DETERMINANTS OF ENERGY SAVINGCOOK STOVE ADOPTION IN RURAL HOUSEHOLDSOF KISUMU NORTH LOCATION, KISUMU COUNTY

By

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DECLARATION

This research report is my original work and has not been presented for a degree in any other university or for any other award.

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To all my children: Eddie, Joano, Roy and Timothy.

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ACRONYMS

FAO - Food and Agricultural organization

GHG: - Green House gas

ICS - Improved cook stove

KCJ - Kenya Ceramic Jiko

KENGO - Kenya Energy and Environmental Organization

MDGS - Millennium Development Goals

NGO - Non Governmental Organization

SPSS -Statistical Package for social sciences

TaTEDO - Tanzania Traditional Energy Development and Environmental Organization

UNEP - United Nations Environmental Programme

USAID - `United states Agency for International Development

ABSTRACT

Many of rural households use traditional stoves which have low energy efficiency leading to using more wood fuel, increase in indoor air pollution and also putting a lot of pressure on biomass sources. There have been efforts to promote use of wood fuel technologies; this program has been spearheaded by the Ministry of Agriculture and Nongovernmental Organizations. There are technologies in Kenya that can reduce the consumption of biomass energy by 80%. They include the improved charcoal stove (KCJ)which can save

up to 50% and the improved fuel wood stoves eg"Kuni Mbili" which can save up to 50% but the adoption rate has remained low. The study was carried out to assess the factors determining the adoption of the improved energy saving cook stoves, asses the level at which the economic status of the household influences the adoption of the improved energy saving stoves, examine how cultural beliefs and practices influence the adoption of improved energy saving cooking stoves and investigate the level at which sensitization of the rural households influence the adoption of improved cook stoves in Kisumu North Location, Kisumu County. Descriptive survey research design was used to collect the required data. The target population included 896 households where Multi stage sampling was used to select 390 households .The study used questionnaires for primary data collection. Qualitative data was analyzed through interviews .The validity of the research results were determined through content and face validity while reliability was done by piloting a section of the sample and carrying out the test retest. The research results were considered reliable since a correlation coefficient of above 0.7 was achieved. Quantitative data was analyzed using descriptive and inferential statistics. Data collected through the open ended questions and analysis of documents was done qualitatively through content analysis and presented in themes. The study established that family size of 4-5 members had adopted the energy saving cook stove 55 (14.1%) strongly agreeing that it saved a lot of fuel, family of 1-3 with 51 (13.1%) and 6-10 members with 27 (6.9%) and those families with more than 10 members with 1 (0.3%) strongly agreeing that it saved fuel. Age was also found to have influence on adoption as middle aged group ranging from 26-45 years were the ones who had embraced the energy saving technology with a frequency of 127, those with56 years and above had frequency of 80, 36-45 had 77,46-55 had 55 while those aged 15-25 had 51 frequencies respectively. Further results on gender and time revealed that the women had embraced the energy saving technology more than the men since most of them were in charge of cooking and were the mostly the decision makers on matters pertaining to cooking in the households. Conclusions and recommendations were drawn from the results based on research objectives. The findings indicate that among the factors influencing the adoption of energy saving cook stoves, information dissemination was the most influential factor, followed by decision dynamics. Economic status of the household head did not have much influence since adoption was observed despite the low economic status. Thus information dissemination needs to be enhanced fully to ensure maximum adoption.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Renewable energy is a priority for sustainable development and is included in the global climate change initiative and several United Nations (UN) conventions. In developing countries 1.6 million people still lack access to electricity and 3billion people rely on traditional biomass fuels for cooking, heating, and other basic household needs. The use of these traditional biomass energy sources result in forest degradation and negatively impact climate change, through reduced carbon sequestration and increased greenhouse gas (GHG) emissions. Additionally they present a public health challenge from indoor air pollution. Such negative impacts highlight the need to invest in sustainable and cleaner energy technology, yet despite investment in research and field testing of energy technologies, uptake remains limited. (UNEP 2005).

Over 3 billion people throughout the world rely on locally available fuels, such as wood, charcoal, dung, and agricultural residues, for cooking and heating Nigel, (2004). The global total production of wood in 2000 reached approximately 3.9 billion cubic meters of which 2.3 billion cubic meters was used as wood fuels. This means that approximately 60 percent of the world's total wood removals from forests and trees outside forests are used for energy purposes (FAO, 2008**).**

Biomass cooking stoves are devices, in which biomass (wood, agricultural residues etc) is used to furnish need for cooking. Although the three-stone five is very common it is often modified in many ways. This includes sinking the combustion zone below ground level or constructing a barrier around it to shield the five. However, most types of these traditional cooking stoves are not only inefficient but also pollute the indoor air affecting the health of the householders. According to the WHO, up to 15 million people die each

year as a result of air pollution. The first attempt to improve traditional solid biomass stoves were made in India in the 1950s. These stoves were designed with a chimney to remove smoke from the kitchen. In the 1970's the oil crisis brought energy issues back to the top of the agenda and improved cooking stove programs were considered as solution to the fuel wood crisis and deforestation and desertification around the world (FAO 1983). During this period research was focused on the technical aspects like thermodynamic and heat transfer. Various international donors promoted cooking stoves all over the world particularly in Asia, Africa and Latin America (FAO 1983). However, the effects of these programmers have often been short-lived.

The main beneficiaries of the improved cook stove programs are the most vulnerable groups in society, i.e. women, children, and law income groups (Karekezi et al, 2005, World Bank, 2005, USAID, 2010). In many developing countries fuel wood collection and use is the primary responsibility of women who devote a considerable time to fuel collection. Kumar and Hotchkiss (1988) estimated that women in the hill areas of Nepal spent 2.5 hours per day on fuel collection. Similarly Karekezi et al (2005) recorded that in Botswana, the average time spent on fuel wood collection was sometimes spent up to 6 hours per day collecting fuel wood. With improved cook stove program, the combustion efficiency increases, reducing cooking time and minimizing the fuel wood demand of a household (Bhatta) Charya and Salam, 2006; Berruest et al, 2008; Johnson et al, 2008. This not only reduces household cash outlays for fuel woods, but also reduces time spent by women collecting fuel wood.

In Brazil 1 million of people rely on wood fuels for most of their energy needs, despite the problems associated with traditional use of wood fuel including energy inefficiency, deforestation, increasing use of time for collection of fuel and deleterious health and environmental efforts. Modern efficient cook stoves can alleviate some of

these problems by reducing some household's cash outlays for fuel, diminish the time spent to collect fuels, reducing air pollution, and relieving local pressure on wood resources. Yet despite the apparent benefits of improved stoves an elusive number of dissemination programs in many countries like Brazil has failed to adapt an own strategy (UNICEF 2003)

In Pakistan a majority of the Pakistan's population 62% reside in rural areas and semi urban slums (Ministry of Finance 2010). The country faces depletion of the already scant forest 4.22million hectares. People living in close vicinity to forestlands sometimes use the forest in unsustainable ways to satisfy their domestic and energy needs and other commercial needs. (Lubna, 2007) Pakistan is already an energy deficient country.

In sub-Saharan Africa countries, Ethiopia for example is highly dependent on biomass energy sources such as fuel wood, charcoal and crop residues. These biomass energy sources account for more- than 90% of the total domestic energy demand, according to the United States Environmental Protection Agency (EPA, 2004). The EPA further reports that about 95% of the total population in Ethiopia uses biomass fuels as their main source of energy for cooking, heating and lighting. Even though urban households have better access to commercial energy than the rural population, the difference in biomass use is not large approximately 99% of rural households and 94% of urban households. Given the high levels of dependence, biomass will continue to dominate energy demand in both rural and urban Ethiopia in foreseeable future. The heavy dependence and inefficient utilization of biomass resources for energy have resulted in high depletion of the forest resources in Ethiopia. In general, Ethiopians are poor and as noted by Geist and Lambin (2003) as well as Vance and Lovanna (2006), poverty, in particular, as well as other socioeconomic factors, result in exploitation of forest resources for domestic energy consumption and commercial gain by the developing world's population.

Biomass energy provides 68% of Kenya‘s national energy requirement and it is expected to remain the source of energy for the foreseeable future Mugo and Gathui, (2010). The current biomass demand in Kenya is estimated at 40.5 million tonnes against a sustainable supply of 16 million tonnes Kamfor, (2002). The demand for firewood and charcoal in Kenya has continued to rise as the population continues to grow.

There have been several improved stove programs facilitated and implemented for communities in different parts of the world with support from Government organizations, scientific institution and funding agencies , for more than five decades. The use of energy saving cook stoves is expected to reduce the volume of fire woods used for cooking and to enhance local environmental and health conditions (Andiema C, 2013).

In order to reduce the social, economic, environmental, and health related risks associated with the use of traditional biomass stoves, some NGOS working in different areas of Pakistan have launched interventions to disseminate improved cook stoves in their project areas. One such program was initiated in Swat for a series of socio political, financial and institutional reasons that by local NGO called Kalam integrated Development Project (KIDP). in 1998. However, KIDIP terminated its activities in Swat for a series of socio-political, financial, and institutional reasons.

In China, the Chinese National improved cook stove program (NISP) started in 1980 with leadership of the Department which operates under the ministry. The CNISP has disseminated 144 million improved cook stove by 1994. This translates to 62% of all rural households by 1994, World Bank (2005)

In the year 2002 Enterprise work Ghana launched the Gyapa improved charcoal stove a variant of Kenya ceramic jiko with funding from USAID and the shell Foundation. By July 2004, over 36000 stoves had been sold. This equates to an annual saving of charcoal

worth 250,000 USD, a total of 28,000tonnes of carbon dioxide emissions averted with sale now climbing beyond 3000 per month

In Malawi it was discovered that households that buy firewood can use 12% to 23% of their weekly expenditure on buying firewood, and hence firewood saving can improve disparable income for these households (Andiema, 2013)

In Ethiopia, in December 2010, the EPA and US Peace Corps signed a memorandum of understanding (MoU) including support for the Global Alliance for clean cook stove. For Ethiopia, the MoU will result in increased promotion of clean cooking stoves and Education related to air quality issues, partly as a response to the burden of disease associated with the use of solid fuels. It is presumed that the large- scale distribution of more efficient stoves still will help reduce pressure on biomass resources, increase land productivity by reducing crop residue and dung usage for fuel and improve family health. The intervention is expected to benefit women and children, in particular, by reducing fuel collection workloads and limiting exposure to flame hazards and the emission of harmful pollutants.

In Kenya, the government has put a lot of restriction on collecting firewood from forests as this has led to severe deforestation in many parts of the nation causing environmental degradation. Following the 1980 United Nations Conference on New and Renewable Sources of Energy, many organizations began to work individually and collaboratively on improved stove development and dissemination. The organizations involved in the early 1980s included the Ministry of Energy, Ministry of Agriculture, the Appropriate Technology Centre, the Kenya Energy and environmental Organization (KENGO), United Nations Children‘s Fund, GTZ and many NGOs. Among the more popular stoves introduced were the charcoal burning _*Kenya Ceramic Jiko*‘ (KCJ), and

the wood-burning *‗kuni mbili'* and *‗maendeleo jiko'* – known also as the *'Upesi'* stove (Okello, 2005).

The improved cook stoves use less wood fuel compared to the traditional three stone cooking stoves. When these stoves are used efficiently they can save 30% of the firewood Zheng et al, (1999) and Helga, (2007). The charcoal ceramic stoves (KCJ) are also energy conserving as compared to the metallic charcoal stove since they retain heat within the stove compared to metallic stove in which much heat is lost to the surrounding environment.

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 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. This is despite the fact that 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.

Evidence linking solid fuel use in developing countries to climate change is slowly but strongly building up and there are growing concerns that inefficient biomass burning may be contributing significantly to global warming Crutzen & Andreae, (1990); (1993); Sagar, (2005); Venkataraman(2005); Johnson(2008); World watch Institute, (2009). Adoption and continued (sustained) use of improved biomass stoves in developing countries is therefore an important sustainability strategy which should be adopted by as many households as possible.

There is need to assess the levels of acquisition and use of the wood fuel saving technologies in order to be able to estimate how successful the government has been in reducing demand on fuel wood from forest and other sources as well as reducing the burden on women and children who are involved in gathering firewood and other domestic activities as well as improve on the indoor air conditions. According to Drigo (2007) in southern Asia there is more or less marked deficit conditions covered. In 2000, some 14 percent of the area of the sub-region but affecting almost half of the sparse rural population. Of this, some 35 percent that is about 45 million people live in areas with acute deficit conditions. The combination of balance maps with poverty parameters created a new indicator, subsistence energy, in the mapping of extreme poverty, a new dimension of analysis and a new tool for poverty alleviation policies and forestry and energy development planning. This reveals the economic pressure that forced the population of Southern Asia to resort to utilization of the Wood fuel. The global use of wood fuel and round wood is 3271 (106) m3 per year (FAO, 2001, 2002). About 55% is used directly as fuel, e.g. as split firewood, mainly in developing countries. The remaining 45% is used as industrial raw material, but about 40% of this is used as primary or secondary process residues, suitable only for energy production, e.g. for production of upgraded biofuels (FAO,2001). About 70–75% of the global wood harvest is either used or potentially available as a renewable energy source. This amount does not include the large amount of logging residues and other woody biomass left on-site after logging operations integrated with conventional forestry all over the world (FAO,2002).

Biomass currently represents approximately 14% of world's final energy consumption (IEA, 1998). About 25% of the usage is in industrialized countries, where a significant level of investment in environmental protection has been made to meet emissions standards, especially air emissions. The other 75% of primary energy use of

biomass is in heat production for developing country household energy needs and in process heat production for biomass-based industries through the use of their generated residues (Overend RP, 2002).

1.2 Statement of the problem

The acquisition and use of wood fuel energy conservation technologies is very important for Kenya to be able to decrease demand on wood fuel and tackle the problem of deforestation. According to Kisumu District Survey Report 2004-2008, several cooking stove programmes had been started in Kisumu North Location by Kenya Energy and Non-Governmental organizations. Traditional fuels, normally available locally at low or no cost, are characterized by low combustion efficiency many times cited around 10% Kammen, (1995). Poor combustion efficiency leads to emission of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) causing an increase in GHGs when the rate of consumption of biomass is higher than its replacement (Sanga and Jannuzi, 2005).

