Biomass Fuel Market Study

Study Commissioned by

EU-Nakuru County Sanitation Programme

Demonstrating and Upscaling an Innovative Sanitation Value Chain for the Peri-Urban Low Income Areas in Nakuru County, Kenya

County Government of Nakuru

Study Report Presented by

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August 2016

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ABBREVIATIONS AND ACRONYMS

BDS	Business Development Services
EU	European Union
HH	Households
KCJ	Kenya Ceramic Jiko
KEBS	Kenya Bureau of Statistics
LIAs	Low Income Areas
NAWASSCO	Nakuru Water and Sanitation Services
NCSP	Nakuru County Sanitation Programme
PPPs	Public Private Partnerships
SCODE	Sustainable Community Development Services
SNV	Netherlands Development Organisation
UT	Umande Trust
VEI	Vitens Evides International

SWAHILI TRANSLATION

Duka	Neighbourhood retail shop
Jiko	Cook Stove
Kunimbili	Type of Firewood Stove
Makaa	Charcoal
Ugali	Dish made of maize meal

DEFINITION OF TERMS

Biomass Fuel	Fuel obtained or processed from organic matter/biomass e.g. briquettes, pellets, wood/wood products, animal waste, municipal waste.
Biomass	Organic matter derived from living, or recently living organisms i.e. plants or plant-based materials which are not used for food or feed.
Briquettes	A compressed block of charcoal dust or other combustible biomass materials such as sawdust, wood chips, market waste, animal/human waste, etc. Briquettes are categorized in three classes; Carbonized, Semi carbonized, and Non-carbonized.
Carbonization	The process of converting an organic substance into carbon or a carbon-containing residue through pyrolysis or destructive distillation.
Pellets	Biofuels made from compressed organic matter or biomass. They are similar to briquettes but relatively smaller in size.

EXECUTIVE SUMMARY

This market study was conducted between May and June 2016 in Nakuru Town. It was commissioned by the Nakuru County Sanitation Programme (NCSP) as part of The Sanitation Programme dubbed "Demonstrating and Upscaling an Innovative Sanitation Value Chain for the Peri-Urban Low Income Areas in Nakuru County, Kenya". The 48 month European Union (EU) funded programme is a collaborative effort between Nakuru Water and Sanitation Services Company (NAWASSCO), Netherlands Development Organisation (SNV) Kenya, Vitens Evides International (VEI), Umande Trust (UT), and Nakuru County Government. The overall objective is to demonstrate and implement a viable sanitation value chain, benefitting residents of un-sewered (peri-) urban low income areas in Nakuru.

Biomass has been reported to be the most widely used energy source in Kenya at about 68%, followed by petroleum products at 22%, electricity 9% and other forms of energy at 1% (Kituyi, 2002, MoE 2002). This leaves a huge opportunity to create and promote the adoption of sustainable products from waste to offset charcoal and firewood use, which would be environmentally sustainable, healthier, and would save low-income families money. The NCSP seeks to use innovative ways to re-use faecal matter and urine in bio-fuel and bio-fertiliser production in Nakuru, Kenya and to implement it through local Public Private Partnerships (PPPs) between NAWASSCO, the local water company, and local social enterprises. NCSP is in the process of testing and piloting the faecal sludge biofuel products with the aim of eventual adoption by the market. In line with this, the market study sought to establish the following: (1) The customer segments for biomass fuel and respective usage of biomass fuel products in each segment; (2) The ability and willingness of consumers to buy biomass fuel products; (3) The attitudes of the consumers towards biomass fuel products (including biomass fuel products partly made from human waste); and (4) The profile of biomass fuel distributors in Nakuru Town.

362 households and 238 businesses and institutions (including hotels and restaurants, hospitals, schools and chicken farmers) were interviewed in Nakuru town. The households were zoned based on areas of residence, in this case: high, medium and low income areas. The Akvoflow application was used to administer an online version of a questionnaire survey. Both quantitative and qualitative data types were collected and used complementarily to yield a unique blend of information for the study. Focus group discussions and market observations were used to ensure triangulation of information. The data was checked for consistencies using SPSS data tests and analysis was conducted using the QPSMR software. The findings are as reported in this report in frequencies, percentages, charts, tables and in narrative form.

Customer segments and respective fuel usage

The analysis showed that 54% of the households use charcoal, 24% use gas, 13% use kerosene, 8% use firewood and 1% use electricity. This establishes that charcoal is relied on as the main fuel by majority of the households though gas takes up a larger share with rise in affluence. Households were also found to have an average monthly consumption of 30 Kgs of firewood; 30 Kgs of charcoal; 6 Kgs gas and/or 10 litres of kerosene. On average, gas was found to be the most costly fuel, followed by firewood, charcoal and then kerosene. The average monthly spending was found to be Kshs 1,760, Kshs 1,000, KSH 990 and Kshs 540 respectively at the household level.

The tendency of fuel stacking among most households was noted in this study. This is where households combine two or more fuels to fulfil their energy needs, rather than completely switching to another fuel. Charcoal ranked as the preferred alternative fuel across the board. Results also indicated that key energy

choice drivers are cost and availability. The KCJ stove was found to be the most popular stove among households.

For the businesses, fuel types ranked in terms usage were as follows: charcoal (81%), gas (34%), firewood (21%), electricity (9%), and kerosene (3%). In terms of fuel types, schools preferred firewood while hospitals preferred gas. Charcoal was largely used in restaurants and kiosks. Notably, majority of the businesses spend an average of Kshs. 10,000 – Kshs. 20,000 on fuel every month. Unlike a majority of households that main rely on local retailers to source their fuels, 45% of the businesses and institutions interviewed source their fuel from brokers and 33% from local retailers.

Attitudes towards biomass fuel products

The study revealed that two in every three households are aware about briquettes. Pellets and pellet use, however, registered minimal awareness. Further, the study revealed more briquettes awareness among households in the low and medium income areas as compared to households in the high income areas. Briquettes made from different types of waste were found to be more appealing to lower income groups and female respondents. The results also revealed that word of mouth is a strong marketing tool in this segment.

Among businesses, results indicated that 56% of the businesses interviewed are aware about briquettes as a fuel option. Awareness of briquettes especially in schools was high. However, awareness did not significantly translate to usage. Only 17 businesses reported to have used briquettes. Human waste briquettes registered a 62% consideration among businesses and institutions; the lowest consideration being among hospitals but highest in schools.

Fuel distributors in Nakuru

The results from the study showed that charcoal is highly traded and well distributed in Nakuru Town. Vendors indicated that high demand was pushed from the restaurants, households and chicken farmers. They affirmed that there is a great need in the fossil fuel market and would readily stock human waste briquettes and pellets provided that it is well priced and that it offers the benefits that their customers need.

Conclusions and Recommendations

The study concludes that in order for the programme to successfully pilot faecal sludge biofuel products with the aim of eventual adoption, the following key factors should be considered: understanding the profile of the target market, raising product awareness and education on hygiene and safety, pricing and bundling with the right equipment, and placement of the fuel in the right distribution channels.

For households, the study established that the rate of conversion from awareness to usage is higher for briquettes than it is for pellets. In view of this, the market seems to be more receptive to briquettes than pellets. Some of the reasons for this include compatibility with the fuel equipment and cost efficiency. It would therefore be prudent to focus on rolling out the biomass fuel product starting with briquettes with the aim of eventual introduction of pellets.

The study also established a higher willingness for charcoal users to use briquettes as compared to the other fuel users. Given that charcoal emerged as the main fuel across the board for households (high, medium and low income areas) and for more than half of the businesses, this should be a key consideration during the piloting of the product. In the household segment, this will largely be households in the low income areas whereas for the business segment, this will largely be the restaurant businesses. However, factors of cost,

efficiency and availability are important for this group. Due to the nature of the hospitality industry, it is also worth noting that hygiene concerns rank high especially for briquettes made partly out of human waste.

The programme would need to consider the pairing of the fuel and equipment. Kenya Ceramic Jiko (KCJ) is the most popular stove in the region among households and also among the small restaurants and businesses. A bundling that focuses on value and affordability would be ideal.

The programme would also need to address low product awareness by adopting messaging that addresses hygiene and safety concerns. One of the proposals made is the involvement of relevant government bodies when piloting the product. In addition, adopting the right distribution channel would address product availability concerns which emerged as a barrier to usage. The large number of and proximity of dukas (shops) in residential areas makes them a key distribution channel for households. It is therefore important to consider placing the new product in these outlets. Since brokers and transporters are the main suppliers of different sources of fuel for small and medium businesses, they are likely to be key influencers. It would be advisable to partner and leverage on their network and credibility in the market.

The final section in this report provides a more detailed write-up on the insights, conclusions and recommendations for consideration.

1.0 INTRODUCTION

1.1 Programme Background

The Sanitation Programme dubbed "Demonstrating and Upscaling an Innovative Sanitation Value Chain for the Peri-Urban Low Income Areas in Nakuru County, Kenya," is a 48 month European Union (EU) funded programme and a collaborative effort between Nakuru Water and Sanitation Services Company (NAWASSCO), Netherlands Development Organisation (SNV) Kenya, Vitens Evides International (VEI), Umande Trust (UT), and Nakuru County Government whose overall objective is to demonstrate and implement a viable sanitation value chain, benefitting residents of un-sewered (peri-) urban low income areas in Nakuru.

The Nakuru County Sanitation Programme (NCSP) seeks to use innovative ways to re-use faecal matter and urine in bio-fuel and bio-fertiliser production in Nakuru, Kenya and to implement it through local Public Private Partnerships (PPPs) between the local water company and local social enterprises. The re-thinking of the entire sanitation value chain revolves around reviewing the Nakuru context and identifying the main needs. This involves facilitating strategic partnerships under PPP arrangements and developing sustainable business models as well as demonstrating financially viable business plans for the value chain actors and scalability and replication potential in Kenya.

Biomass has been reported to be the most widely used energy source in Kenya at about 68%, followed by petroleum products at 22%, electricity 9% and other forms of energy at 1% (Kituyi, 2002, MoE 2002). This leaves a huge opportunity to create and promote the adoption of sustainable products from waste to offset charcoal and firewood use, which would be environmentally sustainable, healthier, and would save low-income families money.

An innovative biomass fuel that provides an environmentally sustainable, healthier and potentially more affordable alternative is the faecal sludge biomass fuel product. The Nakuru County Sanitation Programme is in the process of testing and piloting the faecal sludge biofuel products with the aim of eventual adoption by the market. In line with this, there is need to have a better understanding of the biomass fuel market in Nakuru with a focus on: customer segments, consumer needs and perceptions, market potential, and other prevailing market characteristics. This information will help shape the strategies to be adopted by the Nakuru Water and Sanitation Services Company as well as the producers and distributors of the products.

1.2 Objectives of the Study

The study sought to establish the following:

(i) The customer segments for biomass fuel and respective usage of biomass fuel products in each segment.
(ii) The ability and willingness of consumers to buy biomass fuel products.
(iii) The attitudes of the consumers towards biomass fuel products (including biomass fuel products partly made from human waste).
(iv) The profile of biomass fuel distributors in Nakuru Town.

1.3 Study Team

The NCSP team led in coordinating the data collection activities in Nakuru and also in the facilitation of the focus group discussions. They also provided logistical support. Africa Turnaround Limited, a Local Capacity Builder, was actively engaged in business development and also offered technical input in the compilation of the report. Intraspace Market Consultancy Limited led in data analysis and insight generation.

The team of enumerators used the Akvoflow tool to collect data and supported the technical team in carrying out data cleaning and coding. The enumerators carried out the market observations and documented the observations in form of field notes and tables.

The list of the study team members and the data collection schedule is referenced in Annex 11.3 and 11.4.

1.4 Acknowledgements

Africa Turnaround Limited sincerely appreciates the team that contributed to the successful completion of the study. Special thanks go to the NCSP team and partners for their technical assistance and logistical support and link to Akvoflow - the data collection application. We also extend our gratitude to Intraspace Market Consultancy Limited for their valuable input in analysing the data and drawing insights. Finally, we recognize the important role played by the dedicated team of enumerators and community health workers who were involved in the mobilization of focus group discussion participants. The list of the team members involved in the study is annexed in this report.

2.0 SURVEY METHODOLOGY

2.1 Review of Data Collection Tools

To undertake this study, data was obtained largely using the Akvoflow application tool to administer an online version of a questionnaire survey. Both quantitative and qualitative data types were collected and used complementarily to yield a unique blend of information for the study. Data from the Akvoflow tool was submitted online and qualitative data from focus group discussions and observations captured in the form of notes. Focus group discussions and market observations were used to ensure triangulation of information.

2.2 Structure of Survey - Geographical Coverage, Field Work Planning and Execution

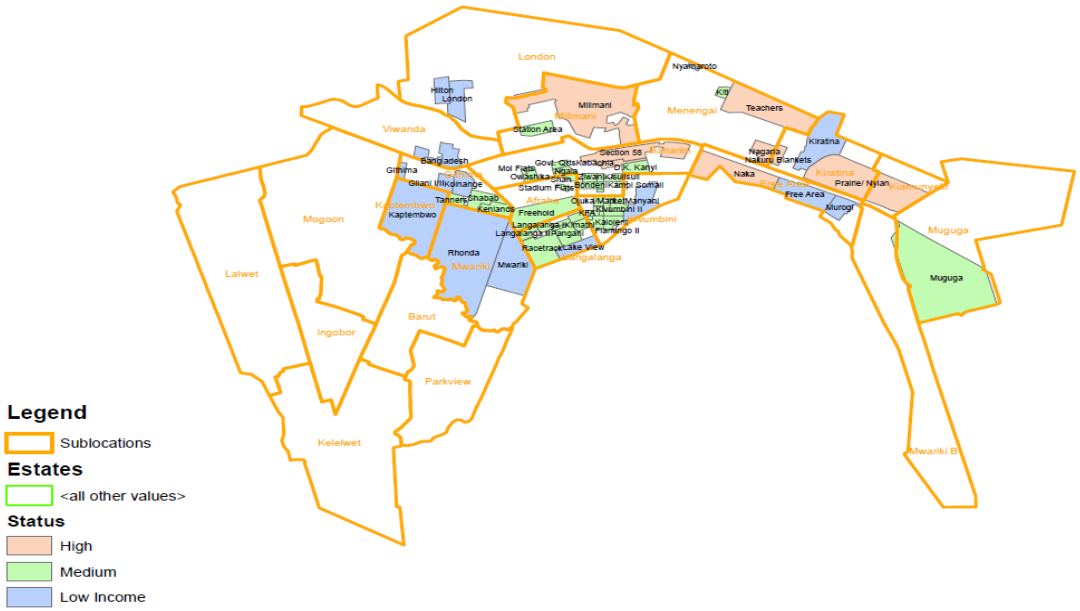
The scope of this study is Nakuru town. Nakuru town is the 'capital' of Nakuru County, the fourth largest town in the country. According to the Nakuru County Integrated Development Plan (2013-2017), Nakuru municipality had a population of 307,990 in 2009 and is expected to reach 393,101 in 2017. According to the 2009 Census, Nakuru town had a population of 155,881 men and 152,109 women in 2009 whereas the projected population is 198,958 men and 194,143 women in 2017.

Table 2a: Nakuru Town – Number of Households

Sub-County	Area in Km²	No. of Divisions	No. of Locations	No. of Sub locations	No. of Households
Nakuru Town	297.2	3	7	21	91,116

Source: Nakuru County – First County Integrated Development Plan (2013-2017)

Figure 2.1: **Sub locations and Estates in Nakuru Municipality**



For this study, Nakuru was zoned into low income, medium income and high income areas as per the NAWASSCO zones. The NAWASSCO Pro Poor Strategy and Action Plan (2013-2017) indicates that the total population in the low income areas in Nakuru Town is 218,626; representing more than half of the urban population.

The following areas were sampled in this study.

Low Income Areas	Medium Income Areas	High Income Areas
1. Eastern zone (Free Area, Mwariki South, Kiratina) 2. Western zone (Rhonda, Kaptembwa, Barut) 3. Northern zone (Hilton, Nyamaroto) 4. Central zone (Pangani,Lakeview) 5. Southern zone (Manyani Lower, Kaloleni)	1. Shabab 2. Racecourse 3. Freehold	1. Section 58 2. Teachers 3. Milimani

Population per LIA zone: Eastern zone (60,421); Western zone (97,822); Northern zone (9,616); Central zone (14,798); Southern zone (35,995)

The following table outlines the sample size per cluster.

Cluster	Attained Sample Size	Description
Households in Nakuru Town (Total Population - 91,116 households)	362 households. Margin error of 5% at 95% confidence level.	Sampled: • 243 Low income households (using the 5 NAWASSCO zones to cover all areas geographically) • 58 Medium income households • 61 High income households
		8 FGDs were carried out in the following areas: Rhonda, Kaptembwa, Hilton, Nyamaroto, Manyani, Lakeview, Kiratina, and Free Area
Businesses and Institutions in Nakuru Town (Total - 76 Medium Restaurants and Hotels; 1,197 Small Restaurants)	238 businesses and institutions (restaurants, hospitals, chicken farmers and schools) Margin error of 5% at 95% confidence level.	Sampled: • 201 Restaurants (small and medium sized) • 14 Chicken farmers • 15 Hospitals • 8 Schools
Distributors/Retailers of Fuels and Stoves in Nakuru Town	17 fuel distributors and suppliers (charcoal, briquettes, firewood) and 45 stove distributors and suppliers reached	Market observations were conducted targeting: • Producers/ distributors/ retailers of cook stoves • Retailers of briquettes/pellets • Distributors/ retailers of charcoal

2.3 Qualitative Information Collection

Qualitative information was collected through focus group discussions and informal discussions with key informants.

2.4 Quantitative Information Collection

Quantitative data was collected through the Akvoflow online application.

2.5 Data Entry and Analysis

Data collected through the Akvoflow tool, which allows for real-time data collection whilst eliminating the data entry component, was downloaded in MS Excel format and was checked for consistency and cleaned. It was then assigned numerical codes for ease during data analysis. The data was checked for consistencies using SPSS data tests and analysis was conducted using the QPSMR software. The findings are reported in frequencies, percentages, charts, tables and in narrative form.

2.6 Study Limitations and Constraints

Time constraints: The data collection process was lengthy given a number of variables. For example, during the data collection exercise, the restaurants could only be reached between 9am-11am on weekdays.

Information collection constraints: In Kenya wood for charcoal production is sourced through both legal and illegal means. Due to the nature of the charcoal industry, the information collected from producers and distributors was done more informally. Market observations notes were made but the contact information for some of the producers and distributors was not shared.

Questions that needed clarification: Some questions were marked as requiring clarification during the data collection exercise. For example, some households felt that they could not single out one fuel as the main fuel and therefore offered multiple answers.

Insignificant responses on some questions: An insignificant number of users gave feedback on the specific questions regarding briquettes and pellets since they were not users or knowledgeable about them. Some of the aspects included information on: different forms of briquettes/pellets in the market, the length of use by consumers; preferred shapes and general likes and dislikes. The focus group discussion, however, provides insight on some of these elements.

During the data collection exercise, the enumerators noted that some 'unique' groups could have added value if they were included in the study. For example, the Indian community members who are said to use briquettes in their food preparation process.

2.7 Study Assumptions

Zoning of Residential Areas: For the purpose of this study, the households were zoned into high, medium and low income areas as guided by the NAWASSCO zoning system. The study assumes that there are some homogenous characteristics among the households based on the selected zones.

3.0 LITERATURE REVIEW

3.1 Energy Demand and Supply in Kenya

Currently, Kenya's population is estimated to be 44,037,656. Notably, 78% of the population lives in rural areas whilst 22% resides in urban areas. Kenyan consumption of energy is largely dominated by biomass (68%), followed by petroleum product (21%) and electricity (9%), the remaining 1% consisting of solar and other form of energy (IEA, 2015).

Biomass energy is expected to remain the main source of energy for the foreseeable future (Mugo, F. and Gathui, T., 2010). Wood fuel and charcoal are the main biomass sources of energy and are mainly used in rural areas. On the other hand, imported petroleum and electricity are the two principal components of the domestic energy market in Kenya, and consequently directed to a larger extent toward urban areas, supplying both households and businesses (IEA, 2015). According to the Integrated Assessment of the Energy Policy by UNEP (2006), Kerosene as a cooking and lighting fuel is also important for the poor in rural and urban areas and has in some cases served as a substitute for wood fuel.

Table 3a: Annual consumption of various energy types

	Firewood (tonnes/yr)	Wood for Charcoal (tonnes/yr)	Wood Wastes (tonnes/yr)	Farm Residue (tonnes/yr)	Kerosene (litres/yr)	LPG (kg/yr)	Electricity (Kwh/yr)
Rural Household	14,065,004	7,624,935	136,459	2,649,981	172,761,463	1,406,270	93,376,810
Urban Household	358,709	6,020,663	83,863	12,832	150,707,171	16,883,884	723,013,990
Cottage Industry	467,145	2,860,900			2,142,950	7,021,875	353,558,397
Total	14,890,858	16,506,498	220,321	2,662,813	325,611,584	25,312,028	1,169,949,197

Source: IEA, 2015

According to the survey carried out by the Kenyan government in 2002, 34.3 million of tonnes of biomass was consumed annually, of which 15.1 million was made of fuel wood (firewood) and 16.1 million was made of wood for charcoal, outlining the clear domination of wood fuels as the share of the total biomass (IEA,2015). However, one of the main challenges encountered is the wide gap between demand and sustainable supply. The demand for wood fuel is 40.5 million tonnes while the supply is 16 million tonnes of biomass hence a deficit of 24.5 million tonnes i.e. a 60.5% deficit.

In the year 2000, fuel wood supplied 89% of rural energy with a per capita annual consumption of 741 kg and 7% urban household energy with a per capita annual consumption of 691 kg. For the cottage industry, restaurants and kiosks consumption was the highest at an estimated 1.3 million tonnes per year. Charcoal on the other hand was reported to supply 82% of urban household energy with a per capita annual consumption of 152 kg, while for rural households, it contributed 34% with a per capita consumption of 156 kg. Charcoal consumption for restaurants and kiosks was estimated at 0.43 million tonnes per year (Mugo, F. and Gathui, T., 2010)

Notably, biomass as the predominant energy source, also presents some challenges. For instance, the use of biomass fuels has adverse effects on health. The smoke produced when not vented out of the cooking space, causes the most adverse effects from biomass combustion. The emissions contain suspended particulate matter, polycyclic organic matter which includes a number of carcinogens, especially benzo-a-pyrene, and gaseous pollutants such as carbon monoxide and formaldehyde. The effects on health can range from chronic obstructive pulmonary disease to nasopharyngeal cancer. When infants and children are exposed, acute bronchitis and pneumonia occur because their respiratory defences are impaired (UNEP, 2006). Fuel wood, charcoal production and agriculture also contribute widely to woodland degradation and deforestation.

3.2 Fuel Consumption by Fuel Type

Fuel wood: Households are the most important category in wood energy consumption with an estimated consumption of 6.5 tonnes per household per year (Mugo, 2001). Firewood is mainly used for cooking, water heating, house heating, lighting and other home businesses. The second highest consumer of wood fuel are the cottage industries which include brick making, tobacco curing, fish smoking and bakeries. Others include small restaurants/hotels and kiosks and learning institutions. In view of the importance of cottage industries in income and employment generation and wealth creation at the rural population, their energy requirements need specific attention to ensure their sustainability. On average, most cottage industries use between 20-30% of the total operation costs on energy which is mainly from wood (Githiomi J.K. and Oduor, N., 2012). According to a study conducted by GVEP, over 95% of about 20,000 institutions (schools, colleges, hospitals) in Kenya use fuel wood as the main source of energy for cooking and heating water.

Charcoal: About 47 per cent of Kenyan households use charcoal. This can be further analysed in terms of rural and urban areas; 82 per cent of urban households use charcoal in comparison with 34 per cent of households in rural areas (GVEP, 2010). Contrary to the popular view that charcoal is a fuel for low income urban dwellers, 83 per cent of high income groups regularly use charcoal, meaning that charcoal is consumed by all categories of urban dwellers. The GVEP Study (2010) also noted the rapidly changing usage patterns for charcoal. Charcoal consumption has dropped from 2.91 million tonnes in 1997 to 2.48 million tonnes in 2000 and to 1.6 million tonnes in 2004. Studies have also shown that there is a shift from biomass fuel to kerosene and liquid petroleum gas (LPG) by mid income urban households, and to LPG and electricity by higher income urban households (UNEP, 2006).

LPG: The use of LPG for cooking has grown steadily in both rural and urban markets. Kenya had fewer than 50,000 household LPG cylinders in use in 1995, confined to a few key urban areas. By 2002, over 700,000 cylinders were in use, particularly in urban areas of the country (GVEP,2010).

Electricity: About 15 per cent of the Kenyan population has access to electricity, 46 per cent in urban areas but a staggering low 3.8 per cent in rural areas. The target for electricity connection in rural areas currently stands at 20 per cent of the population by 2010. (GVEP, 2010).

Table 3b: Fuel consumption estimates in the household sector for 2004

Fuel Type	Quantity of Fuel
LPG	41,884 tonnes
Kerosene	305,825,000 litres
Charcoal Consumption	1,600,000 tonnes
Firewood	14,600,000 tonnes
Residues	4,940,000 tonnes

Source: UNEP, 2006

Table 3c: Fuel price estimates

Fuel	Costs (Kshs)
Kerosene price(Kshs/l)	81.03 - 83.83
Fuel wood price(Kshs/bundle)	70
LPG price(Kshs/kg)	217.27
Electricity price(Kshs/Kwh)	11.62
Charcoal price(Kshs/4kg tin)	61.4
Motor Spirit Premium price(Kshs/l)	119.23
Automotive Gas Oil price(Kshs/litre)	66.13
Lubricant price(Kshs/ l)	382.657

Source: Global Alliance for Cookstoves, Market Segmentation Study

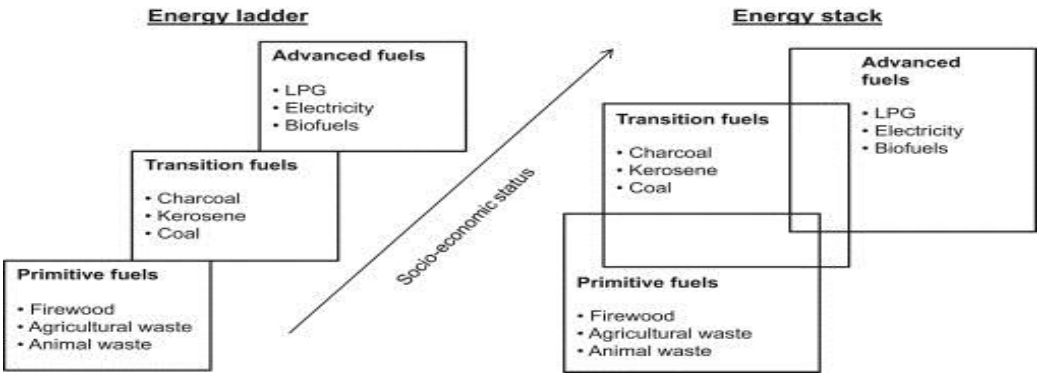
As guided by the fuel consumption estimates in the households sector (2004), in terms of consumption value, the annual consumption value per fuel type is estimated to be Kshs. 9.1 Billion for LPG, Kshs 25.2 Billion for Kerosene and 24.5 Billion for Charcoal.

3.3 Energy Consumption Patterns

A study carried out by KIPPRA in 2010 showed that the most popular fuel types in terms of their various uses are: kerosene (80%), followed by charcoal (60%), fuel wood (55%), electricity (37%) and LPG (21%) in that order. The usage of fuel wood, charcoal and kerosene in rural areas is higher, compared to urban areas. However, the use of LPG and electricity in the rural areas is lower, compared to that of urban areas. While lower prevalence of electricity use in rural areas can be attributed to lack of connectivity, lower LPG use can be attributed to lack of access and information.

The fuel stacking and fuel ladder models suggest that as people become richer, they may be expected to move from traditional biomass fuels to more advanced and less polluting fuels (e.g. from wood to charcoal, kerosene, and then to gas). The fuel ladder model on the other hand postulates that fuel switching is mainly observed when there is significant increase in income (KIPPRA, 2010). According to the Global Alliance for Cookstoves Market Segmentation Report, energy consumption patterns in Kenya portray more of fuel stacking than fuel switching, where households are observed to be using multiple fuels. Fuel stacking occurs in 54% of Kenyan households; using two fuels with 2% using only one fuel type.

Figure 3.1: Fuel Stacking



Source: Global Alliance for Cookstoves, Market Segmentation Presentation

3.4 Charcoal Market Value Chain and Distribution

The most common charcoal supply chain consists of three levels. First the transporters visit the production site or a designated collection point with a motorised or non-motorised means of transportation and buy the charcoal in bulk. They then transport the charcoal to vendors (wholesale or retail) mostly in urban areas. In the national survey study findings (Mutimba and Baraza, 2005), 56% of producers sold their charcoal to vendors via transporters as well as directly to households, food businesses and other customers including social institutions.

According to the GVEP study, which looked into the Baringo value chain that serves Nakuru, the charcoal prices vary depending on the season; lower prices during the dry season and higher prices in the rainy season owing to low suppliers and high cost of production. Charcoal pricing increases from KES 7.2/Kg at the producer level to KES 80/Kg at the consumer level. In Nakuru, the retail price is KES 56/Kg (2013) when sold direct to household customers in small quantities.

Charcoal is packaged using second-hand maize or sugar sacks and twine ropes. A standard bag contains about 35kg of charcoal with twine ropes woven on top of the sack to secure the charcoal. At the retail level it is sold in different quantities. On one end there are outlets for bulk purchases using bags, while at the other end are small scale retailers, found within very close proximity to households. These small scale retailers mostly sell charcoal in small units, the most common being the 2 kg tin.

3.5 Cook Stoves Industry

There are many different types of cook stove technologies in use across Africa, ranging from stoves that are just slightly more efficient than a three-stone fire, to efficient biomass cook-stoves (ranging from rocket stoves to pellet gasifier stoves) and clean fuel options using liquid petroleum gas (LPG) and ethanol. Different technology choices imply different efficiencies, costs, distribution models, and challenges in terms of meeting end-user needs (Lambe, 2015).

Some of the key success factors identified when it comes to cook stoves include: stove quality and features (efficiency, reduced emissions, design that meets the diverse needs of users, accessibility, ease

of use); finance for both end-users and stove enterprises; an enabling policy and regulatory environment; and a commercial approach (Lambe, 2015).

