



Kilifi County



Government



CONTEXT ANALYSIS ON THE PROGRESS TOWARDS IMPROVED CLEAN COOKING ENERGY AT HOUSEHOLD LEVEL IN KILIFI COUNTY

FINAL REPORT



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List of Acronyms and Abbreviations

CAP	Country Action Plan
CBO	Community Based Organizations
CCAK	Clean Cooking Association of Kenya
CET	Common External Tariff
DFID	Department for International Development
EA	Enumeration Area
ESMAP	Energy Sector Management Assistance Program
GACC	Global Alliance for Clean Cookstoves
GHG	Green House Gas
GIS	Geographic Information Systems
GLPGP	Global LPG Partnership
GROOTS Kenya	Grassroots Organizations Operating Together in Sisterhood in Kenya
HAP	Household Air Pollution
HH	Household
IAP	Indoor Air Pollution
ICS	Improved Cookstoves
IER	Integrated Exposure Response
ISO	International Organization for Standardization
IWA	International Workshop Agreement
KCJ	Kenya Ceramic Jiko
KENDBIP	Kenya National Domestic Biogas Programme
KEBS	Kenya Bureau of Standards
KES	Kenya Shillings
KIRDI	Kenya Industrial Research and Development Institute
KNBS	Kenya National Bureau of Statistics
KOSAP	Kenya Off-Grid Solar Access Project
LPG	Liquefied Petroleum Gas
MoE	Ministry of Energy
NGO	Non-governmental Organization
ODK	Open Data Kit
MOU	Memorandum of understanding
NCCAP	National Climate Change Action Plan

NDC	Nationally Determined Contributions
PAYG	Pay-as-you-go
PSUs	Primary Sampling Units
RBF	Result Based Financing
SDG	Sustainable Development Goals
SEP	Special Energy Programme
SEforALL	Sustainable Energy for All
SMEs	Small and Medium-sized Enterprises
SNV	Netherlands Development Organization
SPSS	Statistical Package for Social Sciences
TS	Three Stone
RBF	Result Based Financing
UNDP	United Nations Development Programme
USD	United States Dollar
WHO	World Health Organization

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Terminologies

Although there are no universal definitions of the terms “improved cookstoves”, “improved cooking solutions” and “clean cooking solutions”, this study adopts the definitions used by a World Bank (ESMAP) report on the state of the global clean and improved cooking sector, May 2015. These definitions, given below, were guided by the ISO

1. **IWA** (International Workshop Agreement) tier classification system.
2. **Cooking solution:** Any combination of technology and fuel used for cooking.
3. **Traditional cooking solutions:** Baseline cooking technologies that employ no functional considerations for fuel and/or thermal efficiency. Examples include the three stone, open U-shaped clay or mud stoves, metal charcoal stoves, and unvented coal stoves.
4. **Improved cooking solutions:** Cooking solutions that improve, however minimally, the adverse health, environmental, or economic outcomes from cooking with traditional solid fuel technologies. This definition encompasses clean cooking solutions and the entire range of improved biomass cookstoves.
5. **Improved biomass cookstoves:** Biomass stoves that improve on traditional baseline biomass technologies in terms of fuel savings via improved fuel efficiency. Some improved cookstoves also lower particulate emissions through improved efficiency of combustion, but the critical distinction from “clean” cooking solutions is that “improved” stoves may not reach sufficiently low emissions levels to generate meaningful health benefits. Examples include basic chimney improved cookstoves (ICS), basic portable ICS (e.g. Kenya Ceramic Jiko), and intermediate ICS (e.g. rocket cookstoves).
6. **Clean cooking solutions:** Cooking solutions with low particulate and carbon monoxide emissions levels (IWA ISO Tier 3-4 for the indoor emissions indicator, within the Global Alliance’s Monitoring and Evaluation framework). These include stoves based on petro-chemical fuels (LPG, natural gas, and kerosene), electric stoves and electromagnetic induction cookstoves. Biofuel cookstoves powered by ethanol and other plant-based liquids, oils or gels, and biogas cookstoves are also included in this category. Solar cookers and retained heat cooking devices are also considered clean cooking solutions. The terms of reference for this study provide explicit requirement for evaluation divided largely between cooking technologies and cooking fuels. While the structure of this report discusses the approaches and findings largely across these two components of cooking, the distinction is less obvious in cooking solutions that are not packaged as such. For example, cooking solutions like the 3 kg and 6 kg LPG complete

cylinders (with grill and regulator) and biogas are sold both as technologies and fuels. On the other hand, some cooking solutions are designed for specific fuels (e.g. the Mimi Moto gasifier for pellets) and therefore any meaningful discussion will have to be done in that context.

7. **Primary cooking solution:** the cooking solution that is most used (frequency of use).
8. **Secondary cooking solution:** the second most commonly used cooking solution for households (frequency of use).
9. **Use rate:** Percentage number of households in possession of and using technology or fuel. This is synonymous with the penetration rate.
10. **Branded stoves:** Cookstoves manufactured or imported by formally registered entities that have a distinct product name. These stoves are standardized and typically have a warranty.
11. **Technology and fuel stacking:** This phrase describes the use of multiple devices and fuels to satisfy household energy needs
12. **Traditional Cooking Solutions:** There are two types:
 - a) **Three stone:** Most basic form of cooking solution that uses stones as the stove (to support cooking appliance) and firewood.
 - b) **Artisanal metallic charcoal stove:** These are traditional metallic charcoal stoves that do not include a ceramic / clay liner or any other component to help with fuel and thermal efficiency.
13. **Improved cooking solutions :** Refer to the following types of cookstoves:
 - a) **Fixed biomass stove unmovable firewood stove:** Is designed with improvements, however minimal; to the thermal efficiency of the three stone. This may range from stone and concrete cooking areas to units incorporating a clay/ceramic liner and chimney. Examples include Rocket stoves, Jiko kisasa and Maendeleo stove
 - b) **Improved artisanal portable firewood stove:** Improved artisanal portable firewood stoves that have incorporated a clay/ceramic liner for improved thermal efficiency. The most dominant stove was the Kuni mbili stove
 - c) **Branded firewood stove (manufactured):** Improved and branded portable firewood stoves whose production is standardized, and factory based. Examples include BURN's Kuni Okoa, EcoZoom's Zoom Dura and Envirofit's supersaver wood stoves.
 - d) **Improved artisanal portable charcoal stoves:** Charcoal stoves that have incorporated a ceramic liner for improved thermal efficiency. The Kenya Ceramic

Jiko (KCJ) was the most predominant stove of this category with an adoption rate of >98%.

e) **Branded charcoal stoves improved and branded portable:** charcoal stoves whose production is standardized, and factory based.

14. Result Based Financing (RBF):- This is a system where the financiers only disburse funds when the agreed results have been achieved.

15. A sample Survey:- Is a method for collecting data from or about the members of a population so that inferences about the entire population can be obtained from the subset, or sample, of the population members¹

16. As per the 2009 Kenya Population and housing Census, three strata for a place of residence were created, namely: Rural; Core-Urban; and Peri-Urban and defined² as below:

- a) **Rural.** This is a large and isolated part of an open or agricultural area, including trading, market and service centres with relatively low population concentrations of less than 2,000 people.
- b) **Urban.** This is a built-up and compact human settlement with a population of at least 2,000 people defined without regard to the local authority boundaries. It usually is a trading, market and service centre that provides goods and services to both the resident and surrounding population and is therefore sometimes referred to as an urban centre.
- c) **Peri-Urban:** This is the area beyond the central built-up area that forms the transition between urban and rural areas. As a result of the extension of town boundaries, peri-urban areas are formerly rural and agricultural lands that are gradually turning to urban land use.

¹ <https://www.sciencedirect.com> 02/12/2019 at 10.00 am

² Further information is provided in the Analytical Report on Urbanization, Volume VIII (March 2002), KNbs.

Executive Summary

The context analysis on clean cooking energy was carried out to establish on the status of the cleaning cooking, Kilifi County. The study analysed data from both secondary sources and primary (collection of data from fieldwork) sources. The survey locations (fieldwork data collection) were categorised into Urban, Peri – Urban and Rural areas.

Key Findings

- a) **Policy and Legal Frameworks:** At the County level, the analysis shows that there are critical gaps on the policy front. For example, the Kilifi County Spatial plan 2015-2025 and Kilifi County Energy Policy, June 2017 are still in draft form and the Kilifi County Forest Conservation Bill has yet to become law.
- b) **High prevalence of inefficient cookstoves in rural areas despite high level of community knowledge on clean cooking stoves:** From the findings in this study 89.3 % of households in rural area use inefficient cookstoves with three stone accounting for 87.7% and traditional metal jiko 1.6%. Kenya targets to progressively reduce access to inefficient cookstoves to 42.3%, 34.8% and 25.3% in 2017, 2020 and 2022 respectively³ (see table 5). From this survey study, the average percentage of households using inefficient cookstoves in Kilifi County is 64.2% compared to the National target of 34.8% in 2020.
- c) **Availability woodfuel in plenty.** There is plenty of cheap woodfuel in Kilifi County. The percentage of households with access free firewood 85.3%, 40.6% and 14.7% from rural, peri – urban and urban respectively. However, the rate of afforestation and reforestation is low.
- d) **Inadequate local capacity to produce improved cookstoves:** - Currently only Mtwapa Energy Centre is involved in production improved cookstoves. This slows down access to clean cooking at households' level.
- c) **Transformative Clean Cookstove Programme.** Kilifi County does not have a clean cookstove programme/project that will guide it to implement universal access to clean cooking. The programme should have a smart targets and a budget.

³ SE4All Kenya Action Agenda 2015

- d) Households below poverty line:-** From the analysis of data collected from field, 58.2 %, 35.3% and 16.7% (Figure 5) of households in rural, peri – urban and urban areas in Kilifi County live below the poverty line, US\$1.90 per day in 2011 PPP⁴.

Conclusion

The study shows a marked increase in the percentage of households using of LPG from 2% in 2013 to 10.7% in 2019. The use of LPG in urban area is 24.7%. Woodfuel remains the dominant cooking fuel in over 80% of the households. The use of three stone stands at 58.1%. The use of three stone in rural areas stands at 87.7%. This implies that the use of woodfuel will remain a dominant household cooking fuel for a long time.

Comparison analysis between the findings in this survey with previous survey studies done by KNBS shows some consistence progression. Therefore the findings in this survey can be used for planning purposes.

Recommendations

- a) Support to finalisation policy and legal frameworks:** The County needs support to finalise the Kilifi County Spatial plan 2015-2025, Kilifi County Energy Policy, June 2017 and the Kilifi County Forest Conservation Bill
- b) Opportunity for Partnership:** To accelerate access to clean cooking at households, stakeholders working in Kilifi County need to collaborate to create synergy. Some of the stakeholders that are open to partnership are Energy4Impact, Mtwapa Energy Centre, department of Gender (County Government) and GROOTS.
- c) Support the county government to develop a transformative programme:** The programme will have budgeted smart targets to address the issue of low penetration of clean cooking in Kilifi County. The programme will give guidance, coordination and implementation of the clean cooking programme. GROOTS should also work on financing options borrowing from other programmes such as Result Based Financing (RBF) under Kenya Off – Grid Solar Access Programme (KOSAP)

⁴ <https://www.worldbank.org>> Kenya date 21/10/2019

1 Background Information

1.1 Introduction

This report analyses the status of clean cooking at the household level in Kilifi County through sample survey, review of the legal, regulatory and policy frameworks. The study further looks at the various stakeholders involved in clean cooking within the county and gaps in adoption of clean cooking technologies. The development of the context of the County of Kilifi was informed by a range of sources and methods: ranging from desk reviews; key informant interviews and field survey.

The report addresses the gaps in the legal and policy framework that contribute to increased adoption of clean cooking. The report enlightens the audience on specific interventions that will be needed for a given population or region within the county to ensure access to clean cooking.

1.2 Objectives of the Assignment

The overall objective of context analysis on clean cooking energy was to establish the status of the cleaning cooking, Kilifi County. The specific objectives are:

1. Understand the adoption levels of improved clean cooking technologies in Kilifi County
2. Understand the existing policy and legislative frameworks in the county
3. Establish key stakeholders within the clean energy sphere within the county

1.3 Background & Rationale

World Health Organization studies indicate that around 3 billion people still heat and cook using solid fuels (i.e. wood, crop wastes, charcoal, coal and dung) in open fires and leaky stoves⁵. Most folks are poor, and live in low and middle-income countries. Such inefficient cooking fuels and technologies result in household air pollution which exposes individuals to inhalation of dangerous soot particles. In poorly ventilated dwellings, indoor smoke can be 100 times higher than acceptable levels for fine particles. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth. This exposure results in increased death and illness like pneumonia, stroke, heart diseases, chronic obstructive

⁵ <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

pulmonary disease and lung cancer. Related studies in Kenya have also revealed that open fires have resulted to burning of houses and degradation of environment.

In Kenya, 76% of the population relies on biomass for cooking, thus serious implications on public health (including an estimated 15,700⁶ deaths linked to indoor air pollution). This, negatively impacts on women's well-being and economic development opportunities as well as the environment, (Stockholm Environmental Institute report 2016). Kenya is already a leader within sub-Saharan Africa in developing and distributing clean cookstoves. This has been demostated by the development of favourable policy and regulatory framework for adoption of clean cooking. However, in order to achieve large scale adoption and use; there is need to review the gaps in the regulatory frameworks, economic and behavioural barriers.

It is on this background that GROOTS Kenya and Clean Cookstoves Alliance of Kenya (CCAK) with support from Netherlands Enterprise Agency (SNV) are implementing an Evidence Based Advocacy Project on clean cooking under a Partnership Programme known as Voice for Change. The project aims at addressing the gaps in the legal and policy framework to contribute to increased adoption of clean cooking. The gaps identified can be addressed by advocating for the development of clean cooking standards, testing protocols and regulations; county policies and plans, guidelines for extension officers to promote clean cooking and fiscal incentives. If these gaps are addressed at the National and County levels, the resulting favourable environment will contribute to increased adoption of clean cooking technologies in the long term.

The overall goal of this advocacy plan is to increase the adoption of clean stoves and fuels in Kenya through inclusion of clean cooking in national and county plans as well as budgets. The advocacy plan should also enable a level playing field, harmonisation of testing protocols, standards and labelling. Mainstream clean cooking in the existing extension network, guidelines on clean cooking promotion will be developed for use by the extension workers while advocating for increased budget allocation for implementation of clean cooking programmes.

Kilifi County was selected to benefit from this project by the virtue of it being one of the fourteen marganilised counties in Kenya. These the which have been left behind in terms of development. The national government together with the development partners and civil

⁶ GACC presentation made at "WHO Indoor Air Quality Guidelines Workshop", February 2014

societies are supporting those counties to extent necessart to bring the quality of services in those areas to the level generally enjoyed by the rest of the nation, so far as possible.

1.4 Problem Description

a) Implementation of SDG No. 7

The United Nations (UN) Secretary General launched the Sustainable Energy for All (SE4All) Initiative in September 2011 to achieve three inter-related goals by 2030;

1. Ensuring universal access to modern energy services;
2. Doubling the global rate of improvement in energy efficiency;
3. Doubling the share of renewable energy in the global energy mix.

In 2015 SE4All was adopted as Sustainable Development Goal (SDG) No. 7 which call for affordable, reliable, sustainable and modern energy for all by 2030. In 2015, the Government has developed Kenya SE4All Action Agenda. This document is supposed to guide the implementation SDFG No.7 in Kenya. Despite over 30 years of promoting improved cookstoves and fuels, the uptake of clean cooking solutions is still low in Kenya – estimated at 46.5%⁷ in a country with a population of approximately 40 million people⁸. To achieve universal access to clean cooking by 2030 as per SDG No No 7, the adoption of clean cooking solutions must be drastically scaled up.

b) High levels of usage of woodfuel (Firewood and Charcoal) by Households

In the context of Kilifi County, the situation is dire. Only 2% of residents in Kilifi County use liquefied petroleum gas (LPG), and 8% use paraffin. 67% use firewood and 21% use charcoal. Firewood is the most common cooking fuel by gender with 65% of male headed households and 73% in female headed households using it (Kenya Bureau of Statistics, 2013, p. 13).

c) Development of County Policy that will accelerate uptake of Improved Cookstoves

To avert the current situation, CSOs propose among other interventions, to champion for a policy change. The County Government of Kilifi will need to provide fiscal incentives in promotion of clean cooking technologies. The County should also develop the requisite guidelines that will be used for awareness creation by the extension network working under the ministries of energy, health and agriculture.

