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Investigation of drivers and barriers to LPG uptake after re-introduction of 16 % VAT on LPG among low-middle income households in Nairobi County.

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INVESTIGATION OF DRIVERS AND BARRIERS TO LPG UPTAKE AFTER RE-INTRODUCTION OF 16 % VAT ON LPG AMONG LOW-MIDDLE INCOME HOUSEHOLDS IN NAIROBI COUNTY.

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Margaret M. Thumbi

Approval

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ABSTRACT

Promoting access to clean household cooking energy is a crucial issue that has policy implications for the urgent need and global efforts to achieve universal energy access by 2030, as set out in Sustainable Development Goal (SDG 7). This qualitative study explored the Theory of Change on interventions that are capable of bringing change. In addition, the Lay Logic model on barriers and facilitators on scale-up on clean cooking fuel was utilized. The model has five domains of concern consumer perspective in low- and middle-income households in an urban setting. More than 3 billion people globally still rely on traditional fuel as a source of cooking fuel. This has resulted in an enormous health burden due to household Air Pollution (HAP) with approximately 4.3 million premature deaths arising from the use of solid fuel (charcoal, wood) and kerosene. A growing body of evidence and global consensus indicates that scaling up the use of clean cooking fuels will contribute to the achievement of all 17 SDGs set by the United Nations in 2015. Liquified Petroleum Gas (LPG) is a clean-cooking fuel that is rapidly scalable; it is thus seen as a key component in achieving Kenya's ambitious target of attaining 100% clean household energy access by 2028. The Kenyan government zero-rated Value Added Tax (VAT) on LPG in 2016, this recorded a progressive increase in uptake from 13% in 2016 to 24% in 2020. Although in July 2021 16% standard Value Added Tax (VAT) on LPG was re-introduced. Consequently, the re-introduction of the 16% VAT negatively impacted the resource-poor low and middle-income households, this led to an increase in the LPG cost thus causing LMI Households to revert to alternative traditional fuels either exclusively or through supplementing LPG. Traditional fuels are polluting and have adverse effects on health, livelihoods, the environment, and climate, this study sought to explore the effect of the re-introduction of 16% VAT on LPG uptake. The objectives of this research were, to i) establish the outcome of the re-introduction of 16% VAT in LMI households, ii) determine other fuel options that households switched to after the VAT re-introduction, and iii) the drivers that determine the type of fuels used by households and trends observed.

Key Words: Re-introduction of 16% VAT, clean cooking fuel, traditional fuel, Low-middle income household, Liquified Petroleum Gas.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

HAP- Household air pollution

LMICs- Low- and middle-income countries

Kshs-Kenyan Shilling

LPG- Liquefied petroleum gas

GHG – Greenhouse gases

PAYG- Pay-as-you-go

$PM_{2.5}$- Particulate matter less than 2.5 μm

SDG- Sustainable Development Goal

WHO- World Health Organization

WLPGA-World LPG Association

GLPGP- Global LPG Partnership

IEA- International Energy Association

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DEDICATION

I dedicate this work to my children, Jedidiah Tei Wendi, and Julius Mwendwa Wendi, for their prayers and moral support.

CHAPTER ONE

INTRODUCTION

1.1 Background

Clean cooking fuel is recognized as a key element in the context of achieving Sustainable Development Goal (SDG) 7, which focuses on affordable, reliable, sustainable, and modern energy (Meixi Gan, 2019). Clean fuels such as Liquefied Petroleum Gas (LPG) and bioethanol among others are considered reliable, clean, efficient energy sources produced from readily available renewable resources (Hsu et al., 2019). The 17 Sustainable Development Goals are a blueprint to achieve a better and sustainable future for all (Meixi Gan, 2019). LPG contributes directly to SDGs 3,5,7,8,9,13 & 15 and indirectly to the remaining ten SDGs. LPG is a by-product derived from crude oil and natural gas that goes through production and refining. In the market, it is found as propane or Butane or a combination of both with over 1000 applications (Meixi Gan, 2019).

Household air pollution (HAP) caused by the combustion of traditional fuels for cooking and heating is responsible for almost 5% of the global burden of disease (Pye et al., 2020b) and 4.3 million premature deaths and impaired quality of life globally (Puzzolo et al., 2013a,) (World Health Organization., 2018) & (Hsu et al., 2019). Charcoal, kerosene, and firewood, the most common cooking fuels in Kenya (Kumar et al., 2017) are thus major contributors to respiratory disease, lung cancer, as well as carbon emissions, pollution, and deforestation (Morgan, 2018; Schraufnagel et al., 2019) Women and children are mostly affected by solid fuels as they spend most of the time in the kitchen cooking. Traditional fuels have also created a significant demand for forest products, causing further degradation of already scarce natural resources with wood fuel demand frequently outstripping supply (Pye et al., 2020). This has also led to food insecurity.

The use of clean fuels such as LPG can substantially reduce- HAP by limiting exposures to fine particulate matter (PM2.5), (Abbafati et al., 2020). The World Health Organization (WHO) has thus recommended the urgent need to scale up the adoption of clean fuels, such as LPG in low and middle-income countries (LMICs). In addition to the health effect of HAP combustion of traditional fuels leads to the formation of Green House Gases resulting in global warming and climate change. The negotiations at COP26 emphasized the need to scale up clean cooking energy and identified that supporting Sub-Saharan African countries was a significant part of working

together to protect the planet and people and ensure a greener, more resilient future for all. Understanding the drivers and barriers to the adoption and exclusive use of LPG among other clean cooking fuels has thus become an urgent issue (Vigolo et al., 2018).

In Kenya, LPG penetration has increased rapidly over the past five years, especially in urban areas (WLPGA & Annual Report, 2019). In 2016 the Government of Kenya zero-rated VAT on LPG to accelerate the uptake of LPG hence the attainment of 100% use of clean cooking fuels by 2028. However, in 2021 the 16% standard rate on VAT of LPG was re-introduced, thus with the potential to reverse the progress that had been obtained by affecting demand and market uptake due to increased cost and affordability. On the other hand, bioethanol is emerging as a scalable cooking option, with the ability to meet the needs of low-income earners, by meeting the requirement for fuel to be sold in small affordable quantities (Dalberg, 20 19). However, bioethanol attracts an import tariff of 25% and VAT of 16%, which affects the cost of production and market price. Interruption in the supply of clean cooking fuel or lack of a "level playing field" can lead to switching to polluting fuels Rosenthal et al., 2018)., therefore it is crucial to develop strategic policy to address the challenges to clean cooking fuel supply.

To promote the uptake of clean cooking fuel (LPG), the Government of Kenya zero-rated LPG in 2016, with the strategy of rapidly expanding domestic use to acquire 35% of the population by 2030 (Hsu et al., 2019). The progress has been commendable since LPG uptake has increased from 13 % in 2016 to 24% in 2019/2020 (Abbafati et al., 2020). In July 2021, the 16% VAT was reintroduced for LPG. Low and medium-income households have been hugely impacted by the increase in LPG costs. After the reinstatement of 16% VAT, ceased to be the primary source of fuel for LMI households, as they switched to polluting fuels. Research conducted by the University of Liverpool, University College London, and Moi University in collaboration with the Kenyan Ministries of Health and Energy established that half of the urban households cooking with LPG in Western Kenya decreased their uptake following the 16% VAT reintroduction. The households hence reported cooking more frequently with polluting fuels such as; charcoal, kerosene, and wood (Abbafati et al., 2020), moreover, COVID-19 pandemic, caused a greater challenge for LPG consumption (Shupler et al., 2021a), as a result of the financial crisis, loss of employment, reduced working hours and cessation of movements which all exacerbated inequalities in the uptake of

clean cooking fuels among households (Shupler et al., 2021a), (Shupler et al., 2022). During this period, LMI households prioritized other household expenditures, switching to more affordable traditional fuels (Abbafati et al., 2020). In addition, they changed in cooking behavior and the type of food consumed (Shupler et al., 2021b)(Pope Daniel et al, 2021). LPG consumption in Kenya increased by 59%, between 2003 and 2016, according to the (Petroleum Institute of East Africa, 2018).

Current prices for LPG in Kenya are among the highest in the world because of fluctuating prices of petroleum in the international market and exchange rate, in addition, the conflict in Ukraine has had a ripple effect in African countries on inflation thus exorbitant food and fuel prices (Abbafati et al., 2020). In Kenya, LPG is supplied by a private entity and the Government has no control over the prices, the Importer sets prices (Shupler et al., 2021b). For the Government to regulate the prices they need to ensure the importation of LPG is through an open tender system (OTS) framework and have a common holding facility for LPG, this is likely to affect the supply chain and demand for LPG in Kenya. A common holding facility for LPG is under construction in Mombasa by Kenya Pipeline Company, this will bring new players into the market thus encouraging competition, which will result in a price reduction

The Government of Kenya 2019 took steps toward ensuring LPG safety by revising the LPG regulatory framework. The Energy and Petroleum Regulatory Authority (EPRA) is responsible for regulating clean cooking fuel in Kenya. The regulator monitors and enforces the obligations of clean fuel marketers and consumers' rights. This has reduced the illegal refilling of gas, rebranding, and counterfeiting of gas, thus ensuring the safety of the cylinders in the market. For example, it is required for a retailer to have an EPRA license and a written authority from the brand owner hence allowing retailers to sell the brand to consumers (Energy Regulatory Authority, 2019), (Energy Regulatory Authority, 2019b). The government intends to position LPG as a primary cooking fuel, reducing health and environmental challenges caused by unclean fuel (Pye et al., 2020).

1.2 Problem Statement

Approximately three billion people globally still rely on traditional fuels such as charcoal, wood, and kerosene, for cooking as compared to clean cooking fuels. Despite the wide use of solid fuel

and kerosene, it contributes enormously to the health burden thus causing high mobility and mortality rates. Household air pollution (HAP) is the most important environmental health risk factor. Day-to-day exposure to household air pollution puts household members at high risk of premature deaths with up to 4.3 million deaths due to heart disease, stroke, chronic obstructive pulmonary disease, pneumonia, and cancer (WHO Indoor Air Quality, 2014). These diseases are chronic and hence affect the quality of life and their day-to-day activities and in most cases, women and children are the most affected (Ngeno et al., 2018).

Environmental degradation through deforestation leads to greenhouse gas (GHG) emissions which are the major driver of global warming, causing droughts and floods, depletion of biodiversity, and food insecurity, leading to widespread social and economic impacts (Morgan, 2018). While on the other hand, clean fuels such as bioethanol and LPG are clean, affordable, reliable, and efficient sources of energy. Although LPG is a fossil fuel, it emits no black carbon and has a minimal level of particulate matter (PM 2.5). LPG remains unaffordable for low-middle-income households. Polluting fuels are preferred to LPG because consumer perceptions of LPG cost are thought to be high, and the taste of different types of meals when cooked using LPG is said not to be as good as when cooked with polluting fuels. Nonetheless, using clean fuel is a key determinant of improved livelihoods in most households through employment, climate mitigation, improved health, and averting death (Rosenthal et al., 2018).