According to the UNEP study conducted in 2010, the urban communities in Kenya have over the past decade adopted (and will continue to adopt at a higher rate) the fuel-saving KCJ charcoal stoves. Over 85 per cent of urban households used these stoves in 2002 compared to 47 per cent in 2000 and 13 per cent in 1997 (UNEP, 2006).

Some of the adoption barriers for stoves include: liquidity constraints where consumers find it difficult to come up with the entire purchase price in one lump sum depending on the type of stove; consumers finding difficulty in determining quality; inability to verify claimed fuel savings from an improved cook stove or having unrealistic expectations of the improved cook stoves; and durability concerns (Global Alliance for Cookstoves, 2013)

3.6 Briquettes

Briquettes are a household, institutional and industrial fuel made by compacting biomass waste. The main feedstock include, charcoal waste, agricultural residues, sawdust etc. which are normally considered unusable waste. Briquettes are made from raw materials that are compacted into a mould. Briquettes could be made of different shapes and sizes depending on the mould. The appearance, burning characteristics of briquettes depends on the type of feedstock, the binder used, the level of compactness and the mould used. The size and shape should be designed to match the market (Stove to be used). For household use, a high surface area (compared to its weight) is needed to enhance burning. This helps to make combustion uniform and complete, reducing harmful gases and smoke. Common household cooking tasks of briquettes include boiling, frying, simmering and quick heating. Briquettes work well with tasks that tend to take longer like boiling and frying because they burn for longer and maintain almost steady heat intensity (Wereh, 2013).

According to GVEP, there are no statistics for briquette use in Kenya, however the percentage of the population using briquettes is thought to be very low.

Wereh (2013) established that while briquettes could be used in the commonly available cook stoves (mostly the KCJ); there were several challenges experienced that meant their use was not being optimized. Cook stoves were seen to experience challenges with the use of briquettes in terms of: access to air, there was not enough ventilation on the cook stoves; lighting the briquettes on the cook stoves was a heavy task; most of the cook stoves were small and did not hold a sufficient number of briquettes for cooking; the nature of the stoves made it hard to add briquettes during cook time. If households are to substitute more of their fuel use to briquettes, there needs to be a technological improvement on the kind of stove to be used with briquettes as the fuel, this cook stoves should have enough ventilation and be big enough depending of the size of the household to be accommodated. However it remains likely that briquettes will still be used in conjunction with traditional charcoal, so, a stove that burns both fuels efficiently would present the ideal option (Wereh, 2013).

The study carried out by GVEP in 2010 uncovered a number of key performance features upon which choices of fuel appeared to be made: energy content, price, heat intensity, length of burn, ‘extinguishability’ and levels of smoke production. The table below compares these features and details

the energy content constant across each fuel. It shows that per unit of energy delivered, briquettes were competitive on price with all fuels, and sometimes sold at a lower price.

Table 3d: Comparison Table: Briquettes and Other Fuels

Quantity considered (Constant Energy)	Briquette 1.4 Kg = 30 MJ	Kerosene 0.78 Kg = 30 MJ	Charcoal 1.0 Kg = 30 MJ	Firewood 2.7 Kg = 30 MJ
Price	Highest: KES 138 Lowest: KES 23	Highest: KES 51 Lowest: KES 47	Highest: KES 25 Lowest: KES 10	Highest: KES 11 Lowest: Free
Relative Heat Intensity	Low	Variable	Moderate	High
Relative Length of Burn	High	Variable	Moderate	Low
Extinguishable	No	Yes – Easy	Yes – Difficult	Yes – Moderate
Amount of Smoke Produced	Low	None	Low	High

Source: GVEP, 2010

3.6.1 Perception of human waste briquettes

The study on "turning faeces into fuel in Kenya" by Lewis (2015), established that people do indeed have reservations about cooking with faecal matter briquettes. However, the people sampled in Naivasha demonstrated that once they have the opportunity to try out the odourless briquettes for themselves, the reservations tended to disappear.

4.0 OBJECTIVE 1: CUSTOMER SEGMENTS AND RESPECTIVE FUEL USAGE

4.1 INTRODUCTION

The study objective sought to provide insight into the customer segments, understanding the profile, demographics and respective fuel usage. Households, businesses and institutions are a key focus in this section.

4.2 HOUSEHOLDS

Profile

4.2.1 Households Sample

A total of 362 interviews were successfully administered at the household level. The sampled households were in areas zoned as high income, medium income and low income areas.

***Table 4a*: Number of Households Interviewed per Location/Area**

High Income Area		Medium Income Area		Low Income Area		
Section 58	21	Shabab	18	Eastern Zone	Free Area	20
Teachers	20	Racecourse	20		Mwariki South	17
Milimani	20	Freehold	20		Kiratina	20
				Western Zone	Rhonda	23
					Kaptembwa	21
					Barut	19
				Northern Zone	Hilton	20
					Nyamaroto	21
				Central Zone	Pangani	20
					Lakeview	19
				Southern Zone	Manyani Lower	24
					Kaloleni	19

4.2.2 Households Demographic Profile

51% of the respondents interviewed were male and 49% were female. This is a representation of the population in Nakuru Town, which, according to the 2009 Census, had a population of 155,881 men and 152,109 representing the same ratio.

Find below the demographic profile of the 362 respondents by age, marital status and highest education attained.

Figure 4.1: Age of respondent

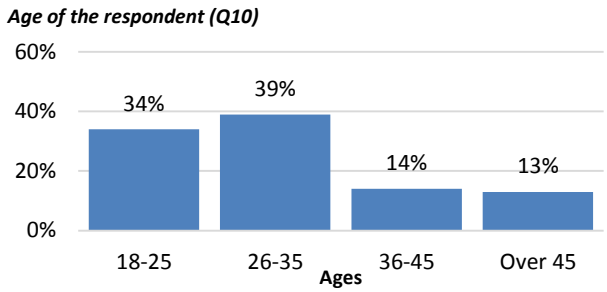


Figure 4.2: Marital status of respondent

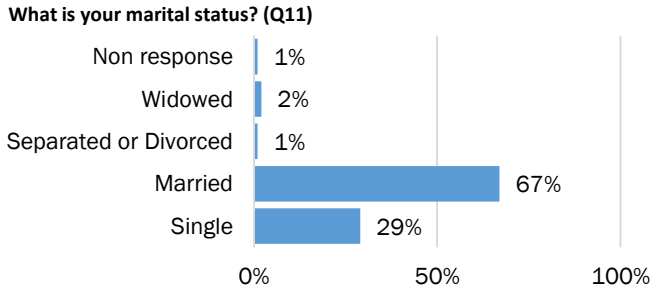
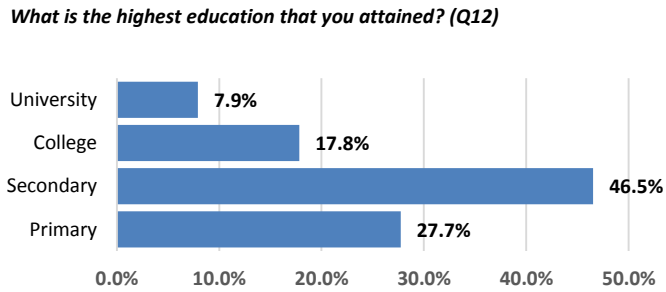


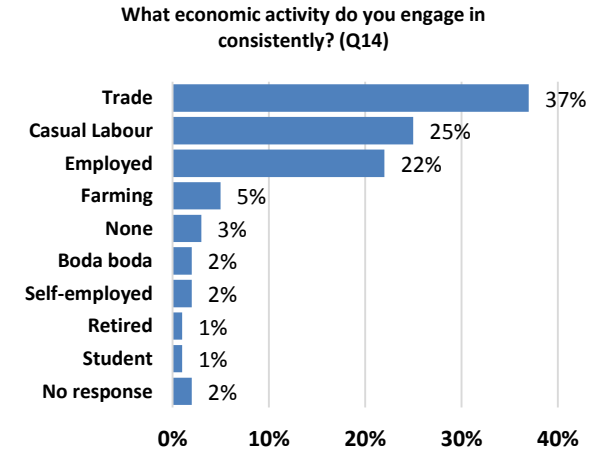
Figure 3.3: Highest education attained by respondent



4.2.3 Households Economic Profile

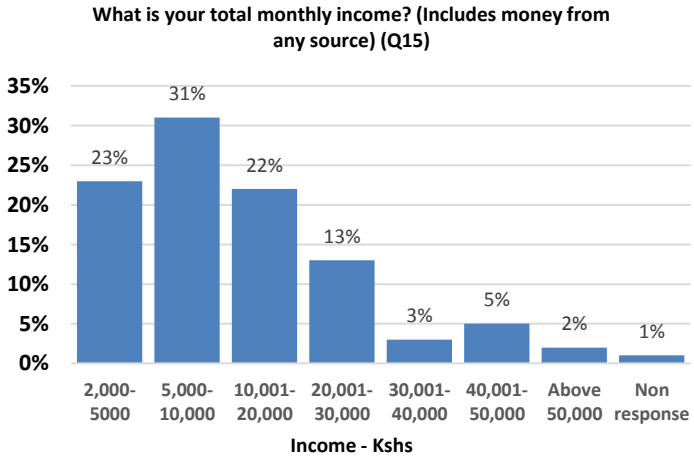
81% of the respondents are tenants while 19% are homeowners. 76% of the respondents earn a monthly income of Kshs 20,000 and below. As an economic activity, more households are likely to be engaged in trade, casual labour or employment. Find below the profile of the respondents by economic activity and monthly income.

Figure 4.4: Economic activity that respondents are engaged in



Base: 249 Respondents, HH heads only

Figure 4.5: Monthly income of respondents



Base: 249 Respondents, HH heads only

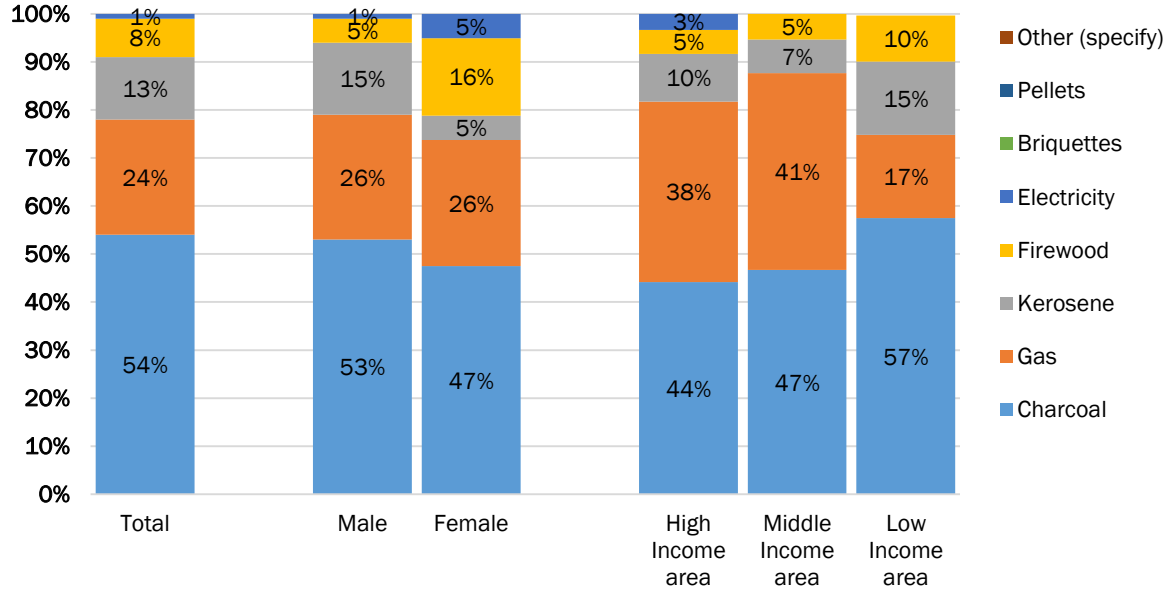
4.2.4 Main Fuel Type Used

54% of total households use charcoal a main fuel, while 24% use gas, 13% use kerosene, 8% use firewood and 1% use electricity. This means that charcoal is the leading cooking fuel by way of market share. It is worth noting that cooking gas is used more by households in high and medium income areas as compared to households in low income areas. Charcoal and gas come up as the top two fuels across the high, medium and low income areas. Kerosene use is more prevalent in the low income areas, though it is also used in the medium and high income areas. On the other hand, men are more likely to use kerosene as compared to women. Of the households sampled, none is currently using pellets or briquettes.

The figure below shows the main fuel type used as it relates to the gender of the respondent as well as the residential zone.

Figure 4.6: Main fuel type used in the household

What fuel type do you use? (Q16)

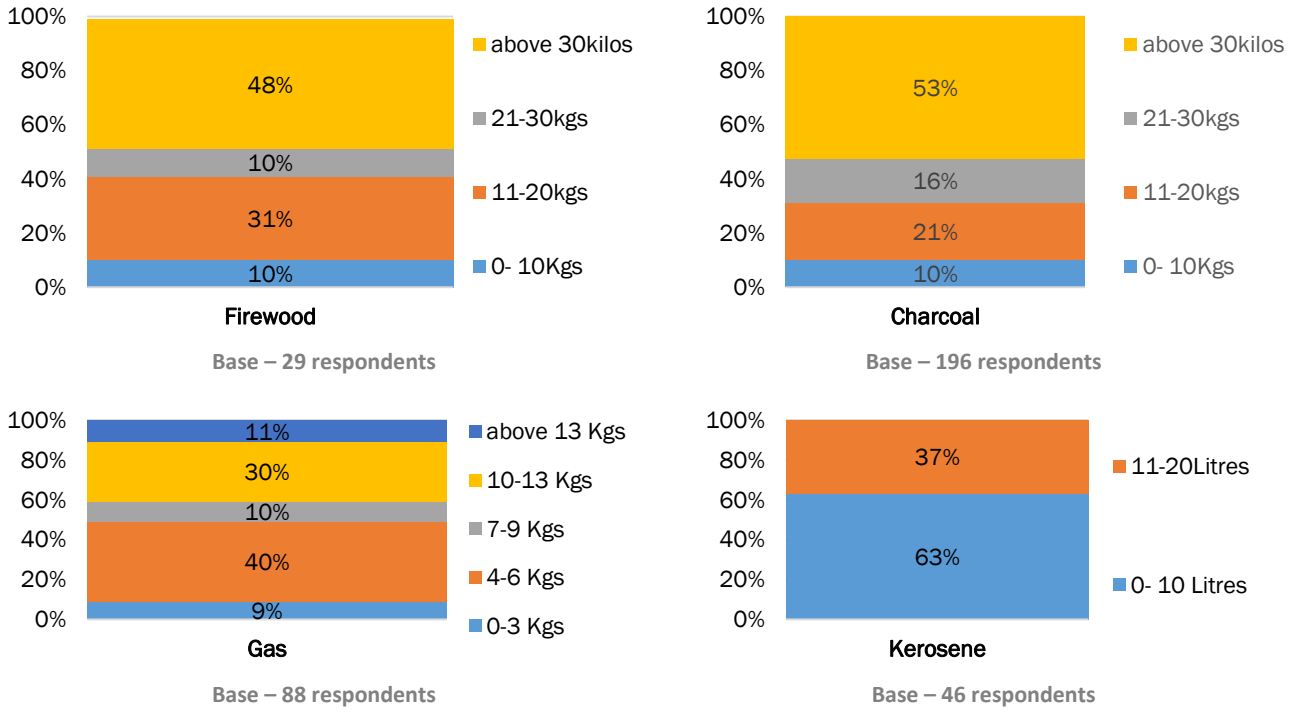


4.2.5 Average Consumption of Main Fuel

Of the total households that use firewood as a main fuel, 48% consume above 30 Kgs of firewood per month, while 31% consume between 11-20 Kgs per month. 53% of the total households who consume charcoal as a main fuel use above 30 Kgs per month while 16% use between 21-30 Kgs. Of the households that rely on gas as the main fuel, 50% use 4-9 Kgs of gas every month, while 30% use 10-13 Kgs. This may give an indication that households consider gas for fast cooking items. 63% of the households that rely on kerosene as the main fuel use 0-10 litres per month.

Households that use more than one fuel often prefer firewood and charcoal to prepare hard-to-cook foods and gas and kerosene for quick foods (like for breakfast meals). With 53% of households using charcoal as a main fuel and consuming above 30kgs and 48% of households using firewood as a main fuel and consuming over 30kgs, there is indication that both firewood and charcoal are bulky fuels. This also indicates that there is a heavy toll on the environment given that the source of firewood and charcoal is trees.

Figure 4.7: Average consumption of main fuel (Total respondents 362)
What quantity of fuel do you use per month? (Q17)



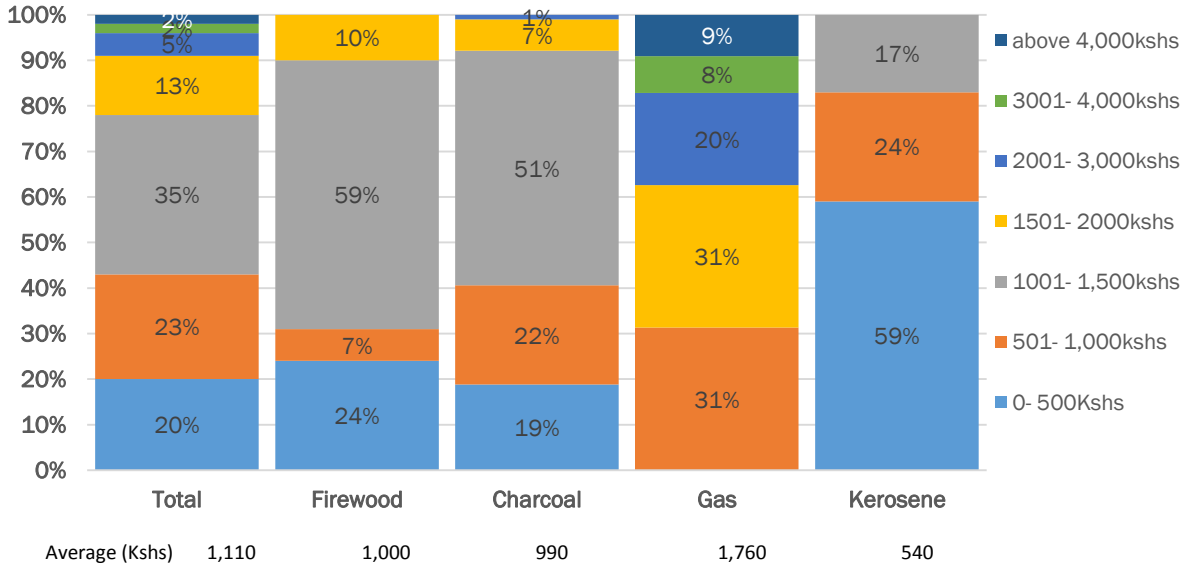
4.2.6 Spending on Main Fuel

On average, gas is the most costly fuel by way of cost of consumption, followed by firewood, charcoal and then kerosene. The average monthly usage among households is Kshs 1,760, Kshs 1,000, Kshs 990 and Kshs 540 respectively. It is interesting to note that while firewood is commonly perceived to be cheaper, as evidenced by the focus group discussions, the average household usage comes second to gas.

Below is a graph showing the actual usage per fuel type:

Figure 4.8: Average monthly spending of main fuel

How much do you spend on this fuel per month? (Q17)

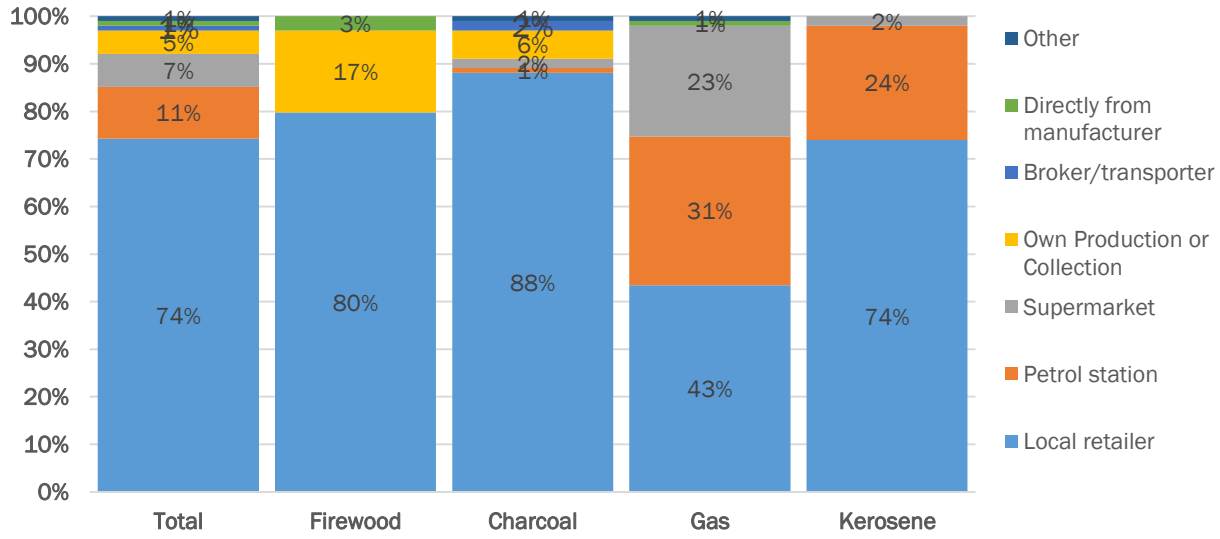


4.2.7 Sources of Main Fuel

74% of all households rely on local retailers for supply of their fuels, while 11% source from petrol stations, 7% from supermarkets and 5% from own collection/ production. This indicates that local retailers are the preferred suppliers of cooking fuels. The local retailers include: market vendors, saw mills selling firewood, retail shops selling gas cylinders and neighbourhood kerosene shops. It is worth noting that 17% of household that use firewood as a main source of fuel do their own production / collection. This indicates a depletion of the natural resources, trees in particular within Nakuru town.

Figure 4.9: Sources of main fuel

Where do you source your main fuel from? (Q18)



4.2.8 Other fuels

Majority of the households have the tendency to alternate between fuels. For gas and kerosene users, charcoal is the immediate alternative; it ranks as the top alternative across the board. For gas consumers, 78% choose charcoal as the immediate alternative while for kerosene consumers, 70% choose charcoal as the immediate alternative. Firewood is the least popular fuel as an alternative fuel. This means that charcoal is the most popular alternative fuel for those who do not use charcoal as a main fuel. This confirms charcoal as the dominant fuel in the market.

Below is a table indicating alternative fuels used by households.

Figure 4.10: Alternate fuels used by households

What other fuel type do you use currently? (Q19)

KEY	Very high rating	High rating	Average score	Low score	Very low score

		Main fuel				
		Total	Firewood	Charcoal	Gas	Kerosene
Other fuel (alternative)	Total	359	29	196	88	46
	Charcoal	38%	59%	10%	78%	70%
	Kerosene	30%	17%	44%	11%	13%
	Gas	28%	17%	39%	10%	17%
	Firewood	4%	7%	7%	0%	0%

Indicatively, only households that have gas as an alternative spend lower than those using it as the main fuel. Other fuel users tend to spend more on alternatives than on the main fuel.

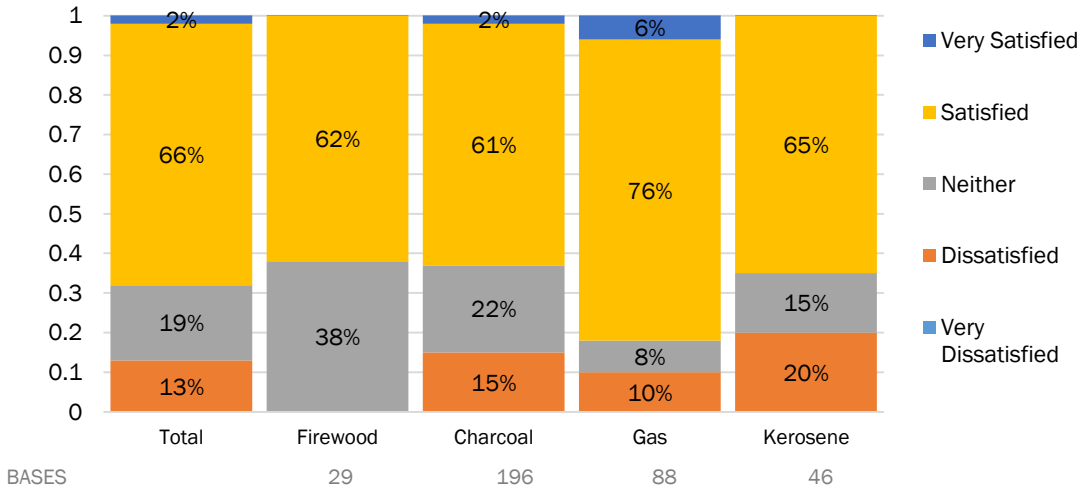
4.2.9 Satisfaction with Fuel Type

Households are largely satisfied with their fuel of choice; 66% indicate that they are satisfied and 2% very satisfied. Users of gas are the most satisfied compared to all other fuel users. 6% are very satisfied, while 76% are satisfied and 10% are dissatisfied. 15% of charcoal users are currently dissatisfied with a total of 63% saying they satisfied and 22% are neither satisfied nor dissatisfied. It is interesting to note that none of the households that use firewood as a main source of fuel are either dissatisfied or very dissatisfied; while 38% responded that they were neither satisfied nor dissatisfied. This indicates that 38% of firewood users are indifferent. This may be due to the fact that they are driven to the use of this fuel because of lack of other alternatives.

Below is a graph showing satisfaction by fuel type:

Figure 4.11: Satisfaction with fuel type

How satisfied are you with this fuel? (Q20)

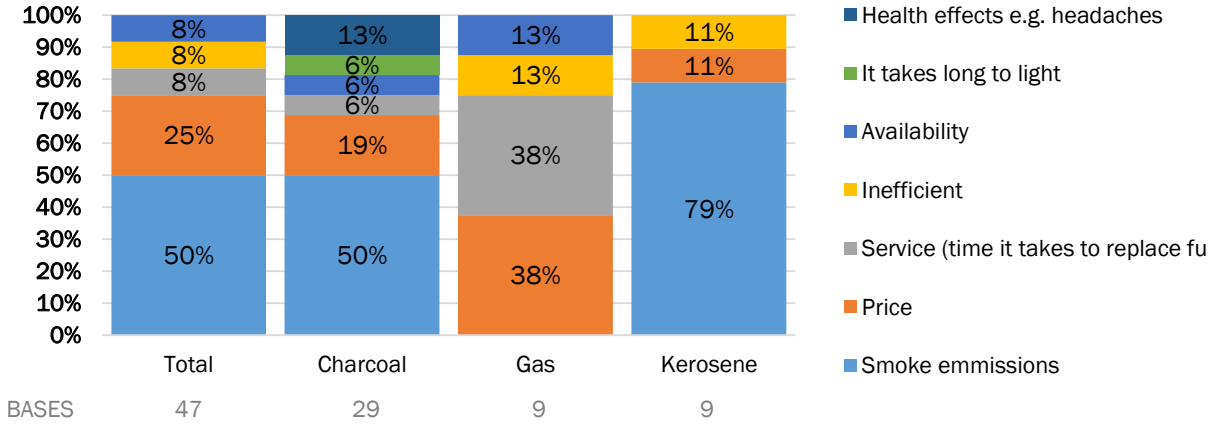


4.2.10 Dissatisfaction Drivers

On average, smoke emissions is the greatest dissatisfaction driver followed by high prices. Of the households using charcoal, 50% said that they were dissatisfied with the fuel because of smoke emissions while 19% quoted price and 13% quoted health effects. The drivers for dissatisfaction for kerosene users was smoke emissions at 79%, price at 11% and inefficiency at 11%; while for gas the dissatisfaction driver was price (38%) and replacing services (38%). This indicates that there is room for the introduction of cleaner fuels in the market. It is also evident that the fuel market in Nakuru town is highly price sensitive, meaning that fuels that have an average lower price, yet are efficient, have a higher chance of penetrating the market.

Figure 4.12: Dissatisfaction drivers

Why are you dissatisfied with the fuel you are using? (Q21)

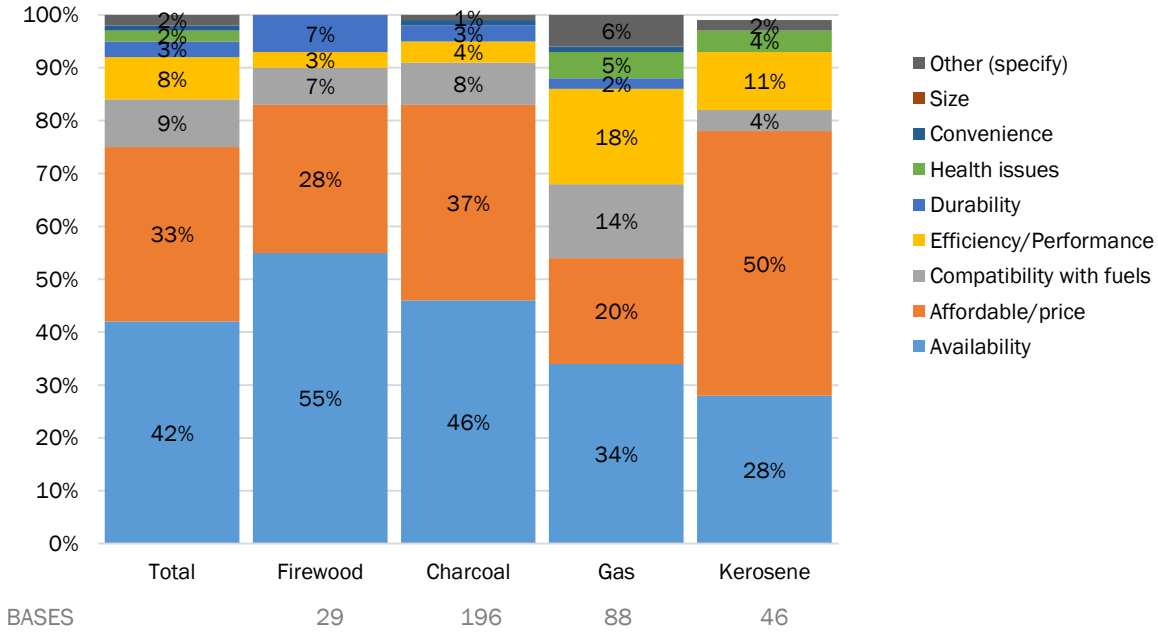


4.2.11 Purchase Drivers

Cost and availability are the main drivers of consideration of any type of fuel for the households. While kerosene is the most affordable, gas is seen as the most efficient and clean source of energy. From the study, 42% of the households chose the fuel type based on availability, 33% based on affordability and 9% based on compatibility with other fuels.