⁷ Ministry of Energy and Petroleum, Sustainable Energy for All Kenya Action Agenda, March 2016

⁸ KNBS projection in 2015

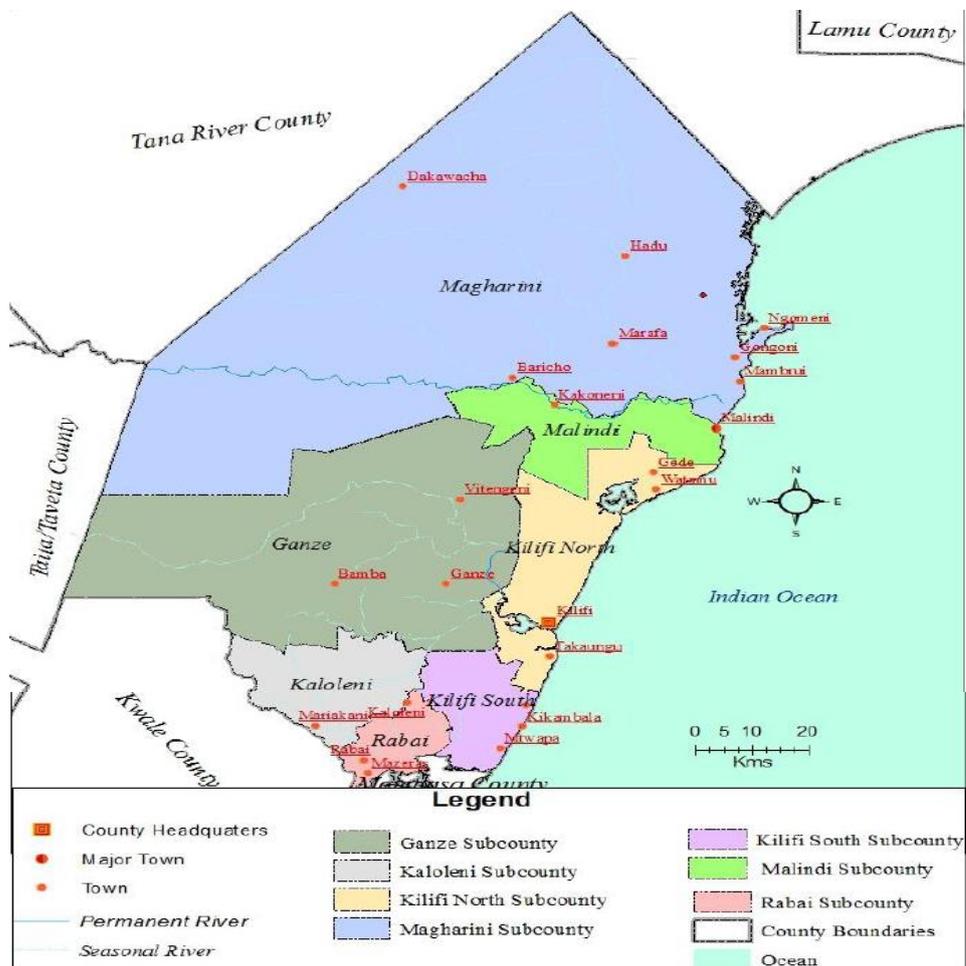
GROOTS Kenya proposes to champion for the Kilifi County Forest Conservation bill to be gazetted. This will allow for the implementation of the subsequent Kilifi County Woodfuel Regulations.

Standards and other protocols need to be disseminated to sector members at the county level. This will be critical in the implementation of the cooking energy strategies already identified in the CIDP. Moreover, understanding the county stakeholder perspective in terms of preferences towards fixed and mobile cookstoves.

1.5 County Overview

1.5.1 Position and Size

Figure 1 Map Showing Sub-Counties in Kilifi County



Kilifi County is one of the six counties in the Coast region of Kenya. The County lies between latitude 2°00' and 4°00' south, and between longitude 39°05' and 40°14' East. It borders Kwale County to the South West, Taita Taveta County to the West and Tana River County to the North, Mombasa County to the South and Indian Ocean to the East. The county covers an area of 12,370.8 km².

1.5.2 Administrative and Political Units

The county has seven sub counties namely: Kilifi North, Kilifi South, Ganze, Malindi, Magarini, Rabai and Kaloleni. It has 35 wards, 54 locations, and 165 sub locations as shown in the Table 1. Magarini sub-county is the largest while Rabai is the smallest sub county in terms of area.

Table 1: Kilifi County Administrative Units by Area

Sub County	Area (Kms ²)	No. of wards	No. of location	No. of Sub locations
Kilifi North	530.3	7	7	22
Kilifi South	400	5	7	16
Ganze	2,941.6	3	14	48
Malindi	627.2	5	8	18
Magarini	6,979.4	6	8	28
Kaloleni	686.4	4	11	21
Rabai	205.9	4	7	12

(Source: KNBS Kilifi 2017)

1.5.3 Demographic Features

The county is predominantly inhabited by the Mijikenda community. Nevertheless, county residents constitute a representation of Kenya's forty four (44) tribes and a small population of foreigners⁹. The population of the county is estimated to be 1,453,787 from the Kenya Population and Housing Census of 2019, composed of 704,089 male, 25 intersex and 749,673 Female. The county's dependency ratio stands at 101.45 per cent¹⁰. Table 2 shows population distribution within Kilifi County.

Table 2: Population Density and Distribution in the County

Sub County	Area (km ²)	Population	Density (Persons /km ²)
Kilifi North	530.30	178,824	337
Kilifi South	400.00	269,091	673
Ganze	2,941.60	166,540	57
Malindi	627.20	333,226	531
Magarini	6,979.40	191,610	27
Kaloleni	686.40	193,682	282
Rabai	205.90	120,813	587
Total	12,370.80	1,453,786	118

(Source, KNBS, Census 2019)

⁹ Kilifi County CIDP 2018 - 2022

¹⁰ Kilifi County CIDP 2018 - 2022

Urban Population

The county's main urban centres are Malindi, Kilifi, Mtwapa, Kaloleni, Mazaras, Mariakani, Watamu, Magarini, Marereni, Majengo and Bamba. The county's urban population stands at 328,652 in 2018, constituting about 22.6% of the total population. This proportion of urban population mirrors that of the country at 39% and that of Africa at 36%, which is projected to increase to 50% and 60% by 2030 and 2050, respectively¹¹. Unfortunately, rapid urban growth is taking place without corresponding capacity of the city and town planning and management institutions to guarantee sustainable urban livelihoods. This is evidenced by a myriad of environmental problems including the proliferation of slums, squatter settlements, incessant collapse of buildings, traffic congestion, competing land uses, ribbon pattern of development and urban sprawl. Table 3 below shows the population projections for the urban centres in the county.

Table 3: Population Projection for Urban Centres in the County

Urban Centres	2009 (Census)	2018 (projection)	2020 (projection)	2022 (projection)
	Population	Population	Population	Population
Malindi	84,150	113,641	120,679	128,152
Mtwapa	48,150	65,666	69,733	74,051
Watamu	10,030	13,545	14,384	15,275
Majengo	7,788	10,517	11,169	11,860
Marafa	6,051	8,172	8,678	9,215
Mazaras	6,886	9,299	9,875	10,487
Kaloleni	5,573	7,526	7,992	8,487
Marereni	5,949	8,034	8,531	9,060
Kilifi	44,257	59,767	63,468	67,399
Mariakani	24,055	32,485	34,497	36,633
Total	243,364	328,652	349,006	370,620

(Source: KNBS, 2017)

¹¹ KNBS 2017

2 Legal, Regulatory and Policy Frameworks

Policy, regulations and standards are tools used by governments to promote or stifle the growth of the sector of economy to which it is applied. The government of Kenya has put in place various frameworks creating an enabling environment for growth of clean cooking industry. The main challenges lies in implementation of these frameworks. Some of the key frameworks at National Government and Kilifi County Government Level supporting clean cooking are:

2.1 National Government Legal and Policy Frameworks Related to Clean Cooking.

1. ***The Customs Union Integration Pillar:*** It establishes free trade on goods and services within the bloc and imposition of a common external tariff (CET) on imports from non-EAC countries when sold to EAC partner States. Under this integration pillar, the bloc amended custom duties and the CET with the new tariffs coming into effect from 1 July 2018. Relevant to the cooking sector was the zero-rating (0% import duty) of inputs and raw materials for use in the manufacture of energy saving stoves imported by gazetted users in all EAC parties except Tanzania. Among these duty rates is the imposition of a 35% import duty on complete sets of non-electric cooking appliances including stoves for Kenya. Tax on parts for manufacturing stoves was, however, maintained at 10%.
2. ***The Constitution of Kenya 2010***, which specifically provides that each county government is responsible for county planning and development in electricity and gas reticulation and energy regulation, there is a need to update some of the current regulations to reflect the requirements of the Constitution.
3. ***The Energy Act 2019***, provides some clarity on what these responsibilities entail. Relevant to this cooking sector study is the county governments' responsibility in regulating and licensing of:
 - i) biomass production, transport and distribution;
 - ii) biogas systems; and
 - iii) charcoal production, transportation and distribution.

The Act also proposes the establishment of the Rural Electrification and Renewable Energy Corporation, which, among other things, will be mandated with developing and promoting the use of renewable energy and technologies including those of biogas, biomass, charcoal and fuelwood.

4. ***The Energy Policy of 2018:*** Regarding the cooking sector, the policy specify protocols and strategies for biomass, biofuels, biogas and LPG among others.

Among the strategies presented include, but are not limited to:

- promote efficient conversion and cleaner utilization of biomass energy; promote use of briquettes as an alternative to wood fuels;
- promote the use of biogas an alternative to woodfuel and kerosene for both domestic and commercial use.

5. The Forest (Charcoal) Rules of 2009 and revised in 2012

Key components of the regulations include:

- charcoal producers and transporters must be licensed by the Kenya Forest Service (KFS) and licensing requirements are laid out;
- commercial charcoal producers must organize themselves in Charcoal Producers Associations (CPAs) which in addition to facilitating sustainable charcoal production, must implement reforestation conservation plans;
- charcoal wholesalers or retailers should not trade with unlicensed producers and should keep records of their sources of charcoal;
- charcoal producers are prohibited from use of endangered or threatened plant species in charcoal production, among others.

6. The Forest Conservation and Management Act of 2016: retains the licensing role of KFS noting that the service is to “receive and consider applications for licenses or permits in relation to forest resources” and to “implement and enforce rules and regulations governing importation, exportation and trade in forest produce”. Among the Regulations provided for by the Act concern production, transportation and marketing of charcoal. The Act continues to note that anyone who “makes or is found in possession of charcoal in a national, county or provisional forest; or in community forest, private forest or farmlands without a license or permit of the owner” commits an offence.

7. The Energy (Liquified Petroleum Gas) regulations of 2009 are subsidiary regulations anchored on The Energy Act, 2006. These regulations outline the licensing requirements for those involved in the LPG business including the importation, bulk storage, filling, transportation, wholesale and retail trade of LPG. It also includes safety measures and powers of inspection of business vehicles or facilities by the ERC, as well as requirements to adhere to KEBS standards for cylinder specifications and handling, storage and distribution of LPG. The Regulations also standardized the capacities of LPG cylinders (at 1kg, 3kg, 6kg and 13kg) and the valves used, and established an LPG cylinder exchange pool that “regulates the exchange of LPG cylinders among the LPG marketing companies”. This exchange pool made it possible for variedly branded cylinders to be accepted at any refill station. Discussions with stakeholders indicate that these regulations are currently

under review with one of the main revisions expected to be abolishing the cylinders exchange pool. If gazetted, the revised regulations will allow licensed distributors to select partners with whom to associate with in the cylinder exchange.

8. The Energy (Improved Biomass Cookstoves) Regulations of 2013. The regulations are intended for manufacturers, importers, distributors, technicians, and contractors of improved Biomass Cookstoves, and institutions using biomass fuels for cooking and heating purposes. Institutions that rely on biomass for cooking are required to install improved biomass cookstoves and maintain records of the stoves installed in their premises. The regulations also set out the various classes and requirements for licensing for installation, maintenance, manufacture, importation and distribution of cookstoves for both household and institutional use.

9. Standards

The Kenya Bureau of Standards (KEBS) has various standards in guiding manufacturers of cookstoves both internationally and at a national level.

a. International Standards

The International Organization for Standardization (ISO) has developed some of the best available international guidelines with regard to the cooking sector. The current guiding standards are:

- The ISO Harmonized Laboratory Test Protocols guided by ISO 19867-3. Standard test sequence for emissions and performance, safety and durability.
- Voluntary performance targets for cookstoves based on laboratory testing, and ISO 19867-1. The voluntary performance targets result in 6 tiers of performance for various categories as summarized in Table 4 and can be used to benchmark the performance of various stoves. It should be noted that the various tiers are not designed to be interpreted together as the different indicators are relevant for different impacts.

2.2 Table 4: Voluntary Performance Targets - Default Values

Tier	Thermal Efficiency	CO Emissions (g/MJ delivered)	Fine Particulate Matter Emissions (mg/MJ delivered)	Safety (score)	Durability (score)
5	≥50	≤3.0	≤5	≥95	<10
4	≥40	≤4.4	≤62	≥86	<15
3	≥30	≤7.2	≤218	≥77	<20
2	≥20	≤11.5	≤481	≥68	<25
1	10	≤18.3	≤1031	≥60	<35
0	<10	>18.3	>1031	<60	>35

Source: ISO/TR 19867 - 3 : 2018

b. National Standards

- KS 2520 – 2014 Domestic biogas stoves – Specification;
- ISO 17225-3: 2014 Solid biofuels - Fuel specifications and classes Part 3: Graded wood briquettes;
- ISO 17225-7:2014 Solid biofuels - Fuel specifications and classes Part 7: Graded nonwoody briquettes, among others.
- KS 1814- 2018 *The Biomass Stoves* – Performance Requirements, which provides specifications to produce both domestic and institutional biomass stoves. The specifications speak to the various components of a biomass stove including the cladding, the ceramic liners, the size of the pots that can be supported, and the insulation material between the liner and the cladding among others. The standards also specify thermal and emission performance requirements for stoves. When tested according to ISO 19867-1, the thermal efficiency requirement for domestic natural draft biomass stoves is at least 30% for charcoal ceramic stoves and 40% for other stoves. A minimum of 45% efficiency is expected from forced draft domestic biomass stoves and all types of institutional biomass stoves.

Regarding emissions, the KEBS Standards provide performance requirements for PM2.5 and CO.

Discussions with sector stakeholders indicated that the Standards, as currently presented (KS 1814-2018), are very stringent and have rendered a large majority, if not all, of the biomass stoves within the market non-compliant. Consequently, business within the formal sector is on a go-slow due to concerns over performance emission levels.

10. Finance Act of 2018 saw the introduction of an anti-adulteration levy of KES 18 per liter levied on kerosene. While this levy was mainly intended to discourage the adulteration of vehicle fuels, it is expected to have the secondary effect of reducing the use of kerosene for household cooking, especially among the urban poor, due to the increased unit costs of the fuel. Consequently, it is expected that households will turn to cheaper alternative fuels with LPG being a very likely alternative given stove preference among urban households.

Government strategies

Kenya's Vision 2030 is the country's development blue print for transformation to an industrialized middle-income county by 2030. The Vision recognizes the “development of new and renewable sources of energy” as a key enabler for this development. It also hopes to ensure sustainable energy for all by 2030.

The Vision seeks to promote the adoption of improved cooking stoves and charcoal kilns. The efforts to promote the uptake of alternative fuels and improved cookstoves are already being seen through government programming, initiatives and legislation both at the national and sub-national level. Among national actions are:

- i. ***The Gas Yetu – The Mwanachi Gas Project*** by National Oil Corporation of Kenya aims to distribute 6Kg LPG complete cylinders with the goal to increase LPG penetration to 70% by 2020. The project design includes distribution of complete cylinders at a discounted price of KES 2000 enabled by a government subsidy on the initial cylinder stove, and development of last mile distribution channels where the distribution model involves working with at least one distributor per sub-county. At the time of this study, a pilot test had been conducted in Kajiado North Sub-county and Machakos County. The media, however, reported that the project had been suspended after the pre-qualified supplier delivered unsafe 6 kg cylinders¹². If implemented as currently envisioned, the project will have significant impact on LPG penetration and usage.
- ii. ***Draft National Climate Change Action Plan for 2018-2022***, Under the Nationally Determined Contribution, Kenya seeks “to abate GHG emissions by 30% by 2030 relative to the business as usual scenario of 143 CO₂eq . According to the Action Plan, the largest proportion of these reductions is expected from shifts in energy demand; adoption of alternative fuels including LPG and ethanol in urban areas and improved biomass cookstoves in rural areas is estimated to contribute to 7.3 MtCO₂eq in reductions. Additionally, this shift is expected to have significant health benefits among them being the “reduction of deaths from household air pollution from 49% of the annual total deaths (21,560 in 2017) to 20%. To this effect, the Action Plan proposes goals and actions to promote the uptake of these technologies by 2022 among them being:

¹² The East African May 19 2018

- “Number of households using improved biomass cookstoves increased by 4 million, through a programme that promotes:
 - Loan programme through micro-finance institutions to assist with the up-front cost of cookstoves
 - Local manufacture and servicing of clean cookstoves, e.g., tax-relief incentives for manufacturers; training and loans for local service
 - Local businesses to stock improved cookstoves, with an emphasis on women-led businesses
- Number of households using LPG, ethanol or other cleaner fuels for cooking increased to 2 million;
- Biogas technology scaled up to increase access to clean energy through the construction of 6,500 digesters for domestic use and 600 biogas systems in various schools and public facilities”. This is being implemented by the Ministry of Energy.

iii. Sustainable Energy for All: Kenya Action Agenda 2016

The SE4All Kenya Action agenda targets achieve a 100% access to modern cooking solutions by 2030. Table 5 shows clean cooking fuels progression for households until 2030.

Table 5: Clean Cooking Progression for Households Until 2030

Year	2013	2017	2020	2022	2027	2030
LPG(%)	8.6	13.6	15.0	18.6	25.6	35.3
Biogas(%)	0.1	0.2	0.3	0.4	0.6	0.8
Bioethanol(%)	0.0	0.0	1.0	1.5	3.0	4.5
Electricity(%)	0.6	1.0	1.2	1.5	2.0	2.3
HHs access to clean fuels-non-solids (%)	9.3	14.8	17.5	22.0	31.2	42.9
Improved cookstoves-Solid fuels	37.2	42.9	47.7	52.7	57.6	57.7
Total access to modern cooking services (%)	46.5	57.7	65.2	96.7	88.8	100.0
Access to unclean cooking services (%)	53.5	42.3	34.8	25.3	25.3	25.3
Total access to cooking (%)	100.0	100.0	100.0	100.0	100.0	100.0

Source : SE4AALL Kenya Action Agenda 2015.

iv. Kenya Country Action Platform - Pre-final CAP, amended 2016

5 million Kenyan households using clean cookstoves and fuels for cooking and heating applications by 2020.

