Market Intelligence on Improved Cook Stoves in Mtwara Region

ICS Taskforce Tanzania
November 2013

About ICS Taskforce

Facilitated by SNV, the ICS Taskforce of Tanzania was created in 2011, with the Ministry of Energy and Minerals (MEM) as the Chair and the Tanzania Renewable Energy Association (TAREA) elected as the secretariat. The ICS Taskforce was initiated with the aim to increase coordination in the Improved Cook Stove (ICS) sector, for stakeholders to better understand and develop the sector through multi-stakeholder processes, while doing the necessary studies to come to a joint way forward for further ICS market development in the country. This document is one of the resulting documents of the ICS Taskforce. Other documents include: a technical assessment report of ICS in Tanzania, market intelligence studies for ICS in different regions of the country, ICS policy analysis, and a Country Action Plan for Clean Cookstoves and Fuels.

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ISBN: 978-9987-9895-4-6

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Acronyms and Abbreviations

AMCOs	Agricultural Marketing Cooperative Societies
ALRI	Acute Lower Respiratory Disease
CARMATEC	Centre for Agriculture and Rural Mechanization Appropriate Technology
CBA	Cost Benefit Analysis
CBOs	Community Based Organizations
COPD	Chronic Obstructive Pulmonary Disease
COSTECH	Tanzania Commission Of Science and Technology
CRDB	Cooperative and Rural Development Bank
FBO	Faith Based Organization
FDC	Focal Development College
GVEP	Global Village Energy Programmes
IAP	Indoor Air Pollution
ICS	Improved Cook Stove
LED	Light Emitting Diode
MAMCU	Masasi Mtwara Cooperative Union
NBC	National Bank of Commerce
NGO	Non-Governmental Organization
NMB	National Microfinance Bank
NPV	Net Present Value
PV	Photovoltaic
RE	Renewable Energy
SACCOS	Saving and Credit Cooperative Societies
SIDO	Small Industries Development Organization
SNV	Netherlands Development Organisation
TANECU	Tandahimba Newala Cooperative Union
TASAF	Tanzania Social Action Fund
TIB	Tanzania Investment Bank
TZS	Tanzanian Shilling
USD	United States Dollar
WHO	World Health Organization
Wp	Watt-Peak

Executive Summary

Introduction

Promotion of Improved cook stoves in Tanzania has recorded a very low uptake of the technology despite of several efforts by different stakeholders since 1980s. Lack of awareness, coordination of ICS industry, clear policy and strategies and business models are cited as the challenges toward developments of the stove sector. The work presented in this document is on Market Intelligence study in Mtwara region as the first step by stakeholders to devise strategies of addressing the challenges.

Objectives of the Study

The main objective of the assignment is to establish market information on ICS and RE in general, including supply and demand sides data, supply chains, existing gaps and threats, strength and opportunities, consumer options and preferences, and propose areas for improvement including institutional, financial and value chain addition arrangements. The output of MI study will be used as an input for an ICS sector development Program PID planned for conclusion late 2013 by SNV, the client who commissioned this assignment.

Study methodologies

Study methods involved data collections through literature review for secondary data, interview and consultations, site visit and administration of semi-structured questionnaires for sample frame. Validation and verification data were done through meeting with district council officials.

The study involved sample frame of households, institutions and businesses in Mtwara region. Sample size was narrowed to three districts in the region that were selected based on geographical diversity in the region. From each selected district three villages, each from different wards were then selected for detailed survey. A total of 211 households in 9 villages, in 9 wards and three districts were covered during the survey. Data compilation and analysis was done using excel software after field work.

Findings from the Study

Findings from MI are presented based on the envisaged and outlined study outputs:

1) Population size for the target areas and population density

Mtwara region is one of the 30 administrative regions of Tanzania that occupies 16,720 km^2 or 1.9% of Tanzania mainland area in its south western part. The region is administratively divided in 7 districts with total population of 1,270,000 and male/female ratio of 0.89 that is below the national average of 0.95. Population density of the region is 76 persons per km^2 and above the national average of 5. However the region's household size of 3.7 is the lowest in the country.

2) Socio demographic profile of the population in the target areas

Market Intelligence (MI) study in Mtwara region concentrated on three districts councils that include Masasi, Mtwara and Newala with 62.5% of the total region's population. The districts have 16 divisions, 90 wards, 488 villages and 2106 sub-villages. Combined population of the districts is 53.6% of the total region population which grows at the rate of 3.65%. Total number of households in the target districts is 186,061 and the average household size is 3.6, slightly below the region's average.

At least 85% of the population lives in rural area and agriculture is their main occupation. Like most parts of the rural areas in Tanzania the type of agriculture is subsistence farming where cashew nut is the major cash crops. Major food crops include maize, cassava, rice and sorghum other economic sectors include fishing and businesses.

In terms of social infrastructure the districts has 369 primary schools, 74 secondary schools and 129 health facilities. The districts are easily accessible from other regions via tarmac roads while mobile phone services coverage for entire districts.

3) Quantitative information on cooking and lighting options being used, sources and average distances travelled to access such sources

About 93% of rural households rely on firewood for cooking with an average consumption of 67 kg of fuel each per month. Urban and semi urban households largely depend on charcoal for cooking with an average consumption of 4 sacks (each equivalent to 50 kg cement bag) per month. While households using firewood collect them at an average distance of 2.4 km from their homes charcoal is delivered to the consumers' residents by informal traders.

Education facilities that provide food include 64% of primary schools and 23% of secondary schools in the region and the source of energy for cooking is firewood whose consumption is estimated at 0.6 per student per day.

Kerosene is still the major source of energy for lighting for at least 50 % of households, followed by dry cells 39%, PV systems 9% and open fire and car batteries account for the rest 2%. A typical household that use kerosene lanterns consume 1 litre of kerosene per week and 0.5 a litre for the households using wick lamps. Households using dry cells to power LED lamps use an average of 2.4 to 3.5 cells per week. With the exception of PV systems other energy source are available in the villages.

About 9.7% of primary schools are connected to grid electricity, 1.6% solar PV systems and the rest 88.7% lack energy for lighting. Grid penetration for secondary school is 45% while PV systems are installed at 27% of the schools leaving 13% without improved energy source services. Grid connection rate to health facilities is 15.4% and 48% of the facilities use solar PV systems for lighting. The remaining 36.5% use kerosene for lighting and all are dispensaries. Dispensaries in rural areas are allocated 5 litres of kerosene each by district authorities for lighting per month

4) Cost/price incurred/ paid by consumers to access various types of cooking and lighting options available in target areas

Prices of charcoal range from TZS 2,000 to TZS 3,000 per volume of 50 kg cement bag while that of firewood ranges from TZS 1,000 to TZS 2,000 per 5 kg bundle. Average Weekly household expenditure on charcoal is between TZS 3,063 and TZS 6,000 depending on the size of a household and the extent to which firewood is used in combination with other energy source especially firewood. Households that buy firewood incur weekly expenditure from TZS 2,982 to TZS 4,224.

Education facilities use firewood brought by students from home because most of them are day schools.

5) Preference and willingness of consumers and potential consumers of cooking and lighting options

Households and institutions using firewood prefer three stone traditional stoves over improved technologies mainly because of lack of awareness and availability of the technologies. Households that use charcoal for cooking are already willing to pay between TZS 5,000 to TZS 7,000 per ICS stove

Majority of off-grid households prefer solar PV systems that can power 3-5 lamps and they are willing to pay between TZS 5, 290 and TZS 11,239 per month for the financed products.

6) *Estimated demand of ICS, biogas and lighting options for households, institutions and other facilities*

There is an estimated demand of firewood and charcoal ICSs for 177,893 households and 33,229 households respectively in target areas. Education facilities have demand of firewood ICS for 252 primary schools and 74 secondary schools. Demand of biogas for cooking is estimated for 600 households who practice zero grazing in Masasi town where assurance of availability of adequate cow dung can be guaranteed.

A total of 184,758 households have potential demand of solar PV for lighting. The demand of PV systems also exists for 288 primary schools and 25 secondary schools. These are facilities that do not have improved energy sources services.

7) *Information on coordination and or potential coordination of the ICS, biogas and solar distribution activities in the target areas*

There is no formal coordination of ICS, biogas and solar distribution activities in Mtwara region. Individual initiatives by private sectors have been the major drivers of the uptake of technologies in the region.

8) *Approximate number of micro-businesses in the target areas per 1000 households and existence of micro-businesses already providing electricity based services which do not use grid power*

The target project area has an average of 46 micro-businesses per 1000 households; among them 35 either sell products or provide electricity based services that are off-grid related. The businesses include shops, kiosk, phone charging services and cereal processing machine.

9) *Readiness of entrepreneurs and micro enterprises to engage in energy service businesses such as distribution of ICS, construction of ICS and biogas technology, battery and distribution of solar lighting products and services*

Non energy enterprises still hesitate to enter energy businesses because they lack awareness on the business potential of the products, working capital is so limited for micro-businesses and most of them are uncertain of returns on such venture.

10) *Observation and verification of evidences in the target areas for appropriateness for ICS businesses*

Charcoal ICS dealers source their products from Dar es Salaam and they use road transporters to deliver their stoves at a cost of TZS 500 to 700 per stove. Stove prices range from TZS 5,000 to TZS 7,000. Annual sales of charcoal ICS has doubled over the last three years and the awareness among the potential consumers is increasing.

11) *Description of other organizations/initiatives that are operating within the household clean energy sector in the targeted areas, which are of particular relevance to the project, including main activities, approach taken and lessons learnt from their experience*

There is no experience of improved technology projects for cooking in Mtwara region. Available experience is from UN women, an organization that implemented a two year project on home lighting using solar PV technology. The organization worked with the community to facilitate training of local artisans in installation, maintenance and repair of PV systems. The credit facility for solar PV product was then established to finance small PV systems and the role of managing the facility was assumed by appointed community committees. Experience indicates that the committees failed to manage the fund because beneficiaries were able to pay for the system only during the cash nut harvesting season. The situation necessitated the

project to change PV systems size from 30 Wp to 5 Wp in order to match the product prices with beneficiaries level of affordability.

12) Data base of cooking energy actors in the study areas

There are estimated 14 charcoal ICS dealers in the target area and most of them are found at district headquarters. No identified entrepreneur that is involved in construction of firewood ICS or running biogas businesses. The target area has at least 12 major dealers that stock a full range of solar PV system components, 20 retailers who mainly stock some components especially solar modules and about 20 technicians that are involved in installation, maintenance and repair of solar PV systems.

13) Number and impacts of IAP/ hazards resulting from cooking technologies and services in households, enterprises and institutions in the target areas

The extent of IAP in the surveyed district is not well documented for the purpose of comparison with maximum WHO recommended levels of human exposure to the pollutants. Existing respiratory system related disease does not establish the extent to which they are attributed by smokes from cooking fuel though in 2009 WHO estimated 18,900 deaths that attributes to IAPs in Tanzania.

14) Number of agricultural and rural penetrating companies with their outreach potentials/ numbers and geographical coverage

Two cooperative unions in Mtwara region namely, TANECU LTD and MAMCU LTD are involved in buying and transportation of cashew nut from rural areas. Their network is very extensive and they willing to discuss modalities on transportation of improved energy technology products with the project.

Conclusion

Demand of forest products including fuel wood by local population in Mtwara region exceeds the rate of afforestation posing a threat if the situation is not addressed. Massive use of firewood and charcoal improved cook stove can significantly contribute to the reduction of the problem. However, awareness on benefits of the stoves among potential consumers is not adequate though already charcoal ICS stoves are marketed in the region.

The capacity of the region to manufacture the stoves locally is also lacking due to lack of expertise in production of the stoves and availability of quality materials such as clay soil. Quality of ICS that are currently sourced from Dar es Salaam and sold in the market cannot be guaranteed.

Biogas technology is not common in Mtwara region and the technology potential is limited by low livestock population in the region. Other potential technology include solar PV for lighting and phone charging, Thought the technology has been used for a decade now in the region its access by the target population is limited to few due to high initial costs involved with the technology. Available products do not provide functional assurance. Smoke associated by use of kerosene is the main reason consumers are switching from the energy source to dry cell powered LED lamps. This demonstrate positive attitude towards improved technology by consumer and therefore offering opportunity for successful adoption of solar PV technology.

Recommendations

In order to build ICS business infrastructure a number of things need to be in place. These include quality of improved technology products, encouraging local manufacture, putting in place financing mechanism for the products and awareness raising campaigns. These activities need to be coordinated at all levels of supply chain.

1. INTRODUCTION

1.1 Background of the Study

Majority of households, institutions and businesses in Tanzania depend on combustion of low quality fuels in open fires and inefficient traditional stoves for cooking. Such energy use practices have negative impact of deforestation, global climate change and public health in general. As part of addressing the impacts several improved cook stoves (ICS) dissemination efforts by different stakeholders have been underway since 1980's with limited success.

Lack of awareness, coordination of ICS industry, clear policy and strategies and business models are cited as the challenges toward developments of the stove sector. In recognition of these barriers, actors of ICS industry in Tanzania intend to develop an impact oriented, private-sector led, commercially viable, and sustainable ICS sub-sector in Tanzania. The work contained in this document, therefore, forms part of the initial endeavor towards that direction by conducting feasibility study on policy analysis, market intelligence and technology assessment.

1.2 Objectives of the Study

The main objective of the assignment is to establish market information on ICS and RE in general, including supply and demand sides data, supply chains, existing gaps and threats, strength and opportunities, consumer options and preferences, and propose areas for improvement including institutional, financial and value chain addition arrangements.

Specific objectives

i. To assess the biomass energy situation in Mtwara region.

ii. To provide data on current cooking energy supply options: document the main energy products and services that are available in targeted regions particularly for both households and institutional cooking and lighting (firewood, charcoal, briquettes, pellets, sawdust, LPG, crop residues, husks, kerosene, dry cell torches, candles, car batteries, electricity, etc.).

iii. To identify evidence of the potential energy demand for ICS cooking, biogas and (solar) lighting products in target areas and distances people currently travel to access such products and or services.

iv. To estimate the number of micro-businesses per 1000 households within the target areas.

v. To assess the extent to which micro-businesses already exist which are seeking to supply the market of ICS, cooking energy and lighting products.

vi. To assess the readiness of non-energy entrepreneurs in the target areas to engage in providing energy services such as ICS, biogas and (solar) lighting products distribution.

vii. To analyze the main challenges and drivers to adoption and scaling up of ICS and other RE technologies and key lessons learnt from existing experience.

viii. Describe the activities of other organizations that are operating within the household clean energy sector, which are of particular relevance to ICS subsector including main activities, approach taken and lessons learnt from their experience.

ix. To identify the bio mass cooking and lighting energy entrepreneurs in the study areas.

x. Identify and quantify indoor air pollution data/ information from relevant institutions, actors and cook stove end users.

xi. To map agricultural companies and others penetrating in rural areas with extensive networks, as potential distributors of cooking and lighting technologies.

xii. To assess the market availability of products to consumer energy uses, etc.

1.3 Scope of the study

The study was conducted in Mtwara region, one of the selected regions for market intelligence on ICS. Other selected regions include Arusha, Iringa and Tanga. Market Intelligence(MI) from Mtwara region together with that already concludedin Lake Zone will, together with the ICS policy assessment and technical status report finallybe used as an input for an ICS sector development Program PID planned for conclusion late 2013.

2. STUDY METHODOLOGY

2.1 Introduction

This chapter presents the detailed methodology adopted while carrying out the study on Improved Cook Stoves (ICS) Market Intelligence in Mtwara region. It explains how the surveyed areas were sampled out and sampling frame and size established. It also explains the instruments used to achieve outlined study outcomes and how the survey exercises were carried out. Finally, coverage extent of the survey and the way obtained data were processed and analyzed for this report.

2.2 Survey Methodology

The study of Market Intelligence on ICS was designed to establish market information on ICS and RE in general, including supply and demand sides data, supply chains, existing gaps and threats, strength and opportunities, consumer options and preferences, and propose areas for improvement including institutional, financial and value chain addition arrangements.
Methods of data collections were;

i. Literature review for secondary data collection
ii. Interview and consultations
iii. Site visit and Administration of semi-structured questionnaires
iv. Validation and verification meeting with district officials
v. Data Compilation, analysis and reporting.

Sampling Design

Collection of secondary data: demographic data were obtained from 2012 National Population Census report and social–economic profiles of the target districts obtained from district planning offices of respective districts. The two sources of information led to the achievement of the first two study outputs;

- Population size for the target areas and population density.
- Socio demographic profile of the population in the target areas

Specific, detailed and more updated district data required for this study were gathered through interview and consultations with heads of the key departments at district council headquarters.No index entries found.

Semi-structured household questionnaires were used to collect household consumer data on energy uses for cooking and lighting and therefore contributing to the following four study outputs:

- Quantitative information on cooking and lighting options being used, sources and average distances travelled to access such sources.
- Cost/price incurred/ paid by consumers to access various types of cooking and lighting options available in target areas
- Preference and willingness of consumers and potential consumers of cooking and lighting options to pay for improved technologies and services.
- Estimated demand of ICS, biogas and lighting options for households, institutions and other facilities (the questionnaire was used together with demographic information collected in secondary literature)

Semi-structured Business Questionnaire was used to establish information on existing and potential energy related enterprise data in the districts. That was useful in dealing with the following four expected study outputs on micro-business survey:

- Information on coordination and or potential coordination of the ICS, biogas and solar distribution activities in the target areas.
- Approximate number of micro-businesses in the target areas per 1000 households.
- Existence of micro-businesses already providing electricity based services which do not use grid power.