The reduction of wood fuel demand from forests can assist in forest conservation which is very important because of the essential roles forests play such as; carbon sequestration and thus mitigating against climate change; as water catchment areas; habitat for many living organisms as well as increasing the aesthetic value of an area. There has been a shortage of wood fuel in many parts of Kenya Ngugi, (1988). This high demand causes people to turn to nearby forest for firewood and charcoal thus leading to deforestation and soil erosion (Wanambwa, 2005).

One way to minimize pressure on forests, reduce household‘s wood fuel demand, improved indoor air conditions as well as mitigate against global warming and climate change is by adopting wood fuel conservation technologies. These technologies do not only assist in energy conservation but they also emit less pollutants thus reducing women

and children exposure to indoor air pollution. There has been a disparity in their adoption and limited data are available relating to adoption of these technologies. It is believed that the use of energy cook stoves would save on use of wood fuel yet the take up is low. Promotion of energy technologies such as improved cook stoves has been going on in many countries yet the uptakes of the technology remains relatively low. Many projects were started in Kisumu North in the year 2009 with an aim of conserving fuel wood by Kenya energy and non-governmental organizations (KENGO), but still the uptake of the energy saving stove is still slow according to Kisumu Poverty Reduction Strategy paper (2010). This research therefore investigated determinants of adoption of energy saving cook stove technologies in rural households of Kisumu North Location in Kisumu County- Kenya.

1.3 Purpose of the study

The purpose of the study was to establish the determinants of adoption of energy saving cook stoves among rural household of Kisumu North Location, Kisumu County

1.4 Objective of the study

The study was guided by the following objectives:

- **i.** To examine how social status of the household influence adoption of improved energy saving cook stoves in the rural area.
- **ii.** To assess the level at which the economic status of the household influences the adoption of the improved energy saving stoves among rural households.
- **iii.** To examine how cultural believes and practices influence the adoption of improved energy saving cooking stove among rural households.

iv. To investigate the level at which sensitization of the rural households influence the adoption of improved cook stoves among the rural households.

1.5 Research questions

i. How does social status of the households influence the adoption of energy saving stoves?

ii. To what level does economic status of the household influence adoption of energy saving stoves?

iii. How does cultural believes and practices influence the adoption of improved energy saving cook stove in the rural areas?

iv. How does sanitization level of the household influence the adoption of the improved energy saving cook stove in the rural areas?

1.6 Significance of the study

The study established the determinants of adoption of energy saving stoves among rural households of Kisumu North Location, Kisumu County. There was need for research in appropriate technology which has been applied in the making of the energy saving cook stove so that technology can be linked to the local, social and economic environment.

This research was intended to achieve this through the appraisal of various aspects of appropriate technology. This study was unique in that it was designed to include non-users of the improved energy saving stoves while other studies appear to concentrate on the users of the improved energy saving cook stoves only thus ignoring the factors influencing non –users and their views. The inclusion of this group provided information related to adoption of energy saving cook stove.

1.7 Basic Assumption of the study

Rural households in Kisumu North location use different types of stoves for cooking ;a house hold would accept and would adopt a device which fit the life of the rural family provided she perceives it as relevant and aid in making life easier; Household accepts and adopts a device if they are aware of its existence and well informed about it, provided the benefits are perceived to be greater than the initial and maintenance cost is low; Users of the him proved energy cook stoves are able to correctly identify the challenges involved in adoption and utilization of energy saving cook stoves.

1.8 Limitation.

Some of the non-users of the improved energy saving stove were not very free to talk about why they are not using these kinds of stoves. The study covered household from the same geographical location therefore it was not possible to identify all possible determinants of adoption of the improved energy saving stoves among the rural households, however, this study serves as a basis for undertaking similar studies in other locations. It also gives direction of future research

1.9 Delimitation of the study.

This study was carried out within Kisumu North Location, Kisumu County. The researcher was familiar with the vernacular language being spoken by the locals and used every means possible to create a conducive atmosphere for discussion with both the non-users and the users of the improved energy saving cook stove.

The researcher convinced them that the purpose of the study was not for victimization at all and therefore any information given would be used for the research purposes only

1.10 Operational Definition of significant Terms

Technology adoption: The choice to acquire and use a new invention or innovation

Diffusion: The process by which something new spreads throughout a population

3-stone stove: This is the most rudimentary form of cooking, whereby three large stones are placed in triangular pattern on the floor. These stones act as the stove, over which a pot is placed. Households generally use firewood, charcoal or agricultural waste as fuel when using the 3-stone method.

Clean energy: This term is used to refer to modern fuels with significantly low levels of smoke emission, and reduced environmental implications.

Fuel Switching: The practice of using more than one fuel type to satisfy daily cooking needs. This often occurs when households prefer to cook different meals with different stove types.

Gender roles: A set of social norms which are considered appropriate for specific gender group. These are usually culturally determined and guide the behavior of households. Cooking for example is a gender role given to female members in the study site.

Greenhouse gas: Gas that absorbs radiation like gas that contributes to the warming of the earth's surface, e.g carbon dioxide, methane, nitrous oxide, ozone, or water vapor.

Kenya Ceramic Jiko: The Kenyan ceramic KCJ is a light, portable charcoal burning stove consisting of two distinct units- a metal cladding and a ceramic liner.

Kuni Mbili jiko: A cook stove that is designed to take two pieces of firewood at a time

Maendeleo Jiko: A device developed to replace the three stones with inbuilt ceramic Liner that is inverted, bell bottom shaped with an opening for feeding fuel wood and V- shaped pot rest.

Cultural beliefs: Set of written rules that prescribe how a group of people with common life traits live and interact with one another. The cultural practices set a given norm to which every member has to follow in that society. The cultural practices influence acceptance of new external cultural belief in the community

Individual acceptance: Personal decision on adults to conserve the following. The individual acceptance is determined by the individual willingness to accept to adopt a new innovation or technology. The individual acceptance may be influenced by factors such as cost.

Biomass: Those are energy resources derived from forest formation such as closed forests, woodlands, bush lands, grasslands, Farmlands, plantation and agricultural and industrial residues.

1.11 Organization of the study

This document is organized into five chapters: Chapter one is the introduction and includes background, statement of the problem, purpose of the study, objectives of the research, research question, Significance of the study basic assumptions of the study, limitation of the study, delimitations of the study and definition of key terms. Chapter two contains literature review with a brief background of pretest and posttest and then delves into the determinants of adoption of improved energy saving cook stoves among rural households of Kisumu North Location Kisumu County, Kenya. It also highlights the theoretical and conceptual frameworks upon which the study is anchored. Chapter three focuses on research methodology to be employed. This is covered in the following sub-areas research design, target in the following sub areas; researcher design, target population, sample size and sample selection, data collection and the data analysis which will be employed . Ethical consideration is also discussed in this chapter. Chapter four comprise of data analysis, Presentation and interpretation and lastly chapter five contains summary of findings and discussion. It also contains references and appendices.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature reviewed. The various areas discussed have been presented with respect to the views of other authors and academicians on the determinants of adoption of improved energy saving stoves by rural households. The various sections presented here are; theoretical framework, concepts of appropriate technology, empirical review on determinants of adoption of improved energy saving stoves by rural household and the conceptual framework.

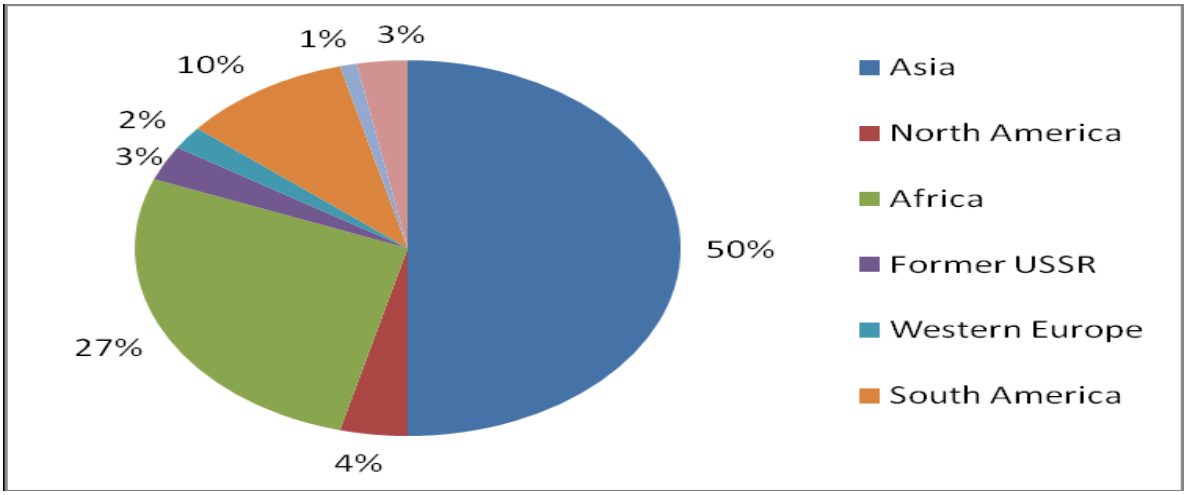
2.2 Wood fuel situation

The heavy dependence and inefficient utilization of biomass resources for energy have resulted in high depletion of the forest resources in the world (UNEP 2006). Therefore the study presents the wood fuel situation globally, in developing countries and in Kenya.

2.2.1 Global Wood fuel situation

The total production of wood in 2000 reached approximately 3.9 billion cubic meters of which 2.3 billion cubic meters was used for wood fuels. This means that approximately 60 percent of the world's total wood removals from forests and trees outside forests are used for energy purposes FAO, (2008**).** Thus it is very important for efforts to be made in order to reduce the demand on wood biomass and thus conserve the forests and the environment. Asia and Africa produces over 75% of the wood fuel Emily, (2001) (Fig. 2.1). The projections of global wood fuel consumption by 2010 ranged from 1.5 billion m^3 (a decrease of 16% from 1998 levels) to 4.25 billion m^3 (an increase of 136%).

Figure 2. 1: Global Wood fuel Production, 1998



(Emily, 2010)

2.2. 2 Wood fuel situation in Developing Countries

In Africa over 90% of the wood taken from forests is wood fuel. The majority is consumed directly as fuel wood, however, a varying but substantial amount is transformed into charcoal. More than 80% of it is used in urban areas making charcoal the most important source of household energy in many African cities (Seidel, 2008; Kammen et al, 2005, Amour, 1997).

Wood is the most important of several biomasses, however, in many individual nations, dependence on wood varies. In some countries, like Nepal in Asia, and Kenya, Uganda, Rwanda, and Tanzania in Sub-Saharan Africa, wood fuels provide 80% or more of total energy requirements. Table 2.1 shows that there will be a greater demand for wood fuel by the year 2030 in Africa and yet there is shortage in its supply currently. Thus there is need for adoption of technologies that minimize wood fuel consumption in order to make its usage sustainable and also encourage forestation and re-afforestation.

Table2.1: FAO projections of wood fuel consumption to 2030 in Africa

	1980	1990	2000	2010	2020	2030
Fuel wood (million cubic metres)						
Africa	261.1	305.1	364.6	440.0	485.7	526.0	544.8
Charcoal (million tons)						
Africa	8.1	11.0	16.1	23.0	30.2	38.4	46.1

Source: Adopted and modified from Arnold & Pearsson (2003)

Demand for fuel wood and charcoal is driven primarily by growing numbers of rural poor, who depend on wood for their cooking and heating needs. Charcoal is also an important fuel among the urban population, whose numbers are expanding rapidly. According to Mangat, (2009) , statistics provided by Camco Global shows that wood fuel is one of the major causes of environmental degradation and accounts for about 18% of the world‘s GHG (green house gases). It is estimated that 17-18% of green house gases are produced in tropical regions (most of the region covers developing nations) by land that is being cleared for agriculture, logging and activities that degrade the integrity of forests. The International Energy Agency estimated that the number of people using fuel wood and other biomass fuel in Africa will rise by more than 40% between 2000 and 2030 to about 700 million and that in the latter years there will still be about 1.7 billion users in Asia IEA, (2002). This has a serious implication on emission of GHGs unless efforts are made to adopt improved stoves in order to improve efficiency, reduce demand of biomass fuel from forests and thus mitigate against global warming and climate change.

Most households in developing countries use traditional stoves e.g the three stone and the metallic charcoal stoves which are less efficient in energy conservation. Many Sub-Saharan African countries share the problem of over-exploitation of wooded lands.

Vast areas that were once highly productive in terms of biomass yield have been completely depleted. Estimates indicate that over 11 million hectares of tropical forests are lost annually under excessive clearance and mismanagement Kammen, (1995). This eliminates the ground cover making the land prone to soil erosion thus accelerating land degradation and reducing one of the main sources of wood fuel causing fuel shortage

2.2.3 Wood fuel situation in Kenya

The current biomass demand in Kenya is estimated at 40.5 million tonnes against a sustainable supply of 16 million tonnes Kamfor, (2002). Biomass energy (mainly firewood and charcoal) constitutes 70 per cent of national energy supply, 90 per cent of which is consumed by households (UNEP, 2006).

Around 1152 kg/household (equivalent to more than 20 trees/year) TaTEDO, (2005). The adoption of wood fuel saving technologies would go a long way in ensuring sustainable use of the forest resources as the fuel wood demand will decrease, it also reduces the time a woman spend in fetching firewood therefore releasing her to be involved in other productive activities.

Currently the uptake of the fuel wood improved stove is estimated at 5% Muchiri, (2008) and yet majority of the rural people in Kenya use firewood as their main source of fuel. This has implication on sources of the biomass and ends up causing encroachment to forests in search of fuel wood impacting negatively on forest conservation. It also does mean that many people in the rural households especially women and children are exposed to indoor air pollution which is detrimental to their health thus the need for adoption of the improved stoves.

Fig. 2.2: Jiko Kisasa with a Traditional pot

Source: Miles (2007)

Fig. 2.3: Kuni Mbili jiko

Source: Majid (2006)

2.2.4 Improved Charcoal wood stove (Kenya Ceramic Jiko)

The Kenya Ceramic Jiko (KCJ) is one of the successful stove dissemination projects in Africa. The KCJ is made up of a metal cladding with a wide base and a ceramic liner. At least 25 per cent of the liner base is perforated with holes of 1.5 cm diameter to form the grate. The stove has three pot rests, two handles, three legs and a door. The door is used to control the airflow. The standard model weighs about 6 kg, which means it can be carried around easily (KENGO, 1991; Karekezi and Kithyoma, 2002, Coelho et. al 2004).