- v. *The Kenya Off-grid Solar Access Project*, a flagship project of the Ministry of Energy running from 2017 to 2023 and financed by the World Bank, seeks to “increase access to modern energy services in underserved counties of Kenya” . According to the Project Appraisal Document, Subcomponent 2B of the Project, has an allocation of US\$6 million that concerns clean cooking solutions for households. The project will promote “cleaner household cooking appliances and fuels” in efforts to help target counties (including West Pokot, Turkana, Isiolo, Samburu, Marsabit, Kilifi, Kwale and Tana River) transition to cleaner, more efficient, improved stoves. Stoves promoted under the project include woodstoves that are at least Tier 2 ((roughly 30 percent efficient) and Tier 3 charcoal stoves (roughly 40 percent efficient).

2.3 Kilifi County Government legal and policy framework

- 1. The Draft Kilifi County Spatial Plan 2015-2025 :** -recognizes that the County relies heavily on biomass for heating and lighting even though the county is endowed with lots of renewable energy resources such as sun, wind, biogas and municipal waste, which remain largely unexploited (County Government of Kilifi, 2018, p. 87). The spatial plan provides for an integrated approach on how the county can exploit its renewable energy resources.
- 2. The Kilifi County Forest Conservation Bill, 2016:-** upon which, Kilifi County Woodfuel Regulations 2017 are based on shows the legislature’s commitment to the issue. The Bill is expected to become law in 2019. This Bill provides for the Woodfuel Regulations. Subsequently, the Kilifi County Woodfuel Regulations spell out the pathway by which forest resources will be used, and how licensing of wood fuel producer associations will be done. At its core is the use of environment impact assessments in informing the implementing officers. These regulations will be critical in ensuring that charcoal production in the county adhere to the best practises and technologies available.
- 3. Kilifi’s enabling environment is anchored in the County of Kilifi CIDP.**

The County Government Act 2012 stipulates that “a county government shall plan for the county and no public funds shall be appropriated outside a planning framework developed by the county executive committee and approved by the county assembly.” County planning includes development of a five year County Integrated Development Plan (CIDP), which has clear goals and objectives, an implementation plan with clear outcomes, provisions for monitoring and evaluation and clear reporting mechanisms.

A review of these CIDPs shows that the County aspires to see an increase access to clean cooking at household level as indicated in 2013 - 2017 and 2018 - 2022 CIDPs below:

- a) **The 2013-2017 CIDP**, the County Government was able to put in place an energy department, carry out energy resource mapping and drafted Kilifi County Energy Regulation. Various cooking energy-related milestones were achieved by the departments of Energy. For example, the energy department installed three biogas digesters and one household biogas digester, bought two briquetting machines and one charcoal kiln which were stationed at the Mida Jatropha office and Magarini charcoal producers' office, respectively, the key focus being reduction of deforestation¹³.
- b) **The 2018-22 CIDP**. The 2nd Kilifi County Integrated Development Plan (CIDP 2018-2022) builds on the gains registered under my first term. This five-year Plan provides a development roadmap for the County for the period between 2018 and 2022. Through the CIDP, the County aspires to see an increase in the proportion of households using energy saving jikos and reducing the number of households using wood as a source of fuel. A review of this CIDP shows that the department of energy has been allocated KES 30 million to increase the number of households using LPG, energy saving jikos and related technologies. It must be noted that the department of Environment has also proposed a budget of KES 50 million to increase uptake of energy saving jikos under climate change action plan.

Overall, Kilifi County has a favourable policy environment to serve as an entry point for GROOTS to champion on the issue.

¹³ Kilifi CIDP Volume 1 (2018-2022)

3 Approach and Methodology

This study employed multiple data collection approaches including literature and data review, households survey and key informant interviews.

3.1 Sampling Framework Design

Ideally, enumeration of all households gives a better results on the status of access to clean cooking in the County. However, due to cost and time constraints, it was not practical to conduct a census and therefore a sample was drawn to represent households' access to clean cooking. To cope with the heterogeneity of the households within the County, stratified sampling and simple random sampling were used. All the households were grouped into three clusters namely Urban, Peri –Urban and Rural. Then within each of the three clusters, a fixed number of households were located to each of the selected ward within the cluster. From ward level, a number of households were allocated to a selected village within the given Ward. The respective Sub – County and Ward administrators assisted in the selection of wards and villages. The key criteria for the selection of the wards and villages was to ensure that they match the characteristics of the given cluster. For instance a ward and a village selected in an Urban Cluster, should possess the characteristics of an urban area as much as possible.

3.2 Survey Location

The study was categorised into Urban, Peri-Urban and rural areas. The categories have similar characteristics across the board in all the sub – counties of Kilifi County. Hence the data collected is a representation of all the urban, peri –urban and rural areas in Kilifi County. These areas urban, peri –urban and rural were represented by Kilifi North, Kaloleni and Ganze sub-counties respectively. In general the three sub-counties were selected from seven sub – counties mainly because logistics which includes resources and workload

Kilifi North was chosen mainly because is the headquarters of the County, it is centrally located and it is more surrounded by forests. The study wanted to find out if the proximity of urban area to forests has any impact on the choice of households fuels particularly woodfuel. Ganze and Kaloleni subcounties were selected because of their proximity to Kilifi North, in addition to the factor that their the best representative of the characteristics of their respective cluster.

3.3 Estimation of the Size of the Sample

The survey will target the sub-counties of Kilifi North, Kaloleni and Ganze. The total number of households in these sub – counties is 133,525¹⁴. The infinite population sample size formula (where the population is greater than 50,000) has been used to determine the size of the sample.

From the sample size formula, $n_0 = D ((Z^2pq)/d^2)$ (Source: Survey methods and Practices, 2010),

where

n_0 = non corrected minimum required sample size

D is the design effect usually incorporated when using stratified sampling (it increases the sample size in order to get the real characteristics of the population). In this case is taken as 1.

Z represents the probability that a sample will fall within a certain distribution. The Z-values for confidence levels for this survey is set at 1.96 at 95 percent confidence level.

P is the proportion in the target population estimated to use wood fuel and biomass out of the total primary energy consumption, $p=88\%$.¹⁵

$q = 1 - p$,

d is the degree of accuracy desired, set at 0.05.

the sample size will be given by:

$$n_0 = \frac{1.96^2 \times 0.88 \times 0.32}{0.05^2} = 446 \text{ respondents}$$

During calculations consideration for the finite population was taken into account and the correction factor, for the size of the population was used. However, since the corrected ‘n’ is negligible, it has no effect in the sample size since the target household population is greater than 50,000. The valid sample size is 446.

Correction for finite population provides the valid sample size (n) as in the equation below.

¹⁴ KNBS Kilifi County Number of Households Projection 2018

¹⁵ KNBS and SID, 2013, House and Energy Publications

$$n = \frac{n_o}{1 + \frac{(n_o - 1)}{N}}$$

Where: N = Actual Population / household numbers.

It must be noted that increasing the sample size enhances the level of accuracy of the data collected. Therefore, the consultant rounded the sample size to nearest hundred. Therefore the sample size used in the study was 500.

3.4 Sample Distribution

The sample was proportionate to the population under the survey study. Table 9 in Annex 2 shows the detailed distribution of the sample size across the wards and villages in the three sub-counties of Kilifi North, Kaloleni and Ganze. Each ward from the given cluster, was allocated a uniform number 50 households, which narrowed down to 10 households per village. The last stage of households were randomly sampled from preselected villages in a given ward.

Table 6 shows the distribution of the sample size across the wards in the three sub-counties of Kilifi North, Kaloleni and Ganze.

Table 6: Distribution of Sample Size Across the Wards in Kilifi North, Kaloleni and Ganze

Sub -County	Ward	Projected No. HHs in 2018	Sample Size		
			urban	Peri-urban	Rural
Kilifi North	Sokoni	19,069	50	-	-
	Mnarani	3,870	50	-	-
	Watamu	8,332	50	-	-
	Sub -total	31,271	150	-	-
Kaloleni	Kaloleni	12,302	-	50	-
	Mariakani	15,556	-	50	-
	Kayafungo	8,275	-	50	-
	Sub -total	36,133	-	150	-
Ganze	Bamba	9,212	-	-	50
	Ganze	7,164	-	-	50
	Sokoake	7,530	-	-	50
	Jaribuni	6,203	-	-	50
	Sub -totals	30,109	-	-	200

Source: KNBS Kilifi County Number of Households Projection 2018

3.5 Selection of Enumeration Areas (EAs)

The Sub-County and Ward Administrators were consulted during EA selection. The sub-counties were be the basic stratum in the design, further stratified into EAs covering urban, peri-urban and rural areas.

Each enumeration area (Ward) was allocated a total of 50 households. Sub-County and Ward Administrators assisted in categorisation of wards into villages that are urban, peri-urban and rural. The villages formed the Primary Sampling Units (PSUs). Each village was allocated 10 households as shown in Annex 10.2.

Enumerators randomly selected households during the survey. A total of 10 enumerators were used in this study. Each enumerator administered 50 questionnaires per ward. These enumerators reside in the local survey areas, speak the local languages, understand the local sociocultural context and are trained in research methods. In the selection of the respondents, preference was given to the household member directly involved in budgeting for cooking.

3.6 Data Collection Tools

A mix of survey tools were used to collect the data required for the survey. Both quantitative as well as qualitative data collection methods were used. The tools were designed in a way that ensured that all the information required for analyses was captured. The tools include:

1) Household questionnaire.

The tool was a semi-structured questionnaire (with closed/open questions and tables), used in all the sampled households. Data collection was carried out using smart phones. The phones were installed with ODK software. Data collected was uploaded to a cloud server upon completion of the interview (in areas with internet connection) or saved on the phone then uploaded as soon as the enumerator was within an area with a connection. Sets of pictures were taken by the enumerators when asking respondents about their types of stoves, knowledge of stoves and preference.

2) Key Informants Interviews (KIIs)

Semi-structured questionnaires were used to adequately capture the views of individuals with relevant experience in improved cooking interventions in the clean cooking sector. The key informants were drawn from the various sector stakeholder groups including government officials, development agencies and formal financing institutions in clean cooking sector, clean cookstove programme coordinators and managers, NGOs and CBOs also formed part of the informants. The list of key informants is included in the Annex A1.4. Key informants interview included;

- a) Various relevant departments in Kilifi both from National and County Government
- b) Civil Society Organisations and Donor Agencies in Kilifi County.
- c) Private sector

- d) Energy service providers – The energy service providers surveyed included commercial producers of charcoal and firewood, biogas technology solution providers and cooking technology (equipment) dealers/artisans..Notably, apart from the Mtwapa Energy Centre and suppliers of LPG, most of other service providers are quite informal.

3. Case Studies

This report highlights five case studies that highlight a range of subjects in the sector. These have been used to provide details, insights, examples or emphasis on findings from the field and from literature review.

3.7 3.3 Data analysis

Data collection was based on Computer Assisted Personal Interviews (CAPI) where the survey questionnaire was administered by use of mobile phones. The first step was to programme the paper questionnaire using CSPRO and thereafter the phones were configured and installed with the ODK application that was used in the survey. The enumerators saved the collected data to a server and either transmitted immediately the interview is finalised or in case of absence of network in the field, the data was transmitted later at the end of the day. The supervisor in charge of data regularly reviewed the data received in the servers and advised the field teams accordingly. Upon completion of the survey, the data was consolidated and shared for cleaning.

The quantitative data was processed and analysed using the Statistical Package for Social Sciences (SPSS) package and the Microsoft excel. The information is presented this data form of text, frequency distribution tables and graphics – as appropriate.

4 Findings from the Field

4.1 Cookstoves used mostly by Households

The findings from the survey showed that:- 10.7% of households in Kilifi County use liquefied petroleum gas (LPG), 0.5% use electricity and 5% use paraffin. 83.8% use woodfuel of which firewood contributes 58.1% and charcoal 25.7%. In terms of cookstoves, 58.1% use three stone, 6.5% traditional metal jiko, 19.2% ceramic jiko (energy saving jiko), 5% paraffin cookstives, 10.7% LPG cookstoves and 0.5% use electric cooker. Figure 2 shows the primary (most frequently) cookstoves used by households. 64.6% of woodfuel consumers use inefficient cookstoves (three stone at 58.1% and traditional metallic jiko at 6.5%).

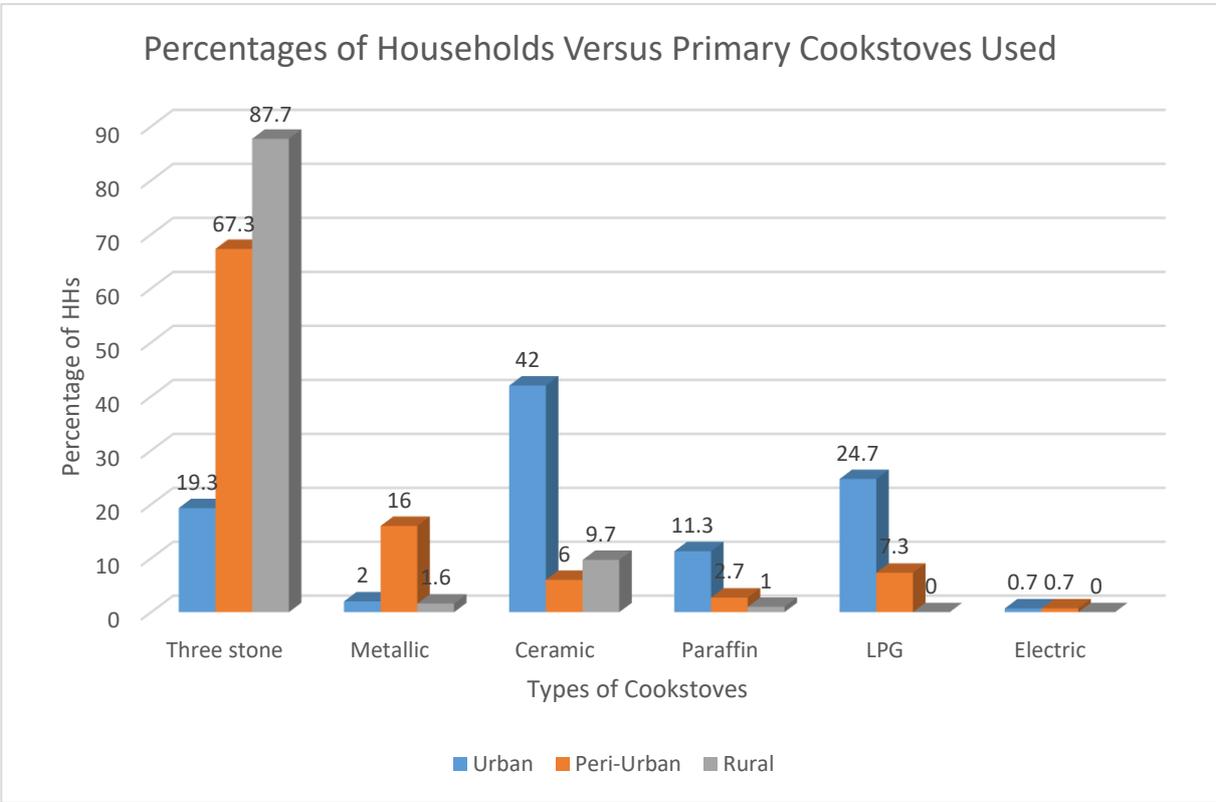


Figure 2: Households' Access to Various Types of Cookstoves

Cooking technologies used at the household level still lag behind. The three stone accounted for the highest share (58.1%). 6.5% of the households use the traditional metal jiko, 19.2% ceramic jiko (energy saving jiko), 5% paraffin cookstives, 10.7% LPG cookstoves and 0.5% use electric cooker. Figure 2 shows the most frequently used cookstoves used by households. 64.6% of woodfuel consumers use inefficient cookstoves (three stone at 58.1% and traditional metallic jiko at 6.5%).

The Table 7 shows the comparisons of findings in this survey report and KNBS, 2015/016 KIHBS. The studies shows an increase in the use of woodfuel and LPG while there is a drop in the use of Kerosene and an increase of in the use of LPG. The drop in the percentage of households can be attributed to increase in kerosene prices as a result of government taxes. The increase in the use of LPG can be attributed to urbanization and economic improvement of the households. The increase in the use woodfuel could be as a result of households who were initially using Kerosene switching to charcoal and also urbanisation. This shows validity of the survey study findings are valid.

Table 7: Comparison of the Survey Study Findings

Studies	LPG	Kerosene	Woodfuel
1. This report Survey findings (%)	10.7	5	83.9
2. KNBS, 2015/2016 KIHBS (%)	7.6	7.9	79.4

4.2 Sourcing of Woodfuel by Households.

As indicated in figure 3 forest are the main source woodfuel in Kilifi County standing at about 87%. It should be noted that the source of woodfuel for those who buy is forest.