- Readiness of entrepreneurs and micro enterprises to engage in energy service businesses such as distribution of ICS, construction of ICS and biogas technology, battery and distribution of solar lighting products and services.

Market Observation Questionnaire was used to establish energy product market through physical observation of the survey areas/villages and discussions with ward and village executive officers. It aimed to address one study output:

- Observation and verification of evidences in the target areas for appropriateness for ICS businesses.

Institution Questionnaire was used to collect information on actors that work on energy related products and those that can take part in the dissemination of energy technologies. That was helpful in establishing existing enabling energy product market environment and assessment of agricultural companies that for distribution of the products (supply chain assessment) in order to realize the last four study outputs:

- Description of other organizations/initiatives that are operating within the household clean energy sector in the targeted areas, which are of particular relevance to the project, including main activities, approach taken and lessons learnt from their experience.
- Data base of cooking energy actors in the study areas
- Number and impacts of IAP/ hazards resulting from cooking technologies and services in households, enterprises and institutions in the target areas.
- Number of agricultural and rural penetrating companies with their outreach potentials/ numbers and geographical coverage.

Sampling Frame

Households, institutions and businesses in Mtwara region were considered as a sampling frame of the study.

Sample Size

Three districts in Mtwara region were selected as representatives of other districts in the region. From each selected district three villages, each from different wards were then selected for detailed survey. A total of 211 households in 9 villages, in 9 wards and three districts were covered during the survey.

Table 2.1: Number of Surveyed Households in Selected Villages of Target Districts

Name of Selected District Council	Name of Selected Ward	Name of Selected Village	Number of Surveyed Households	Total Number of Surveyed Households in a District
Masasi	Mlingula	Mlingula	25	69
	Chingulungulu	Namatutwe	24	
	Namajani	Namajani	20	
Mtwara	Nachenjele	Mbawala	24	72
	Chawi	Chawi	24	
	Nanguruwe	Naguruwe	24	
Newala	Mikumbi	Chilangala	25	70
	Mnyambe	Mnyambe	22	
	Chihangu	Chihangu	23	
TOTAL				211

Survey Instruments

Four Market survey instruments were prepared in consultation with the client of this study for approval. They include Households questionnaire, Market observation questionnaire, local business questionnaire and institution questionnaires.

Training of Interviewers

Before conducting field work 3 interviewers were trained in each district. The training was on conducting household interview and filling in questionnaires for identified staffs mainly from district community development departments in the respective districts.

Field Exercise at the District Headquarters

The first three days in the selected districts were spent at their headquarters. Courtesy calls were first paid to District Executive Directors (DED's) where self introduction and briefing about the study were made by the consultant. The directors assigned staffs from community development departments to accompany the consultant for the purpose of conducting interview and consultations with district council head of departments and assisting in identification of the target villages for field works. The staffs also provided assistance of arranging meetings with other institutions and businesses at the district headquarters. Interview and consultations were made to the following district officials in each selected district: District Executive Directors, District Planning Officers, District education Officers for secondary Schools, District education Officers for secondary Schools, District Medical Officers, District Community development officers, District Trade officers, District cooperative officers, District Natural resources and Environment officers and District Livestock Officers.

After meetings with district officials interviews were made with businesses at the district headquarters. The businesses include solar PV dealers, electrical/electronic appliances shops, charcoal stove dealers and other businesses using charcoal stoves for cooking such as restaurants and food vendors in towns.
Then institutions like NGOs and other initiatives that have implemented energy related projects in the district were also visited. The visits at the district headquarters were finalized by meeting executives of Agricultural Marketing Cooperatives (AMCOs).

Having finalized interviews/consultations at district headquarter, community development officers assisted in identification of 3 villages in the district for detailed study and 3 staffs to help administration of household questionnaires. The officials were trained by the consultant who also supervised their works in the villages.

Field Exercise in Villages

All staff and consultant worked as a team moving together from one village to another. Up on arrival in the study villages, a courtesy call was made at the Village Executive Officers (VEOs) or Ward Executive Officers (WEOs) that provided data on the overview of the respective villages. The executives assigned 3 local enumerators from the villages to accompany the study team and introduce it to the households for administration of the questionnaires. Visits and then interviews to schools, health facilities, businesses and AMCOs in the villages were conducted by the consultant himself. The consultant also checked the accuracy of collected data by household interviewers and correction were made where necessary before moving to another village.

Coverage of the Study

At the village level, the study covered at least 20-25 households, all primary and secondary schools, all health facilities, all major shops, food vendors and AMCOs.

Data Processing

Data processing and analysis was done by using excel software package.

3. PROJECT AREA DESCRIPTION

3.1 Location, Administration and Population of Mtwara Region

Geographical Location

Mtwara region is one of 25 regions of Tanzania Mainland. It is the southernmost region. It lies between longitudes 38° and 40°30" east of Greenwich. It is also situated between latitudes 10° 05" and 11° 25" south of the Equator. It borders Lindi region to the north, the Indian Ocean to the east and separated by the Ruvuma River from Mozambique in the south. To the west it borders Ruvuma region.

Region size and Administration

The region occupies 16,720 square kilometers or 1.9% of Tanzania Mainland land area of 885,987 square kilometers. Administratively, the region is subdivided in7 districts which are further subdivided in divisions, then wards, villages and finally sub-villages (or hamlets).

Population

District's population of Mtwara region, average household sizes and sex ratio are shown in the Table 3.1.

Table 3.1: Population, Average Household Size and Sex Ratio in Mtwara Region

No	District/Council	Population (Number)			Average household Size	M/F Sex Ratio
		Total	*Male*	*Female*		
1	Mtwara District Council	228,003	107,922	120,081	3.9	90
2	Newala District Council	205,492	95,018	110,474	3.5	86
3	Masasi District Council	247,993	118,976	129,017	3.6	92
4	Tandahimba District Council	227,514	105,322	122,192	3.7	86
5	Mtwara Municipal Council	108,299	51,062	57,237	3.8	89
6	Nanyumbu District Council	150,857	72,237	78,620	3.7	92
7	Masasi town Council	102,696	49,411	53,585	3.6	92
		1,270,854	**599,648**	**671,206**	**3.7**	**89**

Annual population growth rate of Mtwara region is 1.2% against national average of 2.7% making it one of the 5 regions with the lowest rate in the country. The region has the average household size of 3.7 which is also the lowest in the country while the national average is 4.8. The region has male/female sex ratio of 0.89 that is lower than the national average of 0.95 and it is one of the two regions with the lowest ratios in the country. However, the region's population density of 76 persons per square kilometer is above national average of 51.

3.2 Social Demographic and Economic Profiles of Target Districts

This section presents detailed social demographic and economic profiles of target districts for Market Intelligence on ICS in Mtwara region. Specific district information includes their geographic location, size, boundaries, administration, demographic data, climate, economic activities and available social facilities and infrastructures. They are all summarized in Table 3.2.

Table 3.2: Social Economic/Demographic Profile of the Target Districts for MI study of ICS

DISTRICT COUNCIL	MASASI	MTWARA	NEWALA
Geographical Location	Southern Tanzania between longitude 36^0 -38^0 East of Greenwich and latitudes $10^{0-}12^0$ degrees South of the Equator.	Southeast of Tanzania between longitude 39 ° 0" - 40° 27" East of Greenwich and latitudes 10° 0" - 10 ° 07" south of the Equator	Southeast of Tanzania between longitude 39 ° - 40° East of Greenwich and latitude 10° -11° south of the Equator
District Size (Km^2)	4,429.2	3,597	2,439
Boundaries	It is borderedbyNachingwea district (North), Lindi district and Newala districts (East); Nanyumbu (West) and Ruvuma river (South)	It is bordered by Tandahimba district (West),the Indian Ocean (East), Lindi region (North) and Ruvuma River (South)	It is bordered by Masasi District (West), Tandahimba (East), Lindi (North), Ruvuma River (South).
Administration: Number of Divisions Number of wards Number of Villages Number of sub-villages Number of electoral constituency	 5 34 176 986 1	 6 28 157 638 1	 5 28 155 482 1
Demographic data Population Sex Ratio Male/Female Population Growth Rate (%) Number of households Average Household Size Population density (/ km2)	 247,993 0.92 2.1 68,887 3.6 53	 228,003 0.9 1.4 58,462 3.9 ?	 205,492 0.86 1.2 58,712 3.5 87
Climate	The mean annual rainfall is 900mm. The District average temperature is 25^0C while the highest temperature is 32^0C and the lowest temperature is 22^0C.	The average annual rainfall ranges between 800mm-900mm while the average temperature ranges between 23°c in June and 30°c in October	Annual rainfall (900-1200mm), averaging 1,000mm, mean temperature is 22 ° C.
	Over 90% of the people live in rural areas and their livelihood depends	The district depends on farming as the main source of income, of which	Agriculture accounts for 85% of the district economy, cashew nuts

Economic Activities	mainly on farming and livestock keeping. The GDP of the district is estimated at TZS 114,760/=)	contributes about 75% of the total income. Other economic sectors are fishing and businesses.	contribute 75% of income. Income per capital is TZS 470,638/= other economic sectors are animal husbandry, industry and commerce.
Employment Per Sector (%) Government Agriculture Trade Other			 ? 85 ? ?
Number of Education Facilities Primary Schools Secondary schools Vocation Training Centre Tertiary education Institutions	 123 27 4 1	 127 20 ? ?	 119 27 1 1
Number of Health Facilities Hospital Health centre Dispensary Licensed Medical stores Independent laboratories	 1 3 37 6 ?	 0 4 37 ? ?	 1 3 33 10 1
Water Supply Coverage: Access to portable water (%)	42	62.2	23
Energy Sources and Uses (%) Firewood Charcoal Gas Electricity Kerosene		 98 (rural)/93 urban ? ? 2.2 88(rural)/70 (urban)	 96.7 2.8 0.1 0.1 0.3
Major Industries	MasasiCashewnut processing factory is the only factory in the district.	?	Two cashew nut processing factories. Other small factories are carpentry, tailoring, cassava processing and

			mechanics.
Communications			
Land Line connection	633		302
Mobile Phone services	4		2
providers	3		0
Internet café	1		1
Post office	0		0
Courier services			

4. FINDINGS FROM CONSUMER SURVEY

This chapter presents the findings on existing energy sources for cooking and lighting that are used by three categories of energy consumers; namely households, social institutions and businesses. Then demand for improved energy technologies for cooking and lighting (ICS, biogas and solar PV) by the consumers is estimated.

4.1 Household Survey

4.1.1 Profile of Household Respondents

Interviews for 211 households in 9 villages in 3 districts of Mtwara region were carried out to establish status of their energy uses for cooking and lighting. Respondents constituted 63% men and 37% women. Their ages ranged from 17 to 88 years the average age being 42.2 years. Majority of the respondents, 76% had attained primary school education level, 10% secondary school education and 1% tertiary education levels. The rest 13% of respondents had not undergone any formal training. Number of family members per household was between 1 and 11; the average was 4.5 above the region's average of 3.7 according to 2012 National Households Census.

Table 4.1 summarizes household respondents' profiles in terms of number, ages, education levels and household sizes for all surveyed districts in Mtwara region.

Table 4.1: Number, Age, Education Level and Household Sizes of Household Respondents in Mtwara Region

DISTRICT		MASASI	MTWARA	NEWALA	TOTAL
Number of Respondents	Total Number of Respondents	70	72	69	211
	Male Respondents (%)	61	60	68	63
	Female Respondents (%)	39	40	32	37
Age of respondents	Minimum age of respondents(Years)	18	17	22	17
	Average Age of Respondents (Years)	38.4	41.6	46.7	42.2
	Maximum Age of Respondents(Years)	77	72	88	88
Education Level of respondents	Respondents without Formal Education (%)	1.4	29	7	13
	Respondents with Primary School Education (%)	94.3	60	75	76
	Respondents with Secondary School Education (%)	4.3	8	16	10
	Respondents with Tertiary Education (%)	0	3	1	1
Household size of Respondents	Minimum Number of Household Members	1	1	1	1
	Maximum Number of Household Members	7	11	11	11
	Average Number of Households Members	4.1	4.6	4.7	4.5
	Average Households Size (2012 census)	3.6	3.9	3.5	3.7

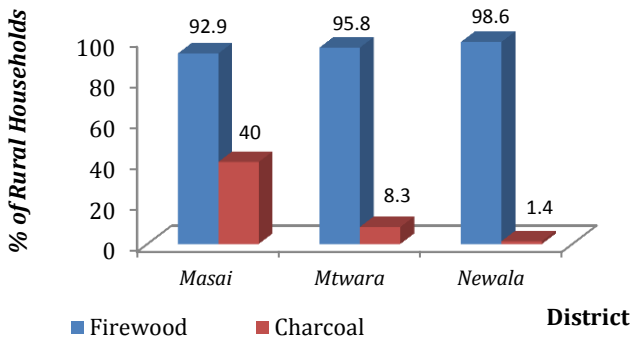
4.1.2 Energy Sources Used For Cooking

a) Types of Energy Sources Used For Cooking

At least 93% of the surveyed households in Mtwara region use firewood for cooking. Charcoal is mainly used in urban areas but rarely in rural areas. Some households use both firewood and charcoal as shown in Figure1.

Proportion of households that use charcoal for cooking is highest in Masasi district because settlements of the visited villages in the district are densely populated with relatively more commercial activities. Though located in off-grid rural area, these villages are kinds of small townships.

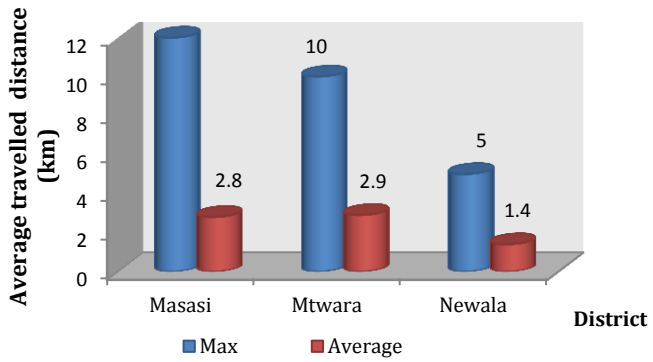
Figure 1 Percentage of Households That Use Firewood and Charcoa For Cooking in Mtwara Region



b) Distance Travelled By Households To Collect Energy Sources For Cooking

Household members in Mtwara region collect firewood near their farms and travel up to 12 kilometers. Average travelled distance ranges from1.4 to 2.9 kilometers (Figure 2). Charcoal is sold in the villages by mobile informal traders and the energy source users purchase them at their homes.

Figure 2: Average Distance Travelled by Household Members to Collect Firewood in Mtwara Region



c) Amount of Energy Sources Used For cooking

Mtwara region's households use averages of 2.8 to 3.9 bundles of 5 kg each per week for cooking. Charcoal is sold in a package of 50 kg bags of cement and on average 2 to 4 bags of charcoal are used by a household per week. Firewood shortage is less acute in Newala district

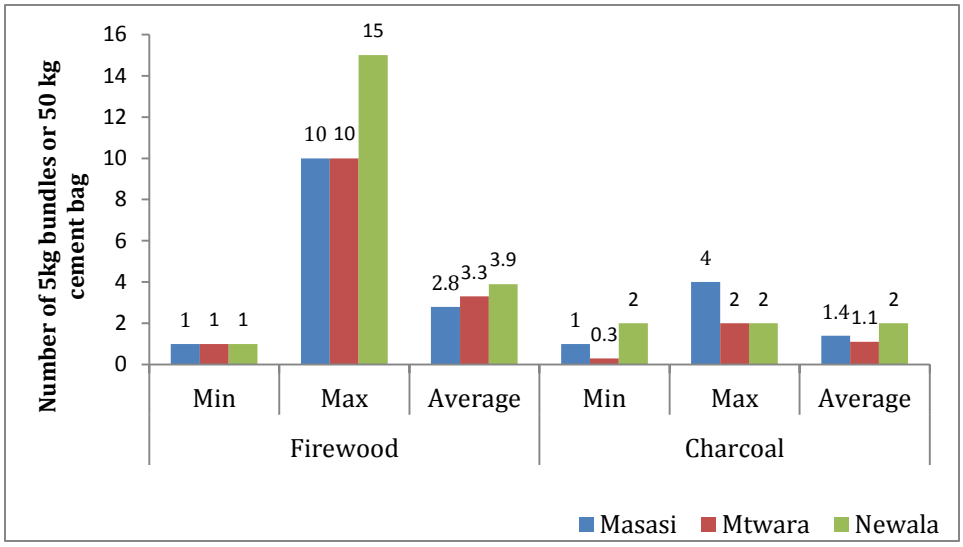


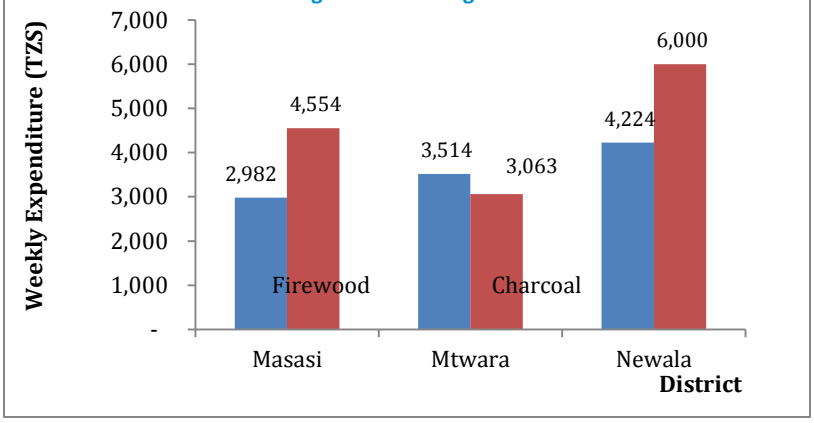
Figure 3: Number of Bundles of Firewood and Bags of Charcoal Used by Households Per Week for Cooking in Mtwara Region

compared to other districts in the region. This explains why the amount of firewood used by households in the districts (Figure 3) is higher than those in other districts in the region.

d) Household Expenditure On Energy Sources For cooking

Prices of charcoal range from TZS 2,000 to TZS3,000 per volume of 50 kg cement bag while that of firewood ranges from TZS 1,000 to TZS2,000 per 5 kg bundle. Average Weekly household expenditure on charcoal is between TZS 3,063 and TZS 6,000 depending on the size of a household and the extent to which firewood is used in combination with other energy source, charcoal for cooking. Households buy firewood in rare cases and in such situations weekly expenditure is from TZS 2,982 to TZS 4,224 (Figure 4).

