriers, which hinders them from buying more stock, hence affect their profits. In a follow up question, respondents' views were sought on best financing options that could be adopted to enhance the distribution/promotion of improved cookstoves/ clean fuels. For this question, twenty (32) respondents representing 80% responded on enterprise financing with low interest rates; while the remaining eight (8) representing 20% responded on subsidizing stoves for the poor. The findings from the study affirmed the study by Shrimali, Slaski, Thurber & Zerriffi (2011) who indicate that enterprise financing provides significant funding for the development of enterprises. Figure 4.7 presents the Recommended Financing Options by Retailers.

Figure 4.7: Recommended Financing Options for Improved Cookstoves/ Fuels by Retailers



Source: Field Data (2019)

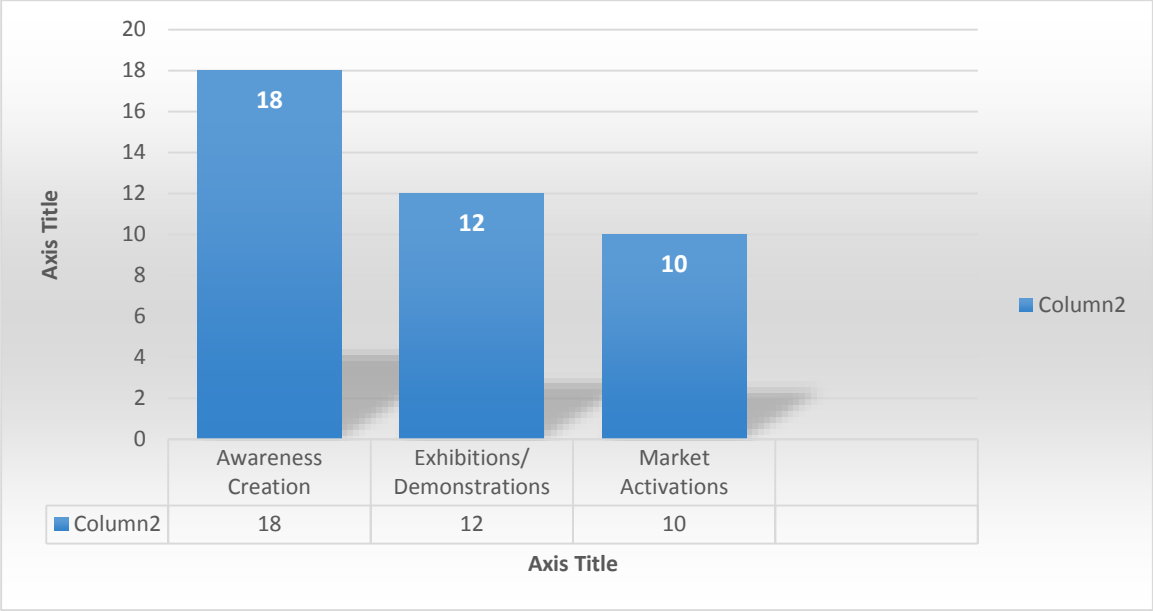
4.2.4.3 Distribution Channels and Marketing Strategies

Additionally, retailers were asked about the distribution channels and Marketing Strategies they adopt in their cookstove/fuel business. First of all, respondents were asked about the area where they market. Fourteen (14) respondents representing 35% market in urban areas; twenty-two (22) representing 55% market in both urban and peri-urban areas; four (4) of them representing 10% market in rural areas. Again, data was collected on how these retailers reach their target market, thirty-eight (38) responded on supplies taken by the clients, whereas two (2) respondents employ both strategies of customers coming for the stoves on their own; and also making deliveries on behalf of their customers. Furthermore, respondents were asked on the mode of payment by their customers; twenty-four (24) respondents, representing 60% sell stoves/fuels in cash only; whereas sixteen (16) respondents, representing 40% sell their cookstoves/fuels on both credit and cash.

Furthermore, respondents who sold on credit were asked if they encounter any challenges in the repayment of credit by customers. All respondents responded on facing challenges in terms of selling on credit. Of the sixteen (16) respondents who sell on credit, eleven (11) of them representing 69% face late payment challenges; whereas five (5) of them, representing 31% encounter non-payment challenges.

Respondents were also asked on what marketing strategies to be adopted to enhance sales. Eighteen (18) representing responded on awareness creation to promote the cookstoves/ fuels; twelve (12) of them responded on Exhibitions / Demonstrations; whereas ten (10) of them responded on Market Activations. The findings of the study hence confirmed the study by Sinha (2002) who discovered that awareness creation was one of the major reason for the success of the NISP in China. Figure 4.8 presents the recommended marketing strategies to be adopted to enhance sales.

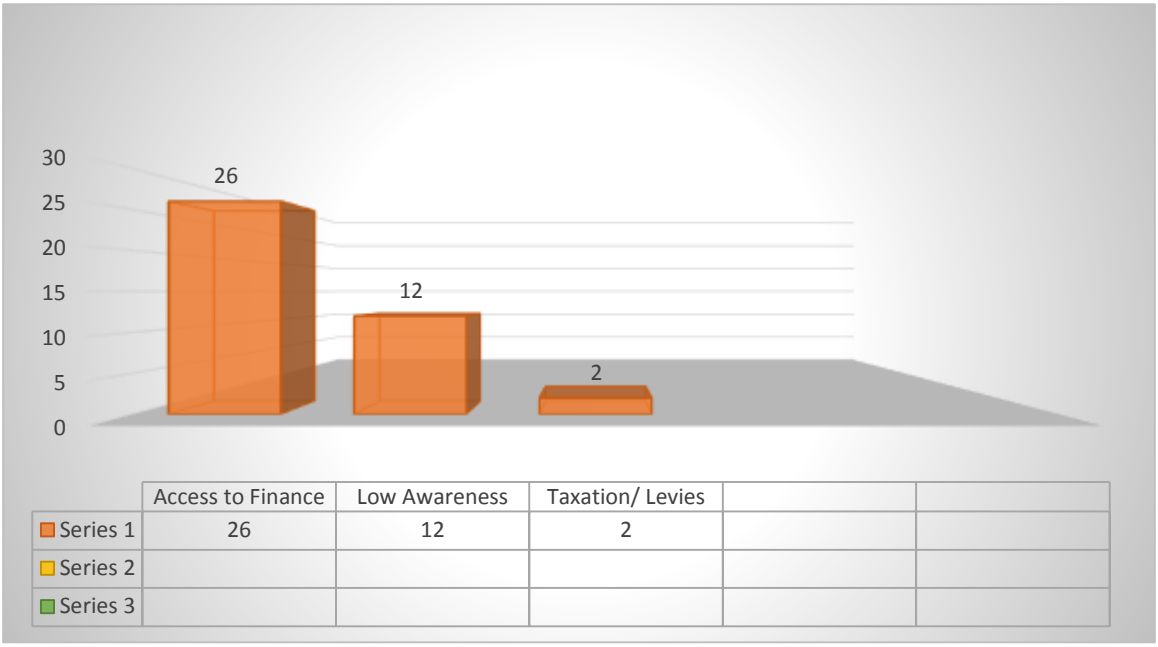
Figure 4.8: Recommended Marketing Strategies



