ELCI –ACTS Greening the Fishery Economy Project

A pilot study report on sustainable utilization of biomass Energy among the Fisher folk of L. Victoria beaches, Kenya

African Centre for Technology Studies

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A pilot study report on sustainable utilization of biomass Energy among the Fisher folk along L. Victoria (Kenya) Beaches

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Acknowledgement

Indeed, this field study would not have come to a conclusion without the intimate involvement of all players within the fishery fraternity as well as energy actors. We wish to appreciate the cooperation received from all Beach management Units, especially their leadership who willingly provided us with necessary information that was significant during the survey period. We extend our gratitude to the fish mongers and fishermen for their instrumental contribution across the study time. We also recognize the invaluable input received from Kenya Marine and Fisheries Research Institute (KEMFRI) staff, Kisumu regional office. Considerable measures and logistical arrangements for the field occurred timely hence we appreciate ACTS and ELCI staff in Nairobi and field officers for the critical roles they played prior and after the study. Finally we thank ACT for funding this pilot project that specifically targets sustainable utilization of energy among the fisher folk.

Executive Summary

Lake Victoria has over decades been identified as a major fresh water lake and main source of fish for East African countries. Over 30 million livelihoods across the entire lake stretch (in Kenya, Uganda and Tanzania) depend on the lake's existence for their survival. In Kenya, over five communities leaving around the lake depend on fishing as their main activity. Secondary activities related to fishing have supported many families including processing, supply of wood, boat construction, trading, transportation among others. Fishing sector has been adversely affected by climate change. Nevertheless, anthropogenic activities due to unsustainable practices along the lake have too contributed to this phenomenon through emissions and deforestation.

High poverty index in the region, has contributed to majority of fish processors using inefficient processing techniques that compromise sustainability of fuel base. That is, artisanal fishers mostly cannot afford deep freezers to preserve their fish and are thus forced to sell their catch at low prices to intermediaries. For the ones who prefer to struggle to avoid selling at throw away prices, research indicates that the main methods for preservation of the bigger fishes (Nile perch and tilapia) is by smoking, especially by the male gender.

This pilot project was aimed at influencing the fisher fork in the counties of Kisumu, Homabay, Siaya and Busia on adoption of improved cookstove technologies (use of rocket stoves and *chocco* kilns) mainly for frying and smoking respectively. The study was informed by a preliminary survey conducted five months prior to kick off. Both frying and smoking highly depend on firewood which has led to destruction of the natural vegetation around the lake region .Through greening the fisheries economy project African Centre for Technology Studies (ACTS) and Environment Liaison Centre International (ELCI) seek to address root causes to climate variability and change through approaches that encourage mitigation and adaptation.

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1. Introduction

1.1 Background

Approximately 90% of fish caught in Kenya is from L. Victoria while marine fishing accounts for only 4% of the total output (EPZK, 2005). In a study conducted by the fisheries department in Kenya, it is estimated that a total of 798,000 people are directly or indirectly supported by the fishing industry as compared to 720,000 in 1995 whereby there were 34,000 fishermen, 238,000 dependents and 526,000 people engaged in the provision of support and ancillary services such as trade in fishing inputs, fish handling, processing and marketing (KMFRI, 2004). Recent statistics show that there are about 42,000 fishermen in Kenya and approximately 90% of them are in Lake Victoria basin but this number has increased by over 28% since 1995(Fisheries Dept 2000).

One of the problems that have jeopardized fishers is the lack of access to finances. It was thought that fisheries cooperatives, created in the 1970's, might contribute to alleviate this problem by providing loans based on savings made by member's contributions. However, most of the cooperatives collapsed soon after being set up due to mismanagement (King, 2000). Financing among major fishery stakeholders (fishers, processors and traders) is prudent as an enabler to acquiring technologically efficient gadgets among them storage facilities, processing kits like improved cookstoves, advanced fishing gears etc. Looking at the energy needs of fisher fork along the lake region, investment in energy efficient systems proves very important. There is a realization on the need to search for decentralized and renewable energy-based options to meet the rural energy needs in a sustainable way (Anseri et al,(2012)).