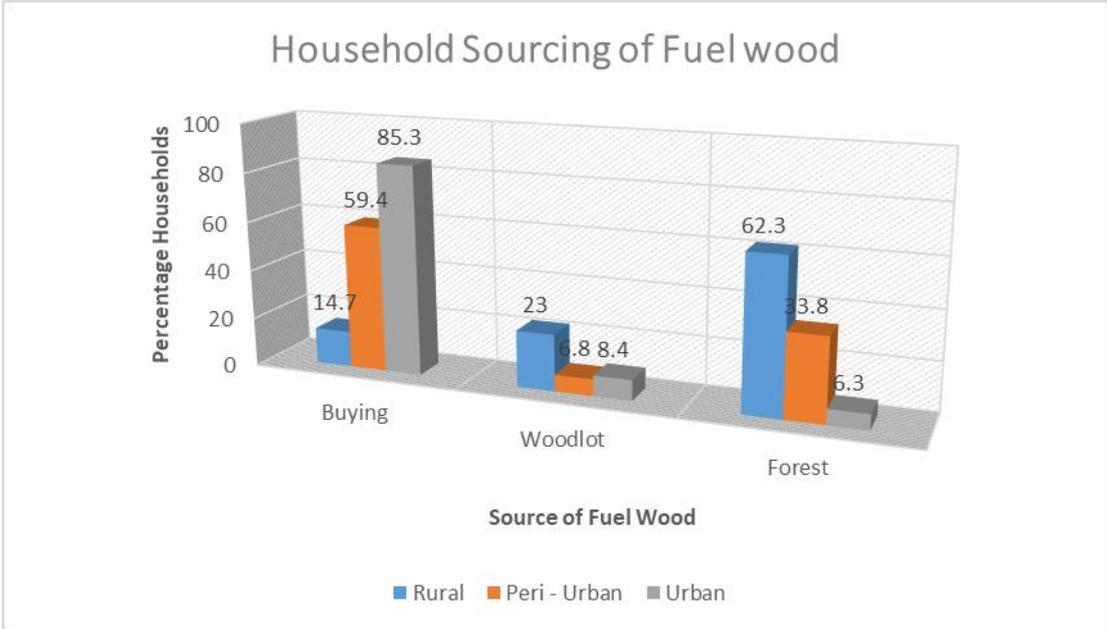


Figure 3: Households Source of Woodfuel

4.3 Respondent Willingness to Buy ICS

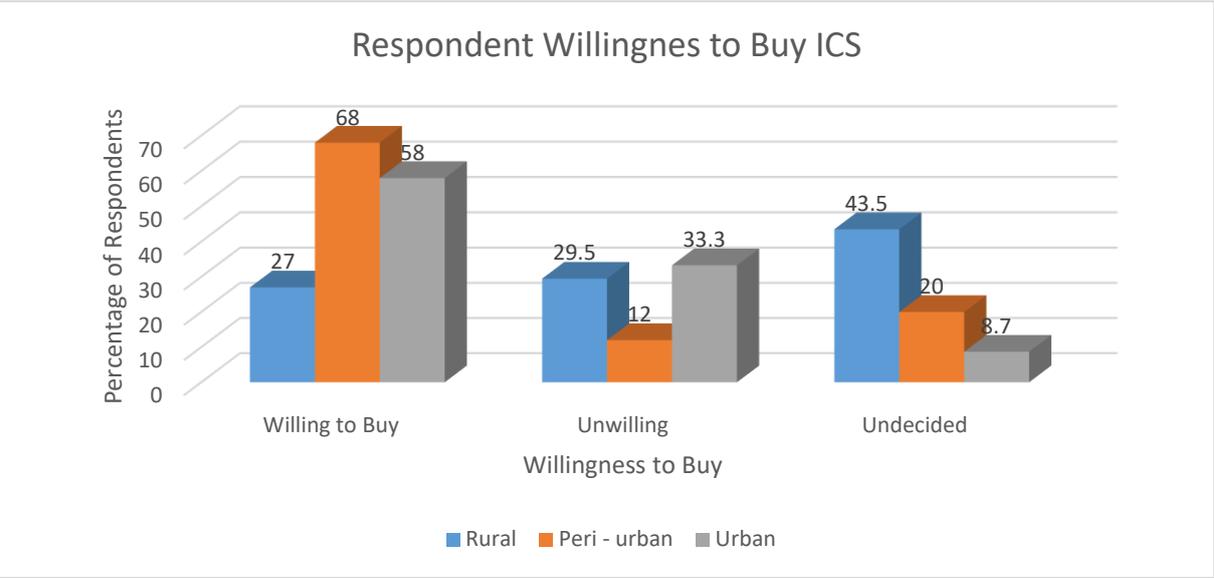


Figure 4: Willingness to Buy Improved Cookstove

4.4 Barriers to adoption and use of improved clean cooking technologies

4.4.1 Finance Barriers

From the supply side, production, testing, creation of consumer awareness and last mile distribution activities of cookstoves within the supply chain remains capital intensive. This is one of the reasons why there is only one energy centre; Mtwapa Energy Centre, situated in Kilifi County, serving five counties namely Kilifi, Mombasa, Kwale, Taita Taveta and Lamu. The Centre is government owned under the Ministry of Energy. The Centre offers capacity building in production of ceramic cookstoves. The Centre produces two types of ceramic cookstoves namely Kenya Ceramic Jiko (KCJ) - charcoal cookstove and Maendeleo - firewood cookstove. The centre is underfunded hence it does not play its role effectively.

From the demand side, the barrier is structured in two forms. The initial cost of acquiring the ICS and the subsequent cost of the fuel. The initial cost of acquiring an ICS is higher when compared to the traditional cooking technologies. For example, a three stone has no initial cost when acquiring it. But if this end-user wanted to obtain an improved branded biomass stove for instance, they would require between KES 2,800-5,200 (USD 28 - 52). This is contrasted with the KCJ, which retails between KES 300-700 (USD 3 - 7) and the kerosene wick stove that retails between KES 300 - 1,500(USD 3 - 15).

The cost of fuel can be a barrier if it is being introduced for the first time (for example, an end-user who has been collecting firewood for free) or if the fuel is only available in large quantities

that require lumpsum payments. The cost of refuelling a 6kg complete LPG cylinder is KES 900 (USD 9) and lasts for 4 weeks for the average household size of 4 members that uses it as a primary fuel. This survey estimates that the average cost of a 1 kg of gas for the urban household is KES 155 (USD 1.55) while for rural household; it stands at KES 160 (USD 1.6, which lasts for approximately one week depending on the rate of use. The average cost of one litre of kerosene is KES 100 (USD 1) for both rural and urban areas.

From the KNBS, 2015/016 KIHBS, the analysis of poverty based on households at the national level shows a decline from 38.3% in 2005/06 to 27.4% of all households covered in 2015/16. This report shows that 58.2 %, 35.3% and 16.7% of households in rural, peri – urban and urban areas respectively in Kilifi County live below the poverty line, US\$1.90 per day in 2011 PPP¹⁶ see figure 5. According to KNBS, 2015/16 KIHBS, the overall national poverty headcount rate (proportion of poor individuals) dropped from 46.6% in 2005/06 to 36.1% in 2015/16¹⁷. The 2015/16 KIHBS indicates that Kilifi County poverty headcount rate dropped from 71.7% in 2005/06 to 46.6% in 2015/16. The percentage of households below poverty line in Kilifi County from this study is 36.7% compared to the the national percentage from the KNBS, 2015/016 report is 27.4%.

The KNBS studies indicates the poverty level at Kilifi County is higher compared to the national level which is in agreement with the findings from this study report. This partly explains why the findings in this study particularly in urban where the percentage of households using three stone is at 19.3% the its percentage of households living below the poverty line is at 16.7%.

¹⁶ <https://www.worldbank.org>> kenya date 21/10/2019

¹⁷ KNBS, Basic Report on Well –Being in Kenya, March 2018

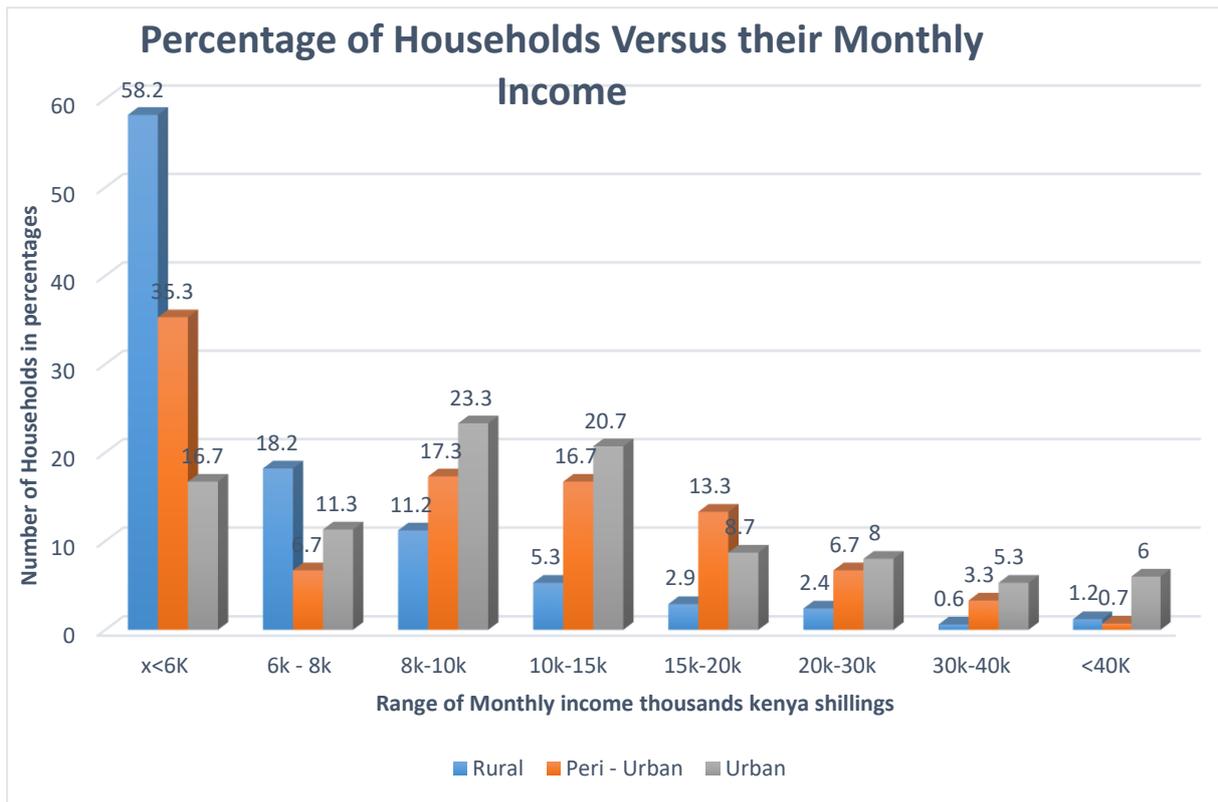


Figure 5: Households Monthly Income in Kilifi County

4.4.2 Policy and Regulatory Barriers

Creating an enabling environment for the production and importation of ICS is key in ensuring that the products are available in the market at an affordable cost. Some policies such as waivers of import duty for the raw materials used for the manufacture of cookstoves have promoted the development of the clean cooking sector. However, some have negatively affected different players in the supply side of cookstove and fuel as discussed below. For example, the imposition of a 35% import duty on non-electric cooking appliances has affected the ethanol fuel importers who must import both the cookstoves and fuels, as they are not produced locally. This is in addition to the import duty and VAT on the fuel. This cost is passed on to the end-users who may find the stove and fuel unaffordable thus hindering market penetration.

Import of raw materials for the manufacture or assembling of cookstoves is zero-rated. This is a right step in promoting local manufacturing but a disadvantage to the importers who share the same market with the local manufacturers/assemblers.

To streamline the national policies, the County Government of Kilifi will need to provide fiscal incentives, as well as increased budget allocations to promote clean cooking as required. The county should also come up with clear policy goals that will guide universal access to clean

cooking. Budget allocation can be used to provide smart subsidies to ensure consumers are able to afford the products. Doing so will help reduce the price points across the clean cooking value chain.

In August of 2016, the Banking (Amendment) Bill 2015 which set a cap on the lending rate at no more than 4% above the Central Bank base rate was signed into law. The amendment came into effect a month later. Banks in Kenya eventually scaled down on providing loans and micro loans, choosing to direct most of their lending to government debt instruments. This has negatively affected access to finance among the sector players.

Another challenge in the policy environment is the lack of inclusion of the views of key stakeholders in the sector. One example is the formulation of the KEBS biomass performance requirement standard. The standard has requirements on safety, durability, emissions, marking, packaging, storage and usage that the manufacturers/importers must adhere to. From the discussion, the standards are so high that it makes it impossible to produce or sell biomass cookstoves in Kenya as no manufacturer can be able to meet the stipulated requirements. Although the leading manufacturers were consulted, their views were not included in the final document.

4.4.3 Market Intelligence and Awareness

Support from the Clean Cooking Alliance (formerly Global Alliance for Clean Cooktoves - GACC) resulted in the 2014 Kenya consumer segmentation report. Critical progress has been made from the findings towards increasing adoption of cookstoves. Moreover the sector has grown as a result of government policy changes and increased investment by the private sector.

The 2014 consumer market segmentation is now dated by over 4 years. This poses a challenge to manufacturers, importers and distributors of various cooking technologies and fuels who use this information. Moreover, the problem is exacerbated by the lack of up to date information from the rural and remote areas. It is important to note that market research is resource intensive and takes away resources from the private sectors core business. Only a few have the resources to carry out the needed market assessment to advice or improve their service offering.

On the demand side, knowledge and awareness of the existing cooking technologies in the market and the effects of traditional cooking technologies is key in determining the kind of technology that a household will purchase. People are not aware of some of the new cooking technologies in the market. From the clean cooking context analysis fieldwork survey, the percentage of households' responses to awareness of clean cooking solution is shown in Figure 6. From the figure, the level of awareness of improved cookstoves is quite high at 83.8%. However, this awareness is not comprehensive enough in terms environmental and socio-economic impacts of improved cookstoves. This means the high level of three stone cookstoves at 87.7% is not necessarily due to lack of awareness.

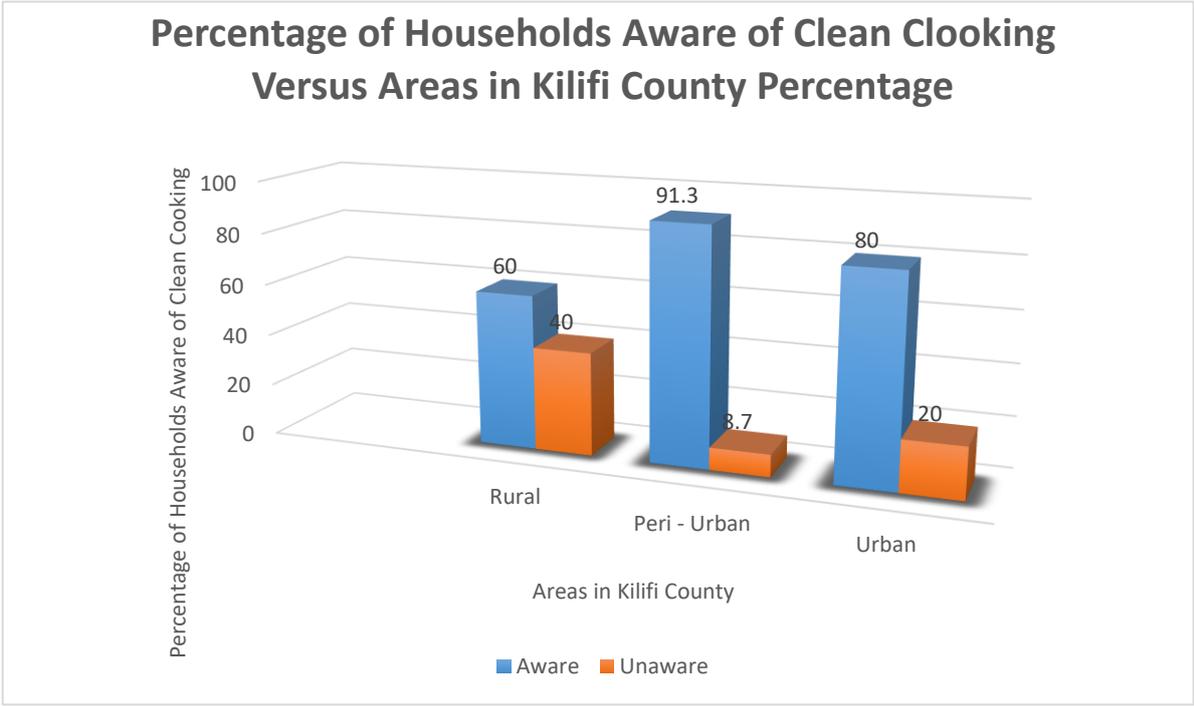


Figure 6: Percentage of Households Aware of Clean Cooking

4.4.4 Technological Barriers

Some of the ICS are limiting in terms of their design this is in regards to stability and diameter of the cooking space as most ranged between 24-29 cm in diameter. This makes it hard to use for very large families who have to use the large cooking pots. From this study, the size of some households Kilifi county were found to be as large as 21 persons. It is for this reason that some manufacturers have designed new models to address these concerns. For example, wisdom innovation developed Model 2-M2 to address the issue of stability and durability, which were concerns in the first model of their stove. BURN manufacturers also introduced the jikokoa xtra, which is bigger in size as compared to the jikokoa. This was also the case in Ecozoom

where a wood stove of 28 cm was introduced which was bigger in size than the previous model of 24 cm. The ease of operation can also be a technological barrier. This includes factors such as how easy it is to light the stove, ability to systematically regulate heat and fuel use, partial fuel refill and ability to detect the level of fuel. Cookstoves that address these factors are highly desired by the end-users. The woodfuel cookstoves do not address most of these factors.