Source: Field Data (2019)

Respondents were also asked about the major challenges they experience as retailers in the Cookstove sector. Twenty-six (26) respondents responded on Access to finance to support their business; twelve (12) respondents responded on low level of awareness of the improved cookstoves; thus affecting their business; whereas the remaining two (2) respondents responded on Taxation/ Levies as a major challenge affecting their business. The findings of the study affirmed the studies by Schlag & Zuzarte (2008) and Ashwani (2012) who revealed that clean stoves/fuels entrepreneurs face huge financial barriers, with limited global investment capital in the sector, thereby affecting margins of both manufacturers/producers and distributors/ retailers in the sector. Figure 4.9 presents the major challenges affecting retailers in the Cookstove sector.

Figure 4.9: Major Challenges Affecting Retailers in the Cookstove Sector



Source: Field Data (2019)

4.2.5 Manufacturers/Producers of improved cookstoves/clean fuels

4.2.5.1 Background Information

Data was also collected on manufacturers/ producers of improved cookstoves and clean fuels. Background information about the names of their companies/ enterprises were collected. In total, fifteen (15) responded to the study; made up of eight (8) manufacturers of improved cookstoves only; three (3) producers of fuels only; and four (4) manufacturers/ producers of both improved cookstoves/ clean fuels. Two (2) of these respondents representing 13% have been in the business for less than 2 years, seven (7) of them, representing 47% have been in the business between 2-5 years; and six (6) of them, representing 40% have been in the business between 6-10 years. The statistics is summarized in Table 4.7

Table 4.7: Number of Years in Cookstove/Fuel Business

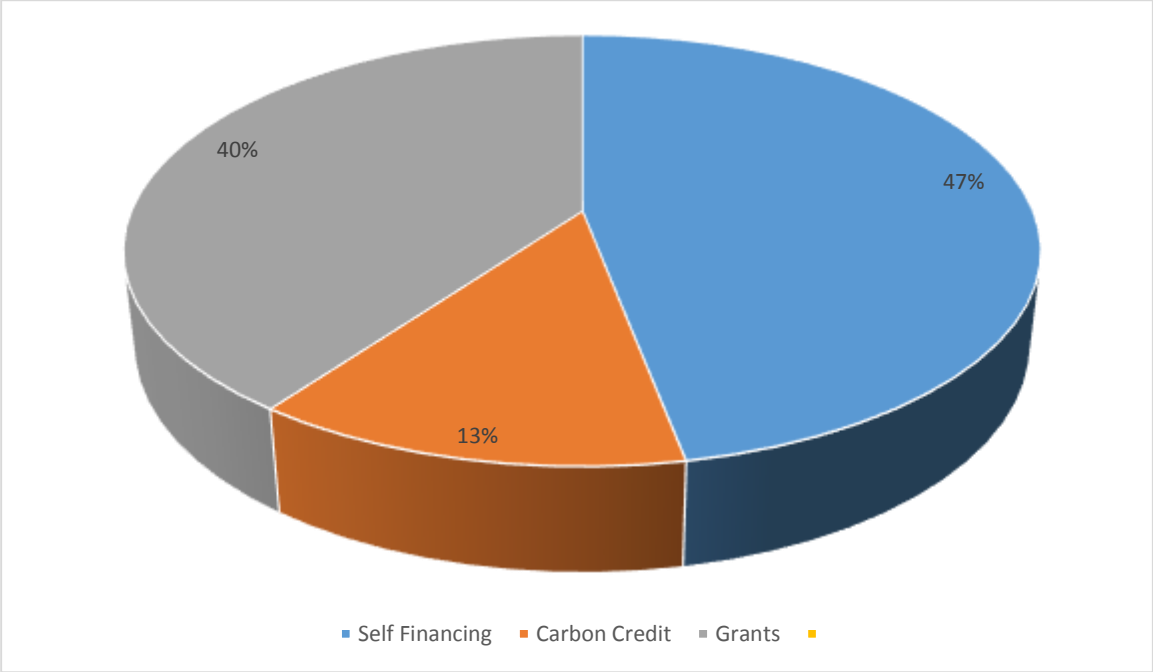
Number of Years	Frequency	Percentage
Below 2 years	2	13
2-5 years	7	47
6-10 years	6	40
Total	**15**	**100**

Source: Field Data (2019)

4.2.5.2 Financing of the business

Data was collected on respondents about how they finance their business. To begin with, manufacturers were asked on how they finance the production of improved cookstoves/ fuels. From the total number of 15 respondents, seven (7) of them, representing 47% self-finance their businesses; six (6) of them, representing, 40% of respondents secure funding through grants; whereas two (2) respondents, representing 13% secure funding through carbon credits. No respondents access credit from finance institutions. Figure 4.10 present the Financing Options for the Production of Improved Cookstoves/ Fuels by Producers**.**