1.2 Rationale and objectives

We recognize that much attention has been diverted towards regulating the size of fishing nets in order to regulate the size of fish caught during the fishing exercise. However, many actors have not taken into consideration the aspect of energy used in carrying out the chain of activities. In this regard, African Centre for Tecnology Studies (ACTS) IN PARTNERSHIP WITH Environment Liaison Centre International(ELCI) have narrowed down to enhance capacity among actors in the fishing industry in terms of minimizing energy spent during post-harvest handling with specific intervention in frying and smoking activities. The amount of fuel used by fish mongers during processing/value addition around the lake threatens existence of natural resources (Jambiya and Sosovele 2002).

Smoking and frying dominate other preservation methods(). Overutilization of biomass towards energy provision is alarming (Kauzeni et. al., 1998). It was noted that majority of the fish mongers use traditional three stone jikos to burn biomass for which is used in preservation process. This is associated with a myriad of health adversities (Commoner et al., 1991). This includes respiratory related ailments, eye cataracts among other diseases since most fish harvested from the lake is preserved by smoking and frying with considerable amounts taken to factory for filleting. During the time of intervention, order by filleting factories had reduced substantially a situation that forced many fishermen to sell fish at throw-away price translating to increased stock for local sales. It is important to note that most of the fish purchased by factories comprise of the Nile perch species whereas majority of other species are locally purchased. The field visits were conducted in two folds, ie technology survey phase and installation phase.

1.3 Objectives

The main objective for this pilot study was to promote adoption of efficient cookstoves and kilns among Lake Victoria fisher fork by installing demonstration burners for later up scaling.

Specific Objectives

1.2.1 To establish existing stove designs used by fish mongers in preservation and processing of fish along Lake Victoria beaches

1.2.2 To explore ways of designing a prototype biomass stove that has improved efficiency in comparison to existing models

1.2.3 To install ten fixed rocket stoves for use among fisher groups across on selected beaches.

2. Materials and Methods

2.1 Area of Study

Being a pilot study, seven beaches were visited within four counties namely Kisumu, Homabay, Busia and Siaya. Specific beaches on to which survey on existing technologies were carried are Paga, Usenge, Usoma, Nambo, Dunga, Tilapia and K'Oginga . Installation of demonstrative burners was carried out at K'Oginga Beach and Usenge Beach both in Homabay and Siaya counties respectively.

2.2 Methodology

Information regarding existing stove designs was mainly incepted through open discussions with fish mongers and visiting various sites highlighted above. Data on efficiency and stove characteristics was primarily recorded during practical investigations of the water-boiling tests.

2.3 Findings

During the survey along the seven beaches, Dunga, Usenge, Nambo and Tilapia depicted busy fish frying activities; Honge was mainly sun drying of Dagaa where as Paga and Usoma beaches showed minimum activity. However, all the beaches offered the visiting officers cordial welcome and looked forward towards possible interventions at the sites.

2.4 Conceptual Designs

a) Dunga beach had both traditional and rocket stoves (2) both double skirted. The designs are as below;

Photo 1: Rocket stove at Dunga Beach

No smoking kiln was available.

b) Tilapia Beach had several improved stoves accounting to fifteen and were being used for a variety of functions including fish frying. The stove designs at this particular beach are as below;

Photo 2:Rocket Stove at Tilapia Beach

Photo 3: Another Version at Tilapia Beach

No smoking activities were available during the time of survey.

c) Nambo beach did not have improved stoves though a big number of mongers were using the traditional three stone stoves. Other than the rest of the beaches, Nambo has several smoking kilns although all are traditional (lunyu style). This together with Usenge beach were reported to be handling the largest number of fish due to the large clusters in the lake shores within their extend. The designs are as shown below;

Photo 2: Traditional 3 stone stove at Nambo beach

Photo 3:Smoking Kiln at Nambo Beach

d) Usenge beach was mainly characterized with traditional three stone jikos used to fry large amounts of catches as indicated above with minor spots of dagaa frying and drying. This, too had several traditional kilns (lunyu kilns) for smoking purposes.

