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DRIVERS OF UTILIZATION OF IMPROVED ENERGY SAVING COOKSTOVES PROJECTS IN KENYA: A CASE OF BOMET COUNTY

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Abstract

In the developing world, there have been a number of initiatives aimed at supporting improved wood and charcoal burning cook stoves projects which have health, economic and environmental benefits. Worldwide about half of the populations' energy consumption is dependent on traditional fuel sources including wood, charcoal, coal, and animal dung, along with traditional and inefficient stove technologies. Use of traditional inefficient cooking stoves is largely attributed to indoor air pollution from high level of smoke, deforestation caused by inefficient fuel consumption and climate change. Recent uptake adoption of improved cook stoves is slowly reversing this trend albeit slowly. To this end, understanding drivers of utilization of improved energy saving cook stoves is important. The study was be guided by the following specific objectives: To find out the influence of household characteristics on utilization of energy saving cook stoves; to investigate the influence of level of awareness on utilization of energy saving cook stoves; to examine the influence of quality on utilization of energy saving cook stoves; and to study the influence of cost on utilization of energy saving cook stoves in Kenya. The target population was 5600 households in Bomet County. The study adopted a descriptive survey of by use of a sample size of 100 respondents. A simple random sampling technique method was used and data was collected through the use of questionnaires. The secondary data was obtained from published documents such as journals, periodicals, magazines and reports to supplement the primary data. A pilot study was conducted to pretest the validity and reliability of instruments for data collection. The data was analyzed by use of both qualitative and quantitative methods with the help of Statistical Package for Social Sciences (SPSS) version 21 and excel. The correlation and regression analysis was used to establish the direction and strength of the relationship of the variables at 5% level of significance. The analysis showed that level of awareness had the strongest positive influence on utilization of improved energy saving cook stoves projects (Pearson correlation coefficient =.665 and p-value =0.005). In addition, household characteristics, stove quality and stove cost are positively correlated to effective utilization of improved energy saving cook stoves projects with Pearson correlation coefficient of .600, .587 and .555 with p-values of .008, 0.010 and 0.022 respectively. The study established that level of awareness was the most significant factor. The study recommends for similar studies to be undertaken in other counties in Kenya for generalization of the findings of this study.

Key Words: *Energy Saving, Cooking Stoves, Household Characteristics, Level of Awareness, Stove Quality, Stove Cost.*

INTRODUCTION

The Global Village Energy Partnership (GVEP) defines improved energy saving stoves, (ICS), as a mature energy technology for the efficient conversion of energy from biomass to heat. Efficiency is achieved by the use of an insulating material such as clay. Stove quality is determined in terms of durability, efficiency in fuel use, and safety in terms of emission reduction (Krshisagar and Kalamkar, 2014)

Biomass energy provides 68% of Kenya's national energy requirement and it is expected to remain the source of energy for the foreseeable future (Bielecki and Wingenbach, 2014). The current biomass demand in Kenya is estimated at 40.5 million tonnes against a sustainable supply of 16 million tons (Kamfor, 2002). Biomass energy resources are derived from forests formation such as closed forests, woodlands, bush lands, grasslands, farmlands, plantations and agricultural and industrial residues. The demand for firewood and charcoal in Kenya has continued to rise as the population continues to grow.

The Global Alliance for Clean Cook Stoves (GACC) estimates that up to three billion people in developing countries – nearly half the world's population – cook over open fires and inefficient coal, charcoal and dung-burning cook stoves inside their homes (GACC, 2014). Statistics by World Health Organization (WHO) indicate that two million people globally die each year from respiratory illnesses – pneumonia, chronic lung disease, and cancer – all due to these toxic smoke emissions associated with cook stoves. That means one death every 16 seconds (WHO, 2014).

Inefficient energy saving stoves has far wider impacts on the environment. Due to their large fuel consumption, they encourage deforestation. Overharvesting of fuel wood disrupts wetland ecosystems, contributes to mud-slides and loss of healthy watersheds, and can lead to increased sedimentation in rivers and streams. The result is pressure on regional food security and agricultural productivity. Inefficient cook stoves also lead to emission of green house gases to the atmosphere (Ramsar Livelihoods, 2014).

Despite the efforts and programs put in place to arrest the use of inefficient technologies and/or promote new improved technologies, still there exists a large gap to achieve a sustainable, clean and efficient cooking energy solution. This calls for a well-defined policy for the identification and development of choice of technology to use biomass fuel for cooking with high efficiency and low emission. For these reasons, existing cooking equipment and technology need to be revisited and improved to achieve clean and efficient cooking.

Global Perspective of Improved Energy Saving Stoves

In an effort to reduce fuel consumption and improve indoor air quality, a number of programs have been set up globally. These programs are being conducted all over the world by governments and Non-Governmental Organizations (NGOs) in various countries like China, India, Afghanistan, Mexico, Bangladesh, Guatemala, Mongolia, Nepal, Haiti and Uganda (Troncoso *et al.* 2011, World Bank, 2010, USAID, 2014). The drop in fuel consumption not only helps to decrease deforestation rate, it also helps to improve the economic condition of rural people by reducing their fuel cost which accounts for 36% of their total income. As only women and children are involved in biomass collection, the reduction in fuel consumption also helps them to save time incurred during this tedious process. Improved indoor air quality helps to protect people from chronic respiratory diseases, eye irritation and cardiovascular diseases which are caused due to indoor air pollution.

Kenyan Perspective of Improved Energy Saving Stoves

Kenya is highly dependent on biomass fuel, specifically charcoal and fuel wood. Ninety-five percent of people in rural areas in Kenya (greater than 68% of the national average) rely on firewood for cooking. Each household is estimated to consume 13 kg of wood per day on average (GACC, 2014). Charcoal on the other hand supplies 82% of urban household energy and 34% of rural households. This high demand is a primary driver of reduction in Kenya's forest cover, which now stands at less than 3% of national territory (World Agro forestry Centre, 2014). Other large consumers of biomass are educational and other institutions. Kenya currently has over 70,000 educational institutions. It is estimated that approximately 20,000 of these consume about 270 tons each of wood fuel per year; an estimated 5.4 million tons annually **(**Kamfor, 2000).

The cook stoves traditionally used by Kenyan families are made of three stones overhung by a cooking pot that heats up during wood combustion. The inefficient design of these primitive cook stoves allows both heat and smoke to escape (Ramsar Livelihoods, 2014). Household Air Pollution (HAP) in Kenya contributes to 14,300 premature deaths annually, with women and young children affected disproportionately (Global Alliance for Clean Cook stoves, 2014).

The current penetration of improved charcoal stoves as reported by Muchiri (2008) is estimated at 60% of the rural households and over 80% for the urban households (UNEP 2006). The level of penetration of improved efficient woodstoves for the rural households is still below 5%, yet there is enormous potential (Muchiri, 2008).The adoption of these technologies has been slow and unevenly extended as there are still many households which are unaware of the technologies, yet the technologies were initiated over 30 years ago. Thus the objective of the Kenya government to reduce demand on wood fuel, conserve the forests and thus mitigate against increase in green house gases (GHG) and reduce indoor air pollution is yet to be achieved.

Statement of the Problem

According to International Energy Agency (IEA 2010), globally it is estimated that about 1.5 million pre mature deaths each year are associated with the indoor air pollution from the use of biomass in inefficient cook stoves, which is more deaths than malaria, almost as equivalent as tuberculosis and almost half as many as HIV/AIDS. Energy supply in developing countries is primarily dependent upon traditional sources including wood, charcoal, agricultural residuals and animal wastes (IEA, 2010). About fifty-six percent of the population in developing countries depends on traditional biomass and coal and cook with open three-stone fire which is associated with high level of indoor air pollution; to which 38 percent of annual deaths is attributed (WHO, 2009). Like many other sub-Saharan countries, Kenya's energy supply is heavily dependent on solid fuel that accounts for above 85% (NCCSPE, 2011). This heavy dependence and inefficient utilization of biomass resources is partly attributed to the depletion of the country's forest resources (Gebreegziabher *et al*, 2010) and 4.9% of the Kenya's burden of disease (Damte and Koch, 2011).