Figure 4.13: Purchase drivers for fuel

Why did you choose this particular fuel type? (Q22)



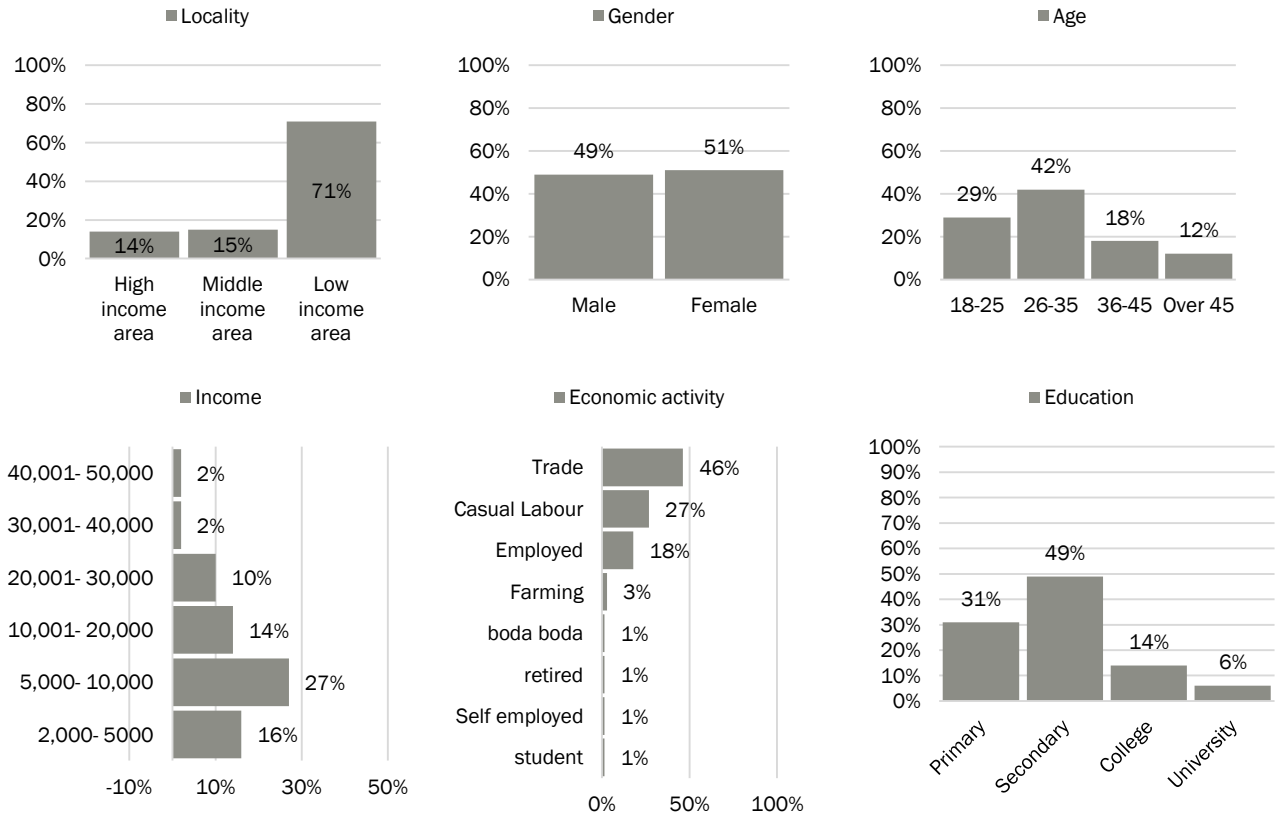
Household Profile per Fuel Type

This section looks at profiling the households per main fuel type used. This is with the aim of recognizing the unique characteristics and preferences of the households in order to inform the project on the customer profile and the strategies that can be adopted when reaching the particular segments.

4.2.12 Charcoal Users (196 households – 54% of the respondents)

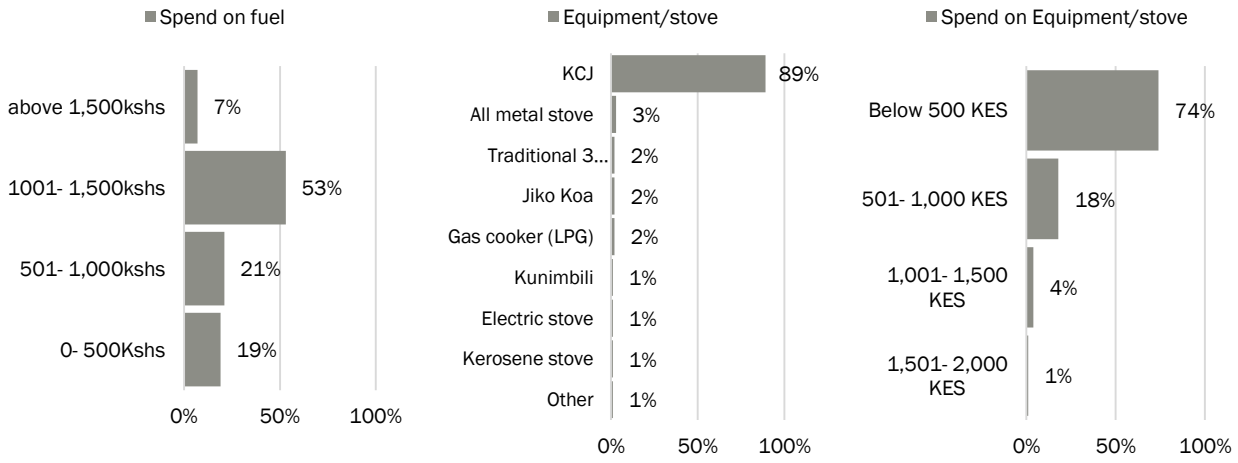
Charcoal is predominantly used by households living in low income areas, majority of them earning a monthly income of between Kshs 5,000 to Kshs 10,000.

Figure 4.14: Profile of Households that use Charcoal as their main fuel



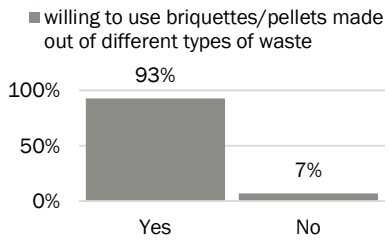
A household will use an average of Kshs 990 on charcoal every month and will have spent an initial cost of Kshs 663 on the equipment. The average usage of charcoal for households is 30 kg as evidenced by in the table/graph. KCJ is the most popular equipment with affordability as the top driver.

Figure 4.15: Average Spending on Fuel and Equipment Preferences and Spending – for HHs that use charcoal as their main fuel



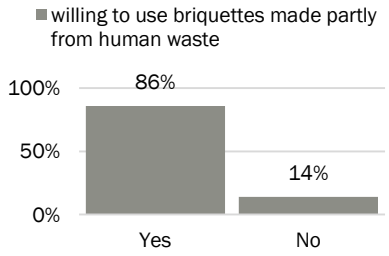
While majority (of the charcoal consumers) are willing to try the new type of fuel, cost efficiency and availability would be the core motivation for trial. However, the users need assurance on the hygiene and safety of the new source of energy.

Figure 4.16: Households willingness to use briquettes and pellets made from different waste – for HHs that have charcoal as their main fuel



WHY	
Cost efficiency	54%
Availability	23%
Environmental conservation	9%
Burn for long time	3%
Efficient in use	1%

WHY NOT	
Hygiene/safety	3%
Smell	1%
Culture or tradition	1%
Religious reasons	1%
Satisfied with the current fuel	1%



WHY	
Cost efficiency	33%
Availability	22%
Environmental conservation	18%
No health effect/hygiene issues	5%
Performance/how they work	4%

WHY NOT	
Hygiene or safety	13%
Culture or traditions	1%
Smell	1%

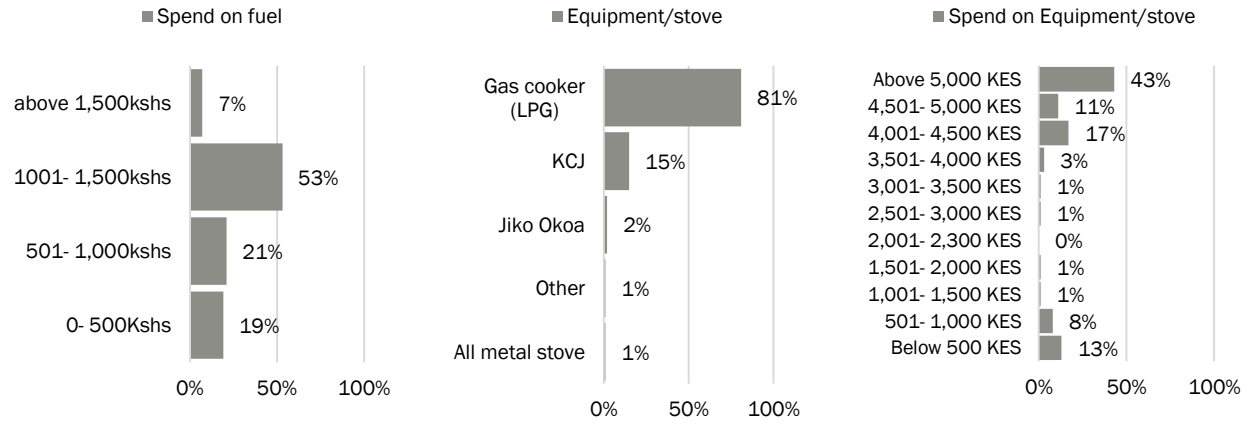
4.2.13 Gas Users (88 households – 24% of the respondents)

Gas is predominantly used by the employed segment with some level of education and stable source of income as high as above Kshs 50,000. This is the desired source of fuel for many. Surprisingly, the study shows a number of gas users located in the low income areas implying that there are brackets of HHs with varying income levels and fuel preferences. It is also worth note that 40% of the HHs that use gas as the main fuel spend between Kshs 0-1,000 per month indicating the different refill options for gas users across income levels.

Figure 4.17: Profile of Households that use Gas as their main fuel

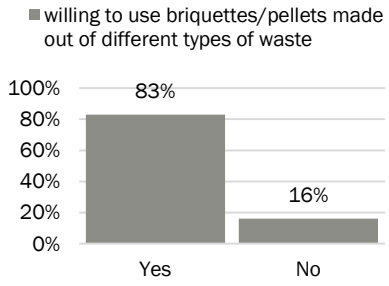
A household will use an average of Kshs 1,760 on gas every month and will have spent an initial cost of Kshs 3,690 on the equipment. The LPG gas cylinder and burner (meko) is the most popular equipment.

Figure 4.18: Average Spending on Fuel and Equipment Preferences and Spending – for HHs that use Gas as their main fuel



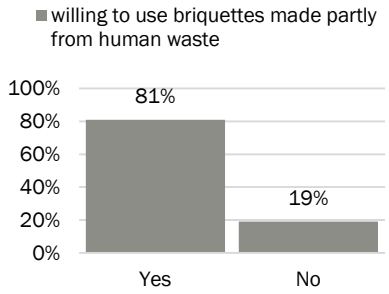
Indicatively, 8 in every 10 gas users would be willing to try the new type of fuel; however, not all would feel comfortable with biomass as a source of fuel.

Figure 4.19: Households willingness to use briquettes and pellets made from different waste – for HHs that have Gas as their main fuel



WHY	
Cost efficiency	52%
Environmental conservation	15%
Availability	10%
Efficient in use	2%

WHY NOT	
Hygiene/safety	3%
Dont like using biomass/not comfortable	3%
Other reasons	3%



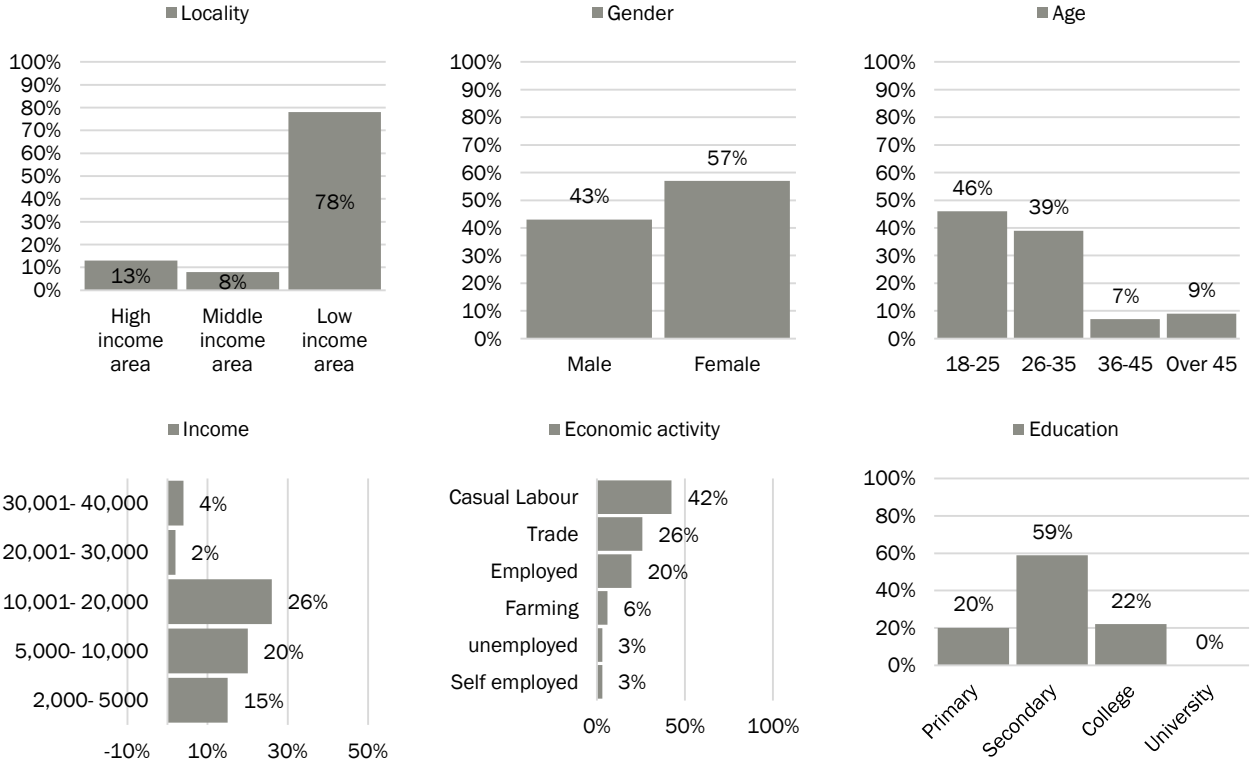
WHY	
Environmental conservation	28%
Cost efficiency	27%
Availability	14%
No health effect/hygiene issues	6%
Efficient in use	2%

WHY NOT	
Smell	7%
Hygiene or safety	6%
Culture or traditions	2%
Not compatible with cooker	1%
Burn slow	1%
Never seen how they work	1%

4.2.14 Kerosene Users (46 households – 12% of the respondents)

Kerosene is predominantly used by casual labourers and youthful segments (18-25 years). To most users, this was the first fuel used during the "hustling" days.

Figure 4.20: Profile of Households that use Kerosene as their main fuel



A household will use an average of Kshs 540 on kerosene every month and will have spent an initial cost of Kshs 508 on the equipment. The kerosene stove is the most popular equipment.

Figure 4.21: Average Spending on Fuel and Equipment Preferences and Spending – for HHs that use Kerosene as their main fuel

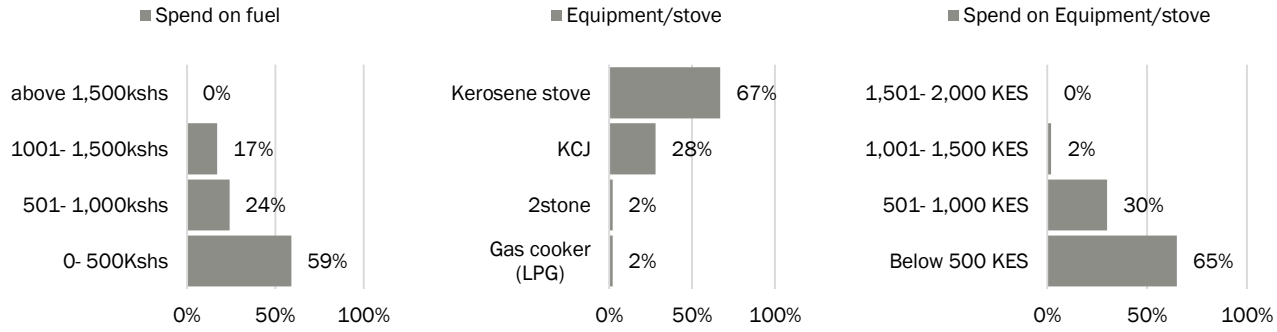
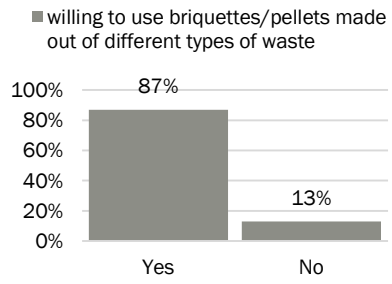
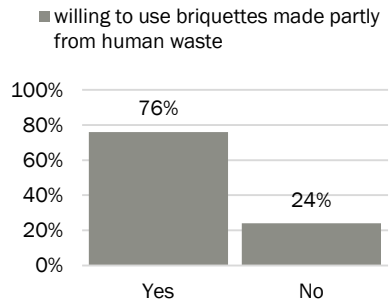


Figure 4.22: Households willingness to use briquettes and pellets made from different waste – for HHs that have Kerosene as their main fuel



WHY	
Cost efficiency	65%
Availability	9%
Smoke free/no health effect	4%
Other	4%

WHY NOT	
Smell	4%
Hygiene/safety	4%
Not compatible with my cooker	2%
Other reasons	2%



WHY	
Cost efficiency	37%
Environmental conservation	17%
Availability	11%
Burn for long time	4%
No health effect/hygiene issues	4%

WHY NOT	
Hygiene or safety	11%
Culture or traditions	4%
Not compatible with cooker	2%
Smell	2%
Just afraid to use	2%
Never seen how they work	2%

Focus Group Discussion (FGD)

4.2.15 Focus Group Discussion – Fuels Summary

The FGD confirmed that the factors influencing fuel use at the household mostly depend on:

- Cost of the fuel
- Type of cook stove owned by the household
- Time of the day
- Type of food being cooked

- State of finances in the household
- Number of people being served

In terms of costs, LPG gas was found to be the most expensive followed by charcoal, kerosene and firewood in that order.

Charcoal costs averaged Kshs 40-Kshs 50 for a 2 kg can and Kshs 1,500 for a sack weighing approximately 45 Kgs. Sourcing was mainly from local grocery stalls and local shopkeepers.

Kerosene costs between Kshs 45- Kshs 55 per litre. Most people said they preferred purchasing from petrol stations as the quantities were more assured as compared to local shops.

Gas refills were going for Kshs 1,100 for a 6kg cylinder and Kshs 2,000 for a 13 Kg cylinder. Sourcing was mainly from supermarkets, local gas shops in the estates and petrol stations.

For firewood, the measurement unit was in bunches and sourcing was from timber yards which mostly sell offcuts as firewood. A bunch was going for between Kshs 50- Kshs 100.

In summary, households with three members and above were found to alternate using the various cook stoves depending on the food being cooked. Light foods like tea or rice were mostly cooked using kerosene stove, gas or firewood. Heavy foods like beans or githeri were mainly cooked using charcoal stove. Another point which arose was that cooking foods like ugali with either charcoal or firewood gave it a better tasting aroma as compared to cooking using gas or kerosene.

Challenges faced using the various types of fuels.

- **Charcoal:** In most places where the FGD was conducted, the respondents live in one room rentals which are poorly ventilated. Due to the lack of space, cooking has to be done indoors and this leads to carbon monoxide inhalation leading to headaches and other health effects.
- **Kerosene:** Kerosene also has smoke emission and a strong odour when used indoors.
- **Firewood:** It cannot be used indoors due to the smoke pollution. During the rainy season, it becomes a challenge to use wet firewood which takes a long time to light and smokes a lot.
- **Gas:** The main challenge was the cost of refills. Using gas as the only fuel consumption option in a household of between 3-5 people could result in very high bills.

4.3 BUSINESSES AND INSTITUTIONS

PROFILE

4.3.1 Business Sample

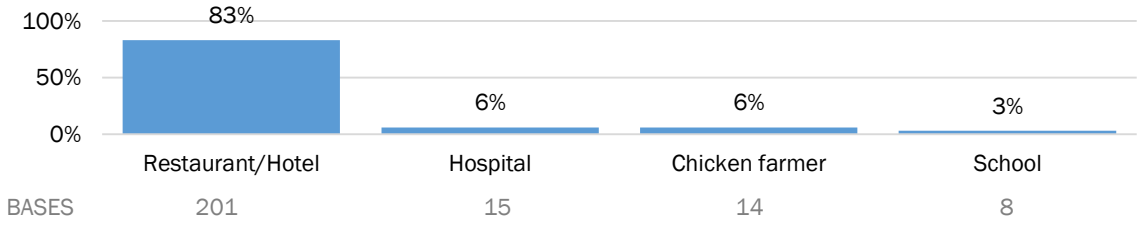
A total of 238 small and medium sized businesses and institutions were interviewed in the region. Majority are based in the CBD since interviews were conducted with key decision makers within the business premise.

Table 4b: Number of businesses/institutions interviewed per location/area

CBD	98	Kiratina	6
Shabab	22	White House	7
Milimani	12	Pipeline- Kiondo Area	5
Kaptembwa	12	Lanet	5
Freehold	11	Njoro	2
Section 58	9	Bookmark	2
Free Area	9	Bondeni	2
Mwariki South	8	Kaloleni	2
Kenol street	7	Not Specified	17
Rhonda	7		

The businesses and institutions interviewed constitute the following: 201 restaurants and hotels, 15 hospitals, 14 chicken farmers and 8 schools.

Figure 4.23: Type of business/institution/industry



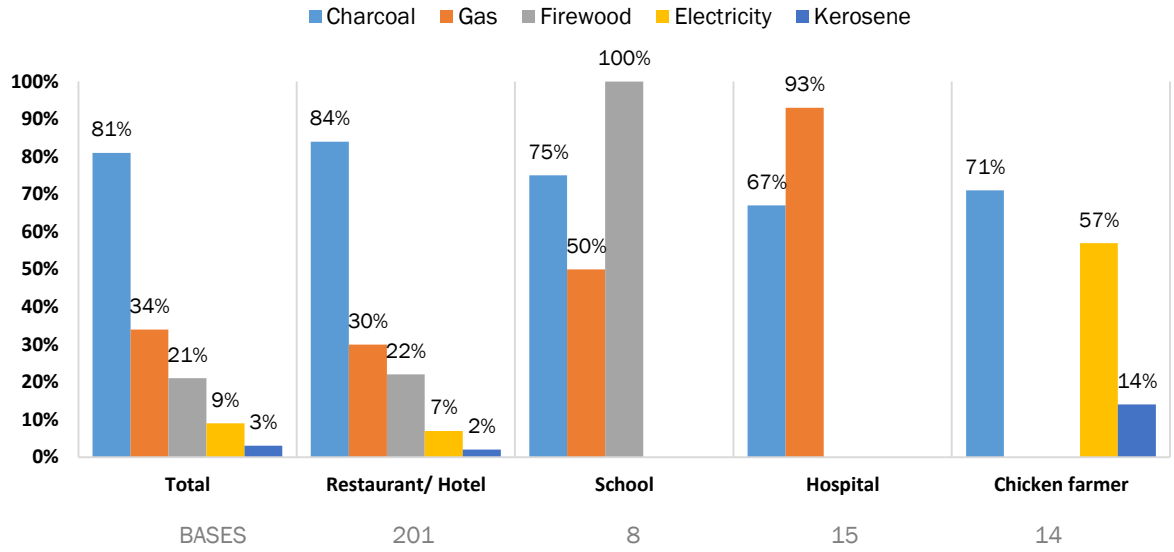
ANALYSIS OF FUEL CONSUMPTION

4.3.2 Main Fuel Type Used

Businesses and institutions rely on multiple fuels depending on the purpose. Out of the 243 businesses and institutions interviewed, 81% use charcoal, 34% use gas, 21% use firewood, 9% use electricity and 3% use kerosene. Schools and learning institutions predominantly use firewood while hospitals prefer gas. All the schools interviewed use firewood. Restaurants and hotels mainly use charcoal. Electricity is relied on by poultry farmers especially for brooding.

Figure 4.24: Type of Fuel Used

What type of fuel do you use? (Q10)

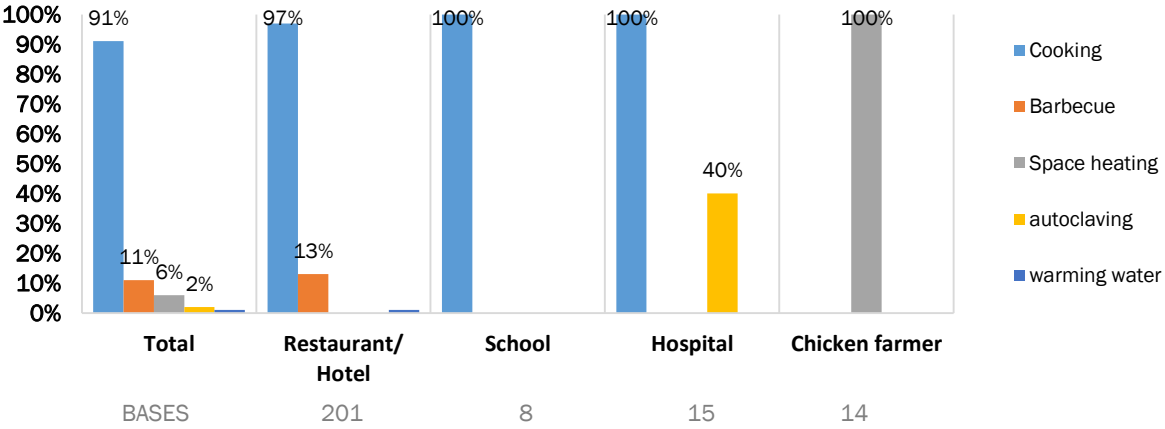


4.3.3 Purpose of fuel

Cooking is the core use of fuel for most businesses interviewed. Out of the 243 businesses and institutions, 91% use their fuel for cooking, 11% for barbecue, 6% for space heating, 2% for autoclaving and 1% for warming water. Chicken farmers also present a high demand for fuels for their need for space heating.

Figure 4.25: Purpose of Fuel

For what purpose do you use the fuel? (Q11)



4.3.4 Average Spending on Fuel

Most businesses spend an average of Kshs 10,000 – Kshs 20,000 on fuel every month. Charcoal cuts across all institutions with the highest average spend across all sources of energy. Firewood is most popular for schools while gas is preferred by hospitals.

Figure 4.26: Average Spending per Fuel per Business/ Institution

		Total	Restaurant/ Hotel	School	Hospital	Chicken farmer
	Bases	**243**	**201**	**8**	**15**	**14**
Firewood	Use	40%	43%	100%	20%	0%
	Amount	4,483	4,169	10,941	5,350	-
Charcoal	Use	70%	72%	75%	53%	71%
	Amount	12,004	10,261	4,167	3,244	5,411
Gas	Use	28%	25%	0%	93%	0%
	Amount	8,146	3,794		11,014	-
Electricity	Use	8%	6%	0%	0%	50%
	Amount	6,000	6,000	-	-	921
Kerosene	Use	3%	2%	0%	0%	14%
	Amount	400	-	-	-	520

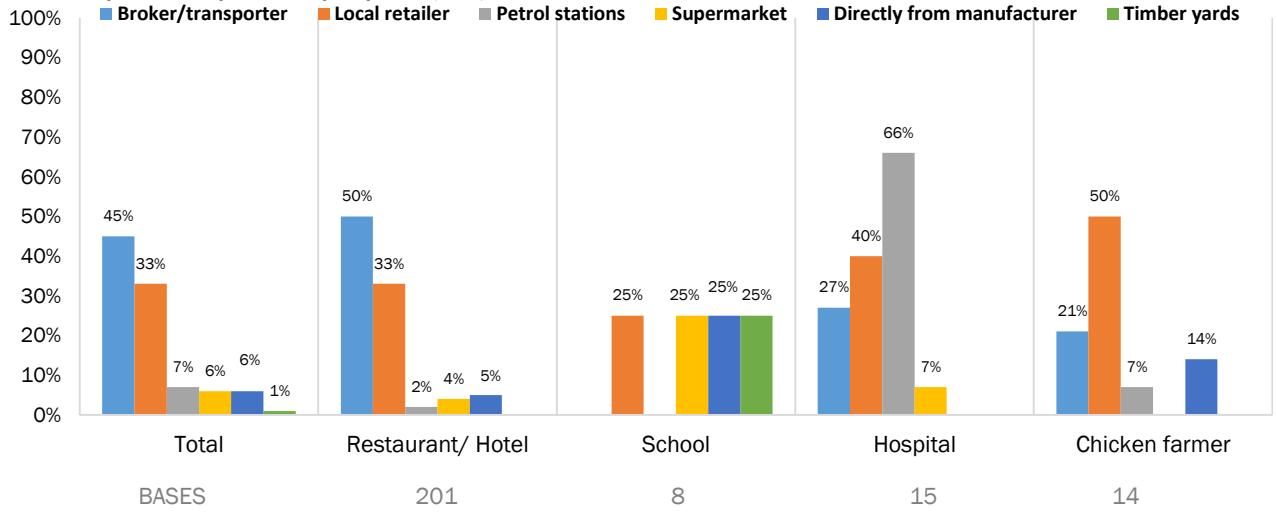
4.3.5 Sources of Main Fuel

Brokers and transporters are the main suppliers of different sources of fuel for small and medium businesses. Timber yards are the main sources of firewood for schools. Petrol stations are the main source of cooking for hospitals.

Out of the businesses and institutions interviewed, 45% source their fuel from brokers, 33% from local retailers, 7% from petrol stations, 6% from supermarkets, 6% directly from manufacturer and 1% from timber yards.