The choice of cooking technologies and fuels is a composite process with several secondary and tertiary contributing factors. At the heart of the cooking, the problem is the use of traditional cooking technologies and fuels. Drivers of the prevalent choice of traditional cooking include high cost of alternatives, limited or non-existent supply of distribution channels, lack of awareness and inappropriate technological design.

4.4.5 Supply - Chain Barriers

Limited options for dissemination of cookstoves and fuels in the deep rural and remote areas of Kilifi County hinder the uptake. Unreliable or unavailable physical infrastructure is a key factor. Apart from kerosene and charcoal that have fully developed supply chains in the county, the rest of the fuels lack well defined supply chains that penetrate to such areas. Due to this limitation, preferences are set towards technologies that can be served by fuels that are readily and consistently available. This is, perhaps, one of the key hindrances in households purchasing stoves for new and novel forms of fuel even if these are better matched to their needs.

4.4.6 Socio-cultural factors influencing clean cooking development

Households continue to use the existing traditional device or fuel in parallel, and they may revert to it entirely (Ruiz-Mercado et al. 2011). Such a behaviour is attributed to issues such as fuel cost which is not readily available or social norms such as gender roles. Field report for this study, figure 7 confirm that households do stack their fuel alongside traditional stoves in Kilifi County. The fuel stacking model shows 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). This practice is more prevalent in urban centers.

Low awareness, high initial cost of fuel and fear of switching to technologies and fuels¹⁸ continue to be an impediment to adoption of ICS. The size households in Kilifi County varies greatly from 1 to 20 persons. Big family size are found mainly in peri – urban and rural areas.

¹⁸ Challenges cited by several commercial cookstove distributors operating in Kenya.

Family with large family have preference for three stone cookstoves because because most of the improved cookstoves available in the market are designed to serve small family size.

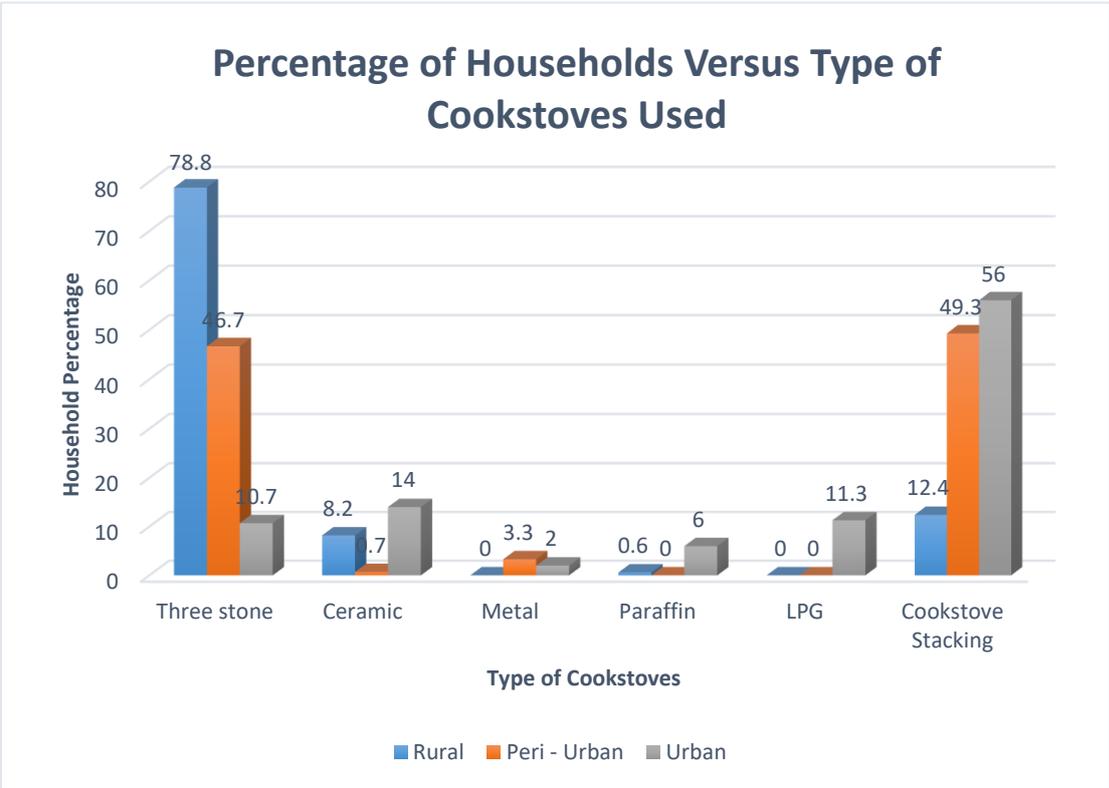


Figure 7: Types of Cookstoves used by Households

Place of Cooking

From figure 8, this study reveals that some households in Kilifi County cook outside their houses. The practice is higher in rural areas and peri – urban compared to urban areas.

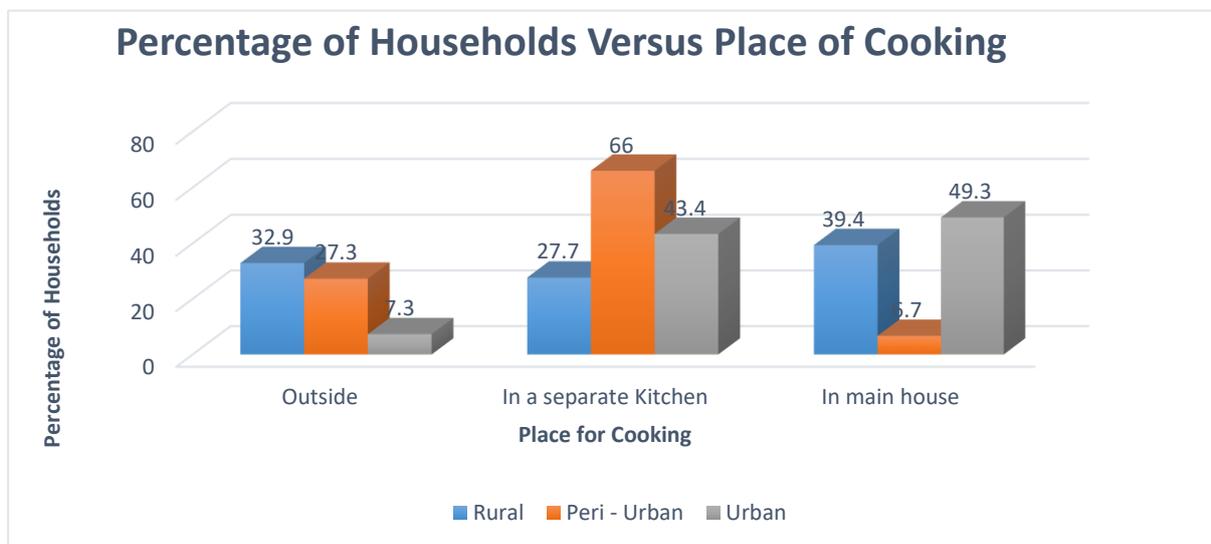


Figure 8: Place of Cooking

Literacy Level

From figure 9, the illiteracy and semi – illiteracy stands at 52.1% compared to 56.6% of KNBS, 2015/2016 KIHBS. The percentage indicates that the illiteracy has by 4.5% between 2019. This partly leads to low rates of adoption of new technology. This implies more time will be required to train those with no formal education and those who have not completed primary education to embrace new technology.

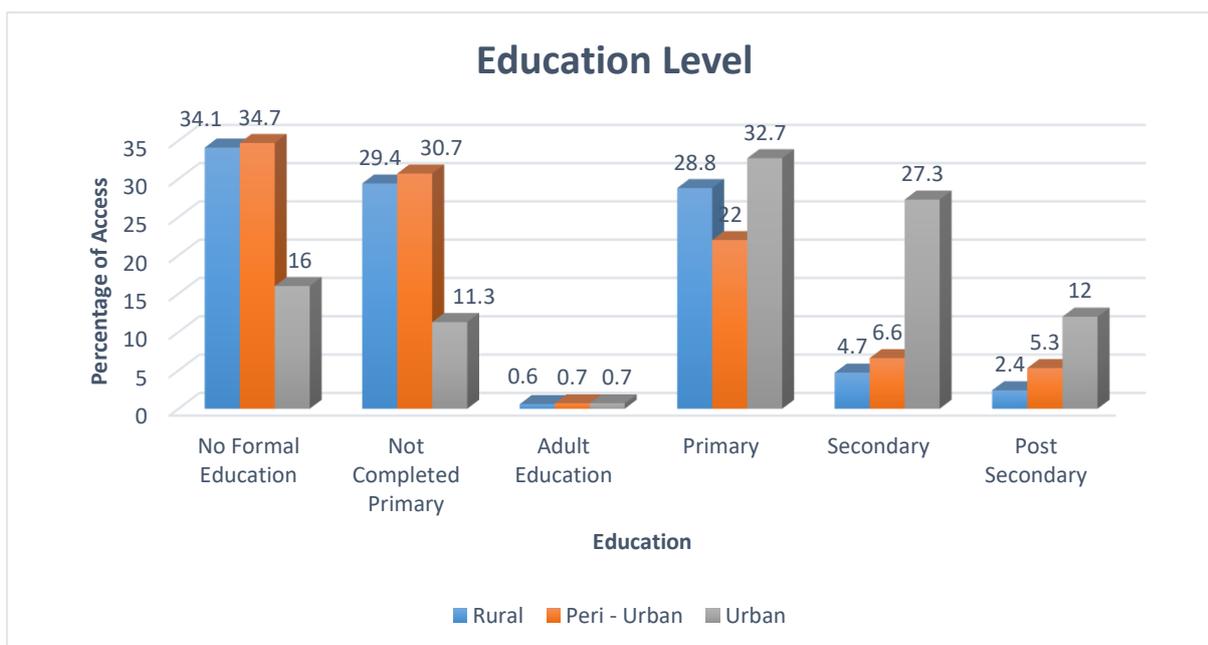


Figure 9 : Kilifi County Literacy Level

The KNBS 2015/016 KIHBS shows that the percentage of the population in Kilifi County that completed primary and secondary levels of education are 20.5% and 9.0%. This survey study report shows the percentage of the population that has completed primary and secondary levels of education as 28.4% and 12.7% respectively while 6.6% have post-secondary education, see figure 10. The percentage increase are 7.9% and 3.7% respectively. The KNBS and SID 2013 publication, Exploring Kenya’s Inequality – Kilifi County; shows the percentage of the population of in Kilifi County with no formal education, those who have attained primary education and those with secondary education and above as 36%, 52% and 13% respectively. The survey report are shows those with no formal education, primary, secondary and education and above as 28.3%, 52.3% and 19.9% respectively, see figure 9.

Head of Household

From figure 10, 73.3% of the household are headed by men. This shows the need to reach out to men in the campaign for clean cooking initiative.

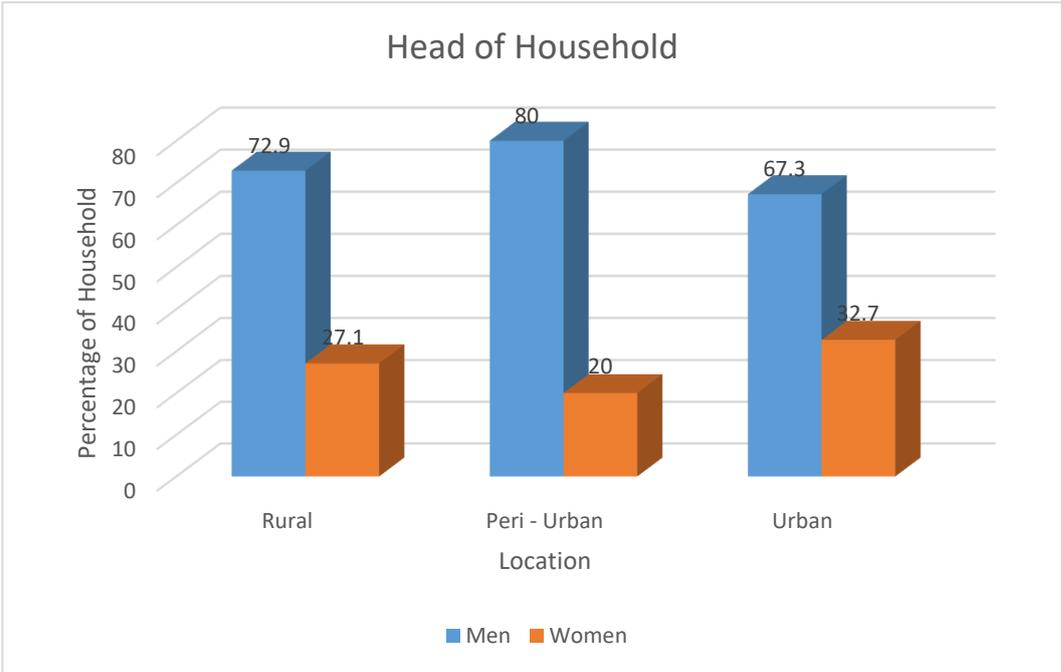


Figure 10: Head of Household

Type of House Inhabited

The type of house inhabited gives an indication of the socio-economic status of the household. Rural is leading in the number of households with temporary households while the urban is leading in the number of households with permanent houses.

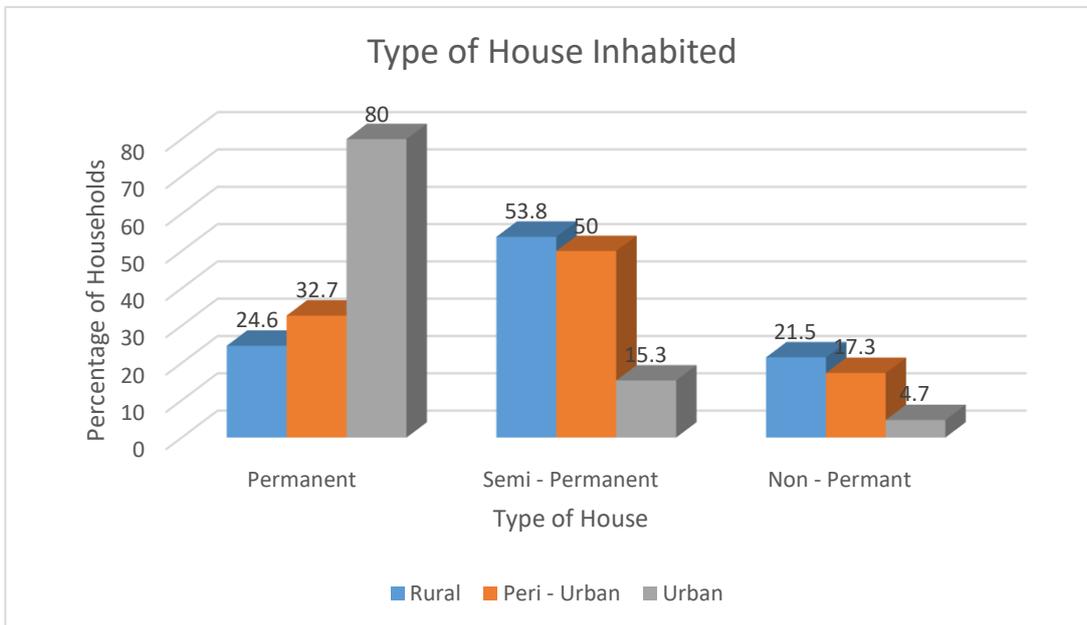


Figure 11: Type of House Inhabited

Mode of cookstove Acquisition

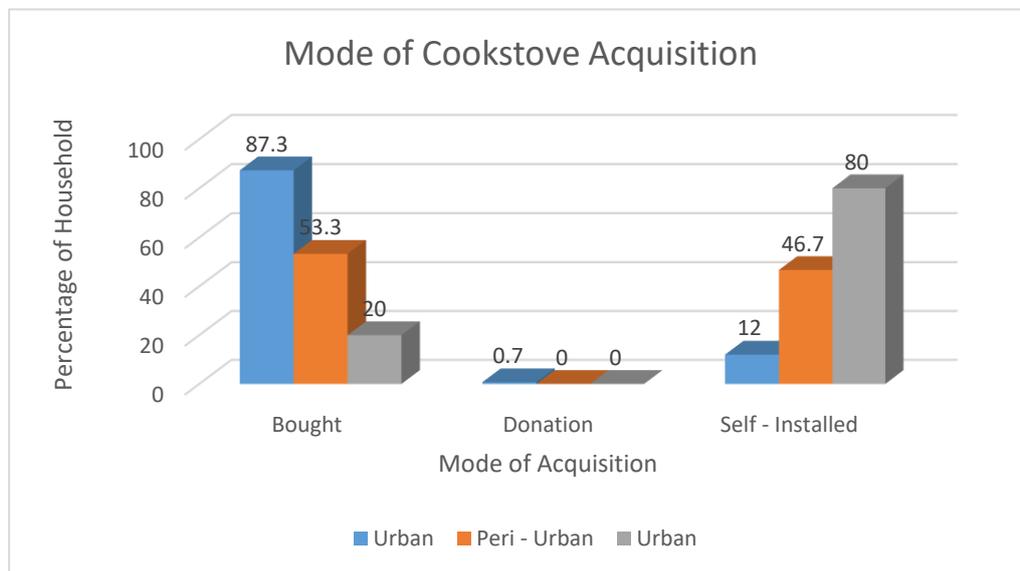


Figure 12: Mode of Cookstove Acquisition

4.4.7 Health

The impact of this is negative health consequences, GHG emissions and environmental degradation and destruction. As demonstrated by the information collected in this study, other attributes including physical location (rural vs urban), size of household, access to fuels, socio-

cultural practices, cost of technologies and fuels, choice of meals, past dependency, size and location of cooking areas which all contribute to various technologies and fuels used. For example, charcoal is constrained at the upstream stage but has very few barriers elsewhere.