Since 1970s, many improved energy saving biomass cook stove projects have been set and promoted by governments, donors, and Non-Governmental Organizations in the developing countries (Puzzolo *et al*, 2013; Gifford, 2010; Makame, 2007). Given the expected household benefits, research to examine how household characteristics, stove cost, quality and level of awareness on utilization of improved cook stoves at the household level has become more urgent and deserves attention (Mobarak et al, 2012; Damte and Koch, 2011). Understanding the factors that influence a household's decision to utilize the

improved stoves is essential element for the realization of economic, social, environmental, and health benefits of improved cook stoves and for the success of intervention projects (Lamarre-Vincent, 2011). This study therefore sought to fill this gap.

Objectives of the Study

General Objective

The general objective of the study was to determine the drivers of utilization of improved energy saving stoves in Kenya

Specific objectives

The specific objectives of the study were to;

i. Determine how household characteristics influence utilization of improved energy saving stoves projects in Kenya
ii. Establish how level of awareness influence utilization of improved energy saving stoves projects in Kenya
iii. Identify how stove quality influence utilization of improved energy saving stoves projects in Kenya
iv. Find out how stove cost affect utilization of improved energy saving stoves projects in Kenya.

Scope of the Study

This study was undertaken in Bomet County. The county borders a long stretch of the Mau forest which is a natural forest and home to different species of animals and plants. However, the forest is facing extensive destruction due to encroachment. Bomet County is also prone to abject poverty mainly attributed to lack of employment. As a result, majority of the population, especially youths have resorted to wood fuel and charcoal burning businesses for their survival. The government, Non Governmental Organizations (NGOs) and financial institutions have initiated financial assistance to the youths in the county to establish improved energy saving stoves projects to generate income. Therefore this location was ideal for this kind of study. The study was based on a survey of 5600 households that have been using energy saving stoves for more than 2 years. The study focused on the drivers of utilization of improved energy saving stoves in Bomet County. The study was also limited to study variables which included; technology, level of awareness, quality and cost on utilization of utilization of energy saving stoves.

Significance of the Study

The findings of this study will enable the government to identify the areas to focus on, in formulation of policies relating to training and regulation on cook stove quality. It will also inform the government on how to support increase in utilization of improved cook stoves through subsidies and sensitization. The findings will also benefit research institutes by adding to the existing body of knowledge on improved cook stoves. It will extend existing literature and open up areas for further research; and act as a reference point for academic researches seeking to further the available knowledge on improved cook stoves. It will enable them identify areas to focus on, in the research, in terms of the technology and skills required in order to ensure that the quality of cook stoves manufactured is maintained. These findings will then be availed to the government for enforcement. This study will inform international development organizations on the current status of the quality of cook stoves manufactured, and the areas to focus on, in their activities, for example, training the local artisans on the appropriate technologies, or facilitating the appropriate manufacturing processes through funding and capacity building. It will also enable them identify means of supporting the cook stove projects to ensure increased utilization of cook stoves.

The study will benefit the stove manufacturers in creating awareness on the stove standards that they need to meet during manufacture. It will also

create awareness on the factors affecting their production activities, so that they may best be able to deal with these factors, in order to optimize their production. This study will benefit the consumers by informing them on the importance of using improved cook stoves, and the information collected will ensure their needs are better understood, which will result in increased utilization of the cook stoves.

LITERATURE REVIEW

This chapter reviews previous studies relevant to the researcher's topic of study. The review focuses on the objectives set out in chapter one. By exploring these areas of literature, a significant contribution is made to this research. The first section of the review focuses on the importance of theories in relation to the drivers of utilization of energy saving stoves projects. In the second section, conceptual framework of the study is stipulated. The last section provides the empirical work on energy saving stoves followed by the research gap and summary of the chapter.

Theoretical Framework

This section examines relevant theories to the study variables. According to Kombo and Tromp (2009), a theoretical framework is a collection of interrelated ideas based on theories. It is a reasoned set of prepositions derived from and supported by data or evidence and it accounts for or explains phenomena and attempts to clarify why things are the way they are based on theories. A theory is defined as a reasoned statement which is supported by evidence, meant to explain phenomena (Kombo and Tromp, 2006). It is a systematic explanation of the relationship among phenomena. Mugenda (2008) defines a theory as a framework of explaining phenomena by stating constructs and the laws that inter-relate these constructs to each other.

The Diffusion of Innovations (DoI) Theory

Diffusion of innovation theory was advanced by Everret Rogers as a general diffusion model in 1962; although research in the area was initiated earlier in 1940s and 50s by different researchers. Diffusion theory provides tools, both quantitative and qualitative for assessing the likely rate of diffusion of a technology and additionally identifies numerous factors that facilitate or hinder technology adoption and implementation.

According to Rogers, innovations posses certain characteristics that determine the ultimate rate, and pattern of adoption. These characteristics include relative advantage, compatibility, complexity, trial ability and observeability. Some potential adopters are more innovative than others and can be identified as such by their personal characteristics; cosmopolitanism, level of education and so on. The adoption decision unfolds as a series of stages; from knowledge of the innovation through persuasion, decision, implementation and confirmation. The actions of certain kinds of individuals, opinion leaders and change agents can accelerate adoption. The diffusion process usually starts out among pioneering adopters, reaches "take-off" as a growing community of adopters is established and the effect of kick in, and levels off as the population of potential adopters become exhausted. Innovators are usually a tiny number of visionary, imaginative and creative individuals who spent great time and energy on developing new ideas and gadgets. Early adopters on the other hand are those on the lookout for strategic leap forward in their lives or businesses and are quick to make connections between clever innovators and their personal needs. Their natural desire to be trend setters causes the "take-off" of an innovation. They become an independent test bed, ironing out the chinks and reinventing the innovation to suit mainstream needs.

Early majorities are pragmatists, comfortable with moderately progressive ideas and will not act

without solid proof of benefits. They are cost sensitive and risk averse and always looking for simple, proven, better ways of doing what they already do and that they require guaranteed off-the-shelf performance, minimum disruption, minimum commitment of time, minimum learning and either cost neutrality or rapid payback periods. Late majority are conservative pragmatists who hate risk and are uncomfortable with new ideas. Their only driver is the fear of not fitting in and hence tries to follow mainstream fashions and established standards. Meanwhile laggards hold out to the bitter end; they see a high risk in adopting a particular product or behavior.

This theory holds even in societies where the technology originates. Rogers demonstrates adoption resistance using the example of Captain Lancaster's discovery and use of lemon juice for scurvy prevention in sailing ships in 1601. But in as much as the captain's discovery that lemon juice lowered the mortality rate of sailors, it was not until 1747, almost one and a half century latter, that the British navy finally adopted the practice.

However, not all innovations in all communities take long periods of time to be adopted. Some innovations diffuse from first introduction and are widely used in a few years, at least in some societies; depending on how compatible the innovations is with existing societal norms and the benefits and ease with which it can be adopted. A case in question is the fast adoption of the internet by the Americans. Rogers (2003) found that 71% of adult Americans had adopted the internet in just a dozen years (1989-2002). Mobile phones and their associated technologies like money transfer technology have also diffused very rapidly in developing countries where they have overtaken many older technologies like money orders, fax, and landlines. The theory provides a broad framework for the study of organizational factors affecting the adoption of business tools, including e-business and e-technologies (Minish-Majanja and Kiplang'at, 2005). It has also been applied in a wide variety of situations that involve the uptake of innovations, including the use of ICTs (Harris, 2002). The quick pace at which mobile phone technologies was adopted in Kenya meets three of the five criteria of diffusion of innovations theory, namely relative advantage, compatibility and complexity. With respect to relative advantage; mobile phones have delivered more advantages than other methods of communication in receiving and sending information from and to suppliers, customers, friends and relatives. On complexity; mobile phones in comparison to computers do not require high literacy levels and are also readily available due to their relative affordability. Kuuya (2010) found in his research in the informal sector in Kenya, that cost, societal norms and the environment as major considerations when adopting technology in the informal sector. In the context of improved cook stoves, the compatibility of the improved cook stoves has helped it to diffuse rapidly in Kenyan society. Furthermore, the energy saving has fitted well in Africa's energy and environmental culture. This theory relates to the influence of technology on utilization of improved cook stoves

Technology Acceptance Model

The Technology Acceptance Model (TAM) was originally proposed by Davies in 1986. The model is originally designed to predict user's acceptance of Information Technology and usage in an organizational context. TAM focuses on the attitude explanations of intention to use a specific technology or service. It has become a widely applied model for user acceptance and usage. There are a number of meta-analyses on the TAM that have demonstrated that it is a valid, robust and powerful model for predicting user acceptance (Bertrand and Bouchard, 2008).