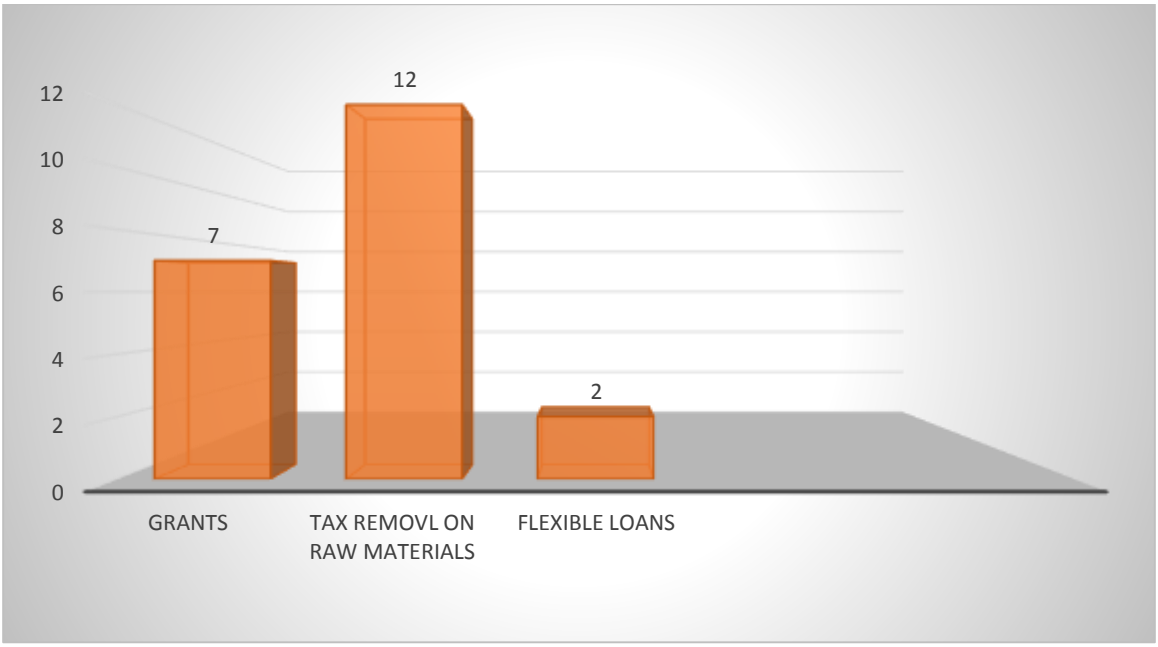
Figure 4.10: Financing Options for Production of Improved Cookstoves/Fuels by Producers



Source: Field Data (2019)

Again, respondents were asked whether they encounter financial barriers in their business. From the responses, all fifteen (15) respondents encounter financial barriers. Whereas nine (9) of them responded that financial barriers do not enable them to upscale production; three (3) responded that financial barriers do not enable them to access production equipment/machinery; the remaining three (3) responded that financial barriers do not allow them to engage in effective research and market development of their cookstoves/ fuels. In a follow up question, respondents' views were sought on best financing options that could be adopted to enhance the production of improved cookstoves/ clean fuels. For this question, seven (7) respondents representing 47% responded on Grants to be provided; six (6) of them responded on Tax removal on imported raw materials; whereas the remaining two (2) representing 13% responded on granting of Flexible loans /credit for upscale in production. Figure: 4.11 presents the Recommended Financing Schemes by Manufacturers/Producers.

Figure 4.11: Recommended Financing Schemes by Producers



Source: Field Data (2019)

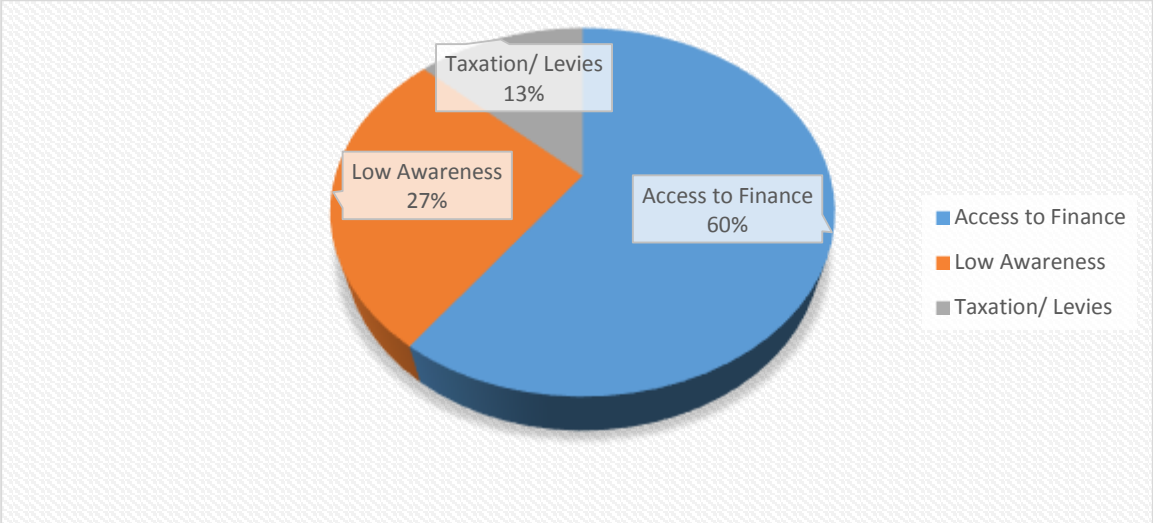
4.2.5.3 Distribution Channels and Marketing Strategies

Additionally, manufacturers/producers were asked about the distribution channels and marketing strategies they adopt in their cookstove/fuel business. First of all, respondents were asked about the area where they market. Three (3) respondents representing 20% market in urban areas; nine (9) representing 60% market in both urban and peri-urban areas; three (3) market in rural areas. Again, data was collected on how these manufacturers/producers reach their target market, all the fifteen (15) responded that they reach their target market through Word of mouth; in addition, six (6) of them combine Word of mouth as well as Television/Radio advertisements; Two (2) also combine Word of mouth and Online Marketing. Furthermore, respondents were asked on the mode of payment by their customers. From the data, it was found that eleven (11) of them representing 73% sell their stoves on both credit and cash, while four (4) of them representing 27% sell in cash only. In a follow- up question, respondents who sold on credit were asked if they encounter any challenges in the repayment of credit by customers. All respondents responded that they face

challenges in terms of selling on credit. Of the eleven (11) respondents who sold on credit, seven (7) of them representing 64% face late payment challenges; whereas four (4) of them, representing 36% encounter non-payment challenges.