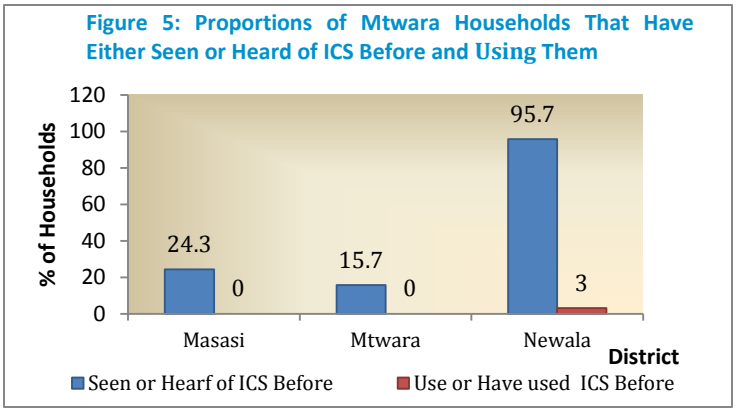
Figure 4: Household Weekly Expenditure on Energy For cooking in Mtwara Region



e) Households Levels of Awareness and Adoption of ICS

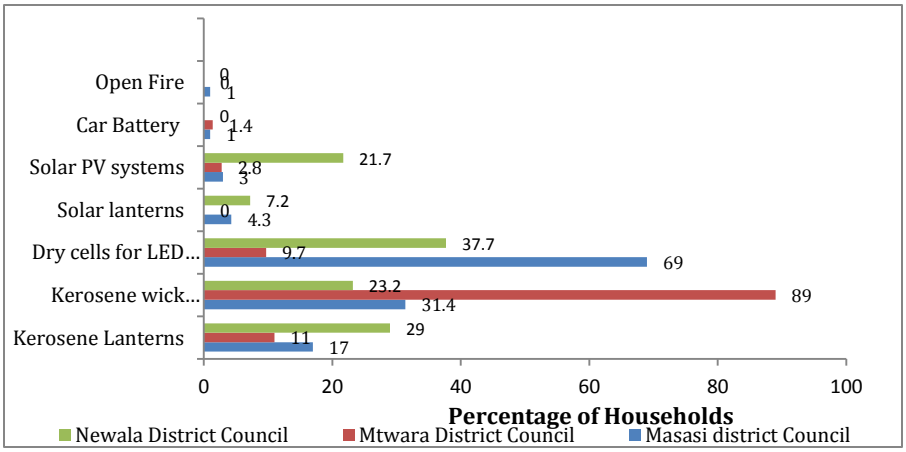
There is a low level of awareness and adoption of improved cook stoves in Mtwara region. Of the surveyed households in the region few had either heard or seen ICS as shown in Figure 5. Higherlevel of awareness inNewala district council is related to charcoal ICS type only and not for other types such as firewood stoves. Those who had heard of or seen ICS were not using them except for 3% of households' in Newala district.

Figure 5: Proportions of Mtwara Households That Have Either Seen or Heard of ICS Before and Using Them



Two main reasons for non-adoption of the ICS technology were low level of awareness on the technology by households and unavailability of the stoves and/or lack of expertise on their construction (Figure 6).On the other hand, households are accustomed to traditional stoves and have perception that charcoal ICSare expensive.

Figure 6: Reasons For Not Using ICS By Mtwara Region Households That Either Know or Had Heard Of ICS Before



4.1.3 Energy Sources Used For Lighting

Kerosene is mainly used for lighting in all districts of Mtwara region. However, the energy source is gradually being replaced by dry cells to power LED lamps and solar PV systems. This trend is highly noticeable in Masasi and Newala district as indicated in Figure 4.8. Reasons for the shift is due to increasing cost of kerosene and smokes associated with its use. Dry cell powered LED lamps are also used for prolonged hours than kerosene lanterns or wick lamps.

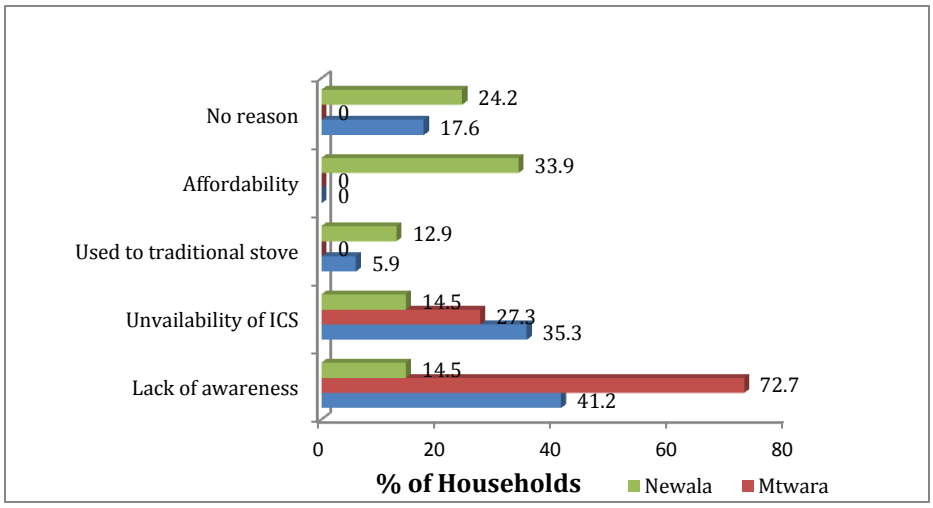


Figure 7: Energy Sources Used For Lighting Households in Mtwara Region

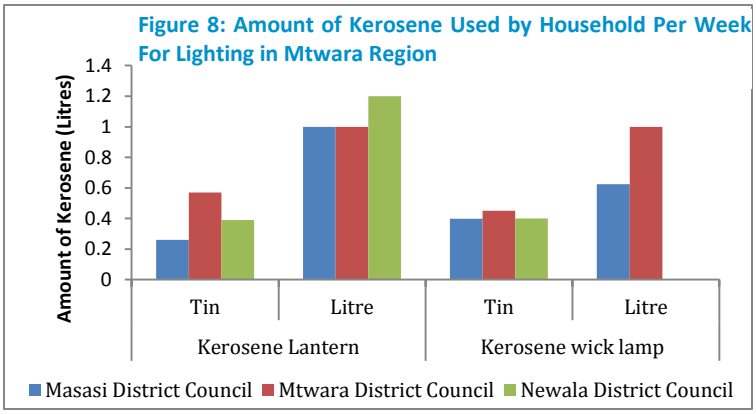
i. Use of Kerosene for Lighting

a) Amount of Kerosene Used For Lighting

Amount of kerosene used by households in Mtwara region largely depend on fuel purchasing patterns of a particular household. Households with kerosene wick lanterns purchase fuel in units of tin (1 tin = 5% of a liter) on daily basis while households that use kerosene lanterns prefer buying fuel in liters.

Kerosene lanterns' users consume about a liter of kerosene each per week for lighting but wick lamp users need about half of the amount per week (Figure 8).

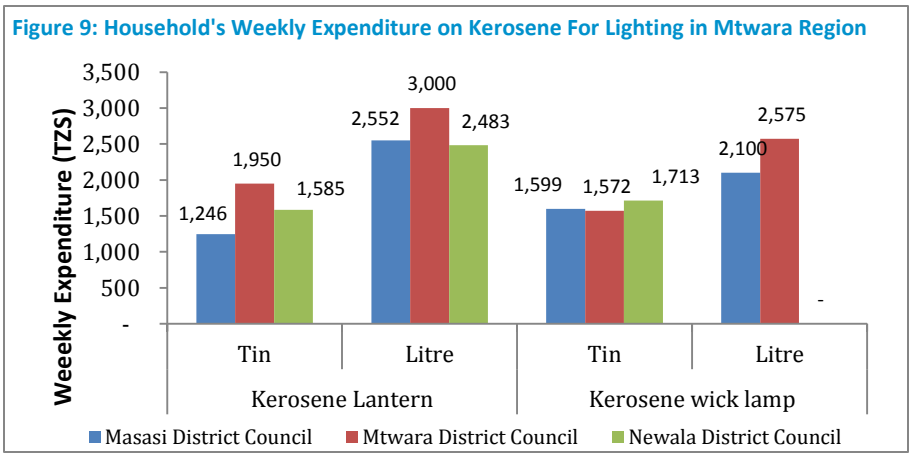
Figure 8: Amount of Kerosene Used by Household Per Week For Lighting in Mtwara Region



b) Expenditure on Kerosene for Lighting

As a result of purchasing patterns, household expenditure on kerosene is higher for kerosene lanterns than wick lamps (Figure 9).Purchasing patterns are linked to the households level of income and therefore on the amount used because of a difference in levels of affordabilities too. Kerosene is available shops and kiosks in all villages.

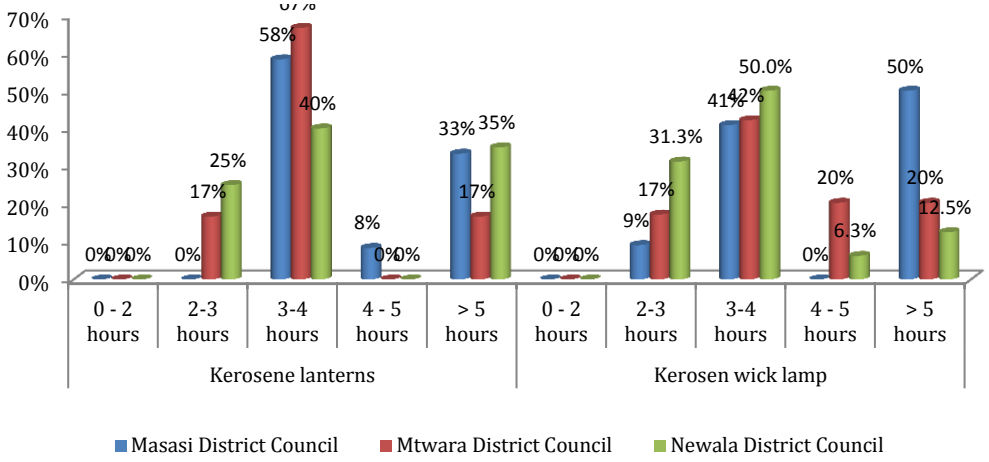
Figure 9: Household's Weekly Expenditure on Kerosene For Lighting in Mtwara Region



c) Lighting Hours per Day

Lighting hours per day for majority of households using kerosene range from 3 to 4 hours, a duration between sunset and the time when they go in bed. A considerable number of households also light their houses for the whole night.

Figure 10: Percentage of Households Versus Lighting hours for Households that Use Kerosene For lighting in Mtwara Region



ii. Use of Dry cell For Lighting

Households with dry cell powered LED lamps use average of 2.4 to 3.5 pieces of cells per week (Figure 11) at expenses ranging from TZS 1,400 to TZS 1,920 (Figure 12). Dry cells are available in village kiosks at prices from TZS 250 to TZS 750 depending on the quality of the cell brand. The main drivers for the use of dry cells are smoke free lighting, cost saving on kerosene and longer lighting hours with LED lamps than kerosene lanterns/wick lamps (Figure 13).However, most of households that use LED lamps face challenges ofshort lifespan of the lamps and their dim light output.

Figure 12: Number of Dry Cells Used Per Week By Households With Dry Cell Powered LED Lamps in Mtwara Region

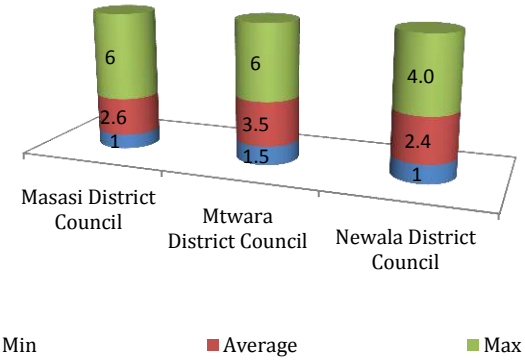


Figure 11: Weekly Expenditure On Dry Cells For Households With Dry cell Powered LED Lamps in Mtwara Region

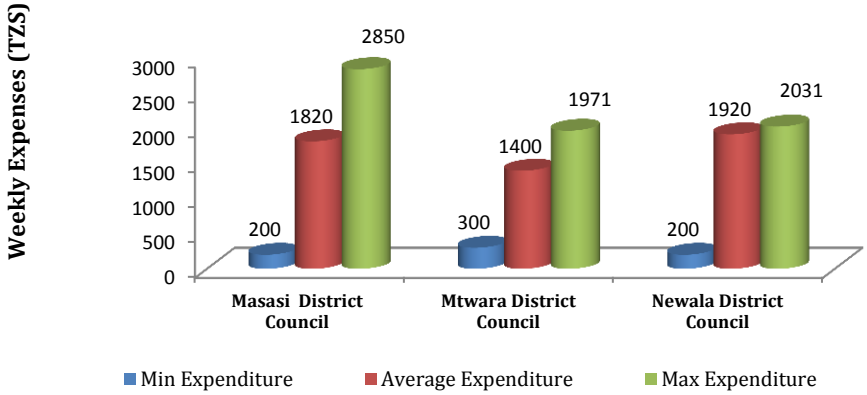
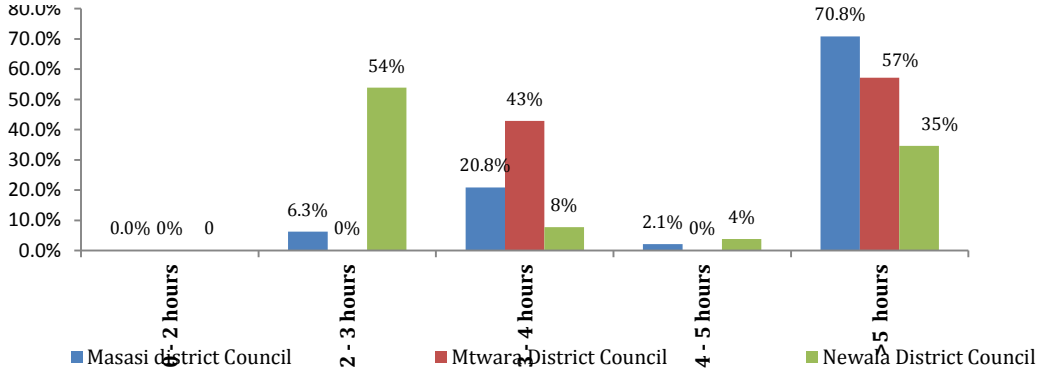


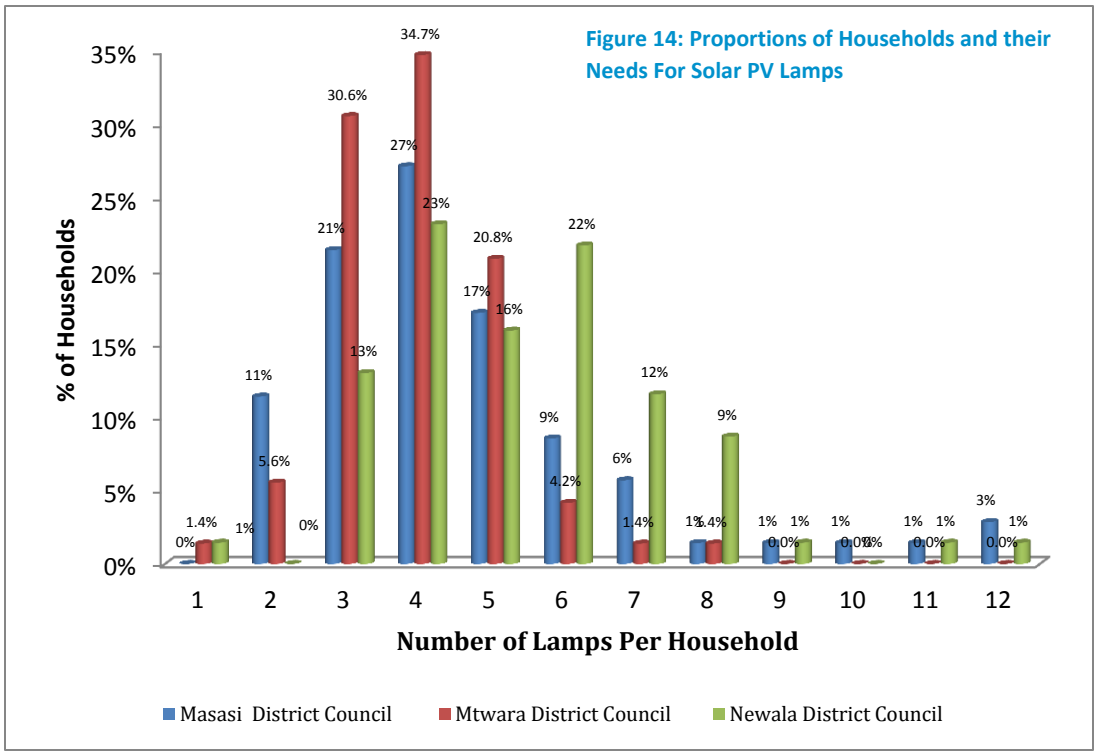
Figure 13: Percentage of Households Versus Number of Daily lighting Hours For Households Using Dry cells Powered LED Lamps In Mtwara Region



iii. Preference and Willingness of Consumers To Pay For Improved Lighting Options

Households in Mtwara region prefer 1 to 12 lighting points in their houses; the average number being 4 to 5 lamps per household. More than 50% of the households prefer 3 to 5 lighting points in the houses (Figure 14).