In 2016, the Government zero-rated the value-added tax (VAT) for LPG to increase the uptake of clean cooking fuel to attain 100% adoption by 2028. However, in 2021 July the value-added tax was re-introduced, thus changing the cost of LPG whereby to refill a 6 Kg cylinder initial cost was KShs 800 but with the reimposition of 16% VAT the cost was KShs 1500, while to refill a 13 Kg Cylinder was Kshs 2000 but moved to 3250 (Abbafati et al., 2020)

It is presumed that the reinstatement of the 16% VAT on LPG will affect the progress made on the adoption of clean cooking fuels to attain 100% uptake by 2028 as most households will revert to traditional fuels whose prices are presumed to be better than clean cooking fuel (LPG) (Abbafati et al., 2020). To avoid the effects of traditional fuels on health, environmental degradation, climate mitigation, and social-economic factors, there is a need to address the problem of clean cooking

fuel uptake and more so policies. This may lead to an acceleration of the transition to clean cooking fuel (Morgan, 2018), & (Kumar et al., 2017b).

1.3 Objectives

1.3.1 General objective

To establish the uptake of LPG after the re-introduction of 16% VAT on LPG in low- and middle-income households in Nairobi County

1.3.2 Specific Objectives

The study sought to fulfill the following specific objectives

i. To establish the outcome of the re-introduction of 16% VAT in LMI households in Nairobi County.
ii. To determine what other options/choices of fuel households utilized after the re-introduction of 16% VAT on LPG in Nairobi County.
iii. To determine the drivers of fuel choices among LMI households in Nairobi County

1.4 Research Questions

The study sought to answer the following research questions.

i. How has the reintroduction of 16% VAT on LPG affected the uptake of LPG among LMI households in Nairobi County?
ii. What other choices of fuels did the household utilize after the 16% VAT reintroduction on LPG in Nairobi County?
iii. What were the drivers of clean cooking fuel uptake among LMI households in Nairobi County following the re-introduction of 16% VAT?

1.5 Scope

The focus was on low- and middle-income households at the Pipeline and Fedha estates in the Nairobi area respectively. The two estates were chosen for this study due to their densely populated areas with the majority of the population residing around the estate being either low- or middle-class households. Households were randomly selected. The study started in November 2021 and was completed in June 2022. A sample size of 204 was determined, out of the targeted population of 247, using The Fisher Calculation Method.

1.6 Significance of the study

This study aims to promote the use of clean cooking fuel through recommendations on re-instating 16 % VAT on LPG, to enable affordability among low- and middle-income households thus improving health, climate, environmental and socioeconomic factors. Therefore, this study will inform the policymakers and key stakeholders on issues of LPG uptake, demand, and market trends of clean fuels and sustainable measures for improved clean cooking fuel uptake. Effective policies will address the various issues affecting the uptake of LPG and strategies to tackle the challenges. Researchers will benefit from the study through the addition of a body of knowledge in the area, by identifying gaps and seeking to fill this in future research. Investors/stakeholders will be able to better understand the market trends of clean cooking fuel. The government through the regulatory board will be able to promote compliance standards and safe practices in the utilization of clean cooking fuels.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive review of the theoretical aspects of the use of clean cooking fuels, a review of various global empirical research conducted on clean cooking fuels, and the gaps in the study that requires further research, and finally presents a conceptual framework with various variables that determine clean cooking fuel adoption and their sustainable use.

2.2 Theoretical literature review

2.2.1 Adoption and sustainable use of LPG

Several theories have been developed on how traditional cooking fuels impact health, climate, and the environment, thus making women and children the most vulnerable. In addition, how the effect of traditional fuel has resulted in a decline in the scale-up of clean cooking fuel thus limiting health, climate, and environmental dividends (Kumar et al., 2017a). Much of the literature has emphasized the need to address the policy aspect of clean cooking fuel since approximately 3 billion people mostly from Asia, Latin America, and Africa rely on solid and kerosene fuels, (i.e., wood, charcoal, crop waste) for their everyday cooking energy sources (Kumar et al., 2020a).

2.2.2 Theory of change

This is a set of interventions, expected to lead to specific developmental change to promote desired change based on the available evidence. In the Theory of Change, address problems that hinder progress and effective solutions are identified (UNDAF Campanion Guidance, 2017) the ultimate success of a theory of change is determined by its ability to demonstrate achievements of the outcomes and if there is evidence of success, the theory is said to be effective (Johnson et al., 2015). The desired change based on this study is to scale up the adoption, and sustained use, through addressing policies on the uptake of clean cooking fuel to enable improved health, environment protection, improved lively hoods, and food security (Karanja et al., 2020). The theory begins with the desired outcomes then followed by assumptions, then works backward on the outcome pathway (Clean Cooking Alliance, 2020).

According to (Schraufnagel et al., 2019), approximately 4.3 million people from low- and middle-income countries die prematurely due to exposure to HAP which is occasioned by inefficient combustion of traditional fuels that leads to acute respiratory infections, cancer, obstructive pulmonary diseases, and in addition, resulting in the land, and forest degradation due to the high demand of the traditional fuel. It is imperative to engage in interventions that accelerate uptake, adoption, and sustainable clean cooking fuel (Kumar et al., 2017b) to prevent the effects of household air pollution.

The transition from traditional cooking fuel to clean cooking is a complex process that requires efforts to transit to clean fuels hence multiple drivers and facilitators are involved according to the Lay logic model (Rosenthal et al., 2018a). The study will concentrate on the consumer perspective and therefore outline four factors depicted in the theory of change.

Theory of Change focused on four main aspects of interventions as outlined below

1. Supporting the growth of clean cooking fuel
2. Increase consumer demand
3. Strengthen enabling environment
4. Generating research evidence and learning

Figure 2.1 below outlines the Theory of Change with a detailed explanation identifying the current situation, assumptions, enablers, outputs, and outcomes. The pathway is interlinked to show the connection of these various factors contributing toward scaling up the adoption of clean cooking fuel in households. Assumptions made should be aligned with the problem of the study.

The Theory of Change also addresses barriers and facilitators that are likely to influence the outcome of clean fuel uptake. Barriers include social processes, economic instability, and natural disasters e.g., COVID-19. Facilitators include improved infrastructure to enable ease of doing business and increased accessibility of LPG.

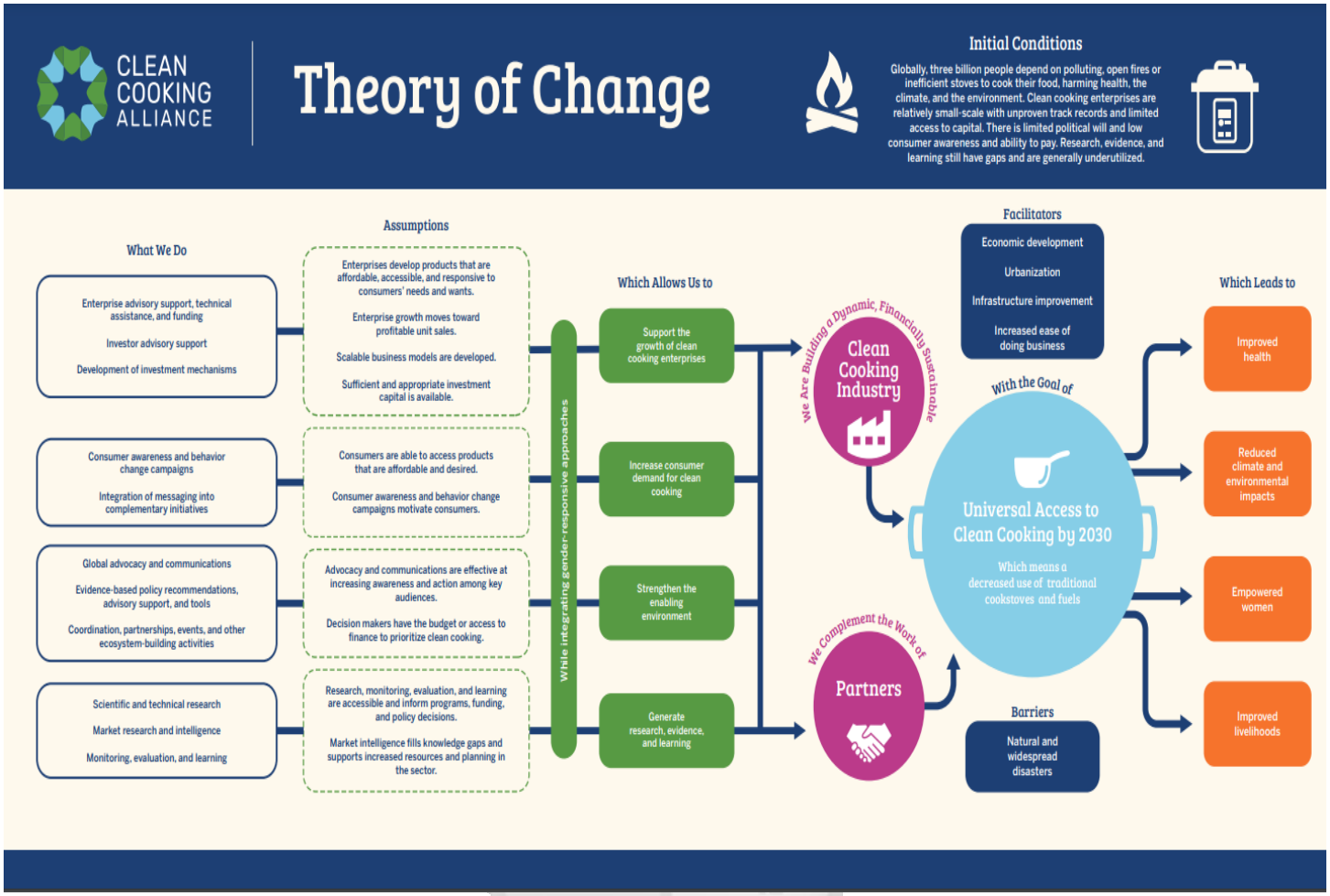

FIGURE 1: SOURCES; THEORY OF CHANGE ADAPTED FROM CLEAN COOKING ALLIANCE (2020).

2.2.3. Support the growth of clean cooking enterprises.

The assumption is that the enterprise develops products according to consumers' needs and wants whereby the products should be accessible, affordable, and responsive. When there is business growth this also affects growth in households positively whereby the consumer utilizes the product in this case a cooking fuel hence improved health, climate, and livelihood. For there to be a positive outcome, various factors are at play, such as the facilitators that include, ease of doing business, improved infrastructure, and urbanization. Through uptake of clean fuel, it influences the growth of the business.

2.2.4. Increase consumer demand.

The assumption is that when the consumer is equipped with knowledge of the product through awareness and campaigns, this leads to a consumer making an informed choice of which type of fuel to settle on thus instigating behavior change. This result in the consumer being able to access products that are affordable, accessible, and desired. This brings about increased uptake of clean cooking fuel by the consumer who consequently meets the set outcome of increased consumer demand.

2.2.5. Enabling environment

The assumption is that policymakers can influence decisions about policies on taxes, infrastructure, and regulatory measures by enforcing safety standards on clean fuel (LPG). Advocacy and communication are effective at increasing awareness. Policymakers have access to finances to prioritize clean cooking fuel. Investors are also willing to participate in clean cooking fuel activities to enhance uptake, adoption, and sustainability.

2.2.6. General research evidence and learning

The assumption is that research will inform policy-making decisions. The marketing intelligence will fill the knowledge gaps and support increased resources and planning in the energy sector and more so in clean cooking fuel.