Respondents were also asked about the main challenges they face as manufacturers/ producers in the sector. Nine (9) respondents responded on Access to finance to support their business; Four (4) of them responded on low level of awareness of improved cookstoves; thus affecting their business; whereas the remaining two (2) respondents responded on Taxation/ Levies as a major challenge affecting their business. This study finding confirmed the study of Shrimali *et al.* (2011) who discovered that enterprise financing provides significant funding for business development especially for start-up enterprises.

Figure 4.12: Major Challenges Affecting Manufacturers/ Producers in the Cookstove Sector



Source: Field Data (2019)

4.2.6 Financial Institutions

4.2.6.1 Background Information

Data was also collected on 3 selected financial institutions in the country, namely; Commercial Bank, Ecobank and Fidelity Bank to ascertain their knowledge, and support for the development of the Cookstove Sector in Ghana. Background information about the names of the Banks were collected. In addition, data on the sex of respondents, their positions and number of years working in the Bank were collected. All 3 respondents were males. Their positions included two (2) Business Development Managers and one (1) Investment Banking Manager who have all been working in their respective Banks between 2-5 years.

4.2.6.2 Financing of the Cookstove Sector

To begin with, respondents were asked about the awareness of their banks about the Cookstove Sector in Ghana. All three (3) respondents responded in the affirmative. Also, respondents were asked whether their banks consider the sector profitable to invest in, of which they all indicated no, "due to the fact that the sector is young and relatively unknown". Again, respondents were asked whether there are financial products designed by their respective banks to support the Cookstoves & Fuels businesses in the country. The responses were that "currently, there are no specific financial products designed to support actors in the sector, although Ecobank and Fidelity Banks have financial products designed for some renewable energy projects".

Furthermore, respondents were asked if their respective banks consider allocating investment in supporting improved cookstoves and clean energy initiatives, as directed by the Bank of Ghana. All respondents answered affirmatively," provided the sector grows and become more attractive to invest in, then banks would be automated to invest massively in the sector". Finally, respondents suggested flexible loans as an appropriate financial model for the development of the sector.

4.3 Analysis of Qualitative Data

4.3.1 Interview with the Energy Commission

The Director of the Renewable Energy Department of the Energy Commission was also engaged in an interview in order to ascertain the enabling policies by the Government of Ghana for the development of the sector. On what current enabling policies the Government is currently pursuing to support the cookstove sector? The interviewee revealed that: *Standards for improved cookstoves in the country has just been developed and gazetted, which will become mandatory for all improved cookstove manufacturers to obtain standards and labels for their stoves from the Energy Commission by the close of 2019. However, in the meantime, manufacturers are mandated to undertake voluntary testing of their stoves.* He added that: *the cylinder recirculation model is also being piloted in selected areas of Ghana, which will be implemented very soon.*

Furthermore, the interviewer sough to ascertain if the Government consider subsidies in promoting adoption of improved cookstoves, to which the interviewee responded that: *although subsidies exist to assist low- income families to shift from the use of traditional stoves to improved cookstoves, Government's intervention through subsidies is not as effective as expected from past experiences, due to the fact that the target group are not the ones who actually benefit from them, thus it does not become a favorable option to consider.*

Again, the interviewee was asked on how the Government intends to drive financial investment into the sector. The interviewee pointed out that: *The Government is currently in engagement with the Green Climate Fund, which is being managed by Ecobank to provide financial support for climate change initiatives of which the Cookstove sector could put in application to access funding.* The interviewee also added that: *Government of Ghana is in partnership with the Korean Government for the distribution of 500,000 improved cookstoves to Ghanaians in order to promote the adoption.*

In conclusion, the interviewee was asked on viable financial models to stimulate the development of the Sector in Ghana, of which he responded that: *Government is interested in the development of the sector, and therefore have been a lot of advocacy by stakeholders for the reduction of tariffs/ taxes on imported raw materials to reduce production costs, however, since this intervention has not yet been effected, the Government is encouraging private partnerships between actors in the sector with local and foreign investors to secure enough finances for the production and distribution of improved cookstoves for the development of the sector.*

4.4 Discussion of Findings

The purpose of this study was to propose sustainable business models for the development of the Cookstove Sector in Ghana. To achieve this, the researcher came up with four (4) specific objectives. The first objective sought to investigate the barriers accounting for the low adoption of improved cookstoves and clean fuels in Ghana. The analysis revealed numerous factors which include: affordability/ financial challenge, inaccessibility of improved cookstoves/ fuels, low level of awareness and Quality challenges as contributing to the low adoption of improved cookstoves and fuels in Ghana. From the study results, affordability/ financial challenge was the most significant barrier hindering the effective adoption of improved cookstoves/ clean fuels, with more study participants responding to it. This finding thus affirmed the study findings by scholars such as Pachauri *et al*. (2013), Mobarak *et al*. (2012) and Beltramo *et al*. (2014) who identified affordability/ financial constraint as a major barrier contributing to the low demand of improved cookstoves and fuels in developing countries. The result was presented in Figure 4.4.

The second objective sought to investigate the financial barriers facing actors within the Cookstove and fuel value chain in Ghana. The result revealed the following: all the key actors namely,

manufacturers, retailers and end-users revealed the inability to access finance as hindering the production and purchase of improved cookstoves and clean fuels.

On the part of the manufacturers/ producers, inability to access funds/capital for business expansion, purchase of quality raw materials and factory machinery/ equipment, etc makes it very difficult to produce in large scale so as to harness the full potentials of these clean cooking technologies, for business growth and to derive the expected socio-economic, health and environmental impacts. Additionally, the result revealed that barriers to accessing finance do not enable manufacturers and producers of improved cookstoves and clean fuels to effectively undertake sales and distribution strategies through advertisement and promotional sales to market products since they lack the financial resources to invest in expenditures relating to transportation, branded T Shirts, Branded cars, motorcycles, etc in order to reach consumers found in rural and peri-urban communities.

For retailers, the study found that retailers also faced access to finance challenges, hindering them from purchasing more improved cookstoves/ clean fuels, thereby affecting their margins.

For end-users, the study revealed that most end-users faced affordability challenges. Furthermore, their inability to access finance hinders them from acquiring these modern cooking devices, further worsening the situation, and contributing to the low adoption.

Thus the findings from the second objective affirmed the study findings of Edwards & Langpap (2005) who suggest that access to finance through loans/credit, grants plays a significant role in promoting adoption of improved cookstoves.