Figure 14: Proportions of Households and their Needs For Solar PV Lamps



Households are willing to pay up to TZS 50,000 per month for improved lighting services, in particular PV systems. On average, they are willing to pay between TZS 5, 290 and TZS 11,239 per month. This amount is below the current expenditure on kerosene and dry cells for lighting. This can be explained by current expenditure patterns on kerosene that involves purchase of fuels on daily basis.

4.2 Institution Survey

4.2.1 Health facilities

There are123 health facilities in surveyed districts councils of Masasi, Mtwara and Newala; among those facilities 2 are hospitals, 10 health facilities and the rest 101 are dispensaries.
All hospitals and 50% of the health centers in the districts are connected to grid electricity. In general 15.4% (or 19) of health facilities are connected to grid and 48.0% (or 59) are powered by solar PV systems. The rest 36.6% (or 45) do not have modern lighting energy services and they all carry dispensary status. A

summary of types of health facilities, their number, and their ownership and energy sources for lighting in the districts is found in Table 4.2.

Kerosene is used for lighting in health facilities without modern energy services. District authorities allocate 5 liters of kerosene per month for each health facility for lighting. This reflects expenditure of TZS 10,000 on kerosene per facility. All facilities are provided with LPG by district councils for vaccine refrigeration.

Figure 155: Willingness To Pay For Solar PV System For Lighting Per Month By Households in Mtwara Region

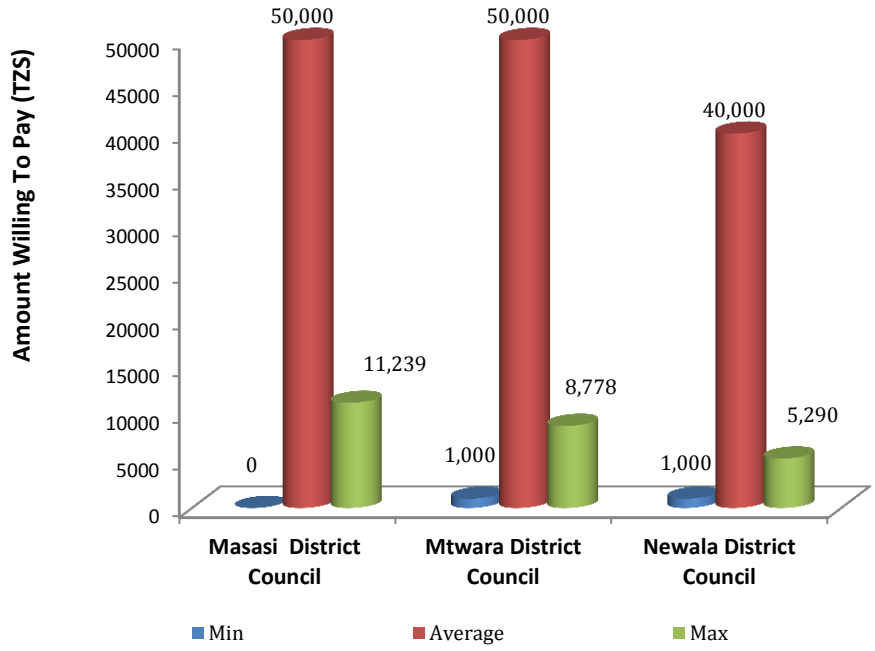


Table 4.2: Health Facilities and Their Energy Sources for Lighting in Mtwara Region

	Type of Health Facility	Ownership	Number of Health Facilities	Number of Health Facilities connected to grid	Number of Health Facilities installed with PV systems	Number of Health Facilities without modern energy services	Remarks
MASASI	Hospital	Government	0	0	0	0	• Govt. PV system at health centre is not working. There is a need for replacement of batteries. • 8 of the installed PV systems at govt. dispensaries are not working.
		FBO	1	1	0	0	
		Private	0	0	0	0	
	Health Centre	Government	2	1	1	0	
		FBO	1	1	0	0	
		Private	0	0	0	0	
	Dispensary	Government	28	3	13	12	
		FBO	9	2	7	0	
		Private	0	0	0	0	
TOTAL			**41**	**8**	**21**	**12**	
MTWARA	Hospital	Government	0	0	0	0	• 1 health centre and 7 dispensaries are in areas targeted for grid expansion. • The district council plan to install PV systems at 5 dispensaries during 2013/14 financial year. TZS 60 Million is already allocated.
		FBO	0	0	0	0	
		Private	0	0	0	0	
	Health Centre	Government	3	1	2	0	
		FBO	1	0	1	0	
		Private	0	0	0	0	
	Dispensary	Government	42	2	15	24	
		FBO	0	0	0	0	
		Private	0	0	0	0	
TOTAL			**46**	**3**	**19**	**24**	
NEWALA	Hospital	Government	1	1	0	0	• One dispensary is within grid area but not connected. •
		FBO	0	0	0	0	
		Private	0	0	0	0	
	Health Centre	Government	2	1	1	0	
		FBO	0	0	0	0	
		Private	1	1	0	0	
	Dispensary	Government	32	5	18	9	
		FBO	0	0	0	0	
		Private	0	0	0	0	
TOTAL			**36**	**8**	**19**	**9**	
RAND TOTAL			**123**	**19**	**59**	**45**	

4.2.2 Education Facilities

Energy Sources for Cooking

The surveyed districts have a total number of 369 primary schools and 74 secondary schools. Of the total number of primary schools 235 (or 63.7%) provide food to pupils and the number is 17 (or 22.9%)for secondary schools with such services to students. All schools use firewood for cooking and none has improved cook stove the reason being lack of awareness on the technology. Schools use traditional stoves and experience indicates usage of around 0.6 kg of firewood per meal per student. Schools do not buy firewood instead pupils or students bring the woods from their homes since most of them are day scholars. The served food is either lunch or porridge and in few cases both.
There are about 1,138 staff houses for all types of schools in three districts.

Energy Source for Lighting

Grid penetration rate to primary schools is 9.8% (or 36 schools) while that for secondary school is 12.1% (9 schools). Very few schools, 2 and 5 for primary and secondary schools respectively are boarding.
Schools that use PV systems for lighting are 6 (1.6%) primary schools and 20(or 27%) are secondary schools.
Energy sources of lighting for staff houses are kerosene and PV systems. More than 30% of staff houses visited by the consultant in the villages during the survey were using PV systems for lighting. The systems were bought by teachers either from their own savings or on credits.

Table 4.3 summarizes number of education facilities that are available in three districts and their respective energy sources.

Table 4.3: Number of Education Facilities and Their Sources of energy For Cooking and Lighting

Type Of School	Primary Schools				Secondary Schools				Grand Total
District Council	**Masasi**	**Mtwara**	**Newala**	**Total**	**Masasi**	**Mtwara**	**Newala**	**Total**	
Total Number of Schools	123	127	119	**369**	27	20	27	**74**	443
Total Number of Students	44,739	46,153	36,319	**127,211**	7,840	5,582	6900	**20,322**	147,533
Total Number of Classrooms	600	790	732	**2,122**	307	187	206	**700**	2,822
Total Number of teachers	1,032	953	814	**2,799**	364	186	199	**749**	3,548
Total Number of staff Houses	421	244	268	**933**	65	62	78	**205**	1,138
Number of boarding Schools	2	0	0	**0**	3	1	1	**5**	5
Number of schools that provide food to students	82	77	76	**235**	8	6	3	**17**	252
Number of Schools that use Firewood For cooking	82	77	76	**235**	8	6	3	**17**	252
Number of schools that Use traditional firewood stove	82	77	76	**235**	8	6	3	**17**	252
Number of schools that Use ICS for cooking	0	0	0	**0**	0	0	0	**0**	0
Number of schools that are connected to grid	5	25	6	**36**	4	2	3	**9**	**45**
Number of Schools that uses PV systems for lighting	0	6	0	**6**	7	7	6	**20**	**26**
Number of schools that is within 5 km from grid areas	6	11	22	**39**	9	5	6	**20**	**59**

4.3 Business Survey

4.3.1 Energy Sources Used For Cooking

a) Businesses in the villages

To understand energy sources used for cooking by businesses, survey efforts were directed to restaurants and food vendors as the major energy users.The survey conducted in 9 villages of Mtwara region indicated existence of 58 restaurants that gives an estimation of about 6 businesses per village.

Restaurants in villages were using firewood for cooking and the amount of wood used was 1 to 3 bundles of 15 kg each per day depending on the level of business. Expenditure on the energy at the price of TZS 1,000 per bundle of firewood was therefore TZS 1,000 to TZS 3,000 per day. All restaurant owners were aware of existence of improved charcoal stoves but they did not have knowledge of their benefits in terms of fuel saving. On the other hand, firewood availability was not a serious problem to them.

About half of food vendors in the villages were also using charcoal for cooking and their expenditure was between TZS 300 to TZS 3000 per day. None of them was using improved cooking stove but all indicated interest in the type of stove after knowledge of their benefits. Their ability and willingness to pay for ICS was between TZS 8,000 to 15,000.

b) Businesses in town

There are 213 licensed restaurants and hotels in Mtwara district council and 5 in Newala district. Restaurants in towns were mainly using firewood but food vendors in towns were using charcoal. The vendors are operating their businesses at market places and sometimes in open space and were therefore prohibited by district authorities to use firewood because of smokes and hygiene purposes.

Food vendors are aware of benefits of improved cook stoves but none indicated interest in using them for business purposes although they are using them at homes. Reason given by the vendors was short life span of charcoal stove clay liners that demands frequent repairs. The process of cooking food especially ugali exerts excessive force to the stoves that lead to their breakage. As a result the vendors are in favor of traditional charcoal stoves because of confidence they have in their durability.

This food vendor in Newala town said: "I prefer charcoal stoves made of rims of car tires because they are durable"

4.4 Estimated Demand of ICS, Biogas and Lighting Options

4.4.1 Estimated Demand of ICS

Findings from consumer survey indicated that proportions of households using firewood for cooking in the district councils were 92.9% in Masasi, 95.8% in Mtwara and 98.6% in Newala. Households using charcoal were 40% in Masasi, 8.3 in Mtwara and 1.4% in Newala district council. Based on these findings the estimated total demand of firewood and charcoal is 211,122 ICS as summarized in Table 4.4.

Table 4.4: Estimated Household demand of ICS in Mtwara region

District Council	Masasi	Mtwara	Newala	Total
Total Number of Households	68,887	58,462	58,712	186,061
Estimated demand of firewood ICS (Basis: % households using firewood)	3,996	56,007	57,890	177,893
Estimated demand of charcoal ICS (Basis: % of households using charcoal)	27,555	4,852	822	33,229
Estimated Total demand of ICS	91,551	60,859	58,712	211,122

Schools use firewood for cooking and the estimated demand is for firewood ICS. Schools that provide foods are potential demand for the stoves and their total number is 252 and for each district is as indicated in Table 4.5.

Table 4.5: Estimated Demand of ICS for Schools in Mtwara Region

District	Masasi	Mtwara	Newala	Total
Estimated Demand of firewood ICS for primary schools	82	77	76	235
Estimated Demand of firewood ICS for primary schools	8	6	3	17
Total	90	83	79	**252**

Table 4.6: Number of Livestock in Mtwara Region

Type of Livestock	Number of a Livestock in District Councils			Total
	Masasi	Mtwara	Newala	
Cows: Exotic Indigenous *Total*	3,000 11,856 *14,856*	241 5,227 *5,518*	280 1724 *2,004*	*22,378*
Pigs	6,196	55	1,220	7,471
Goats; Exotic Indigenous *Total*	? ? *18,842*	103 44,245 *44,348*	455 119,715 *120,715*	*183,905*
Sheep	4,302	3610	1,478	9,390
Total	**44,196**	**53,531**	**125,417**	**223,144**

4.4.2 Estimated demand of Biogas

Biogas technology experience is very limited in Mtwara region and the region potential is very low because of livestock index that is below the national average. Table 4.6 summarizes the number of livestock in surveyed districts in Mtwara region.

For the purpose of establishing household demand of biogas, only number of households with exotic cows is considered because the livestock can guarantee availability of enough wastes for production of gas. Requirement of at least 2 cows per household in order the household to use gas for cooking purposes is equally important. The number of households and average exotic cows in surveyed districts is indicated in Table 4.7. From such conditions current demand of 600 biogas units is available in Masasi district.

Table 4.7: Number of Households with Exotic cows in Mtwara Region

Type of Livestock	Number of Household Involved in the district			Total
	Masasi	**Mtwara**	**Newala**	
Cows: Exotic	**600**	**100**	**92**	**792**
Average # of Cow/household	**5**	**1**	**1**	

Source: District Agricultural and Livestock Officers.

4.5 Indoor Air Pollution

Indoor Air Pollution (IAP) is known for its potential of health hazards such as burns, increased incidences of respiratory tract diseases and eye irritations because of emissions caused by firewood combustion. Study (Rehfuess, 2006) revealed that inhaling indoor smokes double risks of pneumonia and other acute infection of lower respiratory tract infection (ALRI) among children under 5 years of age. Women exposed to indoor smoke are three times more likely to suffer from chronic obstructive pulmonary diseases (COPD) than women who cook with cleaner fuels. The extent of IAP in the surveyed district is not well documented for the purpose of comparison with maximum WHO recommended levels of human exposure to the pollutants. Existing ALRI and COPD does not establish the extent to which they are attributed by smokes from cooking fuel. However, in 2009 WHO estimated 18,900 deaths attributes to IAPs in Tanzania.

5. FINDINGS FROM MICRO-BUSINESS SURVEY

5.1 Coordination of the ICS, Biogas and Solar Distribution Activities

There is no formal coordination of ICS, biogas and solar distribution activities in Mtwara region. Individual initiatives by private sectors have been the major drivers of the uptake of technologies in the region. The existing distribution activities for these technologies in targeted districts in Mtwara region are described next.

5.1.1 Improved Cook Stoves

Masasi District

During the study visit in Masasi town two charcoal ICS sales outlets were identified and the stoves are sold in town since 2000. One dealer specializes in blacksmith products where ICS is one of the products. The source of stove supply is Sahana area in Temeke district, Dar Es Salam region and the two sizes of the stoves are sold at TZS 6,000 and TZS 7,000 for small and big sizes respectively.

Table 5.1: Sales of Charcoal ICS in Masasi town

Name of ICS dealer	Phone Contact	Years in ICS Business	# of stoves sold per month
Halima Mohamed (Bagamoyo Shop)	0783-31654	13	10-15
Issi Ismail	Nil	Not known	60 -120
Total			**70-135**

The two dealers do not have knowledge of other ICS dealers in Masasi town. One of the dealers mentioned Mnanje village, located 15 kilometers from Masasi town as a source charcoal ICS without metal frames that are fabricated on special orders.
Customers served are from both urban and rural areas though more awareness on benefits of ICS is for town customers than those in villages. Village customers prefer traditional charcoal stoves because of low prices that range from TZS 3,500 to TZS 5,000.

Mtwara District

In Mtwara district ICS are sold at the main food market in Mtwara town. There are about 7 dealers at the market and source of stoves is Vingunguti area in Dar es salaam. Very few charcoal ICS are fabricated in Mtwara region and a negative perception among dealers and customers is on durability of the stoves due to poor quality of soil used for liners to fabricate the stove. Such stoves are sold at lower prices (TZS 3,500) compared to those sourced from Dar es salaam(TZS 7,000) and they do not attract many customers.

Charcoal Improved stoves at Mtwara main food market

The awareness on ICS technology exists in town where most of customers are found.

Newala district

Improved charcoal stove technology is not new in Newala district. There are four (4) improved charcoal stove dealers in the district and the stoves are sold since 2000. The dealers sell charcoal as one of the business lines in their shops, others being home wares.