The TAM model which deals with perceptions as opposed to real usage, suggests that when users are presented with a new technology, two important factors influence their decision about how and when they will use it (Davis, 1989). These key factors are perceived usefulness, perceived ease of use and attitude towards using actual

system. Perceived usefulness (PU) was defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease-of-use (PEoU) is defined as the degree to which a person believes that using a particular system would be free from effort. This theory relates to the influence of level of awareness on utilization of cook stoves

Schumpeter's theory

Schumpeter theory stipulates that innovation is fundamental to the entrepreneurial process of wealth creation and entrepreneurs as individuals who sought monopolies based on some innovation (Wickman, 2006). According to Schumpeter's theory the entrepreneurs both create and commercially exploit new knowledge which hitherto did not exist in the economic system and that have reaching effects throughout the whole economy. Such innovations also challenge the existing order (Glancey and McQuaid, 2000).

Entrepreneurs must do something new or there is no point in their entering a market. To Schumpeter, innovation encompasses any new way of doing something so that value is created. Innovation can also mean a new product or service, but can also include a new way of delivering an existing product or service so that it is cheaper or more convenient for the user (Wickman, 2006). Improved energy saving cook stoves providers saw an opportunity in the rural population and went on to exploit this opportunity by creating agencies down to the village level. This gave the manufacturers a chance to create new possibilities, the chance to offer the market a fresher, more affordable commodity (Venter and Rwigema, 2004). This theory relates to the influence of household characteristics on utilization of improved cook stoves.

Theory of Subsidies

Standard economic theory offers two broad rationales for how subsidies could improve free-market economic outcomes: By providing resources to the poor and underprivileged; and by correcting for the failure of the market mechanism to create an efficient allocation of goods and services. The first rationale concerns the goal of economic justice: well-designed subsidies have the potential to bring about a more equitable distribution of economic well-being than that generated by an unfettered free-market economy. In contrast, the second rationale concerns the role of subsidies in correcting for market inefficiencies.

The economic approach to the design and analysis of subsidies can help guide practitioners to design cost-effective programs. Economic analysis can highlight where subsidies are effective in meeting social goals (which encompass both efficiency and equity considerations), and where subsidies are wasteful or distorting. Avoiding distortions and correcting market failures can help a program budget achieve more of its objectives and come closer to its overall aim.

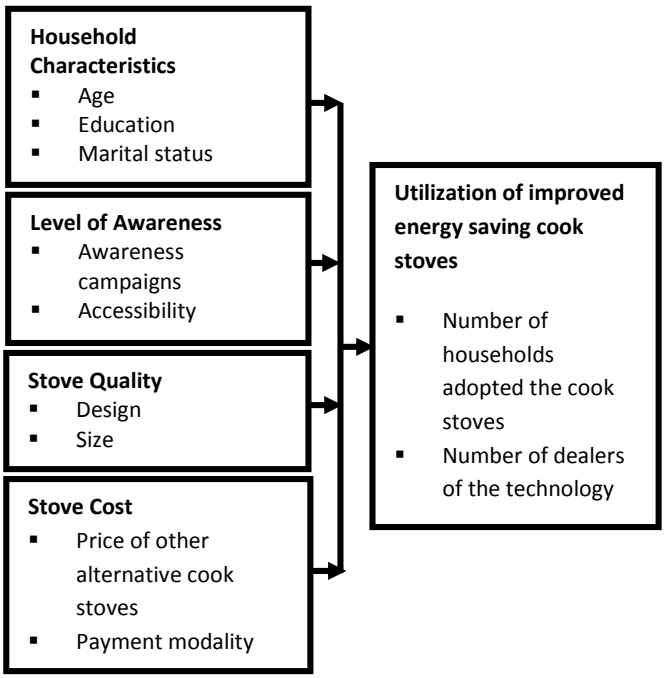
A second reason for analyzing subsidies through the lens of economic analysis is that in this era of fiscal austerity, nearly all government expenditures, both explicit spending and implicit "tax expenditures," are coming under close scrutiny. In order to survive, programs will have to be well designed and capable of passing benefit-cost tests. Many public subsidies do little to promote economic equity, and rather than correcting for market failure, they induce distortions in economic decisions and behavior; such programs may justifiably be scaled back or terminated when they come under increased scrutiny. In contrast, well-designed subsidies for community development have the potential to advance both equity and efficiency goals simultaneously. Practitioners need to be prepared to explain how subsidies for their programs differ from the more wasteful ones that many policymakers and others may think of.

Many cook stove projects use subsidies to keep prices affordable, either direct (price subsidy) or indirect, covering the costs of research and development, producer training, and public awareness-raising (Rai, 2009). Notably, cook stove

programs that have been most successful have not applied direct subsidies to the price of the stove, but have instead used indirect subsidies to support research and development, manufacturing, and marketing (Cordes, 2011 and Akbar et al 2011). A recent review of the enablers and barriers to the uptake of improved cook stoves in Asia, Africa, and Latin America found that large subsidies can diminish the perceived value of the stove, and thus reduce households' willingness to use, maintain and eventually repurchase the product (Rehfuess *et al* 2013).The same study found that overall, an entrepreneurial mode and appropriate business skills are crucial to the success and financial viability of cook stove initiatives seeking to create demand for their products. Commercial ventures have the direct incentive to improve products on an on-going basis to meet user needs and expand their customer base.

Conceptual Framework

Mugenda, (2008) defines conceptual framework as a concise description of the phenomenon under study accompanied by a graphical or visual depiction of the major variables of the study.



Independent Variables **Dependent Variable**

Conceptual Framework

Household Characteristics

For the success of improved cook stoves disseminating initiatives, programs and projects and for the realization of the potential benefits of improved cook stoves, first stoves must be adopted and then sustainably used by households (GACC, 2012; Barnes et al, 1994). For this end, research understanding factors influencing the adoption and sustained use of improved cook stoves is crucial (Puzzolo, 2013; GACC, 2012; Mobarak et al, 2012; Barnes et al, 1994).

The previous studies found contradictory results with regard to the correlation between age and improved cook stoves adoption. A review by Lewis and Pattanayak (2012), household head's age was indicated to be significant negative factor that determines the adoption of improved cook stoves across studies reviewed. In contrary, Gebreegziabher *et al* (2010) found household head's age to be positive and statistically significant determinant factor of cook stove stove adoption and utilization decision. The finding of Dawit (2008) reveals that household head's age is negatively and statistically significant determinant factor of cook stove utilization. With regard to the influence of a household head' age on household's improved cookstoves adoption decision, recent work of Puzzolo *et al* (2013) found inconsistency among research findings.

Therefore, based on the previous empirical works and with the assumption that older people may tend to be conservative in accepting new cooking technologies, in this study it is expected that age affects the household's cook stove utilization decision negatively.

Single women (female headed households) were found more likely to utilize improved cook stoves as compared to married women, male headed counter parts (Damte and Koch, 2011; Inayat, 2011; Adrianzen, 2009). The authors argue that in patriarchal society since husband more power to make economic decisions in the household,

married women's improved cook stoves purchasing decision depends upon the willingness of their spouse. Having this understanding, thus, it is expected that marital status (in favor of single) to affect utilization stove adoption decision positively in rural households.