The third objective was to assess the nature of current business models within the Cookstove sector in Ghana. The result of the study revealed the following:

For Manufacturers/ Producers, the study found that majority of them self–finance their businesses/ operations, funding through grants followed, with few of them securing funds through carbon credits. Access to finance through credits/ loans from finance institutions was non-existent among the manufacturers/ producers who participated in the study. The result was presented in Figure 4.10. Furthermore, responses about the distribution channels and marketing strategies they adopt in their cookstove/fuel business revealed that most of them market their products in both urban and peri-urban areas. Again, the results of the data collected showed that all of them reach their target market through Word of mouth, with few of them combining Word of mouth with Television/Radio advertisements and Online Marketing. Moreover, responses about the mode of payment by their customers revealed that most of these Manufacturers/ Producers sell their cookstoves/ fuels on both credit and cash, with very few of them selling in cash only. Those who sell on credit revealed that they often encounter challenges of late payment and non-payment of products by creditors.

For retailers, the result of the study also indicated that majority of them self–finance their businesses/ operations, with few of them purchasing the stoves on credit from manufacturers they deal with. The result also revealed that access to finance through credits/ loans from finance institutions was non-existent among the retailers who participated in the study. Additionally, responses about the distribution channels and marketing strategies they adopt in marketing their cookstove/fuel business revealed that most of them market their products in both urban and peri-urban areas. Again, the results of the data collected on how these retailers reach their target market, revealed that most of the products are taken by the customers themselves, with few of the retailers using both approaches of customers coming for the stoves on their own and also making deliveries on behalf of their customers. Furthermore, responses about the mode of payment by their customers revealed that most of these retailers sell their cookstoves/ fuels in cash only, with few of them

selling their products on both credit and cash. Those who sell on credit revealed that they often encounter challenges of late payments and non-payment of products by creditors.

Additionally, results from the data collected from the financial institutions revealed that there are no specific financial products designed to support actors in the Cookstove sector. Again, financial investment in the sector is not considered profitable as the sector is young and relatively unknown. Nonetheless, respondents were hopeful that if the sector grows and become more attractive to invest in, then banks would be automated to invest in the sector.

Furthermore, discussions with the Director of the Renewable Energy Department of the Energy Commission revealed enabling policies such as standardization for improved cookstoves, and implementation of the cylinder recirculation model by the Government of Ghana for the development of the sector. Again results from the study revealed that the Government is currently in engagement with the Green Climate Fund to provide financial support for climate change initiatives of which the Cookstove sector could put in application to access funding. Moreover, the Government of Ghana is also in partnership with the Korean Government for the distribution of 500,000 improved cookstoves to Ghanaians in order to promote the adoption.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

While the preceding chapter presented the analysis and discussion of the study findings, this chapter discusses the summary of findings, conclusion and provides recommendations of sustainable financing and business models for the development of the cookstove sector in Ghana.

5.2 Summary of Key Findings

This study sought to propose sustainable financing and business models to tackle the financial and marketing/distribution barriers hindering the widespread adoption of improved cookstoves and clean fuels in Ghana, with four (4) specific objectives. The first objective was to investigate the barriers accounting for the low adoption of improved cookstoves and clean fuels in Ghana, the second objective was to investigate the financial barriers facing actors within the Cookstove and fuel value chain in Ghana, the third objective was to assess the nature of current financing and business models within the Cookstove sector in Ghana and lastly to propose sustainable financing and business models for the development of the Cookstove sector in Ghana. The study was necessary since sustainable financing models and market-based approaches are pre-requisites for achieving scalable dissemination of improved cookstoves and clean fuels in Ghana.

From the study, numerous factors such as financial challenges, Inaccessibility of improved cookstoves/fuels, Low Level of Awareness and Quality Challenges were revealed as contributing to the low adoption of improved cookstoves and fuels in Ghana. Out of these challenges, financial challenge/barrier was identified as a major challenge affecting all key actors (manufacturers/ producers, retailers and end-users) within the cookstove value chain, depriving manufacturers/

producers, retailers from harnessing the full potentials of clean cooking technologies for business growth. This finding was affirmed by the studies of Pachauri *et al*. (2013), Mobarak *et al*. (2012) and Beltramo *et al*. (2014) who identified financial challenge as a major barrier contributing to the low demand of improved cookstoves and fuels in developing countries.

In line with objective two (2) of the study, the findings revealed that all key actors (manufacturers, retailers and end-users) faced financial barriers in accessing finance for the production and purchase of improved cookstoves and clean fuels. On the part of the manufacturers/producers, their inability to access funds/capital for business expansion, purchase of quality raw materials and factory machinery/equipment, etc makes it very difficult to produce in large scale for business growth and to derive the expected socio-economic, health and environmental impacts. For retailers, the study found that retailers also faced access to finance challenges, hindering them from purchasing more improved cookstoves/clean fuels, thereby affecting their margins. In cases where credit is available, high interest rates on credit/loans lead to high selling price of the cookstoves, thereby negatively affecting sales. For end-users, the study revealed that most end-users faced affordability challenges. Furthermore, their inability to access finance hinders them from acquiring these modern cooking devices.

Additionally, the result revealed that barriers to accessing finance do not enable both manufacturers/ producers as well as retailers of improved cookstoves and clean fuels to effectively undertake sales and distribution strategies through advertisement and promotional sales to market products since they lack the financial resources to invest in expenditures relating to transportation, branded T Shirts, Branded cars, motorcycles, etc in order to reach consumers located in rural and peri-urban communities.

Furthermore, the study revealed that all manufacturers/producers and retailers reached their target market through Word of mouth, with few of them combining Word of mouth with Television/Radio advertisements and Online Marketing.

Moreover, the study found that Manufacturers/Producers and Retailers sell their cookstoves/fuels on both credit and cash bases, with very few of them selling in cash only. Late payment and non-payment of cookstoves/ fuels by creditors were some of the challenges encountered from selling on credit basis.

Finally, the study revealed that adoption of marketing strategies such as awareness creation, exhibitions/demonstrations and market activations could enhance the sale and use of improved cookstoves and fuels. The findings of the study confirmed the study by Sinha (2002) who discovered the contribution of awareness creation programs to the success of the NISP in China.