Figure 4.27: Source of main fuel

Where do you source your main fuel from? (Q15)



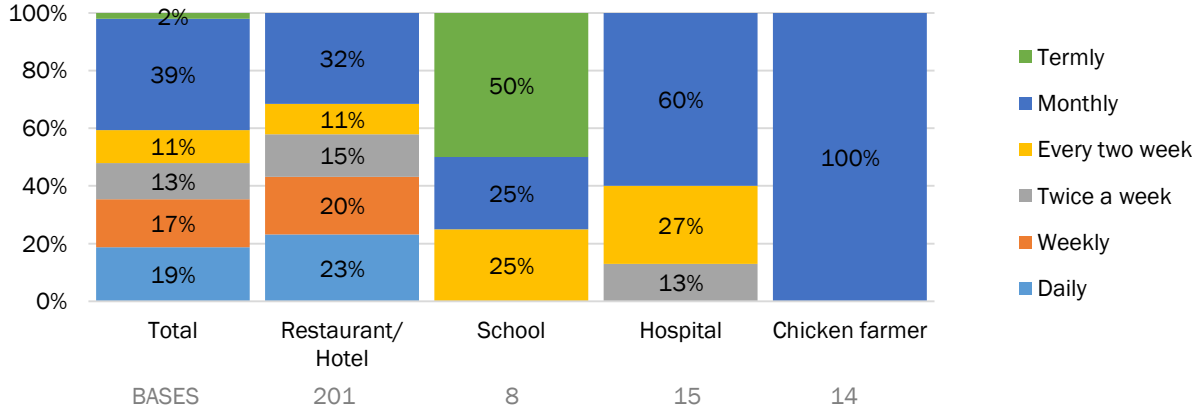
4.3.6 Frequency of Purchase

It is evident that most businesses plan and budget for fuel on a monthly basis. However, schools align their spending as per school terms or semesters since their revenues are dependent on student fees. Only restaurants and hotels purchase their fuel daily, with 23% of those interviewed saying they do so.

Out of the businesses and institutions interviewed, 39% purchase their fuel monthly, 19% daily, 17% weekly, 13% twice a week, 11% every two weeks and 2% termly.

Figure 4.28: Frequency of purchase

How often do you purchase your fuel? (Q14)



5.0 OBJECTIVE 2: CONSUMER PREFERENCES FOR BIOMASS FUELS AND FUEL-STOVE COMBINATIONS

5.1 INTRODUCTION

The study objective sought to establish the preferences for fuel and unmet needs of the households, businesses and institutions. The study also provides insight into the stove/equipment preferences.

5.2 HOUSEHOLDS

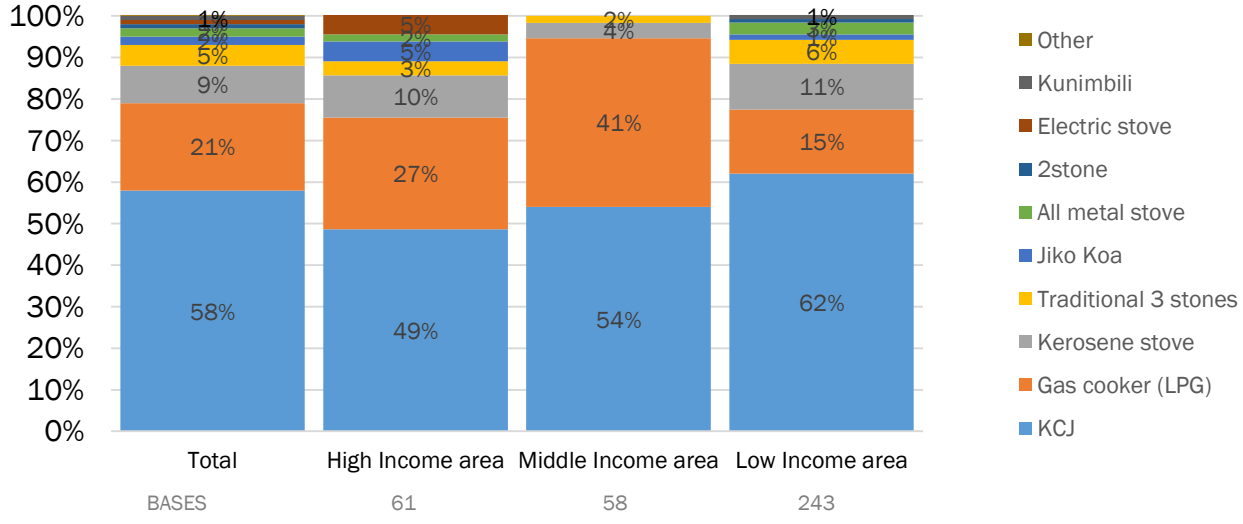
EQUIPMENT

5.2.1 Main Fuel Equipment

Kenya Ceramic Jiko (KCJ) is the most popular stove in among households. This also confirms charcoal as the dominant fuel. Interestingly, the low income areas have more alternatives to fuel equipment than middle income areas, indicating that they are more likely to switch to other fuels based on satisfaction metrics indicated in graph. Out of the 362 HHs interviewed, 58% use the Kenya Ceramic Jiko (KCJ), followed by 21% using the LPG gas cooker. 9% use the kerosene stove, 5% the traditional 3 stones, 2% use Jikokoa, 2% the all metal stove, and 1% respectively for the two-stone, electric stove, kunimbili and unspecified jiko.

Figure 5.1: Main fuel equipment

What type of equipment do you use? (Q23)



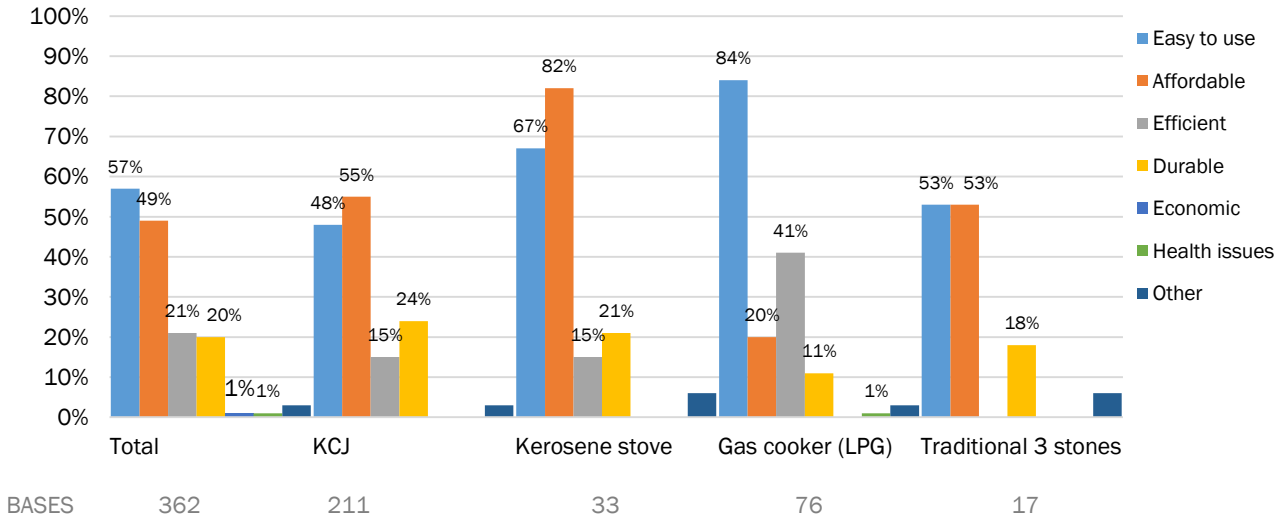
5.2.2 Drivers of Preference

Overall, ease of use and affordability of equipment are the main reasons households choose a certain type of stove. For charcoal users, KCJ is affordable and easy to use. The gas cooker is perceived to be the highest in terms of efficiency but least affordable.

57% households say that that they prefer the stove they are using due to ease of use, 49% due to affordability, 21% for efficiency, and 20% for durability.

Figure 5.2: Preference drivers for equipment

Why do you prefer that particular equipment? (Q24)



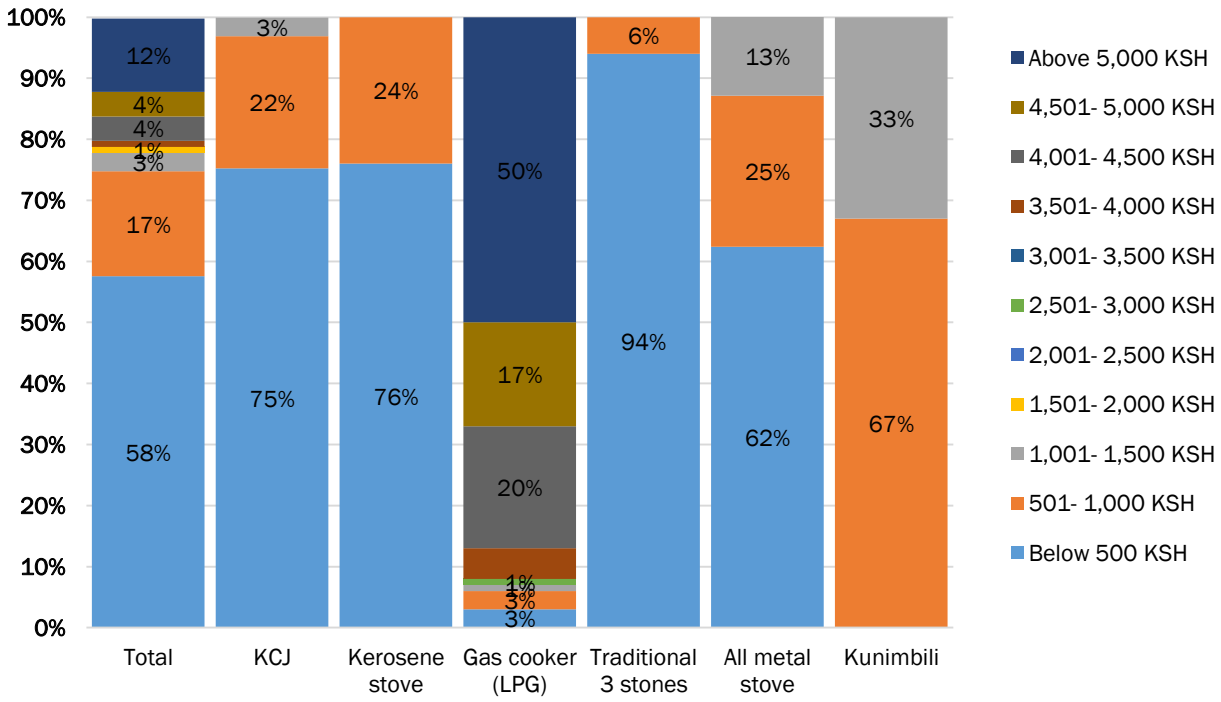
BASES	362	211	33	76	17

5.2.3 Spending on Equipment

57% of the respondents indicated that they spend Kshs 500 or below on fuel equipment. In terms of set up costs, gas is the most expensive.

Figure 5.3: Spending on equipment

How much did the stove/equipment cost? (Q25)



BASES	201	8	15	14	5

Electric stoves are the most expensive with spending of above Kshs 5,000. Jikokoa is said to cost Kshs 2,408 while KCJ users spend Kshs 378 on equipment purchase. On average, households spend Kshs 1,323 on equipment. Price, then, becomes the main reason why household have embraced KCJ. The following table shows the average spending on equipment based on the household head's gender, residence, income and area of residence.

Table 5a: Average spending on equipment

	Spend in KSh
Electric stove	5,000
Gas cooker (LPG)	4,415
Jikokoa	2,408
Kunimbili	915
All metal stove	508
2stone	500
KCJ	378
Kerosene stove	370
Traditional 3 stones	280
Other	1,568

		Spend in KSh
HH head Gender	Male	1,440
	Female	1,938
Residence	Own home	970
	Tenant	1,410
Income	2,000- 5000	883
	5,000- 10,000	1,028
	10,001- 20,000	1,138
	20,001- 30,000	1,785
	30,001- 40,000	1,913
	40,001- 50,000	2,780
	Above 50,000	3,050

	Spend in KSh
High Income area	1,878
Middle Income area	2,028
Low Income area	1,089

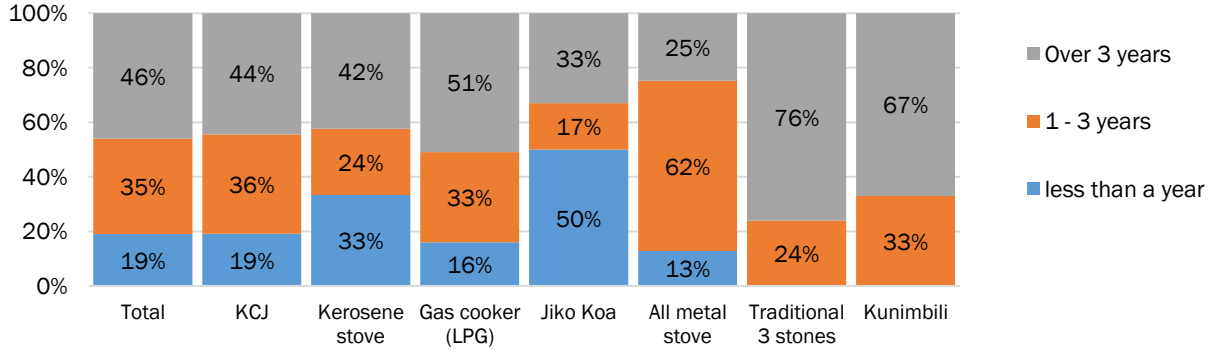
Based on the residential area, the HHs in the high income area have an average spending of Kshs 1,878 on equipment, Kshs 2,028 for the medium income area and Kshs 1,089 for the low income area.

5.2.4 Duration of Usage

Out of the 362 HHs interviewed, 19% have had the equipment they are using for less than a year, 35% for 1-3 years and 46% for over three years. Jikokoa seems to be the latest entrant in the category with 50% of those using it having purchased it within the last year. Notably, all metal stoves are likely to be replaced within a span of 3 years. This could indicate that the average life span of metal jikos, including KCJ is 3 years.

Figure 5.4: Duration of usage of equipment

How long have you had the equipment/stove? (Q26)



5.2.5 Challenges with Equipment

Health effects are the consumers' greatest concern with fuel equipment use; 44% of households indicate the same. While KCJ is adopted by most consumers because of its low price, it actually scores higher on challenges due to health effects; with 51% of households that use it supporting this notion. Other main challenges with fuel equipment mentioned were fuel inefficiency 18%, use of only one type of fuel 18% and lack of durability 16%.

Figure 5.5: Challenges with the equipment used

What challenges are faced using the stove? (Q27)

	Total	KCJ	Kerosene stove	Gas cooker (LPG)	Jikokoa	All metal stove	Traditional 3 stones	Kunimbili
Total	362	211	33	76	6	8	17	3
Health effects	44%	51%	61%	8%	83%	63%	71%	33%
Fuel Inefficiency	18%	19%	36%	9%		38%	18%	
Uses only one fuel type	18%	17%	27%	22%		13%	18%	33%
Not durable	16%	22%	3%	7%		13%	6%	33%
Breaks easily	10%	17%		1%		13%	6%	
Not safe to use	4%	3%	6%	3%		25%	6%	
Expensive	3%			13%				
Smoke emissions	3%	2%	6%			13%	6%	
Size of the stove	3%	3%		5%		13%		
Other challenges	7%	4%	3%	14%		13%		
No challenges	13%	6%	9%	37%	17%	13%	6%	

KEY	Very high rating	High rating	Average score	Low score	Very low score

5.2.6 Other Fuel Equipment

KCJ is positioned as the most popular alternative cooking fuel equipment to all other fuel equipment. Three out of every four gas, kerosene and firewood users have the Kenya Ceramic Jiko. It is important to note that 71% of all households using the traditional stones- normally used for firewood as a main fuel, were also using KCJ as an alternative fuel equipment. This means that any fuel that is adaptable to KCJ has the greatest chances of penetrating the household fuel market in Nakuru town.

Figure 5.6: Alternative equipment used by households

What other type of stove do you use? (Q28)

		Main Equipment							
		Total	KCJ	Kerosene stove	Gas cooker (LPG)	Jikokoa	All metal stove	Traditional 3 stones	Kunimbili
Other Equipment	Total	362	211	33	76	6	8	17	3
	KCJ	38%	18%	73%	70%	67%		71%	100%
	Kerosene stove	20%	27%	9%	9%		50%	12%	
	Gas cooker (LPG)	20%	26%	12%	11%	17%	25%	12%	
	Jiko Koa	4%	5%		3%				
	Kunimbili	3%	5%				13%	6%	
	Traditional 3 stones	2%	3%		1%		13%		
	Electric stove	1%	1%						
	All metal stove	1%	1%		1%				
	Other	1%			1%				
	No other	10%	14%	6%	4%	17%			

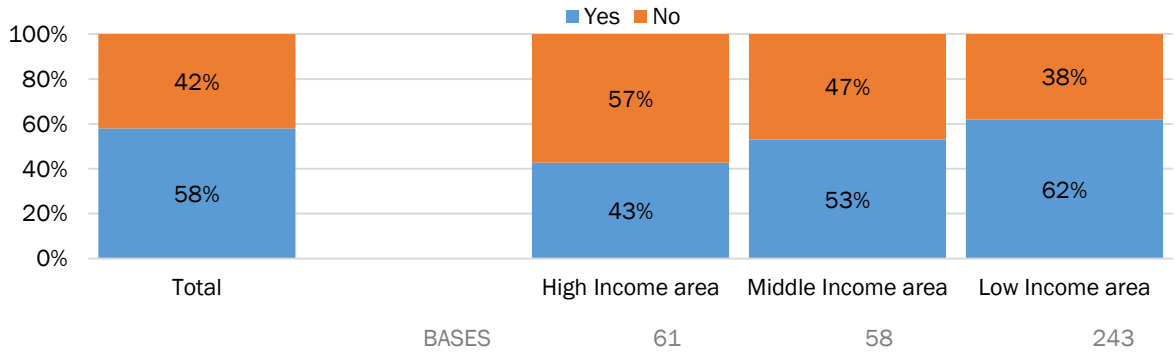
KEY	Very high rating	High rating	Average score	Low score	Very low score

5.2.7 Future Intent with Equipment

Likelihood of changing equipment declines with affluence. Out of the HHs interviewed, 58% have plans of changing the equipment that they use and 42% have no plans of changing the equipment. This indicates that fuel equipment used by households in high income area is more dependable as compared to equipment used by households in low income areas.

Figure 5.7: Future intent with equipment

Do you plan to change the stove you are using one day? (Q29)



5.2.8 Needs for New Equipment

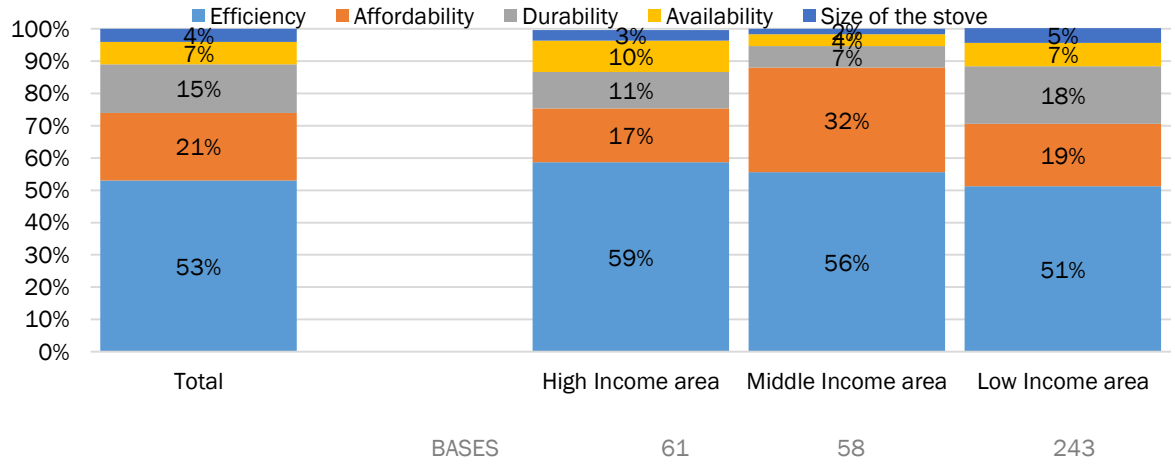
Fuel and cost efficiency are the success drivers for a player seeking to capture this market. Durability also comes up as a key element of consideration.

Out of the HHs interviewed, 53% say that efficiency is the most important characteristic that they look for in a stove, 21% talk of affordability, 15% talk of durability, 7% talk of availability and 4% consider the size of the stove. This indicates that while price is a key

factor to consider when purchasing the fuel equipment, once purchased they still expect it to be efficient and durable.

Figure 5.8: Needs for new equipment

When choosing a stove type, what is the most important characteristic that you look for? (Q30)



5.2.9 Willingness to Pay for New Equipment

Households in high income areas are willing to spend the most on new equipment as compared to other areas; they are willing to spend an average of Kshs 2,013. However, HHs in low income areas are willing to spend more money on fuel equipment as compared to middle income areas; with an average of Kshs 1,616 and Kshs 1,458 respectively. Consequently, kerosene and firewood users are more likely to spend more on new equipment as compared to charcoal users; with an average of Kshs 2,018, Kshs 1,870 and Kshs 1,633 respectively. The indication that HHs in low income areas are more willing to upgrade their fuel equipment than those in middle income areas indicates a potentially higher rate of adoption of fuels and equipment in low income areas.

Table 5b: Willingness to pay for new equipment

MAIN FUEL	Spend in KSh
Electricity	3,383
Kerosene	2,018
Firewood	1,870
Charcoal	1,633
Gas	1,445

PROFILE		Spend in KSh
HH head Gender	Male	1,600
	Female	1,540
Residence	Own home	1,505
	Tenant	1,680
Income	2,000- 5000	2,060
	5,000- 10,000	2,075
	10,001- 20,000	1,283
	20,001- 30,000	1,275
	30,001- 40,000	513
	40,001- 50,000	1,400
	Above 50,000	950

REGION	Spend in KSh
High Income area	2,013
Middle Income area	1,458
Low Income area	1,616

Table 5c: Equipment – Current Spending on Equipment vs. Willingness to Spend on New Equipment

SPEND ON EQUIPMENT (KSH)	
High Income area	1,878
Middle Income area	2,028
Low Income area	1,089

WILLINGNESS TO SPEND ON NEW EQUIPMENT (KSH)	
High Income area	2,013
Middle Income area	1,458
Low Income area	1,616

The likelihood of purchasing new equipment declines with affluence. Notably, the HHs in middle income areas spent the highest on their current equipment and are not willing to spend as much on new equipment.

Focus Group Discussion

5.2.10 Focus Group Discussion – Cook Stoves

Participants listed various types of cook stoves in use. The key cook stoves were:

- Kenya Ceramic Jiko
- Gas cooker
- Kerosene stove
- Three stone fire

Overall the most common cook stove was the Kenya Ceramic Jiko which is a charcoal jiko followed by the kerosene stove, gas cooker and finally the three stone fire.

The key consideration towards the use of various cook stoves depended on various aspects, namely;

- Economic condition/ Financial status of the household
- Size of the family
- Type of food being cooked
- Time of the day
- Ownership of household

Charcoal cook stoves are the most common among households having more than three members with usage varying according to the factors enumerated above. Cheap charcoal stoves range from Kshs 150-450.

Kerosene stoves were also widely used by the participants in the various focus group discussions. Prices ranged from Kshs 300-Kshs 600.

Gas cookers averaged Kshs 3,000-Kshs 25,000. Over half of the respondents interviewed did not have gas cookers due to the high initial purchase cost and high refill costs.

Three stone fire was the most prevalent cook stove for firewood users. This was at a minimal cost as the stones for the set up were readily available from the surroundings. The main characteristic was that over 90% of the firewood users were people residing in their own compounds or owning their homes. Firewood use was non-existent among people living in rental households.

The respondents faced various challenges using the various cook stoves.

- Charcoal stoves; safety issues attributed to danger of the stoves being knocked over and starting a fire and challenges in lighting.
- Kerosene stove; safety concern - prone to fire dangers from being knocked over, leave a pungent kerosene smell on the clothes after being used and when putting it off.
- Gas cookers; High costs of refills
- Fire wood stoves; Challenge in lighting, cannot be used indoors.

5.3 BUSINESSES AND INSTITUTIONS

Equipment

5.3.1 Equipment Used

Household stoves are most common among small and medium business – they find industrial stoves too expensive. 48% of restaurants / hotels use household stoves while only 17% use industrial stoves. Boilers are common in schools while industrial stoves are common in hospitals. Out of the businesses and institutions interviewed, 42% use the household stove, 17% use industrial stove, 11% the boiler, 5% the gas cooker. Only 1% uses the ordinary KCJ.

Figure 5.9: Equipment used

What type of equipment or stove do you use? (Q.16)

	Restaurant/ Hotel	School	Hospital	Chicken farmer
Total	201	8	15	14
Boiler	10%	50%	20%	
Industrial stove	17%		40%	
Household stove	48%		27%	
Gas cooker		50%	40%	
Infrared bulbs				29%
Cooker			40%	
Oven	1%			
Ordinary KCJ				14%
Kunimbili	1%			
Three stones		26%		
Poultry pot				7%

5.3.2 Drivers for Preference

Efficiency is the top driver when investing in equipment. Boilers lead on durability whereas household stoves lead on affordability. Out of the businesses and institutions interviewed, 49% prefer the stove/equipment due to efficiency and performance. The next factor of preference is affordability (45%) followed by durability (36%). The greatest influence for choice of industrial stove is efficiency/ performance at 64% while the greatest influence for choice of household stove is affordability at 69%. This indicates that businesses, especially hotels and restaurants, are price sensitive when it comes to the choice of fuel equipment.

Figure 5.10: Drivers for preference

Why do you prefer that particular equipment/stove? (Q17)

	Total	Boiler	Industrial stove	Household stove
Total		27	42	103
Efficiency/performance	49%	30%	64%	40%
Affordable/price	45%	37%	50%	69%
Durability	36%	44%	57%	50%
Compatibility with fuels	32%	30%	33%	45%
Size	2%		10%	3%
Less demanding	2%			
Suitable for the job				1%
Routine				1%
Fast				
Easy to use				
Popular				
Availability				

5.3.3 Spending on Equipment

Indicatively, many businesses still use household jikos. However, with the customization of the industrial jikos, many businesses can now access them at affordable rates.

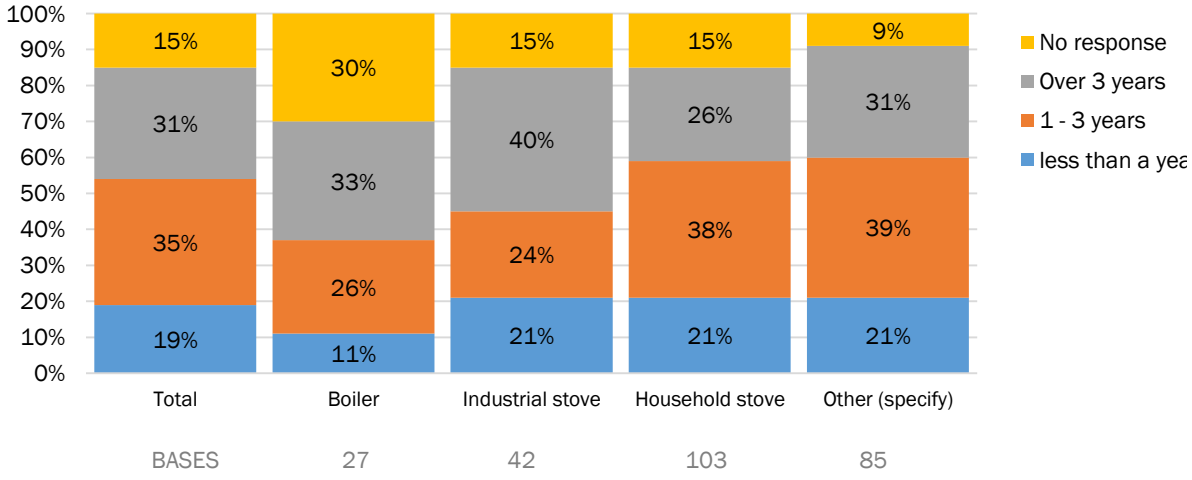
Businesses spend a range of between Kshs. 3,000-50,000 on boilers; between Kshs 5,800-60,000 on industrial jikos; between Kshs 4,500-45,000 on gas cookers; and between Kshs 300-5500 on household jikos. This shows a wide price range depending on the specifications of the equipment in use and suited to the different businesses from small businesses to larger institutions.

5.3.4 Duration of Usage

Most businesses have used the current equipment for more than one year. There is an indication of low frequency of changing equipment. 35% have had the equipment for between one to three years; 31% for over three years; and 19% for less than a year.

Figure 5.11: Duration of usage

How long have you had the equipment/stove? (Q19)



5.3.5 Challenges with Equipment

Smoke emissions are the top complaint for current equipment used, especially by the industrial stove users. However, even though household stoves are more affordable, they are inefficient and less durable. Out of the 243 businesses and institutions interviewed, 47% talk about health effects as a challenge faced using the stove or equipment, 24% durability, and 15% talk about the inefficient use of fuel.

Figure 5.12: Challenges with equipment

What challenges are faced using that stove? (Q20)

	Total	Boiler	Industrial stove	Household stove	Other (specify)
Total		27	42	103	85
Smoke emissions	47%	59%	52%	57%	41%
Not durable	24%	7%	17%	29%	22%
Inefficient use of fuel	15%	7%	10%	22%	15%
Fuel compatibility with stove	2%			1%	2%
Overheating	2%	4%	5%	4%	2%
Excessive heat	2%	19%		5%	2%
Quite expensive	2%		3%		5%
Dirt	2%		4%	3%	3%
Takes long to light	1%			2%	2%
Gas depletion unknowingly	1%	4%		1%	1%

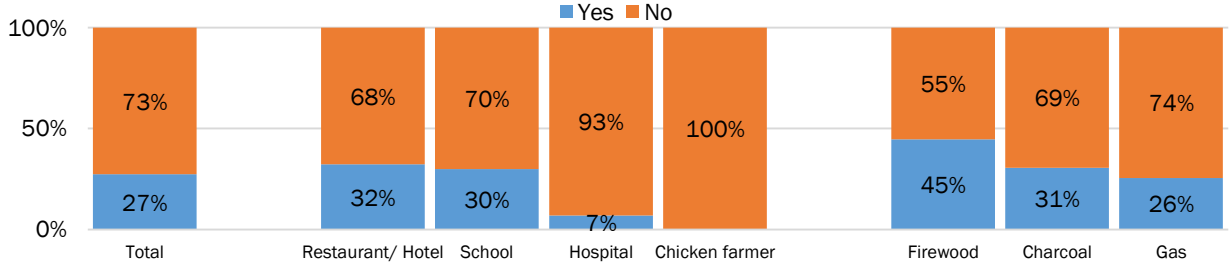
KEY	Very high rating	High rating	Average score	Low score	Very low score

5.3.6 Future intent with equipment

Only one in every ten businesses is likely to consider new equipment in the near future. A few would consider switching to gas cooker and burners. 27% of the businesses and institutions interviewed plan on changing the equipment they are currently using; 73% do not plan on changing the equipment they are using within one year.