A review by Lewis and Pattanayak (2012) found that household head's education is positively and statistically significant factors that determine the adoption of improved cook stoves across studies reviewed. It is argued that educated potential customers are more likely to be aware of the benefits of improved cookstoves as compared to uneducated or less educated customers (Inayat, 2011; Menon and , Thandapani, 2011; Adrianzen, 2009). Menon and Thandapani (2011) again claim that the consumers education about the different financial instruments they can avail to purchase the cook stove so that the perceived expensiveness can be minimized. Damte and Koch, Gebreegziabher et al (2010), Dawit (2008) and Makame (2007) found household head's education as a positive factor in influencing Mirt stove adoption decision in Ethiopia. It was found positive association between the household head's level of education and cookstove adoption.

With regard to family size, Puzzolo et al (2013) found inconsistency among findings. A review by Lewis and Pattanayak (2012) found that household size is statistically significant and positively associated with the probability of adoption of improved cookstoves across studies reviewed. Pine et al (2011) found that household size is statistically significant factor that determines improved cookstoves adoption decision. The study revealed statistically positive correlation between improved cookstoves adoption and large family size. These authors claim that households with larger family size consume larger fuel wood as compared to households' smaller family size that results in influencing larger family size households to economize fuel wood usage. Gebreegziabher et al (2010) found that family size is positive and statistically factor in influencing adoption decision of cook stove. Households with large family size were found more likely to adopt improved cook stoves. Given this previous literature, it is expected that large family size positively affects households cook stove decision.

Level of Awareness

Another factor that also does limit utilization of energy saving stoves is information. According to Bhattacharya and Cropper (2010) technology diffusion is limited by unavailability of information and they proposed that the best sources of information are the people who have already utilized the technology. China is one of the countries that has had a successful improved stove program whereby early 90s it had disseminated 120 million improved stoves to the rural areas. According to Ramakrishna (1991) and Smith *et.al(*1993) the success of China was attributed to the high level of awareness of the program which included local rural energy offices were in-charge of technical training, service, campaign implementation, and monitoring for the dissemination programs

Stove Quality

According to Makame (2006), poor quality of the improved stoves, is a major factor for failure to utilization of improved charcoal stoves in urban Zanzibar. Stove quality is determined by its design and its performance in terms of efficiency, safety and durability (Karavaiand Petrichenko, 2015), Partnership for Clean Indoor Air, 2012, GACC, 2014).

Research carried out by GACC identified a gap in the quality of cook stoves manufactured. The study recommended the need for training of entrepreneurs on how to improve the quality of their products, (Global Alliance for Clean Cook stoves, 2013). Culturally appropriate stove design is important. Stove modifications by users resulting from unsuitable design features including

enlargement of the entrance (Troncoso, 2011; Pandey, 2010) and grate removal (Anderson, 2012; Jagoe and Bruce, 2007) compromise the efficiency of the stove (Jagoe and Bruce, 2007). Some households believed chimney stoves to be incompatible with thatched roofing increasing fire risk, and proving complex to set up (Chowdhury *et al.,* 2011).

Durability is also important. Frequent stove cracking or parts breaking, have an impact on satisfaction and sustained use (Jagoe and Bruce, 2007, Chowdhury *et al.,* 2011). Also, proper installation and regular are critical for appropriate functioning (Troncoso, 2011; Chowdhury *et al.,* 2011)

Women who use different technologies are more likely to try an additional method (Chowdhury *et al.,* 2011). Reasons for multiple cooking strategies include not being able to cook traditional food on the IS (Velasco, 2008), requirements for smaller pieces of wood, doubts about the ability of a smaller stove to cook efficiently (Simon, 2007), and IS being considered unsuitable for larger gatherings, since it can be difficult to cook food in larger quantities on the IS (Troncoso, 2011; Pandey, 2010).

Stove Cost

Elvira (2008) reported that people base their decisions to buy a device on actual prices and do not have a good knowledge about the operational cost. Dupont (1998) in a study found out that both USA and Thai ranked the price of a technology as an important determinant for the adoption of the energy efficient appliances. The process of stove manufacture requires sufficient funding all throughout, to finance set up of the factories, purchase of raw materials, labor, transport, research and development, and marketing of the final products. Review on literature has shown that about one-third of African countries have programs for improved biomass cook stoves, although there are only few specific policies in place. Non-governmental organizations and small enterprises continue to promote and market stoves as well (Byrne *et al,* 2008).

Many cook stove projects use subsidies to keep prices affordable, either direct (price subsidy) or indirect, covering the costs of research and development, producer training, and public awareness-raising. Chinese improved stoves are not only suitable for fuel savings but also, designed for convenience and attractiveness, highlighting the lessons learned from problems in early programs that stressed fuel savings. Stove adopters paid the full cost of materials and labor. The government only helped producers through stove construction, training, administration, and promotion (GIZ, 2008)

Where communities were required to pay the full cost for the ICS, price was an important barrier among poorer households (Chowdhury *et al.,* 2011) especially households not engaging in the labour market (Troncoso, 2011). In poorer households, the benefits of fuel saving are an important selling point. High levels of poverty in the community mean that households have different priorities competing for scarce resources, and fuel saving is valued principally because it translates into cost savings (Jagoe and Bruce, 2007). Many programmes focus on reaching as many households as possible rather than on equitable distribution. Indeed, Troncoso et al. (Troncoso, 2011; Pandey, 2010) suggest that according to Roger's diffusion of innovation theory, it may be best to target early adopters, with late adopters following suit when a critical mass of users has been reached (Troncoso, 2011).

Empirical Review

Despite the potential benefits and the efforts of national, regional and global initiatives, programs and projects the rate of utilization of improved energy saving cookstoves has fallen behind the expectation due to different factors (Puzzolo, 2013; Berkeley Air Monitoring Group, 2012; Lewis and

Pattanayak, 2012; GACC, 2010; WHO, 2009; Barnes et al, 1994). To identify drivers influencing utilization of improved energy saving cookstoves studies have been conducted and the main findings are summarized.

Inayat (2011) conducted a study to investigate factors that make people adopt improved cookstoves in rural Northern Pakistan by taking into account household characteristics and source of fuel-wood. The study found household head's level of education (proxy for awareness), income, household working members and source of fuel-wood to be determinant factors of improved cook stoves adoption decision. Households not collecting wood for free were found more likely to adopt improved cook stoves in rural Pakistan. On the other hand, total household head's age, household size, landholding and open fire hazards knowledge were found statistically insignificant factors in determining improved cook stoves adoption.

Adrianzen (2009) analyzed the concerns of village technology adoption pattern and village social capital and household characteristics to identify factors affecting improved cookstoves adoption decision in Northern Peruvian Andes. The study found that the higher success village adoption pattern, with stronger social capital, has a significant positive effect on a household's improved cookstoves adoption decision. From household characteristics, the household's head gender and level of education, the household's number of adults, presence of a female adult member in the household, the household's wealth and the household's participation in women and environmental clubs were found statistically significant factors to influence a household's decision of improved cook stoves adoption. Slaski and Thurber (2009) identified inherent motivation, affordability by the and compatibility/low required users engagement as positive determinant factors of adoption, while low motivation, low affordability and high required users engagement as important obstacles of cook stoves adoption by the poor.

Lewis and Pattanayak (2012) conducted a review of 11 empirical studies with regard to factors affecting improved cook stoves adoption and utilization. Based on the review, household head education, income, household size, fuel-wood price and access to credit were found to be statistically significant positive factors that determine the adoption of improved cook stoves. On the other hand, significant negative associations were found between the adoption of improved cook stoves and household head's age and socially marginalized status. A filed assessment of improved cookstoves adoption practices in Indonesia was conducted by Geary et al (2012). The assessment investigated that awareness of dangers of indoor air pollution, knowledge about and the availability of improved cookstoves, the built environment to install and the increase price of wood fuel as well as social networks are factors that positively affect improved cookstoves adoption and utilization decision. On the other hand, the free availability of fuel-wood was found to be one of the factors that lead to the decision not to adopt and utilize improved cookstoves.