Example of Theory of Change process

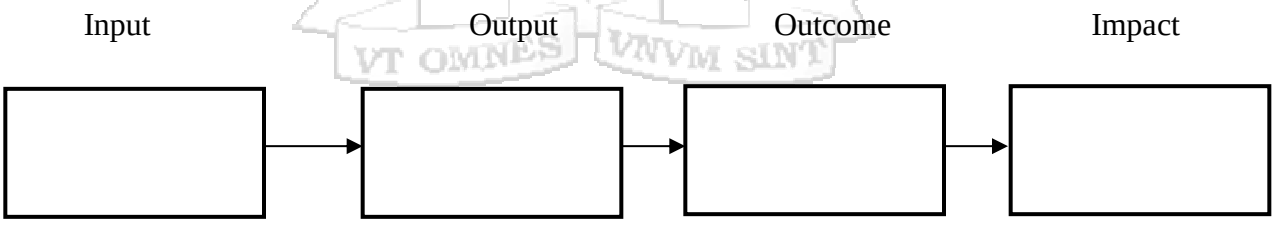

FIGURE 2:DEMONSTRATES A SIMPLIFIED PROCESS OF THE THEORY OF CHANGE.

Assumption: To improve the uptake of clean cooking fuel the cost must be affordable.

Input: Must address tax policy, such as reverting LPG to zero rate in order to provide a playing field of clean cooking fuel with traditional cooking fuels.

Output required: Provide an awareness campaign to the consumer on LPG utilization and the impact of using clean cooking fuel.

Outcome: The above process will lead to increased uptake of clean cooking fuel.

Impact: The anticipated outcome is improved health, improved environmental conditions, and climate mitigation.

2.2.7 Lay Logic Model

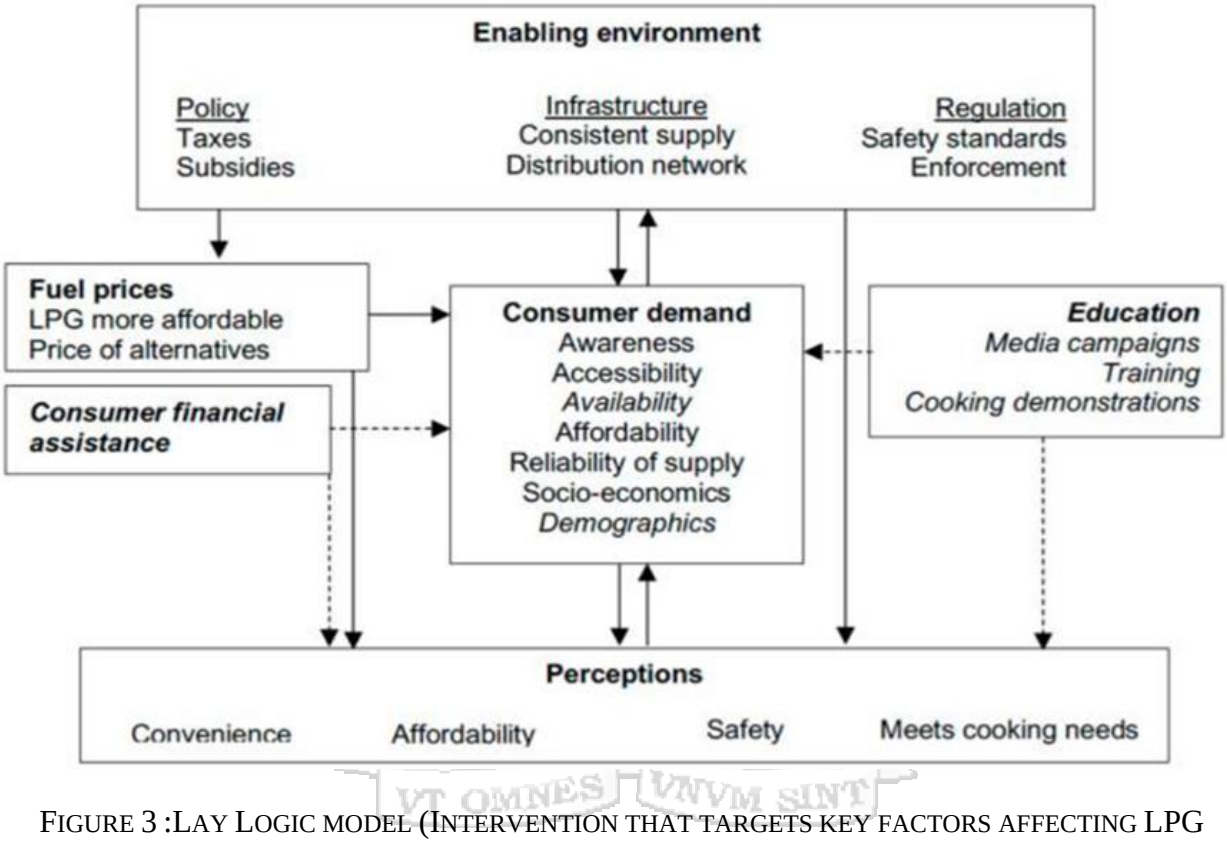

FIGURE 3 :LAY LOGIC MODEL (INTERVENTION THAT TARGETS KEY FACTORS AFFECTING LPG UPTAKE (ADAPTED FROM ROSENTHAL ET AL., 2018).

The Above Lay Logical model is informative on barriers and facilitators of uptake of clean cooking fuel, with more emphasis on a consumer perspective. The Lay knowledge addresses the challenges encountered in the day-to-day use of LPG; this hence can be used to inform policymakers on the appropriate direction in tackling the problem. The study will pay more attention to enabling the environment and more to policies on taxes and consumer perception.

2.3 Empirical review

2.3.1 Scale-up, adoption, and sustainability of LPG uptake

Liquefied petroleum gas (LPG) is widely available across geographical regions of sub-Saharan Africa. Although with limited use in many countries, despite being an efficient and safe cooking fuel with the potential to deliver benefits to health, climate, and environment (Stanistreet et al., 2019). Several governments of sub-Saharan countries including Ghana, Kenya, and Cameroon have made it a priority to provide a majority of their populations with clean cooking fuel to address the effects of air pollution, forest preservation and economic development (Stanistreet et al., 2019).

Kenya, Cameroon, and several other countries have set ambitious targets to scale up LPG consumption to attain universal energy. The Kenya government has an ambition of attaining a 100% 2028 uptake of clean cooking fuel. In Cameroon, in 2011, a population of 18% was using LPG as their primary source, with 34.4 % being the urban population and rural 1.6% (Stanistreet et al., 2019). Approximately 70% of the population in Cameroon uses solid fuel for cooking, which contributed to significant mortality and morbidity in the country due to solid fuels. To address problems of energy security, deforestation, and air pollution, the Cameroon government developed a strategy to increase the uptake of LPG as a cooking fuel from 12% to 58% by 2030 (Bruce et al., 2018). Several countries have been working hard to transition to clean cooking fuel, and some of these countries such as Brazil have already achieved the transition. While Tanzania, 2015 announced its goal to increase the uptake of modern cooking fuel to 75% by 2030, this goal was for all modern cooking energy (Gill-Wiehl et al., 2022).

The Kenya government in 2016 zero-rated VAT on LPG, which led to increased uptake of LPG (Dalberg, 2018). In July 2021, the government re-introduced the 16% standard rate VAT of LPG (Abbafati et al., 2020). The reintroduction has led to slow uptake of LPG, and this has resulted in sliding back to traditional fuels thus affecting the progress achieved before re-introduction. According to the research conducted by the University of Liver pool, University College of London, and Moi University in collaboration with the Kenya Ministry of Health and Energy, established that half of the households in urban areas of western Kenya decreased the uptake of LPG following the re-introduction of VAT. However, unlike Kenya in 2008, the Tanzanian government removed the import duties and value-added tax on LPG to increase the demand for

the fuel, despite the efforts to remove taxes, according to the 2017-2018 survey of Tanzania Households Budget indicated only 8.1% and 0.4% of LPG was attained in urban and rural respectively. This low uptake of LPG is not unique in Tanzania alone, but other LPG programs also face similar barriers (Gill-Wiehl et al., 2022). Previous LPG studies have provided interventions to accelerate the uptake of LPG by providing free stoves, subsidies, or microloans with repayment schedules, but still, the uptake rate is low (Karanja et al., 2020), (Kumar et al., 2017b),(Puzzolo et al., 2013).

According to Asante et., al the government of Ghana launched a rural LPG program in 2013 as a mode to reduce solid fuel (wood, charcoal) and enhance a clean environment, improve health reduce deforestation thus maintaining water catchments, with the aim was to provide 50% of LPG by 2020 (Asante et al., 2018). Asante 2018, noted that 58% of households did not refill their LPG cylinder nine months after the initial installation and only 8% were able to refill the LPG. This was attributed to cost, distance for LPG refill stations, and inadequate implementation of the LPG framework. While in other countries in Africa, LPG adoption and usage have been gaining ground at a fast rate compared to Kenya. For instance, in Senegal, 95 %, of most people use LPG as the main source of energy Wilson K et, al 2018, and WLPGA annual report 2019. In Kenya, especially for most households that live on less than a dollar a day, the initial cost of a cylinder and accessories at an average cost of 40 USD is unaffordable for a common citizen. People at the bottom of the pyramid will prioritize food and shelter rather than efficient fuel (Puzzolo et al., 2013b).

2.3.2 Drivers of fuel choices among LMI households

According to Kimemia and Annegarn, the South African government encouraged its population on using LPG because most households were using electricity, which was costly for the government. The transition to LPG from electricity cut huge bills, 70% of the users, seven years down the line was still impressed by the LPG intervention that improved their welfare (Kimemia & Annegarn, 2016). While in Indonesia, the government converted its primary cooking fuel from Kerosene to LPG in more than 50 million households this was a mega project. This was beneficiary to the government in reducing the huge petroleum fuel subsidy (Budya & Yasir Arofat, 2011).

Different countries desire on scaling up LPG uptake for common reasons such as improve on health, forest protection, mitigation of climate change, and improve on economic factors (Bruce et

al., 2018). Adoption to clean fuel requires implementation of the drivers of clean cooking fuel that address tax policies, regulatory measures, awareness, accessibility, availability, and affordability. In recent years, LPG in Kenya has grown rapidly; however, the market penetration remains very low due to constraints like affordability thus affecting the demand. The reimposition of value-added taxes on LPG has affected the demand in most households (Abbafati et al., 2020). The high LPG prices are exacerbated by high global LPG prices due to the Ukrainian war. The majority of these countries have common drivers for the uptake of LPG (Wilson et al., 2018). Various factors are driving the demand for LPG globally; in Kenya, policy measures and affordability of the product are key enabling factors. To ensure the availability of LPG, there are two LPG terminals in Mombasa and the LPG is transported by rail and trucks into the hinterland (SE4ALL, 2016). Kenya has implemented policies to accelerate the demand for LPG adoption, it encourages pay-as-you-go. Other national LPG programs have explained the need for awareness, information, and maintenance support. India, South Africa, Sudan, Mozambique, and Nicaragua found out with proper awareness of LPG safety and maintenance (Budya & Yasir Arofat, 2011), (Kimemia & Annegarn, 2016), (Asante et al., 2018) accelerates the uptake.