Photo 6: Traditional stone at Usenge

Photo 7:Rocket stove at a household in Usenge

- The rest of the beaches had minimum frying activities as fish is ether sold to factory agents immediately at the beach management unit or mongers carry to their premises/homes for frying while others sale fresh.

Installation

In October 2013, ACTS in collaboration with ELCI installed ten rocket stoves at Usenge and K' Oginga beaches in Siaya and Homabay Counties respectively as a pilot demonstration on the use of improved stoves that bear high fuel efficiencies. This was as intervention towards helping communities in the mentioned counties adapt to the climate change and minimize fuel consumption.

2.5 Site selection & Fabrication

The selection of the two sites (Usenge and Homabay) was decided upon after analysis of several factors including but not limited to daily average catch statistics, existence of any improved technologies, number of mongers using traditional three stone stoves, viability and reception of the new technology as well as priorities of the beach management units and fishing groups involved. Thus, the results of a baseline survey carried out prior to the technology survey played a very significant role on informatory basis. After a successful survey of the existing stove designs, a local fabricator was conducted and provided with necessary modifications that guided installation of five improved rocket stoves at Homabay; K' Oginga beach_ Shauri Yako Fishmongers group and Usenge beach (as highlighted before). The installation activity was carried out during mid-October 2013 and later succeeded by efficiency tests.

2.6 Capacity development

In the course of the installation exercise six members of the Beach management Unit and Mongers from the group among them a qualified mason were trained on the fabrication of the stoves at Homabay. At Usenge Beach a total of three community members and two masons were trained on fabrication process. This was necessary for the purpose of enhancing project sustainability and replication upon which sourcing local human resource for the same task within the proximity will attract minimal cost.

2.7 Efficiency Test Results

The procedure adopted for this efficiency test followed the water boiling test protocol developed by the Shell Foundation, Household Energy and Health programme. The tests were carried out under less ideal conditions. By this a few deviations may have been encountered. Wind conditions were a bit varied due to the site under which the pilot was carried out. The main purpose for carrying out the tests was to determine stove's thermal efficiency and wood usage at each phase in comparison to the local stove used for fish frying.

Table 1: Results for High Power Test Characteristics for Rocket Stove

Rocket l Stove			
Test Characteristic	**UNITS**	**High Power (Cold Start)**	**High Power (Hot Start)**
Time to boil Pot # 1	Min	38	30
Temp-corrected time to boil Pot # 1	Min	42	33
Burning rate	g/min	37	44
Thermal efficiency	%	15	17
Specific fuel consumption	g/liter	216	213
Temp-correct Fuel Consumption	g/liter	238	235
Temp-correct specific Energy consumption.	kJ/liter	4646.578	4588.638
Firepower	watts	11874	14261

Table 2 : Results for Low- power phase Characteristics-Rocket Stove

Rocket Stove – Low Power		
Test Characteristic	**UNITS**	**Low Power (Simmer test)**
Time of simmer	Min	45
Burning rate	g/min	7
Thermal efficiency	%	73
Specific fuel consumption	g/liter	72
Specific Energy consumption.	kJ/liter	1,401
Firepower	Watts	2,140
Turn down ratio	-	6.11
5LWBT Fuel Benchmark (Complete)	g	1,578
5LT WBT Energy Benchmark (Complt)	kJ	30,764

Table 3: Results for High- power phase Characteristics-Local Stove

Local Stove			
Test Characteristic	**UNITS**	**High Power (Cold Start)**	**High Power (Hot Start)**
Time to boil Pot # 1	Min	36	35
Temp-corrected time to boil Pot # 1	Min	40	40
Burning rate	g/min	68	66
Thermal efficiency	%	8	10
Specific fuel consumption	g/liter	387	373
Temp-correct Fuel Consumption	g/liter	436	427
Temp-correct specific Energy consumption.	kJ/liter	8503.717	8325.95
Firepower	watts	22,056	21,410