The stove is suitable for cooking and space heating. The KCJ helps to direct 25-40 per cent of the heat from the fire to the cooking pot. The traditional metal stove that the ceramic Jiko replaces delivers only 10-20 per cent of the heat to the pot, whereas an open cooking fire yields efficiencies as low as 10 per cent (Kammen, 1995).

The KCJ (Figure 2.4) stove was developed through a design process spearheaded by the Ministry of Energy. The jiko stove easily found acceptance among urban stove producers who were initially offered free training and marketing support by KENGO, working with the ministries of Energy, Agriculture and Environment and Natural

resources. KCJ is purchased mostly due to its ability to reduce cooking time, produce high quality meals, reduce charcoal consumption, minimize accidents, and ease of cleaning and maintenance. Its physical appearance is not a major concern or reason for a family to buy or not to buy the stove. There are many sub-quality versions of the KCJ on the market which do not have the tensile strength and resilience of

The original model, nor do they have a liner with as much resistance to cracking and breakage (DFID, 2000).

Fig 2.4: Kenya Ceramic Stove

Source: Majid (2006)

Although most producers and dealers of the jiko stove have been men, many women in small urban areas have benefited immensely from the technology, significantly improving their standards of living through gains in time and income (Okello, 2005).

Reductions in fuel use associated with the KCJ and other improved stoves have been examined in a number of countries. In Tanzania, annual fuel consumption for traditional charcoal stove was found to be around 1080 kg/year/household while for improved charcoal stove it was around 370kg/year/household (annual charcoal saving is 710 kg/household which is equivalent to around 60 trees) (TaTEDO, 2005)

In Rwanda, the savings with improved charcoal stoves were even greater. There, consumption of charcoal dropped to 0.33 kg per person per day from 0.51 kg per person

per day. This means that in a year a family could save about 394 kg of charcoal worth 6,310 Rwanda Francs (Ksh. 7,232) (Smith et al, 1994).

In Kenya charcoal use among a sample of families using the KCJ fell from 0.67 kg to 0.39 kg/person/day. This totals over 600 kg of charcoal/year for an average family, and a savings of over $US 64.7/year i.e. Ksh.5590 Karekezi and Ranja, (1997); Coelho et al, (2004). Other tests done in Kenya indicated an average decline in daily charcoal consumption from 0.7 kg to 0.4 kg per person with an improved stove Johnson et al (2007), adding up to a total yearly saving of 613 kg per family Smith et al. (1993). This would save on the money used for purchase of charcoal and thus help in improving the family living standards. It would also reduce demand for charcoal thus saving the forests trees, shrubs and herbs and thus promoting environment conservation.

According to Johnson et al. (2007) up to the equivalent of 10 tonnes of carbon dioxide may also be saved per household per year with an improved stove. This would reduce the GHG emission to the atmosphere and thus assist in mitigating global warming and climate change

2.3 Social status of household and adoption of energy saving cook stove

2.3.1Family Size

Family size is assumed to have a positive influence on the adoption of the improved energy saving cook stove technology. It is assumed that larger household will cook more food for the family members requiring use of larger pans and more fuel wood hence, will be inclined to adopt the improved energy saving technology. It is expected; therefore that a larger household size will affect positively the decision of adopting the improved energy saving cook stoves technology (Inayat, 2011).

According to Karanja (1999), a family size has an influence on the adoption of energy saving technologies as she found out that a family size of 1-3 and 4-6 children seemed to have adopted more energy saving technologies as compared to a family size of 7-9 and 10-12. She attributed low adoption of energy saving technologies by larger families and thus their preference of the inefficient wasteful mode of cooking (open field).

This implies that large families can end up becoming poor managers of environmental resources and thus the need for awareness creation of the benefits even to larger families when energy saving technologies is adopted.

Household size is expected to have appositive influence on the adoption of the Maenedeleo stove technology. It is also expected to have a positive influence on the model of the stove used (Inayat, 2011).

2.3.2 Level of Education

High numbers of illiterate people living in rural areas and the illiteracy is high among women who are the main users of stoves; Cortlear (1990) observed that years spent in formal education may affect possibility of adopting an in novation and a likely source of inspiration for innovation. Makame Omar Makame (2007) empirical findings confirm that, the role of information on what Rodgers (1983) considered as triability and observability characters of innovation are very crucial ingredients in the diffusion and adoption of innovation in the social systems. Consumer innovation like stoves is relatively less observable, and thus diffuses at extremely slow rate unless it should be highly pronounced.

According to Kumar et al (2003) in their study on dissemination of energy efficiency technology in India, depicted that low educational attainment was one of the determinants of slow adoption of improved cook stoves technologies, Bhatt and Sacham,

(2004) added that the pattern of household domestic energy consumption changes with increases in the income level. Similarly Sagar (2005) also posited that household energy consumption behavior can be explained in terms of wealth and substitution effects of increase in household income.

Education level of the household head influences the adoption of technologies as learned people usually adopt new ideas faster than those who have not been to school (Jogo 2001).

According to Hirok et al (2010), people with higher education level have better access to information and knowledge that is beneficial in their domestic activities. They also tend to have higher analytical capability of the information and knowledge necessary to implement new technology and realize the expected result. Hence the higher education level allows household heads to make efficient adoption decisions Rahn& Hyffman, (1984) and be the early adopters who can take advantage of new technology and profit from it (Gardner and Russer , 2001).

Cotlear (1990) argues that formal, non-formal and informal education may provide specific or general knowledge, which provides the benefit and uses of new technology.

A study conducted in Malawi by IFAD, (2002) revealed that education had a positive influence on the adoption had fireless cooker. Household with one or both or both parents with some formal education accepted the fireless cooker technology more readily.

According to (Aneani et al, 2012), education status is stated to have an influence on adoption decisions as many technologies because of higher level of education, the women who are mostly the cooks, would be in a position to technically and economically asses the new technology to clear debuts and uncertainties associated with it and enhance its adoption. However, according to Andiema et al (2001) in their study of socio

economic factors influencing adoption of “Maendeleo” cook stove found out that the level of education of the household is not a major determinant of adoption since the adoption of the Maendeleo cook stove technology cut across all the levels of education.

A number of studies that sought to establish the effects of education on adoption in most cases relate it to years of formal schooling (Tjorhom, 1995, Feder and Slade, 1984) generally; education is thought to create a favorable mental attitude for the acceptance of new practices (Waller et al 1998: and caswel et al, 2001). According to Rodgers (1983) and Ehler and Bother (2000) technology complexity has a negative effect on adoption and this could only be dealt with through education.

2.3.3 Gender Issues associated with improved energy saving cook stoves.

There is distinct gender dimension in the household energy sector in much of the developing world. Mathotra et al (2004) discuss that women and men do not have the same burden of environmental and health factors associated with biomass use, to the same extent. Women in many countries are responsible for the collection, transportation, processing and storing of fuel, as well as the cooking activities; while men typically make decision of financial nature (Matlhotra et al 2004 , schlag & Zuzart, 2008, who 2006) it is thus possible to reduce that the health burdens associated with traditional biomass cooking are disproportionally felt by women because of their customary involvement in cooking, women’s exposure is much higher than Men’s (Anaemi et al 2012)

The time associated with the preparation of food using inefficient cooking technologies as well as the collection and processing of firewood is also of a significant concern. In the rural communities that rely almost exclusively on solid biomass for cooking fuel, the burden of firewood collection falls on women and, to a lesser extent, young girls.

Women gather firewood on foot, often walking long distances with heavy loads (Schlag & Zuzarte, 2008: 9) this time spent collecting fuel wood represents an opportunity cost that could potentially be spent on income generation and or education activities (schlag & Zuzarte, 2008, Joan et al 2009).

Malhotra et al (2004)158 adds that gender consideration are vital social aspects to consider in stove programme design. The needs of men and women are different when it comes to household energy. He argues that a technology that aims at benefiting women in the cooking energy sector must meet the following criteria: the device must retain all the features that the women value in their traditional cooking systems. The new device should serve all the uses the current device is being put to; the women should be able to look after the regular operation and maintenance themselves; and the device should be aesthetically appealing "if modern stoves fail to meet those criteria; they might run the risk of not being used by women - the primary beneficiary of improved stoves."

2.4 Economic status of the house hold and adoption of energy saving cook stoves

2.4.1 Income Level

Household income can be used as a proxy to working capital because it determines the available capital for the investment in the adoption of technologies and it is a means through which the effect of poverty can be assessed. According to the World Bank (2003), poverty is the main cause of environmental degradation. One way of measuring the household poverty is through income. Household income has a bearing on the socio-economic status of family.

According to GTZ, (2008), the low level of income of the households depending on biomass fuels is a major barrier to increasing the dissemination of improved stoves. For poor households stoves represent a high initial investment cost which prevents them

from purchasing the products. Income levels plays a role in determining whether one acquires a new technology or not .The lower the level of income the lower the adoption of any technology while the higher the level of income , the higher the level of acquiring the use of a new technology. This is because most of the new technologies have a cost and only those with money are able to adopt the technology faster.

Wallis Report (1997) sited that the consumers will seek out those financial products and supplies which offer the best value for money and they are educated about it. Hence for adoption of improved energy cook stoves to be adopted by the rural households there is need for awareness to be created about such products and the consumers be explained for how it adds value to other cooking devices.

To be able to acquire and adopt new technologies, economic power is necessary. It appears that the financial situation favours rural women. According to available information, rural credit is scarce and is seldom extended to women because they lack assets, and usually land is registered under the man's name except in a few cases where a woman has bought land herself. Ownership is generally associated with men in the traditional community. Most rural communities are traditional set up.

Tinker (1980) notes that women's uncertain access to land, credit and education prevents their access to and control of technology which could help them out of the mire of poverty so that they could afford credit and education, the vicious circle intensifies women's dependency on men in rural areas and encourage urban migration.

In a workshop for trainers and planners on appropriate technology for the rural family in BO, Sierra Leone, (ECA 1982), It was observed that there were no discriminatory laws against women's in obtaining loans. But traditional believes and practices discriminate against them.

2.4.2 Employment status

Although there are other factors that hinder development in Africa such as poor governance and structural adjustment programmes, the effect of gender inequality in the development process cannot be ignored. The actual contributions of men and women in Africa economies are unequal in Africa, women work longer hours than men, in Kenya for example, women are productively engaged for 12 hours a day compared to shows for men (Chiuri, 1996). Yet most of what women do productively is ignored and is not included in the system of local and national accounts; that means that most women's productive work is not accounted for.

Celeskki (2000) adds that another factor contributing to women's low labour. Women living in developing countries spend long hours on household survival activities, but despite this large expenditure of time and physical energy. Their efforts are often unacknowledged.

Rural households affected by HIV/AIDS tend to experience severe labor shortage not only because the sick person is less able to work, but also because the other household members (often women and girls) spend increasingly more time on caring for the sick as the disease progresses. Afield study form western Kenya IFAD /FAD, 2003 showed that women often spend two or five hours each day on collecting firewood, many women in female headed households in several village listed water and collection among their most time consuming tasks. It is obvious that initiatives and support that can free labour may greatly assist households to cope with the impacts of HIV/AIDS as well as to provide rural women and men with options to improve their livelihoods.

The adoption and use of the improved cook stoves in Kenya has strong links to gender and poverty issues. Khamati, (2000), in her study of the rural stoves programme in Kenya states that over the years, the improved cook stoves have been more difficult to

introduce in rural areas because stoves cost money and the traditional three-stone cooking system is free. She further states that rural people are generally very poor and women and children mostly collect their fuel wood for free, so there is less incentive than in the urban areas to spend money on a stove for reasons of fuel conservation.

2.4.3 Sources of income

Financial limitations present considerable challenges for rural energy expansion. The upfront cost of renewable and energy efficient technologies can represent barriers for the rural poor, who have difficulty credit access from convention banks due to their lack of assets for collateral. Banks and financing agencies are generally not equipped to manage myriad of micro-projects. Women often face additional cultural and legal barriers in applying for bank loans. Overall, there is a shortage of capital available for funding small scale decentralized energy systems. Possible solutions involve the organization of ad hoc (specialized financing institutions and mechanisms for aggregating demands).

Governments as well as international agency recognizing the difficulty faced by poor farmers and rural duelers in obtaining credit for investment in their productive activities have begun to design program tailored to meet their specific needs (FAO 2000). Balachandra (2006) looked at the changing patterns of the fuel wood used from traditional wood stoves to kerosene and from Kerosene to LPG and electricity and note that biomass as a source of fuel to relatively cleaner fuels is primarily driven by income.

2.4.4 Cost

According to Msami P.T (2012) the price competitiveness of fuel is significant barriers to improved cook stove adoption. In rural households where wood fuel is collected for free households are less inclined to use improved cook stove.

Sing et al (2006) analyzed the barriers to adoption of cleaner and more efficient technologies in the Indian power sector and cited that high initial capital costs and lack of proven variability for the technology in India are the main barriers to adoption of advanced technology. However a study carried out by Jaffee (2003) reveal that as the cost of the technology falls, more consumers receive positive net benefit and adopt the technology. If the benefits are normally distributed across consumers the rate of adoption will follow an s-shaped curve. This suggests that higher prices or lower capital costs should increase the rate of technology adoption.

Empirical evidence from the United States suggest that higher energy prices have encouraged the adoption of energy efficient worm air conditioners, central air conditioners, and gas water heaters (Newell et al 1999). This is newer evidence that decrease in capital cost have had a larger effect on operating cost Jaffe suggest that either higher discounts rates or capital market constraints have played a role in adoption by consumers. This is consistent with the finding that of Abara and Sigh (1993) those larger fixed costs become constraints to technology adoption especially if the technology requires substantial amount of initial step up cost.

Oster and Morehad (1999)in Andiema, argues that technology that are capital intensive are only affordable by wealthy farmers and hence the adoption of such technologies is limited to larger farmers who have wealth (Khamna, 2001)

2.5 Cultural beliefs and practices of members of the household and adoption of energy saving cook stoves

According to Macdonald (2000), the concept of culture may be defined as the shared beliefs and symbols of a group of individuals (Mc Donald 2000). Theorist like Powel D: Maggio (1991) have stressed that many dynamics in the organizational

environment stem not from technological or material imperatives but rather from cultural norms, symbols, beliefs, and ritual.Vitell et al (1993) describe how culture differentially affects individual's formation of teleological and deontological norms, hence, individuals prescribing reasoning.