2.4 Study gap

Numerous studies have expounded on the issue of policy mainly on the tax levies for clean fuels (Dalaba et al., 2018),(Dalberg, 2019), (Kumar et al., 2017b), (Hsu et al., 2019). LPG is affected by the tax levies consequently affecting the cost of these fuels; favorable tariffs will level the playing field for clean cooking fuels with traditional fuels whose tariffs are lower compared to clean fuels (Morgan, 2018) (Dalberg, 2018). Affordability will be enhanced by addressing the issue of taxation. The government should formulate concessions on clean cooking fuel to make it more competitive thus increasing the demand (Pye et al., 2020). The high cost of clean cooking fuel because of the re-introduction of the 16% VAT on LPG has a negative impact; it has led to a return of the use of biomass and kerosene fuels that are considered fair in terms of cost, thus affecting the health of most women and children. Awareness is the degree of knowledge and perception of clean cooking fuel adoption. Lack of awareness may lead to a deterrent to clean cooking energy uptake, this is according to (Kumar et al., 2020b). Therefore, awareness is crucial if 100% uptake of clean cooking fuel is to be attained by 2028.

Governments will need to increase efforts to expand and accelerate access to clean cooking energy, by improving affordability, accessibility, safety, and awareness, in areas where the uptake is low, thus providing unprecedented opportunities to reduce an enormous global health burden (Morgan, 2018), especially amongst women and children, and thereby free up a vast amount of human potential (Rosenthal et al., 2018a).

2.5 Facilitators and barriers to clean fuel uptake

2.5.1 Consumer perspective

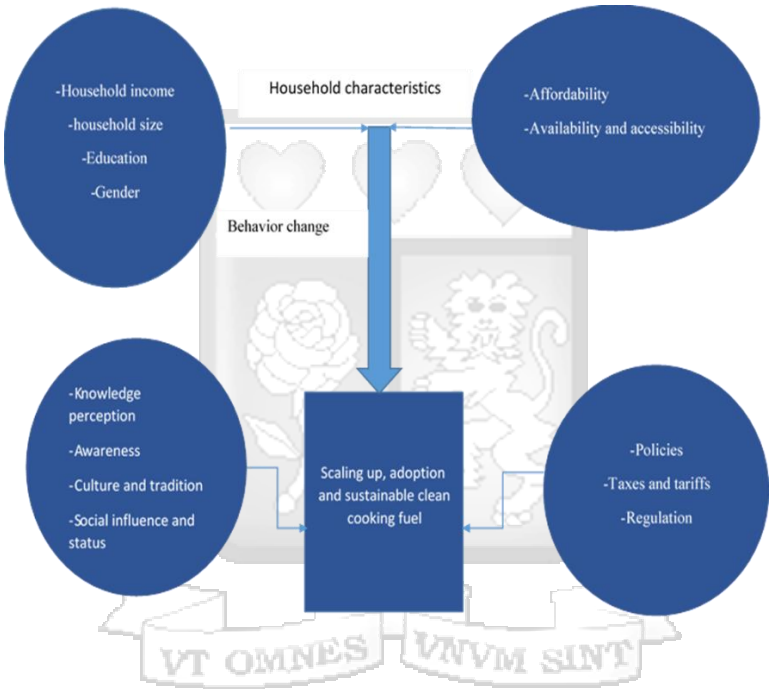

FIGURE 4: FACILITATORS AND BARRIERS TO CLEAN FUEL UPTAKE.

2.6 Connecting theory and the study's conceptual framework

This research will seek to determine relationships between different variables that could affect clean fuel uptake. LPG is more available than before, but there is a need to address awareness, affordability, accessibility barriers, socioeconomic factors, demographic characteristic, cultural influence, and attitudes toward technology. The conceptual framework outlined below guides data collection and analysis.

Drivers and barriers have a major influence on clean fuel uptake. The concept explores various factors at work that are key influencers in clean fuel uptakes such as household income, household

size, education, perception, awareness, taxes, and policies. These are the determinants of upscaling, adoption, and sustainability of LPG among LMI households. The outcomes of economic affect; are improved economic status due to reduced health burden expenditure, and improved food security. While the impact on environmental protection is through alleviating deforestation and ensuring, the safety of biodiversity is improved. The final impact is the social impact this shall enhance women's empowerment, and improved lively hood, improved health, and education (Karanja et al., 2020).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research Philosophy, research design, population of the study, and data collection techniques utilized in the study. It also presents data quality, reliability, and validity of the analysis.

3.2 Research Philosophy

The research paradigm is a framework of the research, which determines the methodology to be used in the research. The study is based on the positivism paradigm. The positivism paradigm believes knowledge should be objective and free from any bias of researchers' beliefs and values (Ryan, 2018).

3.3 Research Design

Research design is a logic that links the research purpose with research questions, data collection, and analysis to give a conclusion (Ponelis, 2015). The research design relies on the research paradigm selected (Creswell. John, 2009). The study employed a descriptive positivism design to give enriched and in-depth information on the study subject in their natural setup. The survey method was adopted for data collection to obtain a holistic understanding of the phenomena (Zainal, 2007) -in this case, LPG uptake through engaging the research participants in conversation and obtaining their views on LPG uptake and adoption.

The study has taken a qualitative approach, according to (Creswell W. John, 2014), the approach for research involves philosophical assumptions, research design, and the specific method.

Therefore, this research is a qualitative survey based on a descriptive positivism design. Qualitative research is enriched, with in-depth data on the phenomena because of engaging in conversation with the study participants using an unstructured questionnaire.

3.4 Study Area

The reason why Nairobi was chosen as a suitable site for research was to ascertain if the level of uptake has been affected after the reintroduction of 16 %VAT on LPG among the low- and middle-income households, considering that urban and peri-urban areas have a high uptake of clean cooking fuel (Nilsson et al., 2021). The study area of interest was Low- and Middle-income households in Nairobi County mainly Pipeline and Fedha Estate Embakasi. Pipeline estate in Embakasi South is a low- middle-class estate that is home to approximately 100,000 people who work mainly at the Factories, and around Airport as casual, and water vendors. The pipeline estate has High-rise unplanned flats with poor infrastructure, and a lack of water supply, and electricity in some areas. Pipeline estate is a crowded estate and human traffic is a common phenomenon.

Fedha Estate is also a low-and middle-income estate characterized by high-rise buildings and a high population with minimum zoning. The rents are affordable; with most people starting up life opt to reside in this area due to accessibility to most social amenities.

The economic survey 2017 by the Kenya Bureau of Statistics, states that low-middle income households are classified based on their monthly income, for instance, low-income rates are < KSHs 30,000 and below while middle income has a rate of <KSHs 60,000 Kenya shillings. The study, therefore, captured the entire income scope of the LMI Households through its questionnaire. The two study areas had a comparative response rate as shown in figure 5 below.

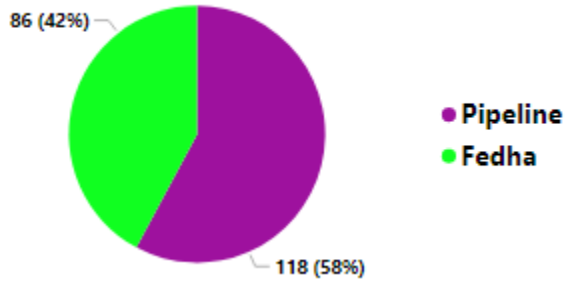

FIGURE 5: COMPARATIVE RESPONSE RATE PER AREA OF STUDY

3.5 Population of study

The study population of interest was low-and middle-income households. This informed on the distribution and usage of clean cooking fuel. The inclusion criteria of the population of interest were above 18 years, living in Fedha estate or Pipeline estate, and being an LMI household, while the exclusion criteria were for anyone below 18 years and not residing in Fedha or Pipeline estate and if not an LMI household. The sample from the population was randomly selected based on the inclusion criteria. The sample size is the number of respondents participating in the study The sample size for the study was determined using Fisher's formula and a sample size of 247 households was arrived at, as follows (Fisher, 1991).

3.5.1 Sample size

The sample size for the number of respondents interviewed was determined as per Fisher's formula (Fischer et al., 1998).

Formula; $N = Z2pq \div d2$

Where,

N - Quantity of sample size desired

P- Ratio in the selected population expected to have the features under study (20%)

q- (1-p) - the ratio in the selected population expected not to have the features under the study (80%)

d- Level of statistical significance set at (0.05)

Z- Normal standard variation at the required confidence level, a 95% confidence level was used (1.962)

Therefore, $n = (1.962 * 0.2 * 0.8) \div (0.05) = 247$ respondents

3.6 Sample Design and Technique

The sampling technique used for recruiting participants was purposeful which a non-probability technique is. This sampling technique is used in qualitative research to recruit participants who can provide in-depth and detailed information concerning phenomena under investigation (Suri, 2011). In non-probability sampling, the researcher relies on their judgment concerning the selection of a participant. A good sample is representative of the population of interest, which is large enough to answer the research questions (Lohr et al., n.d.)

3.7 Data Collection method and procedure

The data collection involved the use of an unstructured questionnaire as a primary data source, in gathering the information about the study, prior consent was sort from all participants before the data collection. The questionnaire was developed based on study objectives to facilitate responding to the research questions. Two research assistants were trained to assist in data collection. A questionnaire was formulated and validated by carrying out a pilot study of 25 participants, this enabled checking the validity of the tool. The questionnaire was modeled in google form, and then populated in Google Sheets, which was imported to excel, R software was used in data analysis. Google form was essential as it enabled observation of COVID-19 measures and also proper storage of collected information for future reference was securely encrypted through the google cloud server system.

3.8 Data quality

3.8.1 Reliability

To ensure the reliability of the data, training for the data collection tool was done for the research assistants and followed by a pilot study of 25 (10% of the target population) participants a day before data collection, to confirm the effectiveness of the questionnaire, and to check areas that required improvements. The output data was checked for data quality dimensions including completeness and consistency, before being used for data collection.

3.8.2 Validity

The validity of the questionnaire was ensured by having a well-designed questionnaire that was deemed appropriate and suitable. The supervisor validated the questionnaire before it was used, in addition, a pilot study was carried out whereby a target of 25 respondents translated to 10 % of the

total targeted population of 247. The research instrument was appraised to ensure it covers adequate information to meet the study objectives.

Content validity is defined as the degree to which a data collection instrument covers the content or data that it is intended to be measured (Yaghmalef & Ct, 2003). High-quality data is crucial in any field work, reliable and replicable data will lead to a ripple effect on the research work. Therefore, for quality data, the selection of participants must be fit for the purpose.

3.9 Data Analysis

This is a very crucial area in research in unlocking insightful information from the raw data. It involves data collection, categorization of data gathered, and interpretation of the data to determine patterns, trends, or relationships. The data collected was uploaded on Google data sheets. The data was categorized, in different categories to make it usable in the analysis. The software used for the analysis of this qualitative data was R. The populated data in Google spreadsheets were imported to Excel files and then the raw data was analyzed using R. The data was categorized based on similarities between elements under research. This involved the use of R in statistical analysis whereby it computed frequencies and proportions in figures, tables, and Pie charts to generate trends, relationships, and patterns of the variables. The interpretation of the content of this information was carried out since it was more simplified and easier to execute a conclusion based on the findings.

3.10 Ethical Considerations.

Strathmore University Ethical Review Committee granted clearance to carry out the research and the National Commission of Science and Technology Innovation granted a research License for

During data collection, respondents were encouraged to volunteer for the research, and the participants were informed that they have the right to withdraw from the study if they wish. They gave informed consent before participating in the study. The Researcher gave detailed information concerning participation in the study to enable them to make an informed decision without undue pressure or coercion. The questionnaire had easy-to-understand language. The privacy of the participant was highly observed by ensuring their details were not included in the questionnaire. Confidentiality was also highly observed. The study was objective throughout the entire period of

research. The study adhered to the Strathmore Institutional ethical review committee (IERC) stipulated guidelines.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION OF FINDINGS

4.1 Introduction

This chapter presents findings, analysis, and interpretations of the data collected to establish the outcome of the reinstatement of the 16% VAT on LPG in low- and middle-income households at Pipeline and Fedha Estates in Nairobi County and the rate of uptake of the LPG. The chapter also presents the demographic data, the choice of cooking fuel utilized in the households, substitute sources of cooking fuels after the price increase of LPG, and the drivers of LPG uptake.