In order to scale up on adoption of cookstoves, social and cultural barriers need to be removed. It has been found that 15,700¹⁹ deaths occur annually in Kenya because of exposure to noxious smoke emanating from use of unclean fuel burnt in poor quality stoves. Kenyan households and more specifically households in County of Kilifi have to adopt efficient cookstoves and fuel in order to reduce their exposure to ambient polluted air.

Figure 14 shows the response on impact of Household impact on health from the field work interviews carried out during this study. Although people are aware of the immediate effects of household air pollution resulting from the use of traditional cooking technologies such as irritation in the eyes and coughs, they may not be aware of the long-term effects of the same such as pneumonia, stroke, ischemic heart disease, chronic obstructive pulmonary disease and lung cancer. These long-term effects of household air pollution have a greater social- economic impact on households and should be considered when deciding on which cooking technology to use.

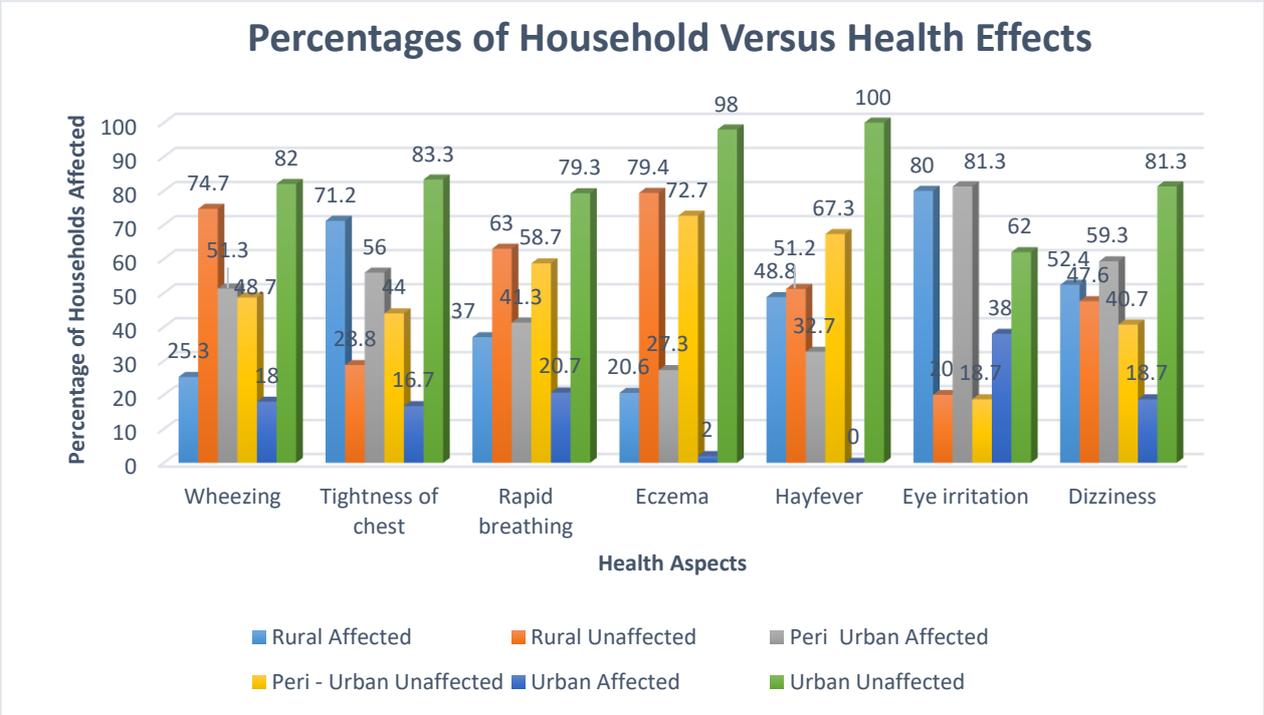


Figure 13: Impact of Household Cooking on Health

⁵ GACC presentation made at “WHO Indoor Air Quality Guidelines Workshop”, February 2014

The county government employs public health and agriculture extension officers as a key strategy in reaching out to communities to adopt health and good agricultural practices respectively. These structures are effective opportunities to promote clean cooking behaviour change. The lack of guidelines for extension and community health officers negatively contributes to awareness creation on the impacts of traditional technologies of cooking. In addition, low capacity of government technical officers to develop these guidelines acts as a barrier.

If the capacity of technical officers can be developed, appropriate guidelines for community training will be developed, and financial resources allocated to awareness creation. These officers will be aware of the array of technologies available for adoption and sensitize communities on the positive impact of switching to clean cooking technologies. The CIDP has outlined strategies of how it intends to transition households to adopt better cooking technologies in a bid to improve the current socio-cultural state.

4.4.8 Ecological and climatic factors

Kenya's GHG emissions are projected to increase from 59 MtCO₂e in 2010 to 102 MtCO₂e in 2030 (Government of Kenya, 2013). It is estimated that a household of four using charcoal or woodfuel contributes 1.2 tonnes of CO₂ per year (GLPGP, 2013). To avert this, mass adoption of Improved Cookstove and Clean Fuel solutions has the largest potential for emission reduction thus enabling Kenya to meet its Intended Nationally Determined Contribution (INDC) goals. For instance, Improved Cookstoves is projected to reduce up to 5.6 MtCO₂e by 2030 while clean fuel projected emissions reductions stand at 1.5 MtCO₂e (Kenya, INDC 2015).

The County Government of Kilifi has aligned its strategies to try and avert unsustainable forest resource use as outlined in the preceding policies. It is expected that as the policies are implemented, the pressure on biomass resources will be managed as the County meets the energy demand of its rising population. With strategies such as the promotion of biogas and improved cookstove, the County will reduce its contribution to Kenya's GHG emission. The County Government will need to align their strategies even more so that it can be able to access the Climate Fund and other financial resources to advance the clean cooking agenda.

4.4.9 Gender factors and Inclusivity factors

The gender dimension is an important aspect of the socio-cultural norms in relation to clean cooking. Nearly all Kenyan communities are characterised by patriarchy systems; men are the dominant decision makers of meaningful economic decisions at the household level (Stockholm Environment Institute, 2008).

While advocating for increased adoption of clean cooking, equal participation of men, women, youth and people with disability is important. They play different roles in decision making and in the transition to clean cooking.

From the key informant interviews it was evident that decision making at household level is made by the head of the household. The study shows 73.4% of them are headed by men while 26.6% are headed by women. For successful implementation of clean cooking, both gender must be involved²⁰.

4.4.10 Lack of A transformative Programme

The National Government has put in place various policies and legal framework to support clean cooking solutions. However, there use of three stone 87.7%, 67.7% and 19.3% of households in rural, peri –urban and urban areas respectively, in Kilifi County Three stone cookstoves²¹. The use of three stone in rural areas of Kilifi County has remained continuously high. This may not be reducing soon given that the County government has not put in place a transformative programme to address this issue. 58.2% of the Kilifi County population use three stone cookstoves. At a projected population of 1,453,786 (source: KNBS Census 2019), the population using three stone is 846,103. This translates into 176,272 households (on average, the size of households in Kilifi is 4.8 persons per household)

²⁰ Kilifi County Clean Cooking Context fieldwork survey, conducted by GROOTs Kenya, September 2019

²¹ Kilifi County Clean Cooking Context fieldwork survey, conducted by GROOTs Kenya, September 2019

5 Stakeholders working on improved clean cooking technologies

5.1 Government

5.1.1 Department of Lands, Housing, Energy, Physical Planning and Urban Development

The mandate of the Energy Department as per the Energy Act 2019 are:

- 1) County Energy Planning; Preparation of county energy plans, Physical planning relating to energy resource
- 2) County Energy Regulation; Regulation and licensing retail supply of energy products, biomass and charcoal production, energy efficiency codes
- 3) County Energy Operational and Development; Electricity and gas reticulation, Collect and maintain energy data.

5.1.2 Department of Economic Planning

The department that provides guidance and advisory services to other departments in preparation of their annual plans/programmes and workplans. It ensures that both the international and national development agendas are captured at the county government level. However, the department does not decide the priority of project implementation as this is a prerogative of the parent department proposing the project/programme.

5.1.3 Department of Environment and Natural Resources

It is mandated to undertake County Environment Policy and Management, Forestry development policy and management, Development of re-forestation and agro-forestry, Restoration of strategic water towers, Protection and conservation of Natural environment, Pollution control, and Climate change affairs. The following performance objectives provides areas of cooperation with GROOTS in promotion of efficient biomass households :

- Protect and manage the environment for sustainable development and posterity
- Promote innovation and appropriate technologies for sustainable utilization of natural resources
- To create enabling environment for good governance in environment and natural resources management
- Enhance climate change resilience and low emission development pathway in all economic sectors for sustainable development and posterity

The department has partnered with Nature Kenya to distribute improved cookstoves to communities leaving around the Arubuko Sokoke forest.

5.1.4 Department of Health

The Ministry has a network of community health volunteers working on WASH issues. Cooking energy has not strongly come to the forefront in the work of the ministry. Sanitation has taken centre stage. Thus, in the context of Kilifi, an opportunity exists for GROOTS Kenya to engage this high influence, low interest actor to see to it that tools used by community health volunteers, public health officers and other programmes being implemented can focus on cooking energy.

5.1.5 Mtwapa Energy Centre- Ministry of Energy

The centre falls under the Ministry of Energy and is situated in Kilifi County. It covers five coastal counties namely Kilifi, Mombasa, Kwale, Taita Taveta and Lamu. Its core mandate is to promote use of renewable energy (biogas, biomass, wind, solar, small hydropower, fireless cookers, cookstoves) and energy efficiency. The Centre promotes two models of woodfuel cookstoves; Kenya Ceramic Jiko (Charcoal) and Maendeleo Cookstove (firewood). Maendeleo comes in two versions – fixed and mobile. The centre has the capacity to produce 300 cookstoves per month. To this end, the Centre's experience will be critical in promoting renewable energy use through capacity building, installation, monitoring and maintenance of renewable energy technologies²².

5.1.6 Department of Agriculture – Livestock: National Government

Its core mandate is to improve the livelihood of Kenyans and ensure food security through creation of an enabling environment and ensuring sustainable natural resource management. The Ministry is implementing National Agricultural and Rural Inclusive Growth Project (NARIGP), World Bank supported project running from 2016 to 2021. The initiative has a component of clean cooking. The programmes support promotion of biogas for household use. The project has so far installed three operational domestic biogas plants in Kilifi County. The Ministry can play a critical role in promotion of biogas plants.

5.1.7 Members of the County Legislature

The county legislature is pivotal in development of county legislation. Thus, their influence is important in ensuring the passing of relevant legislation that affects cooking energy issues. To

²² Key Informant Interview Report 2019

this end, GROOTS Kenya will engage the relevant departmental committee members for energy, finance, health and environments.

5.1.8 Kilifi County Department of Gender

Despite the gender issues related to clean cooking, the department has focused most on other areas of development such as the addressing gender-based violence and youth empowerment. Subsequently, cooking energy issues have not been integrated into the Kilifi County Department of Gender. Thus, this actor can be considered as a high influence low interest actor on the issue. The department has well developed network which GROOTS Kenya can take advantage off to disseminate clean cooking advocacy.

5.1.9 Kenya Forest Service (KFS)

From its mandate and functions, KFS is both a service provider, and an enforcement agency on forest conservation. The agency has engaged Community Forest Associations in an integrated approach to forest management. KFS is not conducting any cooking energy related projects or programmes. This presents a great opportunity for GROOTS Kenya to partner with KFS towards championing for cooking energy related projects at the county level. Overall, in Kilifi County's context, KFS can be considered to have a high influence but low interest stakeholder.

5.1.10 Council of Governors (C.o.G)

The C.o.G has seriously advocated for county issues with the most important being revenue share between both government levels. However, on issues of clean cooking, C.o.G is not actively involved. Thus, GROOTS should endeavour to target the chair of the energy committee and the chair of the caucus of county energy ministers to influence the issue in the long term.

5.1.11 Knowledge Institutions

The mandate of knowledge institutions to conduct clean cooking related research cannot be understated. Universities, and government research agencies play an important role in conducting and disseminating the research results. GROOTS Kenya will engage local universities in the emerging survey processes to build the case for increased access to cooking energy solutions in the county. To this end, such institutions remain high influence low interest actors.

5.2 CSOs and development partners

5.2.1 Energy4Impact

The organisation has over 10 years of operation in all the sub – counties in Kilifi County. Energy4Impact is a non-profit organisation working with local businesses to extend access to energy in Africa, impacting the quality of life for millions of people. Growing sustainable clean energy markets improves livelihoods and accelerates economic growth.

The organisation also offers support to micros, SMEs and project developers in the energy sector. These include business, strategic, technical, financial and operational support to companies to expand and build local markets. They work with entrepreneurs to help them access equity, debt and grant funding. We also work with financial institutions, investors and donors to help them better understand the local energy sector. Our informant said to increase energy access in off-grid areas, they need to look to new ideas. New technologies and innovative business models are constantly emerging in this dynamic sector, but knowing what works best in the long term requires research, field testing – and finance. Some of the projects they have supported in pioneering include:

- a) **Kenya's energy and cash plus pilot project:** This 20 month pilot is testing new approaches for linking cash transfer beneficiaries in two of the most deprived areas (Kilifi and Garissa) in Kenya with off-grid energy solutions. Designed to integrate into the country's social protection programme, the Energy and Cash Plus pilot project supports the government's ambition to achieve universal energy access by 2020 for the most vulnerable segment of the population. Funded and managed by UNICEF, Energy4Impact is working with the Busara Centre for Behaviour Economics and Somali Aid to support the implementation of the programme.
- b) **Scaling-Up Wire (Nishati Na Wanawake):** This programme seeks to build on the success of the multi-year Women in Renewable Energy (WIRE) programme and expand its reach to six additional energy-poor rural counties in Kenya and Tanzania. With improved cookstoves at its heart, the expansion, funded by The Adventure Project, will help more women-led enterprises to further develop the market for clean cooking, while also minimising carbon dioxide emissions and creating more jobs.
- c) **Ideas 2 Impact:** Energy4Impact is part of a consortium that is implementing a five-year programme to support innovation in the development sector. The programme will offer a number of prizes to stimulate innovative problem solving around key challenges in energy access, water and sanitation and climate adaptation. Energy4Impact is the energy access theme lead on the project team. The programme is funded by UK Department for International Development (DFID).
- d) **Transforming Energy Access (TEA):** As a member of a consortium led by Carbon Trust and including TERI and ERC Cape Town, Energy 4 Impact is implementing the 4 year DFID-funded TEA programme with the objective to improve coordination across a series of programmes incubating solutions to energy access, as well as identifying and funding additional activity in collaborative partnerships and skills development.

Energy4Impact's role is to draw the link between innovation in research and academic, businesses and projects in Africa.

e) **Project JUA:** Funded by the Ovo Foundation, this project aims to install solar PV systems in private schools and clinics in some of the least developed counties of Northern and Coastal Kenya, with a pilot project in Turkana and Kilifi.

f) **Advocacy and capacity building of efficient household cookstoves in Kilifi**

Magarini Charcoal Producers Association

5.2.2 The Nature Kenya

The organisation set up its operation in Kilifi in 1993. Its core mandate is conservation of biodiversity and Sustainable livelihood for communities living around the forest e.g encouraging production of honey for processing, Butterfly Keeping, Commercial tree farming. It operates in the sub – counties of Malindi, Ganze, Kilifi North and Magarini. The organisation works with communities surrounding the forest.

The Nature Kenya supports clean cooking by distributing liners to women. So far we have supplied 2,000 liners in Magarini Subcounty.

5.2.3 Islamic Relief Kenya

The organisation started its operation in Kilifi County at the beginning of 2017. Its activities are based in Chonyi and Magarini sub- counties. Its core mandate is humanitarian Assistance which include WASH programme, Food Security, Disaster Risk management, Environmental Conservation, Child Protection and Empowerment of the Vulnerable (table banking, Village savings and loan

Although there are no project in clean cooking, were are involved in installation of Solar PV borehole water pumping systems for drinking and irrigation.

5.2.4 Plan International

It set its base in Kilifi County in 1996 and operates in the following sub – counties Chonyi, Kauma – Jaribuni, Ganze - Bamba and Kilifi North. Its core mandate is support to improve the environment of children and capacity building of the youth

Although it has no activities in energy sector, it has well developed network which can be used to support energy activities. It supported IFC to promote household solar lighting by: Awareness creation, capacity building through training women entrepreneurs and self-help groups on sales, Community mobilisation.

5.3 Entrepreneurs

5.3.1 Local Artisans

Local artisans have limited technical and economic activities since they do not engage in large scale operations. This reduces their ability to conform to standards since investment is required in changing the production process. It is anticipated that local artisans may be adamant to promote regulations in the cooking sector and block any guidelines since such a development has a financial implication on their operations or may be perceived as an attempt to edge them out of the sector. If their awareness on the benefits of clean cooking and business opportunities can be increased, then a chance exists for them to advocate for the issue.