The main customers include urban households and very few rural households (civil servants and businessmen). The source of stove supply is Gerezani area in Dar Es Salaam and dealers use road transportation companies to bring the products into the district. Transport charges range from TZS 500 to TZS 700 per stove for the main stoves sizes of 10" and 12" that are common in the market.

Combined monthly sale of charcoal ICS for Newala town is estimated at more than 150 with prices ranging from TZS 3,000 to TZS 8,000 depending on the size of the stove and dealer's margin on the product. The level of awareness on improved stove is high and customers know benefits of the stoves in contrast with traditional ones. According to two major charcoal ICS dealers in the district, current monthly ICS sale has doubled compared to the sales recorded in 3 years ago.

One of Charcoal ICS sales outlet in Newalatown

Table 5.2: Sales by Major Charcoal Improved Cook Stove dealers in Newala District

Name of ICS dealer	Phone Contact	Years in ICS Business	# of stoves sold per month
Abdu Musa Bendera (Bendera Shop)	0788-048638	2	33
MihamedSelemaniMnowite (Dogo Store)	0712-457522	5	75
ShabanIssa shop	0784-741440	13	60
Total			**168**

5.1.2 Biogas

No identified business that was involved in supply or construction of biogas. There is a recently constructed biogas unit at Namajani Prison which is not yet fully operational. CARMATEC assisted the prison to design and supervise construction of the unit. Otherwise no any other biogas technology use was found in all districts. The number of cattle in the district is too low in most of the places to justify use of the technology.

5.1.3 Solar PV

Masasi District

Masasi district has 6 major solar PV dealers who stock a full range of PV system components and about 20 retailers who sell solar modules only. PV dealers operate in the district for the last 15 years and there were new 4 entrants in the market for the last two years.

The district has strong commercial linkage with other districts including Nanyumbu, Newala, Nachingwea and Tunduru districts. Prices of solar modules range from TZS 2,000 to TZS 3,000 per watt-peak similar to price offers by dealers in Dar es Salaam and sold modules sizes are up to 200 Watt-Peak. Solar PV suppliers in Dar Es salaam include Zara Solar Ltd, Rex Investment Ltd and Steps Entertainment.

Table 5.3:Sales of Solar Modules by Major PV dealers in Masasi District

Name of PV dealer	Years in business	Fast Moving Solar Module Size (Watt-Peak)	Solar module Price (TZS/Watt-Peak)	Estimated number of sold solar Modules per month
Terminal 2 Solar	15	100 -140	2600	15-20
Tinginya Shop	3	15-120	2000-2700	60
Advertise Electronics	4	5-50	3000	50
Nankwinda shop	2	30-80	2500 -3000	12 -20
Songa Electrical Supplies	3	40-200	2000	60
Total Sales				**197-210**

The major dealers in Table 5.3 stock full ranges of PV system components and prices of components differ from one dealer to another. Table 5.4 shows prices of the products by Songa Electrical Supplies whowas identified as the biggest dealers in the district in terms of sales turnover, quantity of stocked products and lowest price offerin the district.

Table 5.4: Prices of Solar PV systems Components at Songa Electrical Supplies, Masasi District

Product	Price (TZS)
Solar PV Modules (40 -200 Watt-peak)	2000/Watt
Solar Batteries(chloride exide) 12v/26 Ah 12V/50 Ah 12V/75 Ah 12V/100Ah	 70,000 120,000 150,000 180,000
12 V/100 sealed battery (Regal)	270,000
12 V/150 sealed battery (Regal)	370,000
Charge Controllers (Steps brand) 12V/6A 12V/10 A 12V/5A 12V/20A	 50,000 80,000 90,000 100,000
Inverters 12V/130Watt 12V/150 Watt	 40,000 50,000

12V/300 Watt 12V/330 Watt 12V/550 Watt	70,000 90,000 110,00
12V/2 Watt LED Lamps	5,500

Mtwara District

Mtwara district has 5 major PV dealers who stock full ranges of solar PV products and most of them sell other products including electrical and electronic appliances. The first dealers started PV business in 2000 and other dealer followed after Sida/MEM solar PV market development project intervention in the region in 2005. The project trained more than 20 technicians and some of them are being used as PV system installers by PV dealers.

Source of solar PV product is Dare s salaam and solar modules are offered at a price range of TZS 2,000 to TZS 2,500. Monthly sales of solar related products for the interviewed dealers range from TZS 500,000 to TZS 800,000 per dealer. Most of the customers prefer smaller sizes of PV systems from 10 – 15 Wp but stocked solar modules sizes are up to 200 Wp.

Table 5.6: Sales of solar related products in Mtwara town

Name of PV dealer	Years in business	Fast Moving Solar Module Size (Watt-Peak)	Solar module Price (TZS/Watt-Peak)	Estimated sale solar products (TZS/ month)
Mbecha General Supplies	13	10	2000-2500	800,000
Mmomi Hardware	2005	15-20	2500	500,000
BICO	New			
Lupanda	2005			
Big Boy	New			
Total Sales				**1,300,000**

Table 5.7:Prices of Solar PV system Components in Mtwara town District

Product	Price (TZS)
Solar Module (5-200 Wp)	2000-2500 per Wp
12v/6 Amps Charge Controller (Morningstar)	60,000
12V/10 Amps Charge Controller (Morningstar)	80,000
12V/26Ah solar Battery (Chloride exide)	55,000
12V/50 Ah solar battery (Chloride exide)	125,000
12V/75Ah Solar battery (chloride exide)	135,000
12V/100 Ah solar battery (Chloride exide)	170,000
12V/70Ah sealed battery (Regal Brand)	260,000
12v/100 Ah sealed battery (Regal brand)	320,000
150 Watt Inverter (Bico Solar)	45,000
300 Watt Inverter (Bico Solar)	100,000
12V/ 1 Watt LED Lamp (Sundar brand)	6,000
12V/ 1 Watt LED Lamp	4,500

Source: Mbecha General Supplies, Mtwara District

Mbecha general supplies, main PV dealer in Mtwara town

Newala District

There is only one, three years old dealer of solar PV products in the district after 2 similar dealers stopped the business due to low sales. This might be explained by presence of cheaper sources of the products in the neighboring Masasi district. The dealers stocks solar modules and balance of system components including solar batteries, charge controller, inverters and DC Lamps.

Solar modules sizes range from 5 to 100 Watt-Peak (Wp) at the price of TZS 3,500 per Wp. Prices of full range of solar products in Newala district is shown in Table 5.8.

Table5.8: Prices of Solar PV system Components in Newala District

Product	Price (TZS)
Solar Module (5-100 Wp)	3,500 per Wp
12v/10 Amps Charge Controller	70,000
12v/100 Ah sealed battery (Resden brand)	320,000
150 Watt Inverter	50,000
300 Watt Inverter	80,000
12V/ 1 Watt LED Lamp (Sundar brand)	6,000
12V/ 1 Watt LED Lamp	5,000

Source: Nyambi shop, Newala District

The estimated maximum sales per month is 10 solar modules during cashew nut harvesting season where 50 Wp solar module is the fast moving solar module size. The dealer serves customers from Newala district and Mozambique.

5.2 Number of Micro-Businesses in Target Areas

During field survey common businesses in the villages were identified. They include shops, kiosks, restaurants, phone charging services and milling machine. A total of 368 businesses were found in 9 villages in the surveyed districts. The numbers of such businesses in the districts are indicated in table 5.9.

Table 5.9:Types and Number of Businesses in Surveyed Villages in Mtwara Region

Type Of Business	Masasi District Council	Mtwara District council	Newala district Council	Total
Shops	5	36	14	55
Kiosks	45	18	23	86
Restaurants	16	32	10	58
Phone charging	22	34	80	136
Milling Machine	14	8	11	33
TOTAL	**102**	**128**	**138**	**368**

If total number of households in the surveyed districts is considered and divided by 1000 the findings reflects an average of 36 businesses for every 1000 households for all districts in the region as shown in table 5.10.

Table 5.10: Number of Businesses Per 1000 Households

District	Masasi District Council	Mtwara District Council	Newala District Council	Total
Number of Households in surveyed villages	4,091	1,757	2,083	**7,931**
Number of Businesses Per 1000households	25	72	66	**46**

5.3 Existence of Micro-Businesses Already Providing Off-grid Electricity Based Services

Out of the 46 businesses per 1000 household, 35 of them were already providing off-grid electricity products or services. Products included dry cells and LED lamps while electricity services included phone charging and cereal milling. Table 5.11 shows the number of micro-businesses that were providing off-grid electricity products and services.

Table 5.11: Number of Businesses Already Providing Off-grid electricity Based Products and services

District	Masasi District Council	Mtwara District Council	Newala District Council	Total
Number of Businesses already providing off-grid electricity services	86	71	124	**281**
Number of businesses per 1000 households	21	40	59	**35**

5.4 Readiness of Entrepreneurs and Micro-Businesses to engage in Energy Services Businesses

Types and number of businesses found in the surveyed districts in Mtwara region are presented in Table 5.11. Businesses in Masasi district council reflect those registered in 2013 after formation of the district from the current Masasi Municipal council. It should be noted that the presented businesses were only formalized enterprises otherwise most of the businesses in rural areas are informal.

Interviewed businesses were hardware, phone shops and retail shop and a total of20 businesses were asked their interest in the improved technology businesses. Hardware businesses regard ICS venture as minor investments. About67% of the interviewed businesses indicated interested in solar PV businesses if provided knowledge on the technology, sources of equipment and working capital. The rest were comfortable with their current businesses.

Table 5:11: Type and Number of Licensed Businesses in Mtwara Region

Type of Businesses	**Number Of Businesses in District Council**			**Total Number of Businesses**
	Masasi	Mtwara	Newala	
Retail Shops	14	367	516	897
Guest Houses		4	20	24
Hotels/Restaurants		100	5	105
Petrol Station		1	5	6
Kiosks		664	308	972
Hardware shops		2	11	13
Cereal Milling Machine	4	75	33	112
Garage		1	3	4
Timber /Carpentry		264	4	268
Butchery			8	8
Fish Business			35	35
Motor/bicycle spares		8	18	26
Mobile phone shop			7	7
Bars		62	11	73
Ceramics		45		45
Cigarette agents		9		9
Pharmacy		6	10	16
TOTAL				2,620

Source: District Trade Offices

6. ENABLING ENVIRONMENT SURVEY

6.1 Evidence of Appropriateness for ICS businesses in the Target Areas

6.1.1 Improved Cook stoves Business

Firewood ICS are appropriatefor rural energy consumers because the woods are easily available and cheaper than charcoal. However, awareness on this technology is completely lacking. Potential consumers are not even aware of existence of the technology. Given the distance travelled by consumers to collect firewood and potential of ICS in addressing problems related to uses of traditional firewood stoves there is a high chance of acceptance of the technology. However, successful businesses will require building capacity of installers in villages and existence of extension activities in order to disseminate the technology.

Charcoal ICS are appropriate for urban areas where the available energy source is charcoal. The stoves are already in the market but potential of deeper penetration is high with sensitization programs to consumers, addressing stove quality issues and availability of stoves at reasonable prices. All these activities need to be coordinated.

6.1.2 Biogas Businesses

Due to low number of exotic cattle in Mtwara region biogas businesses is not currently appropriate for most of the areas in the region. Masasi district is the place that can be considered for biogas businesses. Most of the dairy cows are found in Masasi town where, according to district livestock officer, cow shelters have concrete floors. Moreover, biogas can replace charcoal in order to save costs incurred on fuel by households. The temperature is about 30^{o}C and water is easily available in urban areas unlike rural areas. The number of dairy cows is about 3000 in Masasi town. Coordination is required to disseminate the technology. That should involve creating awareness on the potential of technology and building capacity of technicians to construct biogas plants.

6.1.3 Solar PV Businesses

The need for electricity is high and most of the region will not be reached by grid in the near future. All rural areas are appropriate for PV businesses.

6.2 Lessons Learnt From Other Organizations/initiatives

6.2.1 Mtwara District Council

- **UN Women**

UN Women is the UN funded program for community development in Mtwara district. The organization has facilitated installation of ninety 20-Watt PV systems for three lighting points and phone charging each. Installation of additional eighty five 5-watt solar PV system is in progress and materials for the installation were already procured a month before the time of this study.

The approach taken by the project was, first, identification and conducting energy needs survey in three villages for project intervention in Mtwara district .Then two women from each village were identified and sent to India for a six month solar PV system installation and maintenance training. Later, the women went back to the villages – Chekelini and Nikechela village where they are involved in PV systems installation and maintenance work.

The first batch of installed PV systems was a grant and sourced from India at $130 each. The villages formed solar energy committee that had a role of overseeing installation and maintenance

of systems and collection of money from beneficiaries. Each beneficiary was required to make a deposit of TZS 20,000 and commit a payment of TZS 5,000 every month for maintenance of systems.

Additional PV systems have been sourced from Dar essalaam at USD 5,000.

Since the 2- year project is over, the organization is looking for an NGO that can help run the project. The experience from the project implementation is difficulty in follow up of project activities due to distance (45 to 82 km) and remoteness of the villages from the Mtwara district headquarter. The villages had also difficulties in collection of funds from beneficiaries especially during cashew nut non - harvesting season.

- **Tanzania Social Action Fund (TASAF)**

Tanzania Social Action Fund (TASAF) is a government of Tanzania funding facility organisation that provides a mechanism to allow local and village governments to respond to community demands for interventions contributing to the attainments of specific Millennium Development Goals. In Mtwara district council TASAF support three areas:

- Services to poor community with particular emphasis on education, health, water and road sectors.
- Support to different vulnerable groups based on their identified needs, and
- Support of able bodied communities with food insecurity problems.

TASAF has funded installation of solar PV systems at 2 dispensaries, 8 secondary schools and 6 primary schools in Mtwara district. The aim is to improve health services at dispensaries and to enable students and pupils study at night. This was implemented under phase II of TASAF programme that will wind up in June 2014.

TASAF programmes are implemented in all regions in the country and the second phase of the programme is already concluded for other regions. Funding for the on-going activities was contributed by OPEC specifically for Lindi and Mtwara region.Thethird phase of the programme addressing community poverty issues has been launched countrywide but not in Mtwara region pending finalization of the current programme.

Experience learnt from TASAF on installed PV systems is the issue of sustainability of the systems due lack of arrangement for maintenance and repair. Other systems are undersized and not working properly. There was inadequate expertise on sizing of PV systems during planning phase of the project.Solar PV systems were installed at day primary schools and they are, therefore, not used for study at night by pupils.

Table 6.1: Institutions installed with Solar PV Systems by TASAF Program in Mtwara District Council

Type of Institution	Name of Institution	Ward	PV System Size and Uses	PerformanceOf PV system
Dispensary	Kawawa Dispensary	Manyanga	2 x 100 Watt Solar PV system provides power for lighting and Television	Working
	Narunga Dispensary	Njengwa	4 x 100 Watt PV system provides power for lighting and TV	Not working (inverter not working))
Primary School	Naringu Primary school	Msangamkuu	3 x 100 watt PV system used for lighting in 3 classrooms at each school	Working intermittently
	Kihamba	Kitanya		Working

	Primary school			
	Majengo Primary School	Njengwa		Not working
	Namisangi Primary school	Mtimbwilimbwi		working
	Mihule Primary school	Nitekela		Working intermittently
	Namambi Primary School	Mnima		Working
Secondary school	Kisiwa Secondary School	Naumbu	2 x 100 watt PV system is used for lighting in 3 classrooms	Working
	Njengwa Secondary School	Njengwa	2 x 100 watt PV system is used for lighting in 2 classrooms	Working
	Likonde Secondary School	Mayanga		Working intermittently
	Ndumbwe Secondary School	Ndumbwe		Working intermittently
	Libobe Secondary school	Libobe		Not working (vandalized)
	Chawi Secondary school	Chawi		Working
	KitayaSecondary school	Kitaya		Working
	NamtumbukaSec. school			Working

- **Small Industries Development Organization (SIDO)**

SIDO was established in October 1973 as a parastatal organization under now Ministry of Trade, Industry and Marketing. Its objective is to develop the small industry sector in Tanzania.
SIDO collaborated with Tanzania Commission for science and Technology (COSTECH) to train about 20 artisans in construction of improved stoves in 1980's. The artisans are in about 20 groups of 3-20 people that are involved in construction of charcoal stoves. SIDO supports the groups in training on business management and product quality improvement. The organization also provides grants and credits to the groups.
One of the groups was visited by the study team. The group has blacksmith workshop and its main activities include fabrication of water gutters, water can and charcoal stoves. The lesson learnt was that the group had difficulties to fabricate improved charcoal stoves due to lack of clay soil in Mtwara district. Clay soil is found in Ndanda area, hundreds of miles from the district.

- **21st Century Education Program (TZ21)**

This is a five-year Tanzania 21st Century Basic Education Program (TZ21) sponsored by the American people through the U.S. Agency for International Development (USAID), the Ministry of Education and Vocational Training, and private sector partners Cisco, Intel Corporation, Microsoft. The program was launched in June 2012.

The goal of TZ21 is to integrate Information and Communication Technology (ICT) into primary level education to improve the quality of primary school education in Zanzibar and the Mainland. The new technologies are integrated into teaching and learning to increase students' achievements in reading, mathematics and science. The program will strengthen professional development at teacher training colleges and centers in Mtwara and build decision making capacity at the Ministry of Education and Vocational Training headquarters and district levels.