Table 4: Results for Low- power phase Characteristics-Local Stove

Local Stove – Low Power		
Test Characteristic	**UNITS**	**Low Power (Simmer test)**
Time of simmer	Min	36
Burning rate	g/min	68
Thermal efficiency	%	8
Specific fuel consumption	g/liter	387
Specific Energy consumption.	kJ/liter	8503.717
Firepower	Watts	5,283
Turn down ratio	-	4.11
5LWBT Fuel Benchmark (Complete)	g	3,045
5LT WBT Energy Benchmark (Complete)	kJ	59,365

2.8 Graphical Analysis of the test process

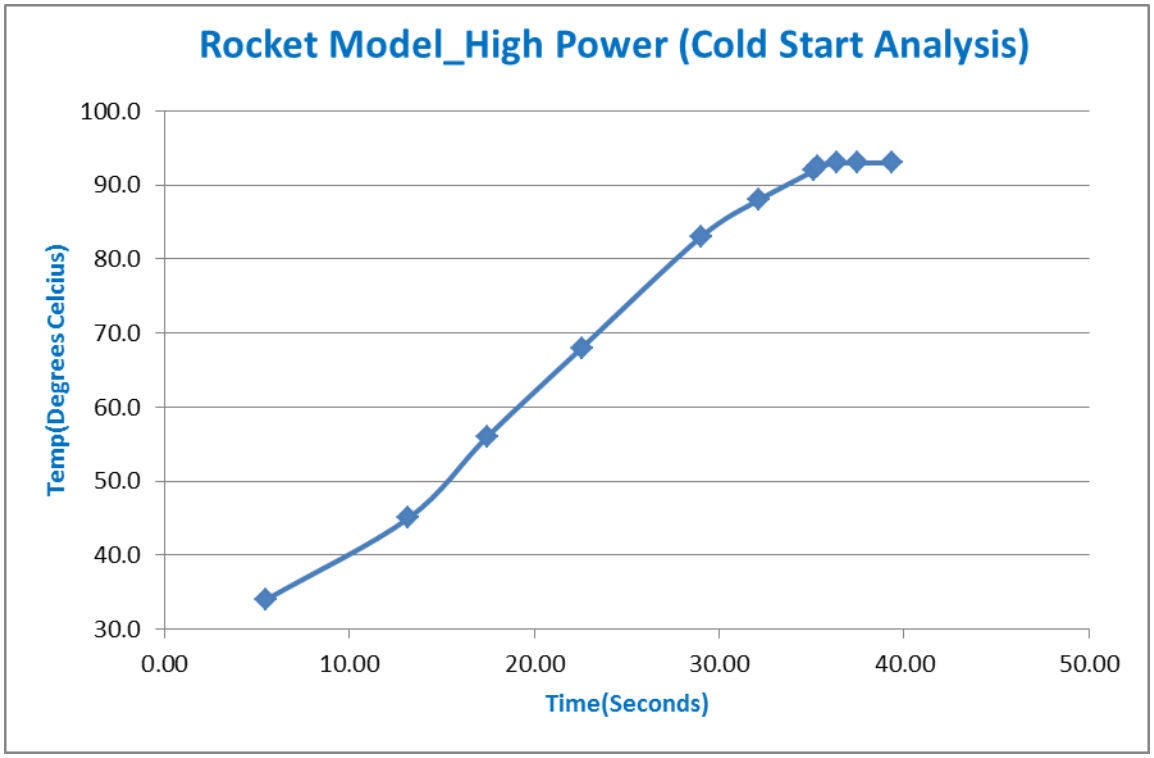

Figure 1: High Power (Cold Start) Temperature variation with Time Rocket Stove

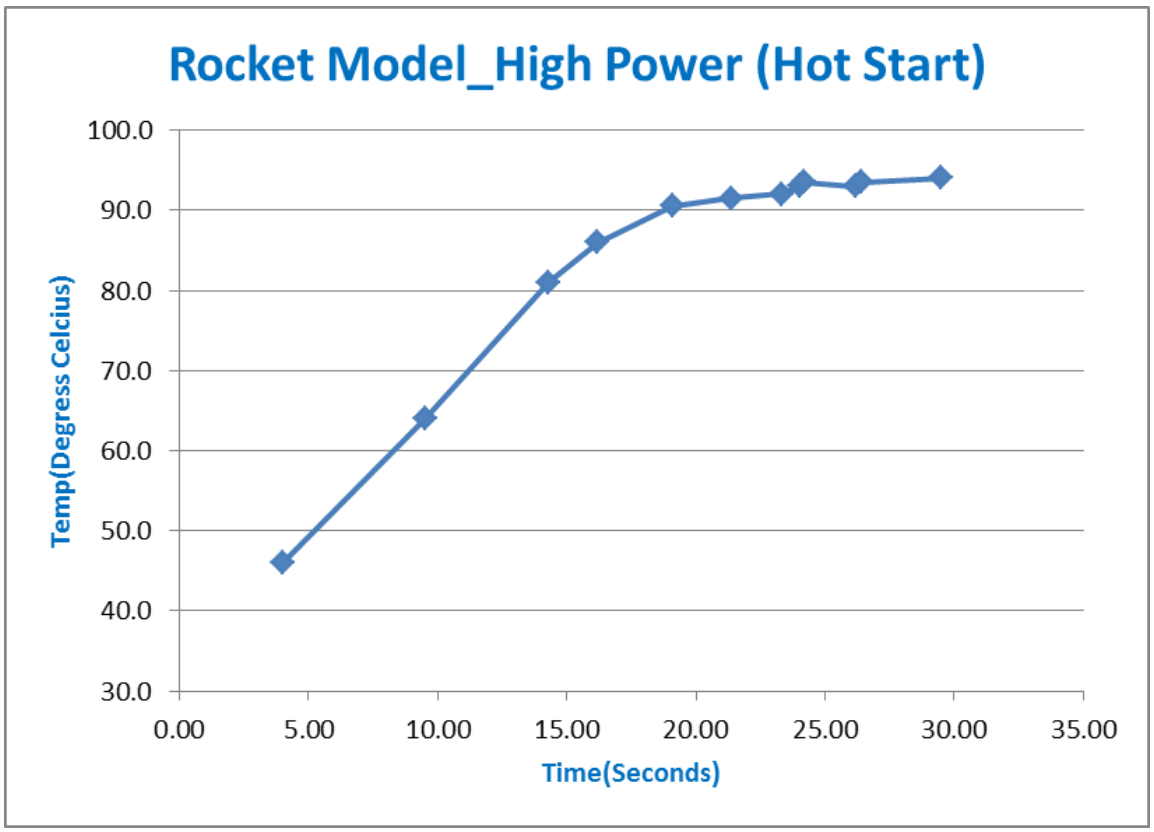

Figure 2: High Power (Hot Start) Temperature variation with Time Rocket Stove

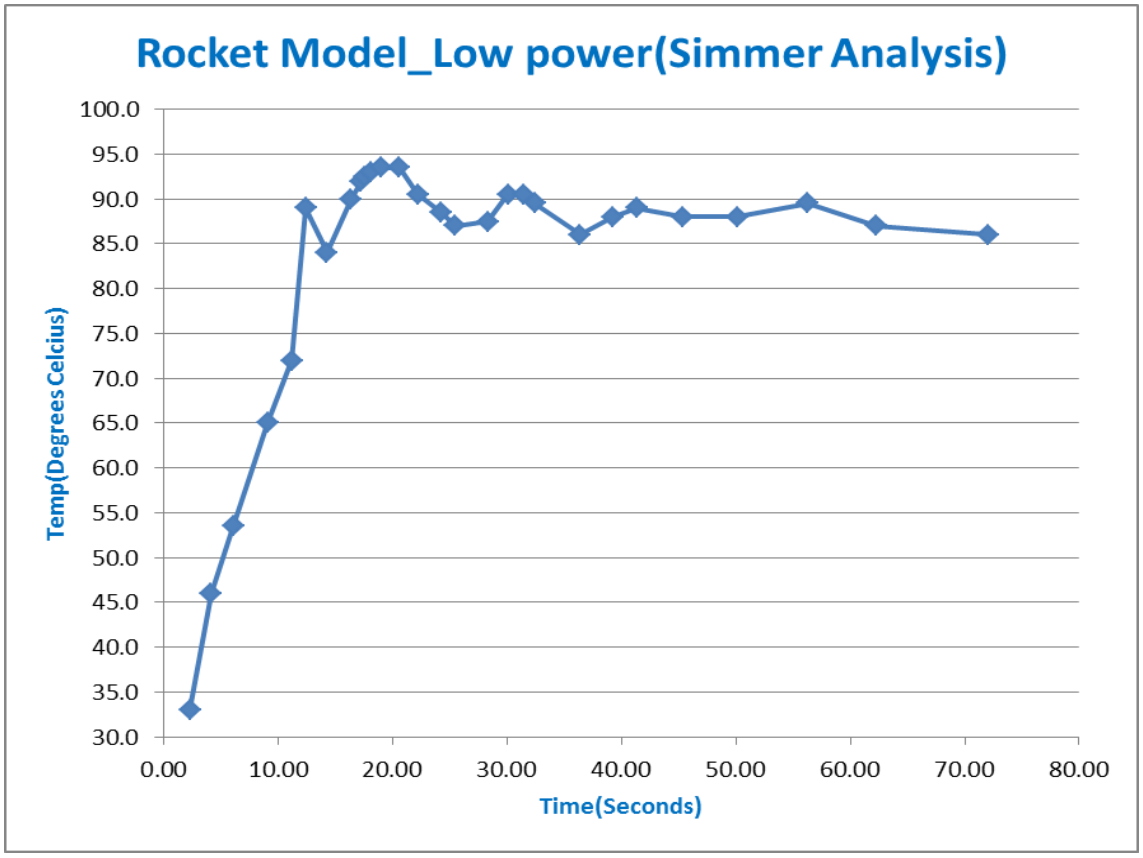

Figure 3: Low Power (Simmer phase) Temperature variation with Time Rocket Stove

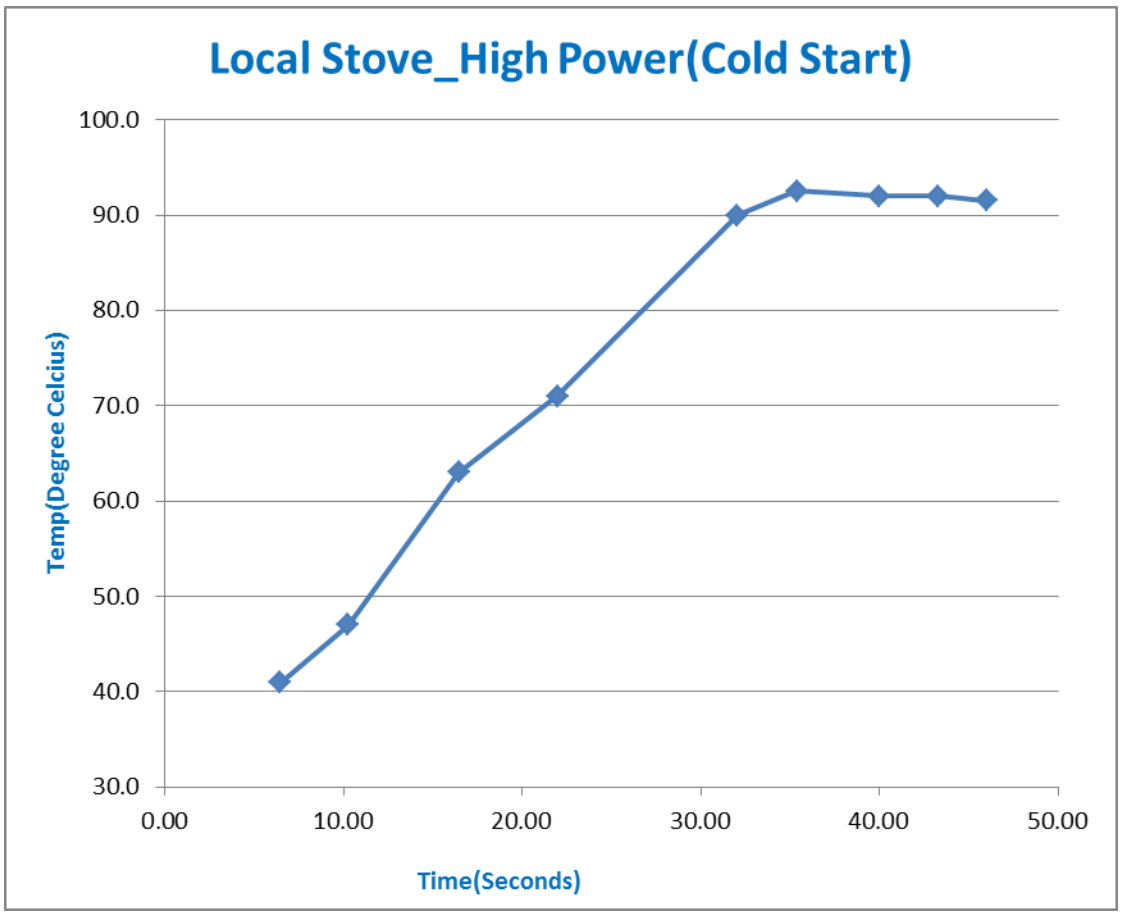

Figure 4:: High Power (Cold Start) Temperature variation with Time Local Stove

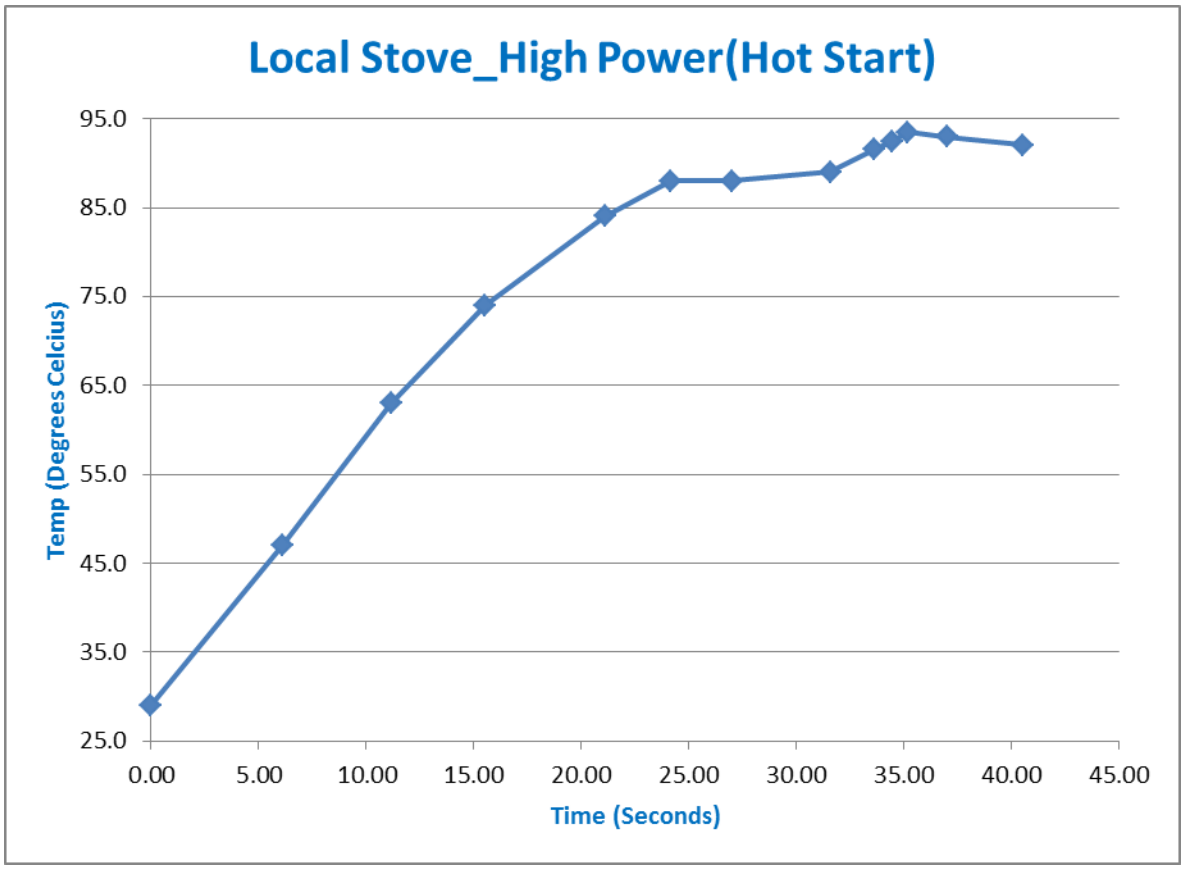

