Sustainable Woodfuel (charcoal and firewood) Systems in Coastal Regions in Tanzania

A Trainers Course Manual

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CONTENTS

ACKNOWLEDGEMENT ON DEVELOPMENT OF THE TRAINER'S COURSE MANUAL

This manual is a training and knowledge resource for trainers course aimed at enhancing skills and knowledge for stakeholders to carry out grassroots trainings. It has gone through revisions to suit the objectives of the trainer's courses. The first version of the manual was developed for the trainer's course on Sustainable Clean Energy Entrepreneurship as module 2 of the 4 modules offered. This course was organized by Wangari Maathai Institute for Peace and Environmental Studies, University of Nairobi and Partnership on Women's Entrepreneurship in Renewable (wPOWER) and supported by the State Department, United States of America (USA). The training was offered in July, 2014 to 27 participants (18 women and 9 men) from wPOWER partner organizations (Green Belt Movement, Swayam Shiksha Prayog, CARE International, Solar Sister and Women for Women International) across Kenya, Rwanda, Uganda, Tanzania, Nigeria, and India. A second version of the manual was developed and applied in conducting the trainer course on sustainable tree-based energy cooking systems led by ICRAF and World Vision and Concern Universal under the project on *empowering forest dependent communities through commercialisation of small-scale forestry* supported in Malawi by European Union and Department of International Development (DFID). The trainers' course was carried on in November 2015 in Malawi. Thirty eight people comprising of development facilitators, forest officers, women involved in portray, artisans, from the 6 Districts in which the project was being implemented were trained. The reviews made by Ogossy Gasaya of Tanzania Wildlife Management Authority-TAWA are highly appreciated.

This third version was developed for the trainer's course under the response plan on *scaling-up sustainable woodfuel (charcoal and firewood) systems in the coastal regions (Mtwara, Lindi and Pwani) in Tanzania.* The response plan is supported by Climate Technology Centre and Network (CTCN). The response plan is being implemented by World Agroforestry Centre (ICRAF) and the request was made by Tanzania Renewable Energy Association (TAREA) through Tanzania Commission of Science and Technology (COSTECH). The trainers' course is part of the capacity development and awareness raising under the response plan. The training materials in this third version of the manual include new information compiled from results of the Stakeholder Approach to Risk-informed and Evidence based Decision-making process (SHARED) workshops conducted in November 2017 in Mtwara, Lindi and Pwani under the response plan. This manual indicates lessons delivered using training and knowledge materials prepared by trainers who were also trainees promoting co-learning approach hence tapping knowledge that exist among stakeholders and practitioners. The training manual adopts a system approach to sustainable woodfuel with components including sustainable wood production, efficient processing of wood into charcoal, effective marketing/trade, consumption, policy and regulatory framework on woodfuel and gender issues in the systems. Annexe 1-5 provides other resource materials used during the training. Annex 6 provides a brief of the training and how it was delivered. Annex 7. Inspiration story on impact on increased production of charcoal and income after participation in the trainer's course. Copies of the training resources were provided to the trainees and trainers.

The objectives of the trainings and awareness raising trainers course were under the response plan include:

- Compilation of training/knowledge resources from a "whole system" perspective;
- Testing the available training materials for suitability for grassroots courses;
- Co-learning on systems approach and innovations for sustainable woodfuel among researchers, practitioners and policy makers involved in various aspects of the wood fuel systems
- Gathering ideas about the content and delivery options for grassroots courses.

This manual comprises of 6 modules which were delivered through lectures, discussions and demonstration and was delivered by both trainers and trainers through a co-learning approach (Table 1.) The trainers course was carried out in March 2018 at Lindi, Tanzania and a brief of the training is provided as an annex 6. Module one and two were offered in day one and modules three to six in day two.