Through the CIDP Kilifi County has identified the capacity building of artisans as an enabler to cross-sectoral achievement of providing clean energy that reduces dependency on forest resources (County Government of Kilifi, 2018, p. 148). Dissemination of national policies such as the biomass standards at the local county level will be done to sensitize local artisans on changes in the sector.

5.4 CBOs

5.4.1 Magarini Charcoal Producers Association (MCPA)

MCPA is a Legal entity registered under the Societies Act and operates in collaboration with Kenya Forest Services and Kilifi County Government: Department of Environment, Forestry, Natural Sources and Solid Waste Management. MCPA is an umbrella of 33 charcoal producer groups within Magarini sub county, with a stock of 297,160,000 stems in Adu and 24, 668,163 tree stems in other farming areas. Before the government banned all tree cutting activities in the forest, the CBO was receiving 10,000 bags of charcoal per week. The CBO buys charcoal at KES.450 per bag and sells it at KES. 750 Given this conservation efforts being done by the association demonstrate its high interest and influence on the issue. The objectives of MCPA are:

- To promote sustainable improved **technologies** in charcoal production .
- To make the charcoal business a vibrant source of income .
- Create employment to the members
- Produce charcoal from trees sourced from plantations established through an out-growers programme
- To protect, conserve and plant the endangered tree species .
- To undertake any social responsibility within the operation area .

- To proactively support the KILIFI COUNTY GOV. and KFS in implementing the charcoal rules and regulations (2009).
- To undertake environmental sensitization and education to members and the general public.
- To enhance networking and collaboration with other stakeholders for the wellbeing of members of the association.

5.4.2 Mida Jatropha

It was established in 2015 with the purpose of growing Jatropha for biodiesel production. Jatropha Seedlings were grown in 2016 and in 2018, the CBO started processing the biodiesel. The season for processing biodiesel is June –July. A half-litre of biodiesel oil cost KES. 110.

During off season, the group engages in processing of other oil plants such as coconut, Mkilifi and briquetting. However, there are many challenges they facing is frequent breakdown of the diesel generator which is almost bringing their activities to knees.

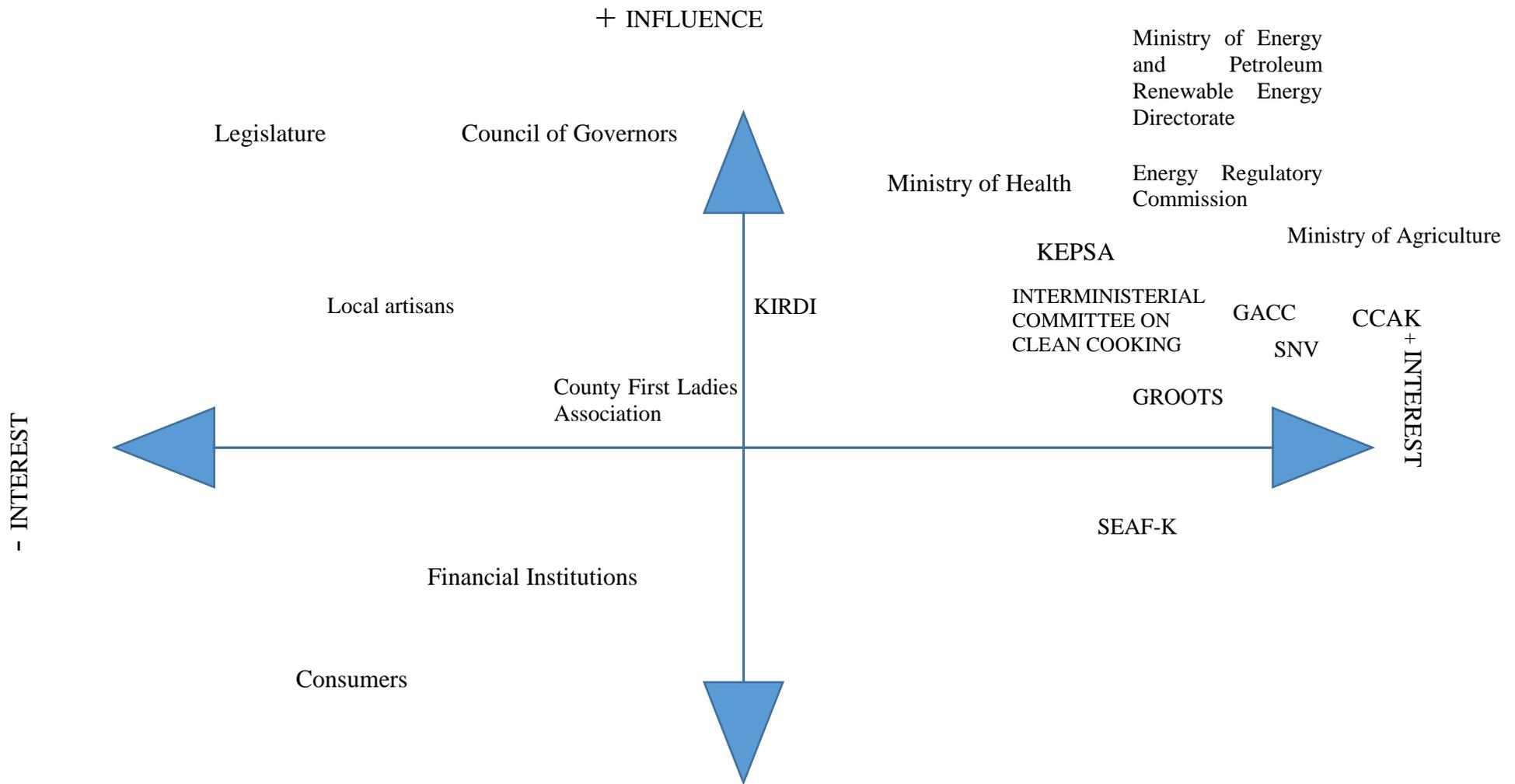


Figure 14: Power Analysis

6 Case studies

Five case studies have been highlighted in the report covering a range of subjects in the cooking sector. These have been used to provide details, insights, examples or emphasis on findings from the fields and from literature review.

6.1 Case Study 1: The Three-stone Cookstove

Figure 16 shows percentages access of households to different types of cookstoves. From the figure, the proportion of household users three stone is low at lower in urban at 19.3 % areas while the number of household users in peri –urban is at 67.7% and rural areas at 87.7%. This use of three stone in rural areas of Kilifi County is quite high and it won't be decreasing soon. From the study, on average 58.1% of the households in Kilifi County use three stone making the dominant cooking technology. It has remained the most common form of cooking technology for decades and continues to defy efforts to displace it as the centre of cooking especially in rural areas. As mentioned above, it seems counterintuitive that it is the most preferred stove among rural households. While acknowledging that the process of stove selection is a complex multidimensional decision-making process, this study proposes reasons why this has remained case.

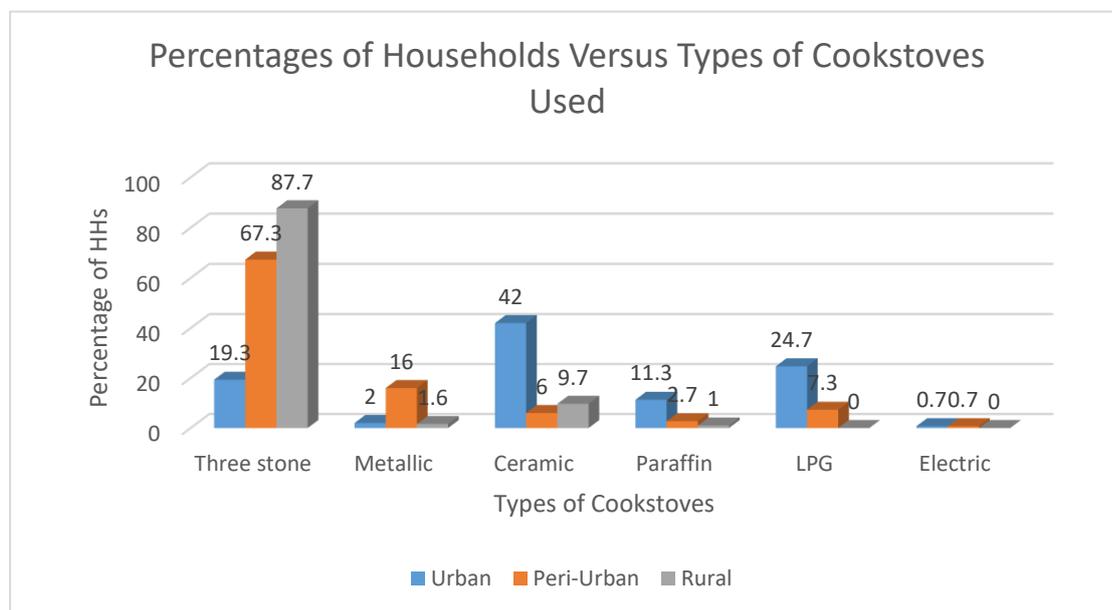


Figure 15: Percentages of Access to Various Cookstoves in Kilifi County

a. Perceptions and attitudes towards the problem

Cooking using the Three stone is considered traditional and promoters of alternatives expect households to see it as such and therefore be inclined to readily adopt other forms of cooking. It is also considered an inferior technology associated with very low efficiency rates. While the

low-efficiency rates have been demonstrated, the idea that it is an inferior technology is a misconception as will be discussed in point number (b) below. Since it is considered inferior, efforts to displace the Three Stone do not ask how the alternatives can mimic the existing setting. Drivers of choice favouring the Three Stone go beyond the technology itself and, like with other technologies, include the type of housing and availability of appropriate fuels within reasonable distances. Like other past research, this study also finds that most of the Three Stone users are rural households with considerably greater access to woodfuel than the urban households and have cooking spaces that can accommodate this type of cooking. Therefore, while many initiatives seek to replace the technology, it is the rural setting that is a greater determinant of this choice. As shown in figure 17. in Kilifi County, 32.9 % and 27.3% of households in rural and peri – urban respectively cook outside their houses.



Figure 16: A woman Cooking Outside her House in Kilifi County

b. Appropriate technology

The Three Stone is a widespread technology that has been refined over thousands of years. Its advantages are often misunderstood or overlooked. In addition to being durable and sturdy, the Three Stone has an all-in one design that can accommodate varying sizes and shapes of cooking appliances from pans to kettles. The ability to adjust according to the size of the cooking utensil distinguishes this option. Besides the stones themselves, there are no moving parts, bearings, rollers or springs reducing the risk of breakages or malfunction. No parts require replacement even after sustainable use. Users can use it for dual or triple purposes including roasting, drying and space heating while cooking. Multiple solid fuel sources are compatible including

firewood, maize cobs, maize stalks, and animal dung among others. In some instances, the smoke produced repels insects.

There is also a wide range of flexibility in adjustment of the firepower. This enable the users to cook any amount of food ranging from 2 people to about 30 people. This studyy indicates family sizes in peri –urban and rural family can be as high as 20. Most of the improved and energy saving cookstoves available in the market are made to save up to a family of 10 persons.

c. Inaccurate assumptions

In promoting alternatives to the Three Stone, the headlines messages are around fuel cost savings. It is estimated that the Three Stone overall thermal efficiency is between 5 and 20%. Although this is an important consideration, it will be most attractive in Kilifi County where there is plenty woodfuel.

6.2 Case study 2: Use of Flexi Biogas System

Flexi Biogas plants have been installed in three households in Kambe Ribe Ward, Rabai sub – county in Kilifi County. They were installed on one day 01st August 2017 at a cost of KES 61,000 each and they are both working. The model is atandard flex biogas plant of capacity 6 M³. The plants were by Biogas International Ltd – Nairobi with funding from SNV Kenya. Figure 18 shows the Flexi Biogas System.

Advantages of the technology

- Easy to install. It takes about 4 hrs to install
- Cheap compared to others
- Used to prepare all types of meals
- Easy to light
- Feedstocks readily available – Two cattle will produce enough feedstocks
- Feed the digester is only done once per day
- Biogas is a renewable clean fuel with no smoke and indoor air pollution
- Saves cutting of trees for firewood thus conserving environment

Disadvantages of the technology

- Technician are not available locally
- During low temperatures production of gas is very low and sometimes it fails to reach the burner
- Spare parts are not locally available

Comments or recommendations from the public and neighbours about the technology

- The standard flexi Biogas system of capacity 6 m³ produces enough fuel to meet 100% of the cooking needs of 8 – 10 persons per household.
- The plant has a lifespan of 10 years when exposed to elements of weather. If it protected direct from UV radiations by covering it with a micro-greenhouse as indicated in figure 11, the lifespan increases by 5 - 7 years.

The farmer has one cattle produces enough feedstocks for this size of a biogas plant. The biogas plant was installed in August 2017 and I switched from using firewood to biogas ever since.



Figure 17(a) Flexi Biogas Showing Digester Envelop. (b) Covered by Micro-Greenhouse Tunnel

6.3 Case Study 3: Sustainable Charcoal Production

Magarini Charcoal Producers Association (MCPA) has demonstrated that charcoal industry can be converted from informal into a thriving formal sector business. Since time immemorial charcoal business has been considered illegal and destructive to environment. However, the demand for charcoal continues to increase with the growth of urban centres across the country. The paradox of it is that even the police officers charged with arrest of charcoal burners/producers use charcoal in their houses or eat roasted meat. The end result is banning charcoal production is not a solution to forest destruction.

MCPA is a legal entity registered under the Societies Act and operates in collaboration with Kenya Forest Services and Kilifi County Government: - *Department of Environment, Forestry, Natural Sources and Solid Waste Management*. Their core mandate is sustainable production of charcoal to improve livelihood. MCPA is an umbrella of 33 charcoal producer groups within

Magarini sub county, with a stock of 297,160,000 stems in Adu and 24, 668,163 tree stems in other farming areas. MCPA has made the following achievements:

1. Sustainable woodfuel development

- Rehabilitation of tree harvested sites in Adu, Marereni, Wathala, Chamari, Changoto and Bungale areas and also tree planting in 30 schools.
- In each of the 33 Charcoal Producers Groups (CPG) has established a tree nursery capable for holding 250,000 seedlings of assorted species per year.
- The association was able to remove 60% illegal charcoal producers within Dakatcha woodland and from all CCAs in collaboration with KFS.

2. Improvement of livelihood

The association ensures that there is ready market for the charcoal producers. They have establishment of charcoal collection points where producers sell the charcoal at KES. 450 per bag. The Association transports the charcoal to urban centres mainly in Mombasa where a bag is sold at KES. 750. The Association pays taxes and has created employment activity. It sells about 40,000 bags of charcoal per month bring KES. 30 million per month into Kilifi County Economy.

3. Efficient Charcoal Production

To improve efficiency in charcoal production, the kilifi County Government has supported the Association with briquetting machine to ensure the charcoal dust is converted into briquettes and used as a fuel.

The Association has plans to introduce market efficient charcoal kiln. This will further improve the efficiency of charcoal production.

6.4 Case study 4: Fixed Dome Shaped Biogas Plant

This plant was installed in 2013 in Malindi sub –county, Shella ward Kisufini village; at a total cost of KES 75,000. The model is fixed dome masonry of capacity 9 m³. Figure 19 show the biogas cookstove used. It was financed by SNV Kenya. The plant is performing exceptional high since it was installation up to date. Its digester has only been emptied once for refreshment.



Figure 18: Biogas Cookstove

Advantages of the technology

- long lasting
- Cheap to maintain
- Used to prepare all types of meals
- Easy to light
- Feedstocks readily available – Two cattle will produce enough feedstocks
- Feed the digester is only done once per day
- Biogas is a renewable clean fuel with no smoke and indoor air pollution

6.5 Case study 5: Capacity Building for Biogas Systems

According to Kenya National Domestic Biogas Programme (KENDBIP), the cost of installing a 10 m³ is about KES.80, 000. This size of the plant produces enough gas to cook for about 20 persons²³. A 13 kg LPG cylinder will last a family of 10 people one month and will have spent KES 2,400 in refilling the cylinder. In three years the family will have spent a total KES. 86,400 in refilling a 13 kg LPG cylinder, enough money to install a 10 m³ biogas plant. A farmer who have some livestock, the cost of feedstock of feedstock (animal waste) and water are almost free. With proper maintenance the biogas plant stay for over 50 years. This makes biogas suitable clean cooking in rural areas.

During the field work data collection, six domestic were visited. Some of these biogas were installed by the Ministry of Energy, Ministry of Agriculture, The Kilifi County Government and SNV –KENDBIP 2009 -2013. One of the domestic biogas plant had never worked since its installation in 2017. The farmer had a zero grazing unit, producing enough feedstocks for

²³ Biogas International Ltd

the biogas plant and had an employee looking after the animals. The farmer had also drilled a borehole producing enough water for the farm requirements.

The farmer narrated to us how he was much he has disappointment. He said that he was unable to get an expert to identify and rectify the problem. However, from our assessment, we advised him get a plumber to test the flow of the gas through the conveyor pipe connecting the heater and the digester gas chamber. Figure 20 shows a zero grazing and a biogas system that has never worked since its installation.



Figure 19: A Zero Grazing Unit and Biogas System not Working

A second farmer we visited had a biogas plant which though working, it had challenges related to feeding through the inlet and free flow of the used feedstock through the outlet. These challenges were related to design of the system.

In a different case, the farmer informed us that of recent, his gas was burning with a pop sound and he was getting scared. We asked the farmer if he had drained water from the conveyor pipe. He told us that he had not and he was not aware of it. We inspected the conveyor pipe, identified the drainage valve and drained of the water from the system. The gas started burning properly without the pop sound (figure 21).