The program has so far managed to provide computers with internet connectivity for all primary schools in Mtwara district. The study team visited Chawi primary school with 4 x 140 Watt PV systems installed 2 month before the time of this study. The system runs 4 computers for teaching Swahili, English and science subjects.

It is early to learn experience from the program. However, the team learnt that internet connectivity at Chawi was out of order though computers were working. It was also learnt that teachers at Nanguruwe primary school were not using the computers because they had not yet received training from the program.

- **Microfinance Institutions**

All main commercial banks in the country have branches in Mtwara region. The banks include NMB, CRDB, Exim Bank, Boa Bank, NBC and Postal Bank. A total of 24 SACCOs are registered in Mtwara district council and 6 of them are active. All active SACCOs have commercial linkages with either CRDB or NMB. One of them has an additional linkage with SELF. No energy related project that has been implemented by SACCOs.

Table 6.2: Active SACCOs in Mtwara District council

No.	Name of SACCOs	Ward	Location and linkage with commercial bank
1	Chalile SACCOs	Nanyamba ward	
2	Rural Teachers SACCOs	Mtwara town	
3	District Council SACCOs		
4	Moma SACCOS	Ziwani	
5	Mayembechini	Kitaya	
6	MuunganoMalunga	Tangazo	Linkage with SELF

6.2.2 Masasi District Council

- **Masasi District Council**

In collaboration with friends in Germany (Enzkreis), Masasi District Council plans to assemble solar lanterns and cookers in the district. Two instructors at Masasi Focal Development College (FDC) have been trained in Germany and the aim is to incorporate solar energy course into the college curriculum. The emphasis is on assembly of solar energy products that are tailored to local energy needs at affordable price. The next step of the program will be introduction of biogas. Since the project is still in planning phase, it is too early to draw experience from the planned initiatives.

- **NGOs in Masasi District Council**

Masasi district council has registered 38 NGOs and 160 CBOs. MANGONET is the umbrella organization of 14 registered NGOs in Masasi district council. Two NGOs namely; KIMASIandMasasi Environment Conservation and Agriculture Association (MECAA)are involved in environment

conservation. Another NGO, Masasi Women Development Association (MAWODEA) is involved in solar drying of fruits and vegetables.

- **Tanzania Prison**

The prison has constructed a biogas plant in Namajani village in Masasi district and trained artisans for biogas construction. The prison was assisted by CARMATEC of Arusha to design the plant and train artisans who are staff of Tanzania Prison while others were from other parts of the district.

- **Microfinance Institutions**

Three commercial banks operate in Masasi town and they all have offices in the town. The banks include National Microfinance Bank (NMB), National Commercial Bank (NBC) and Cooperative and Rural Development Bank (CRDB). Registered SACCOs in Masasi district council are 8 and four of them are active. One SACCOS is linked with Tanzania Investment Bank (TIB).

Table 6.3: Active SACCOS in Masasi District Council

No.	Name of SACCOs	Ward	Location and linkage with commercial bank
1	Umoja SACCOs	Mwena	Linkage with TIB
2	Amani SACCOs	Mwena	
3	Ukombozi SACCOs	Lukuledi	
4	Muungano SACCOs	Nanganga	

6.2.3 Newala District Council

- **NGOs**

Newala District Council has seven (7) registered NGOs, twenty four (24) CBOs and three (3) FBOs. All NGOs are based in Newala town and none of them is directly involved in energy related projects. However, three NGOs namely DEVIM, NEYONE and UWAMAMA implement environment conservation projects focusing on tree planting.

- **Microfinance Institutions**

National Microfinance Bank (NMB) is the only commercial bank found in Newala district council. There are 23 registered SACCOs in the district and among them 7 are active. The active SACCOs are located in town with the exception of two that are found in rural areas. Four SACCOs have commercial linkages with Cooperative Rural Development Bank (CRDB) in Mtwara town.

Table 6.4: Active SACCOS in Newala District Council

No.	Name of SACCOs	Ward	Location and linkage with commercial bank
1	Boma SACCOS	Mtonya	In town
2	Newala Health SACCOs	Mtonya	In town with linkage to CRDB
3	Newala SACCOS	Luchingu	In town with linkage to CRDB
4	NewalaTandahimba Teachers SACCOs	Luchingu	In town with linkage to CRDB
5	Changamka SACCOs	Luchingu	In town
6	Pangana SACCOs	Mchemo	In villages with linkage to CRDB
7	Lekatulinge SACCOs	Makonga	In villages

7. SUPPLY CHAIN SURVEY/ ASSESMENT

7.1 Supply Chain Survey

7.1.1 ICS Supply Chain

There are no manufacturers and suppliers of ICS in Mtwara region. Instead, dealers of ICS in the region source the product from Dar essalaam via road transporters not exclusively for stoves but also other consumer goods imported into the region. Transporters consolidate goods purchased by different traders from Dar es salaam destined to Mtwara region in order to reduce transport costs through economies of scale.

ICS dealer in Newala town is offloading stoves from the track to motorcycle for storage purposes.

Numbers of dealers that were identified in the surveyed districts are indicated in Table 7.1.

Table 7.1: Number of Charcoal ICS dealers in Mtwara Region

District Councils	Number of ICS dealers
Masasi	3
Mtwara	7
Newala	4
Total	14

It is worth noting that the indicated dealers in Mtwara and Masasi district councils were identified in Mtwara and Masasi Municipal councils respectively that were not part of the identified districts for MI study. The reason is that the headquarters of the district councils are located in the municipal councils and the major towns in the municipals have direct commercial linkage with district councils. They are places where major shopping is done by people from the district councils.
Charcoal ICS are imported due to limited expertise on construction of ICS in Mtwara region and availability of quality materials for stoves such as clay soil is also a challenge. Two areas in the region, in Nanyumbu and Ndanda, were mentioned by interviewed dealers as known source of clay soil and therefore potential for further investigations on suitability of their soil for the ICS. Another challenge is low level of awareness by potential consumers on benefits of ICS over traditional stoves in terms of fuel saving.

7.1.2 Biogas supply Chain

Biogas industry in Mtwara region is dormant because of low livestock population, limited awareness on potential benefits of the technology and technical capacity of construction, operation and maintenance of biogas plants. A recently constructed biogas plant at Namajani prison in Masasi was the only identified plant in the surveyed districts. CARMATEC in Arusha region assisted in design of the plant and conducting training to prison staff.

District biogas potential exists in Masasi district where the number of exotic cattle is about 3000 and mainly in town for about 600 households. Livestock department of Mtwara district council has introduced dairy cows in 9 villages since 2008. The livestock were provided free of charge to groups of farmers. Each group has 10 members and already every member in 9 groups has received a dairy cow and additional cows will be provided to two groups in different villages. The aim is to sensitize the community on benefits of dairy cows that did not exist in the district before. Names of Villages that has received the cows and their number are found in Table 7.2.

Table 7.2: Villages and Number of Dairy Cows in Mtwara District Council

Name of Village	Ward	Number of dairy cows
Nachenjele	Mbawala	10
Nyundo	Nitekela	10
Kitamabondeni	Nitekela	10
Mkutimango	Mnima	10
Manamawa	Dihimba	10
Unguja	Libobe	10
Libobe A	Libobe	10
Chekeleni	Kitele	20
Chemchem	Kitele	10
Muungano*	Muungano	20
Kilambo*	Tangazo	4
Total		**124**

*planned villages for additional dairy cows

7.1.3 Solar PV Supply Chain

A total number of 12 solar PV dealers, 20 solar PV retailers and 20 installers are available in Mtwara region. Dealers stock all PV system components including solar modules, charge controllers, batteries, inverters and lamps. Although solar PV is a core business of the dealers in the region all dealers diversify their products in order to sustain their operation costs and earn profits. Retailers stock only limited components mostly solar modules. SIDA/MEM Solar PV project trained 20 technicians from different district in the region and most of them are installers of PV systems. Table 7.3 indicate the number of actors of PV supply chain in Mtwara region

Table 7.3: Type and Number of solar PV actors in Mtwara Region

District	Masasi District Council	Mtwara District Council	Newala District Council	Total
Number of Solar PV dealers	6	5	1	12
Number of solar PV retailers	20	0	0	20
Number of trained Technicians	20			20
Total				**52**

According to dealers in the region the main challenge of solar PV industry is poor installation of PV systems that is done by unskilled people in rural areas. The impact of such practice was poor reputation on the technology and therefore reducing rate of community adoption of the technology. Rural households prefer small PV systems of up to 15 Watt-Peak in size that cost up to TZS 400,000 and they use them mostly for about 3 lighting points and phone charging.

7.2 Agricultural and Penetrating Rural Companies

There are two strong cooperative unions in Mtwara region that are entitled in collection and sales of agricultural produces, mainly cashew nut in Mtwara region. Masasi-Mtwara Cooperative Union (MAMCU) LTD is responsible with Masasi and Mtwara districts while Tandahimba - Newala Co-operative Union (TANECU) LTD takes care of Tandahimba and Newala districts.
MAMCU LTD offices are located in Mtwara town serving 34 Agricultural Marketing Cooperative Societies (AMCOs) that are found at ward levels in Mtwara district council and the union is ready to cooperate with the project. On modalities of cooperation, the general manager is of opinion of organizing the meeting that will bring together all AMCOs because they deal with potential consumers directly.

TANECU LTD also expressed willingness to cooperate with the project but insisted on seriousness of the project designer on the subject matter. The remark comes from experience of union executives that attempted cooperation with a solar PV initiative that did not take off. Arrangement had been made between the union and CAMCO Ltd to finance 100 households who were AMCOs members and the union collected money (TZS 13 million) for purchase of PV system. The project did not take off and the project initiator did not bring feedback to the union on what had happened. The union was forced to return money to their members after retaining it for a year.
There are 30 registered AMCOs in Newala district that are found at ward levels.

8. ENERGY OPTION ANALYSIS

In this chapter cost-benefit analysis is done at household level where each household cooking technology entails a number of different costs and benefits. Since more than 93% of the households in Mtwara region use traditional firewood for cooking the analysis compares the costs and benefits of households' switching from traditional wood-burning stoves to improved wood burning stoves. The household level analysis is calculated by estimating the direct positive costs and benefits. The direct costs are the purchase costs of an ICS as well as the maintenance and fuel wood costs. The direct benefits include the savings on expenditure for firewood, savings in the consumed amount of firewood, and the associated reduction inCO2 emissions.

8.1 Econometrics Used For Cost Benefit Analysis

Net Present Value (NPV), a common criterion by which acceptability of a capital investment can be judged is then used.If the net present value is positive, it would mean that the investment for the improved cooking stove earns a higher rate of interest than an alternative investment opportunity.

8.2 Underlying Assumptions for Cost Benefit Analysis

To arrive at competitiveness of the ICS, several assumptions were considered as presented in Table 8.1.

Table 8.1: Assumptions for Cost benefit Analysis of Firewood Improved Cook Stoves

ICS input Parameter	Value	Value (USD)	Explanation of input parameter and source
Capital Cost (TZS/year)		20	Market price of Improved wood stoves according to GVEP, DEEP program. Portable rocket wood stove is considered because best thermal efficiency and lowest cost.
O & M cost (USD/year)		2	Operations and maintenance of stove is assumed
Lifetime (years)	5		Economic lifetime of the stove by Abermel (2007), economic valuation of ICS in Uganda
Fuel Cost (TZS/Household/Month)	14,293	11.2	Average cost on firewood from household survey in three districts of Mtwara region
Fuel Escalation Rate (%)	6.1		Fuel cost will increase at a minimum rate of inflation rate. The indicated is inflation rate for Sept 2013 (Bank of Tanzania).
Fuel Savings (%)	50-70		Proportions of fuel wood after switching from three stone traditional stove to ICS, according to several literatures - GVEP, DEEP program and some GTZ reports. 60% is used for analysis.
Discount Rate (%)	15.33	10	Overall lending Tanzanian shilling rate by commercial bank (from BOT Sept 2013 review). But 10% is a commonly used USD rate and therefore used in analysis.
Carbon Offset Price (USD)		20	CBA of the installation of ICS in Bangladesh (Alam Nazimul, et al, DEC

			2012)
Carbon Offset Value (t CO2-e/ stove-year)			Calculated according to IPCC guidelines (2006). Refer Table 8.2 for calculations.
Exchange rate (TZS)	1612.5	1	Bank of Tanzania (15th Nov 2013)

8.3 Cost Estimation

Estimation of costs includes capital costs of USD 20 (purchase cost of stove), maintenance cost of stove at USD 2 per year and firewood expenses of USD48 per year.

8.4 Benefit Estimation

Benefits include fuels saving per year (0.6 x 115.2= USD69.1 per year) and carbon offset value of 160.74 USD/stove/year.

Table 8.2: Estimation of Benefits of Firewood Improved Cook Stove

Carbon Offset Value		
Average Amount of Firewood consumed by household Per We	16.67	Kg/hh
Amount of fuel consumed Per Year	866.67	Kg/hh/year
Fuel Saving With use of ICS	60%	
Amount of fuel Saved Per year	520	kg
Amount of fuel combusted in 1 kg of firewood	0.000138	TJ/hh
Amount of fuelwood saved in 1 year per household	0.07176	TJ/hh
Emission Factor form fuel wood from IPCC guideline	112000	
Amount of CO_2 saved Per Year per stove	8037.12	Kg
Amount of CO_2 saved Per Year per stove	8.03712	t CO2 e/stove-year
Price of 1 ton CO_2	20	USD/t CO_2 e
Carbon Offset Value	**160.74**	USD/Stove/year
Firewood Expense savings		
Average Household Expenditure on Firewood Per week	2.22	USD
Average Household Expenditure on Firewood Per Year	115.2	USD
Firewood saving per year	**69.1**	**USD**
TOTA BENEFITS PER STOVE PER YEAR	**229.9**	**USD**

8.5 Results of Cost Benefit Analysis

Using nominal discount rate of 10% and stove lifetime of 5 years, NPV is computed and the results indicated that the value is USD 769.72. Benefit /Cost ratio was 4. This means, based on a period of 5 years and a discount rate of 10%, the investment of 1 USD yields a return of 4 USD, considering economic benefits of fuel savings and carbon emission offset. Other benefits such as reduced cooking time, better health and preservation of forest reserves were not considered.

Table 8.3: Cost-Benefit Analysis of Firewood Improved Cook Stove

Capital Cost			**Lifetime**	5	Years
Purchase cost	20	USD			
			Nominal Discount Rate	10.0%	
O & M costs			Inflation rate	6.1%	
Maintenance cost	2	USD	**Real Discount rate**	3.7%	
Firewood expense	46	USD			
	48				
	Year	**Cost**	**Benefit**	**Benefit - Cost**	
	0	20	0	-20.00	
	1	48.1	229.9	181.78	
	2	51.0	229.9	178.85	
	3	54.1	229.9	175.74	
	4	57.4	229.9	172.44	
	5	60.9	229.9	168.93	
	NPV	**$262.98**	**$1,032.70**	**$769.72**	
	Net Benefit/Cost			**3.9**	

9. CONCLUSION

9.1 Biomass Energy Situation

Demand of forest products by local population in Mtwara region for poles, fuel woods and timber is increasing and it currently exceeds the rate of afforestation. This has led to suspension of harvesting the products by district authorities until forest resource assessment is undertaken. There has been tree planting initiatives by the districts of planting trees every year but their survival rate is low due lack of water. Furthermore, forest harvesting is still taking place illegally as fuel woods such as charcoal are available in all districts despite the fact that no charcoal trading licenses are given in the districts. Though shortage of charcoal and firewood is not yet serious the likelihood for such level of problem is inevitable in future if the situation is not addressed. Mtwara district council has estimated 17,342 ha of forest reserves and 13,017 of community forests. Masasi district council has 212,600 ha of land forest. The total area with natural vegetation in Newala district council is estimated to be about 26,379 ha while planted trees cover about 223 ha.

9.2 Current Cooking and Lighting Energy Supply Options

At least 93% of rural households use firewood for cooking whereas urban residents use charcoal. Rural households consume an average of 67 kg of firewood each per month that reflects expenditure of USD9 for the same period. While households that use charcoal for cooking in rural areas constitute less than 16%main users are civil servants and businesses. Education facilities that provide food include 64% of primary schools and 23% of secondary schools in the region. All facilities use traditional three stone firewood stoves for cooking and the average firewood consumption is 0.6 kg per meal per student.

Kerosene is still the main source of energy for lighting for at least 50 % of households, followed by dry cells 39%, PV systems 9% and open fire and car batteries account for the rest 2%. A typical household that use kerosene lanterns consume 1 litre of kerosene per week and 0.5 a litre for the households using wick lamps. Households using dry cells to power LED lamps use an average of 2.4 to 3.5 cells per week.

About 9.7% of primary schools are connected to grid electricity, 1.6% solar PV systems and the rest 88.7% lack energy for lighting. Grid penetration for secondary school is 45% while PV systems are installed at 27% of the schools leaving 13% without improved energy source services. Grid connection rate to health facilities is 15.4% and 48% of the facilities use solar PV systems for lighting. The remaining 36.5% use kerosene for lighting and all are dispensaries. Dispensaries in rural areas are allocated 5 litres of kerosene eachby district authorities for lighting per month.