Figure 5.14: Future intent with equipment

Do you plan to change the equipment/stove within the next one year? (Q21)



6.0 OBJECTIVE 3: CONSUMER PERCEPTION TOWARDS BRIQUETTES AND PELLETS MADE PARTLY FROM HUMAN WASTE

6.1 INTRODUCTION

The study objective sought to provide insight into the attitudes of potential customers towards briquettes and pellets and especially the perception towards those partly made from human waste.

6.2 HOUSEHOLDS

BRIQUETTES AND PELLETS

6.2.1 Awareness Levels

The respondents are more aware about briquettes than they are about pellets. Out of the 362 HHs interviewed, 67% have heard about briquettes while 33% have not heard about them. The households in the high income areas are less aware as compared to the low and medium income areas. On the other hand, 86% of the households interviewed have not heard about pellets. Households living in low income areas are more aware of briquettes and pellets, indicating that though producers and suppliers of these products in the past may not have had sustained awareness campaigns, they particularly targeted low income segments of the market.

Figure 6.1: Awareness levels - Briquettes
Have you heard about briquettes? (Q34)

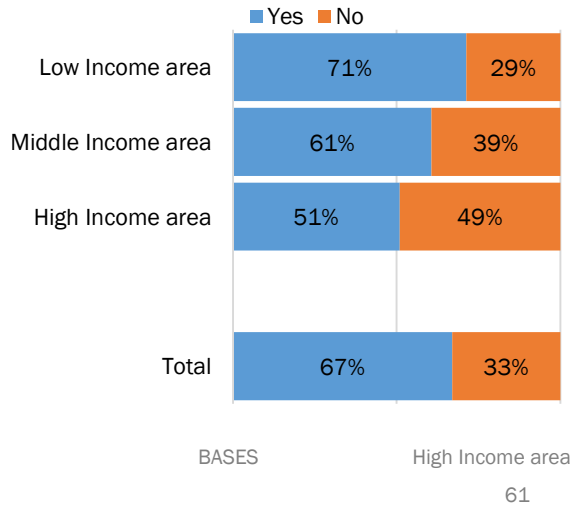
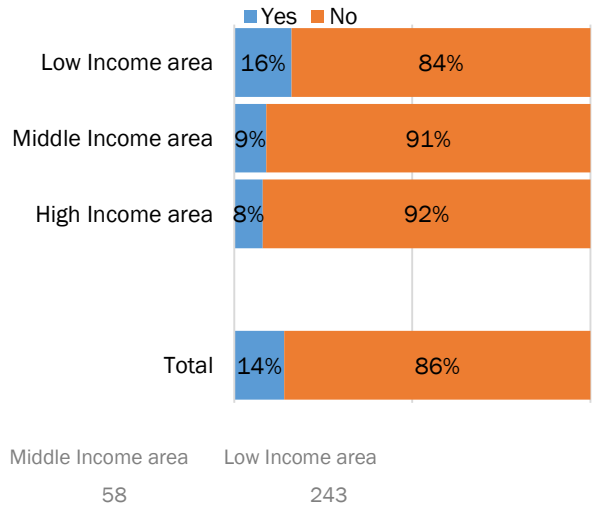


Figure 6.2: Awareness levels - Pellets
Have you heard about briquettes? (Q35)



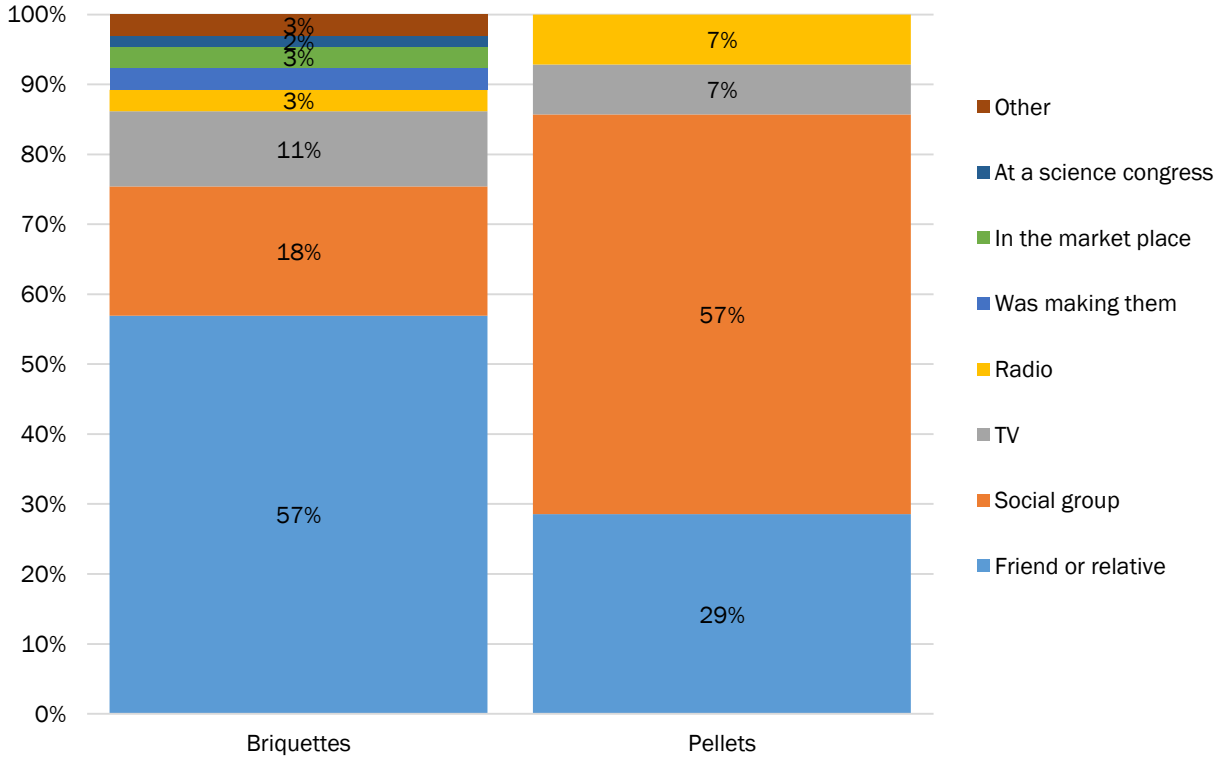
6.2.2 Awareness Drivers

Word of mouth is a key channel for awareness creation when targeting households. Out of the HHs that are aware about briquettes, 57% found out about them from a friend or a relative followed by 18% from social groups and 11% from TV. For pellets, out of the 14% HHs who are aware about pellets, 57% heard about them from social groups, 29% from a friend or a relative followed by 7% from radio and 4% through TV. For those aware of briquettes, only 11% and 3% have learnt about them from TV and radio respectively. For

those who are aware about pellets, 7% learnt about them from TV while 7% learnt about them from radio. This indicates that the current suppliers have mainly focused on below the line advertising. There is an indication that some of the drivers of awareness may have been accidental rather than deliberate and coordinated.

Figure 6.3: Awareness Drivers

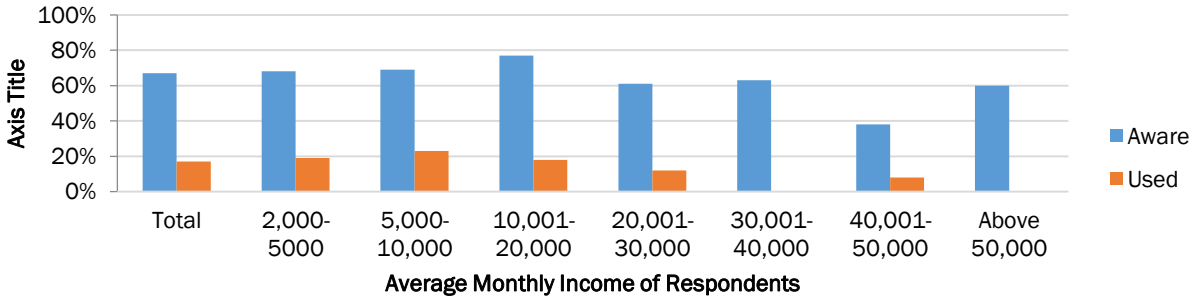
How did you find out about briquettes and pellets? (Q36/37)



6.2.3 Conversion to Usage

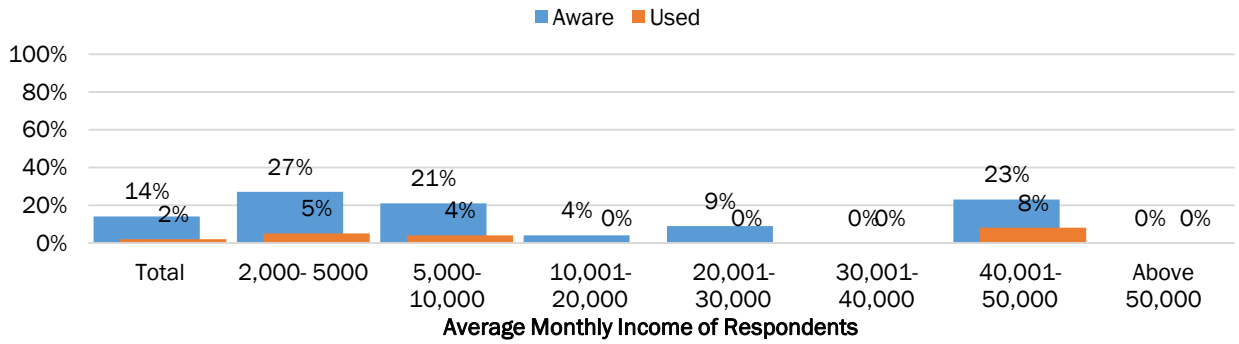
On average, only 25% of those who are aware about briquettes have used them in the past. On the other hand, only 14% of those who aware about pellets have used them in the past. This shows that the conversion to usage is higher for briquettes than it is for pellets.

Figure 6.4: Conversion to usage - briquettes



Base: Aware (243); Used (41)

Figure 6.5: Conversion to usage - pellets

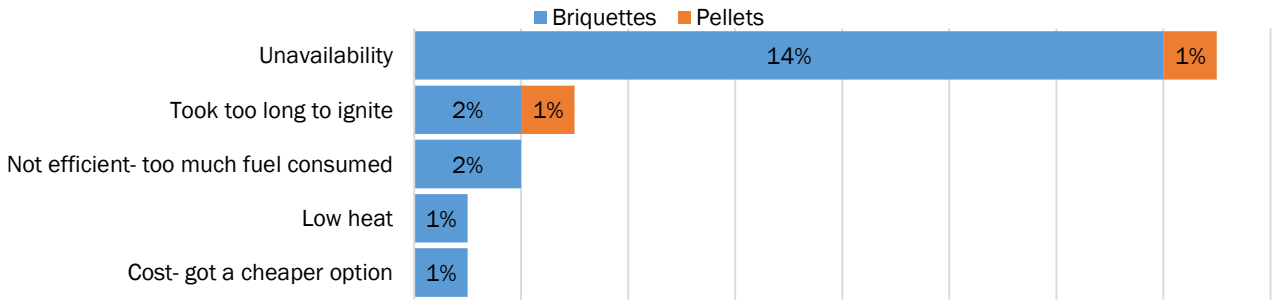


Base: Aware (50); Used (2)

6.2.4 Reasons for no longer using briquettes and pellets

Product availability is a barrier to usage of both briquettes and pellets. Other complaints raised include low performance i.e. users find it too slow, not efficient, has low heat and more expensive compared to current fuel used. The reasons indicated provide the new entrants in the market with an opportunity to gain a competitive edge in the briquette and pellet market.

Figure 6.6: Reasons for no longer using briquettes and pellets
Why did you stop using briquettes? (Q40) Why did you stop using pellets? (Q41)



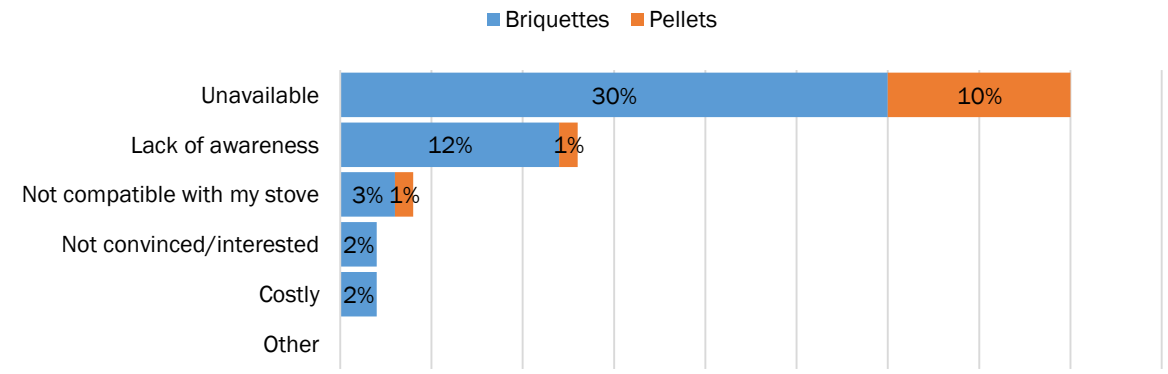
Base: Only those who have used - Briquettes (41 respondents); Pellets (2 respondents)

6.2.5 Barriers to Usage

For those who have not used briquettes, 30% say that it due to unavailability, 12% due to lack of awareness, 3% due to non-compatibility with the current stove. For those who have not used pellets, 10% say that it due to unavailability, 1% due lack of awareness, 1% due to non-compatibility with the current stove. Availability is, therefore, the main driver for usage and not awareness, which comes in second.

Figure 6.7: Barriers to usage

Why are you not using briquettes? (Q42) Why are you not using pellets? (Q43)



Base: Only those who have not used

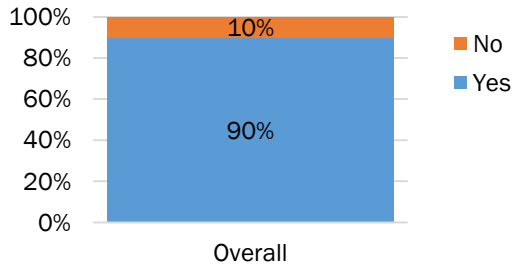
BRIQUETTES AND PELLETS (MADE FROM DIFFERENT TYPES OF WASTE)

6.2.6 Willingness to consider briquettes and pellets made from different types of waste

Findings show a high anticipation for briquettes/pellets made of different types of waste. The briquette made from different types of waste is more appealing to lower income groups, female respondents and informal settlements. As shown below, 90% of the respondents are willing to use briquettes/pellets made out of different waste (e.g. chardust, sawdust, agricultural and market waste). More households living in low income areas are likely to use briquettes and pellets as compared to households in high income areas. This indicates that income levels are an important demographic in defining the customer profile for these fuels. It also confirms that households in low income areas are currently dissatisfied with their current fuels as compared to households in high income areas.

Figure 6.8: Willingness to consider briquettes/pellets made using different waste

Would you be willing to use briquettes/pellets made out of different types of waste like chardust, sawdust and agricultural and market waste?



The table below summarizes the following observations:

Table 6a: Willingness to consider briquettes/pellets made using different waste

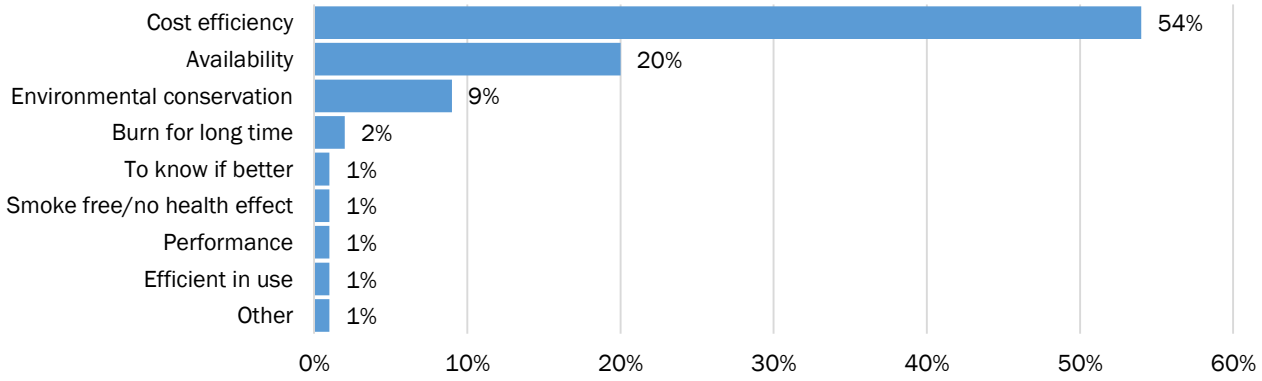
PROFILE		Willingness to Consider
Respondent Gender	Male	86%
	Female	93%
Residence	Own home	91%
	Tenant	89%
Income	2,000- 5000	93%
	5,000- 10,000	94%
	10,001- 20,000	91%
	20,001- 30,000	82%
	30,001- 40,000	100%
	40,001- 50,000	92%
	Above 50,000	20%

Survey Location	Willingness to Consider
High Income area	77%
Middle Income area	85%
Low Income area	94%

Cost and availability would be the main success factors for the briquettes and pellets in the market. 54% of the households that are willing to consider briquettes made from different types of waste say that it is because of cost efficiency, followed by 20% stating availability and 9% citing environmental conservation.

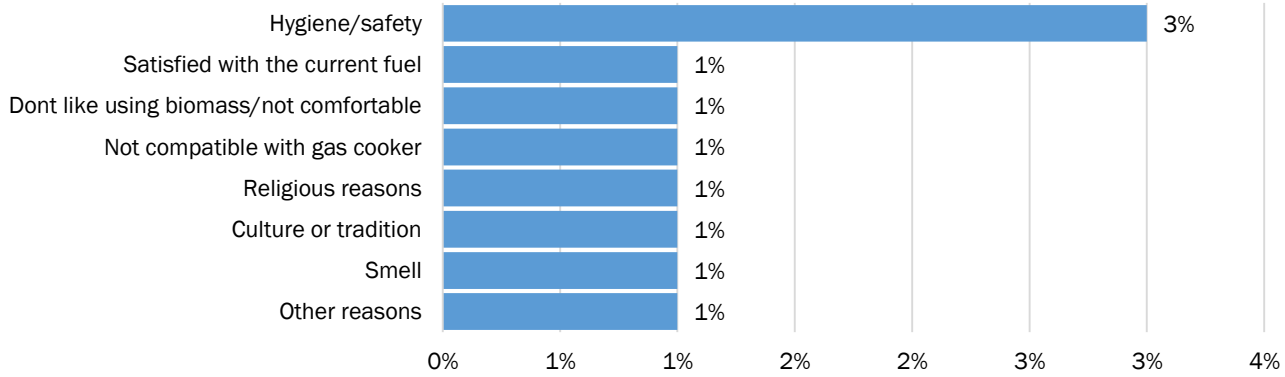
Figure 6.9: Reasons for consideration (briquettes/pellets made from different waste)

Why would you consider using this type of briquettes/pellets?



Fears of hygiene, smell as well as beliefs are some barriers to consideration.

Figure 6.10: Reasons for not using (briquettes/pellets made from different waste)
Why would you not be willing to use this type of briquettes/pellets?



6.2.7 Willingness to Consider (Briquettes/Pellets partly made using Human Waste)

Briquettes partly made from human waste are more appealing to low income earners. Only 40% of households earning above Kshs 50,000 indicated they would consider using the pellets and briquettes as compared to HH earning between Kshs 2,000 and 5,000 (93%). This difference in willingness is more significant when compared between male and female (85% and 79% respectively) and own home and tenancy (84% and 82% respectively). This indicates that the main distinctive demographic in confirming the willingness to use pellets and briquettes made from human waste is income levels.

Table 6b: Willingness to consider briquettes/pellets made using human waste

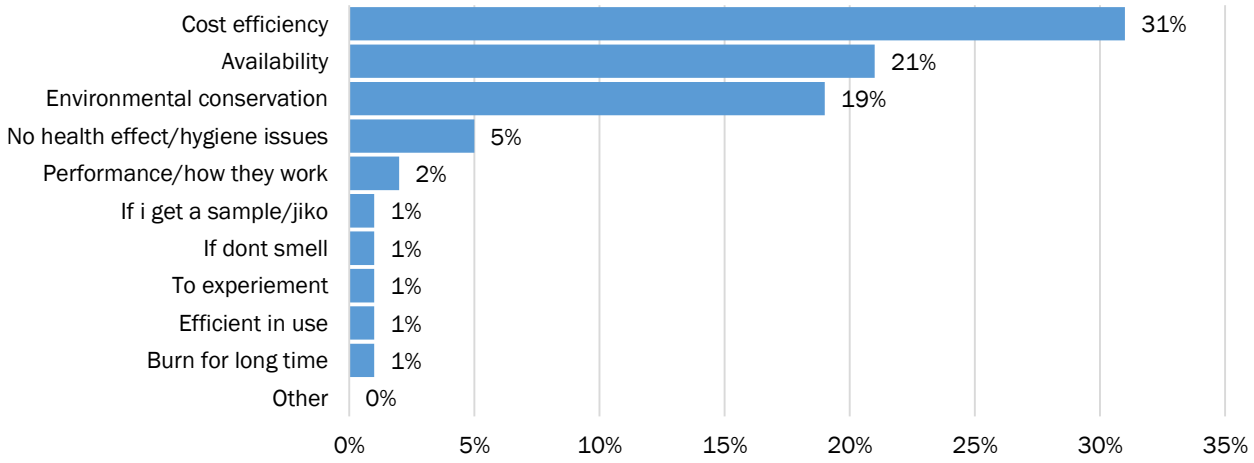
PROFILE		Willingness to consider
Respondent Gender	Male	85%
	Female	79%
Residence	Own home	84%
	Tenant	82%
Income	2,000- 5000	93%
	5,000- 10,000	90%
	10,001- 20,000	88%
	20,001- 30,000	58%
	30,001- 40,000	88%
	40,001- 50,000	69%
	Above 50,000	40%

Survey Location	Willingness to consider
High Income area	72%
Middle Income area	71%
Low Income area	88%

Out of those households who are willing to consider, 31% say that they would base it on cost efficiency, followed by 21% basing it on availability and 19% on environmental conservation.

Figure 6.11: Reasons for consideration (briquettes/pellets made from human waste)

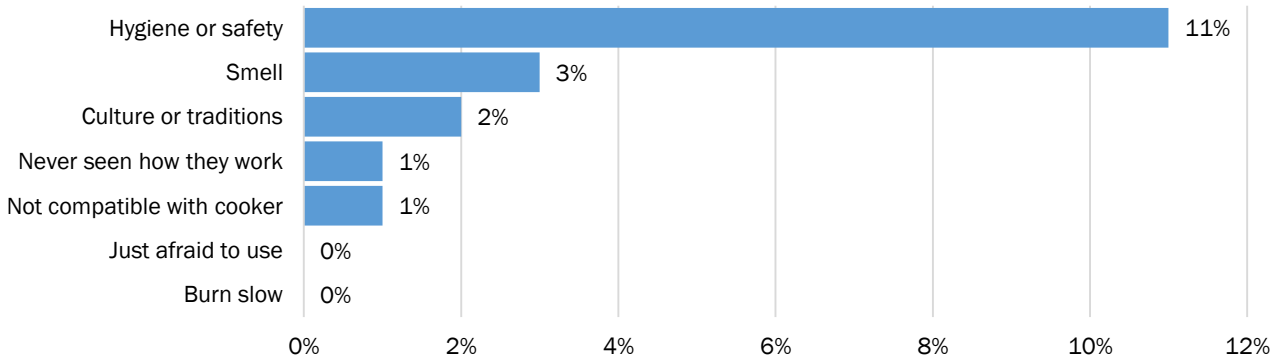
Why would you consider using this type of briquettes/pellets?



However, a number of households believe that they need hygiene measures while using it. Out of those who are not willing to consider, 11% say it is because of hygiene and safety, followed by 3% share concerns about the smell.

Figure 6.12: Reasons for not using (briquettes/pellets made from human waste)

Why would you not be willing to use this type of briquettes/pellets?



FOCUS GROUP DISCUSSION INSIGHTS

6.2.8 Focus Group Discussion – Cook Stoves

Respondents were found to be knowledgeable on briquettes with only a few not having heard about them. They heard about them from various sources ranging from:

- Media – Print, radio, television
- Women groups
- Internet and social media
- Promotion from local producers

Very few respondents were found to have tried out the briquettes. Those who had used briquettes mentioned that they had used the sausage type briquette. They had used them in the normal KCJ cook stove for normal cooking. They also mentioned that the briquettes lit longer than normal charcoal but had a higher ash residue as compared to normal

charcoal. They were open to using briquettes made out of waste since the briquettes they were using were made out of waste.

Briquettes: Very few of the respondents were found to be using briquettes. Prices mostly averaged Kshs 50 per Kg.

Pellets: The study did not find a respondent who has used pellets.

Majority of the respondents were in the affirmative that they would have no problems using human waste briquettes as long as they were safe to use and did not pose a health risk and were cheaper than conventional charcoal. Respondents posed the question on whether the briquettes emitted some smell given that the feed stock was faecal matter.

Samples of the faecal matter briquettes were circulated to the respondents and most were curious about them and readily touched, inspected and smelt them. Most respondents said that they would like samples to try out in their households so as to gauge their performance. It was agreed that the Pilot Study would address this issue.

Questions raised by respondents

- Are they safe to use?
- What if my child ingests the faecal charcoal briquette will he/she fall sick?
- Do they have a smell when burning?
- Can I load the briquettes into the cook stove and still touch food?

6.3 BUSINESSES AND INSTITUTIONS

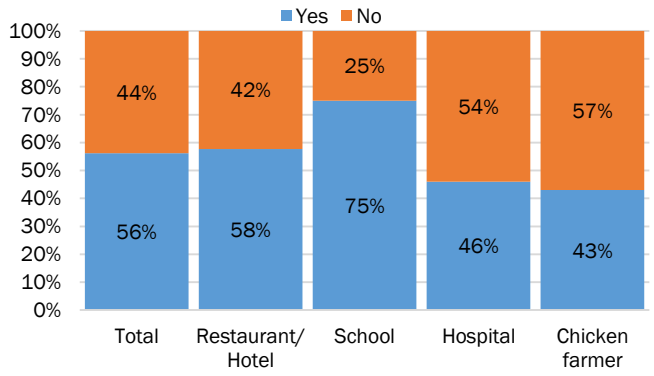
Briquettes

6.3.1 Awareness and Usage – Briquettes

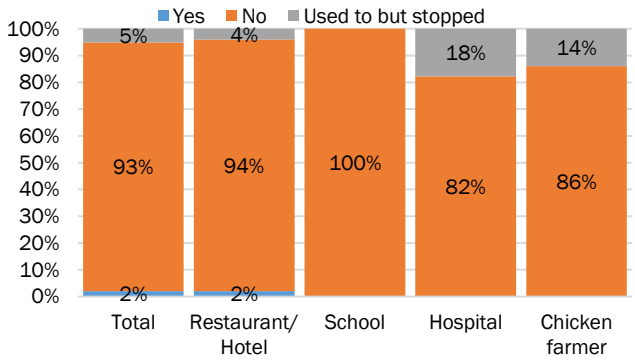
There is high awareness of briquettes especially in schools. 75% of schools interviewed reported that they were aware of briquettes as compared to 57% of chicken farmers. However, only 2% of those who aware are currently using while 5% used briquettes in the past and then stopped using. This indicates that awareness does not necessarily translate to usage and that more often than not, awareness and usage need to be treated as two separate marketing objectives.

Figure 6.13: Awareness and Usage - Briquettes

Are you aware of briquettes as a fuel option? (Q23)



Are you currently using briquettes? (Q24)



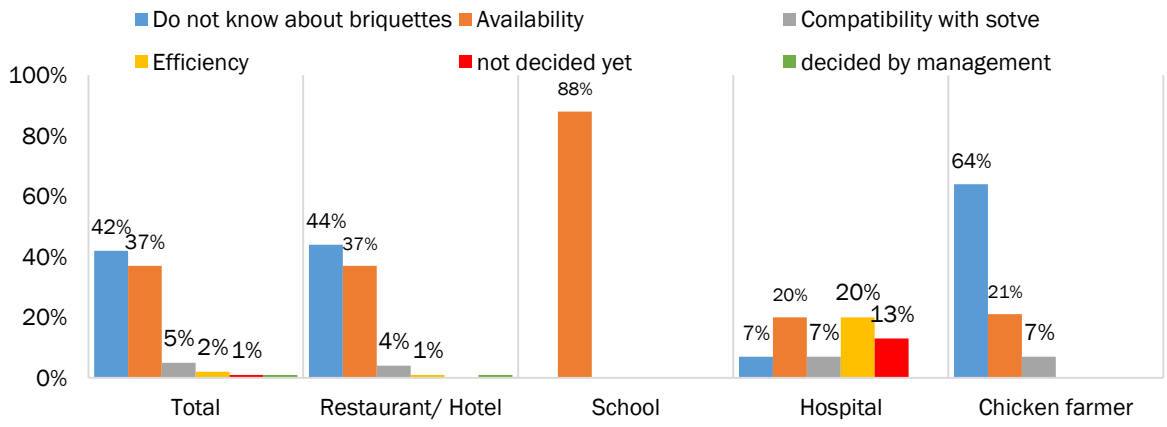
BASES	Restaurant/Hotel	School	Hospital	Chicken Farmer
	201	8	15	14

6.3.2 Barriers to Usage – Briquettes

Awareness and availability were mentioned as the main barriers to usage of briquettes; 42% of all businesses indicated that they did not use them because they were not aware, while 37% mentioned lack of availability as the reason. Other reasons mentioned were compatibility with stove and efficiency. This indicates that while some businesses may be aware of briquettes, availability is the main barrier to usage.