According to Rogers (1962: 1969) among the various norms existing in a social system, one is of particular relevance: the norm which prescribes the behavior individuals will follow with respect to novelty and change. The Americans for example are said to be attracted by the new. By contract, countries like France considers change as having much less positive appeal (often), this attitude is linked with a basic fatalism and/or cultural ethnocentrism.

Some researchers believe that dominant designs can help an innovation to succeed; some others believe that building an innovation in the paths of the old ones is the key to the success of an innovation. Innovations that are compatible with the intended adopters values, norms and perceived needs are more readily adopted (Caswel et al (2001), Malhotra et al (2004).

In an increasing global business environment one of the central challenges facing firms is how to balance the desire for standardized global policies, with appropriate consideration of the specific norms of various cultural context (Barletta and ahoshal 1998, Enderle, 1997) different cultural background lead to different ways of perceiving the world and cultural differences affect individuals' ethical reasoning (MacDonald 2000). He explains that the concept of culture may generally be defined as the shared beliefs and symbols of a group of individuals. Theorists like Powel and et al (1991) have stressed that many dynamics in the organizational environment stem not from cultural norms, symbols, beliefs and ritual. Vitell et al (1993) further describes how culture differentially affects

individuals formation of teleological and deontological norms; hence, individuals' prescriptive reasoning.

Cultural transmission simply replicates the existing distribution of behaviors, beliefs and so on (Binford 1983:222).Humans rely on social learning or cultural transmission to acquire the majority of their behavior (Bandura 1977 Boyd and Richerson 1985: Cavalli- ssofoza and Feidman 1981) adds that culture also has a powerful influence on information related behaviors including at the most basic, level what is considered to be legitimate information (Hall 1983) .In many cases the past, culture influence the adoption like in the case of pure water in Egyptian village, with their religion perceived water boiling hot/cold as in compatible with their religious beliefs or in the case of the people in modern India, where there is a strong norm against eating food with the left hand because they believe that it is unclean, how can we persuade 900million of people to eat with their left hand? If we are not capable of convincing them that eating with the left hand is not unclean, how can we persuade them to accept an innovation? In persons voluntaristic theory of action it describes an actor who makes choices in a situation, choices limited by objective conditions and governed by normative regulation of the means and ends of action (Warner 1978: 121).

According to Baran, Patterson, Harris and Beyond 2006) technology adoption incorporates two essential elements, the embracement of the technology by individuals and its embedment in society.

2.5.1. Decision making dynamics

When a new technology is introduced in rural communities not only do individual and household factors (such as ability, wealth, risk aversion, etc) affect the household's likelihood of technology adoption; but and probably more importantly, network and village factors also appear to matter. In the recent years, the empherical development

literature on technology adoption has especially focused on the presence of social factors related to social learning and information diffusion at the village level (Conley and 2008, ishmam 2002, Foster et al 1995).

Each community in Kenya has its own socio cultural practices that not only shape their code of conduct but also provide their identities and guidelines on the control and use of resources. Men are the heads of households and therefore top decision makers in resource use and management with inheritance of resource, especially land mainly handed over to the male members of the community. Clay mines, sand, the factors in the production of improved cook stove are the ones to control the sale and benefits that emanate from the ICS business. Women however are the main users of the improved cook stoves as men rarely get involved in the kitchen.

Currently in Africa, when energy technology must be purchased, men tend to play a central role in the decision- making because these are important financial decisions even when they involve the kitchen which is generally viewed as women's domain (WEC/FAO 1996) (Clany 2003)

Schirnding, (2000) adds that due to the women's disadvantaged social status, women have little decision making powers in their families, communities and countries, and have limited access to productive assets. Investments to improve stoves, kitchens and cooking fuels tend to be considered as marginal items when men make the decisions about household purchase. Women interested in acquiring new energy equipment may lack the capital to buy it or be unable to obtain the money from their husbands.

2.6 Sensitization of the Members of the Household and adoption of energy saving cook stoves

2.6.1 Information dissemination

The area of information dissemination is problematic as far as appropriate technology is concerned. Information dissemination is not an easy task particularly in rural areas and more so when dealing with illiterate or semi-illiterate people who may be too poor to afford modern gadgets.

According to Carr (1982), there is definite lacking in appropriate technology information in the rural areas and more so among women than men. He noted that many improved technologies which are appropriate for rural women are not being used by them because in one way or another they are denied access to them. Furthermore in the majority of cases, rural women are completely unaware of the existence of improved technologies which could help them. Carr adds that women information does not trickle down to the village level. It is usually the men who receive it. This kind of rural person i.e. a woman may be in need of setting up a business, for instance pottery and ceramics, would not have technological information that could give her a good base to start operation.

An alternative theory of technology diffusion posits that the limiting factor in technology diffusion is information, and that the most important source of information is people who have already adopted the technology. This implies that adoption itself generates information externalities. These externalities and the fact that information is a public good provide a rationale for government provision about energy efficiency. This has led to appliance labeling requirements, which Newell et al (1999) find to have encouraged the adoption of energy efficient air- conditioners and water heaters in the United States.

Makame Omar Makame (2007) says that emphirical findings confirm that the role of information on what Rogers (1986) considered as viability and observability characters of innovation are very crucial ingredients in the diffusion and adoption of innovation in the social system. Consumer innovation like stoves is relatively less observable, and thus diffuses at extremely slow rate unless it should be highly promoted

Howard and Moore (1982) emphasize that for adoption, consumer must become aware of the new brand .An important characteristic for any adoption of innovative service or product is creating awareness among the consumers about the service/product sell themselves (cooper, 1997). Hence if Australian consumers are not adopting internet banking, it may be because they are not aware about such a service being available and the added value that it of

In India and China where households were given stoves without explanation, stoves sat idle (Ergeneman 2003). A similar situation occurred in an Internally Displaced Persons camp (IDP) in Uganda where individuals had expressed interest in fuel efficient methods of cooking; improved cook stoves were disseminated but stove use training was no initial demonstration of stove purpose and fuel saving strategies prior to dissemination which ultimately reduced the rate of acceptance.

An obvious disadvantage of improved cook stove is that they cost money (Ergeneman, 2003;Gill, 1985; Jagadish, 2004) Furthermore, cement stove models need to be rebuilt after 2-3 years of use, creating additional costs. In comparison, the three stone can be obtained at no cost and are extremely durable. The economic situation of subsistence population is such that they do not see the long term benefits for the short – term cost of the stove (Manuel, 2003) cost is a significant barrier to broader stove use. As a means to increase dissemination of improved cook stoves more affordable. Subsidies increase stove dissemination, but decrease the true worth of a store (Haider, 2002) and do

not ensure that stoves get used. Subsidies can be offered in partial or full depending on the project sponsors. Subsidies in India and Tanzania resulted in stove which sat idle as were used for other purposes such as tools (Ergen ema, 2003: Manuel 2003 Mission, 2006; Schesinger, 2008) Stove recipients in a Kenyan project didn't value the subsidized stoves simply because they were free. Stoves given away for free were often perceived as worthless by the recipients (Manuel 2003). In Ergeneman's evaluation of a partially subsidized stove project in India, manufacturers who received the subsidies focused on government requests in low efficiency stoves that went unused (Ergeneman 2003).

The introduction of a new object into any community requires a particular means of dissemination to encourage adoption when this process is neglected so too is adaptation (Clark, 1989. Ergeneman, 2003).

2.6.2 Perceived usefulness ease of use and Frequency of use

Davis introduced in 1989 a development of the theory of reasoned action that was supposed to explain why people accept or reject new products (Davis 2000).It was specifically designed while keeping in mind the adoption of appropriate technology related products in the community context. The key components of this model were perceived usefulness and perceived ease of use (Davis 2000).Studies have used this model also in the setting of private individuals, as the theory is relevant outside the community as well. The model stipulates that usage behavior depends on the subject intention to use, which depends on the perceived usefulness of the product.

The perceived usefulness is defined as the extent to which a person finds that using the new improved energy cook stove will enhance his or her cooking activity (Doll et.all 1998).According to Barezek et all (2007), the perceived usefulness of the products is its ability to provide means and relationship than the given thing as a means to a

designed end or to provide a rationale upon which to make decisions. Means and knowledge accounts for why consumers' use a product .The perception of usefulness is formed in interaction with other individuals and a system. The perceived usefulness of the knowledge can be applied in a particular decision making situation of which decision is contingent upon. (Vankatesn and Davis, 2000).

2.7 Theoretical framework

Adoptions of new technology are influenced by a variety of factors. The study will be based on the theory of diffusion of innovations formulated by Rogers (2003) but which can benefit from other theoretical contributions from other authors (Pareek and chattopadhya, 1966: Agarwa 1983, shih and Vakatesh,2004; dearing,2009.]

The diffusion of innovations theory describes the process by which an idea or object perceived as a new (an innovation) is communicated to individuals and accepted by the majority of a population. It requires a time period for the individual members of the social system to receive the information about the innovation through different channels, to evaluate its usefulness, and to decide to use it or not. We propose that the introduction of new/devices takes place in a dynamic system with strong interactions between the user, the technology, the fuels and the larger socioeconomic and ecological context. Since the main goal of a stove user is to prepare cooked food rather than the cooking device in itself the argument is that at the household level the innovation being introduced is not only the cook stove device, but a set of modified (or use) cooking practices making fried rice, Ugali, handmade tortillas- that result into the incorporating of the new stove technology and fuels into the existing household system.

2.7.1 Existing gaps in knowledge

Whereas the theory has been used to explore a variety of factors determine adoption, the other factors such as the cultural beliefs and practices, social status of the house hold, economic status of the house hold is not adequately explored. This is the knowledge gap which this study seeks to address. The study will explore the determinants of adoption of improved energy saving cook stoves among rural households. The determinants as outlined in the conceptual framework include; social, economic factors, cultural beliefs and practices and information dissemination among the rural households.

2.8 Conceptual Framework

According to Mugenda and Mugenda 2003), a conceptual framework helps the reader to quickly see the proposed relationship between the variables in the study and show the same graphically or diagrammatically. The conceptual frame work of this study is based on four variables namely social, economic status of the household, cultural beliefs and practices of the members of the households and the sensitization level of the members of the household

Figure 2.1 below shows how the independent variables influence the adoption of the improved energy saving cook stoves which is the independent variable.

Variables

Independent variables

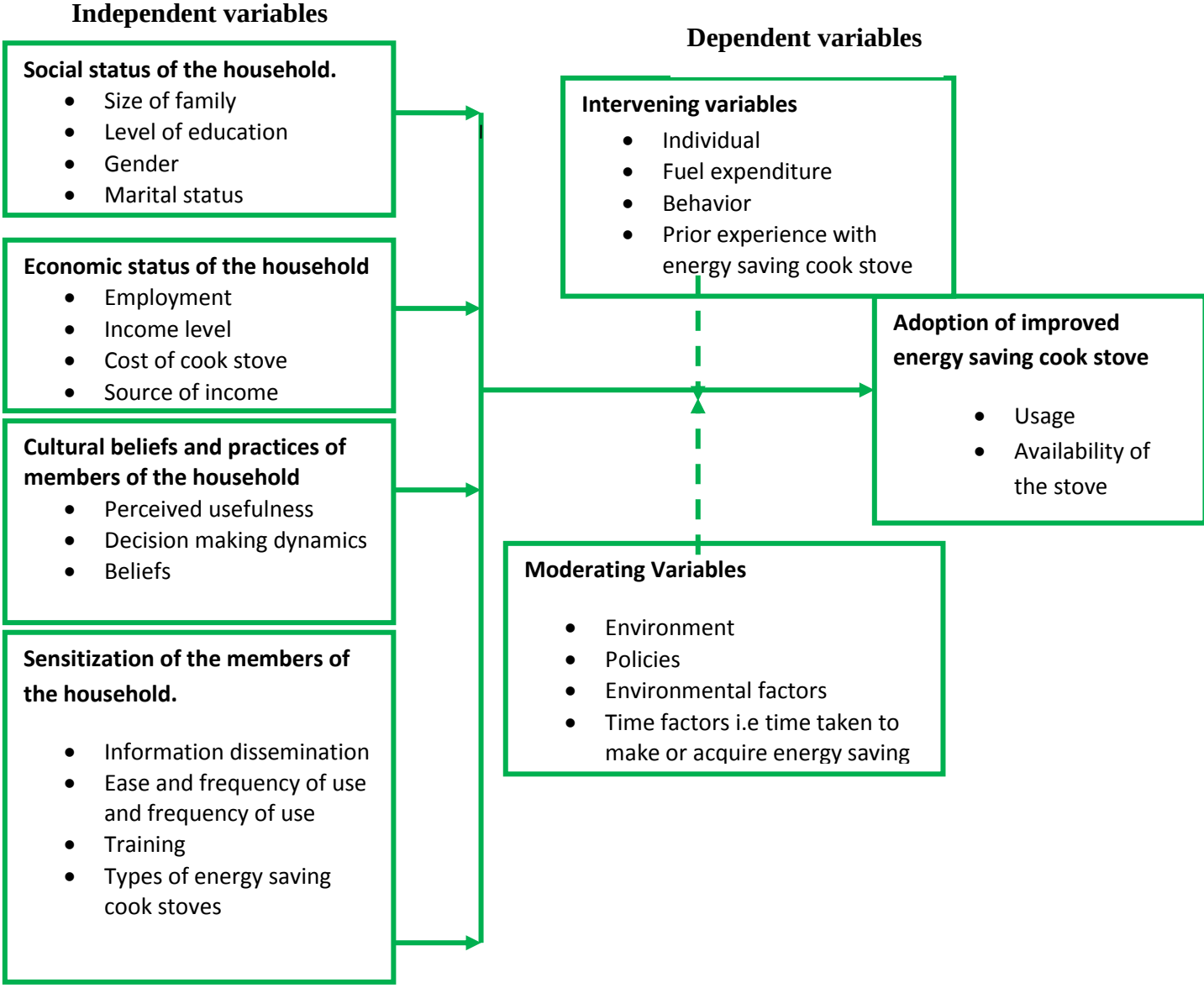


Fig. 2.1. Conceptual Framework

In this study the dependent variables investigated included the social status of the household, economic status cultural beliefs and practices of the members of the household and the sensitization level of the members of the household. Social status of the household such family size, level of education, Gender and the marital status of members of the household can have a positive or negative effects on adoption of improved energy saving cook stoves, Rogers,(2003) states/ argues that adoption was appositive or negative among the people who are educated compared to the literate.