4.1 Demographic profile

The study had a target of 247 respondents but managed to get the views of 204 respondents as shown in Table 4.1.1. This translated to a study response rate of 82.6%.

TABLE 4.4.1: RESPONSE RATE

Target population	Responses	Response rate
247	204	82.6%

The number of respondents for the study was 204, a proportion of 83% of the targeted population.

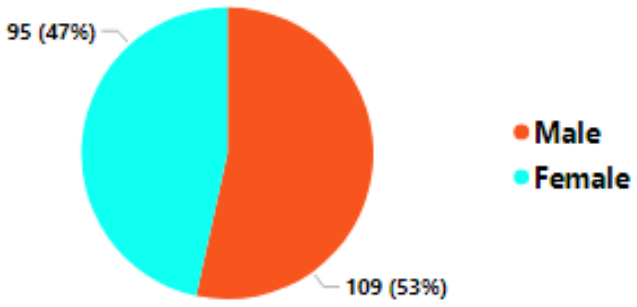

FIGURE 6: GENDER OF THE RESPONDENTS

The study results in figure 6 indicate that most of the respondents were male (53%) compared to the female respondents who were 47%.

TABLE 4.1.5: AGE GROUP OF RESPONDENTS

Age Group of respondents		
Age Group of respondents	*Frequency*	*Proportion*
36-45 yrs.	78	38%
26-35 yrs.	53	26%
46-66 yrs.	35	17%
18-25 yrs.	25	12%
66 yrs. and above	13	6%
Sample Size	204	

The study findings in table 4.1.2 indicated that most of the respondents were aged between 36-45 years (38%). On the other hand, only 6% of the respondents were above 66 years. The results show that the population is mainly young and middle-aged people.

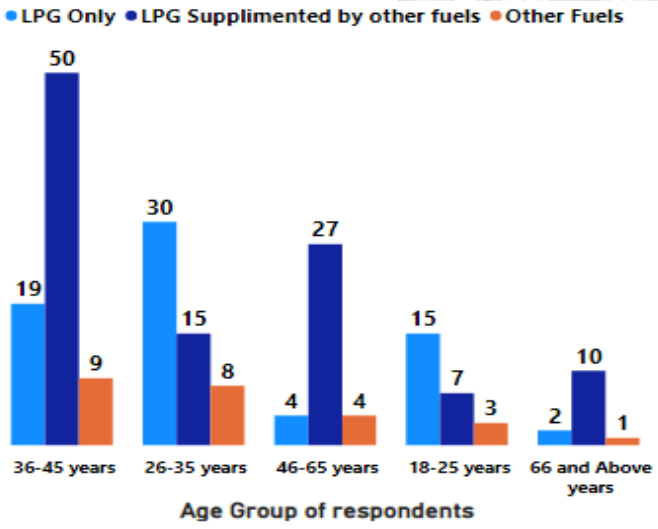

FIGURE 7: AGE GROUP

Figure 7 demonstrates that LPG uptake was high among ages aged between 26-35 years since 30 households utilized LPG. While at the age of 36 to 45, there was a high level of supplementing LPG with other fuels they were 50 households under this category. While at the age of 66 years they were 13 households, compared to other age categories this was low, with only two households utilizing LPG and 10 households combining LPG with other fuels, and 1 household using other types of fuel.

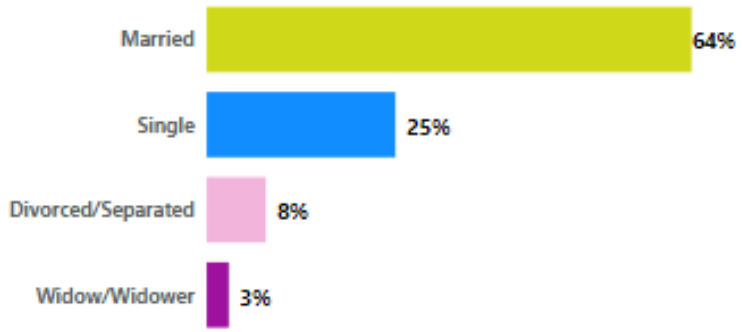

FIGURE 8: MARITAL STATUS

The study results indicated that most of the population were married people (64%). The single population was 25%, the divorced/separated were 8% while the widow/widowed were only 3%.

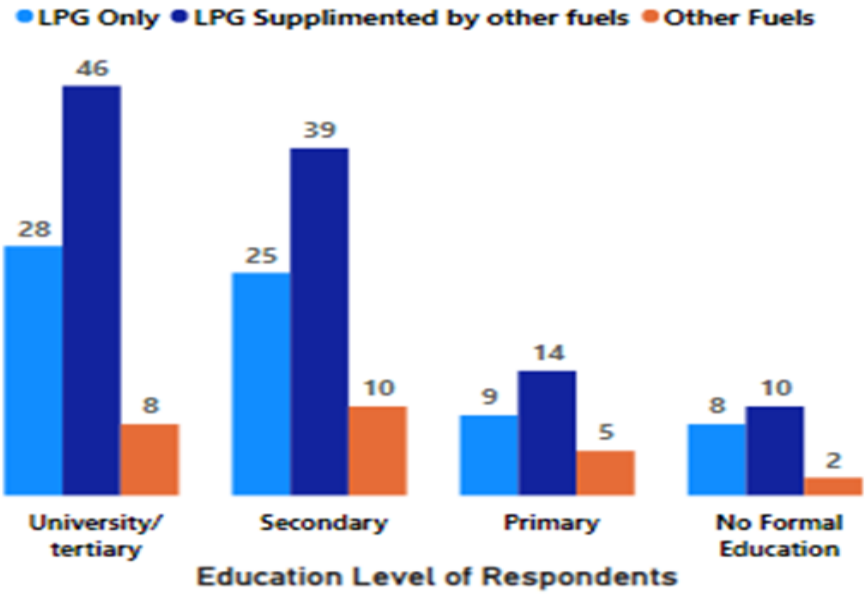

FIGURE 9 : EDUCATION LEVEL OF THE POPULATION

Based on the level of education of respondents, the study results in figure 9 indicated that in the population with university and tertiary levels of education, 28 households used LPG as their main source of fuel while 46 households used LPG and supplemented the LPG with other fuels and 8 households did not use LPG. Instead, they used other sources of cooking energy. This trend is also reflected in the population with secondary education whereby 25 households used LPG as the

primary source while in the same category 39 households used LPG and supplemented with other types of fuel, and 10 households used other sources of fuel. While primary level 9 households used LPG as the main source of fuel, 14 households supplemented with other fuels and 5 households used other fuel. Under no formal education, 8 households utilized LPG, and 10 households used LPG together with other fuels, while 2 households did not use LPG but instead used other sources of energy.

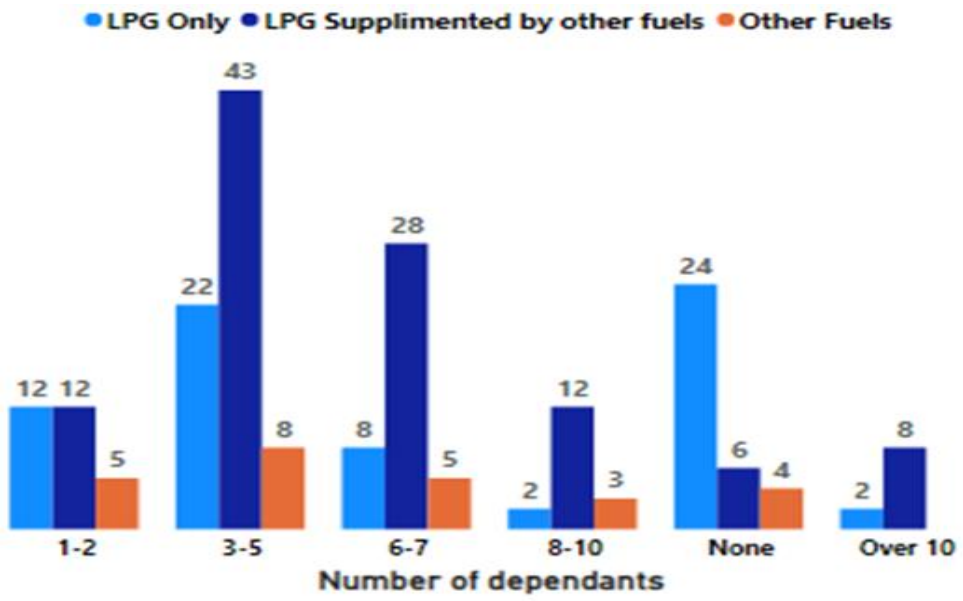

FIGURE 10: NUMBER OF DEPENDENTS

After the re-introduction of 16% VAT on LPG, most households with no dependents continued using LPG only as their source of cooking fuel. Households with fewer dependents moderately used LPG but opted to supplement LPG with other fuels. Households with many dependents i.e., above 6-7 dependents used less LPG (8 households) but 28 households supplemented LPG with other sources of fuel. This was attributed to the cost of fuel and cooking in large quantities for the large family size hence opting to use other fuels than LPG. This is shown in figure 10.

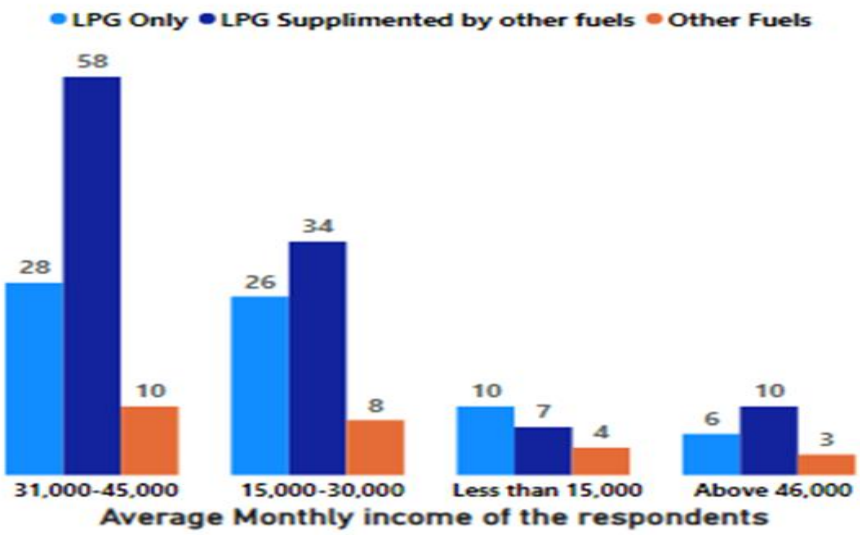

FIGURE 11: AVERAGE MONTHLY INCOME

From the study results in figure 11, most of the population had an average monthly income between KShs. 31,000 and KShs. 45,000, which was the highest earning level, where only 28 households utilized LPG while 58 households used LPG and other fuels, and 10 households earning the same salary did not use LPG but utilized other sources of cooking fuel. This was attributed to the high expenditure rate in the households thus opting for cheap cooking fuel. In category 2 where the income rate was between 15,000- 30,000, the total households were 68 and from the 68 households, 26 households' primary source of fuel was LPG while 34 households combined LPG fuel with other types of cooking fuel and 8 households didn't use LPG but consumed other types of cooking fuel. In the 3 categories of income of less than 15,000 the total households were 21 and from these 21 households, 10 households used LPG, despite the increase in prices because they did less cooking and hence consumed less cooking fuel. While those earning above 46,000 were only 19 households, from these 19 households, 6 exclusively utilized LPG, while 10 households utilized LPG also supplemented with other fuels, and the remaining 3 households did not use LPG as their source of cooking fuel but instead used other sources of cooking fuels.