9.3 Potential Demand for ICS, Biogas and Solar PV products and services

There is an estimated demand of firewood and charcoal ICSs for 177,893 households and 33,229 households respectively in target areas. People currently travel an average of 2.4 km to collect firewood. Education facilities have demand of firewood ICS for 252 primary schools and 74 secondary schools. Firewood is brought by students from home for day schools and purchased for boarding schools. Firewood ICS do not exist in target districts while charcoal ICs are only found at district headquarters.

Of the targeted districts biogas technology potential exists for Masasi district only as other districts do not have adequate exotic cattle for biogas units. The demand of biogas for cooking in Masasi

district is estimated for 600 households who practice zero grazing that can assure availability of adequate cow dung.

Since grid electrification rate for the target areas is 0.7%, a total of 184,758 households have potential demand for alternative lighting technology especially solar PV. Estimated demand of PV systems for lighting exists for 288 primary schools and 25 secondary schools. These are facilities that do not have improved energy sources services. PV systems are currently sold at district headquarters.

9.4 Existence of Enterprises for Energy Related Businesses

The target project area has an average of 46 micro-businesses per 1000 households and among them 35 either sell energy products or provide energy services that are off-grid related. These businesses include shops and kiosks that stock solar PV products, dry cells and LED lamps. Other businesses are phone charging centres and cereal milling machines. Non energy enterprises still hesitate to enter energy businesses because they lackfamiliarity to the products. Since the working capital is so limited, they fear to venture in industry they are not certain of returns.

9.5 Environment for ICS, biogas and solar PV Businesses

Awareness of consumers on the benefits of ICS is lacking and some are not aware of existence of firewood ICS at all. It is difficult for consumers to compare the benefits of charcoal ICS over traditional stove; as a result people prefer the low priced traditional stoves. Enterprises therefore promote inferior stoves that consumers are willing to buy.

Enterprises lack **working capital** and have limited access to finance. Unless there is high profit making potential, entrepreneurs are in favour of fast moving products which might not be the cases for ICS.

There is lack of **expertise** in construction of ICS and required quality materials such as clay soil for fabrication of stoves are not available in the target area.As a result all stoves are imported from Dar es salaam.

Some of the technologies especially solar PV require relatively high **initial investment** that potential rural households are not able to afford. The ability to pay for rural households is limited to pico solar home systems but quality of such products has been questionable.

There is limited experience of dissemination of improved technologies on the target area. Available experience indicates the need for availability of credit facility of improved technologies that should go along with offering products that match consumer' energy needs. Income patterns and level of affordability of the consumers are equally important for the facility. The organization running financing facility should have capacity and experience of working with microfinance at grass root levels.

9.6 Supply Chain Assessment

There are estimated 14 charcoal ICS dealers in the target area and most of them are found at district headquarters. No identified entrepreneur that is involved in construction of firewood ICS and biogas businesses. Charcoal ICS dealers source their products from Dar es Salaam and they use road transporters to deliver their stoves at a cost of TZS 500 to 700 per stove. Stove prices range from TZS 5,000 to TZS 7,000.

The target area has at least 12 major dealers that stock a full range of solar PV system components, 20 retailers who mainly stock some components especially solar modules and about 20 technicians that are involved in installation, maintenance and repair of solar PV systems.

The extent of IAP in the target area is not well documented for the purpose of comparison with maximum WHO recommended levels of human exposure to the pollutants. Existing ALRI and COPD does not establish the extent to which they are attributed by smokes from cooking fuel. However, in 2009 WHO estimated 18,900 deaths attributes to IAPs in Tanzania.

9.7 Agricultural Companies Penetrating in Rural Areas

The target region is endowed with two major cashew nut cooperative unions namely TANECU LTD and MAMCU LTD that are involved in buying and transportation of the agricultural produce from rural areas. The companies have extensive networks that go up to the ward levels in the districts. Though not their core business they are potential distributors of cooking and lighting technologies if the rural population is targeted. They indicated willingness to discuss further about the arrangements for the distribution of the products.

9.8 Market Availability to Consumer Energy Uses

Firewood ICS are potential for rural households whereas urban households are suitable for charcoal ICS. Households that use charcoal for cooking are already willing to pay between TZS 5,000 to TZS 7,000 per ICS stove. Though benefits of firewood ICS is 4 times over its costs consumers do not have any prior knowledge and experience of the product. Its market will largely depend on the level of sensitization of the planned programme. This also applies to education facilities where firewood is the cheaper energy source option for cooking.

Biogas technology is also new to the potential consumers but with potential of replacing charcoal in urban areas of Masasi district who are currently spending between TZS 12,000 to 24,000 per month on charcoal.

More than 50% of the households need 3 to 5 lamps but their average affordability for financed solar PV system is TZS 8,435 per month. This type of customers can be served better by pico solar home systems like solar lanterns or up to accustomed 15 watt solar PV systems that will be within the reach of the majority in rural areas. Use of dry cells powered LED lamps is a proof of needs for the technology.

10. RECOMMENDATIONS

In order to develop a private sector led and sustainable ICS market there is a need to develop a business model that will address the current business challenges. That model should be coordinated by key stakeholders and involve other stakeholders especially entrepreneurs and end-users of the technology.

10.1 Quality of Improved Technology Products

Charcoal ICS stoves and solar PV systems already exist in the market but there is no quality assurance of the products and consumers are not well positioned to distinguish poor and quality products. Awareness on the use of the products should address quality issue as the trend is consumers going for low priced but inferior goods. That done will build consumer's confidence in the products and hence sustainability of the market.

10.2 Local Manufacture of Improved Energy technologies

There are very few areas in Mtwara region with clay soil for charcoal ICS liners. The available ones such as Ndanda area in Masasi districts should be researched for it appropriateness as a source of clay soil for charcoal ICS liners. That will enable local manufacture of the stoves if the local capacity of artisans is built through training in the region. That will guarantee availability of the products and lower prices because of avoided transportation costs from Dar es Salaam to the region.
Building local capacity should also involve training biogas artisan and solar PV systems installers.

10.3 Financing Mechanism for Improved Energy Products

Majority of households are not able to afford upfront costs of improved energy technologies. There is a need of credit facilities to allow the consumers pay for the energy products by installments that should coincide with cashew nut harvesting season (September to December) in order to avoid defaults.

10.4 Awareness on Improved Technologies

The level of awareness on the improved technology is very low and experience of uses of such technologies is also limited. There is need of sensitization program on benefits, availability and prices of products at village levels if improved technologies have to be adopted. Enterprises are not doing much on this because of associated costs in marketing the products and instead rely on walk in customers that receive information through references. This should be done by the program until the awareness of the consumers is available for the market to run on purely commercial basis.

10.5 Coordination of ICS industry

he ICS industry can address the above mentioned through coordinated effort. There is a need for a coordinating body throughout the supply chain of the product. That will allow technology entrepreneurs get access to information on the products and at the same time provide linkage to the consumers.

10.6 Diversity of Products

During survey in Mtwara district energy need for phone charging was ranked second priority after the energy need for lighting. Combination of multiple features of the products such solar lanterns that can also charge mobile phones will increase the chance of adoption of the technology.

ANNEX 1: TERMS OF REFERENCE FOR THE STUDY

Terms of Reference For Market Intelligence on ICS in Mtwara, Arusha, Iringa, and Tanga Regions

1. Background and Rationale

In January 2011, SNV Tanzania supported a desk study on the household Improved Cook Stoves (ICS) sector in Tanzania, to get an in-depth understanding of the sector and its challenges. The results of the desk study were discussed in a multi-stakeholder workshop in Arusha on March 25th 2011. One of the key findings of the study is that ''*Improved Cook Stoves (ICS), have been studied, promoted and commercialized in Tanzania since the 1980's. However, despite many efforts by a wide variety of stakeholders, the actual use of ICS remains limited".* This finding is further qualified by the UNDP's report (2009) which indicates the ICS uptake to be merely 1% of all households; and estimates from TaTEDO are 10-20%.

The major challenges in the household ICS sector as researched by SNV are:

- The sector is informally organized and lacks adequate communication, coordination and advocacy mechanisms on issues defined below
- The sector has limited product diversity meeting consumer fuel use-cooking practice needs
- The sector lacks economies of scale, which leads high cost of production and transaction and poor competitive advantage
- The sector lacks sustainable working distribution models, with inadequate private sector development and participation; it is more being potentially limited in functionality and/or under-utilized in development efforts
- Research and development is needed to assess the potential of a variety of appropriate ICS technologies and fuels/inputs
- Lack of knowledge on user segmentation, needs, satisfactions, sensitization and experience with regard to ICS
- Lack of knowledge on geographic areas (urban vs rural) and their characteristics with regard to ICS
- Little evidence-based awareness on ICS benefits (health, monetary, efficiency, labour-time, gender)
- Lack of clear policies and strategies to support the ICS sub-sector
- Insufficient business development skills and capacity among small entrepreneurs

These challenges triggered key actors to form an ICS Task Force. The Task Force was formed in March 2011 and it consists members from the Rural Energy Agency (REA), Ministry of Natural Resources and Tourism (MNRT), Tanzania Renewable Energy Associations (TAREA), Tanzania Traditional Energy Development and Environment Organization (TaTEDO), SNV, Round Table Africa (RTA), Ministry of Energy and Minerals (MEM), Tanzania Bureau of Standards (TBS), Tanzania Private Sector Foundation (TPSF), University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), Sustainable Energy Development Centre (SEDC) and the Commission for Science and Technology (COSTECH). In a Stakeholders meeting held in December 2012 at the College of Engineering and Technology, of the University of Dar es Salaam, Envotec was added to the list, as a representative of ICS makers. TAREA is the Secretariat of ICS Task Force.

The ICS Task Force intends to develop an impact oriented, private-sector led, commercially viable, and sustainable ICS sub-sector in Tanzania, and prioritized the following:

Phase 1: Coordination of the ICS sub-sector and stakeholders to better understand and develop the ICS sub-sector through multi-stakeholder processes and feasibility studies. Feasibility studies will include policy analysis, market intelligence and technology assessment.

Phase 2: Based on Phase 1, develop the Programme Implementation Document (PID) to implement a national ICS programme.

2. Objective of the Assignment

Lack of clear and reliable ICS market information and data is among key factors hindering wide scale and sizable commercialization and dissemination of ICS in Tanzania. In addition, such lack of information, adversely impact on effective coordination, financing, effective recognition by the government, and sizable private sector involvement in the subsector. The objective of the assignment is therefore to establish market information on ICS and RE in general, including supply and demand sides data, supply chains, existing gaps and threats, strength and opportunities, consumer options and preferences, and propose areas for improvement including institutional, financial and value chain addition arrangements. The findings of Market Intelligent (MI) from these three regions together with that of Lake Zone (already concluded) will, together with the ICS policy assessment and technical status report, finally be used as an input for a ICS sector development Programme PID planned for conclusion in November 2013.

Specific objectives

- To assess the biomass energy situation in the targeted area.
- To provide data on current cooking energy supply options: document the main energy products and services that are available in targeted regions particularly for both households and institutional cooking and lighting (firewood, charcoal, briquettes, pellets, sawdust, LPG, crop residues, husks, kerosene, dry cell torches, candles, car batteries, electricity, etc.).
- To identify evidence of the potential energy demand for ICS cooking, biogas and (solar) lighting products in target areas and distances people currently travel to access such products and or services.
- To estimate the number of micro-businesses per 1000 households within the target areas.
- To assess the extent to which micro-businesses already exist which are seeking to supply the market of ICS, cooking energy and lighting products.
- To assess the readiness of non-energy entrepreneurs in the target areas to engage in providing energy services such as ICS, biogas and (solar) lighting products distribution
- To analyse the main challenges and drivers to adoption and scaling up of ICS and other RE technologies and key lessons learnt from existing experience.
- Describe the activities of other organizations that are operating within the household clean energy sector, which are of particular relevance to ICS subsector including main activities, approach taken and lessons learnt from their experience.
- To identify the bio mass cooking and lighting energy entrepreneurs in the study areas.
- Identify and quantify indoor air pollution data/ information from relevant institutions, actors and cook stove end users.
- To map agricultural companies and others penetrating in rural areas with extensive networks, as potential distributors of cooking and lighting technologies
- To assess the market availability of products to consumer energy uses, etc.

3. Methodology

Methodology to achieve the objectives above shall include:

- Site visits, interviews and consultations
- Literature review for secondary data collection
- Administration of semi structure data collection tools including questionnaires.
- Data compilation, analysis and reporting

- Validation and verification workshops/ meetings with data providers and policy makers
- Findings documentation and dissemination

In situations where reliable data required is unlikely to be available from secondary sources, primary field research will be conducted including:

3.1 ICS and RE related micro-businesses survey to:

- Assessing the number of micro-businesses involved in energy businesses and particularly cooking and lighting energy.
- Assessing the number of micro businesses in RE services (small kiosks, food vending, others.)
- Understanding the challenges these businesses face.
- Assessing the level of interest amongst non-energy micro- entrepreneurs in entering the market.

3.2 Consumer survey: (these should be a mix of households and local traders such as street food vendors, small local shops etc that could benefit from productive use of energy)

- Assessing the current consumer source of energy for cooking and lighting.
- Assessing barriers and perception to uptake of energy products
- Assessing the distance to such energy sources and the cost per unit volume or weight
- The demand and willingness to pay
- Assessing indoor air pollution awareness and incidences/ impacts reported/unreported, known/unknown.

3.3 Survey on agricultural and other rural penetrating companies with extensive networks

- Identify agricultural and other rural penetrating companies such as those contracting large number of farmers
- Assess their geographical coverage, outreach to farmers (numbers), how they organize their channels with farmers,
- Assess their interest as potential distributors of solar/ICS in their geographical coverage.

4. Expected outputs

- Population size for the target areas and population density.
- Socio demographic profile of the population in the target areas.
- Quantitative information on cooking and lighting options being used, sources and average distances travelled to access such sources.
- Cost/price incurred/ paid by consumers to access various types of cooking and lighting options available in target areas.
- Preference and willingness of consumers and potential consumers of cooking and lighting options to pay for improved technologies and services.
- Estimated demand of ICS, biogas and lighting options for households, institutions and other facilities.
- Information on coordination and or potential coordination of the ICS, biogas and solar distribution activities in the target areas.
- Approximate number of micro-businesses in the target areas per 1000 households.
- Existence of micro-businesses already providing electricity based services which do not use grid power.
- Readiness of entrepreneurs and micro enterprises to engage in energy service businesses such as distribution of ICS, construction of ICS and biogas technology, battery and distribution of solar lighting products and services.
- Observation and verification of evidences in the target areas for appropriateness for ICS businesses.

- Description of other organizations/initiatives that are operating within the household clean energy sector in the targeted areas, which are of particular relevance to the project, including main activities, approach taken and lessons learnt from their experience
- Data base of cooking energy actors in the study areas
- Number and impacts of IAP/ hazards resulting from cooking technologies and services in households, enterprises and institutions in the target areas.
- Number of agricultural and rural penetrating companies with their outreach potentials/ numbers and geographical coverage.

5. ACTIVITIES

5.1 Project area description

5.1.1 Mapping of locations were MI have been conducted/ surveyed.

5.1.2 Desk based research on:

- Geographic, socio-economic and demographic context of the targeted regions
- The institutional aspects, legal and administrative framework related to cooking and lighting energy development and which may have influence on the implementation of related projects/ activities in this area
- Environmental urgency (deforestation rate a.o.) to engage with ICS, biogas and other clean energy options.
- Available penetration rate, plans, projects for ICS or biomass cooking services in the target regions in the near future.
- Socio-demographic description of targeted areas, community size, the average income of population
- Assessment of the existing energy infrastructure/services in targeted region/villages on which people rely on; define its main deficiencies; Current level of access to cooking technologies and services (food vending, tea rooms, households, schools, hospitals, kiosks, food roasting, crop curing, heating, crop preservation.
- Assessment of on-going projects/programmes dealing with energy services in the targeted regions, lessons etc.
- Presence of potential local partners to follow up and implement future projects related to ICS, biogas and solar lighting products.
- Available energy options and sources in target regions.
- Assessment of IAP data from relevant institutions and organizations such as District Medical Officers on attributed smoke respiratory infections and deaths from cooking services.

5.2 Micro-business survey

LCBs/ Consultant will select 3 districts in the target regions in collaboration with SNV and carryout the following:

5.2.1 Visit the districts and survey them to identify the target information.

5.2.2 Estimate the number of micro-enterprises which might be potential providers of energy services and technologies.

5.2.3 Identify the approximate number of businesses already providing energy based services and challenges they face. As many existing providers should be interviewed as possible.

5.2.4 Assess level of interest amongst entrepreneurs and local implementing partners in providing energy services/technologies and barriers to doing so. At least 10 businesses should be interviewed in each location.

5.2.5 Use the observation method to establish cooking technologies and services options and sources available in the target areas.

5.2.6 Interviews with existing energy local business and potential local energy businesses should be conducted using a structured questionnaire. Consultant/ LCB will develop the MI tools in collaboration with SNV advisors.

5.2.7 Meeting with community leaders – a meeting should be held with local community leaders to discuss energy needs and their views on cooking energy products/services (discussion topics will be written).

5.2.8 Community Interviews – Interviews will be conducted with various local NGO, and CBO and financial institutes. Interview guide will be written for information required.

5.2.9 Number and impacts of reported and unreported IAP incidences

5.3 Consumer demand Survey

In order to estimate the demand forecasts for the project, the LCB/Consultant undertake consumer demand survey.