In China Dewan et al (2013) found that the adoption of improved cookstoves can reduce fuel wood for cooking, time to collect fuel wood, and the newly felled trees by 40.1 %, 38.2 % and 23.7% respectively. Ewards et al (2004) also found that in China ICS have both short-term and long term impacts. In the short run ICS reduces the emission of health risky pollutants and in the long term, these stoves play significant role in reducing greenhouse gases emission and mitigate global warming. Boy et al (2000) found that in Guatemala a wood-burning improved stove, called Plancha (the modified), can save wood by about 39%, thus, saves time spent for wood collection and reduces the level of indoor air pollution. They argue that these roles of improved cookstoves have important implication for the interrelated aspects

of development like health promotion, protection of the environment and the households' economy

In the context of improved cook stove manufacture, Research carried out by GACC identified a number of training requirements in the cook stove sector in Kenya. These include the need for training of entrepreneurs on how to improve the quality of their products, how to better understand consumer preferences and incorporate feedback, how to attract investment, how to market their products, and how to keep financial records (Global Alliance for Clean Cook stoves, 2013).The study recommended inclusion of business leaders and experts from various fields in the cook stove sector with specific skills, to teach these skills. These include experts in accounting, human resourcing, management, and improved stove construction. It also recommended the employment of experienced business development services (BDS) trainer to develop "best practice" guidelines for a successful training; incorporate existing materials from partner organizations to avoid duplication; and make the training resources easily available online. Another recommendation was to hold entrepreneur training workshops (and "training of trainers" (TOT) workshops) by region (Global Alliance for Clean Cook stoves, 2013).

Research carried out by GVEP revealed that businesses involved in ICS production may have a desire to change or expand their business model but find they are restricted either by resources or the skills they have. This challenge was however being overcome through capacity building and linking of complementary businesses. as a result, a number of them had received training on the skills and techniques involved either by an NGO, by family members or people they have worked with. The study found that liner producers were often located in areas where quality clay could be sourced, and possessed pottery skills passed down through generations (Clough, 2012).

Research conducted across five different Geographical regions (China, India Nepal, Haiti and Uganda), revealed that the manufacture of biomass cook stoves is strongly influenced by the financial capability of the end user (Raman et al, 2013). The study illustrated the need for the cost of the improved cook stoves to be optimized to increase the affordability. This is because the sector using biomass cookstoves is generally weaker economically. The implication of these findings is that in order to retain the stove quality, the high cost of these stoves requires subsidy from government.

Menon and Thandapani (2011) conducted a study to understand the utilization dynamics of improved cookstoves among people living in rural India by including variables of motivation, affordability and level of engagement in their analysis. Neighbors influence, awareness campaigns, the effect of perceived risks/benefits of improve cookstoves vis- a-vis traditional stoves, income, education and stove design were found to be enabling factors for adoption decision. The study revealed that respondents who were recommended by their neighbors had founded to be adopters of improved cookstoves. The consumers education about the different financial instruments they can avail to purchase the cook stove so that the perceived expensiveness can be minimized.

The study further revealed that the utilization and sustainability of the project depends on long term funds rather than a burst in large amount of funds within a short span. This is because, although users are willing to purchase improved cook stove when it is offered with subsidy, they generally switch back to the traditional stove after certain period Hence the study found out that it is better to spend the subsidy amount for the result based awareness creation, training programs, research and development work and tax redemption for private enterprises. The study also showed large scale

manufacture of improved cook stoves helped to achieve quality control (Raman et al, 2013).

In Ethiopia Asres (2002) found that the utilization of improved cookstoves (Lakech and Mirt stoves), can save about 475.44 kt wood, about USD 47million and 122, 619 ha of forest per annum; reduce indoor air pollution and improve health conditions as well as mitigate greenhouse gases emission. The study also asserted that Mirt stove saves fuel wood by about 45% as compared to open- fires. The Kenya's national program, under auspice of Ministry of Agriculture, is one of success stories in Africa (Teodoro, 2008). According to Winrock International (2011), Kenya has a good success on utilization story in Africa as compared to other countries and at country level 30%- 40% of households have an improved stove of some type and 50-60 % in urban areas. According to Teodoro (2008), the success in Kenya has been attributed to an important focus on the issues of market, replication, mass production, low cost, efficiency, technology transfer, local production and commercialization as well as the stoves design was simple and small size

A study by Garcia-Frapolli et al (2010) in Mexico also revealed that the adoption improved biomass cookstove, patsari, has a significant contribution for the improvement of living condition mainly because of wood savings (about 53%) and reduction indoor air pollution related health problems(by about 28%). Romieu et al (2009) investigated that patsari wood-burning stove in Mexico has positive impact on improving and reducing women's respiratory system and provides other cofounded benefits such as eye comfort. Armendariz et al (2008) also asserted that improved coostoves in Mexico can reduce particulate matter and Carbon monoxide (CO) concentrations by 74 % and 78% respectively. They found also improved wood-burning stoves reduce personal exposure, for example Carbon monoxide (CO) personal exposure can be reduced by up to 78%. Berrueta et al (2008) revealed that patsari wood-burning stove in Mexico can save wood ranging from 44-65%.

The most successful utilization of improved stoves programme has been China's National Improved Stove Program (NISP) which was initiated in the early 1980s (Gifford, 2010; Smith and Deng, 2010). By 1992, more than 60% of rural households adopted improved stoves (Climate Institute, 2009). According to the report by Global Alliance for Clean Cookstoves (GACC, 2012), China takes the lion share of Asia's improved cookstoves manufacturing by the 2012. The success in China has been attributed to stove designs suited to users' needs, targeted national promotion schemes and effective local implementation (Teodoro, 2008), use of public education and training (Climate Institute, 2009). From this one can understand that for the success of programs and projects, understanding the needs of the people and the most technical, social and cultural requirements, taking into account the national programs scheme, involving the target community in the production and providing training and education to the producers and potential users are crucial concerns. .

Critique of Existing Literature

Existing literature mainly focuses on market access and commercialization of the ICS (Winrock et al 2011). However, little emphasis has been given to the quality of the stoves specifically in terms of safety, durability and efficiency. The cook stove programs are not working together, but keep duplicating their results. This makes data collection difficult since there is no single authority for the source of the data. In addition, the local cook stove market is fragmented. This makes it difficult to disseminate useful information to manufacturers, including uniform training.

A lot of attention has been given to stoves that haven't been in existence in the Kenyan market for long, and less attention is given to the Kenya Ceramic Jiko, which the local artisans are well

familiar with. Dissemination of improved cook stoves doesn't automatically translate to adoption. Although past studies have mainly focused on the health effects of Household Air Pollution, elsewhere it is evident that consumers are more concerned with the stove price, durability and efficiency.

Cultural values also have a great impact on the adoption of the improved cook stoves. For this reason, there is a need to understand the concerns of the end users and do further research on these issues. Although a number of protocols for testing the improved cook stoves have been developed globally, there is insufficient training on how to carry out these tests. In addition, it should be a regulation to document the results, and readily avail this information to the consumers.

Summary of Literature

By reviewing the literature, this chapter has provided a theoretical and empirical framework for the study. From the theoretical and empirical framework, a conceptual framework that guides the study has been developed. The four factors, that is, stove quality, stove cost, level of awareness and household characteristics and the relevant theories, have been reviewed. These factors are considered key determinants of utilization of improved energy saving cookstoves.

Research Gaps

Past studies have focused on factors affecting the rate of uptake of improved cook stoves in Kenya and the prevalence of respiratory diseases caused by indoor air pollution. This study therefore intends to fill these pertinent gaps in literature by studying the selected independent variables on the drivers influencing utilization of improved cook stoves. This study will add to the existing literature by providing empirical evidence on the influence of household characteristics, level of awareness, stove quality and stove cost, on the utilization of improved cook stoves.

RESEARCH METHODOLOGY

This chapter outlines the method used for the research. The chapter therefore outlines the population, data collection instruments and data collection procedures as well as data analysis. Additionally, the chapter explains how the research was carried out to achieve the study objectives.