TABLE 4.1.3: REASON FOR CHOICE OF THE FUEL

Reason for the choice of fuels		
Reason	*Frequency*	*Proportion*
Cost	85	42%
Accessibility	52	25%
Safety/Health	50	25%
Availability	17	8%
Sample Size	204	

From the study results in table 4.1.3, 85 respondents (42%) indicated that they chose the fuel based on its cost. 25% of the population under study stated that they chose the fuels based on accessibility, safety, and health. Only 8% of the respondents attributed their choice of fuel to availability.

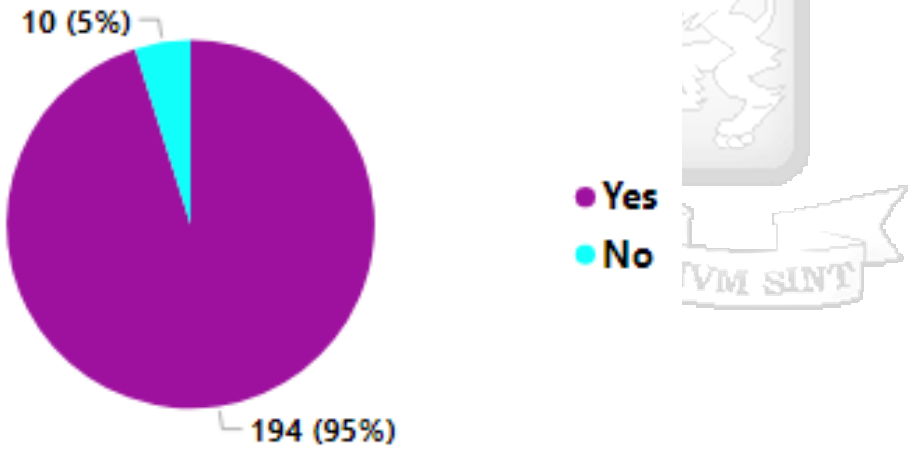

FIGURE 12: PREVIOUS EXPERIENCE WITH LPG

194 of the total 204 households (95%) indicated that they had used LPG before the time of study while only 10 households out of the total 204 (5%) indicated that they had no previous experience with LPG. This is shown in figure 12.

4.2: The outcome of the re-introduction of 16% VAT on LPG in LMI Households

The study sought to determine the outcome of the re-introduction of 16% VAT on LPG in the low- and middle-income population: a case study in Pipeline and Fedha in Nairobi. The study wanted to establish from the respondents whether there was a change in the use of LPG after the re-introduction of 16% VAT and whether there were households who supplemented the fuel with other fuels or switched from LPG to other sources of fuel.

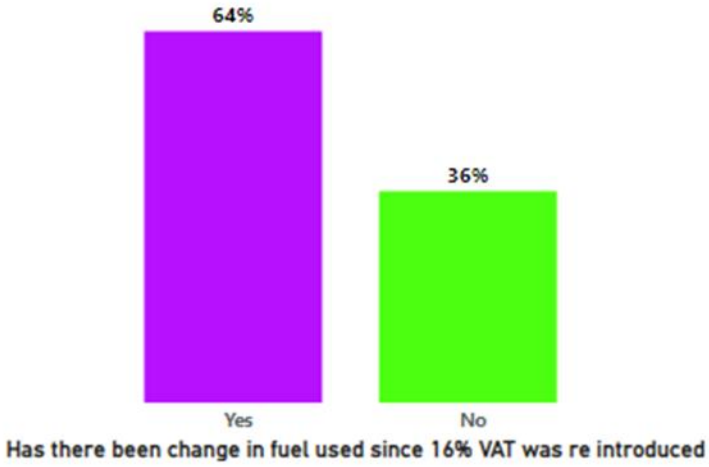

FIGURE 13: CHANGE IN USE OF LPG

When the VAT was re-introduced based on figure 13, 64% indicated they changed from LPG, while 36 % of the total sample indicated did not change from LPG. This indicates that the re-introduction of 16% of LPG led to most respondents (64%) switching from LPG. The study results are in Table 4.2.1. Shows that after the re-introduction of 16% VAT on LPG, most of the population under study (64%) opted to change from LPG by either supplementing or substituting LPG with other fuels while 36% did not change from LPG. In addition, in Table 4.2.1 the other types of fuels utilized were, 54% charcoal, 30% ethanol, 13% kerosene, and 3% firewood.

Other Fuels Used apart from LPG		
Fuel	*Frequency*	*Proportion*
Charcoal	77	54%
Ethanol	43	30%
Kerosene	19	13%
Wood	3	3%
Sample Size	142	

TABLE 4.2.1: SUPPLEMENTING LPG WITH OTHER FUELS

4.3: Options /choices of fuel households utilized after the re-introduction of 16% VAT on LPG in Nairobi

The study's second objective was to determine the fuel choices utilized after the re-introduction of 16% VAT on LPG in low- and middle-income populations in Nairobi.

TABLE 4.3.1: ALTERNATIVE FUEL AFTER RE-INTRODUCTION OF 16% VAT ON LPG

Fuels the consumer moved to, from LPG		
Fuel	*Frequency*	*Proportion*
Did Not Change from LPG	69	34%
Charcoal	67	33%
Ethanol	38	19%
Kerosene	26	13%
Firewood	4	2%
Sample Size	204	

The study findings in table 4.3.1 indicate that after the re-introduction of 16% VAT on LPG, most people opted to supplement LPG with other fuels or shifted to other fuels. The switch to other fuels is shown in table 4.3.1 whereby 33% opted for charcoal, 19% opted for ethanol, and 13% opted for kerosene while only 4% used firewood as a source of fuel. This finding confirms that 34% continued using LPG while 67 % of the total population of 204 switched to other sources of fuel.

4.4: Drivers of fuel choices among LMI households in Nairobi

The third objective of the study was to establish the drivers of fuel choices among the low- and middle-income households in Nairobi. The study sought to know from respondents the reasons for the choices of the fuel they use in their households. In addition, the study sought to observe the trends in fuel consumption of the respondents based on age group, their average monthly income, level of education, and households' number of dependents, all of these are attributed to be drivers of LPG. The feedback on the perception of LPG uptake was captured as indicated in Table 4.4.1 and figure 14. The impacts of the alternative fuels on the respondents were also assessed.

Table 4.4.1 Perception of LPG uptake

Perception	Frequency	Percentage
Convenience	69	34%
Cleanness	47	23%
Health	31	15%
Safety	22	11%
Accessibility	18	9%
Affordability	16	8%

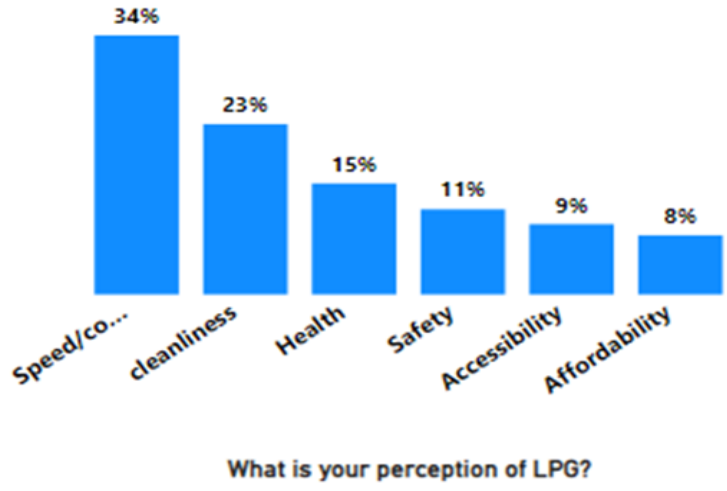

FIGURE 14: PERCEPTION OF LPG

The population perceived LPG fuel as follows: (34%) indicated that LPG is a convenient fuel, 23% indicated that the fuel is clean, 15% indicated that it promoted good healthy, 11% indicated that the fuel is safe, 9% indicated that the fuel is easily accessible while 8% indicated that the fuel is affordable. Affordability was rated the lowest with 8 % this was attributed to the increased cost of the LPG after the VAT was re-introduced therefore affecting the buying power for most households thus supplementing or switching to alternative fuels as indicated in table 4.2.1 and table 4.3.1 respectively.

TABLE 4.4.1: IMPACT OF CHANGING FROM LPG

Impact of changing from LPG to new fuel		
Perception	*Frequency*	*Proportion*
Decreased Expenditure	94	46%
Did not move to a new fuel	65	32%
Other reasons	24	12%
Improved Health	9	4%
Clean Environment	5	2%
Increased Expenditure	3	1%
Clean Source of cooking fuel	3	1%
Safety	1	0%
Sample Size	204	

The study results in table 4.4.1 show the perception of respondents about the new choices of fuels. The results indicate that after the re-introduction of 16% VAT on LPG 46% of the population perceived that a change in fuel consumption from LPG would decrease their expenditure on fuel, 46% perceived that there would be improved health, 2% stated that there would be cleaner environment while 12% of the population had other perceptions. Conversely, 1% of the population perceived that the change in fuel consumption from LPG would increase their expenditure on fuel.

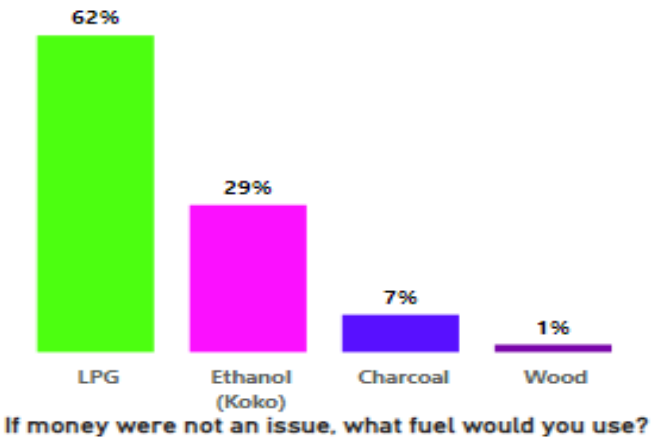

FIGURE 15: PREFERRED FUEL

The study results in figure 15 indicate that even after the re-introduction of 16% VAT on LPG, 62% of the population under study would still prefer LPG as the best source of fuel if the cost would not be an issue. While 29% of the population would prefer ethanol, 7% would prefer charcoal while 1% would prefer firewood. The result of 62% preference for LPG if only cost would not be an issue, translates to a low affordability level of 8% in fig. 4.4.1.

4.5: Summary of the chapter

In this chapter, the outcome of the re-introduction of 16% VAT on LPG, the options /choices of fuel households utilized after the re-introduction of 16% VAT on LPG, and the drivers of fuel choices among households in Nairobi were determined. The study findings from the qualitative study indicated that the re-introduction of 16% VAT on LPG led to an increase in fuel cost, leading to the population opting to supplement or completely change to other fuel sources. The study established that the main driver of fuel consumption is the cost/affordability of cooking fuel. The study also established that the population prefers LPG as the best source of cooking fuel if the cost would not be an issue, because they perceived it to be clean, convenient, and offers good health because of negligible emission of particulate matter and black carbon.