Aggarual et al(2004) states that education level is a factor that may contribute to either adoption or non-adoption of improved energy saving cook stoves. Size of the family can also influence adoption of the improved energy saving cook stoves (Karanja 1999, Inayat 2011). This coupled with the gender and the marital status of the household may lead to adoption of the improved energy saving cook stoves. Economic status of household such as employment, income level, cost and sources of income are likely to lead to adoption of energy saving cook stoves. For example low cost of the device may influence one to buy. In contrast when the device is expensive and cannot be easily afforded, one may resort to other devices which can be easily acquired like the traditional three stone fire place which consumes a lot of fuel.

Cultural beliefs and practices of the members of the household are likely to hinder the adoption of the energy saving cook stoves, especially in communities where there are strong cultural believes in certain food preparation methods. Sensitizations of members of the household such as information dissemination which are associated with communication are likely to influence adoption of the energy saving cook stoves. Extraneous variables such as the environmental factors, time taken to acquire or make device and the environment where the person lives although not directly linked to the main reason for adoption of the energy saving cook stoves may influence its adoption. Intervening variables such as individual characteristics, fuel expenditure, behavior, and prior expenses with the improved energy saving cook stoves may influence adoption given the appropriateness for use of advice the adoption rate of the improved energy saving cook stoves as opposed to the device they are used to like the three stone fire stoves.

2.9 Summary of Literature Review

Many projects have been initiated by both government and non-governmental organization in Kenya to enhance energy conservation. One such project was the improved energy saving cook stove yet the rate of adoption still remains slow (Kisumu District Poverty Reduction Strategy 2010).

The literature reviewed showed that different factors determine the adoption of improved energy saving cook stoves among the rural household. The studies reviewed in this section tended to focus on the social, economic, Sensitization of the members of the household and the cultural believes and practices which influence adoption of energy saving cook stoves.

Much of the studies focused on poverty among the rural households and especially facing the women who are by culture have the responsibility of taking care of the family members and the appropriateness of the device to the users. There is need for research on other determinants of adoption of approved energy saving cook stoves among rural households.

The heavy reliance on fuel wood energy has excreted an imbalance of demand and supply, consequently resulting in adverse environmental impact in Kenya. As part of innovation efforts, several energy conserving technologies have been developed in Kenya. (Adiema C. 2013). A unique cook stove named Maendeleo was made and promoted in Kenya and more so Kisumu West constituency Kisumu county with the goal of reducing the quantity of wood household use for energy and ultimately reduce pressure on local vegetation. However, despite the demonstrated technological multiple benefits, and the institutional promotional efforts of the Maendeleo stove technology; the adoption level of the stoves have remained low.

The purpose of this study therefore is to investigate the determinants of adoption of energy saving cook stoves among rural households.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter sets out various stages and phases that were followed in completing the study. It involves a blueprint for the collection, measurement and analysis of data. This section is an overall scheme, plan and structure conceived to aid the researcher in answering the raised research questions. In this stage, most decisions about how research was executed and how respondents were approached, as well as when, where and how the research was completed. Therefore in this section the research identified the procedures and techniques that were used in the collection, processing and analysis of data. The chapter describes the research design and methodology that was used to guide the study under the following sub-headings: the research design, target population, sample and sampling design, data collection instruments, data collection procedures and data analysis procedures.

3.2 Research Design

According to Kerlinger (2008) ―Research Design is the plan and structure of investigation conceived so as to obtain answers to research questions or test the research hypotheses. The plan represents the overall strategy used in collecting and analyzing data in order to answer the research questions. Cooper and Schindler (2003) summarizes the essentials of research design as an activity and time based plan. Descriptive research design is used to gather information on the nature or condition of a present situation. Past events and how they relate to current conditions are also put into consideration (Cresswell, 2009; Best & Kahn, 2006).

The study adopted descriptive survey because it allows the researcher study phenomenon that do not allow for manipulation of variables as noted by Kombo and

Tromp (2006). The study was exploratory and could be appropriately executed through a descriptive survey as stipulated by Cay (1982). He observed that descriptive survey design is used on preliminary and exploratory studies to allow the researcher to gather the information, summarize, present and interpret.

The design was suitable for obtaining information from heads of the households (male or female) This was done through the use of questionnaires, interviews schedules and observation check list to collect data on information pertinent to adoption of energy saving cook stoves in the households by using this design the researcher was able to find answers to questions by analyzing specific variables relationships related to adoption of energy saving cook stoves among rural households of Kisumu North Location.

3.3 Target Population

Target population is the specific population about which information is desired. According to Ngechu (2004), a population is a set of people, services, elements, events, group of things or households that are being investigated. Mugenda and Mugenda, (2003), explain that the target population should have some observable characteristics, to which the researcher generalized the results of the study. The target population of this study included households from three sub-locations namely, Bar A, Bar B and Nyahera. The households were targeted because the study was focusing on the rural residents of Kisumu North location who could best be found in households as opposed to meeting people on street. A total of 390 households had also been chosen because the study required household survey.

Table 3.2: Kisumu North House Holds

Sub location	House hold	Km	Density
BAR A	957	6.4	697
BAR B	898	6.7	607
NYAHERA	2041	16.4	595
TOTAL	**3896**	**29.5**	**616**

3.4 Sample size and Sampling Procedure

Introduction

This section describes the sample size and sampling technique to be used in conducting this study.

3.4.1 Sample Size

Sample size of 390 household selected from the households in Kisumu North was used in the study. The sample size was determined according to Kothari (2004) what stated that 10% of the sample is a sufficient representation of the population.

From the sampling frame the required number of subjects, respondents, elements or firms is selected in order to make a sample. The sampling frame for any probability sample is a complete list of all the cases in the population from which a sample is drawn (Saunders et al., 2007). A sample is a smaller and more accessible sub set of the population that adequately represents the overall group, thus enabling one to give an accurate (within acceptable limits) picture of the population as a whole, with respect to the particular aspects of interests of the study. Sample of corresponding households will be drawn from 3896 possible households

According to Scott Smith (2013) the necessary Sample Size = (Z-score) ^{2} – Std Dev*(1-StdDev) / (margin of error)^2. Where z-score corresponds to the confidence interval and STD

corresponds to standard deviation. Taking a 95% confidence level, .5 standard deviation, and a margin of error (confidence interval) of +/- 5%.

$((1.96)^2 x 999.5(.5))/(.05)^2$

(3.90x.25)/.0025

.9606/.0025

390 households are needed

3.4.2 Sampling Procedure

According to Ngechu (2004) selecting a representative sample has significance in making a sampling frame. From the population frame the required number of subjects, respondents, elements or firms were selected in order to make a sample. Multistage and Simple random sampling was used to select the sample. First stage sampling will include simple random sampling select the houses. Second stage of sampling will involve selecting every owner of the house selected to fill the questionnaire or answer the interview questions. Iyoke et al (2006).

In this study the researcher was interested in the household owner, woman or the man who did the cooking. In a case where a child was the one heading a household then he or she was to take part in the study if he or she fell within the sample of 390. Otherwise the researcher will skip such households with no person in charge of cooking.

To choose the first household simple random number Method was used to select the names of three locations. The one that was picked first was chosen to start the survey. The actual survey started by the researcher going at the center of the randomly chosen location after which she spanned a bottle of the ground to determine the first household to determine the survey. The household at

which the bottle stopped spinning while facing was sampled first. After this, subsequent households followed a similar routine of spinning the bottle at the end of each sample

Table 3.3 Kisumu north sample size

Village	Household frequency	Proportion to size	Sample size
BAR A	957	.10	96
BAR B	898	.10	90
NYAHERA	2041	.10	204
TOTAL	**3896**	**.10**	**390**

3.5 Research Instruments

Data for this study was collected through questionnaire and interview schedules. The questionnaires had five sections. Section A contained influence of social status on adoption of improved energy cook stove, section B contained questions on influence of economic status of households, section C contained questions on influence of cultural beliefs on adoption of improved cook stoves, section D contained questions on the influence of sensitization of the members of the household on adoption of the improved energy cook stove. The questionnaires had closed and open ended questions.

The researcher also used an observation check list which contained observable factors related to determinants of adoption of improved energy saving cook stoves. The checklist contained items such as the type of stoves in use, the kind of fuel in use, family size and age.

The checklists were personally filled by the researcher during the period the households were visited. Structured interviews which involved the use of a set of predetermined and highly standardized questions were also used to collect information from the other groups targeted in the

study such as the elderly persons and those who are unable to read or write. The interviews were administered by the researcher and her trained research assistants. They were used to collect qualitative information from the respondents in a structured ordered manner.

3.5.1 Pilot Testing

The researcher carried out a pilot study to pretest the validity are reliability of data collected using the questionnaires. 10 cases of the households were selected from Kisumu central location which is a neighboring location to be interviewed face to face. Participants who were interviewed at this stage did not take part in the final data collection phase. Clarity of the items in the instruments was determined to enhance validity and reliability.

3.5.2 Validity of the Instruments

Validity refers to the degree to which results obtained from analysis of data represent the phenomenon under study (Mugenda and Mugenda, 1999). This means that validity is concerned with the accuracy of data obtained in the study whether it actually represents the variables of the study. In this study, the lecturers were given the instruments to check if they were in line with the objectives of the study.

3.5.3 Reliability of the Research Instrument

Reliability is the measure of degree to which research instruments yield consistent results or data after repeated trials (Mugenda and Mugenda, 1999; Robson, 2008).

A pilot study was carried out in a few households in Kisumu which was not part of the actual study. A reliability test was carried out through the test –retest method. Tests were administered to the subjects for the first time then administered to the same subjects after two weeks. Mean scores from

the two tests were then correlated using Pearson product moment correlation coefficient. Each instrument was expected to be reliable if it yielded to a correlation coefficient of 0.7 and above.

The correlation coefficient (r) of halves is correlation by Spearman Brown prophecy (Re) formula

$$\frac{\text{2 x correlations between the halves}}{\text{1+ correlation between the halves}}$$

$$\text{Re} = \frac{2r}{1+r}$$

Where Re= reliability of the original test

There was a high positive correlation [rho=.808] with the results significant [p< 0.01, p=.00].This implies that the results were significant at the 0.001 level (2-tailed).The high positive correlation implies that the responses were reliable, since the correlation was above the cutoff point of 0.07.Using Pearson correlation coefficient, the results were also found to be reliable. Pearson[r=0.935, with p< 0.01, p=.00]. Thus the responses based on the questionnaire were highly reliable

3.6 Data Collection Procedure

Permission for data collection was sought from the ministry of Higher Education through the department of National Council for science and Technology and other government departments. The researcher then trained 5 research assistants who proceeded to collect the data. Research assistants were those who had completed secondary Education. The training included understanding the questionnaire, the respondent sampling, interviewing skills, data collection techniques, data recording and ethical consideration. The primary data was sourced through administration of questionnaires and interviews. The questionnaires were administered to the households and collected immediately by the research assistants for the purpose of coding and interpreting data. A maximum

of two interviews for qualitative data collection was conducted on a day to allow for note taking and transcription in order to capture complete.

3.7 Data Analysis

The collected data was analyzed using both quantitative and qualitative data analysis methods. Descriptive statistics provided simple summaries about the sample and about the observations that were made Earl R. Babbie (2009). Such summaries were summary statistics or simple-to-understand graphs showing the composition of the sample, the demographic data and simple tally tables. These summaries formed the basis of the initial description of the data as part of a more extensive statistical analysis. Pearson product moment correlation analysis technique was used to find the real determinants of adoption of energy saving cook stoves in the rural area of Kisumu North Location, whereas independent sample t-test was used to find out whether there is significant differences among the household status in terms of the family size, gender and level of income on the adoption of improved energy saving cooks. Data from questionnaire was coded and logged in the computer using Statistical Package for Social Science (SPSS V 19.0). This involved coding both open and closed ended items in order to run simple descriptive analyses to get reports on data status. Data collected through the open ended questions, interviews and analysis of documents was analyzed qualitatively through thematic and content analysis. The collected data was transcribed before coding into themes or categories. This involved breaking down the data into manageable pieces, sorting and sifting, while searching for types, classes, sequences, processes, patterns and themes. The aim of this process was to assemble or reconstruct the data in a meaningful or comprehensible fashion (Jorgensen, 1989. Generalization from the themes about the phenomena in question and discussion in the light of the available literature will then be made. The measures of the

independent variables, using the Likert scales was converted to mean values and then to percentages. Statistical significance of the independent variables was determined by using the t-test.

3.8 Data Management and Ethical Considerations

The researcher obtained all the various letters that proved the authority to collect data and also to assure the respondents of the confidentiality of the information they gave. The management of the collected data was ensured which involved safeguarding the questionnaires for the purposes of data analysis only. The researcher also assured the respondents that the responses they give were purely for academic purposes only where anonymity was advocated for (no writing of respondents' names in the research tools

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study which have been analyzed and discussed under four themes. It focuses on the social, cultural beliefs and practices, education, and the sensitization level of the households on adoption of the energy saving cook stoves in rural households of Kisumu North Location.

4.2: Response Return Rate

Data was collected from all the 390 respondents giving a response rate of 100%.The high rate of return was attributed to the approach whereby the respondents were requested to fill the questionnaires as the research assistant waited and this ensured 100% return rate as there were no call backs**.**

4.3 Socio Demographic Attributes of the Respondents

Demographic information was collected on the gender, level of education and age of the respondents. This enabled the researcher to describe status of the household members along major demographic variables for enhanced explanation of determinants of adoption of energy saving cook stoves.

4.3.1: Gender and Adoption of Energy Saving Cook Stoves

It was important for the study to establish the level of adoption by gender. In order to do this, the respondents were asked to indicate their gender, and the responses were tabulated and presented on Table 4.1.

Table 4.1: Distribution of the respondents by gender.

Location	Frequency	Percentage
Male	78	20
Female	312	80
Total	**390**	**100**

As shown in Table 4.1 , out of the 390 respondents who participated in the study,312 (80%) were female while 78 (20%) were male. This indicated that the majority of the respondents who were found in the households during the day were women, while most men were out working.