Table 1. Components of the trainer's course on sustainable woodfuel systems and facilitation

Module		Components and mode of delivery	Facilitator
1	Introduction to sustainable woodfuel systems	.0 Background information. Woodfuel situation and trend, 2.0 Woodfuel system approach. Wood production, efficient wood to charcoal conversion technologies-kilns, effective marketing and transportation, aspects of sustainability, 3.0 Implications of unsustainability woodfuel system on natural resources and climate change 4.0 Interventions to make woodfuel sustainable. Delivery: Lecture using printed notes plus discussions led by question and answer and examples from trainees. Video clip on challenges faced by women when collecting firewood.	Dr. Mary Njenga* (Research Scientist, Bioenergy, ICRAF), Ogossy Gasaya* (Environmental and Natural Resource Economist, ICRAF) Mandela Chikawe, Regional Agricultural Advisor (RAA), Lindi.
2	Sustainable wood production	4.1. i. Tree nursery establishment, benefits of agroforestry, tree planting, 4.1.ii. farmer managed natural regeneration or rotational harvesting of trees. Delivery: Lecture using pinted notes and plus discussions led by question and answer and an example using PowerPoint presentation from a community group (ECOCE).	Ogossy Gasaya* (ICRAF), Violet R. Byanjweli. (Upendo Halisi group), Ignatusi J. Pesha, (Environmental Conservation and Community Enterprise ECOCE), Tozini Azizi Ally (Kaza Moyo Group), Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager
3	Efficient charcoal processing and processing briquettes as alternative sources of biomass energy	4.2 Improved charcoal processing using more efficient kilns. Delivery: Discussions using printed notes on variety of kilns, benefits and disadvantages of improved vs. traditional kilns and management of the areas after charcoal production. Illustration by a farmer on briquettes production and use. Demonstration with drawings on flip charts on improved kilns by a farmer. Video clip on community based briquette production and use.	Uwesu Omary (Farmers, charcoal propducer and beneficiary of WWF project on improved kilns), Ogossy Gasaya* (ICRAF) Selemani M. Jullu (fuel briquette producer, Madendo Mtima Group,), Mary Njenga* (ICRAF).
4	Efficient woodfuel consumption	4.3 Improved cooking practices and stoves. Benefits and disadvantages of a variety of improved stoves versus traditional cooking stoves. Delivery: Lecture with a powerpoint presentation with photos of the stoves. Demonstrations on a variety of improved stoves at VETA.	Ashiru S. Yusuph, Lecturer and stove manufacturer (VETA Lindi), Ogossy Gasaya* (ICRAF) Wasiya Abdallah (clay stove producer), Bardwin F. Mpunga and Bakari H. Kambale (metal stove producers)
5	Effective marketing and trade	5.0 Effective marketing of woodfuel. Different uses of woodfuel, setting objectives of the business, targeting type of customers, choice between charcoal and firewood, packaging and labelling, banking savings from sales. Delivery: Lecture using powerpoint presentation and discussion with examples from trainees.	Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager), Hamisi O. Salum (Farmer/charcoal producer), Abdullah S. Mpape (Farmer/charcoal producer).
6	Policy and regulatory framework	6.0 Regulations in wood sourcing, charcoal processing, transportation and trade. Delivery: Lecture using powerpoint presentation and discussion with examples from trainees.	Zawadi J. Jilala (Regional Secretariat, Lindi), Ronald N. Pangah (Regional Secretariat, Mtwara)

*Organizing team, [&] Numbering in the manual.

1. O BACKGROUND INFORMATION

1.1 Woodfuel and the need to make it sustainable

Wood is an important source of energy that has been used for millennia for cooking, boiling water, lighting and heating (WHO, 2006). More than 2.7 billion people – 38% of the world's population, relies on the traditional use of solid biomass for cooking, typically using inefficient stoves in poorly ventilated spaces (IEA, 2016). Woodfuel (charcoal and firewood) is the most commonly form of energy used for cooking and heating in sub-Saharan Africa (SSA) and it is also used in small-scale businesses such as restaurants, bakeries, street food kiosks, brick making, drying produce such as tea and tobacco. In SSA more than 90% of the population relies on either firewood or charcoal (IEA, 2006). Africa produce 62% of the global wood charcoal estimated at 52 million tons (Mt) (FAO, 2016a). Tanzania ranked 7th in the world for overall charcoal production, accounting for roughly 3% of global charcoal production at over 1.6 million tonnes (Mt). Woodfuel provide 85–90% of Tanzania's energy supply (World Bank, 2009; URT, 2015b). Charcoal is mainly consumed in urban areas while firewood is used in rural areas. In urban areas in Tanzania, 71% of households depend on charcoal (Doggart and Meshack, 2017). Charcoal contributed over USD 650 million annually to the Tanzanian economy and is a major source of employment and income in both urban and rural areas. The situation is the same in other countries in Eastern Africa where for instance in Kenya 82% of urban households rely on charcoal for cooking and in Ethiopia 70% of all charcoal produced is consumed by urban households (MoE, 2002; GCF, 2014; Yigard, 2002). In Zambia charcoal use increased by four percent between 1990 and 2000 and 85% of urban households rely on it for cooking and heating (Chidumayo et al., 2002). Charcoal production has risen in recent decades as demand has grown among urban households and enterprises (FAO, 2017). Charcoal consumption is expected to grow in SSA in coming decades, especially given that the percentage of population living in urban areas is projected to grow from 36% to 50% by 2030 (World Bank, 2014). The woodfuel value chain has considerable value as it provides income, employment, livelihoods and energy security. For instance in Tanzania and Kenya it has an economic value estimated at US$650 million and US$ 1.6 billion respectively (FAO, 2017) and hence the need for its development as a productive sector.

