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Sustainable Land Use Management in Kilimanjaro Region Opportunity for up Scaling Success and Learning from Experience

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Performance of Efficient Fuel Saving Stoves and Potential for Livelihood Improvement

LIST OF ACRONYMS

CCT	Controlled Cooking Test
KPT	Kitchen Performance test
LPG	Liquefied Petroleum Gas
NGO	Non Government Organization
WBT	Water Boiling Test
SLM	Sustainable land Use Management
TDR	Turn down Ratio
TaTEDO	Tanzania Traditional Energy Development Organization
tCO_2e	Tones of Carbon dioxide Emission

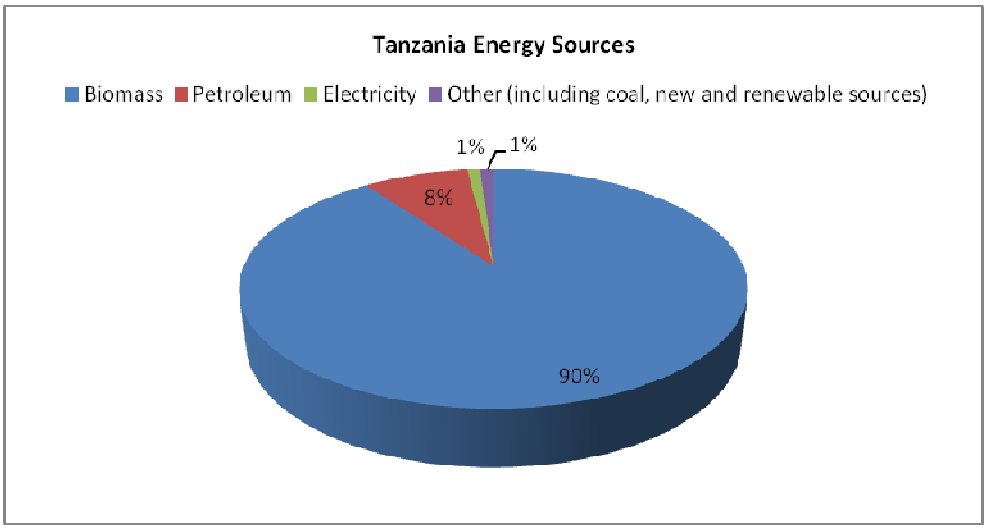
Abstract
Solid bio fuels are the main source of energy for the majority Tanzanians. The energy consumption pertain is dominated by woodfuel accounting 90% of the population, most of which is consumed by households, Firewood is mostly used in rural areas and charcoal in urban areas for cooking purposes. 8% of the Tanzanians use petroleum product Like Kerosene and LPG, 1% Use Electricity and 1% use other source of energy like Solar Cooker etc

Traditional burning of solid biofuels in open fire place like three stone stoves is common for provision of heat for cooking, warming water, boiling and cooking of food for household use. The use of open fireplace (three stone stoves) result into excessive entrance of air and hence uncontrolled burning process which result into inefficient use of solid bio fuels due to loss of heat. Since late 1980s, there have been efforts to promote Improved Cook Stoves in rural and urban areas of Tanzania by the government in collaboration with other actors like NGOs, and Donors.

Threat of deforestation, land degradation effects to the forest ecosystem has compelled efforts in the past decades to promote efficient use of biomass as well as introducing alternative source of energy. More sophisticated technologies are needed for efficient utilization of such energy for cooking, brewing, boiling and heating.

1.0 INTRODUCTION

More than 90% of energy consumed in Tanzania is derived from solid biofuel for cooking and heating which is about (52mill. tones) from charcoal, fuel wood and farm residues. The energy consumption pertain is dominated by woodfuel accounting 90% of the population, most of which is consumed by households, Firewood is mostly used in rural areas and charcoal in urban areas for cooking purposes. 8% of the Tanzanians use petroleum product Like Kerosene and LPG, 1% Use Electricity and 1% use other source of energy like Solar Cooker etc



Utilization of fuel wood in Tanzania is characterized by low efficiencies technologies (three stones fire places range between 12% and 15%).