The fact that majority of the women were found in the households was not surprising because of the cultural construction of gender and the prescription of gender roles. In the community where the study was carried out, culturally the women are rarely expected to access extra labour outside the homes. Due to involvement in the domestic chores, women and children are also the most affected by indoor air pollution by use of energy insufficient stoves (Muchiri, 2008).

4.3.2: Marital Status of the Respondents

To find out the respondent's marital status, they were asked to state their marital status on a questionnaire, whether married, not married, divorced or widowed. The responses were tabulated in table 4.2

Table 4.2: Marital Status

Marital status	Frequency	Percentage
Married	254	65.1
Unmarried	46	11.8
Divorced	8	2.1
Widowed	76	19.5
Widower	6	1.5
Total	390	100.0

From Table4.2 , 65.1% of the respondents were married, 11.8% were not married, 19.5% were widowed, 2.1% divorced and 1.5 % widowers. From the findings it can be deduced that most of the households had families to be cooked for and therefore there was need to observe the kind of stove in use. The study findings concurs with Akello (2008) argument that, the marital status of the respondents can influence acquisition and use of a technology because there is usually need for consultation before a decision is made unlike in the case of female headed households where a woman makes decision on her own.

4.3.2: Age of the respondents

The study sought to know the age of the respondents. This was necessary in highlighting the age bracket of those who have adopted the energy saving cook stoves in Kisumu North Location. Table 4.3 illustrates the frequency of the respondents and their percentages by their age brackets.

Table 4.3 Age of the respondents

Age bracket	Frequency	Percentage
15-25	51	13.1
26-35	127	32.7
36-45	77	19.6
46-55	55	14.1
56-and above	80	20.5
Total	390	100

Out of the 390 respondents who participated in the study, 127 (32.7%) who used the improved energy saving cook stoves were aged between 26-35 years, 80(20.5%) were aged 56 years and above, 77(19.6%) were aged between 36-45 years, 55(14.1%) were aged between 46-55 years and only 51 (13.1%) were aged between 15-25 years. This indicated that most of the households' heads respondents were aged between 26-35 years.

There was a very weak correlation between the age of the respondents and the number of wood saving technologies a household was able to acquire with Pearson's correlation value (r=0.019, n=390,D.OS) (Table4.3.2).Younger household heads had acquired more wood fuel saving technologies, unlike older household heads, who had acquired fewer energy saving cook stoves. It can be deduced from the findings that the youths were more adaptive to new ideas compared to the old. It agrees with a study carried out in the Kathiani, Kenya, Karanja (1999) who found out that the

age bracket 26-36 years had adopted more energy saving technologies as compared to those over 45 years. She attributed her findings to the fact that middle aged respondents are in their reproductive and productive years and this age group adapted energy conservation technologies for effective performance of both reproductive and productive activities

4.4: Influence of Social Status of the Household on Adoption of Improved Energy Saving Cook Stoves

The first objective of the study was to establish whether the social status of the household members influenced the adoption of energy saving cook stoves. It was necessary to find out the influence of the social status of the household members. This was determined using various factors that included: Family size, support from spouses, time spent in acquisition of fuel, gender and level of education.

4.4.1 Family size and adoption of energy saving cook stoves.

To find the influence of family size of the house hold on the adoption of improved energy saving cook stoves, respondent's feedback on the period of using the new technology was analyzed. The response was rated on a five point likert scale basing on whether they strongly agreed that the stove uses less fuel and therefore had used it for along time up to strongly disagreeing. The results were presented as shown in figure 4.4.

Table 4.4 : Family size and Adoption of Energy Saving Cook Stove

Number of household members	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1-3	51(13.1%)	49(12.6%)	5(1.3%)	10(2.6%)	11(2.8%)
4-5	55(14.1%)	73(18.7%)	11(2.8%)	7(1.8%)	26(6.7%)
6-10	27(6.9%)	44(11.3%)	4(1.0%)	4(1.0%)	9(2.3%)
More than 10	1(0.3%)	2(0.5%)	0(0.0%)	1(0.3%)	0(0.0%)
Total	134%	134(34.4%)	168(43.1%)	20(5.1%)	22(5.6%)

From the above cross tabulation table, it is clear that the house hold numbers of 4-5 members have been using the improved cook stoves for a longer time with 55(14.1%) as compared to family house hold members of more than 10 peoplewith27(6.9%) The second in the frequency of the use of the improved cook stoves were those of 1-3 members with51(13.1%) while the least consisted of those household members of more than 10 people with 1(0.3%) These findings conquer with Karanja (1999) findings that family size of 1-3 and 4-6 seemed to have adopted more energy saving technologies as compared to a family size of 7-9 and 10-12.According to Inayat(2011), household size is expected to have a positive influence on the adoption of technology on energy saving cook stoves. It is also expected to have a positive influence on the model of the stove. She attributed low adoption of energy saving technologies by larger families and thus their preferences of the wasteful mode of cooking (open field).

The study findings disagrees with the (Inayats 2011) which stated that family size is assumed to have a positive influence on the adoption of the improved energy saving cook stove technology. It was assumed that larger household will cook more food for the family members requiring use of

larger pans and more fuel wood hence, will be inclined to adopt the improved energy saving technology. It was expected therefore that a large household size would affect positively the decision of adopting the improved energy saving cook stoves technology.

It can therefore be deduced that large families can end up becoming poor managers of environmental resources and thus the need for awareness creation to larger families on the benefits of energy conservation when energy saving technologies are adopted.

4.4.2: Level of Education and Adoption of Energy Saving Cook Stoves.

To explore the effect of education, an analysis was carried out to find the influence of education on adoption of energy saving cook stoves .Respondents were asked to state their highest level of education on a scale from non formal to PhD level. Frequency table showing percentages and frequencies was drawn as shown on Table 4.5.

Table 4.5: Level of Education and Adoption of Energy Saving Cook Stoves

	Frequency	Percent	Valid Percent	Cumulative Percent
Non formal and primary	238	61.0	61.0	61.0
College and secondary	78	20.0	20.0	81.0
University degree	43	11.0	11.0	92.1
Masters degree	17	4.4	4.4	95.6
PhD	14	3.6	3.6	100.0
Total	390	100.0	100.0	

The result of this study shows that majority of the adopters 238 (61.0%) had primary and non-formal education, 78(20.0%) had college and secondary education, 43(11.0%) had university education and very few 31(8.0%) had Masters and phD.

Pearson product moment correlation was also used to establish the strength and direction of the relationship, as to whether more education meant more adoption of the energy saving cook stoves. There was a small positive correlation between education and adoption level[r=0.129, p=0.011].The result were significant, though the correlation was very small. This shows that education had very small positive influence on the adoption level, such that as the level of education increased, there was a tendency of progressive adoption. .

However from these results we can deduce that, the level of education might not have been a major reason for adoption of the energy saving cook stoves technology.

The findings of this study agree with that of Cotlear (1990) argument that formal, non-formal and informal education may provide specific general knowledge, which provides the benefit and uses of new technology hence the adoption of the energy saving cook stoves. These findings disagree with Hirock and Ashok (2010) findings that people with higher education level have better access to information and knowledge that is beneficial in their domestic activities hence easy adoption of the improved cook stove technology.

Table 4.6: Gender and Adoption of Energy Saving Cook Stove.

To find out the influence of gender and hours spent on fuel acquisition and the level of adoption, a cross tabulation was run as shown in Table 4.6.

Count		**Hours spent to get the type of fuel use**					**Total**
		No time spent	**Less than 30 minute**	**30 mins-1 hour**	**1-2 hours**	**More than 2 hours**	
Gender	Male	14	26	22	7	9	78
	Female	24	137	93	32	26	312
Total		38	163	115	39	35	390

The frequency Table 4.6 shows the count and percentages of the respondents in the usage and the acquisition of improved energy fuel. A chi square test of independence was carried out to determine the proportions of male and female who had adopted the energy saving cook stoves. The proportion of female who had adopted was 0.83 and the proportion of male who had adopted was 0.81.The difference in proportions was not significant $\chi^2(\ 2, 390)=0.090$, $p=0.76$. This implies that men were almost equal in the adoption of energy saving cook stoves. Women were slightly higher

than men even though the difference was not significant. The results are consistent with the interview schedule conducted where a group of men and women were interviewed separately to find out whether they differed in the adoption of energy saving cook stoves. The interview brought out that due to high rate of circulation of information concerning technology, both men and women have equal chances of adopting such technology. However, these results differ with Wickramasinghe (2011) findings that women were more likely to switch to cleaner, and energy saving fuels if they are employed in activities outside the home.

4.4.3.1: Time and gender Issues on Adoption of Energy Saving Cook Stoves

An independent sample t-test was carried out to find out whether women and men spent the same time in the acquisition of the kind of fuel used as this influenced the adoption of new energy saving cook stoves. It emerged that there was no statistically significant difference as their means did not differ so much . The influence perceived on the adoption was high as measured using partial eta squared 0.14 which is 14%.This therefore implies that gender and time have a high influence on the type and adoption of the improved cook stoves, whereby those who adopted claimed to use less time in the acquisition of the fuel used.

These findings are consistent with the findings by Malhotra et al (2004) that women in many countries are responsible for the collection, transportation, processing and storing of fuel as well as the cooking activities while men typically make decisions of financial nature

Schlag & Zuzarte, 2008: 9) adds that women gather firewood on foot often walking long distance with heavy loads. This time spent collecting fuel wood represents an opportunity cost that could be spent on income generation and or education activity.

4.4.4: Marital Status and Adoption of Energy Saving Cook Stoves

It was hypothesized that families that used improved cook stoves were those whose couples supported the usage. Thus respondents were asked whether they supported they spouses in adoption of new technologies. A frequency table below shows the number and percentages of respondents supported by their spouses.

Table 4.7: Support received from spouse

Support from spouse	Frequency	Percentage
Strongly supported	97	24.9
Support	125	32.1
Sometimes support	27	6.9
Does not support	111	28.5
Totally does not support	30	7.7
Total	390	100.0

Table 4.5 shows that in 32% of the households, husbands or their wives supported each other in the adoption of improved cook stoves, 25% strongly supported, 6.9% sometimes supported each other. In 28% of the families, their spouses did not support each other in the usage and adoption of the improved cook stoves. It is therefore true according to the high cumulative percentage 57% of the support that spouses give highly influenced their partners in the adoption of the improved cook stoves.

A correlation between support from spouses and level of adoption was also carried out in order to find out whether more support implied more adoption of energy saving cook stoves. There was no significant correlation between support and level of adoption, a small negative correlation was attained[r=-0.01, p=.108], indicating that regardless of whether spouses supported each other or

not, the level of adoption remained constant. This therefore meant that support, even though was high among the spouses, and was not a major factor influencing the adoption of improved energy saving cook stoves.

4.5: Economic status of the household and the adoption of the improved energy cook stoves.

The economic status of the household was important to find out its influence on adoption of energy saving cook stoves. The respondents were asked to state their employment status, average income per month, sources of income and the cost of the devices.

4.5.1 Employment status and Adoption of Energy Saving Cook Stoves

To find out the income status of the family and their influence on the adoption of improved energy saving cook stoves, frequency table was run followed by a regression analysis. First, the respondents were asked through questionnaire to state the employment status of their families, family income and finally main source of the family income. The frequency Table 4.8 therefore tends to explore the employment status of the family households

Table 4.8: Employment status and Adoption of Energy Saving Cook Stoves

Employment status level of adoption Cross tabulation					
		level of adoption			Total
Count		high	moderately adopted	not adopted	
Employment status	permanently employed	3	5	3	11
	temporary employment	10	42	13	65
	self employed	5	32	7	44
	Unemployed	81	46	45	172
	never employed	58	23	17	98
Total		157	148	85	390

According to the frequency on Table 4.8, most of the family members are not employed and do not earn a salary 172(44.1%) and 98(25.1%) constructing 69.2% of the family households.65 (16.7%) were temporary employed, and only 11(2.8%) were permanently employed.

According to GTZ, (2008), the low level of income of the households depending on the biomass fuel is a major barrier to increasing the dissemination of improved stoves. For poor households, stoves represent a high initial investment cost which prevents them from purchasing the products. The Wallis report (1997), states that the consumers will seek out those financial products and supplies which offer the best value for money, and they are educated about it. Hence for adoption of the improved energy cook stoves to be adopted by the rural households, there is need for awareness to be created about such products and the consumers be convinced how it adds value to other cooking devices. From the findings it can be deduced that unemployment which is forming

172(44%) could be a contributing factor to slow adoption of energy saving cook stove in Kisumu North location.

4.5.2. Cost and Adoption of Energy Saving Cook Stove.

To establish the cost of the improved cook stoves as perceived by the residents, they were asked to rate the cost in Kenya shillings. A frequency table showing the results is shown on table 4.9.

Table 4.9: Cost and Adoption of Energy Saving Cook Stove.

		level of adoption			Total
	Count	high	moderately adopted	not adopted	
cost of cook stove	less than 200	46	36	19	101
	200-500	103	65	50	218
	501-1000	6	39	13	58
	more than 1000	2	8	3	13
Total		**157**	**148**	**85**	**390**

From Table 4.9, it is clear that improved cook stoves range between 200-500 Kenya shillings. According to the responses on the price, it is a moderate price and therefore does not hinder its adoption. This conquers with Jafee (2003) findings that as the cost of the technology fall, more consumers receive positive net benefit and adopt the technology. These findings are also consistent with the findings of Abara and Sigh (1993), that those larger fixed costs become constraints to technology adoption especially if technology requires substantial amount of initial step

up cost. From the findings on table 4.9, it can be deduced that, the moderate cost of the energy saving cook stove has positively influenced adoption in Kisumu North Location.

4.5.3: Family Source of Income and Adoption of Energy Saving Cook Stove

It was genuine to establish the source and amount of the family incomes as it might have been a potential cause of failure in acquisition of the improved cook stoves.