Research Design

Kothari (2004) observed that research design is a blue print which facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible hence yielding maximum information with minimal expenditure of effort, time and money. This study used descriptive research design. This design refers to a set of methods and procedures that describe variables. It involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data. Descriptive studies portray the variables by answering who, what, and how questions (Bernard, 2011). The study was descriptive in nature as it is deemed appropriate because it involved use of written questionnaires to be administered to respondents. Baker (2009) recommends descriptive design as it allows the researcher to describe, record, analyze and report conditions that exit or existed. Since this study sought to establish the drivers of utilization of energy saving cook stoves projects in Kenya a descriptive research design was the best design. This has the advantage of providing an in-depth investigation of the problem under study

Target Population of the Study

A target population is as a set of people, services, elements and events, group of things or households that are being investigated (Mugenda, 2008). The study was based on a survey of 5600 households which have adopted energy saving woodstoves and charcoal stoves in the county according to ministry of Energy (2015) in the last 2 years.

Sample Size and Sampling Technique

Owing to practical difficulties with responses from large survey groups, a meaningful survey sample size had to be determined. An appropriate sample size was calculated. A representative sample size with known confidence and risk levels was selected, based on the work of Yamane (1967) formula. An appropriate response rate (sample size) is determined. The formula used by Yamane (1967) is illustrated as shown below;

$$n = \frac{N}{1 + N(e)^2}$$

Where

n = sample size

N =Target population

e = Proportion of the study

Kumar, (2004) indicates that a sample size of 10% of the target population is large enough so long as it allows for reliable data analysis and allows testing for significance of differences between estimates. There are 5600 households and therefore, the targeted population of the study (N = households). A 95% confidence level is deemed acceptable and thus statistically z = 2. Placing information in the above formula at a 95% confidence level and an error limit of 10% results in:

$$n = \frac{5600}{1 + 5600(0.10)^2}$$

= 98 respondents

Ninety eight respondents were therefore deemed to be the lowest acceptable number of responses to maintain a 95% confidence level and a 10% error level. Therefore, a proportionate sample size of 100 household heads which is 10% precision of the population was selected using a simple random sampling technique from the identified study population.

Research Instruments and Data Collection Procedure

The study relied mainly on primary data. The researcher used questionnaire as the research instrument. The study utilized questionnaires that were developed for generating information on key variables of interest from the targeted respondents in the study. The research also used desktop review of existing information about the study areas and collected qualitative data through in-depth interview from respondents who were conversant with the subject through various interactions or experiences. These respondents were specifically targeted for their ability to provide pertinent information to the study. Secondary data was obtained from literature sources or data collected by other people for some other purposes. Secondary data was collected through review of published literature such as journals articles, published theses and textbooks. These sources were reviewed to give insight in the search for primary information. A self-administered questionnaire was dropped to each respondent and picked later.

Data Analysis and Presentations

Data collected was analyzed using both quantitative and qualitative methods with the help of (SPSS) version 21 and excel. Data processing was carried out through editing, coding and classification. Content analysis was employed to analyze the qualitative data whereas statistical method that is regression analysis was utilized to analyze the quantitative data by aide of SPSS Software version 21 and excel. In order to analyze the relationship between the independent variables and the dependent variable the study used correlation analysis and multiple Regression analysis at 5% level of significance. The multiple regression model that aided the analysis of the variable relationships was as follows: $\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon}$ Where;

Y= Utilization of energy saving cook stoves projects (dependent variable);

β0= constant (coefficient of intercept);

$\mathbf{X_1}$= Household characteristics (independent variable);

$\mathbf{X_2}$= Level of awareness;

X_3= Stove Quality;

X_4= Stove Cost;

ε = Error term;

$\beta 1 \ldots \beta_4$= regression coefficient of four variables.

RESULTS AND DISCUSSIONS

This chapter discusses the interpretation and presentation of the findings obtained from the field. The chapter presents the background information of the respondents, findings of the analysis based on the objectives of the study. The primary data was gathered from the questionnaire as the research instrument. For this purpose, the various statistical analysis tools like Cronbach's alpha, correlation analysis and multiple regression analysis have been employed to challenges hindering effective strategic change management in counties in Kenya.

Response Rate

The study targeted a sample size of 100 respondents from which 63 filled in and returned the questionnaires making a response rate of 63%. This response rate was satisfactory to make conclusions for the study. This high response rate can be attributed to the data collection procedures, where the researcher pre-notified the potential participants and applied the drop and pick method where the questionnaires were picked at a later date to allow the respondents ample time to fill the questionnaires. The response rate was therefore adequate for the study to make relevant conclusions basing on the responses.

Reliability Test Results

A pilot study was carried out to determine reliability of the questionnaires. The pilot study involved the sample respondents. Reliability analysis was subsequently done using Cronbach's Alpha which measured the internal consistency (Cronbach, 1951). Gliem & Gliem (2003) established the Alpha value threshold at 0.7, thus forming the study's benchmark. Cronbach Alpha was established for every objective which formed a scale. According to the study household characteristics had the highest reliability (α= 0.853) and this also illustrates that all the four variables were reliable as their reliability values exceeded the prescribed threshold of 0.7.

Validity Test Results

The content validity formula by Amin (2005) was used in this study to establish the validity of the research instrument. The formula is; Content Validity Index = (Number of judges declaring item valid) / (Total number of items). It is recommended that instruments used in research should have CVI of about 0.78 or higher and three or more experts could be considered evidence of good content validity (Amin, 2005). From the results all the four variables were valid as their CVI values exceeded the prescribed threshold of 0.78 as emphasized by Amin (2005).

Gender of the Respondents

The study sought to determine the gender composition of the respondents. From the findings, it was established that majority of the respondents as shown by 55% were male whereas 45% of the respondent were female, this is an indication that both genders were well represented in this study and thus the finding of the study did not suffer from gender bias all through the study.

Age Distribution of the Respondents

The study requested the respondents to indicate their age category. From the research findings, the study revealed that most of the respondents as shown by 38% were aged between 41 to 50 years, 17% of the respondents were aged between 18 to 30 years, 21% were above 50 years whereas 25% of the respondents were aged between 31 to 40 years. This implies that respondents were well distributed in terms of their age during the study.

Educational Level of Respondents

The study sought to establish the educational background of the respondents and the findings. From the study findings, most of the respondents as shown by 47% indicated that they held bachelors certificates, 31% of the respondents had diploma certificates, 21% indicated to have reached postgraduate level and 1% of the respondents had reached secondary level and this implies that most of respondents were well educated and that they were in a position to respond to research questions with ease. The findings therefore indicate that the respondents have the capacity, skills and management acumen to facilitate utilization of improved energy saving cookstoves projects in the area of study. These skills may help them handle and interpret their respective services and the emerging issues on implementation and utilization of improved energy saving cook stoves projects to the best level possible.

Age of Household Head

The study sought to determine the influence of age of household's head on whether it increased household's adoption the technology in the study area. According to study findings, the study established that 86% of the respondents stated that older people tend to be conservative in accepting new cooking technologies, 58% of the respondents indicated that participate in dissemination initiatives/programs, 56% posited that it reduced risks of the improved cook stoves failure, 66% indicated that it enhanced quality and quantity operations of improved cook stoves and 78% of the respondents sated that it enhanced decision making and problem solving in the on adoption of technology. This can be deduced that age of household's head played a significant role on influencing increased household's adoption the technology in the study area.

Age of household's head on adoption the technology

The study sought to establish the influence of age of household's head on whether it increased number of dealer's of improved cook stoves in the study area. The study found out that 56% of the older people tend to be conservative in accepting new cooking technologies, 77% stated that participated in dissemination initiatives/programs, 65% indicated that it reduced risks of the improved cook stoves failure, 60% stated that it enhanced quality and quantity operations of improved cook stoves and 78% stated that it enhanced decision making and problem solving in the on adoption of technology.

Education level of household's head

The study sought to determine the influence of education level of household's head on whether it increased household's adoption the technology in the study area. The study established that 68% of the respondents stated that older people tend to be conservative in accepting new cooking technologies, 64% of the respondents indicated that participate in dissemination initiatives/programs, 88% posited that it reduced risks of the improved cook stoves failure, 60% indicated that it enhanced quality and quantity operations of improved cook stoves and 62% of the respondents sated that it enhanced decision making and problem solving in the on adoption of technology.