Figure 5: High Power (Hot Start) Temperature variation with Time Local Stove

3. Summary of the results

The rocket stove demonstrated higher thermal efficiency at all phases compared to the local stove. Nevertheless, these figures are expected to be higher than the recorded data since the stove was exposed to direct rain and sunshine considering that this was a rainy season. Thus, it had to take some time warming up before effective heat could be transmitted to the boiling container unlike the local stove which was shielded by a shed. In terms of fuel consumption, the rocket stove consumed half the fuel used to boil the same quantity of water using local stove, demonstrating fuel efficiency of 50% in comparison to the local model. As first mentioned, this figure could be higher if tests were carried out at standard/controlled conditions. This sounds economical especially to the fisher fork as fuel costs will drop by fifty percent once the groups adopt the stove. It was also noted that once the stove heats up (hot start) it takes a shorter time to boil water for both stoves since thermal efficiency increases as combustion improves and the stove does not take as much heat as it does when it is cold.

4. Conclusion

The pilot installation of improved cookstoves along Lake Victoria beaches has the potential to improve living standards of the residents and actors in the value chain through both economic and social means. During the undertaking of this activity, it was noted that there is very little diffusion of clean energy technologies among fishery fraternity in the project area. Involvement of public benefit organizations in activities aimed at promoting use of energy efficient devices is still very low among our communities especially in the vulnerable areas such as those within the lake region and its environs.