In efficient technologies like three stone fireplace increase deforestation due to its inefficiency resulting into overconsumption of woodfuel (firewood)

In order to enhance sustainable use of woodfuel as a means of mitigation measure of the adverse effects to the forest resources and land degradation, the use of efficient energy stoves is promoted and disseminated for domestic, Institutional and commercial use.

Efficient fuel stoves are designed and developed to enhance the following

- To reduce woodfuel consumption
- To reduce indoor air pollution.
- To reduce drudgery and save time(5 to 2 days a week) for women and children
- To reduce deforestation and land degradation
- To mitigate climate change effects and sustain biomass supply.
- To enhance local income and employment generation.

Efficient fuel saving stoves have environmental, socioeconomic and livelihood improvement impacts.

2.0 METHODS

Comparison of improved stove to the traditional one is normally used for determination of Performance of the stoves. Comparisons can also be made with other types of stoves.

There are three stove testing protocols

1. ***Laboratory*** **Water Boiling Test (WBT)** –Most variables are controlled to isolate and identify effects of design changes on stove performance. Not meant to predict field performance, but to compare stove designs when performing the same task.
2. ***In-Field*** **Controlled Cooking Test (CCT)** –Comparison of the stove to the traditional cooking method as used by local cooks preparing common meals.
3. ***In-Home*** **Kitchen Performance Test (KPT)** – The stoves as they are used by many cooks in their homes under normal conditions for days at a time.

Important Stove Performance Parameters

- Efficiency
- Specific Fuel consumption
- Turn-down ratio
- Fire power
- Burning rate
- Speed of cooking or time to boil

- User satisfaction
- Toxic Emissions

	WBT	CCT	KPT
Main Objectives	-efficiency -compare	-compare ICS with tradition	-user satisfaction
Where and How conducted?	-Boiling water in controlled Lab conditions -see: www.aprovecho.org	-Cooking food in Lab or field -see: www.aprovecho.org	-Involves several HH's cooking normal daily food for several days -see: www.aprovecho.org
When conducted?	-concept development -Prototypes evaluation	-Final prototype design	-Before dissemination of new ICS
What is learned?	-Stove highest efficiency -Other technical performance	-% improvement from tradition -Indication of max. field performance	-Fuel saving -Indication of user acceptance

STOVE TESTING PARAMETERS

Parameter	Meaning	When determined
Efficiency (%)	Ratio of heat transmitted to pot over energy in the fuel	WBT
Turn-down ratio (TDR) (-)	Ratio of maximum power of stove to power that can just sustain boiling	WBT
Time to boil /speed of cooking (minutes)	Time to bring water to boil/ Time to cook food	WBT/CCT
Fire or stove power (Kw)	Maximum rate of heat released by the fuel	WBT
User satisfaction (?)	Preference dependent *Speed of cooking, stove power, TDR, fuel saving, fuel flexibility, stability, looks/prestige, smoke, cleanliness, durability, affordability, maintainability, compactness, portability,?*	KPT

3.0 RESULTS AND DISCUSSION

- Efficient woodfuel stoves have reduced fuel wood used by households by 63% compared to the earlier used quantity before stove installations.
- 75% fuel wood saving realized in an Institution with Boarding students (in Lushoto)
- Average CO_2 Emission reduction was 3.778t/household. Year, fairly above the expected 3.4tCO_2e /Household. Year expected before, realized in the verification study conducted by TaTEDO and TIRDO in 2010.
- Production/Fabrication potable stove employ 6 people (Supplier of metal parts, Welder, Fastening/folding technician, Painter, Seller of the stove, liner producers)

Types of Stoves disseminated

Stove Type I: Fixed Stove with Chimney (Brick Made)