Marital Status of household head

The study sought to establish the influence of marital status on adoption of technology in the study area. The study found out that 66% of the single women are more likely to accept the technology, 88% of the respondents indicated that married women decision to adopt new technology is affected by their spouses and 55% enhanced decision making and problem solving on the adoption of technology. This implies that marital status influenced the adoption of the technology in the study area.

Level of Awareness

The level of awareness studied in this research comprised of the awareness campaigns, and stove accessibility. The influence of these characteristics on utilization of improved cook stove projects was studied.

Awareness Campaign

The study sought to find out the influence of awareness campaign increase household's on adoption of the technology in the study area. The study established that 68% of the respondents stated that it provided information on the technology, 55% stated that participated in dissemination initiatives/programs, 43% shoed that it reduced risks of the improved cook stoves failure, 40% stated that it enhanced quality and quantity operations of improved cook stoves and 60% indicated that it enhanced decision making and problem solving on the adoption of technology. This implies that level of awareness influenced awareness campaign increased adoption of the technology in the study area.

Cook Stoves Accessibility

The study sought to determine whether cook stoves accessibility increased household's adoption of the technology in the study area. The study established that 68% indicated that it provided information on the technology available, 64% stated it reduced risks of the improved cook stoves failure, 56% posited that it enhanced quality and quantity operations of improved cook stoves and 58% indicated that it enhanced decision making and problem solving in the on adoption of technology. This implies that cook stoves accessibility influenced increase of dealers of improved cook stoves in the study area.

Stove Quality

The stove quality studied in this research comprised of stove design, and stove size. The influence of these characteristics on utilization of improved cook stove projects was studied.

Stove Design

The study sought to find out whether stove design increased household's adoption of the technology in the study area. According to study results in Figure 4.14, the study established that 44% of the respondents stated the through a training on design for entrepreneurs on the technology on how to improve quality of the product, 56% stated that by modification by the users resulting from unsuitable design features, 46% showed the compromising the efficiency of the stove and 74% stated the durability impact on satisfaction for sustained use. This implies that stove design is an important factor which influenced increase of household's adoption of the technology in the study area.

Stove Size

The study sought to find out the influence of stove size increase on household's adoption of the technology in the study area. According to study results in Figure 4.16, the study established that 66% of the respondents stated it provided information on the technology on its usage, 86% of the respondents stated by modification by the users resulting from unsuitable design features, 64% agreed that in compromising the efficiency of the stove and 58% stated it enhanced decision making and problem solving on the on adoption of technology. This can be deduced that stove size is an important factor which influenced the household's adoption of the technology in the study area.

Stove Cost

The stove cost studied in this research comprised of price of alternative cook stoves, and payment modality. The influence of these characteristics on utilization of improved cook stove projects was studied.

Price of Alternative Cook Stoves

The study sought to find out the influence of price of other alternative cook stoves on increase of household's adoption on the technology in the

study area. According to study results in Figure 4.18, the study established that 68% of the respondents stated that people base their decision to buy it on actual prices of alternative cook stoves, 54% indicated that it based on knowledge about the operational cost, 55% indicated on subsidies that are offered to keep prices are affordable and 86% stated on enhancing decision making and on pricing thus affecting adoption of technology. This implies that that alternative cook stove affects the household's adoption of the technology in the study area.

Payment Modality

The study sought to find out the influence of payment modality on increase of household's adoption of the technology in the study area. According to study results in Figure 4.20, the study established that 66% of the respondents stated it provided information on the modes of payment available on the technology, 86% stated that planning and negotiations on purchase of the technology and 48% stated on the savings and purchase the stove with single payment and 70% on purchase on installments. This implies that payment modality played a significant role on the increase of number of dealers of cook stoves in the study area.

Utilization of Improved Energy Saving Cook Stoves Projects

The study sought from the respondents to indicate rate of change of the increase of adoption of technology for the last five years (2011 to 2015). The study established that the successfully implemented projects had made a good increase with an average of 40% of the respondents stated that it increased by 10%, with an average of 60% of the respondents indicated that it increased by more than 10%, with an average of 42% of the respondents posited that it increased by less than 10%, with an average of 35 % of the respondents cited that it decreased by 10%, with an average of 55% of the respondents indicated that it decreased by more than 10% and an average of 23% of the respondents indicated that it decreased by less than 10% in the last five years. The study findings imply that there was slight increase of adoption of the technology in the last five years.

Multiple Regression Analysis

Multiple regression analysis was conducted so as to test relationship among the independent variables on the on utilization of improved energy saving cook stoves projects. The study applied the statistical package for social sciences (SPSS V. 21) to code, enter and compute the measurements of the multiple regressions for the study. According to the model summary Table 4.6, R is the correlation coefficient which shows the relationship between the independent variables and dependent variable. It is notable that there extists strong positive relationship between the indepedent variables and depedent variable as shown by R value (0.781). The coefficient of determination (R^2) explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable and the four independent variables that were studied explain 61.50% of the utilization of improved energy saving cook stoves projects as represented by the R^2. This therefore means that other factors not studied in this research contribute 38.50% of the utilization of improved energy saving cook stoves projects. This implies that these variables are very significant therefore need to be considered in any effort to enhance utilization of improved energy saving cook stoves projects in the study area. The study therefore identifies variables as critical drivers of utilization of improved energy saving cook stoves projects

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.781	.615	.563	.006

Further, the study revealed that the significance value is 0.001 which is less that 0.05 thus the model is statistically significance in predicting how household characteristics, level of awareness, stove quality and stove cost affect utilization of improved energy saving cook stoves projects. The F critical at 5% level of significance was 1.986. Since F calculated (292.170) is greater than the F critical (value = 1.986), this shows that the overall model was significant.

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	22.789	4	5.6973	292.170	.001[a]
	Residual	1.9876	102	.01950		
	Total	24.7766	106			

NB: F-critical Value = 1.986; Predictors**: (Constant):** household characteristics, level of awareness, stove quality and stove cost

Further, the study ran the procedure of obtaining the regression coefficients, and the results were as shown on the Table 4.8 Multiple regression analysis was conducted as to determine the relationship between utilization of improved energy saving cook stoves projects and the independent four variables. As per the SPSS generated table above, the model equation would be: $\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$ becomes: $Y= 1.5643+ 0.600X_1+ 0.665X_2+ 0.587X_3 + 0.555X_4$. This indicates that utilization of improved energy saving cook stoves projects = 1.5643 + 0.600(Household characteristics) + 0.665(Level of awareness) + 0.587(stove quality) + 0.555(stove cost). According to the regression equation established, taking all factors into account (household characteristics, level of awareness, stove quality and stove cost) constant at zero utilization of improved energy saving cook stoves projects was 1.5643. The data findings analyzed also shows that taking all other independent variables at zero, a unit increase in household characteristics will lead to a 0.600 increase in utilization of improved energy saving cook stoves projects.; a unit increase in level of awareness will lead to a 0.665 increase in utilization of improved energy saving cook stoves projects , a unit increase in stove quality will lead to a 0.587 increase in utilization of improved energy saving cook stoves projects and a unit increase in stove cost will lead to 0.555 increase in utilization of improved energy saving cook stoves projects. This infers that level of awareness contributed most to utilization of improved energy saving cook stoves projects in the study area. At 5% level of significance, household characteristics had a 0.008 level of significance; level of awareness showed a 0.005 level of significance, stove quality showed a 0.010 level of significance and stove cost showed a 0.022 level of significance hence the most significant factor was level of awareness.

Regression Coefficient Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	P-value.
		B	Std. Error	Beta		
1	(Constant)	1.5643.	1.223		2.615	.035
	Household characteristics	.600	.109	.458	4.887	.008
	Level of awareness	.665	.100	.500	5.876	.005
	Stove quality	.587	.190	.3.21	4.321	.010
	Stove cost	.555	.199	.209	2.987	.022

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The study sought to establish the drivers of utilization of improved energy saving cook stoves projects in Kenya. The study examined theoretically and empirically how various variables contributed to utilization of utilization of improved energy saving cook stoves projects. In assessing the drivers, the study focused on how select factors (level of awareness, household characteristics, stove quality and stove cost) influenced the utilization of utilization of improved energy saving cook stoves projects. This chapter captures the summary of findings, from which conclusions were drawn and recommendations made.