Lack of awareness and inefficient mechanisms for community sensitization as pertains clean and efficient cookstoves are attributable to the drastic depletion of natural resources along major lakes and rivers in Kenya. Nevertheless, interactions with a few Beach management units and fisher associations during the field exercise informed of their enthusiasm to engage in such conservation practices towards cutting down fuel used during fish processing and preservation. Finally, we do point out that consolidative effort towards promoting innovative green technologies be emphasized with on-point inclusion of proficient energy approaches as we gear towards climate smart practices.

5. Recommendations.

1. Appropriate delivery models should be designed to facilitate dissemination of available technologies on fuel-efficient cookstoves.
2. County legislators should enact and enforce laws that discourage inappropriate harvesting of wood fuel including enforcement of a forestation and reforestation regulations
3. Fish mongers should be sensitized on the need to belong to cooperatives to enable them access financing towards acquisition of improved cookstoves for which repayment can be made in installments
4. Beach management Units should be empowered to come up with by-laws that promote efficient utilization of biomass among fisher fork.
5. County governments in counties that experience busy landing activities should develop policies that favor investors to build factories at major sites to encourage reliable fishing with an ultimate effect of cutting down the cost of transportation
6. Economic instruments should be applied to residents who utilize sustainable wood harvesting and utility to encourage adoption of conservative practices
7. Fitting environmental education with emphasis on health impacts caused by Indoor air pollution(AIP) within primary and secondary curricular should be considered pragmatic
8. Top management of existing fisher cooperatives need routine training programmes to sharpen their management skills in terms of human resource and financial basis.

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