CHAPTER FIVE

DISCUSSION, CONCLUSION, AND RECOMMENDATION

5.1: Introduction

This chapter outlines the summary of the study, discussion of findings, and conclusion, further, it gives recommendations based on the study problem statement, limitations encountered during research, and suggested areas for further research.

5.2: Summary of the findings

The study aims to promote the use of clean cooking fuel and more so LPG, through recommendations on zero-rating of the LPG from the current 16% VAT rate on LPG, to enable affordability among the low- and middle-income households hence improving health, climate, and environmental and socioeconomic factors. The study is anchored on two theories; the First one, is the Theory of change which is concerned with interventions that are expected to lead to specific development change, consequently promoting desired change. The second theory; is the Lay logic model for the scale-up of clean cooking fuel, this theory highlights the enablers/drivers and barriers to the uptake of clean cooking fuel. It focuses on five key domains. The study explored the user perspective, therefore, the key areas of interest in the Lay model were, enabling environment, factors influencing consumer demand, and user and community needs and their perceptions.

The study adopted the positivism paradigm. The positivism paradigm believes knowledge should be objective and free from any bias often associated with the researcher's beliefs or values. The purpose was to obtain in-depth insights into the main factors hindering LPG uptake. The study employed a descriptive positivism design to give enriched and in-depth information on the study subject in its natural setup. A qualitative approach was utilized, and a survey method to obtain a holistic understanding by engaging with the research participants in conversations thus getting their views on the issues of LPG uptake and the re-introduction of the 16% VAT.

The population of interest was low-middle income households residing at Pipeline and Fedha estates in Embakasi south, Nairobi County. The justification for selecting urban areas as opposed to rural areas as the appropriate study site was due to, urban areas are presumed to have a high uptake of clean cooking fuel unlike rural areas, so it was deemed necessary to establish how the

effect of 16% VAT on LPG affected the uptake. The targeted sample size was 247 households but managed to get a sample size of 204 households this translated to a study response rate of 82.6% of the targeted population thus meeting the acceptable threshold.

The data collected was uploaded on Google data sheets. The R software was used for the analysis of this qualitative data. The populated data in Google spreadsheets were imported to Excel files and the raw data was analyzed using R. The data was categorized based on similarities between elements under research. This involved the use of R in statistical analysis whereby it computed frequencies and proportions in figures, tables, and Pie charts. A pilot study of 25 households was undertaken to validate the research tool.

5.3: Discussion of findings

The study explored consumer perspectives mainly on the following aspects: Social demographic: the following features were discussed i.e., gender, Age, Education, and dependents. The option of other cooking fuel after the change of cost is a driver of the LPG uptake. The model by Rosenthal et al., 2018 (enabled an understanding of the barriers and facilitators of scaling up LPG from a consumer perspective.

The study findings are consistent with the previous studies conducted in Ghana, Cameroon, Tanzania, India, and Peru on clean cooking fuel adoption. Changes in value-added tax affected the uptake of LPG, with the re-introduction of 16% VAT on LPG resulting in increased prices of LPG hence affecting the affordability level, which prompted the LMI households to revert to polluting fuels as their prices, were conversely affordable.

5.3.1: Gender

Based on the study findings, the study results in figure 6, indicate that most of the respondents were male (53%) compared to the female respondents who were 47%. Men are considered the head of households, supporting financial household expenditures while women depend on support from the head of household, therefore, men are inclined in deciding on which fuel to adopt due to many factors such as cost, availability, and economic type of fuel, therefore, Mostly it is the women who inform on the type of fuel to utilize because they are the users and they stand in a better

position selecting the type of cooking fuel to adopt too, previous studies by Pope et al 2018 and Stanistreet et al 2019 concur with this finding.

5.3.2: Age

The study findings in table 4.1.2 indicated that most of the respondents were aged between 36-45 years (38%). On the other hand, only 6% of the respondents were above 66 years. The results show that the population was mainly young and middle-aged respondents. Figure 7 demonstrates that LPG uptake was high among the ages between 25-35 years while at the age of 36 to 45 there is a high level of supplementing the LPG with other fuels.

The respondents from the study age group (25-35) were perceived to be consuming clean cooking fuel. These individuals had a likelihood of using clean cooking fuel more because they are open to new technological devices that enable them to carry out activities efficiently and fast thus settling on clean cooking fuel (LPG). While the older counterparts are embedded in the uptake of traditional fuels due to beliefs that traditional methods of cooking, improve the taste of food (Karanja et al., 2020). In addition, the older population is deemed to have a higher burden due to the number of dependents, which calls for more responsibility hence the need to supplement sources of cooking fuels that are presumed to be less costly to accommodate other household expenditures. This confirms what previous studies had established on young people embracing technologies (Kumar et al., 2017b).,(Pye et al., 2020a) hence opting to adopt clean cooking fuel

5.3.3: Education

The education level of respondents is a crucial factor in clean fuel uptake. Based on the findings it is evident that University and tertiary levels of education consumed LPG as their primary fuel. People with a high level of education prefer using LPG as their primary source of fuel because it is perceived to be a healthy practice, and convenient (Gould et al., 2020). Gould et. al, agree that education is a strong predictor of LPG uptake and in addition, most educated people believe that LPG promotes good health.

Therefore, other studies have also confirmed Education as a driving force for choices of fuel uptake as a result of working from an informed perspective (Gould et al., 2020b) (Shupler et al., 2022), & (Rosenthal et al., 2018b).

5.3.4: Size of the family (Dependents)

After the re-introduction of 16% VAT on LPG, most households with no dependents still used LPG only as their source of fuel. They consumed less cooking fuel because the number of times they cook is fewer. However, households with dependents opted to supplement LPG with other fuels. This is shown in figure 4.2.1. Household size: It is thought households with many occupants equal sufficient labor therefore they are likely to get alternative cooking fuels (Kumar et al., 2017c). Based on the study findings households with more than five dependents were fuel stacking, this is a confirmation that several pieces of literature agree (Kypridemos et al., 2020) (Hsu et al., 2019) (Ochieng et al., 2020)&(Pye et al., 2020a) with an issue concerning fuel stacking, also there are varied reasons for fuel stacking, this includes the price of fuel, availability, foods that require long cooking duration

5.3.5: Social economic characteristics

5.3.5.1: Average income level

The study sort to find the average monthly income of the respondents and how it influenced the LPG uptake, based on the findings it was established that with high income of between KSHs 31,000 to KSHs 45,000 resulted in the adoption of LPG as their main source of cooking. While in the same category, 58 households supplemented LPG with other sources of fuel. (Puzzolo et al., 2013), (Ronzi et al., 2019)&(Rosenthal et al., 2018b) these papers are in strong agreement with the study findings on high income leads to the high uptake of clean cooking fuel.

5.3.6: Previous experience before the reintroduction of 16 % VAT on LPG

194 (95%) indicated that they had used LPG before the time of study while only 10 households which translates to 5% indicated that they had no previous experience with LPG. Before the re-introduction of the VAT, LPG was affordable hence most respondents were able to afford thus, high uptake. It is deduced from the study findings, that the re-introduction of 16 % VAT interfered with the uptake of LPG due to an increase in prices, most households reverted to biomass fuels as they considered the prices better than LPG, this finding is consistent with a study conducted by Abbafati et, al 2020 on the negative effects of re-introduction of the VAT thus exacerbating inequality in clean cooking fuel uptake. This has led to households reverting to biomass fuel.

5.3.7 Outcome of the reintroduction of 16% VAT on LPG

The study sought to determine the effects of the re-introduction of 16% VAT on LPG in the low- and middle-income population and establish whether there was a change in the use of LPG after the re-introduction and whether there were those who switched from LPG fuel to other fuels. The reinstatement of 16% VAT, led to a change in the uptake of LPG. From the data analysis, 64% of the respondents indicated they had changed the source of cooking fuel, while 36% of the respondents indicated there was no change in the source of cooking fuel as they continued using LPG. 64 % of the respondents who changed the source of cooking fuel either substituted or supplemented with other fuels, this is confirmation from the literature on the drivers and barriers of uptake of clean cooking fuel by Rosenthal et al, on the Lay model factors that are barriers to uptake of LPG and concur with the study conceptual framework whereby these factors play a critical role in the acceleration of clean cooking fuel, for instance, the affordability. When the VAT rate was zero-rated, the study established high uptake of LPG because it was affordable, but the re-introduction of VAT led to a decline in of uptake LPG, this is consistent with research conducted by Abbafati et al 2021.

Little information is available to the consumer on Ethanol as a source of cooking fuel. Therefore, awareness and campaigns on ethanol are necessary so that to relay the information to the consumers of the product. The study finding is congruent with Dalberg et al 2018, on LPG and Bioethanol have equivalent benefits although the cost of Bioethanol is inflated due to high import tariffs and VAT, which is 16% VAT, and import tariff of 25% (Dalberg, 2018). This translates to the high cost of Bioethanol. If the Government can be able to eliminate the import tariff and VAT on Bioethanol and VAT on LPG, then this would provide a common playing field with Biomass fuels that are considered to have fair tariffs hence resulting in reasonable prices (Dalberg, 2019). Table 4.2.1 indicated that Kerosene had an uptake of 13% of the sample size of 142. Kerosene has a duty tariff of 9%, which translates to a high price per Litre of fuel, and therefore compared to charcoal it is less preferred.

The government raised the duty tariff for Kerosene to discourage its uptake due to Diesel adulteration, additionally, it contributes negatively to the atmosphere through the production of Household air pollution, which causes cardiovascular diseases and lung cancer among others thus causing 4.3 million premature deaths annually, this is consistent with Karanja et al 2019 and (Schraufnagel et al., 2019). The reintroduction of VAT affected the price of LPG, therefore,

making people shift to other sources of cooking fuel such as charcoal, ethanol, kerosene, and firewood which have negative effects on health, environment, and climate (Rosenthal et al., 2018), (Kumar et al., 2017b). Furthermore, the reinstatement of LPG 16% VAT has caused people to switch from clean cooking fuels to polluting fuels thus causing a decline in the progress made when VAT was zero-rated, this corroborates the study by (Abbafati et al., 2020).

5.3.8: Options/Choices of fuel household utilized after the re-introduction of 16% VAT on LPG

The findings indicate that after the reintroduction of 16% VAT of LPG most people opted to use other fuels such as Charcoal 33%, Ethanol 19%, Kerosene 13%, and firewood 2 %. According to the findings, the choice of fuel was determined by the cost that increased, attributed to the 16% VAT reinstatement, therefore, resulting in people opting for other types of fuels majorly the biomass fuels such as charcoal and kerosene. (Yadav et al., 2021). There was a significant association between the reintroduction of 16% VAT on LPG and the choice of fuel in the targeted population. This confirms previous studies by Abbafati et al, &Pye et al 2020, which emphasized the need to accelerate the adoption of clean cooking fuel by addressing the policy of clean cooking fuel.