Table 4.10: Family income

Income amount	Frequency	Percentage
A head per month	87	22.3
Less than 5000	199	51.0
More than 10000	69	17.7
More than 15000	35	9.0
Total	390	100.0

The above frequency table shows that most of the families 51% have an income of less than 5000 Kenya shillings per month, while only 9% have income above 15000 per month. Household income is an indicator of prosperity and may be expected to have a positive effect on adoption of technologies as wealthier households may have higher probability of investing in and using improved stoves (Inayat, 2011). Although income is the most important pointer of the economic status of a farmer, it is difficult to collect reliable information on income from the respondents as most consider it confidential. The study revealed that the respondents irrespective of their income level found the energy saving stoves technology less costly and affordable. Technology with low initial cost is more likely to be adopted than that with technology with high initial cost (Rogers, 2003).Low initial cost has a positive influence on the rate and speed of technology adoption. This

perceived cost therefore, may be expected to increase adoption of the energy saving cook stoves unless other attributes of the technology or other extraneous variables negatively influenced utilization of the improved energy cook stove.

These results differ with Khamati (2000) findings in her study of the rural stoves programme in Kenya that rural people are generally very poor and women and children mostly collect their fuel for free. She adds that improved cook stoves had been more difficult to introduce in rural areas because stoves cost money and the traditional three stone cooking system is free thus the unemployment in Kisumu North location could be a major factor of moderate adoption.

The main source of income for the families that have some income is from subsistence farming as shown in the table 4.11

Table 4.11: Family Main Source of Income and Adoption of Energy Saving Cook Stove

Count		Main source of income in the family				Total
		Subsistence farming	Employment	Business	Others	
Average income of the household	A head per month	68 (17.4%)	6 1.5%)	10 *2.6%)	3 (0.8%)	68 (17.4%)
	Less than 5000	127 (32.6%)	10 (2.6%)	62 (15.9%)	0 (0.00%)	127 (32.6%)
	More than 10000	15 (3.8%)	29 (7.4%)	22 (5.6%)	3 (0.8%)	15 (3.8%)
	More than 15000	2 (0.5%)	19 (4.9%)	8 (2.1%)	6 0.00%)	2 (0.5%)
Total		**212**	**68 (17.4%)**	**6 (1.5%)**	**10 (2.6)**	**3 (0.8%)**

From Table 4.11, very small percentage 68 (17.4%) of the households earn their income from employment. Majority of their income came from subsistence farming, 212 (54.3%) To explore the effect of income on the perception of the cost of energy saving cook stoves,, a cross tabulation was run to establish their views on the cost of the improved cook stoves and whether the cost was worth its price. The following bar chart shows the families' views on the adoption of the improved cook stoves in terms of the cost and their attitude as measured in terms of their views on the worthiness of the cook stoves' price.

4.6: Cultural beliefs and practices of the members of the households and adoption of energy saving cook stoves.

It was important to access the influence of cultural beliefs and practices of the members of the household on adoption of Energy saving cook stoves. In addition they were asked to state how perceived usefulness and decision making dynamics influenced adoption of energy saving cook stoves. They were also asked if cultural beliefs and practices influenced the type of stoves used in the household. According to previous researches, culture and household practices have been a major factor to consider when it comes to adoption of new technologies. Besides culture, religion also has a similar weight.

4.6.1: Perceived Usefulness and Adoption of Energy Saving Cook Stoves.

The respondents were asked to state the usefulness of energy saving cook stoves and their responses were summarized in table 4.5

Table 4.12: Perceived Usefulness and Adoption of Energy Saving Cook Stoves.

Usefulness of energy saving cook stoves	Frequency	Percentage
Useless	41	10.5
Not useful	28	7.2
Somewhat useful	42	10.8
Useful	165	42.3
Very useful	114	29.2
Total	**390**	**100.0**

The results in Table 4.12 indicate that the majority of the household heads perceived energy saving cook stoves as useful, 165(42%) and 114(29.2%) saw it very useful. Only a small number of respondents 41 (10.5%) perceived it as useless. As it has been observed in other cases, it can be deduced that majority of residents from Kisumu North Location perceive energy saving cook stove to be very useful.

4.6.2: Decision Making Dynamics and Adoption of Energy Saving Cook Stoves.

Another factor that has a higher influence could be the decision dynamics in the house hold. This reflects on the decision making in the homesteads on what to buy, how to spend, and more so, on which type of cook stove to adopt. The researcher therefore went further to explore who the decision makers were. The following frequency table shows the decision dynamics of the households.

Table 4.13: Decision Making Dynamics and Adoption of Energy Saving Cook Stoves.

	Frequency	**Percentage**
Mother	185	47.4
Father	170	43.6
Grandparents	12	3.1
siblings/children	12	3.1
Others	11	2.8
Total	**390**	**100.0**

According to the frequency Table 4.13 , it is clear that 185(47.4%) of the decision makers are mothers, contrary to the expectation that these decision makers could be fathers170(43.6%) since they are the heads of the families in African tradition.

These findings disagree with most of the previous findings, such as those in Africa, when energy technology must be purchased, men tend to play a central role in the decision- making because these are important financial decisions even when they involve the kitchen which is generally viewed as women's domain (WEC/FAO 1996) (Clany 2003).

A woman who was asked if any improvement on the design of the device used stated that

"Jiko kisasa na kuni mbili zinatosha, "meaning that the cook stove did not need any improvement.

Another woman was quoted saying,

"yien ario oken pesa mang'eny"

Meaning that the cook stoves were less expensive thus decided to use them.

From the findings it can be concluded that men and women have different roles, activities and responsibilities in the society which are allocated on the basis of their sex, therefore, matters in the kitchen are purely left in the female domain (Kammen,D, 1995)

4.5.3: Effect of beliefs and practices on Adoption of Energy Saving Cook Stoves

To find out whether cultural beliefs and household practices affected the adoption of the improved cook stoves, a question was asked if cultural beliefs and practices had an influence on adoption of energy saving cook stove. The following Table shows the frequencies and percentages of the responses on the effect of culture and household adoption of energy saving cook stoves.

Table 4.14: Effect of beliefs and house hold practices

Rating of effect	Frequency	Percent
Highly affect	28	7.2
Affect	38	9.7
Somewhat affect	31	7.9
Does not affect	127	32.6
Totally no effect	166	42.6
Total	**390**	**100.0**

The results show that cultural believes and house hold practices do not affect the adoption of the improved cook stoves as more than 50% of the respondents disapproved the null hypothesis. These findings agree with Vitell et al (1993) findings that, culture differentially affects individuals formation of teleological and deontological norms; hence, individuals' prescriptive reasoning, however, Baran, Patterson, Harris and Beyond (2006) perceives that technology adoption incorporates two essential elements, the embracement of the technology by individuals and its embedment in society.

4.6: Sensitization of Household Members and Adoption of Energy Saving Cook Stoves

To establish the level of sensitization of household members on the adoption of energy saving cook stoves, respondents were asked whether they had heard of the improved energy saving cook stoves, with a binary response of yes or no. Using a questionnaire, they were also asked exactly where they acquired the information, and the extent to which they thought information dissemination determined the adoption of the improved energy saving cook stove.

4.6.1: Awareness of the Improved Energy Saving Cook Stoves Availability

To explore the awareness of the improved energy saving cook stoves among the respondents, a questionnaire was posted to them asking whether they had heard of the improved energy saving cook stove. The responses were tabulated using frequency tables to display percentages and counts of the responses as shown below.

Table 4.14: Awareness of the Improved Energy Saving Cook Stoves Availability

Know about cooks	Frequency	Percentage
Yes	352	90.3
No	38	9.7
Total	390	100.0

From the Table 4.14, 352(90.3%) of the respondents know about the improved energy saving cook stove while only 38(9.7%) responded to lack information about the new technology. From the findings of the study it can be deduced that majority of the residents of Kisumu North Location are aware of the existence of energy saving cook stoves and this could be a reason for its adoption. This finding disagrees with Carr (1982) findings that there is definite lacking in appropriate technology

information in the rural areas and more so among women than men. He further states that majority of cases of rural women are completely unaware of the existence of improved technologies which could help them. He further added that women information does not trickle down to the village level. It is usually the men who receive it. This is not the case from the findings of the study. The trend is changing Observation done add to the findings that 18% of the households used the three stone fire place despite the Upesi jiko adoption.

4.7.2: Effect of Knowledge Dissemination on Adoption of Energy Saving Cook Stoves

To find out the extent to which Knowledge dissemination affected adoption of energy saving cook stoves, respondents were asked to give their views on a five point likert scale. Frequency table was produced as shown on table 4.15.

Table 4.15: Effect of Knowledge Dissemination on Adoption

Extent	Frequency	Percent
Very low extent	26	6.7
Low extent	45	11.5
Moderately extent	70	17.9
Great extent	118	30.3
Very great extent	131	33.6
Total	**390**	**100.0**

From Table 4.15, the highest frequency was 131(33.6%) with a response of very great extent, followed by 118(30.3%) with a response of great extent. Those who reported little effect of knowledge dissemination on improved energy saving cook stoves had a frequency of 26(6.7%).

Basing on these results, Knowledge dissemination was a factor that influenced adoption of energy saving cook stoves.

A correlation coefficient between level of adoption and effect of Knowledge dissemination was run in order to determine the direction and strength of association. A moderately high positive correlation[$r=0.513$, $p<0.01$] was obtained. This shows that among the factors that influenced adoption of energy saving cook stoves, knowledge dissemination was the highest determinant. This confirms Makame Omar Makame (2007) emphirical findings that the role of information on what Rogers (1986) considered as friability and observability characters of innovation are very crucial ingredients in the diffusion and adoption of innovation in the social system. Consumer innovation like stoves is relatively less observable, and thus diffuses at extremely slow rate unless it should be highly promoted

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENTATIONS

5.1 Introduction

This chapter presents the discussion of the key data findings, conclusion drawn from the findings highlighted and recommendations made there to. The conclusions and recommendations drawn were focused on addressing the objectives of the study which were to examine how social status of the household influence adoption of improved energy saving cook stoves in the rural area, assess the level at which the economic status of the household influences the adoption of the improved energy saving stoves, examine how cultural beliefs and practices influence the adoption of improved energy saving cook stoves and to investigate the level at which sensitization of the rural households influence the adoption of improved cook stoves.

5.2 Summary of the findings.

This study found out that majority of the households in Kisumu North location had adopted the energy saving cooks stoves. The study also established that a few households still used the traditional, three stone fire place alongside the improved cook stoves.

On examination of the influence of social status of the households on adoption of energy saving cook stoves in the rural areas, social aspects such as family size, age, and gender and education level were looked at.

The study established that family size of 4-5 members had adopted the energy saving cook stove 55 (14.1%) strongly agreeing that it saved a lot of fuel, family of 1-3 with 51 (13.1%) and 6-10 members with 27 (6.9%) and those families with more than 10 members with 1 (0.3%) strongly agreeing that it saved fuel.

Age was also found to have influence on adoption as middle aged group ranging from 26-45 years were the ones who had embraced the energy saving technology with a frequency of 127, those with56 years and above had frequency of 80, 36-45 had 77,46-55 had 55 while those aged 15-25 had 51 frequencies respectively.

Further results on gender and time revealed that the women had embraced the energy saving technology more than the men since most of them were in charge of cooking and were mostly the decision makers on matters pertaining to cooking in the households.

The study also found out that education level did not have much influence on adoption as majority of those who had adopted the energy saving cook stove technology, were those with non - formal education with 238 (61.0%), primary education 78%, 20.2% , college education and 43(11.0%) had university education. Only 31 (8.) %) of those who had adopted had matters, PhD.

From the findings of the study there was high adoption of this technology among the rural households of Kisumu North Location. The study therefore established that family size, age and education level has influence ion the adoption of improved energy saving cook stoves.

Further results on gender and time revealed that the women embraced this technology since most of them were the decision makers on matters pertaining to cooking in the kitchens. According to the study findings there was high adoption of this technology. The study therefore established that family size, age and education level has influence on the adoption of improved energy saving cook stoves.

On the assessment of the level at which economic status of the household influenced adoption of energy saving cook stoves, the respondents were asked to rate the price of the improved energy saving cook stoves whether high, moderate, or low, in addition, their income level was established by asking them to state their monthly income and their sources of income. They rated the

price as moderate despite the fact that most of them had a monthly income of less than Kshs.5000 which was mainly from subsistence farming. The study established that economic status did not have an influence on adoption of energy saving cook stoves.

On investigation of the cultural beliefs and practices' influence on adoption of energy saving cook stoves, the study found out that that religion and cultural practices did not influence adoption of the energy saving cook stoves as close to 70% of the respondents stated that their religion and culture did not matter very much when it came to adoption of a new technology. This result could be attributed to the high circulation of information in both rural and urban areas when there is a new product in the area.

The study established that the respondents perceived the energy saving cook stoves to be useful with 165 (42.3%) respondents stating this, 114(29.2%), very useful, 42 (10.8%) somewhat useful, 28(7.2%) not useful and 41 (10.6%) useless.

The study further revealed that most of the decision making on adoption of energy saving cook stoves is done by the mothers with majority of the respondents giving a response of 185 (47.4%) for mothers, 170 943.6%) fathers, 12 (3.1%) grandparents, children 12 (3.1%) and others 11(2.8%).

Lastly, the study investigated the level at which sensitization of the rural households influenced the adoption of improved cook stoves. This study found out that sensitization level of the rural households on the energy saving cook stove technology had highly influenced its adoption. From the study it was established that about 90% of the respondents got the information about the cook stoves from their friends who convinced them of the goodness and the economic value of the energy saving technology. This was confirmed by high number of households that used the improved cook stoves.

5.3 Conclusion

This study concludes that majority of the households visited had adopted the use of the improved energy saving cook stoves for cooking although the traditional three stone fire place was also being used at times. The household heads revealed that they used the improved energy saving cook stoves because it uses very little fuel especially the ‘’kuni mbili’’ stove and the Kenya Ceramic jiko (KCJ) The study further revealed that when cooking food to a large number of people for example in a social gatherings, they sometimes use the traditional three stone fire place. On the side of gender and adoption, it was revealed that more women household heads had embraced the energy saving cook stove technology than men due to its effectiveness in conserving the fuel. Education level of the household head did not matter when it came to adoption of the technology but the benefits of the device.

On the assessment of the level at which economic status of the households influenced the adoption of the improved energy saving cook stove, the study found out that the economic status of the household heads did not have an influence on adoption of energy saving cook stoves as many of those who had adopted had informal education. On cultural beliefs and practices’ influence on adoption, it was revealed that religion and cultural beliefs and practices did not hinder adoption of the energy saving cook stove although it influenced the eating habits.

On the sensitization level of the rural households, it was revealed that most of the respondents, 90% got the information about the improved cook stoves from their friends and therefore the study concluded that information dissemination on this new technology has influenced its adoption as confirmed by the high number of households that used the improved cook stoves.