Figure 6.14: Barriers to Usage - Briquettes

If no, why are you not using briquettes? (Q25)



Base: 238 do not use briquettes

A number of chicken farmers indicated that they are willing to use the briquettes as long as they are: (1) more affordable than their current fuel; (2) the emissions do not affect the chicks; and (3) the product is tried and tested.

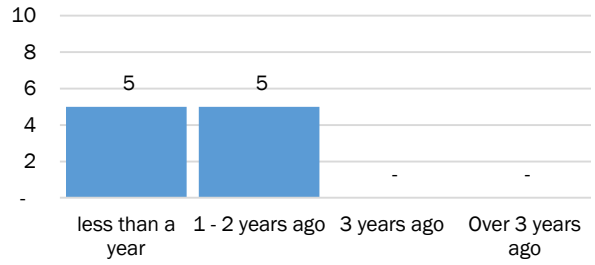
6.3.3 Experience with Briquettes

There is little experience and expertise on the usage of briquettes. 17 businesses and institutions have used briquettes i.e. 7% of the businesses interviewed. This is consistent

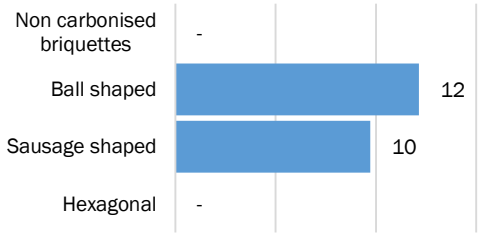
with the data presented above, with reasons for minimal usage being lack of awareness and lack availability. The forms of briquettes used were indicated to be ball shaped and sausage shaped. Businesses that have used the briquettes indicated that they were made of char dust and cow manure.

Figure 6.15: Experience with Briquettes

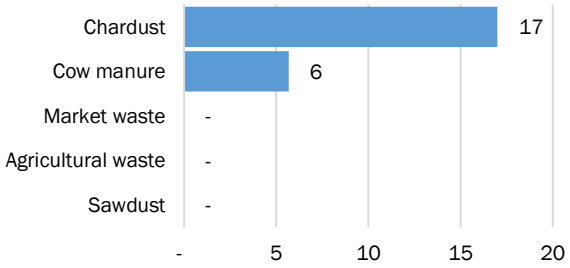
If used, since when? (Q27)



What form of briquettes have you used/or are you using? (Q28)



What are the briquettes you use made of? (Q29)



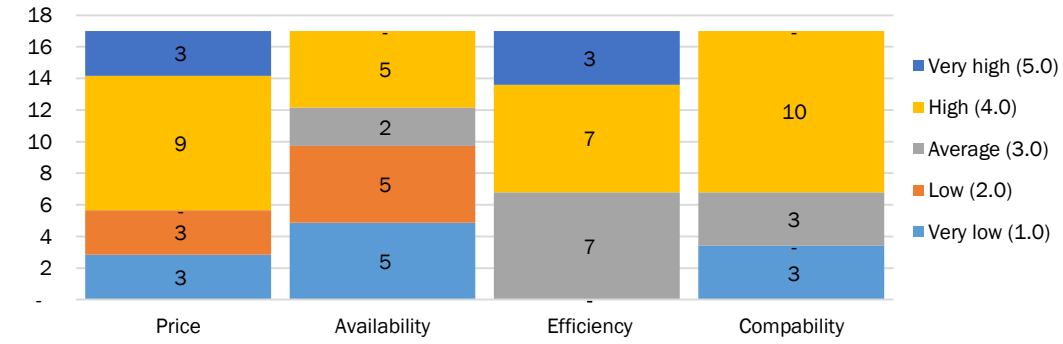
Base: 17 businesses(those who have used briquettes)

6.3.4 Rating Briquettes

The product rates highest on pricing and efficiency but lowest on availability. While it is important to be keen on price and efficiency, effective distribution models seem to be the main factor that will unlock the briquette market.

Figure 6.16: Rating briquettes

On a scale of 1 - 5 what do you/did you like about using briquettes? (Q32)



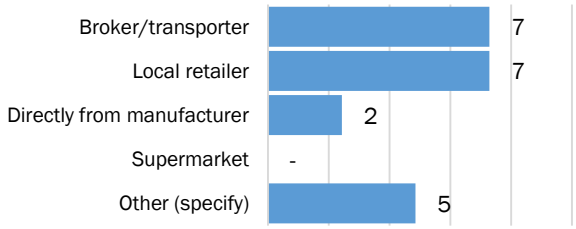
Base: 17 businesses(those who have used briquettes)

6.3.5 Other Considerations

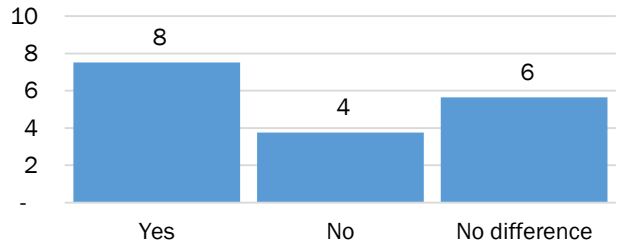
It is important to localize distribution by considering local retailers, brokers and transporters. Market education is also important since users may not differentiate briquettes from charcoal. Out of 17 businesses that used briquettes, 7 sourced from brokers while 7 sourced from local retailers. 6 of the businesses indicated that they found no difference between charcoal and briquettes, revealing a lack of awareness on proper usage.

Figure 6.17: Other Considerations - Briquettes

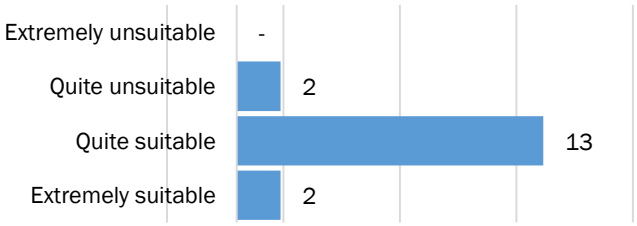
Where do you/did you source your briquettes? (Q33)



Do you find briquettes easier to use compared to charcoal? (Q34)



How suitable do you find briquette use with the equipment/stove you use? (Q35)



Base: 17 businesses(those who have used briquettes)

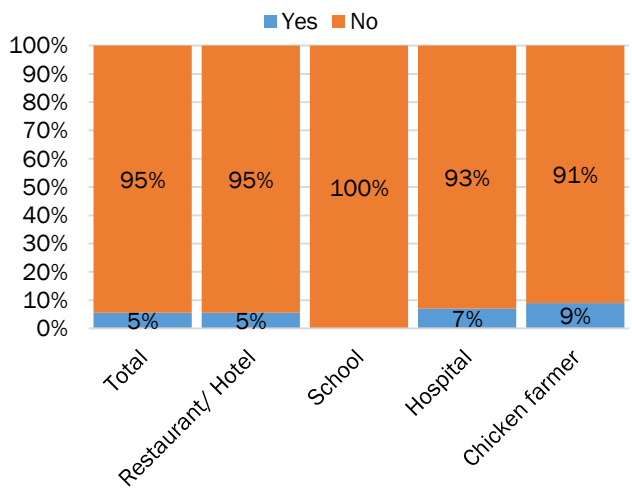
PELLETS

6.3.6 Awareness and Usage - Pellets

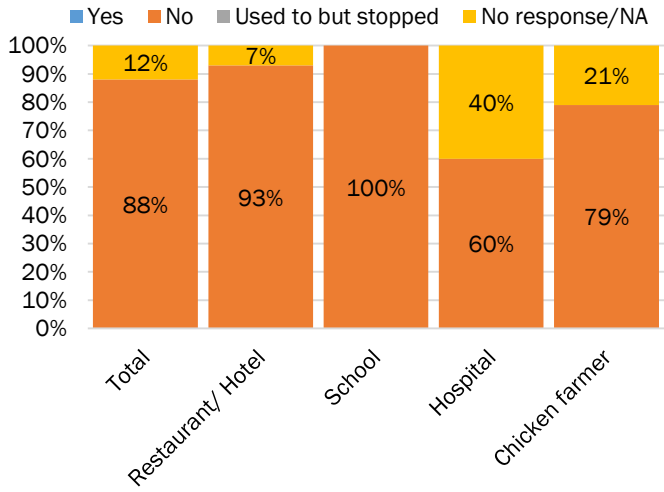
Awareness and usage of pellets is currently insignificant in the region and among the business segment. Out of the 243 businesses and institutions interviewed, only 5% are aware of pellets as a fuel option, 95% are not. Out of those who are aware, none indicated current or previous use. This indicates that the pellet market is largely untested and there would not be cut throat competition for any new entrant.

Figure 6.18: Awareness and Usage – Pellets

Are you aware of pellets as a fuel option? (Q36)



Are you currently using pellets? (Q37)



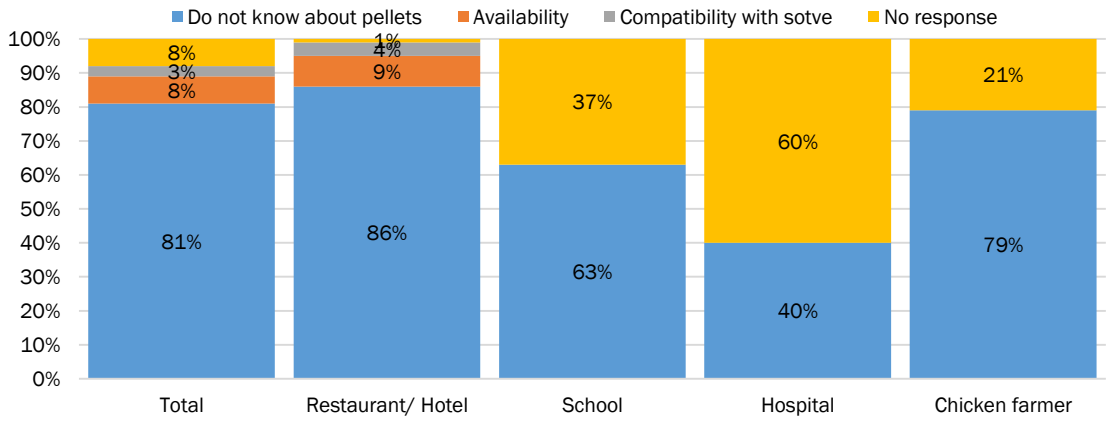
BASES	Restaurant/Hotel	School	Hospital	Chicken Farmer
	201	8	15	14

6.3.7 Barriers to Usage - Pellets

Awareness and availability are prerequisites for the success of pellets in the market. For the businesses and institutions that are not using briquettes, 81% say it is because they do not know about pellets, 8% because of availability, and 3% because of concerns about compatibility with stoves. New entrants in the market will need to be keen on awareness as a main strategy of stimulating demand.

Figure 6.19: Barriers to Usage - Pellets

If no, why are you not using pellets? (Q38)



BASES	Restaurant/Hotel	School	Hospital	Chicken Farmer
	201	8	15	14

Briquettes and Pellets (made from different types of waste)

6.3.8 Willingness to consider briquettes and pellets made from different types of waste

There is a 62% chance of use consideration for briquettes and pellets made of different types of waste. The consideration is lowest among hospitals but higher in schools.

By ranking, chicken farmers are more willing to consider briquettes and pellets made from different type of wastes at 86%, followed by schools at 63%, restaurants and hotels at 62% and finally hospitals at a low of 27% consideration.

Based on the fuel type used, kerosene users are more willing to consider briquettes and pellets made from different type of wastes at 86%, followed by firewood users at 69%, electricity users at 65, charcoal at 63% and finally gas users at 55%.

There is an indication that hospitals are more reluctant to adopt pellets and briquettes from human waste because of public health concerns. This raises the need for public health certification for biofuels made from human waste before they are introduced to the market. There is consistency in the fact that more households using firewood and kerosene are willing to consider using briquettes and pellets from human waste as this research has already confirmed that majority of these users live in low income areas.

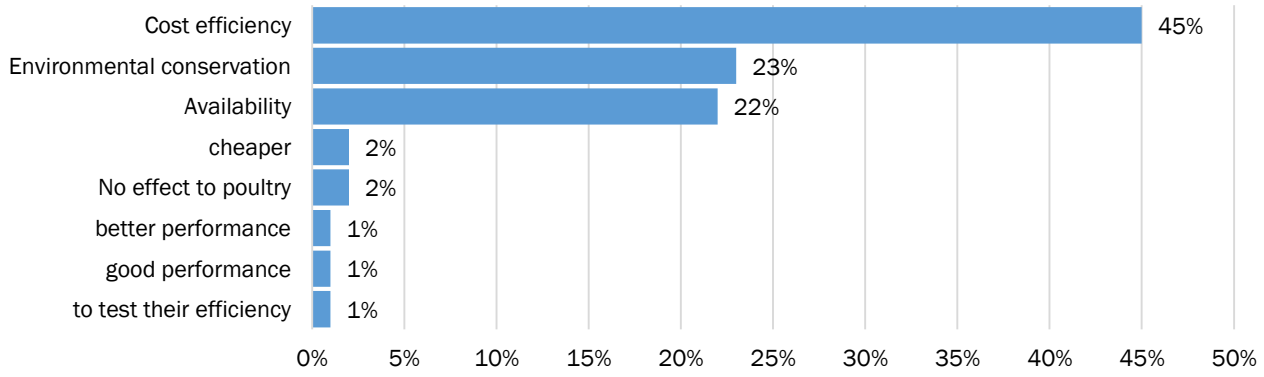
Table 6c: Willingness to use briquettes/pellets made out of different types of waste

PROFILE		Willingness to Consider
Type of business	Restaurant/ Hotel	62%
	School	63%
	Hospital	27%
	Chicken farmer	86%
Fuel used	Firewood	69%
	Charcoal	63%
	Gas	55%
	Electricity	65%
	Kerosene	86%

Survey Location	Willingness to Consider
CBD	55%
Shabab	41%
Milimani	92%
Kaptembwa	33%
Freehold	82%
Section 58	78%
Free Area	89%
Mwariki South	38%
Rhonda	43%
Kiratina	67%
Kaloleni	100%
Other	86%

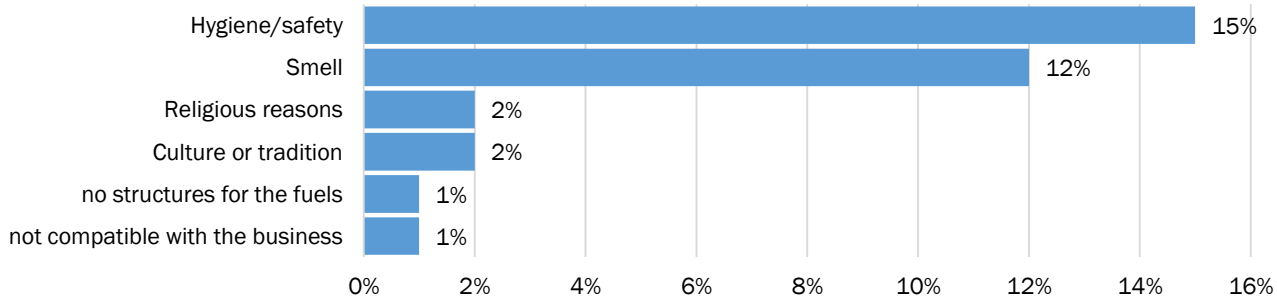
Cost, environmental conservation and availability would be the success factor for the concept. 45% of the businesses interviewed say that they would consider using briquettes and pellets made out of different wastes because of cost efficiency, followed by 23% stating environmental conservation and 22% citing availability.

Figure 6.20: Reasons for consideration (briquettes/pellets made from different waste)
Why would you consider using this type of briquettes/pellets?



Hygiene concerns, smell as well as beliefs are some barriers to consideration. 15% of the businesses interviewed say that they would not consider using briquettes and pellets made from different waste because of hygiene and safety concerns followed by 12% who are concerned about the smell. 2% also talk about religious reasons. This indicates need for product certification on public health standards and consumer education to dissuade public fears on the use of the products.

Figure 6.21: Reasons for not using (briquettes/pellets made from different waste)
Why would you not be willing to use this type of briquettes/pellets?



6.3.9 Willingness to Consider (Briquettes/Pellets partly made using Human Waste)

There is a 49% chance of consideration of pellets made of human waste. None of the schools and hospitals interviewed would consider it at all.

Ranking by businesses, chicken farmers are more willing to consider briquettes and pellets made from human waste at 79%, followed by restaurants and schools at 51%, followed by schools and hospitals with 0% willing to consider this type of fuel.

Based on the fuel type used, kerosene users are more willing to consider briquettes and pellets made from different type of wastes at 86%, followed by electricity users at 61%, charcoal users at 49%, gas users at 36% and finally firewood users at 27%.

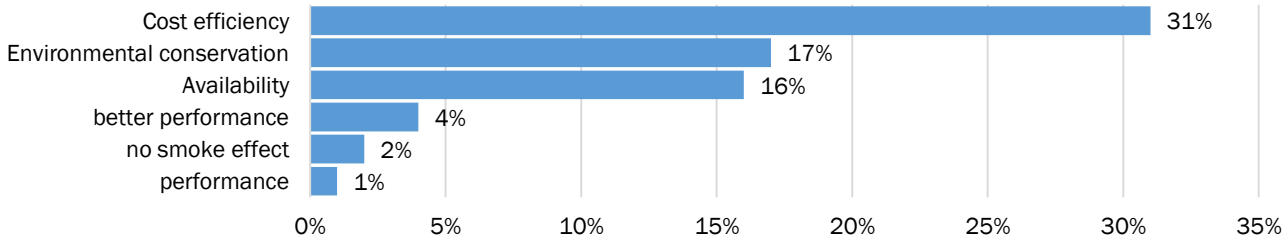
Table 6d: Willingness to use briquettes/pellets made out of human waste

PROFILE		Willingness to Consider
Type of business	Restaurant/ Hotel	51%
	School	0%
	Hospital	0%
	Chicken farmer	79%
Fuel used	Firewood	27%
	Charcoal	49%
	Gas	36%
	Electricity	61%
	Kerosene	86%

Survey Location	Willingness to Consider
CBD	54%
Shabab	9%
Milimani	17%
Kaptembwa	83%
Freehold	55%
Section 58	67%
Free Area	67%
Mwariki South	13%
Rhonda	86%
Kiratina	17%
Kaloleni	0%
Other	67%

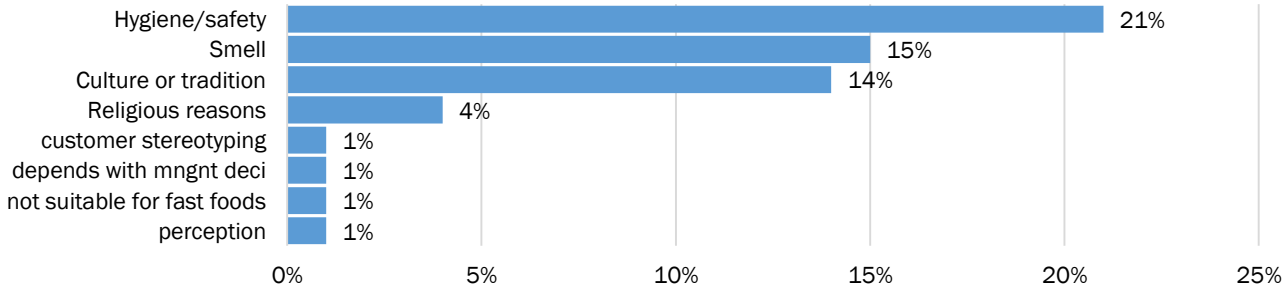
The product is expected to be cost efficient. 31% say that they would consider using briquettes and pellets made partly from human waste because of cost efficiency, followed by 17% because of environmental conservation and 16% because of availability.

Figure 6.22: Reasons for consideration (briquettes/pellets made from human waste)
If yes, why would you like to use the briquettes/pellets? (Q50)



Consumers believe that they need hygiene measures while using the product. 21% say that they would not be willing to use briquettes and pellets made partly from human waste because of hygiene and safety concerns. This is followed by 15% who talk about concerns with the smell, 14% for culture or tradition reasons, and 4% for religious reasons.

Figure 6.23: Reasons for not using (briquettes/pellets made from human waste)
Why would you not be willing to use the briquettes/pellets? (Q51)



7.0 OBJECTIVE 4: BIOMASS FUEL DISTRIBUTORS

This study objective sought to identify the different actors in the supply of fuel and stoves and their roles in distribution. A market observation was carried out to provide more information on the packaging preferences, price and stocking levels. The market observation tables referenced are in the annex section (11.5 and 11.6).

7.1 Profile of Distributors / Retailers of Fuel

The most common type of fuel sold in the region is charcoal. Charcoal is mostly sold in 90 Kg bags though the different vendors package by weight for different customers. Charcoal vendors confirmed that the product was on high demand from households, restaurants and chicken farmers.

Suppliers are willing to have a new product provided that: it costs less; burns for a longer time; and is environmental friendly. They are also concerned about product availability.

The table below indicates the fuel type and the prevalent fuel packaging as noted during the market observation exercise.

Fuel Type	Fuel Packaging by quantity	Suppliers in Nakuru Town
Firewood	Hand Estimate 4 Kg 20 Kg 50 Kg 90 Kg (most units sold)	• Individual suppliers (informal)
Charcoal	Gallon 2 Kgs 5 Kgs 10 Kgs 20 Kgs (bucket) 50 Kgs 90 Kgs (most units sold)	• Kakamega Millennium Diesel Works • Nakumatt • Individual suppliers (informal)
Briquettes (Ball Shape, Chips Like, Fireball, Sausage Shape)	1 Kgs 2 Kgs 4 Kgs (most units sold) Ball Shape 5 Kgs 10 Kgs 12 Kgs 25 Kgs	• Kakamega Millennium Diesel Works • Nakumatt • Botto Solar • Virqut Prerequisites Ltd • Chardust Ltd

The annex table (9.6) summarizes the suppliers and volumes traded for an indication of the sourcing levels.

According to the traders, people do not care much about what the briquettes are made of but rather the cost, heat, and duration.

7.1.1 Information from the Pellet Key Informants

Briquettes and pellets fall in the same category of densified biomass. Pellets are a new phenomenon in Kenya having been introduced into the country from Zambia by SNV through a pellet project in 2013. As per interviews with the three distributors interviewed, the only stock that they had distributed was from the SNV project.

There is some presence of local producers but with a low capacity and lacking a nationwide distribution network; most are found within Nairobi and its environs.

Pellets are mostly used with gasifier stoves and cannot be used in the conventional KCJ cook stoves found in over 90% of Kenyan households.

Pellet distributors in Nakuru

Scode Ltd Nakuru: Scode Ltd is a renewable energy company based in Nakuru County. The company currently is involved in cook stoves, biogas, solar lanterns and home systems and briquettes. The company has to date sold a total of 25 pellet gasifier stoves. The company got an initial batch of 5 tonnes from SNV. To date the company has a balance of 1.6 tonnes having sold out 3.4 tonnes to date from 2014.

As of now, demand for pellets has slowed down and in 2016 the company has (thus far) sold about 20 Kgs. The average selling price is Kshs 40/Kg. With awareness and effective distribution models, there is great chance for a high market adoption.

Wisdom Stoves: Wisdom Stoves is a social enterprise that deals in the manufacture and production of top lit gasifier stoves. The company has a production facility in Kinangop and is housed at Climate Innovation Centre - an innovation hub in Nairobi. The company received a batch of 500 Kgs from SNV in 2014 which they bundled and sold with their gasifier stoves customers mostly in Central Rift Areas of Laikipia and Nyandarua Counties over a period of two and a half months in early 2015. Challenge of availability and cost was the biggest concern for the consumers as they could only access it from Wisdom Stoves who were located far from point where the stove was being used. After exhausting the initial stock of 500 Kgs the company has not received or ordered another batch and is awaiting such a time there is local production of pellets.

7.2 Profile of Distributors / Retailers of Cook Stoves

The most traded types of cook stoves found at the retailers/suppliers were:

- Ordinary KCJ
- Dotcom jiko
- Kunimbili jiko
- Sawdust jiko
- All metal jiko

Other stoves in the market include:

- All Purpose
- Gasifiers
- Biomass Energy Saving
- Brooder Cook stoves
- Chips Fire Stove
- Cookswell Premium Straight
- Electric Cook stove - Chips
- Energy Saving Jiko
- Institutional 1625
- Improved Jiko Makaa
- Jiko Makaa
- Jikokoa
- Jiko Uhai
- Mama Safi Stoves
- Metal Stove
- Odoma Metal
- Ordinary Jiko
- Paraffin Stove
- Signature
- Small Oven Stove
- Stove Jiko
- Footed Electric Grill
- Manual Cookstove
- Oven Cooker
- Premium Firewood Jiko
- Kingbird Combined Cooker
- Kenya Stove
- Jiko Live
- Jiko Stove
- Oven Cookstove

From the listed types, Dotcom jikos and KCJ (small to medium sizes) are mostly sold to households. The metal jikos are sold to restaurants and hotels. These types are found in various sizes (small, medium and large). According to traders, KCJ and Dotcom stoves sell mostly due to high charcoal use in the area. KCJ's high market demand is attributed to the pairing of affordable fuel use and low costs.

The stove manufacturers serving the region include:

- Arumagic Jua Kali
- Bama Jua Kali
- Botto Solar
- Burn Ltd
- Individual Supplier (informal)
- SCODE

At least three of the suppliers listed average sales of over 300 units per month. The majority sell less than 100 units per month.

8.0 SUMMARY OF FINDINGS

8.1 Household Segment

8.1.1 Segment Fuel Usage

Charcoal is the most widely used fuel across the different income levels. The analysis showed that 54% of the households use charcoal, 24% use gas, 13% use kerosene, 8% use firewood and 1% use electricity. This supports the national survey carried out in 2013 that placed charcoal as a predominant fuel. The data on consumption of fuel also revealed that on average, households use 30 Kgs of firewood; 30 Kgs of charcoal; 6 Kgs gas and/or 10 litres of kerosene in a month.

The findings indicated that consumers in the high income area utilized more gas than individuals in the low income areas. Gas is positioned as "working class" fuel, for the employed persons. Kerosene is positioned as the "hustler" fuel – predominantly used by casual labourers and youthful segments aged between 18-25 years. Many households have gas as a clean option and it is used sparingly because it is expensive.

There is evidence of the tendency of fuel stacking among most households. This is where households combine two or more fuels to fulfil their energy needs, rather than completely switching to another fuel. For gas and kerosene users, charcoal is the immediate alternative and it ranks as the top alternative across the board. For firewood consumers, 59% choose charcoal as the immediate alternative, 17% opt for kerosene and 17% opt for gas. For charcoal consumers, 44% choose kerosene as the immediate alternative only 10% use charcoal exclusively. Firewood is the least popular fuel as an alternative fuel, with data indicating only 8% of the total number of households as firewood users.

The energy budget differed significantly across the fuels with kerosene registering the least household monthly spending at Kshs. 540 followed by charcoal at KSh.990. Gas registered as the most expensive at an average monthly expenditure of Kshs. 1,760.

Results indicated that energy choice key drivers were cost and availability. From the study, 42% of the households chose the fuel type based on availability; 33% based on affordability and 9% based on compatibility with other fuels.

The data indicated that households rely on local retailers for their fuel sourcing needs. The local retailers include: market vendors, saw mills selling firewood, retail shops selling gas cylinders and neighbourhood kerosene shops. 74% of households interviewed source their fuel from the local retailer, 11% from the petrol station and 7% from the supermarket.

8.1.2 Preferences for Biomass Fuels and Fuel-Stove Combinations

The results of fuel utilization technologies indicated that the Kenya Ceramic Jiko (KCJ) is the most popular stove in the region among households. Out of the 362 HHs interviewed, 58% use the Kenya Ceramic Jiko (KCJ), followed by 21% using the LPG gas cooker and 9% of households using the kerosene stoves.

The study revealed that the key factors determining choice of stove is the ease of use and affordability of equipment. 57% households say that that they prefer the stove they are using due to ease of use, 49% due to affordability, 21% for efficiency, and 20% for durability. For charcoal users, respondents appraised the KCJ for its affordability and ease of use.

The data showed that households spend Kshs. 500 and below on the KCJ stove. Gas consumers indicated using an average of Kshs. 3,690 on equipment while kerosene users expended Kshs. 500 or below on the stove.

Respondents expressed hopes for a stove upgrade; where kerosene users indicated a willingness to pay an average of Kshs. 1,630 for a stove upgrade. The willingness to change was supported by lower adjusting costs. Meal preparation times and household size were cited as key factors influencing stove use. Households with three members and above were found to alternate using the various cook stoves depending on the food being cooked. Light foods like tea or rice were mostly cooked using kerosene stove, gas or firewood. Heavy foods like beans or *githeri* (bean and maize meal) were mainly cooked using charcoal stove. Another point which arose was that cooking foods like *ugali* (corn flour meal) with either charcoal or firewood gave it a better tasting aroma as compared to cooking using gas or kerosene.

8.1.3 Perception towards Briquettes and Pellets made partly from Human Waste

The study revealed that awareness of briquette and briquette use is substantial with two in every three respondents being aware. Pellet use however registered a minimal awareness with only one in every ten being aware about pellets. Further, the study revealed a more substantial awareness among households in the low and medium income areas compared to households in the high income areas.

The results reveal that word of mouth was a strong marketing tool. Out of the HHs who are aware about briquettes, 57% found out about them from a friend or a relative followed by 18% from social groups and 11% from TV. For pellets, out of the 14% of HHs who are aware about pellets, 57% heard about them from social groups, 29% from a friend or a relative followed by 7% from radio and 4% through TV.

Awareness of pellet and pellet use presents a different dynamic where only 14% of those who aware about pellets have used them. This shows that the conversion to usage is low.

A great impediment to the use of briquettes is product availability. Other common challenges cited included the length of time taken to ignite and fuel compatibility.

Analysis of the study indicates that briquettes made from different types of waste are more appealing to lower income groups, female respondents and informal settlements. On an income level, households in the low income areas (94%) are more likely to consider the briquettes than the households in the high incomes areas (77%) as the demand for fossil fuels is higher in this bracket. Women are more willing to consider (93%) the briquettes than men (86%).