5.3 Conclusion and Policy Implications

The role of the Government through creating a favorable policy environment is key to addressing the various financing and marketing/distribution barriers hindering the development of improved cookstoves and clean fuel businesses in Ghana. The formulation of coordinated and coherent policies, tax policy, standardization, establishment of a clean cooking inter-departmental governance system, among many others are critical for ensuring effective dissemination of improved cookstoves and clean fuels in Ghana.

5.4 Recommendations

From the study's findings, the researcher proposes the following financing and business models on Promotion, Marketing, Financing and Pricing.

5.4.1 Promotion

I. The Social -Economic -Time and -Health (SETH) Model

The Social -Economic -Time and -Health (SETH) Model is recommended as an all-inclusive approach for the promotion of improved cookstoves and clean fuels stoves. This model is based on the assumption that the promotion of improved cookstoves and clean fuels must focus on these four (4) key drivers: Socio-cultural, Economic, Time and Health benefits.

II. Behavior Change Communication (BCC) Models

Additionally, promotional activities for effective uptake of improved cookstoves and fuels must adopt a combination of different BCC models including; the diffusion of innovation theory, health belief model, the theory of planned behavior which are necessary to cause the needed change for the adoption and use of improved cookstoves and fuels.

5.4.2 Marketing

The application of the marketing mix, popularly known as the Four Ps (Product, Place, Promotion and Price) is necessary in order to utilize effectively the social marketing strategy for the upscale of improved cookstoves and fuels in Ghana.

I. Product

The major principle for marketing improved cookstoves and clean fuels is to be demand-responsive. Improved cookstoves and clean fuels must be user friendly, less costly and offer maximum benefits to end-users within the SETH model framework.

II. Place

Place is a crucial component of social marketing as it increases access to improved cookstoves. Construction of a particular type of improved cookstoves (eg; fish smoking cookstoves) must be

situated at a strategic place to enhance accessibility by potential end-users. Additionally, availability and distribution outlets for end-users will augment adoption and use.

III. **Promotion**

Promotion of improved cookstoves and clean fuels could be done through mediums such as; word of mouth, advertisement on radio stations, television stations, community public address systems, etc. Promotional activities should be carried out by adopting the SETH model and the BCC approaches.

IV. Price

Cookstove enterprises who strive to penetrate the market, especially those at the bottom of the pyramid must endeavor to as much as possible strip out the costs and make prices of cookstoves as low as possible. Areas such as; innovation of designs, efficiencies in supply chain and distribution, etc need critical planning so as to reduce production cost as much as possible.

5.4.3 Financing

Some sustainable financing models proposed to aid effective end-user and enterprise financing of improved cookstoves in Ghana include; Dealer financing model, Brokering financing model and Inclusive financing model.

I. Dealer Financing Model

The Dealer Financing Model is a financing option by which a service delivery enterprise provides a service to a customer, and payment made through agreement by a financial institution once certification and client satisfaction has been concluded. In this model, financial institutions would provide credit to end-users for the payment of cookstoves, as well as manage and monitor the

repayment processes, whereas the cookstove builder would construct, install (if necessary) and provide after sales support services.

II. Brokering Financing Model

The brokering financing model is a form of end-user financing whereby third-party organizations or individuals are paid only on commission basis by a financial Institution or the stove enterprise to act as their marketing agents to market improved cookstoves to potential customers.

III. The Inclusive Financing Model

The inclusive financing model provides an all-inclusive model for financing both end-users and businesses in the improved cookstoves and clean fuel market. Donors or investors could provide funds for on-lending to businesses and end-users to support production and acquisition of these improved cooking technologies.

5.4.4 Pricing

Two pricing strategies; the Bundle and Penetration pricing strategies are proposed for business and development partners involved in the promotion of improved cookstoves and clean fuels in Ghana.

I. Penetration Pricing Strategy

With this strategy, prices of improved cookstoves and clean fuels could be fixed based on what a cookstove business believes end-users can afford to pay. Prices of Improved cookstoves and clean fuels could be reduced by using available local materials within the community. This will encourage potential end-users to switch from traditional cookstoves to improved cookstoves as result of the low entry price.

II. Bundle Pricing Strategy

For this pricing system, a business entity sells a set of goods or services at a reduced price than it would have sold them should the customer have bought them separately. Thus combining more products and selling them at a reduced price would facilitate more penetration of improved cookstoves in the cookstove market. Adopting a bundle pricing strategy enables an enterprise to upsurge profit by offering discount to end-users.

In line with the findings, the researcher recommends the following as addition to the proposed business and financing models discussed above.

5.4.5 Addressing Accessibility Challenges

It is recommended that more distributors be recruited to ensure that other brands of improved cookstoves (ICSs) such as CookMate, Envirofit, Abellon, are available to complement the 'Gyapa' cookstove. Additionally, fuels such as LPG, ethanol, gel, carbonized charcoal, pellets, etc should all be made available to ensure greater consumer choice to facilitate the adoption. This could be achieved by supporting clean cooking businesses by i.e. exempting improved cookstoves from district level taxes or market tolls to trigger more distribution outlets.

5.4.6 Awareness Creation

Advocacy programs, awareness creation, market activations, etc on improved cookstoves and clean fuels to be promoted by Non-Governmental Organizations and other Civil Society Organizations (CSOs) to increase awareness on clean cooking.

5.4.7 Capacity Building and Research on Clean Cooking Technologies

Capacity building and Research is also necessary for developing clean cooking technologies (stoves and fuels), that can best suit the cooking needs of majority of the population. In view of this, major actors within the improved cookstove value chain such as, manufacturers/producers (welders, ceramists, artisans, etc), distributors, cookstove projects implementers, etc. need to have their capacity/ skills enhanced or developed towards ensuring quality designs, manufacturing, distribution, marketing and maintenance of improved cookstoves and clean fuels.