Summary of the Findings

What is the influence of household head characteristics on utilization of improved energy saving cook stoves projects in Kenya?

The study sought to establish whether household characteristics did influence utilization of improved energy saving cook stoves projects. From the descriptive results, it was established that the household's head increase household's adoption the technology as older people tend to be conservative in accepting new cooking technologies, participate in dissemination initiatives/programs, reduces risks of the improved cook stoves failure, enhances quality and quantity operations of improved cook stoves and it enhances decision making and problem solving in the on adoption of technology. The study also established that the marital status of household's head increase adoption of the technology as single women are more likely to accept the technology and married women decision to adopt new technology is affected by their spouses. Additionally, the study revealed that the variable(Pearson correlation coefficient =.600) and p-value (0.008 < 0.05) statistically, moderately and significantly correlated to utilization of improved energy saving cook stoves projects at 5% level of significance as it had a positive relationship with the dependent variable. This reveals a household head characteristic is an important factor that can affect utilization of improved energy saving cook stoves projects in the study area. This also reveals that the more a household characteristic becomes the more the utilization of improved energy saving cook stoves projects in the study area Therefore, from these quantitative results it can be deduced that the study which sought to establish the influence of household characteristic on utilization

of improved energy saving cook stoves projects in the study area was achieved because it established that it influences utilization of improved energy saving cook stoves projects in the area.

How does level of awareness influence utilization of improved energy saving cook stoves projects in Kenya?

From study results as the respondents stated that awareness campaign did increase household's on adoption of the technology in the study area as the respondents stated that it provided information on the technology, participated in dissemination initiatives/programs, reduced risks of the improved cook stoves failure, it enhanced quality and quantity operations of improved cook stoves and it enhanced decision making and problem solving on the adoption of technology. This implies that level of awareness influenced awareness campaign increased adoption of the technology in the study area. The study also established that awareness campaign did increase the number of dealers of improved cook stoves in the study area as the the technical team get information about improvement on the technology. The cook stoves accessibility increased household's adoption of the technology in the study area as it enhanced quality and quantity operations of improved cook stoves, technical team get information about improvement on the technology. Further, the study revealed that the variable(Pearson correlation coefficient =.665) and p-value (0.005 < 0.05) statistically, strongly and significantly correlated to utilization of improved energy saving cook stoves projects at 5% level of significance as it had a positive relationship with the dependent variable. This reveals that level of awareness is an important factor that can affect utilization of improved energy saving cook stoves projects in the study area. This also reveals that the more level of awareness becomes the more the utilization of improved energy saving cook stoves projects in the study area Therefore, from these quantitative results it can be deduced that the study which sought to establish the influence of level of awareness on utilization of improved energy saving cook stoves projects in the study area was achieved because it established that it influences utilization of improved energy saving cook stoves projects in the area.

Does Stove Quality influence Utilization of Improved Energy Saving Cook Stoves Projects in Kenya?

From the descriptive analysis, the respondents stated that stove design increased household's adoption of the technology in the study area as they stated the through a training on design for entrepreneurs on the technology on how to improve quality of the product, modification by the users resulting from unsuitable design features, 46 the compromising the efficiency of the stove and the durability impact on satisfaction for sustained use. This implies that stove design is an important factor which influenced increase of household's adoption of the technology in the study area. Further, the study revealed that the variable(Pearson correlation coefficient =.587) and p-value (0.010 < 0.05) statistically, strongly and significantly correlated to utilization of improved energy saving cook stoves projects at 5% level of significance as it had a positive relationship with the dependent variable. This reveals that stove quality is an important factor that boost utilization of improved energy saving cook stoves projects in the study area. This also reveals that the more stove quality becomes the more the utilization of improved energy saving cook stoves projects in the study area Therefore, from these quantitative results it can be deduced that the study which sought to establish the influence of stove quality on utilization of improved energy saving cook stoves projects in the study area was achieved because it established that it influenced utilization of improved energy saving cook stoves projects in the area.

How does stove cost influence utilization of improved energy saving cook stoves projects in Kenya?

From the descriptive analysis, the study results showed that the respondents stated that price of other alternative cook stoves did increase of household's adoption on the technology in the study area. The study established that people base their decision to buy it on actual prices of alternative cook stoves, knowledge about the operational cost, subsidies that are offered to keep prices are affordable and decision making and on pricing thus affecting adoption of technology. The respondents stated it provided information on the modes of payment available on the technology, planning and negotiations on purchase of the technology and savings and purchase the stove with single payment and purchase on installments. This implies that payment modality played a significant role on the increase of number of dealers of cook stoves in the study area. Finally, the study revealed that the variable(Pearson correlation coefficient =.555) and p-value (0.022 < 0.05) statistically, strongly and significantly correlated to utilization of improved energy saving cook stoves projects at 5% level of significance as it had a positive relationship with the dependent variable. This reveals that stove cost is an important factor that boost utilization of improved energy saving cook stoves projects in the study area. This also reveals that the more stove cost becomes the more the utilization of improved energy saving cook stoves projects in the study area Therefore, from these quantitative results it can be deduced that the study which sought to establish the influence of stove cost on utilization of improved energy saving cook stoves projects in the study area was achieved because it established that it influenced utilization of improved energy saving cook stoves projects in the area.

Conclusions

The study established that household characteristics did influence utilization of improved energy saving cook stoves projects. The age of the household head, marital status and education level determined the adoption of the technology. This reveals a household head characteristic is an important factor that can affect utilization of improved energy saving cook stoves projects in the study area.

From study results awareness campaign did increase household's on adoption of the technology in the study area as the respondents stated that it provided information on the technology, participated in dissemination initiatives/programs, reduced risks of the improved cook stoves failure, it enhanced quality and quantity operations of improved cook stoves and it enhanced decision making and problem solving on the adoption of technology. This implies that level of awareness influenced awareness campaign increased adoption of the technology in the study area and also did increase the number of dealers of improved cook stoves in the study area as the technical team get information about improvement on the technology.

The stove quality especially on stove design increased household's adoption of the technology in the study area. Training on design for entrepreneurs on the technology on how to improve quality of the product, modification by the users resulting from unsuitable design features and the risks associated with compromising the efficiency of the stove and the durability impact on satisfaction for sustained use is important

The price of other alternative cook stoves did increase of household's adoption on the technology in the study area. The study established that people base their decision to buy it on actual prices of alternative cook stoves, knowledge about the operational cost, subsidies that are offered to keep prices are affordable and decision making and on pricing thus affecting adoption of technology. The respondents stated it provided information on the modes of payment available on the technology, planning and negotiations on purchase of the technology and savings and purchase the stove with single payment and purchase on installments.

Recommendations

The study recommends that in order to effectively utilize the improved energy saving cook stoves projects in the study area, there is need to look at age of the household head, marital status and education level as they determine the adoption of the technology the area. The awareness campaign should be enhanced to provide the information on the technology, participate in dissemination initiatives/programs, and enhance the quality and quantity operations of improved cook stoves especially in decision making and problem solving on the adoption of technology.

The stove quality especially on stove design should be enhanced to increase household's adoption of the technology in the study area. Training on design for entrepreneurs on the technology on how to improve quality of the product, modification by the users resulting from unsuitable design features and the risks associated with compromising the efficiency of the stove and the durability impact on satisfaction for sustained use is necessary

The price of other alternative cook stoves should be looked into as they affect household's adoption on the technology in the study area because people base their decision to buy it on actual prices of alternative cook stoves, knowledge about the operational cost, subsidies that are offered to keep prices are affordable and decision making and on pricing thus affecting adoption of technology. The modes of payment available on the technology, planning and negotiations on purchase of the technology and savings and purchase the stove with single payment and purchase on installments should be adjusted.

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