Further, the study indicates that briquettes partly made from human waste would still be positively considered by 8 in every 10 respondents in the low income bracket. Men are more likely to consider (85%) briquettes made partly from human waste than women (79%). Hygiene was cited as a major concern in the use of human waste briquettes (11%).

8.2 Businesses and Institutions Segment

8.2.1 Segment Fuel Usage

Analysis of the fuel types by businesses and institutions shows that the most popular fuel types in terms of their various uses are; charcoal (81%), followed by gas (34%), firewood (21%), electricity (9%), kerosene (3%) in that order. In the case of fuel wood, schools consumed the highest amount while hospitals preferred gas in their fuel use. Charcoal was largely used in restaurants and kiosks reflecting the importance of biomass energy in supplying energy in commercial enterprises.

Findings show that the fuels in this market segment are largely used for cooking (91%), followed by barbecue (11%), space heating (6%), autoclaving (2%) and warming water (1%). Majority of the businesses spend an average of Kshs. 10,000 – Kshs. 20,000 on fuel every month. It was estimated that wood fuel budget share in schools was Kshs. 10,941 irrespective of the number or types of meals cooked.

The results on fuel supply sources indicated that 45% of the businesses and institutions source their fuel from brokers, 33% from local retailers, 7% from petrol stations, 6% from supermarkets, 6% directly from manufacturer and 1% from timber yards. Charcoal was mainly sourced from brokers.

8.2.2 Preferences for Biomass Fuels and Fuel-Stove Combinations

The analysis indicated that while industrial stoves proved to be efficient for commercial purposes, they presented economic barriers in terms of cost prompting the use of

household stoves in small and medium businesses. Boilers were utilized in schools while hospitals used the industrial cook stoves.

Findings pointed at efficiency as the top driver when investing in equipment. Boilers lead on durability whereas household jikos lead on affordability. Out of the businesses and institutions interviewed, 49% prefer the stove/equipment due to efficiency and performance while 45% indicated affordability as a key determiner. Most of the businesses revealed that they had used their equipment for more than a year. Only 1 out of 10 enterprises expressed willingness to invest in new equipment in the future. This indicated high switching costs attached to this option

47% of the businesses expressed that smoke emissions from the stoves is a challenge when using stoves. This inefficiency was recorded largely from businesses using household stoves. Inefficient use (15%) of fuel also emerged as a challenge from stove use in the businesses.

8.2.3 Perception towards Briquettes and Pellets made partly from Human Waste

Results indicated that, 56% of the businesses interviewed are aware of briquettes as a fuel option. Out of those who are aware, 93% are not using briquettes, 2% are currently using and 5% used previously but stopped using. Awareness of briquettes especially in schools was high. However, awareness did not significantly translate to usage. Only 17 businesses reported to have used briquettes. Results revealed that lack of awareness (42%) contributed largely to minimal use while 37% cited availability as a major impediment

Human waste briquettes use consideration registered a 62% chance with businesses and institutions. The consideration is lowest among hospitals but higher in schools.

Ranking by businesses, chicken farmers are more willing to consider briquettes and pellets made from different type of wastes at 86%, followed by schools at 63%, restaurants and hotels at 62% and finally hospitals at a low of 27% consideration.

8.3 Biomass Fuel Distributors

The results from the study showed that charcoal is traded widely reiterating high charcoal use in Nakuru. Vendors indicated that high demand was pushed from the restaurants, households and chicken farmers. They affirm that there is a great need in the fossil fuel market and would readily stock human waste briquettes and pellets provided it is priced well and offers the benefits that their customers need.

9.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarises the key insights from the study in line the programme objective of successfully piloting faecal sludge biomass fuel products with the aim of eventual adoption in Nakuru town. Based on the four research areas, this section focuses on strategies to be considered by the programme based on the study.

9.1 Adoption of Pellets and Briquettes

From the study it is clear that the awareness and usage of pellets and briquettes is currently low in the region among the households and businesses. There is, however, a higher awareness for briquettes than pellets among households and businesses. Among households it was also established that the rate of conversion from awareness to usage is higher for briquettes than it is for pellets. 25% of those who are aware about briquettes have used them in the past, on the other hand only 14% of those who aware about pellets have used them. The market seems to be more receptive to briquettes than pellets. Some of the reasons for this are compatibility with the fuel equipment and cost efficiency. 58% of the households use the Kenya Ceramic Jiko (KCJ) which, as supported by the UNEP study conducted in 2010, continues to be adopted among urban communities. It would, therefore, be prudent to focus on rolling out the biomass fuel product starting with briquettes with the aim of eventual introduction of pellets into the market, especially for the households segment.

9.2 Potential Market

From the study, charcoal emerges as the main fuel across the board for households (high, medium and low income areas) and for more than half of the businesses. Charcoal consumers also emerge to be the more likely to switch to briquette use with a willingness of up to 86%. According to the Nakuru County Integrated Development Plan (2013-2017), Nakuru Town has 91,116 HHs. Going by the findings in the study, 54% of the HHs interviewed indicated that they use charcoal. 93% of the HHs that use charcoal indicated that they would be willing to use briquettes and pellets made from different types of waste and 86% expressed willingness to use briquettes made partly from human waste. Putting this into consideration, the programme can aim for a market share of between 46% and 50% of the HHs in Nakuru Town.

For the business segment, the study findings show that 84% of the restaurants and hotels interviewed use charcoal. 62% of the restaurants and hotels that use charcoal indicated that they would be willing to use briquettes and pellets made from different types of waste and 51% expressed willingness to use briquettes made partly from human waste. Putting this into consideration, the programme can aim for a market share of between 51% and 62% of the restaurants and hotels in Nakuru Town.

9.3 Market Segments

The likely target segment for the briquettes will be the charcoal users. In the household segment, this will largely be households in the low income areas whereas for the business segment, this will largely be the restaurant businesses. 71% of the charcoal users are from households largely based in the low income areas, majority of whom earn a monthly income of between Kshs 5,000 to 10,000. Notably, households use an average of Kshs 990 on charcoal every month with an average spending of Kshs 663 on equipment. The average monthly usage of charcoal for households is 30 Kgs. KCJ is the most popular equipment with affordability as the top driver.

Restaurants and hotels are likely to be the key consumers in the business category. However factors of cost, efficiency and availability are important to winning over this group. Due to the nature of the industry, it is also worth noting that hygiene concerns rank high when it comes to introducing briquettes made partly out of human waste. In this regard, chicken farmers and schools are more open in terms of adoption. Findings show that majority of the businesses spend an average of Kshs. 10,000 – Kshs. 20,000 on fuel every month. For restaurants, it also emerged that they would combine briquette/pellet use with other fuels for some meals that require short preparation times.

9.4 Product Positioning

9.4.1 Product Bundling

The programme would need to consider the pairing of the fuel and equipment. Kenya Ceramic Jiko (KCJ) is the most popular stove in the region among households and also among the small restaurants and businesses. A bundling that focuses on value and affordability would be ideal. Among households, all metal stoves are likely to be replaced within a span of 3 years. This could indicate that the average life span of metal jikos, including KCJ is 3 years. This is supported by GVEP study (2010) that recommends a wider program of awareness-raising and dissemination of energy-efficient cooking equipment as a way to assist in the uptake of briquettes as an alternative or supplementary fuel to charcoal.

9.4.2 Product Features

Based on the study results, the opportunity lies in targeting households with a proposition of affordable and cleaner source of energy. According to the study, households base 'satisfaction' on cost, performance, and cleanliness of the energy source. Households rank gas as the top source followed by firewood. In addition, households' identified the key drivers of consideration for a fuel type as cost and availability. Other purchase drivers include: availability, affordability, compatibility, and efficiency.

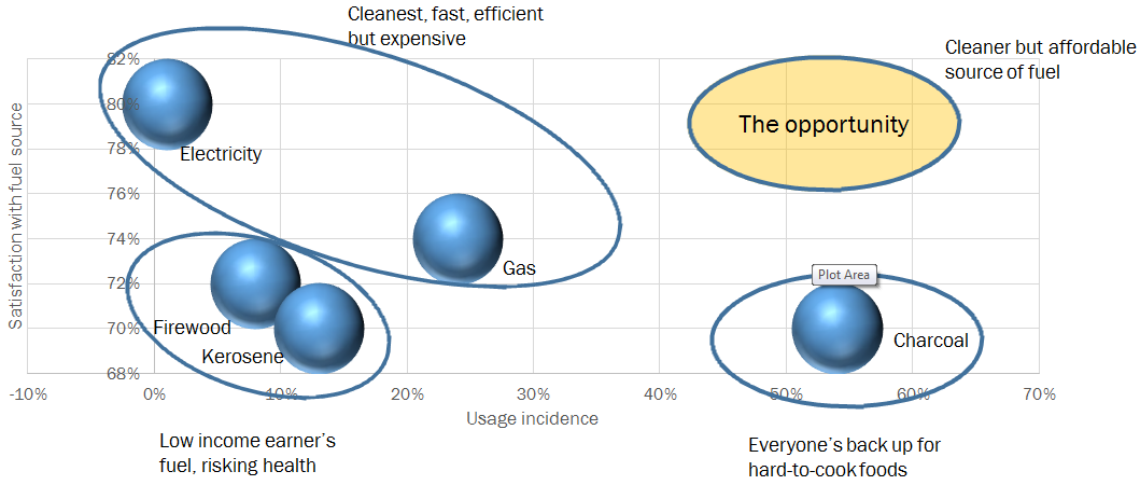
The programme would also need to consider the dissatisfaction drivers on fuels; especially charcoal, which emerged to be the main competitor of pellets and briquettes. It was noted

that availability (distribution), cost, efficiency and smoke emissions ranked high on dissatisfaction factors.

A branded product that is well packaged with the project details and necessary standards will ensure that the quality of the product will not be compromised. Both the households and businesses are keen on affordability and availability.

The following graph illustrates the perception of the households based on satisfaction and usage as it emerged in the study. It shows that there is an opportunity for a cleaner but affordable fuel in the market.

Figure 7.1: Segments of Opportunity



9.4.3 Product Pricing

A household will use an average of Kshs 990 on charcoal every month and will have spent an initial cost of Kshs 663 on the equipment. While majority are willing to try the new type of fuel, cost efficiency and availability would be the core motivation for usage.

It will be important to focus on providing equal or more value based on current consumption patterns. For instance, will the briquettes deliver equal or greater value for the households while considering the households' average consumption and spending. Position the pricing in a way that it appeals to the consumers but also delivers the value.

There will need to be a clear advantage on price and the programme will need to consider the price of competing fuels and aim of a price ceiling for Kshs 1,000 for 30 Kgs worth of charcoal per month per household as guided by the charcoal users patterns.

9.5 Product Awareness and Distribution

Two in every three households are aware about briquettes. The study revealed that word of mouth is a key channel for awareness creation when targeting households. More than 50% of the HHs found out about briquettes from friends, relatives and social groups. The focus group discussion revealed that a number of respondents had also learned about briquettes from media (print, radio and TV), from women groups, social media and promotion from local producers.

The programme would need to address low product awareness in a twofold approach. Below the line marketing would need to be explored as the main strategy to create awareness and promote the product in a targeted way (e.g. education campaigns, ground activations and demonstration of product to the consumer). However, as a second approach, other above the line strategies would be encouraged with the aim of promoting the brand. The messaging would need to address hygiene and safety concerns. For instance, by involving relevant government bodies when piloting the product.

The large number of and proximity of dukas (shops) in residential areas makes them a key distribution channel for households. It is therefore important to consider placing the new product in these outlets. Product availability which emerged as a barrier to usage of briquettes and pellets would also need to be considered during roll-out.

Since brokers and transporters are the main suppliers of different sources of fuel for small and medium businesses, they are likely to be key influencers. It would be advisable to partner and leverage on their network and credibility in the market.

In addition, introducing the briquettes product during the rainy season when charcoal prices are likely to be higher will provide an easier entry into the price sensitive market.

9.5.1 Public Health Education

Engaging community agents in awareness and public education will support in the adoption of the product especially among households.

9.6 Conclusion

In conclusion, there is a significant chance of the product succeeding in the market with the right marketing strategies to increase awareness levels, right pricing, placement in the channels and attention to the softer issues like hygiene and safety through public education..

As indicated, charcoal users are likely to be the easiest to transition into using briquettes. The next target will be those who use other fuels and whose first alternative fuel is charcoal.

Households in the low income areas are more open to invest in affordable, cleaner fuels and the current stoves being used by households should be considered for compatibility. For

businesses, the users of charcoal are also a target. In this case, the hotels and restaurants would be a key consideration.

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11.0 ANNEXES

11.1 Questionnaires

11.1.1 Household Questionnaire

	Question	Response
PROFILE	1. Survey Location	
		Section 58_____
		Teachers_____
		Milimani_____
		Shabab_____
		Racecourse_____
		Freehold_____
		Free Area_____
		Mwariki South_____
		Rhonda_____
		Kaptembwa_____
		Kiratina_____
		Barut_____
		Hilton_____
		Nyamaroto_____
		Pangani_____
		Lakeview_____
		Manyani Lower_____
		Kaloleni_____
	2. Set GPS coordinates	_____
	3. Select Date of the Survey	_____
	4. Enter name of the respondent	_____
	5. Is the respondent the head of the household?	
		Yes_____
		No_____
	Only answer if you responded No to Q5	
	6. What is the name of household head?	_____
	Only answer if you responded No to Q5	
	7. What is the gender of the household head	
		Male_____
		Female_____
	8. ENTER TELEPHONE NUMBER OF RESPONDENT	_____
	9. Observation- Gender of Respondent	
		Male_____
		Female_____
	10. Age of the respondent	
		18-25_____
		26-35_____
		36-45_____
		Over 45_____
	11. What is your marital status?	
		Married_____
		Single_____
		Separated or Divorced_____
		Widowed_____
	12. What is the highest education that you attained?	
		Primary_____

		Secondary_____
		College_____
		University_____
	13. Are you the owner of your home or a tenant?	
		Home owner_____
		Tenant_____
ECONOMIC STATUS	14. What economic activity do you engage in consistently?	
		Employed_____
		Farming_____
		Casual Labour_____
		Trade_____
	15. What is your total monthly income? (Includes money from any source)	
		2,000- 5000_____
		5,000- 10,000_____
		10,001- 20,000_____
		20,001- 30,000_____
		30,001- 40,000_____
		40,001- 50,000_____
		Above 50,000_____
FUEL TYPE AND CONSUMPTION	16. What main fuel type do you use currently?	
		Firewood_____
		Charcoal_____
		Briquettes_____
		Pellets_____
		Kerosene_____
		LPG Gas_____
		Electricity_____
		Bio Gas_____
	17. What quantity do you use per month? How much do you spend on this fuel per month?	_____
	18. Where do you buy your main fuel type?	
		Local Kiosk or Vendors_____
		Supermarket_____
		Market Place_____
		Own Production or Collection_____
	19. What other fuel type do you use currently? What quantity do you use per month? How much do you spend on this fuel per month?	_____
	20. How satisfied are you with this fuel?	
		Very Dissatisfied_____
		Dissatisfied_____
		Neither Dissatisfied nor Satisfied_____
		Satisfied_____
		Very Satisfied_____
	Only answer if you responded Very Dissatisfied |Dissatisfied to Q20	
	21. Why are you dissatisfied with the fuel you are using?	
		Availability_____

		Service (time it takes to replace fuel)_____
		Smoke emissions_____
	22. Why did you choose this particular fuel type?	
		Price_____
		Availability_____
		Time fuel takes to ignite_____
		How long it burns_____
		Compatibility with stove_____
STOVES	23. What type of stove do you use as your main stove?	
		Traditional 3 stones_____
		Kenya ceramic jiko_____
		Type of Gasifier_____
		KCJ_____
		Kunimbili_____
		Jiko Koa_____
		All metal stove_____
		Gas cooker (LPG)_____
		Electric stove_____
	24. Why do you prefer that particular stove?	
		Affordable_____
		Easy to use_____
		Durable_____
		Efficient_____
	25. How much did the stove cost you?	
		Below 500 KES_____
		501- 1,000 KES_____
		1,001- 1,500 KES_____
		1,501- 2,000 KES_____
		2,001- 2,500 KES_____
		2,501- 3,000 KES_____
		3,001- 3,500 KES_____
		3,501- 4,000 KES_____
		4,001- 4,500 KES_____
		4,501- 5,000 KES_____
		Above 5,000 KES_____
	26. How long have you had your main stove?	
		Less than a year_____
		1- 3 years_____
		Over 3 years_____
	27. What challenges do you face using the main stove?	
		Health effects_____
		Fuel inefficiency (uses too much)_____
		Not durable_____
		Uses only one fuel type_____
		Size of the stove_____
		Stove is not safe to use_____
		Has a short lifespan_____
		Breaks easily_____
		Takes a long time to ignite_____
	28. What other type of stove do you use?	
		Traditional 3 stones_____

		Kenya ceramic jiko_____
		Type of Gasifier_____
		KCJ_____
		Kunimbili_____
		Jiko Koa_____
		All metal stove_____
		Gas cooker (LPG)_____
		Electric stove_____
	29. Do you plan to change the stove you are using one day?	
		Yes_____
		No_____
	30. When choosing a stove type, what is the most important characteristic you look for?	
		Availability_____
		Durability_____
		Efficiency_____
		Size of the stove_____
		Affordability_____
	31. Which stove would you switch to?	
		Traditional 3 stones_____
		Kenya ceramic jiko_____
		Type of Gasifier_____
		KCJ_____
		Kunimbili_____
		Jiko Koa_____
		All metal stove_____
		Gas cooker (LPG)_____
		Electric stove_____
	32. How much would you be willing to spend on a new stove?	
		Below 500 KES_____
		501- 1,000 KES_____
		1,001- 1,500 KES_____
		1,501- 2,000 KES_____
		2,001- 2,500 KES_____
		2,501- 3,000 KES_____
		3,001- 3,500 KES_____
		3,501- 4,000 KES_____
		4,001- 4,500 KES_____
		4,501- 5,000 KES_____
		Above 5,000 KES_____
	33. What other characteristic of the stove is important to you?	
		Availability_____
		Affordability_____
		Durability_____
		Efficiency_____
		Size of the stove_____
BRIQUETTES/PELLETS	***Only answer if you responded Firewood|Charcoal|Kerosene|LPG Gas|Electricity|Bio Gas to Q16***	
	34. Have you heard about briquettes?	
		Yes_____
		No_____
	Only answer if you responded Firewood|Charcoal|Kerosene|LPG Gas|Electricity|Bio Gas to Q16	
	35. Have you heard about pellets?	
		Yes_____

		No_____
	Only answer if you responded Yes to Q34	
	36. How did you find out about the briquettes?	
		Radio_____
		TV_____
		Friend or relative_____
		Social group_____
	Only answer if you responded Yes to Q35	
	37. How did you find out about the pellets?	
		Radio_____
		TV_____
		Friend or relative_____
		Social group_____
	Only answer if you responded Yes to Q34	
	38. Have you used briquettes before?	
		Yes_____
		No_____
	Only answer if you responded Yes to Q35	
	39. Have you used pellets before?	
		Yes_____
		No_____
	Only answer if you responded Yes to Q38	
	40. Why did you stop using briquettes?	
		Cost- got a cheaper option_____
		Unavailability_____
		Not efficient- too much fuel consumed_____
		Took too long to ignite_____
		Low heat_____
	Only answer if you responded Yes to Q39	
	41. Why did you stop using pellets?	
		Cost- got a cheaper option_____
		Unavailability_____
		Not efficient- too much fuel consumed_____
		Took too long to ignite_____
		Low heat_____
	Only answer if you responded No to Q38	
	42. Why are you not using briquettes?	
		Costly_____
		Not compatible with my stove_____
		Unavailable_____
		Lack of awareness_____
	Only answer if you responded No to Q39	
	43. Why are you not using pellets?	
		Costly_____
		Not compatible with my stove_____
		Unavailable_____
		Lack of awareness_____
	Only answer if you responded Briquettes to Q16	
	44. What form of briquette are you currently using?	
		Pillow_____
		Sausage shaped_____

		Ball shaped_____
		Hexagonal_____
	Only answer if you responded Briquettes to Q16	
	45. How long have you used them?	
		Less than 1 year_____
		1 to 3 years_____
		over 3 years_____
	46. What are the briquettes you are currently using made off?	
		Char dust_____
		Cow manure_____
		Saw dust_____
		Market waste_____
		Agricultural waste_____
		Don't know_____
	Only answer if you responded Briquettes to Q16	
	47. Would you prefer a different shape for the briquette? Which one?	
		No change_____
		Pillow_____
		Sausage shaped_____
		Ball shaped_____
		Hexagonal_____
	Only answer if you responded Briquettes to Q16	
	48. What do you like about the briquettes you are currently using?	
		Price_____
		Availability_____
		Time it takes to ignite_____
		How long it takes to burn_____
	Only answer if you responded Briquettes to Q16	
	49. Are the briquettes suitable for the type of stove you are currently using?	
		Extremely suitable_____
		Quite suitable_____
		Quite unsuitable_____
		Extremely unsuitable_____
	50. Would you be willing to use briquettes made partly from human waste?	
		Yes_____
		No_____
	Only answer if you responded Yes to Q50	
	51. Why would you be willing to use it?	
		Cost effectiveness_____
		Availability_____
		Environmental conservation_____
	Only answer if you responded No to Q50	
	52. Why would you not be willing to use it?	
		Smell_____
		Hygiene or safety_____
		Culture or traditions_____
		Religious reasons_____
	53. Would you be willing to use briquettes made partly from human waste?	
		Yes_____

		No_____
	Only answer if you responded Yes to Q53	
	54. Why would you be willing to use it?	
		Cost effectiveness_____
		Availability_____
		Environmental conservation_____
	Only answer if you responded No to Q53	
	55. Why would you not be willing to use it?	
		Smell_____
		Hygiene or safety_____
		Culture or traditions_____
		Religious reasons_____

11.1.2 Business and Institutional Questionnaire

	Question	Response
PROFILE	1. Business Location	
		1. Section 58_____
		2. Teachers_____
		3. Milimani_____
		4. Shabab_____
		5. Racecourse_____
		6. Freehold_____
		7. Free Area_____
		8. Mwariki South_____
		9. Rhonda_____
		10. Kaptembwa_____
		11. Kiratina_____
		12. Barut_____
		13. Hilton_____
		14. Nyamaroto_____
		15. Pangani_____
		16. Lakeview_____
		17. Manyani Lower_____
		18. Kaloleni_____
	2. GPS coordinates	Longitude/Latitude
	3. Date of the Survey	00/00/0000
	4. Type of business/institution/industry	1. Restaurant/Hotel
		2. School
		3. Hospital
		4. Industry
		5. Chicken farmer
		6. Other (specify)
	5. Name of business/institution	Name
	6. Contact person name and title (optional)	Name, title
	7. Phone number of contact person (optional)	0
	8. When was the business/inst./ind established?	Year
	9. If Industry, what type of products is manufactured/ processed?	Open question
FUEL TYPE AND CONSUMPTION PER MONTH	10. What fuel type do you use?	1. Firewood
		2. Charcoal
		3. Briquettes
		4. Pellets
		5. Gas
		6. Electricity
		7. Kerosene
		8. Other (specify)
	11. For what purpose do you use the fuel? (multiple choice)	1. Cooking
		2. Smelting
		3. Burning
		4. Steaming
		5. Barbecue
		6. Space heating
		7. Brooding
		8. Other (specify)
	12. What quantity do you use of each fuel type per month?	1. Firewood (KG)

		2. Charcoal (KG)
		3. Briquettes (KG)
		4. Pellets (KG)
		5. Gas (KG)
		6. Electricity (KES)
		7. Kerosene (Litres)
		8. Other (specify)
	13. How much do you spend on this fuel type on average per month?	1. Firewood (KES)
		2. Charcoal (KES)
		3. Briquettes (KES)
		4. Pellets (KES)
		5. Gas (KES)
		6. Electricity (KES)
		7. Kerosene (KES)
		8. Other (specify)
	14. How often do you purchase your fuel?	1. Daily
		2. Weekly
		3. Twice a week
		4. Every two weeks
		5. Monthly
	15. Where do you source your main fuel from?	1. Supermarket
		2. Local retailer
		3. Broker/transporter
		4. Directly from manufacturer
		5. Other (specify)
EQUIPMENT	16. What type of equipment or stove do you use?	1. Boiler
		2. Industrial stove
		3. Household stove
		4. Chicken jiko
		5. Other (specify)
	17. Why do you prefer that particular equipment/stove?	1. Affordable/price
		2. Durability
		3. Efficiency/Performance
		4. Compatibility with fuels
		5. Size
		6. Other (specify)
	18. How much did the equipment/stove cost you?	KES
	19. How long have you had the equipment/stove	1. less than a year
		2. 1 - 3 years
		3. Over 3 years
	20. What challenges are faced using that stove?	1. Inefficient use of fuel
		2. Not durable
		3. Smoke emissions
		4. Fuel compatibility with stove
		5. Other (specify)
	21. Do you plan to change the equipment/stove within the next one year?	1. Yes
		2. No
	22. If yes, which equipment would you switch to?	Open question
BRIQUETTE AWARENESS AND ACCEPTANCE	23. Are you aware of briquettes as a fuel option?	1. Yes
		2. No
	25. Are you currently using briquettes?	1. Yes
		2. No
		3. Used to but stopped

	26. If no, why are you not using briquettes?	1. Price
		2. Availability
		3. Efficiency
		4. Compatibility with stove
		5. Do not know about briquettes
		6. Other (specify)
	27. If stopped using, why did you stop using briquettes?	1. Price
		2. Availability
		3. Efficiency
		4. Compatibility with stove
		5. Other (specify)
	28. If yes, since when?	1. less than a year
		2. 1 - 2 years ago
		3. 3 years ago
		4. Over 3 years ago
	29. What form of briquettes have you used/or are you using? (multiple response)	1. Hexagonal
		2. Sausage shaped
		3. Ball shaped
		4. Non carbonised briquettes
		5. Not aware of different types
	30. What are the briquettes you use made off?	1. Chardust
		2. Cow manure
		3. Sawdust
		4. Agricultural waste
		5. Market waste
		6. Other (specify)
	31. On a scale of 1 - 5 what do you/did you like about using briquettes? (1 being not important and 5 being very important)	1. Price
		2. Availability
		3. Efficiency/performance
		4. Compatibility with equipment/stove
		5. Other (specify)
	32. Where do you/did you source your briquettes?	1. Supermarket
		2. Local retailer
		3. Broker/transporter
		4. Directly from manufacturer
		5. Other (specify)
	33. Do you find briquettes easier to use compared to charcoal?	1. Yes
		2. No
		3. No difference
	34. How suitable do you find briquette use with the equipment/stove you use?	1. Extremely suitable
		2. Quite suitable
		3. Quite unsuitable
		4. Extremely unsuitable
PELLET AWARENESS & ACCEPTANCE	35. Are you aware of pellets as a fuel option?	1. Yes
		2. No
	36. Are you currently using pellets?	1. Yes
		2. No
		3. Used to but stopped
	37. If no, why are you not using pellets?	1. Price
		2. Availability
		3. Efficiency
		4. Compatibility with stove

		5. Do not know about pellets
		6. Other (specify)
	38. If stopped using, why did you stop using pellets?	1. Price
		2. Availability
		3. Efficiency
		4. Compatibility with stove
		5. Other (specify)
	39. If yes, since when?	1. less than a year
		2. 1 - 2 years ago
		3. 3 years ago
		4. Over 3 years ago
	40. What are the pellets you use made off?	1. Chardust
		2. Cow manure
		3. Sawdust
		4. Agricultural waste
		5. Market waste
		6. Other (specify)
	41. On a scale of 1 - 5 what do you/did you like about using pellets? (1 being not important and 5 being very important)	1. Price
		2. Availability
		3. Efficiency/performance
		4. Compatibility with equipment/stove
		5. Other (specify)
	42. Where do you/did you source your pellets?	1. Supermarket
		2. Local retailer
		3. Broker/transporter
		4. Directly from manufacturer
		5. Other (specify)
	43. Do you find pellets easier to use compared to fire wood?	1. Yes
		2. No
		3. No difference
	44. How suitable do you find pellet use with the equipment/stove you use?	1. Extremely suitable
		2. Quite suitable
		3. Quite unsuitable
		4. Extremely unsuitable
BRIQUETTES/PELLETS MADE WITH HUMAN WASTE	46. Would you be willing to use briquettes/pellets made out of different types of waste like chardust, sawdust and agricultural and market waste?	1. Yes
		2. No
	47. If yes, why would you like to use the briquettes/pellets?	1. Cost efficiency
		2. Availability
		3. Environmental conservation
		4. Other (specify)
	48. Why would you not be willing to use the briquettes/pellets?	1. Smell
		2. Hygiene/safety
		3. Culture or tradition
		4. Religious reasons
		5. Other (specify)
	49. Would you be open to use briquettes/pellets partly made out of human waste?	1. Yes
		2. No
	50. If yes, why would you like to use the briquettes/pellets?	1. Cost efficiency
		2. Availability
		3. Environmental conservation
		4. Other (specify)

	51. Why would you not be willing to use the briquettes/pellets?	1. Smell
		2. Hygiene/safety
		3. Culture or tradition
		4. Religious reasons
		5. Other (specify)

11.1.3 Market Observation Tool – STOVES

No.	
Name of supplier	Name
Contact person	Names
Phone number	Mobile
Location of supplier	Area; building; etc.
GPS location	coordinates
Photo	No.
Type of stove	KCJ, Kunimbili, Jiko Koa, all metal stove, type of gasifier, others
Manufacturer	name of company; person
Size of stove	small, medium, large
Target group	HH/institutional (specify)
Price per unit	KES
Unit sales	KES average per month
Comments	Additional observations

11.1.4 Market Observation Tool – FUELS

No.	
Name of supplier	Name
Contact person	Names
Phone number	Mobile
Location of supplier	Area; building; etc.
GPS location	coordinates
Photo	No.
Firewood	Tick
Charcoal	Tick
Briquette	Tick
Type	balls, sausage, pillow, hexagonal, others
Manufacturer	name of company; person
Package size	KG
Price per unit	KES
Unit sales	KES average per month
Comments	Additional observations

11.2 Focus Group Discussion Brief

The Focus Group Discussions (FGD) were carried out in 8 representative areas in Nakuru town over a period of two weeks. The participants were selected with a view to have a representative sample. Community Health Workers stationed in the various areas of Nakuru Town helped in mobilization. The FGD compliments the study in order to give more insight about biomass demand and utilization.