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Appendix A- Questionnaire for End-Users

UNIVERSITY OF GHANA BUSINESS SCHOOL

DEPARTMENT OF FINANCE

RESERACH TOPIC: SUSTAINABLE BUSINESS MODELS FOR THE COOKSTOVE SECTOR IN GHANA

THIS IS PURELY AN ACADEMIC EXERCISE, HENCE ANY INFORMATION GIVEN WOULD BE STRICTLY TREATED AS CONFIDENTIAL

Annex 1: End-User Questionnaire

Part One: Demographic Characteristics of Respondent

1. Gender
   a) Male ( ) b) Female ( )
2. Age

a) 29 years and below ( ) b) 30-39years ( ) c) 40-49years ( )
d) 50-59years ( ) e) 60years and above ( )

3. Marital Status

a) Married ( ) b) Single ( ) c) Divorced ( )
d) Separated ( ) e) Widowed ( )

4. What is your level of education?

a) Tertiary ( ) b) Secondary ( )

c) Primary ( ) d) No education ( )

6. What is your estimated monthly income?

a) Below GHC 500 ( ) b) GHC500- 800( )

c) GHC800-1000 ( ) d) Above GHS1000 ( )

Part Two: Adoption of Improved Cookstoves and Clean Fuels

7. Which type of improved cookstove do you use?

a) Gas stove ( ) b) Envirofit ( ) c) Gyapa ( )

d) CookMate ( ) e) Ethanol stove ( ) f) Other(specify)……..

8. What type of fuel do you use for your stove?

a) LPG ( ) b) Charcoal ( ) c) Wood ( )
d) Briquettes / Pellets ( ) e) Ethanol Gel ( ) f) Other (Specify)……

9. How many years have you used your improved cookstove?

a) Less than 2 years ( ) b) 2-3 years ( )

c) 3-5 years ( ) d) Over 5 years ( )

10. What factors influenced your choice of the improved cookstove?

a) Fuel savings/ efficiency ( ) b) Less smoke ( ) c) Environmental concern ( )

d) Convenience/ Easy to use ( ) e) Other(specify)…….

11. In your opinion, what factors account for the low adoption of improved cookstoves/ clean fuels?
a) Affordability challenges ( ) b) Low level of awareness ( ) c) Quality challenges ( )
d) Inaccessibility of stoves/ fuels ( ) e) Other (specify)……

Part Three: Financing of Improved Cookstoves/ Clean Fuels

12. How do you see the prices of Improved cookstoves?

a) Expensive ( ) b) Moderate ( )

c) Low ( ) d) Other (specify)…….

13. How were you able to finance the purchase of your stove?
a) My savings ( ) b) My relative ( )
c) Credit ( ) d) Other (specify)……

14. If on credit, where did you get the loan?
a) Family ( ) b) Friends ( ) c) Credit groups( )
d) Microfinance Institutions ( ) e) Other (specify) _____

15. Did you encounter any challenges at the time of accessing the credit?
a) Yes ( ) b) No ( )

If yes, what were some of the challenges you encountered?
……
……....

16. In your view, what financing schemes should be adopted to increase affordability and promote adoption?
a) Subsidies ( ) b) Low interests on loans for end-users/ consumers ( )
c) other (specify)……..

Appendix B- Questionnaire for Retailers

UNIVERSITY OF GHANA BUSINESS SCHOOL

DEPARTMENT OF FINANCE

PROJECT TOPIC: SUSTAINABLE BUSINESS MODELS FOR THE COOKSTOVE SECTOR IN GHANA

THIS IS PURELY AN ACADEMIC EXERCISE, HENCE ANY INFORMATION GIVEN WOULD BE STRICTLY TREATED AS CONFIDENTIAL

ANNEX 2: Retailer Questionnaire

Part One: Background Information

1. Name of Company……...
2. Position of respondent in the company (eg: Managing Director /CEO; Sales person)
……..
3. Nature of business
   a) Sole proprietorship ( ) b) Partnership ( )
   c) Limited Company ( ) d) Other (specify)…….
4. How many years have you been in the improved cookstoves / fuels sales business?
   a) Below 2 years ( ) b) 2- 5 years ( )
   c) 6-10 years ( ) d) Over 10 years ( )

Part Two: Financing of the business

5. How do you finance the purchase of improved cookstoves/ clean fuels?

   a) Self-finance ( ) b) Credit by finance institution ( )

   b) Other (specify)……

6. If on credit, do you face any challenge in accessing it?
   a) Yes ( ) b) No ( )

If yes, what are some of the challenges?

a) Too much bureaucratic processes ( ) b) Interest rates too high ( )

b) Others (specify)……

7. Do you face any financial barriers in your business?

a) Yes ( ) b) No ( )

8. If yes to Q7, how does these barriers affect your business?

9. In your opinion, what financing options could be adopted to enhance the distribution/promotion of improved cookstoves/ clean fuels?

a) Enterprise Financing with low interest rates ( ) b) Subsidies on stoves/ fuels ( )
c) Others (specify)…….

Part Three: Distribution channels and Marketing Strategies

10. Where is your target market?

a) Urban ( ) b) Peri-urban ( )
c) Rural ( ) d) All ( )

11. How do the improved cookstoves / fuels supplies reach your target market?

a) Supplies taken by the client(s) ( ) b) Deliveries by self ( )
c) Other (specify).....

12. What is the mode of payment by your customers?

a) Cash ( ) b) Credit ( )
c) Both ( ) d) Other (specify)…….

13. If on credit, do you encounter any challenges in the repayment of credit by customers?

a) Yes ( ) b) No ( )

If yes, what are some of the challenges?

a) Late payment ( ) b) Non- payment ( )
c) Others (specify)……..

14. In your opinion, what marketing strategies could be adopted to enhance sales?

a) Exhibitions / Demonstrations ( ) b) Market Activations ( )
c) Awareness creations ( ) d) Other (specify)……..

15. What major challenge do you experience as a retailer in the cookstove sector? **(Please select only one Item)**

a) Access to finance ( ) b) Low level of Awareness ( )
c) Taxation/ Levies ( ) d) Other (specify) ……...

Appendix C- Questionnaire for Manufacturers/Producers

UNIVERSITY OF GHANA BUSINESS SCHOOL

DEPARTMENT OF FINANCE

PROJECT TOPIC: SUSTAINABLE BUSINESS MODELS FOR THE COOKSTOVE SECTOR IN GHANA

THIS IS PURELY AN ACADEMIC EXERCISE, HENCE ANY INFORMATION GIVEN WOULD BE STRICTLY TREATED AS CONFIDENTIAL

Annex 3: Manufacturer/Producer Questionnaire

Part One: Background Information

1. Name of Company……..
2. Position of respondent in the company (e.g. CEO/ Manager; Production Manager; etc) ……
3. Nature of your business?
   a) Sole proprietorship ( ) b) Partnership ( )
   c) Limited Company ( ) d) Other (specify)…….
4. How many years have you been in the cookstove/ fuel business?
   a) Below 2 years ( ) b) 2- 5 years ( )
   c) 6-10 years ( ) d) Over 10 years ( )
5. What do you manufacture/ produce?
   a) Improved cookstove(s) ( ) b) Fuel(s)( ) c) Both( )
6. Name of improved cookstoves (s)/ Fuel (s) produced

……

Part Three: Financing of the business

7. How do you finance your business?

a) Self-finance ( ) b) Credit by finance institution ( )

c)Other (specify)……

8. If on credit, do you face any challenge in accessing it?
   b) Yes ( ) b) No ( )

9. If yes, what are some of the challenges?

   a) Too much bureaucratic processes ( ) b) Interest rates too high ( )
   c) Others (specify)…….