Findings are consistent with previous studies on the health effects, environmental, climate, and social effects of the uptake of polluting fuels. (Shupler et al., 2022), (Owen & Vianello, 2016),(Asante et al., 2018)& (Kimemia & Annegarn, 2016).The Finding on Fuel stacking as the use of multiple sources of cooking fuel, in the study, has featured on several occasions, especially after there was an increase in the cost of LPG more so with the reinstatement of 16% VAT, which forced most households to look for an alternative to cushion on the cost of LPG. Therefore, most households reverted to using charcoal, ethanol, kerosene, and firewood in combination with LPG. According to Ochieng et al., fuel stacking is a common practice that has its benefits especially if clean types of fuel are the only ones being utilized in the stacking as this will enable the users to achieve several functions through stacking, but that is not the case since most traditional fuels are commonly utilized due to their low cost compared to clean fuels, thus inhibits the achievement of uptake of clean cooking fuel and also cause delays of attaining the universal target of use of clean energy (Ochieng et al., 2020), (Nilsson et al., 2021),(Yadav et al., 2021).

5.3.9: Drivers of fuel choices among LMI household

The study focused on consumer demand. The Lay Model has five domains but since the study was on consumer demand, concentrated on three driving factors as follows; Enabling environment, factors influencing consumer demand, and user and community needs and perception. The demographic factors (e.g., gender, age, education, and size of household) and the perception aspect such as convenience, cleanliness, availability, and affordability are discussed in the lay model. Affordability in the finding was a crucial barrier to the uptake of clean cooking fuel and sustainability. This is similar to other studies conducted by (Thoday et al., 2018), (Puzzolo et al., 2013) & (and Ronzi et al., 2019). The cost can only be made equitable through the use of microloan schemes Puzzolo et al 2012 agree with microfinancing the resource-poor and issuing startup kits to facilitate the uptake of clean cooking fuel. Also pay as your cook smart meter is offered to ensure inclusivity in the adoption of clean cooking methods that shall result in improved health, climate mitigation, and preservation of the environment.

5.3.10: Perception

The findings from the study depicted affordability as a hindrance to LPG uptake. This was occasioned by the increase in the cost of the LPG after the reimposition of 16 % VAT. The increase in cost critically affected the low-middle income households as their income levels are also low therefore forcing them to opt for polluting fuels to cater for other expenses in the households. The findings from the association between income and cost in the adoption of LPG is a confirmation by Abbafati et al and Kumar et al 2020 among other studies.

The 16% has exacerbated the inequalities of clean cooking fuel uptake in LMI. The government needs to address the issue of clean cooking policies if we are to attain 100% uptake of clean cooking fuel by 2028 and in addition, protect the environment, and mitigate climate changes which have become a threat to many countries, for instance in Kenya currently there is food insecurity as a result of drought in most parts of the country. Create awareness of the effect of Household Air Pollution that is causing disease burden and deaths to the population and lastly preservation of the biodiversity.

5.4 Conclusion

Theory of Change and Lay Logic Model was adopted; In the theory of change, a set of interventions were utilized in solving problems. While the Lay Logical model enforced the need to address facilitators and barriers of LPG uptake focused mainly on policies (taxes) and consumers' perceptions The study was consumer perspective oriented.

The study findings from the analysis of the qualitative data indicated that the re-introduction of a 16% standard rate of VAT on LPG increased the cost of fuel which led to the population opting to supplement or completely switch to other sources of fuel.

following the enactment of the Finance act 2021, reintroducing the LPG VAT to 16 %, led to increased price for LPG, the difference was significant, this resulted in most households opting for other type of cooking fuel which fair had prices. Therefore, it is evident that a16% VAT had negative impact on the prices thus affecting the low-middle income households. It is crucial therefore to consider the position of the study of zero rating LPG to increase the uptake rate, thus improve in health, environment and mitigate on climate change.

5.5 Recommendation

The findings from the study have important policy implications, which need to be incorporated into the Energy policy on clean cooking fuel. The following are the policy actions:

The Government should reconsider zero-rating LPG; this will increase affordability, and efficiency, and improve health, livelihood, and environmental and social conditions thus enabling the attainment of sustainable development goals by 2030.

Fuel stacking is a common practice in most households; this calls for acceptance of the practice but encourages stacking using clean cooking fuel such as bioethanol to prevent household Air pollution.

The Government should offer VAT exemption on clean cooking fuels and import duty exemption on denatured bio-ethanol cooking fuel.

5.6 Limitations of the study

The study did not capture the targeted population of 247 respondents due to financial and time constraints and only interviewed 204 respondents that is equivalent to an 83% response rate.

5.7 Suggestions for further research

The Government launched a Community Health Volunteers (CHVs) manual on Household Air Pollution (HAP) in November 2021. The manual is expected to equip CHVs with knowledge and skills in understanding and strengthening the integration of household air pollution in health policies and strategies. Therefore, further research is required to enhance the strategy of integration and aggressive implementation of the guide to reduce the rate of morbidity and mortality burden because of HAP.

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APPENDICES

Appendix I: Informed Consent to participate in Survey

This is purely an academic questionnaire that is intended in collecting crucial data and information regarding challenges faced by households on clean cooking fuel. Your participation in this study shall assist in highlighting these key challenges and contribute immensely to finding practical solutions to various challenges facing the sector.

Potential benefits and risks

There is no material gift or direct benefit in participating in the study. However, the information generated from this study will be beneficial in developing interventions that will help improve on scale-up of clean cooking energy thus, mitigating climate change improvement of well-being quality of life, and achieving sustainable development goals. There is no anticipated harm or risk to you or your family by participating in this study. As stated earlier, the interview will take about 20 minutes, and this may inconvenience you due to a loss of time. In this regard, the interview will be brief. If some questions may cause discomfort, you can decline to answer them.

Care and protection of research participants

Participation in this study is voluntary and you may decline to respond to any question that you feel unsuitable to you. Withdrawal from the interview at any time you wish to is acceptable without fear of victimization. You also have the right to ask any questions that you may have regarding this study and be answered in full. You will not be required to bear any financial cost in this research. Likewise, we will not pay you money for participating in the study and as stated earlier, there is no anticipated harm or risk to your family and you by participating in this study. Information collected will only be used for academic purposes. However, in case of any publications made from the findings of this research, organizations will be acknowledged.

Privacy, anonymity, and confidentiality

The participant shall not require writing their name, address, or phone number on any part of the questionnaire. Any findings of this research will never be traced back to you. No name will appear or be mentioned during presentations made on the findings regarding this research.

Participant Statement

Therefore, the above statement regarding my involvement in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that the information will be kept in privacy, and I can withdraw from the study at any time. I understand the benefits of the study and that no incentives will be given.

Name …….…….…….

Participants' signature/thumbprint ……. Date ……...

Investigators statement

I, the undersigned, have explained to the participant in the language s/he understands the procedures to be followed in the study and the risks and the benefits involved.

Name

Interviewer……...

Signature or Thumbprint……..… Date……

Appendix II: Questionnaire

Scaling up adoption and sustainability of clean cooking fuel among low- and middle-income households in Nairobi County

Section A; Demographics

1. Which estate do you stay in? *
    - Fedha
    - Pipeline
2. Which age group do you belong to? *
    - 18-25 years
    - 26-35 years
    - 36-45 years
    - 46-65 years
    - 66 and Above years
3. What is your gender? *
    - Male
    - Female
4. What is your education level? *
    - No Formal Education
    - Primary
    - Secondary
    - University/ tertiary
5. What is your primary occupation? *
    - Formal Employment
    - Informal Employment
6. What is your marital status? *
    - Single
    - Married
    - Divorced/Separated
    - Widow/Widower
7. Are you the head of your household? *
    - Yes

- No

8. How many children do you have in your household under 5 years? *
   - None
   - 1-2
   - 3-5
   - Over 5
9. What number of dependents do you have? *
   - None
   - 1-2
   - 3-5
   - 6-7
   - 8-10
   - Over 10
10. What is your average monthly income in Kenya Shillings? *
    - Less than 15,000
    - 15,000-30,000
    - 31,000-45,000
    - Above 46,000

11. Have you ever used a clean source of cooking fuel (LPG)? *
    - Yes
    - NO

12. Has there been any change in cooking fuels used in your household in the recent past after the re-introduction of 16% VAT? *
    - Yes
    - No

SECTION B (other option of cooking fuel resorted to)

13. What type of cooking fuel does your household use? *
    - Charcoal (Jiko)
    - Kerosene (Stove)
    - Firewood
    - Bioethanol
    - LPG (Cooking gas)
    - Others
14. Which of these is the main reason for your choice of cooking fuel? *
    - Cost
    - Financial constraints
    - Safety/ health
    - Accessibility
    - Availability
    - Culture
15. From LPG, to which cooking fuel did you move after the introduction of 16% VAT? *
    - Charcoal
    - Kerosene
    - Ethanol
    - Firewood
    - Did not change
16. What has been the impact of the new fuel? *
    - Increased Expenditures
    - Decreased Expenditure
    - Improved health
    - Clean environment
    - Clean source of cooking fuel
    - Safety
    - I did not move to a new fuel
    - Others
17. Which type of fuel are you supplementing LPG with? *

- Kerosene
- Charcoal
- Ethanol (Koko)
- Biogas
- I only use LPG
- I don't use LPG

SECTION C (Drivers of LPG uptake)

18. If money were not an issue, what fuel would you use? *

- Charcoal
- Wood
- Ethanol (Koko)
- LPG

19. What is your perception of LPG? *

- Safety
- Health
- Speed/convenience
- cleanliness
- Affordability
- Accessibility
- Awareness

Appendix III: introduction letter

Ole Sangale Rd, Madaraka Estate,
P.O Box 59857 00200, Nairobi, Kenya.
Cell: +254 703 414/6/7, Twitter: @SBSKenya
Email: info@sbs.ac.ke or visit **www.sbs.strathmore.edu**

Strathmore UNIVERSITY
BUSINESS SCHOOL

Tuesday, 07 June 2022

To Whom It May Concern,

RE: FACILITATION OF RESEARCH – MARGARET THUMBI

This is to introduce Margaret Thumbi who is a **Master's in Public Policy and Management Program** (MPPM) student at Strathmore University Business School, admission number MPPM 123033/19. As part of our MPPM Program, Margaret is expected to do applied research and undertake a project. This is in partial fulfilment of the requirements of the MPPM course. To this effect, she would like to request for appropriate data from your organization.

Margaret is undertaking a research paper on **" Scaleup Clean Cooking Fuel in Urban and Rural Kenya with Liquified Petroleum Gas and Bioethanol "** The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MPPM Program seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours Faithfully,

Caroline Tiara.
Manager – Graduate Programs.
Strathmore University Business School

Strathmore Business School is a Proud member of:

Association of African Business Schools AABS EFMD AACSB

Appendix IV: Ethical Review Clearance

Final Decision

This is to certify that the application for ethics clearance submitted by:
Principal Investigator: Ms. THUMBI, MARGARET MUTHONI
Reference number: SU-ISERC1422/22
For Study: "SCALING-UP CLEAN COOKING FUEL IN URBAN AND RURAL KENYA WITH LPG AND BIO-ETHANOL"
Was reviewed and received the following status: **"done"**
The SU-ISERC wishes you all the best with this research undertaking.
22 July 2022 11:14:05

Appendix V: Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: **643334**

Date of Issue: **12/May/2022**

RESEARCH LICENSE

This is to Certify that Ms.. Margaret Muthoni Thumbi of Strathmore University, has been licensed to conduct research in Nairobi, Narok on the topic: DRIVERS OF COOKING FUEL CHOICE IN LOW- AND MIDDLE-INCOME HOUSEHOLDS IN RURAL AND URBAN AREAS IN KENYA for the period ending : 12/May/2023.

License No: **NACOSTI/P/22/17421**

643334

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

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