5.4 Recommendation

Based on the findings and the conclusions drawn above, this study makes the following recommendations.

- First and foremost, there should be enough advertisement on the adoption of energy saving cook stoves since it curbs the inflating energy needs in the society. Besides, the proper knowledge dissemination should be done to aid this, through open air meetings. This is so because most of the decision makers are those exposed to information adequately.
- Mothers should also be empowered, as the findings bring out that there is adoption of the improved energy cook stoves. If they are empowered, then the next time this study is done, 90% of the population will have adopted these methods.
- More research on energy saving devices should be carried out and the results implemented for the betterment of the society and conservation of the environment.
- The cost of the improved energy saving cook stoves should also reduce to enable subsistence farmers to acquire at low prices in plenty. The government and NGOs should therefore facilitate cost reduction to enhance this.

5.5. Suggestion for further studies

The study recommends that further studies should be done on the effectiveness of improved cook stoves on preparation of different types of foods. The study focused on determinants of adoption of energy saving cook stoves but did not outline the effects of the improved cook stoves technol.ogy on preparation of different types of foods.

The study further suggests that another study should be carried out to establish the barriers to energy saving cook stove acceptance among rural households.

OPERATIONAL DEFINITION OF VARIABLES

Objectives	**Variables**	**Indicators**	**Measurements**	**Data collection method**	**Measurements scale**	**Analysis**
Examine how social status of the household influence adoption of energy saving cook stoves	(Independent social status of the household) (Dependent) adoption of improved energy saving cook stoves	▪ Size of family ▪ level of education ▪ Gender ▪ Marital status ▪ Usage ▪ Availability ▪ Environmental conservation	Number Qualification level Sex Marital status (Married, unmarried widowed, widower, divorced)	Questionnaire Interviews	ordinal	Correlation
Assess the level at which the economic status of the household influence adoption of improved energy saving	(Independent) Economic status	- Employment - Income level - Source of income	Engagement in different activities Salary scale Piece of work	Questionnaire Interview	ordinal	Correlation

stoves among rural households	Dependent variables Adoption of the improved cook stoves	- Usage - Availability - Environmental conservation				
Examine how cultural believes influence adoption of energy saving cook stoves	(Independent) Cultural beliefs and practices (Dependent) Adoption of the energy saving cook stoves	- Individual acceptance - Decision making - Dynamics - Use - Availability - Environmental conservation	Use / ownership Policy in place Availability	Questionnaires Interviews	ordinal	Correlation
Investigate the level at which sensitization of the household	(Independent) Sensitization of members.	- Information - Training - Reasons for	Awareness Availability Ability to maintain	Questionnaires Interviews	ordinal	Correlation

influences the adoption of improved energy saving cook stoves among rural households	Type of energy cook stoves in use. (Dependent) Adoption of improved energy saving stoves.	usage - Availability of the store - Environmental conservation	or repair			

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APPENDICES

APPENDICES

APPENDIX 1: LETTER OF TRANSMITTAL

Grace A. Adhola

P.O.Box 4326-40100, Kisumu.

Tel. No: 0710312174

April 2014

Dear Respondent,

I am a final year Master of Arts student in Project Planning and Management at The University of Nairobi. As part of the requirement for my course, I am carrying out a research titled: '**Determinants of adoption of energy saving cook stoves among rural households of Kisumu North location,'**

You have been nominated to participate in the research study as mentioned above. The process will not take more than ten {10} minutes and will be incorporated within your routine. Your participation is voluntary and you do not risk losing anything if you decline. If you choose to participate please give us accurate and honest answers. Your responses will help inform future decisions on energy saving technologies which can help in conservation of the environment.

I humbly submit my request for part of your time. Your response will be treated with utmost confidentiality and for the purpose of this study only. Thank you in advance.

Yours faithfully

Sign: ……. Date: ……

Jane AdhiamboNyanjom

APPENDIX II: QUESTIONNAIRE

I am a post graduate student at the University of Nairobi carrying out a research on a research on determinants of adoption of energy cook stove among rural households in Kisumu North location Kisumu County, Kenya. Your response in this questionnaire will be kept confidential and used for Academic purpose only.

PART A: DEMOGRAPHIC INFORMATION

1. Location [ ]

   Nyahera [ ]

   Dago A [ ]

   Dago B [ ]

2. Please indicate your gender (Tick appropriately)

   Male [ ]

   Female [ ]

3. What is your age? _____ Years.

a) Level of education [ ]

b) Non formal [ ]

c) College [ ]

d) University degree [ ]

e) Masters degree [ ]

f) Others(specify) _____

4. What is your marital status?

Married, [ ] unmarried [ ] Divorced [ ]

Widow [ ] Widower [ ]

PART B: SOCIAL STATUS OF THE HOUSEHOLD

1. What is the total number of the household members in your family

a) 1-3 ☐

b) 4 -5 ☐

c) 6 to 10 ☐

☐

More than 10

2. Who is the head of this house hold?

☐

a) Mother

☐

b) Father

☐

c) Child

☐

d) Relative /guardian/any other

e) Rate the following statements ☐

3. Your husband/wife encourages you to acquire and use improved energy saving cooks

1.Strongly agree [ ] 2.Agree [ ]3. somewhat agree [ ] 4.disagree [ ] 5.strongly disagree [ ]

5. How many hours a day do you spend to get the type of fuel you use?

a) No time spend ☐

b) Less than 30 minute ☐

c) 30minutes -1 hour ☐

d) 1-2 hours ☐

e) More than 2 hours ☐

B: ECONOMIC STATUS OF THE HOUSEHOLD

Rate the following statement as shown below (tick in your choice)

1. Most of your family members are employed and earning a salary.

1. Very true [ ] 2.True [ ] 3. Somewhat true [ ] 4.not true [ ] 5.not very true [ ]

1. What is the average income of the household

   A head per month [ ]

   Less than 5000/= [ ]

   More than 10,000 [ ]

   More than 15,000 [ ]

2. What is the main source of income in the family

   Subsistence farming [ ]

   Employment [ ]

   Business [ ]

   Employment [ ]

   Others [ ]

3. How much do you spend on household need per month on fuel?

   a) Less than Ksh1000 [ ]

b) Between Ksh 1000- 2000 [ ]

c) Between Ksh 3000- 4000 [ ]

d) More than Ksh 4000 [ ]

COST OF THE IMPROVED COOKSTOVE [ ]

1. How much did it cost you?

a) Less than 200 [ ]

b) 200-500 [ ]

c) 501-1000 [ ]

d) More than 1000 [ ]

2. Rank the cost of the stove

   High cost [ ]

   Moderate [ ]

   Not applicable [ ]

3. Do you think it worth the price you paid?

   YES [ ] Explain

   _____

   No [ ] Explain _____

4. Has it been performing according to your expectation ?

   YES [ ] Explain _____

   NO [ ] Explain _____

PART D Sensitization of the members of the household

1. Have you ever heard of the improved energy saving cook stove; Upesi or Kunii mbili?

   YES [ ] NO [ ]

5. From whom did you first learn about the improved energy saving cook stove?

   a) Friends [ ]

   b) Advertisement radio/tv [ ]

   c) My spouse [ ]

   d) My children/parents [ ]

2. Others specify Does lack of knowledge on new developed improved energy saving cook stove affect its adoption?

   YES [ ]

   NO [ ]

   Explain your answer

   _____

   _____

   _____

   _____

3. To what extent does information dissemination determine the adoption of the improved energy saving cook stove?

   i) Very low extent [ ]

   ii) Low extent [ ]

   iii) Moderately extent [ ]

   iv) Great extent [ ]

   v) Very great extent [ ]

PART E REASON FOR USING THE IMPROVED COOK STOVE

Do you often take part in cooking food at your household level?

YES [ ]

NO [ ]

If yes , why do you prefer the cook you are using at the moment ?

Explain your answer _____

The following are the determinants of adoption of the improved energy saving cvook stove. Please indicate appropriately

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The users fail to accept new technology due to perception they will not achieve desired benefit					
The cost of the improved energy saving cook stove hinders adoption of the stove					
Lack of experience with the improved energy saving cook stove hinders its adoption					

Lack of information hinders adoption of energy saving cook stove at household level					
Traditional beliefs and practices determine the adoption of the energy saving cook stove.					

CULTURAL BELIEFS AND PRACTICES OF MEMBER5S OF THE HOUSEHOLD

1. What is your religion ?

   Christian [ ] Muslim [ ] Hindu [ ] Pagan [ ]

   Others [ ] Others (specify)_____

2. **To what extent do the following statements concerning perceived usefulness and ease in adoption of new cook stove in your household**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The customers fail to adopt new products at household level because they fail to understand their immediate use					
Inadequate information on new products eg. Improved cook					

stoves					
Lack of differentiation between existing and new products					
Difficulty in operation					
Our believes affect the adoption of the energy saving cooks to a great extent					

Decision making dynamics

1. Who makes decision on matters pertaining to financing experience, farm use type of fuel at your household level?

Mother[ ] Father [ ] grandparents [ ] siblings/children[]

Others [ ] Specify _____

TYPE OF ENERGY SAVING COOK STOVES

3. Which kind of cook stove do you use as a family? (Household)

a) The traditional three store fire place

b) Jiko kisasa

c) Kuni mbili

d) Kenya ceramic store

e) LPG Gas

f) Parafin store

g) Electric cooker

h) others

Rate the following statements concerning the energy saving cook stoves

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
As a family we have used cook stove for a long period of time					
We should have an improvement on the traditional stove					
Training is a must before using cook stoves					
The cook stove we use saves time for our family					
.					

Perceived usefulness, ease of use and frequency

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Cook stoves sometimes need repair					
It is easy to get repair for the cook stoves					
Dealers jua kali artisans and metal workers are always available to repair the cook stoves					
The cook stove we use saves time for our family					
.					

APPENDIX III : DATA COLLECTION INSTRUMENT (INTERVIEW SCHEDULE FOR THOSE WHO MAY NOT BE ABLE TO READ AND WRITE)

Sex of the respondent

Male [ ] Female [ ]

1. What kind of cook stove do you use?
2. Have you ever heard about the improved energy saving cook stoves
3. From whom did you first learn about the improved energy saving cook stove?

PROMPT	YES	NO
Producer		
Shopkeeper		
Radio		
Agricultural show		
Extension workers		
Home economics		
Husband		
Women group		
Chief baraza		
Friends		

Others [ ] Specify _____

4. Why did you buy the device?_____

5. Who sold the device to you ?_____

   Does not apply _____

   How long have you used the device?_____

   Years [ ]

   Months [ ]

6. How long have you used the device?

7. Rank the cost of the device.

   High cost [ ]

   Moderate [ ]

   Low [ ]

   Not applicable [ ]

8. Do you feel it is worth the price you paid for?

9. How did you raise the money to buy it?_____

   Not applicable [ ]

10. Has the stove been performing to your expectation:

    YES [ ] NO [ ] Not applicable [ ]

11. If you had an opportunity to advice the designer of the device you use, what advice would you offer?

    _____

    _____

    _____

12. Does the way you use the device interfere/ conflict with your cultural value/ habit

    YES [ ]

NO [ ]

Not applicable [ ]

13. If the device saving time for you

YES [ ] Explain _____

NO [ ] Explain _____

14. If the device need repair , is it easy to get it repaired?

YES [ ] Explain _____

NO [ ] Explain _____

15. Who repairs it for you?

The dealer [ ]

Any jua kali artisan [ ]

Others specify _____

16. When a new device (Appreciated technology) are introduced in this location, who are often trained in operating the?

17. Identify the benefits you have received so far from the use of the cook stove you have

APPENDIX IV: OBSERVATION CHECKLIST

Observation checklist for the type of cook stove used in the house hold, type of fuel and the condition of the stoves.

Name of the stove in use	Condition of the stove	
_____	Well kept _____	Neglected _____

Type of fuel used

Cow dang Charcoal Maize cobs Firewood Gas (LPG) Electricity	

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
SCHOOL OF CONTINUING AND DISTANCE EDUCATION
KISUMU CAMPUS

The Secretary
National Council for Science and Technology
P.O Box 30623-00100
NAIROBI, KENYA

10th June, 2014

Dear Sir/Madam,

RE: ADHOLA A. GRACE- REG NO: L50/61464/2013

This is to inform you that **Adhola A. Grace** named above is a student in the University of Nairobi, College of Education and External Studies, School of Continuing and Distance Education, Kisumu Campus.

The purpose of this letter is to inform you that **Adhola** has successfully completed her course work and Examinations in the programme, has developed Research Project Proposal and submitted before the School Board of Examiners which she successfully defended and made corrections as required by the School Board of Examiners.

The research title approved by the School Board of Examiners is*: "Determinants of Energy Saving Cook Stove Adoption in Rural Households of Kisumu North Location,Kisumu County".* The research project is part of the pre-requisite of the course and therefore, we would appreciate if the student is issued with a research permit to enable her collect data and write a report. Research project reflect integration of practice and demonstrate writing skills and publishing ability. It also demonstrates the learners' readiness to advance knowledge and practice in the world of business.

We hope to receive positive response so that the student can move to the field to collect data as soon as she gets the permit.

Yours Faithfully

UNIVERSITY OF NAIROBI
10 JUN 2014
KISUMU CAMPUS

Dr. Raphael O. Nyonje, PhD
SENIOR LECTURER & RESIDENT LECTURER
DEPARTMENT OF EXTRA-MURAL STUDIES
KISUMU CAMPUS

THIS IS TO CERTIFY THAT:
MS. GRACE ACHIENG ADHOLA
of UNIVERSITY OF NAIROBI, 0-40100
kisumu,has been permitted to conduct
research in *Kisumu County*
on the topic: *DETERMINANTS OF ENERGY SAVING COOK STOVE ADOPTION AMONG RURAL HOUSEHOLDS OF KISUMU NORTH LOCATION, KISUMU COUNTY*
for the period ending:
18th September,2014

Permit No : NACOSTI/P/14/8362/2343
Date Of Issue : 24th July,2014
Fee Recieved :Ksh 1,000

.....
Applicant's Signature

.....
Secretary
National Commission for Science, Technology & Innovation

APPENDIX V: MAP OF KISUMU COUNTY

Figure 3.1 shows the map of Kisumu County and the associated constituencies.