Figure 20: A biogas Plant and the Gas Burning with a Pop Sound

From the observation in the field, most of the biogas plant are working well in Kilifi in Kilifi County. However, the main challenge is lack of skills for maintenance at the grassroots and lack of training for the farmers to handle small problems like draining water from the conveyor pipes, to allow for smooth burning of the gas.

7 Summary, Conclusion and Recommendations

7.1 Summary

1. According to KNBS and SID publications 2013, 2% of households use liquefied petroleum gas (LPG), 8% use paraffin and 88% use woodfuel (firewood -67% and charcoal -21%).
2. Access to unclean cooking is at 64.6% compared to the projected Kenya SE4All Action Agenda at 34.8% by 2020
3. Use wood fuel 83.8% with (firewood - 58.1% and charcoal 25.7%), LPG 10.7%, Paraffin 4.8%, Electricity - 0.5%.
4. Use of Woodfuel rural is 99% (firewood 87.7%, Charcoal 11.3%)
5. Use of LPG in Urban is 24.7%
6. Use of three stone Rural 87.7%, Peri-Urban 67.3% and Urban 19.3%
7. Table 8 shows progressive increase in the use of LPG for households cooking which can be attributed in urbanization and increase in economic status while there is a drop in the use of Kerosene due to increase in price as a result of imposition of government tax. The use of woodfuel dropped from 88% in 2013 to 79.4% in 2015/016 and then increased to 83.9% in 2019. The increase can be attributed to drop in the use kerosene and also urbanization.

Table 8: Comparisons of Findings of Main Cooking Fuels from Other Studies

Studies	LPG	Kerosene	Woodfuel
1. This report Survey findings (%)	10.7	5	83.9
2. KNBS, 2015/2016 KIHBS (%)	7.6	7.9	79.4
3. KNBS 2013, Exploring Kenya's Inequality – Kilifi County	2	8	88

7.2 Conclusion

The study shows a marked increase in the percentage of households using of LPG from 2% in 2013 to 10.7% in 2019. The use of LPG in urban area is 24.7%. Woodfuel remains the dominant cooking fuel in over 80% of the households. The use of three stone stands at 58.1%. The use of three stone in rural areas stands at 87.7%. This implies that the use of woodfuel will remain a dominant household cooking fuel for a long time.

Comparison analysis between the findings in this survey with previous survey studies done by KNBS shows some consistence progression. Therefore the findings in this survey can be used for planning purposes.

7.3 Recommendations

7.3.1 Enabling Environment

Without an enabling environment that permits the inclusion of public and private sector alike in addressing the clean cooking issues, any approach will be grounded in sand and thus prove futile because a framework is non-existent. It must be appreciated that despite lack of County legal energy framework, Kilifi County Government has captured and allocated a budget for executing energy activities in its CIDP 2018 -2022. GROOTs Kenya should consider supporting the finalisation of the zero draft of the Kilifi County Energy Policy.

Kilifi County Forest Conservation Bill had not been gazetted. The gazetment of the Bill will allow for the implementation of the subsequent Kilifi County Woodfuel Regulations whose execution is impossible without the parent act.

7.3.2 Development of a Transformative Programme

One of the objectives of SDG 7 is universal access to modern cooking services by 2030. In 2015, Kenya has developed a document, SE4All Action Agenda to guide the in implementation of the SDFG 7. The document has set various milestones to be achieved progressively within a period of 15 years from 2015 to 2030. According to these milestones, in 2020, the use of inefficient woodfuel cookstoves at households is supposed to reduce to 34.8%. In Kilifi County the use inefficient cookstoves at households as per this study is 64.6%. Firewood is a popular household fuel in rural areas standing at 87.7% and most of the firewood is collected free or bought from either private woodlots of public forest. To address this situation, GROOTs should support Kilifi County government to develop a master transformative programme on clean cooking. All the key stakeholders will be requested to support the implementation of this programme. The purpose of this program would be to fundamentally change the cooking sector beyond the aim of increasing the number of stoves sold, into a clean, sustainable and profitable enterprise.

Market transformation programs aim to address barriers to entry and growth through essential and lasting changes to the characteristics of targeted markets. The common approach to all these targets is to state the number of households using clean cooking technologies or number of clean cooking technologies in the market. The core problem as stated above is the use of traditional technologies and fuels. Since the prevalence of clean technologies is not synonymous with a reduction in use of traditional fuels, the focus should be reducing the prevalent use of traditional fuels. Whereas, focusing on promoting the uptake of millions of improved cooking solutions contributes to addressing this problem, the two are not the same.

Focusing on the solution or technology rewards dissemination efforts, which may not occur in the most critical areas needed and based on the findings of this report, are the rural areas.

Uptake could be skewed towards certain user groups, yet the focus should be on reducing the use of the Three Stone (TS) and other traditional cooking options. A focus on the problem could state, for example, reduce the number of households using TS to n% (or an aggregate number like 2 million) by 2020. This helps to target efforts to those areas where TS is prevalent. Focusing on the solution, as demonstrated by this data could result in very high use rates of modern technologies, especially with the understanding that the households stack fuels and technologies – yet it may not address the core problem. Further, all approaches to promote clean cooking should be designed with the twin purpose of increasing access and use.

7.3.3 Raising Awareness and Formation of Working Groups

Awareness creation has the greatest potential of ensuring that various state and non-state actors become aware of the issue. Once the perception has changed, these actors can start incorporating clean cooking thinking in their various areas of assignment. This approach allows all voices of the stakeholders to be brought on the table for discussion.

In order to shape understanding on the issue, GROOTS will conduct well thought out meetings whose agenda is grounded on sound policy briefs developed from this report. It is envisaged that working groups will be developed to work on thematic areas identified from this report and anchored in the emanating policy briefs. In short, therefore, GROOTs will play a critical role in setting the agenda. The terms of reference of these working groups will also work on crosscutting issues including HAP, GHG abatement and finance.

GROOTS will also engage the County Government to develop and implement community outreach programmes aimed at raising awareness on the benefits of adopting clean cooking technologies. The environmental, financial and health benefits should be well packaged to enable the local community to appreciate them and strive to adopt clean cooking practices. This should be given a priority over implementation of other clean cook stoves. Awareness creation will pave way for implementation of other clean cooking initiatives.

7.3.4 Coordination Sustainable Biomass Solid Energy

GROOTS, should lobby to support the coordination of sustainable biomass solid energy in Kilifi County through convening and coordinating the sector, advocating for enabling government policies, creating public awareness and capacity building.

Introduction or actions to increase the number of goods or service providers, emergence of new and innovative business models, reduction in market barriers, technical and business capacity development and increased awareness of desired product or types of products.

7.3.5 Facilitate Access to Finance and Fiscal Incentives

Fiscal incentives should be designed to promote appropriate design, standardization of products and local manufacturing with the aim of creating meaningful employment opportunities for local technicians and entrepreneurs. This is in line with the Government's Big Four agenda.

7.3.6 Enterprise Financing

The CIDP has provided for the establishment of an energy revolving fund with an aim of partnering with investors on energy investments in the County. This initiative is a critical step towards addressing the financing needs of the sector which for a long time have remained a deterrent for making a business case for mass production of clean cooking technologies. If well thought out, the fund will be useful to spur exponential growth of start-ups or early stage businesses across the cook stove value chain.

GROOTS Kenya will engage the county towards ensuring that this obligation is fulfilled. In order to ensure that the fund succeeds, lessons will be drawn from the following mechanisms;

a) Result Based Financing

Result Based Financing (RBF) is a financing mechanism where payments are made after achievement of pre-agreed and verified results. RBFs are therefore focused on real impact (e.g. number of stoves reaching the end user) and are as a tool to finance social programs that work; financing as a performance incentive. Figure 45 summarises the RBF approach:

b) Grants / Concessional loans

Development agencies have launched various funds targeted at helping entrepreneurs scale up their businesses. initiatives targeted at, or that include, cooking solution in Kenya are:

c) Government financing

The government may, depending on its development agenda, dedicate funding to enterprises to promote uptake of clean and improved cooking solutions. Among initiatives implemented is the Gas Yetu project and KOSAP. *Gas Yetu* is a subsidy program on gas cylinders; among KOSAPs initiatives is an RBF program to promote uptake of improved biomass stoves.

GROOTs Kenya will work with the County to identify various players across the value chain in the county with an aim to understand how a revolving fund mechanism will look like.

7.3.7 Business Models

Evaluating business models involves an analysis of various operational aspects required for the success of a business. These may range from product selection, identifying a customer base, sources of revenue, financing details among others.. This section focuses on payment models/options for acquisition of stoves.

This observation may, however, speak to some of the limitations of access to improved cooking solutions in Kilifi. Studies have identified cook stove prices, which is directly linked to affordability, as a key factor influencing the uptake of improved cooking solutions. The study noted that: “High costs are by far the most important reason households do not switch to LPG”. Affordability is consistently rated as the top demand constraint by the manufacturers and distributors of industrially manufactured, high-quality intermediate ICS (rocket wood and charcoal stoves) in the US\$15–50 range among others. There is therefore, a need for innovative approaches to address this limitation.

7.3.8 Sustainable Production of Charcoal at Upstream

Charcoal is one of the most important fuels yet remains one of the least understood. The fuel balances livelihood sustenance of many communities in rural areas on the one hand (especially in ASAL regions with limited options), and provision of an easily accessible cooking solution for urban households (although now more rural households are using charcoal) on the other. Although the body of knowledge on charcoal has expanded, attitudes towards charcoal are still informed by prevailing historical narratives and current perceptions, which associate the fuel with environmental degradation. As charcoal moves down the value chain from upstream supply to downstream use, a distinct mismatch in attitude towards this fuel is observed. While charcoal production is constantly restricted and little to no support offered to improve the production regimes, there are no reservations with the sale of charcoal and significant support is provided to improve the use of charcoal. Support for production of charcoal stoves, improving distribution and uptake through various initiatives including RBF, is provided by sector players.

The same paradox has been observed at the policy level historically where laws, policy, and declarations have been issued banning charcoal production, but the same restrictions are not applied downstream. Up until the 2009 Charcoal Regulations anchored under the Forest Act 2005, there was no overarching legislation guiding the sector.

Given the importance of charcoal industry, GROOTs Kenya to work closely with the County Government to come up with friendly policies and programmes that will address the challenges charcoal sector is expressing upstream. This will enable formalisation of charcoal stakeholders

at upstream level and bring about sustainable charcoal production. It will be useless to promote efficient woodfuel cookstoves without looking at the fuel production.

7.3.9 Formulation and Implementation of Technology Transfer Programmes

General in Kilifi County, does not have well-trained Artisans in the cook stoves industry. This will enable the Kilifi County to achieve universal access on SE4forAll targets. Capacity building should be done across the board which must include women. They will play a critical role in promoting the adoption of the clean cooking stoves. They are the interface between policy and communities, and constitute the critical mass with resources to grow access. An increased demand for the stoves (achieved through intense community campaign), and improved access to micro financing for the households, would greatly motivate the businesses to invest in producing and stocking the stoves. Additional incentives could be extended to the businesses by the county governments – specifics of which can subsequently be discussed and factored in the county operational framework for Clean Energy.

As part of a broader plan to increase the uptake of clean cooking stoves, there is need to ensure that production is standardised and affordable. In this regard, it would be critical that a number of youth and women groups be identified and trained in the production and repair of the improved cook stoves. By doing so, the county government and partners will equally be contributing to increased employment opportunities amongst the youth, and ensure that the supply of the clean cooking stoves is sustained.

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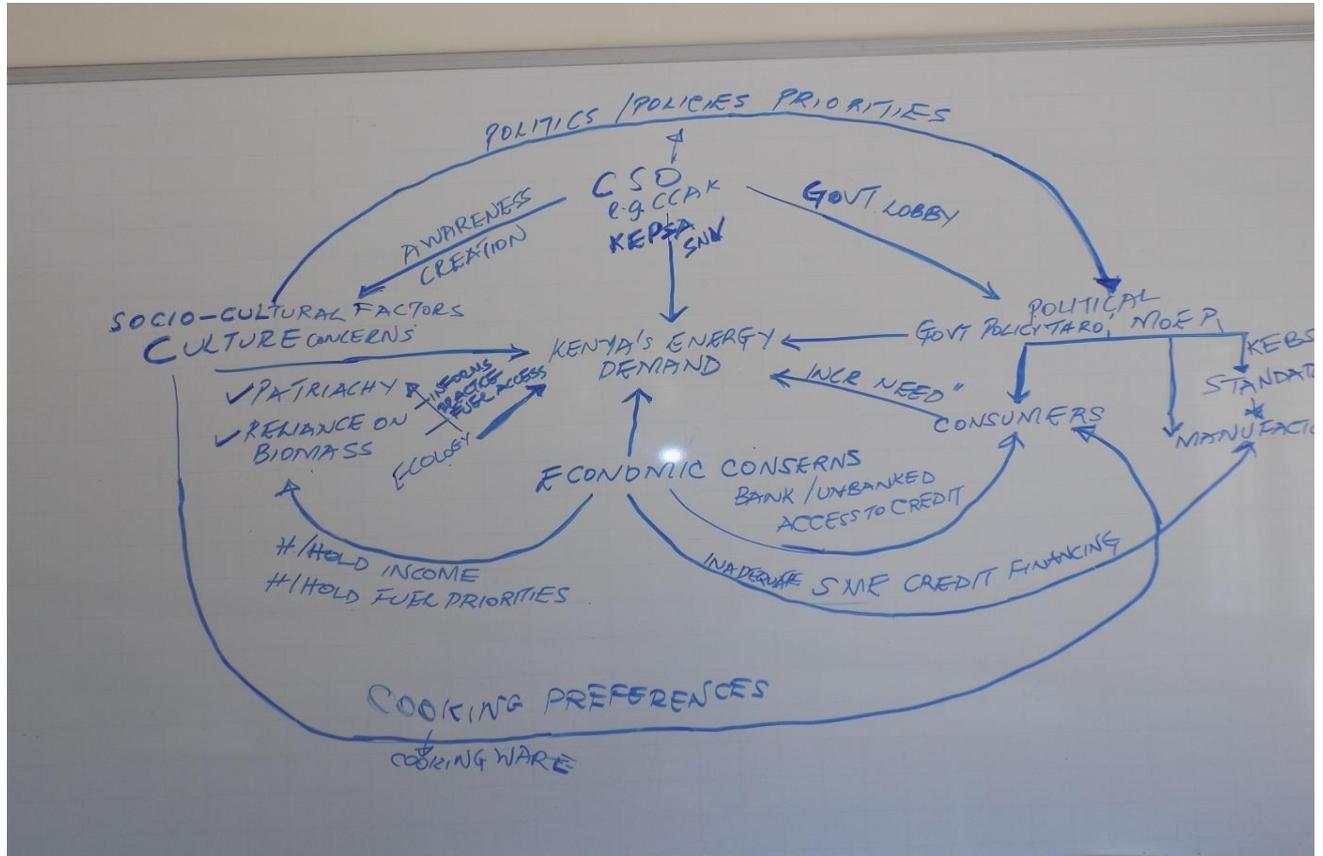
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9 Annexes

9.1 Annex 1. Rich picture showing factors and actors that influence the issue of interest (to be revised)



9.2 Annex 2: Sample Size Distribution

Table 9: Sample Size Distribution in the Urban, Peri – Urban and Rural Areas

Sub -County	Ward	Villages	Sample Size No. of HHs		
			urban	Peri-urban	Rural
Kilifi North	Sokoni	Kasarani	10	-	-
		Kibaoni	10	-	-
		Koroshoni Li	10	-	-
		Kwashakoo	10	-	-
		Mtaani	10	-	-
	Mnarani	Mafumbini	10	-	-
		Ferry	10	-	-
		Mtaani	10	-	-
		School	10	-	-
		Plantation	10	-	-
	Watamu	Jiwe Jeupe Zinalala	10	-	-
		Pole Pole	10	-	-
		Paradise A	10	-	-
		Gede Centre B	10	-	-
		Timboni	10	-	-
	Sub -total	46,568	150	-	-
Kaloleni	Kaloleni	Ngome A	-	10	-
		Ngome B	-	10	-
		Kizurini	-	10	-
		Walea	-	10	-
		Mwandaza A	-	10	-
	Mariakani	Jakaba	-	10	-
		Njoro	-	10	-
		Mwareni	-	10	-
		Makaburini	-	10	-
		Misufini	-	10	-
	Kayafungo	Ngotani	-	10	-
		Gotani B	-	10	-
		Kirubi	-	10	-
		Tsangatsini 1	-	10	-
		Kiboakiche	-	10	-
	Sub -total	40764	-	150	-
Ganze	Bamba	Mitsemerini A	-	-	10
		Mitsemerini B	-	-	10
		Mazunde	-	-	10
		Godoma	-	-	10
		Bamba	-	-	10
	Ganze	Jila	-	-	10

Sub -County	Ward	Villages	Sample Size No. of HHs		
			urban	Peri-urban	Rural
		Kagombani West	-	-	10
		Migodomani A	-	-	10
		Karira A/B	-	-	10
		Madeteni	-	-	10
	Sokoke	Kafitsoni A	-	-	10
		Mkwaju Wa Charo	-	-	10
		Sosoni	-	-	10
		Medoina	-	-	10
		Madamani	-	-	10
	Jaribuni	Miyani	-	-	10
		Makalangenani	-	-	10
		Mwapula	-	-	10
		Jaribuni	-	-	10
		Majengo	-	-	10
	Sub -total	30,109	-	-	200
	Total	115,058	235	153	200

Source: KNBS Kilifi County Number of Households Projection 2018