5.3.1 Approximately 40 consumers will be interviewed (that should include a mix of household, institutions and of local traders that could benefit from improved cooking and lighting energy services such as street food vendors, "NyamaChoma" roasters, Chips Kiosks, restaurants etc.).

5.3.2 Interviews with households, institutions and local traders should be conducted using a questionnaire. LCB/Consultant will develop the questionnaire in collaboration with SNV.

5.3.3 A preference of consumers will be explored in terms of cooking technologies/services desired.

5.4 Enabling Environment Survey:

The LCB/ consultant will directly interview actors and stakeholders in the enabling environment as per the guidance of the data collection tools developed. These include:

- Local Government Authority: inclusive of, but not limited to, relevant departments in agriculture, planning, Community development and environmental unit. The LGA will convene these LGA department staff jointly in a session that is to last no more than 2 hours.
- Civil Society: The LCB/Consultant will directly interview local NGOs, FBOs and parastatal with guidance from the MI field tool. The intent of these interviews will be to gain deeper understanding of challenges and successes in past, present and future clean cooking and lighting programs ongoing in the district.
- Finance: The LCB/ consultant will engage with local micro-finance institutions (SACCOS, etc.) as per the guidance of the data collection tool developed. The intent of the interviews will not be to establish lending mechanisms, but rather to identify potential MFIs who would deems ICS (or RE in general) as worthy of consumer or enterprise credit provision.

5.5 Supply Chain survey/ assessment

The LCB/consultant will directly interview and assess ICS, biogas and solar lighting supply chains (actors) in the target regions. The survey is aimed at identifying existence of developers/ suppliers/ distributors/ transporters of ICS, biogas and solar PV technologies and services available in the target regions. It will also provide information on challenges, opportunities and preferences for an improved scenario. Findings should include number of manufacturers, importers, suppliers, distributors, transporters, retailers and after sale service providers of cooking and lighting technologies in target regions.

5.6 Agricultural and rural penetrating companies with extensive outreach (number) beneficiaries assessment

LCB/ Consultant shall assess existence of agricultural companies, livestock networks, and other rural penetrating companies with extensive networks and explore possibilities of becoming distributors of ICS and solar products.

5.7 Energy options analysis

The LCB/ Consultant should compare various alternative energy cooking solutions/options available in target regions to establish individual technologies life cycle costs analysis of available options and cost benefit analysis. Where possible, the LCB/consultant shall purchase sample products of different ICS encountered in the field during MI surveys.

6. Scope and Duration of the assignment

The scope of this Market Intelligence assignment is defined as follows;

- Baseline survey regions will be conducted three regions by separate LCDs/ consultants to ensure timely deliverables. The regions will include Mtwara, Arusha, Iringa, and Tanga regions.
- Mapping and description of the target regions in collaboration with the ICS Task force
- Data collection, compilation, analysis and reporting
- Validation and verification of MI findings in collaboration with ICS taskforce
- The Assignment shall be undertaken for approximately 60 days from 15th May – 15th July 2013 as follows:
- 15th May – 22nd May 2013: Inception report
- 23rd – 31st May 2013: Data collection tools development and approval in collaboration with SNV and ICS task force
- 1st June – 5th June 2013 – literature collection and review for secondary data collection.
- 6th June -5th July 2013 – site visits, surveys, consultations, interviews, etc.
- 6th -10th July 2013: Draft report
    - 11th July -17th July 2013: consultation workshop/ commenting and inputting/ data validation and verification
    - 25th July 2013: final draft

ANNEX2: LIST OF CONTACTED PERSONS IN THE STUDY AREAS

LIST OF CONTACTED PERSON IN MASASI DISTRICT

NO.	NAME	TITLE	CONTACT
1	Beatrice	District Executive Director	
2	IsayaMtondokoso	Natural Resources Officer	0714-298585
3	Jeremiah Lubeleja	District Planning Officer	0764-396476
4	HappinesMkwama	Trade Officer	0752-488551
5	Mathew Montani	Statistics and Logistic Officer – Secondary schools	0784-629625
6	Said Nanjayo	Ag District education Officer-Primary schools	0784-610715
7	MfaumeMashaka	District Agricultural and Livestock Officer	0784-490751
8	Mwanganda Julius	District Community Development Officer	0753-597752
9	Said Mfaume	Health Officer/ Ag District Medical Officer	0784-494583
10	John Amani	District Cooperative Officer	0784-378656
11	DeoMwakalinga	Secretary, MANGONET	0784-885172
12	Edmund Mkulia	UjiraniMwema AMCOs, board member,Mlingula Village	0687-738742
13	Julius Kabasele	Village Executive Officer – Mlingula Village	0784-190579
14	ShayoSelisi	Academic Master, Mlingula Primary school	0715-921140
15	Ismail Issa Ahmed	Owner, Kijiko Shop	0783-490407
16	SalumMapunda	Ward Executive Officer- Namatutwe ward	0786-879867
17	LilianLiundi	Nurse assistant, Namatutwe Dispensary	0782-346309
18	TunuZahoro	Teacher, Chingulungulu Primary school	0684-076934
19	George Logers	Second Headmaster, Namatutwe Secondary school	0789-585414
20	Emmanuel Mathayo	Chairman, Namajani Dispensary	0685-190029
21	PhiniasRahisi	Ward health Officer – Namajani Dispensary	0787-361899
22	HosseahIghimbi	Headmaster, Namajani Secondary school	0783-956532

LIST OF CONTACTED PERSON IN MTWARA DISTRICT

No	NAME	TITLE	CONTACT
1	Mr. Idd. A. Mshili	Mtwara District Executive Director	0785-337444
2	Mr. Hamisi Fundi	Ag. District Community Dev. Officer/TASAF Project Coordinator	0783-988447
3	Ms. Nyamayao Said	Community Development Officer	0718-204877
4	Mr. LilangaMuhamed	Ag. District Cooperative Officer	0789-800460
5	Ms. Maria Ngatata	Livestock officer	0783-792380
6	Mr. Farjara N. Mramba	District Trade Officer	0787-761770
7	Ms, BernadetaMlungusya	Trade Officer	0787-964608
8	Mr. MuhamediMang'una	District Medical Officer	0786-227937
9	Mr. Said Farahani	Ag District Education Officer- Primary Schools	0787-382539
10	Mr. Godfrey Mwanjala	District Education Officer	0717-289436
11	Mr. Denis Kitare	District Land, Natural Resources and Environment Officer	0712-920705
12	Mr .Hassan Kaunje	General manager -MAMCO	0688-342999
13	Mr. Moris	Project Coordinator – UN Women	0786-534402
14.	Mr. Mbecha Said	Owner-Mbecha General Supplies -solar	0713-985403
15.	Mr. Salum S. Mmomi	Owner-Mmomi Hardware	0713-245850
16.	Mr. DongwalaZamka	Technical Officer – SIDO Mtwara	0784-759976
17	Mr. Said S. Kulyohi	Village Executive Officer – Nanguruwe Village	0787-901236
18	Me. ArunaKunyaka	Teacher – Nanguruwe Primary School	0782-345749
19	Muhamedi Ami	Academic Master- Naguruwe Day Secondary School	0686-263005
20	OmariMaktubu	Academic Master- Naguruwe Day Secondary School	0782-890428
21			
22	UrbaniMakota	Second Headmaster – Chawi Secondary school	0684-006441
23	AminaMapunda	Nurse – Chawi Dispensary	0784-886121
24	BandariMnigu	Headteacher – Chawi Primary school	0686-910633
25	MuhamediKasose	Village Executive officer - Nachenjele	0777-005425
26	MbechaRamadhani	Manager, Mbecha General Supplies	0713-985403
27	SalumMmomi	Manager, Mmomi Hardware	0713-245850

LIST OF INTERVIEWED PERSON IN NEWALA DISTRICT

No	NAME	TITLE	CONTACT
1	MS. GimbanaNtavyo	Ag DED/District Laywer	0783-918391
2	Mr. MensariaMrema	Ag District Planning Officer	0754-340603
3	Mr. Innocent Mahundu	District Cooperative Officer	0787-111061
4	Mr. OmariMsuya	Ag. District Livestock and Fisheries officer	0784-882690
5	Ms. MagrethElikondo	District Natural Resource Officer	0784-539997
6	MsMsemwa Alice	District Education Officer – Secondary Schools	0754-391793
7	Mr. Magnus Munyiki	Statistics and Logistics Officer – Secondary school	0784-225733
8	Mr. Rashid Mandola	District Education Officer – Primary Schools	0787-302521
9	Mr. RafikiMnuone	District Education Technical Officer	0787-804157
10	Mr. Roman Msovelo	Statistics and Logistic officer –Primary schools	0688-461272
11	Mr. Ismail Oga	Ag. District Medical Officer	0682-923618
12	Mr. ChitandaGeofrey	District TASAF Coordinator	0717-504414
13	MsAminaGadi	Ag District Trade Officer	0713-718899
14	Mr. Frank Mtila	District Community Development Officer	0787-779141
15	Mr. KayomboBasilius	District TANESCO Manager	0754-272763
16	Mr. NurdinNyambi	Solar PV dealer, Nyambi Shop	0712-408240
17	Mr. ShabanIssa	ICS dealer, ShabanIssa shop	0784-741440
18	Ms. Anna Mnevarika	Ag. Headteacher, Chihangu P/School	0685-27987
19	Dr. Conrad Mtumbuka	DrIncharge, Chihangu Health Centre	0784-312591
20	MsPililaKomba	Headmistress, Chihangu Sec. School	0784-883115
21	Mr. JumaMahundu	Secretary, Chimele AMCOs	0788-874007
22	Mr. Musa Makapa	Manager, Musa Restaurant - Chihangu	0684-547775
23	MsAshaBakari	Manager, Mama Ali Restaurant	0685-282582
24	Ms Mariam Said	Manager, Nanganga Restaurant	0688-322574
25	Ms. ShaharaSelemani	Nurse attendant, Mikumbi Dispensary	0688-412027
26	Mr. Enock Duncan	Academic Master, Mikumbi Sec. School	0785-493355
27	Mr. Abeid Ismail	Headteacher, Mikumbi Primary school	0789-597684
28	Ms. Shakira Said	Manager, New Laize Restaurant	0784-697321
29	Ms. Aisha Focus	Manager, Aisha Restaurant	0687-635266
30	Ms.MwajumaNasibu	Manager, Majuma Restaurant	0782-231525
31	Mr. NaliBusiku	Clinical Officer, Mnyambe Dispensary	0784-611429
32	Mr. Ali Wapakaya	Headteacher, MnyambePeimary school	0784-219834
33	Mr. ChitopelaFortunatus	Academic Master, Mnyambe Sec. School	0786-966258
34	Ms. CesiliaIbadi	Manager, Amani Restaurant	0783-872589
35	Mr. MuhamedMnowite	Manager, Dogo store	0712-457522
36	Mr. SharifuAbdallah	Manager, Nedeko Hotel	0652-042132
37	Mr. Muhidin S. Muhidin	Manager, Darajani Restaurant	0714-434179
38	Mr. Abdu Bendera	Manager, Bendera shop	0788-048638
39	Mr. DaimuMpakata	General Manager, TANECU LTD	0783-500200
40	Mr. AbubakarJumanne	Marketing Officer, TANECU LTD	0787-981925
41	Ms. Pili Ali	Manager, Pili Restaurant	-
41	Ms. ZeituniMkandimba	Manager, Zeituni restaurant	0782-246639
42	Ms. ShakiraLukanga	Manager, Shakira Restaurant	0657-997196

43	Ms. AshuraSelemani	Manager, Ashura Restaurant	0689-272953
44	Mr. Mustafa Chichemela	Manager, Mustafa Restaurant	0657-215252
45	Mr. JumaChande	Accountant, New Ngonet	0715-959933

ANNEX 3: INSTRUMENTS USED DURING THE SURVEY

Household Energy Consumer Questionnaire **No……**

A: PERSONAL DATA

1. Name of Interviewer……Date of interview ……

2. Village……..Ward…….District……

3. Interviewee's name ……Gender: Male/ Female……..
   Age …….. (Yrs), Education Level…….. Mobile Phone No: ……..……
4. Number of household members ……

B: ENERGY SOURCES AND USES

Cooking

5. What Energy Sources do you use for cooking? How much energy is consumed per week and what is the unit price for each energy source?

Energy Source	Units Used Per Week		Cost Per Unit (Tsh)	Distance to Purchase (km)
	Unit	Actuals		
Firewood				
Charcoal				
Saw dusts				
Agricultural residues				
Kerosene				
LPG				
Others (specify ….)				

Improved Cook Stoves

6. Have you ever heard or do you know improved cook stove (*jikosanifu-explain what it is*)? **YES / NO.**

If **NO** *go to No. 14*

7. Are you using an Improved Cook Stove for cooking in your house (or businesses)? **YES/NO**

If **YES** *answer No. 8-12*

If **NO**, *Explain why and whether you are interested in the stoves*
……
……

8. Where did you get the stove from? or who constructed the stove for you?
……
……

How much did the stove cost you?
.....

Do you think the price was reasonable? **YES/ NO .....**

If **NO**what do you think is a reasonable price for the stove ……

9. What sources of energy do you use with Improved Cook Stove you own?
   Firewood……Charcoal ……Saw dust……Other (*Specify*)……

10. Where do you get sources of energy mentioned in *No.9?*

    Within the village ……..within the ward……..at the district HQ ……..

11. Are the sources of energy easily available? **YES / NO .....**

12. From your experience, what are the benefits of using improved cook stoves compared to traditional stoves?
    ……
    ……

13. Have you experience any problems with your stove? **YES/NO**
    If YES Explain ……

Lighting

14. What is the source of light in your house?

Energy Source	Units used Per Week		Cost Per Unit*	Distance to Purchase (km)	Average Lighting Hours (*Tick Appropriately*)			
	Units	Actuals			<2-3	3-4	4-5	>5
Kerosene Lanterns								
Kerosene tin Lamps								
Open Fire								
Candle								
Dry cells (for torches or LED Lamps)								
Solar Lantern								
Solar Electricity bulbs								
Petrol/Diesel Generator								
Bulbs: grid electricity								
Others (specify)								

[*] *For solar lanterns and solar electricity bulbs accept initial cost of hardware. For bulbs: grid electricity accept average cost of monthly electricity bill.*

15. Do you encounter any problem with lighting in your house?

YES, please describe	NO
	Don't Know

16. Would you like to substitute your current energy source for lighting with modern energy sources like solar electricity or biogas? **YES/NO .....**
    If YES Go to No 17
    If NO Explain why
    .....
    .....
    .....
    .....

17. How many lamps would you like to have in your house? …….

18. How much are you willing and able to spend per month for the new modern energy source? …….

C: OTHER ENERGY REQUIREMENTS

19. What appliances would you like to buy in the future to use in your house or if you had more energy sources? (*Rank them in numbers 1, 2, 3, 4, 5…. in the order of priority. Number 1 means the first priority ….*)

Appliance use	**Priority**
Lighting	
More Lighting	
TV	
Fridge	
Mobile phone	
Fan	
Others (*specify*)	

CHECKLIST: INTERVIEW WITH VILLAGE EXECUTIVE OFFICERS (VEOs)

Name of Village……..Ward……..District……...

Name of VEO/Chairman……. Phone Number ……

VILLAGE DEMOGRAPHY

Population	Men		
	Women		
Number of Households			
Size of the Village (ha / km^2)			

MAJOR ECONOMIC ACTIVITIES IN THE VILLAGE

Economic activity	**Specific activities**	**% household in the major economic activity**
Agriculture	**Food crops grow:** **Cash crops grown:**	
Livestock Keeping	**Type of livestock:**	
Others ……		

ESTIMATED INCOME LEVELS IN THE VILLAGE

Income Level	**Criterion (Based on Possession /Activities done by households)**	**Proportions (%) of Households in the village**
High		
Medium		
Low		

BUSINESSES IN THE VILLAGE

Type of Business	**No. Of Businesses**	**No of businesses already in Household Energy**

INSTITUTIONS IN THE VILLAGE

Type Of Institution	**No of Institutions**
Primary Schools	
Secondary Schools	
Dispensary/Health Centre	
Others …….	

ENERGY ACCESS AND UTILIZATION

Energy Sources	Cooking	Lighting	% Households with Access
Firewood			
Charcoal			
Kerosene			
Crop residues			
Solar PV (SHS)			
Solar lanterns			
Dry cells			
Gen-sets			
Others …….			

ENERGY PRICES AVAILABILITY

Energy Sources	Unit Price	Unit	Availability in the village
Firewood			
Charcoal			
Kerosene			
Crop residues			
Solar PV			
Dry cells			
Gen-sets			
Others …….			

EXPERIENCE WITH ENERGY RELATED PROJECTS/PROGRAMMES

Mention on-going/past energy related programs implemented in the village. For each program:

- Aim of the program.
- Who implemented/financed the program?.
- Activities done by the project/program.
- The role of the community
- Impacts – In terms of number of beneficiaries.
- Challenges.
- Village view on success/failure of the project and recommendation for similar projects.

ACCESS TO FINANCE

- Existence of the sources of finance (MFIs) for consumer goods to households and businesses in the village (e.g SACCOS, agricultural cooperatives, etc)

- Modes of operation of MFIs.

- Terms of financing (Loan amount, interest rate, loan duration, loan security, and eligibility/requirements for financing).

- Easy of access to financing facility.