- Thermal efficiency Above 44% ,
- Saving efficiency Range 50%-75% (AV. 63%)

Stove Type II: (Metal Clad Clay Lined With Chimney)

- Thermal efficiency Above 44% ,
- Saving efficiency Range 50%-75% (Average 63%)

Stove Type III: Clay Lined One Burner without Chimney

- Thermal efficiency 15%-25%
- Saving Efficiency40%-60%

Thermal efficiency Above 44%

4.0 SIGNIFICANT IMPACT OF THE STOVE PERFORMANCE

Monetary Gains and Savings

Due to high efficiencies, modern biomass technologies will consume less wood to generate heat. Stove users will spend less money in purchasing wood fuel by 50% to 75%

Employment Creation

Introduction of improved woodfuel technology services will create employment opportunities to the beneficiaries in the program me area. In the value chain of production suppliers of materials like cement lime and Metal parts of the stoves will generate income, Mason technicians will construct the stoves, and Welding and fabrication artisan will also benefit from the stove because they will be hired to make the metal parts.

Time Savings

Women and children are the main suppliers of firewood, accounting for 60 and 23 percent respectively; men account for 13 percent and household helpers 4 percent. The average time and walking distance for fetching and transporting firewood in rural areas range from 4 hours and 6 km per day respectively. This shows that household members and in particular women invest considerable amount of time and energy in searching firewood. The success of the proposed programme will lead to reduction of cooking and fetching time by more than 50 percent. The time saved could be spent for other family productive and social activities.

Health

Different Health studies have also associated indoor air pollution from smoke and gases (Carbon Dioxide, Methane, Carbon monoxide, etc.) from inefficient stoves with health risks including acute respiratory infections in children, chronic obstructive lung diseases such as asthma and chronic bronchitis, red eyes, headache, sneezes and pregnancy related problems. Women spend 3 to 7 hours per day to cook exposed to smoke often with young children near to them. Various literatures show that burning firewood in three-stone fireplace emits about 589g/MJ of Carbon Dioxide and 18g/MJ of Carbon Monoxide. A better combustion process in efficient biomass stoves will reduce such amount by 40 percent.

Improved Social and Gender Relationships

Introduction of improved charcoal and firewood stoves in household will improve the kitchen environment since there will be reduced smoke generated and also the kitchen will be cleaner. This situation will improve family relationships since rural husbands can now more often sit next to their wives in the kitchen and discuss various family developmental issues while wives are cooking. An evaluation study conducted by the Ministry of Natural Resources and Tourism on impacts of improved woodfuel stoves in selected catchments forest reserves of Morogoro, Tanga, Arusha and Kilimanjaro regions revealed that social relationship between wives and husbands has improved because husband can spend some time in the kitchen when wife is cooking due to reduced smoke emissions in the kitchen.

Forest Conservation

Improved wood fuel stoves reduce quantities of wood fuels used in the households, SMEs and social service centers. Per capita firewood consumption range from 2.25 to 7Kg per day using 3 stone fireplaces. Efficient stoves will reduce by 63% average hence more trees will be saved.

5.0 CONCLUSION

Effient Wood fuel Stoves contribute positively to the livelihood improvement of families using the stoves as well as the beneficiaries in the value chain of efficient wood fuel stove from production to the end users.

The stoves contribute to the reduction of emission of carbon significantly which facilitate resilience to the climate change.

The stove performance on mitigation of the pressure of tree cutting in the forest catchment sources save the purpose of sustainable use of forest resources without causing land degration through soil erosion influenced by tree cutting.

The stove have significant contribution reduction of drudgery of work among the families wood fuel collectors who spend more time collecting firewood , less time of productive work and lack of time to relax.

The stove reduces health risk to the cook due to its efficiency in suppression of indoor air pollution.

The technology of fuel saving stoves is very important for the SLM Project.

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