The areas where the FGDs took place are as below;

1. Rhonda
2. Kaptembwa
3. Hilton
4. Nyamaroto
5. Manyani
6. Lakeview
7. Kiratina
8. Free Area

The FGD questions were structured to further integrate the four key areas that the study had envisioned as listed below;

1. Information about cook stoves
2. Information on fuels
3. Information on alternative fuels
4. Information on faecal matter briquettes

Feedback

This section covers the feedback from the participants as highlighted by the questions posed to the various entrepreneurs.

1) **Information about cook stoves.**

Participants listed various types of cook stoves in use. The key cook stoves were

- Kenya Ceramic Jiko
- Gas cooker
- Kerosene stove
- Three stone fire

Overall the most common cook stove was the Kenya Ceramic Jiko which is a charcoal jiko followed by the kerosene stove, gas cooker and finally the three stone fire.

The key consideration towards the use of various cook stoves depended on various aspects, namely;

a) Economic condition/ Financial status of the household
b) Size of the family
c) Type of food being cooked
d) Time of the day
e) Ownership of household

Charcoal cook stoves are the most common among households having more than three members with usage varying according to the factors enumerated as above. Cheap charcoal stoves range from Kshs 150-450.

Kerosene stoves were also widely used by the participants in the various focus group discussions. Prices ranged from Kshs 300-Kshs 600.

Gas cookers averaged Kshs 3,000-Kshs 25,000. **Over half of the respondents interviewed did not have gas cookers and alluded this due to the high initial purchase cost and high refill costs.**

Three stone fire was the most prevalent cook stove for firewood users. This was at a minimal cost as the stones for the set up were readily available from the surroundings. The main characteristic was that over 90% of the firewood users were people residing in their own compounds or owning their homes. Firewood use was non-existent among people living in rental households.

The respondents faced various challenges using the various cook stoves.

- Charcoal stoves: safety issues attributed to danger of the stoves being knocked over and starting a fire and challenges in lighting.
- Kerosene stove; safety concern - prone to fire dangers from being knocked over, leave a pungent kerosene smell on the clothes after being used and when putting it off.
- Gas cookers; High costs of refills
- Fire wood stoves: Challenge in lighting, cannot be used indoors.

2) Information about fuels

Factors influencing the fuel use mostly depended on;

- Cost of the fuel
- Type of cook stove owned by the household
- Time of the day
- Type of food being cooked
- State of finances in the household
- Number of people being served

In terms of costs, LPG gas was the most expensive followed by charcoal, kerosene and firewood in that order.

Charcoal costs averaged Kshs 40-Kshs 50 for a 2 kg can and Kshs 1,500 for a sack weighing approximately 45 Kgs. Availability was from local grocery stalls and local shopkeepers. In the estates charcoal availability was high.

Kerosene: Costs between Kshs 45- Kshs 55 per litre. Availability was in shops and petrol stations. Most people said they preferred purchasing from petrol stations as the quantities were more assured as compared to local shops.

Gas refills were going for Kshs 1,100 for a 6kg cylinder and Kshs 2,000 for a 13 Kg cylinder. Availability was in supermarkets, local gas shops in the estates and petrol stations.

Firewood: Measurement unit was in bunches. Availability was from timber yards which mostly sell the offcuts as firewood. A bunch was going for between Kshs 50- Kshs 100

Briquettes: Very few of the respondents were found to be using briquettes. Prices mostly averaged Kshs 50 per Kg.

Pellets: The study did not find a respondent who has used pellets.

Challenges faced using the various types of fuels.

- Charcoal: In most places where the FGD was conducted, the respondents lived in one room rental houses which are poorly ventilated. Due to the lack of space, cooking has to be done indoors and this led to carbon monoxide inhalation leading to headaches. This also posed a fire danger in case the cook stove was knocked over.
- Kerosene: Kerosene also has a lot of smoke emission when used indoors. It also leaves the house smelling of kerosene which sticks on the clothes thus even on the outside once has a kerosene smell.
- Firewood: Cannot be used indoors due to the smoke pollution. During the rainy season, it becomes a challenge using wet firewood which takes a long time to light and smokes a lot.
- Gas: Main challenge was the cost of refills. Using gas as the only medium in a household of between 3-5 people could result in very high bills.

Summary

- Households with three members and above were found to alternate using the various cook stoves depending on the food being cooked. Light foods like tea or rice were mostly cooked using kerosene stove, gas or firewood. Heavy foods like beans or githeri were mainly cooked using charcoal stove. Another point which arose was that cooking foods like ugali with either charcoal or firewood gave it a better tasting aroma as compared to cooking using gas or kerosene.
- Time spent cooking varied with the morning and lunchtime being an average of 30-45 minutes while evening ranged from 1 hour to 2 hours due to the need to cook proper meals in the evening.
- The economics of the household was found to have the greatest influence as to the choice of the fuel to be used. In terms of preference gas was fuel of choice but cost prevented most of the respondents from using it.

3) Information about Briquettes

Respondents were found to be knowledgeable on briquettes with only a few not having heard about briquettes. They heard about them from various sources ranging from:

- Media – Print, radio, television
- Women groups
- Internet and social media
- Promotion from local producers

Very few of the respondents were found to have tried out the briquettes and the ones who had used had used the sausage type briquette. They had used them in the normal KCJ cook stove and had used them for normal cooking. They mentioned that the briquettes lit longer than normal charcoal but had a higher ash residue as compared to normal charcoal and that they were open to using briquettes made out of waste as even the briquettes they were using were made of waste.

4) Information on faecal matter briquettes.

The respondents were introduced to the use and manufacture of faecal matter briquettes gradually with questions. The question of them using the briquettes made from human waste was then posed. Majority of the respondents were in the affirmative that they would have no problems using human waste briquettes as long as they were safe to use and did not pose a health risk and were cheaper than conventional charcoal. Respondents posed the question on whether the briquettes emitted some smell given that the feed stock was faecal matter.

Samples of the faecal matter briquettes were circulated to the respondents and most were curious about them and readily touched, inspected and smelt them. Most respondents said that they would like samples to try them in their households so as to gauge their performance of which it was agreed that the Pilot Study would address this issue.

Questions raised by respondents

- Are they safe to use?
- What if my child eats the faecal charcoal briquette will he/she fall sick?
- Do they have a smell when burning?
- Can I load the briquettes into the cook stove and still touch food?

11.3 Pellet Key Informant Summary

Biomass pellets can be defined as compacted biomass mainly wood sawdust although other biomass waste sources are also viable. The size of pellets is generally kept to be about 6mm diameter and 25mm length in the form of a cylinder.

1) History of Pellets in Kenya

Briquettes and pellets fall in the same category of densified biomass. Pellets are a new phenomenon in Kenya having been introduced into the country from Zambia by a SNV Pellet project back in 2013. As per interviews with the three distributors quoted on this report, the only stock that they distributed was with the Project stock from SNV.

There is some presence of some local producers but with a low capacity and lacking a nationwide distribution network and mostly found within Nairobi and its environs.

Pellets are mostly used with gasifier stoves and cannot be used in the conventional KCJ cook stoves found in over 90% of Kenyan households.

2) Summary of the Finding

Scode Ltd Nakuru; Contact Lewis Githaiga; Supply Chain and Procurement officer.
Scode Ltd is a renewable energy company based in Nakuru County. The company currently is involved in cook stoves, biogas, solar lanterns and home systems and briquettes. The company has to date sold a total of 25 pellet gasifier stoves. The company got an initial batch of 5 tonnes from SNV. To date the company has a balance of 1.6 tonnes having sold out 3.4 tonnes to date from 2014.

As of now, demand for pellets has slowed down and for 2016 the company has sold about 20 Kgs. The average selling price is Kshs 40/Kg.

Wisdom Stoves; Contact –Dan Waithaka;-CEO
Wisdom Stoves is a social enterprise that deals in the manufacture and production of top lit gasifier stoves. The company has production facility in Kinangop and is housed at Climate Innovation Centre an innovation hub in Nairobi.

The company received a batch of 500 Kgs from SNV in 2014 which they bundled and sold with their gasifier stoves customers mostly in Central Rift Areas of Laikipia and Nyandarua Counties over a duration of two and a half months in early 2015.

Challenge of availability and cost was the biggest concern for the consumers as they could only access it from Wisdom Stoves who were located far from point where the stove was being used. After exhausting the initial stock of 500 Kg the company has not received or ordered another batch and is awaiting such a time there is local production of pellets.

11.4 Market Study Data Collection Schedule

Data Collection Dates	Activity
23rd – 28th, May, 2016	Business/Institutional /Market observation on cook stoves and fuels surveys conducted
27th May-10th June, 2016	Household survey conducted and data review
13th-17th June, 2016	Focused Group Discussions
24th -26th June, 2016	Data submission to ATL

11.5 Research Team

Name	Role	
Reinilde Eppinga	Coordination	NCSP
Lawrence Kimaru	Coordination	NCSP

John Irungu	Coordination	NCSP
George Theuri	Coordination	NCSP
Kevin Nyandeje	Enumerators	NCSP
Kelly Wanjala	Enumerators	NCSP
Clinton Waswa	Enumerators	NCSP
Evans Omondi	Enumerators	NCSP
Javan Anekeya	Enumerators	NCSP
Community Health Volunteers	Introduced enumerators to households Mobilized groups identified for FGDs and identified venues	
Gideon Mureithi	Data Analysis	ATL / Intraspace
Catherine Kanyi	Report Compilation	ATL
Masua Mutua	Technical Input	ATL

11.6 Stove Distributors and Suppliers

No	Name Of Supplier	Location Of Supplier	Type Of Stove	Manufacturer	Size Of Stove	Target Group	Price Per Unit	Unit Sales
	Name	Area; Building; Etc.	KCJ, Kunimbili, Jikokoa, All Metal Stove, Type Of Gasifier, Others	Name of Company; Person	Small, Medium, Large	HH/Institutional (Specify)	KSh	KSh Average Per Month
1	Woolmat	Kenyatta Avenue	KCJ, Kunimbili, Juakali, Large, Medium, Institutional 1625				550	20
2	Ukwala	Kenyatta Avenue	KCJ	Private Supplier(Daniel) Small, Large		HH / Institutional 185		30
							450	60
							5011	3
3	Upper Tuskeys	Kenyatta Avenue						
			KCJ, Jikokoas, Metal Stoves Odoma Metal Work		Large, Medium	Institutional	1200, 540, 3990	10, 35, 50
						HH		
4	Lower Tuskeys	CBD	Jikokoas, Metal Stoves, KCJ Odoma Metal		Medium	HH	3990	20
5	Stagemat	Opposite Stage	KCJ, Jikokoa, Metal Stove Not Sure		Medium	HH / Institutional 400		45
							1150	10
							950	42
6	Dan's Jua Kali Supplies	Weavers	Improved Jiko Makaa	Dan Jua Kali	Medium	HH	150/Stove	150 X 100
						Supermarket		
						Small Shops		
7	Rivana Supermarket	Kaptembwa	Paraffin Stove, KCJ, Dotcom	Unknown Distributor	Small, Medium, Large	HH	Small-235	
							Medium-310	3 stoves / Month
							Large-575	
8	Arumagic Supplier	Soko Mjinga	Artificial Improved	Arumagic Jua Kali	Small, Medium, Large	HH	Small-150	
			Jiko Makaa, KCJ			Small Shops		
							Medium-200	300 Stoves / Month
							Large-450	
9	Nakumatt	Westside Mall	KCJ	Mary Wakiuru Githendu	Medium	HH	900	8000
			Footed Electric Grill	Weekender	Medium	HH	2195	10000
			Manual Cook stove		Small	HH	3990	20000

No	Name Of Supplier	Location Of Supplier	Type Of Stove	Manufacturer	Size Of Stove	Target Group	Price Per Unit	Unit Sales
10	Naivas	Nakuru High	Jikokoa	Burn Ltd	Small	HH	3850	10000
			Cookswell Premium Straight	Burn Ltd	Small	HH	3990	
			Premium Firewood Jiko		Small	HH	699	5000
11	Tuskys	Free Area	Jikokoa	Burn Ltd	All	HH	3900	10000
			All Metal Stove					
-	-	-	-	-	-	-	-	-
12	Botto Solar Ltd	Section 58	Mama Safi Stoves	Botto Solar	All	Hotels, HH	35-105k	2000000
			Kingbird Combined Cooker			Institutions	60-95k	200000
			Energy Saving Kuni Jiko			Schools, HH		150000
13	Gilanis Supermarket		All Types Of Gasifiers		All	Both	Depends On Size	200000
14	Vision Supermarket	Free Area.	Signature	Not Known	Medium (Sig)	HH	1150	-
	"		Kenya Stove	Not Known	Small (Ks)	HH	530	-
15	Kimani Enterprise	Karatina	Dotcom	Not Known	Medium (Ks)	HH	1390	-
	"	"	Jiko Live	Bama	Small (D)	HH	280	2800
	"	"	Ordinary Jiko	Bama	Medium (D)	HH	500	2500
	"	"	All Metal Jiko	Bama	Large (D)	HH	1300	1300
	"	"		Bama	Standard (D)	HH	380	5700
	"	"		Personal Fabrication	Small (Jl)	HH	1200	1200
	"	"		Personal Fabrication	Large (Jl)	HH	1800	1800
	"	"		Personal Fabrication	Standard (Ord)	HH	200	3050
	"	"		Personal Fabrication	Standard (Am))	HH	700	700
16	Joe Mwaura	Free Area.	Sawdust Jiko	Bama	Medium (Js)	HH	500	500
	"	"	Jiko Stove	Bama	Small (Sd)	HH	240	480
	"	"	KCJ	Bama	Medium (Sd)	HH	150	350
17	Peter Kariuki	Free Area.	All Metal Jiko	Bama	Small (KCJ)	HH	170	850
			KCJ	Bama	Medium (KCJ)	HH	350	1750
			Dotcom	Bama	Small (Am)	HH	170	510
				Bama	Medium(Am)	HH	600	1800
				Bama	Large (Am)	Hotels	2000	2000
				Bama	Small (KCJ)	HH	180	3600
				Bama	Medium (KCJ)	HH	200	3000
				Bama	Large (KCJ)	Hotels	250	3500
				Bama	Small (Dc)	HH	350	1750

No	Name Of Supplier	Location Of Supplier	Type Of Stove	Manufacturer	Size Of Stove	Target Group	Price Per Unit	Unit Sales
				Bama	Medium(Dc)	HH	400	2000
18	Dorcus	Gussi Road	Dotcom	Jack-St Marys	Large(D)	HH	550	16500
		Jukali Exhibition	Ordinary Jiko	Bama	Small(Ord)	HH	150	4500
			Kunimbili	Bama	Medium(K)	HH	1500	10500
			Sawdust Jiko	Jack-St Marys	Medium (Sw)	HH	550	2750
			All Metal	Jack-St Marys	Large(A)	Hotels	1500	3000
				Jack-St Marys	Medium(A)	HH	6500	1300
19	Samuel Igogo	Vision Mart	KCJ	Bama	Small	HH	250	5000
			Dotcom	Bama	Standard	HH	350	17500
			Ordinary Jiko	Bama	Large	Hotels	1500	7500
			Kunimbili	Bama	Standard	HH	550	1100
			All Metal	Bama	Small	HH	250	500
20	John Kamau	Gikomba	Dotcom	Bama	Medium	HH	550	8250
			KCJ	Bama	Large	Hotels	1600	16000
			Ordinary Jiko	Bama	Standard	Hotels	1500	1800
21	Martha Njeri	Near Safaricom Shop	KCJ	Bama	Medium	HH	550	13750
			Ord Jiko	Bama	Small	HH	250	4500
			Dotcom	Bama	Standard	HH	600	9000
			Kunimbili	Bama	Medium	HH	500	4000
22	Westley Suppliers	Flamingo	Jiko Uhai	Wesley Bosire	Small, Medium, Large	HH	Small-450,Med-800,L-1100	50 stoves / Month
						Hotels, Institution		
23			Brooder Cookstove		Medium ,Large	HH	Med-800,Large-1200	30 stoves / Month
						Hotels, Institution		
24		Kivumbini	Saw Dust Jiko		Medium ,Large	HH	Med-650,Large-900	30 stoves / Month
						Hotels, Institution		
			Kunimbili Jiko		Medium	HH	Medium-850	12 stoves / Month
						Small Shops		
25	Bama	Kivumbini	KCJ	Peter Karanja	Small, Medium, Large	Hia, HH	Small-200,M-350,Lg-800	300 Stoves / Month
26			Energy Saving Jiko		Medium	HH/Institutional	Medium -550	30 stoves / M0nth
27		Bondeni AIC	Cookstove Brooder	Nicholas	Large	Hia,HH	Large-950	7 stoves / Month
28		Bondeni AIC	Chips Fire Stove	Meshack	Small, Medium, Large	Institution, HH	Small-5500,M-12000,L-18000	8 stoves / Month

No	Name Of Supplier	Location Of Supplier	Type Of Stove	Manufacturer	Size Of Stove	Target Group	Price Per Unit	Unit Sales
29		Bondeni AIC	Oven Cook Stove	John Njau	Large	Supermarket, HH	Large-15000	9 stoves / Month
30	Fredy Juakali	Bondeni Police	Small Oven Stove	Fred Momanyi	Small	Hotels, HH, Lia, Hia	Small-18000	10 stoves / Month
31		"	Oven Cooker		Small, Medium, Large	Institution, HH	Small-4000,M-6000,L-12000	
32			Energy Saving Jikos		Medium	HH, Hotels, Lia	Medium-800	
33	Fred Juakali Suppliers		KCJ	Fred Juakali Centre	Small, Medium, Large	Institution, HH	Small-400,M-750,L-1500	60 stoves/ Month
34	Jonah Njiru	Flamingo Area	Electric Cookstove For Chips	Peter Njau	Medium	Hia, Institutional	Medium-600	5 stoves /Month
35	Otieno Suppliers	AIC Nakuru East	KCJ	Otieno, M.	Small, Medium, Large	HH, Hotels, Lia	Small.200,M-400,L-700	50 stoves/ Month
36	Njuwa Hardware	Whitehouse Stage	KCJ, Dotcom	Bama	Small, Medium, Large	HH	Small-150, Medium-350	15 stoves/ Months
37			Kunimbili Jiko	Bama	Medium, Large	HH	Medium -350, Large550	50 stoves / Month
38	Epitax Stores	Bismark Petrol St.	KCJ	Pama	Medium ,Large	HH	Medium 350,Large.500	35 stoves / Month
39	Tofigue Hardware	Caleb Africa Limited	KCJ	Pama	Medium	HH, Hotels, Lia	Medium -350, Large550	30 stoves / Month
40	Steve	Ravine Stage	K.C,J	Scode	Small.	HH.	700	10500
			KCJ	Bama Jua Kali	Small.	HH	200	3000
			All Metal	Bama Jua Kali	Small.	HH	300	2400
			All Metal	Bama Jua Kali	Medium	HH	350	2800
41	Ben	Near Main Market	All Metal	Bama Jua Kali	Medium	HH	600	16200
			All Metal	Bama Jua Kali	Small	HH	250	15000
	'		Stove Jiko	Bama Jua Kali	Medium	HH	600	16200
	'		Stove Jiko	Bama Jua Kali	Small	HH	250	13500
	'		Stove Jiko	Bama Jua Kali	Large	HH/ Hotels	700	37800
	''		KCJ	Bama Jua Kali	Small	HH	200	60000
			KCJ	Bama Jua Kali	Medium	HH	250	75000
			KCJ	Bama Jua Kali	Large	HH	300	90000
42	Geoffrey	Near Main Market	Stove Jiko	Bama Jua Kali	Small	HH	250	1000
			Stove Jiko	Bama Jua Kali	Medium	HH	350	1400
			Stove Jiko	Bama Jua Kali	Standard	HH	600	2400

No	Name Of Supplier	Location Of Supplier	Type Of Stove	Manufacturer	Size Of Stove	Target Group	Price Per Unit	Unit Sales
	Geoffrey	Near Main Market	KCJ	Bama Jua Kali	Small	HH	280	4200
			KCJ	Bama Jua Kali	Medium	HH	350	5250
			KCJ	Bama Jua Kali	Standard	HH	400	6000
43	Joyce	Near Family Care Hospital	All Purpose	Scode	Small	HH	1200	8400
			All Purpose	Scode	Medium	HH	1300	10400
			KCJ	Scode	Medium	HH	800	8800
			KCJ	Bama Jua Kali	Small	HH	180	2700
			KCJ	Bama Jua Kali	Medium	HH	200	15000
			KCJ	Bama Jua Kali	Large	HH	250	7500
			KCJ(Long Stands)	Bama Jua Kali	Medium	HH	350	10500
			KCJ(Long Stands)	Bama Jua Kali	Large	HH	400	8000
			Kuni Mbili	Scode	Medium	HH	1000	4000
44	Kenya Blue Sky	Resma Plaza	Biomass Energy Saving	Korea(Imported)	Small	HH	2000	32000
			Biomass Energy Saving	Korea(Imported)	Medium	HH	3000	12000
			Biomass Energy Saving	Korea(Imported)	Large	HH	20000	80000
			Biomass Energy Saving	Korea(Imported)	Extra Large	HH / Hotels	40000	160000
45	John Mwangi	Main Stage	All Metal	Bama Jua Kali	Small	HH	200	2400
			All Metal	Bama Jua Kali	Medium	HH	550	About 8000
			All Metal	Bama Jua Kali	Large	HH/Hotels	700	About 10500
			Stove Jiko	Bama Jua Kali	Small	HH	250	2500
			Stove Jiko	Bama Jua Kali	Medium	HH	600	4800
			KCJ	Bama Jua Kali	Small	HH	180	4500
			KCJ	Bama Jua Kali	Medium	HH	250	6500

SUMMARY TABLE – STOVE SUPPLIERS		
Supplier/ Distributor	**Type of Stoves Sold**	**Monthly Units Sold**
Arumagic Supplier	Multiple Stoves	300
Bama	KCJ	300
Ben	Multiple Stoves	1122
Botto Solar Ltd	Botto Solar Stoves - Various	60
Dan's Jua Kali Supplies	Improved Jiko Makaa	100
Dorcus	Multiple Stoves	74
Epitax Stores	KCJ	35
Fred Juakali Suppliers	KCJ	60
Fredy Juakali	Various	10
Geoffrey	Multiple Stoves	57

Gilanis Supermarket	Gasifiers	
Joe Mwaura	Multiple Stoves	5
John Kamau	Multiple Stoves	26
John Mwangi	Multiple Stoves	110
Jonah Njiru	Electric Cookstove - Chips	5
Joyce	Multiple Stoves	200
Kenya Blue Sky	Biomass Energy Saving - Korean	28
Kimani Enterprise	Multiple Stoves	50
Lower Tuskeys	Multiple Stoves	20
Martha Njeri	Multiple Stoves	66
Naivas	Multiple Stoves	10
Nakumatt	Multiple Stoves	18
Njuwa Hardware	Multiple Stoves	15
Otieno Suppliers	KCJ	50
Peter Kariuki	Multiple Stoves	76
Rivana Supermarket	Multiple Stoves	3
Samuel Igogo	Multiple Stoves	79
Stagemat	Multiple Stoves	97
Steve	KCJ/All Metal	46
Tofigue Hardware	KCJ	30
Trader - not named	Brooder Cookstove	30
Trader - not named	Multiple Stoves	42
Trader - not named	Energy Saving Jiko	30
Trader - not named	Cookstove Brooder	7
Trader - not named	Chips Stove	8
Trader - not named	Oven Cookstove	9
Trader - not named	Kunimbili	50
Tuskys	Multiple Stoves	3
Ukwala	KCJ	83
Upper Tuskeys	Multiple Stoves	95
Vision Supermarket		
Westley Suppliers	Jiko Uhai	50
Woolmat	Multiple Stoves	25

Type of Stove	Price Range
All Metal Jiko	200-250
All Purpose	1200
Gasifiers	
Biomass Energy Saving	2000
Brooder Cook stoves	
Chips Fire Stove	5500
Cookswell Premium Straight	3990
Dotcom	170-350
Electric Cookstove - Chips	
Energy Saving Jiko	
KCJ	180-450
Kunimbili Jiko	550
Institutional 1625	
Improved Jiko Makaa	
Jiko Makaa	
Jikokoa	3850-3900
Jiko Uhai	450
Mama Safi Stoves	
Metal Stove	
Odoma Metal	
Ordinary Jiko	150-250
Paraffin Stove	
Saw Dust Jiko	
Signature	
Small Oven Stove	18000
Stove Jiko	250
Footed Electric Grill	
Manual Cookstove	3990
Oven Cooker	4000
Premium Firewood Jiko	699
Kingbird Combined Cooker	
Kenya Stove	530
Jiko Live	280
Jiko Stove	240
Oven Cookstove	

11.7 Fuel Distributors and Suppliers

No	Name of supplier	Location of supplier	Firewood	Charcoal	Briquette	Type	Manufacturer	Package size	Package type	Price per unit	Unit sales
	Name	Area; building; etc.	Tick	Tick	Tick	Balls, sausage, pillow, hexagonal, others	Name of company; person	Kg	Pre-packed plastic,mp,pb, others	KSh	KSh average per month
1	Nakumatt	Westside mall			√	Balls	Chardust Ltd	4		295	>5000
						Chips like	Vikrut prerequisites ltd	12		165	>700
					√	Balls	Chardust Ltd	0.25		290	>5000
2	Botto Solar Ltd	Section 58			√	Fireballs and sausage	Botto solar	1 - 100		250/kg	>250000
3	Kakamega Millennium Diesel Works	Sabuni road			Yes	Sausage type	Kakamega Millennium Diesel Works	2kg		25	
								5kg		60	Total briqs sale - 600kg/week
								10kg		100	
4	Steve Store	Gilani Estate		Yes		Charcoal	Mogotio, Mau Olegurone	Galan		40	120000
								Bucket		170 and 250	40200
								50kg manila paper		650	39000
								90kg manila paper		1200	36000
5	Mama Belinder Shop	Kaptembwa		Yes		Charcoal	Mau	Galan 1		30	
								Galan 2		35	Total no. of both type 1 and 2galans 1oogalans/day
								90kg manila paper		1200	4 sucks/day
6	Mocks Joseph Kiosk	Kivumbini		Yes		Mixed up shapes	Mau, Bahati, Njoro	2kg		25	
								5kg		60	Total charcoal sale 350 kg/week
								10kg		100	
7	Mwangi J.	Bondeni police		Yes		Charcoal	Mogotio, Mau Olegurone	Galan		40	120000
								Bucket		170 and	40200

No	Name of supplier	Location of supplier	Firewood	Charcoal	Briquette	Type	Manufacturer	Package size	Package type	Price per unit	Unit sales
										250	
								50kg manila paper		650	39000
								90kg manila paper		1200	36000
8	Mama Moraa	Whitehouse	Yes	Yes		Charcoal	Mau, Mogotio	Galan 1		30	
								Galan 2		35	Total no. of both type 1 and 2galans
											1oogalans/day
								90kg manila paper		1200	4 sucks/day
10	Waiyaki Kiosk	Bismark station				Charcoal		90 kgs		1100	8 sucks/day
11	Wainaina	Mogotio stage		Y		Irregular	Marigat	4	Not pre-packed	40	2800
						Irregular	Marigat	90	Bags7sacks	1000	
12	Joseph Simiyu	Free area		Y		Irregular	Marigat	90	Bags/sacks	900	63000
13	Sylvia Nabwire	Free area	Y	Y		Irregular	Marigat	4	Not pre-packed	40	30000
			Y								
14	Eunice Wangari	Free area		Y		Irregular	Marigat	4	Not pre-packed	40	9240
15	John Mureithi	Free area	Y			Irregular	Timboroa	N/a	Hand estimation	10	10500
						Irregular	Marigat	90	Bags/sacks	900	4000
						Irregular	Marigat	4	Not pre-packed	35	1225
						Irregular	Keep left timber yard			5	1500
						Irregular	Keep left timber yard	90	Bags/sacks	30	13500
16	Peter Maina	Moi Flat		Yes		Irregular	Mau, Mogotio	50 kg manila bags	50	600	48600
				Yes		Irregular	Mau, Mogotio	N/a (buyer's own)	20	250	27000
				Yes		Irregular	Mau, Mogotio	Polythene bags	4	50	37800
17	Mary Nyambura	Moi Flat		Yes		Irregular	Mau, Marigat	N/a (buyer's own)	20	270	25920
				Yes		Irregular	Mau, Marigat	Polythene bags	4	60	6000

	SUMMARY TABLE		
	Fuel Type	**Packaging Type**	**Volumes Traded (Units/Kgs)**
Fuel Suppliers			
Kakamega Millennium Diesel Works	Briquettes	2 Kgs; 5 Kgs; 10 Kgs	2400 Kgs
Nakumatt	Briquettes	4Kg; 12 Kgs	722 Kgs
Eunice Wangari	Charcoal	4 Kgs	924 Kgs
Joseph Simiyu	Charcoal	90 Kgs	6300 Kgs
Mama Belinder Shop	Charcoal	Gallon Containers; 90 Kgs	2500 gallons; 100 90-Kg bags
Mama Moraa	Charcoal	Gallon Containers; 90 Kgs	2500 gallons; 100 90-Kg bags
Mocks Joseph Kiosk	Charcoal	2 Kgs; 5 Kgs; 10 Kgs	1400 Kgs
Mwangi J.	Charcoal	Gallon Containers; Buckets; 50 Kgs; 90 Kgs	3,000 Gallon Containers; 236 Buckets; 60 50-Kgs; 30 90-Kgs
Steve Store	Charcoal	Gallon Containers; Buckets; 50 Kgs; 90 Kgs	3,000 Gallon Containers; 236 Buckets; 60 50-Kgs; 30 90-Kgs
Sylvia Nabwire	Charcoal	4 Kgs	3000 Kgs
Wainaina	Charcoal	4 Kgs; 90 Kgs	910 Kgs
Waiyaki Kiosk	Charcoal	90 Kgs	18000 Kgs
John Mureithi	Firewood	4Kgs; 90 Kgs	500 Kgs
Mary nyambura	Firewood	4 Kgs; 20 Kgs	2320 Kgs
Peter Maina	Firewood	4 Kgs; 20 Kgs; 50 Kgs	9234 Kgs
Botto Solar Ltd			1000 Kgs

11.8 GALLERY (FUELS)

Briquettes made of carbonised human waste

Charcoal - Daniel Fuel

Industrial size briquettes from human waste and saw dust

Faecal matter pellets

Kakamega Millenium Fuel

Kakamega Millenium Fuel

Firewood

11.9 GALLERY (STOVES)

Stoves from Geoffrey Ndungu

M1