10. Do you face any financial barrier in your business?

   a) Yes ( ) b) No ( )

11. If yes, in what way does it affect your business?
   a) Inability to upscale production ( )
   b) Inability to access production equipment/machinery ( )
   c) Inability to access quality imported raw materials ( )
   d) Inability to engage in Research & Development of stoves/ fuels ( )
   e) Others (specify)…….

12.In your opinion, what financing options can be adopted to enhance the production of improved cookstoves/ clean fuels?
   a) Flexible loans /credit ( ) b) Grants ( )

   c) Tax removal on imported raw materials ( )
   d) Other (specify)…….

Part Two: Distribution channels and Marketing Strategy

13. Where is your target market?
   a) Rural ( ) b) Peri-urban ( )
   c) Urban ( ) d) All ( )

14. How do you reach your target market?
   a) Word of mouth b) Television/Radio advertisements ( ) c) Print media ( )
   d) Online marketing ( ) e) Other(specify)…….....

15. What is the mode of payment by your customers?
   a) Cash ( ) b) Credit ( ) c) Both ( )

If by cash, skip to Q18

16. If by credit, do you encounter any challenges of repayment by customers?
   a) Yes ( ) b) No ( )

17. If yes, what are some of the challenges?
   a) Late payment ( ) b) Non- payment ( )
   c) Others (specify)……..

18. What is your major challenge as a manufacturer/ producer in the sector? (**Please select only one Item)**

a) Access to finance ( ) b) Low level of Awareness ( ) c) Marketing( )
d) Taxes/ Levies ( ) e) Other, (specify)……..

THANK YOU FOR YOUR TIME

Appendix D- Questionnaire Financial Institutions

UNIVERSITY OF GHANA BUSINESS SCHOOL

DEPARTMENT OF FINANCE

PROJECT TOPIC: ***SUSTAINABLE FINANCING AND BUSINESS MODELS IN THE COOKSTOVE SECTOR IN GHANA***

Annex 4: Questionnaire for Financial Institutions

Part One: Background Information

1. Name of Bank……..
2. Position of respondent …….
3. Sex:
   a) Male ( ) b) Female ( )
4. Age:
   a) 20 – 29years ( ) b) 30 – 39 ( )
   c) 40 – 49 years ( ) d) 50 years and above ( )

5. What is your highest level of education? Please select the most appropriate.
   a) Post Graduate Degree ( ) b) Graduate Degree ( )
   c) HND ( ) d) Other (specify)……

6. How long have you worked with this bank?
   a) 6 to 12 months ( ) b) 1 - 2 years ( )
   c) 2 -5 years ( ) d) 5 years and above ( )

Part Two: Financing of the Cookstove & Fuels Sector

7. Is your bank aware about the Cookstove Sector in Ghana?

   a) Yes ( ) b) No ( )

8. Does your bank consider the sector profitable to invest in?

a) Yes ( ) b) No ( )

If no, what are some of the reasons?

……..

……...

9. Does your bank have financial products to support cookstoves & fuels businesses in the country?

a) Yes ( ) b) No ( )

If yes, what are some of the financial products?

……

……

If yes, what are some of the challenges your bank encounters in investing in the sector?

……

……

If no, why not? ……

……

10. Per the Bank of Ghana's directives, 25% of operational capital is expected to be tailored in environment and sustainability projects, in view of this, does your bank consider allocating investment in supporting improved cookstoves and clean energy initiatives?

a) Yes ( ) b) No ( )

11. What appropriate financial models do you think could be adopted to promote the production, distribution and adoption of improved cookstoves/fuels?

a) Flexible Loans ( ) b) Grants ( )

c) Other (specify)……

Appendix E- Interview Guide for Energy Commission

UNIVERSITY OF GHANA BUSINESS SCHOOL

DEPARTMENT OF FINANCE

RESEARCH TOPIC: SUSTAINABLE FINANCING AND BUSINESS MODELS FOR THE COOKSTOVE SECTOR IN GHANA

THIS IS PURELY AN ACADEMIC EXERCISE, HENCE ANY INFORMATION GIVEN WOULD BE STRICTLY TREATED AS CONFIDENTIAL.

Annex 5: Interview Guide for Energy Commission (Government)

Part One: Background Information

1. Sex:

   a) Male ( ) b) Female ( )

2. Age:

   a) 20 – 29years ( ) b) 30 – 39 ( )

   c) 40 – 49 years ( ) d) 50 years and above ( )

3. What is your highest level of education? Please select the most appropriate.

   a) Post Graduate Degree ( ) b) Graduate Degree ( )

   c) HND ( ) d) Other (specify)……

4. Position of respondent ……

5. How long have you worked with this Ministry?

   a) 6 to 12 months ( ) b) 1 - 2 years ( )

c) 2 -5 years ( ) d) Over 5 years ( )

Part Two: Fostering an Enabling Environment

- What current enabling policies is the Ministry/ government pursuing to support the cookstove sector? (eg: Rural LPG programme, Cylinder Recirculation Model, Capacity Building of entrepreneurs, etc.
- Does the government consider subsidies to enable low income families to afford improved cookstoves?
- How does the Government intend to drive financial investment into the sector? (eg: Grants from donors, Partnerships with investors, etc.)
- Is the government currently partnering with any financial institution(s) in stimulating financial investments in the clean cooking sector? (If yes, please provide the details)
- What forms of financial models do you recommend to stimulate the development of the Cookstove Sector in Ghana? (eg: Subsidies, Grants, Reduction of tarrifs/ taxes on imported raw materials, etc).

Any other comments?

THANK YOU FOR YOUR TIME