On the other hand unsustainable woodfuel processes results into 1-2.4Gt of carbon dioxide equivalent (CO_2e) per year which is 2.7% of total anthropogenic GHG emissions (FAO, 2017). The emissions are generated in various stages of the value chain and wood production, carbonization of wood into charcoal and utilizations are the greatest contributors (FAO, 2017). In very inefficient operations charcoal production can result into 9kg of CO_2e per kilogram of charcoal produced and 29-62%, 28-61% and 9-18% of emissions are from wood sourcing, carbonization of wood into charcoal and end use (FAO, 2017). Inefficient use of woodfuel such as use of poorly dried wood, burned in inefficient cook stoves and in poorly ventilated results into smoke which has been linked to respiratory illnesses. Globally, over 4 million deaths occur annually from illnesses related to the smoke generated by indoor combustion, which mainly affects women and small children (Lim and Vos, 2012). Coughing, sneezing and headaches are common among women who work in smoky kitchens, while bronchitis, lung cancer, asthma and tuberculosis have also been linked to smoke from indoor combustion (WHO, 2006).

Interventions exist with potential to make woodfuel sustainable and efficient. For optimal impacts in reduction of deforestation, GHG emissions and negative effects on public health there is need to address the inefficiencies at all the stages of the value chain and develop enabling policy framework. For instance, sustainable wood production for woodfuel could be achieved through sustainable forest, woodlands, shrublands management, sustainable community-managed woodfuel plantations, integrated food and energy systems, agroforestry and urban forestry, and recovery and reuse of biomass residues and waste streams (FAO, 2017). Shift from traditional kilns to highly efficient kilns and shift from traditional stoves to improved stoves can result into reduction of GHG by 80% and 63% respectively (FAO, 2017). Addressing the different hot spots in the woodfuel value chain at the same time for example combining sustainable harvesting of trees on-farm for woodfuel with more efficient stoves yields higher impacts (Njenga et. al., 2017). Recovery of organic waste including wood waste for briquette production has benefits in reducing loss of trees and emissions, provision of additional fuel, and generation of income and employment (Njenga et al., 2014).

The woodfuel value chain operates under a variety of sectors where for instance wood production is under both forest and agriculture, marketing/trade and transport is under transport while uses is under energy. In most cases these sectors operate in silos. For effective development of enabling woodfuel policy that benefits for instance national government through tax, promotes income generation and employment while conserving the environment there is need for a coordinated regulatory framework aligned to the sustainable development goals. For informed decision making in the policy development and effective implementation there is need for data and participation of actors with a stake in the sector. Clear understanding of gender roles, needs, aspirations and potential of different categories of people is crucial for greater impact. There must be policy direction to support the adoption of sustainable woodfuel production and use technologies and practices which are suitable for the local context (Iiyama et al., 2017).

The three regions of focus in the project include Mtwara, Lidi and Pwani, Tanzania. Mtwara region has a population of 1,270,854 (male 599,648 and female 671,206), Lindi has 864,652 (male 414,507 and female 450,145) whereby Pwani has 1,098,668 (male 537,826 and 560,842) (URT, 2013). According to regional forest officer (RFOs, personal communication) in the three regions, the consumption of charcoal in urban centres is 90, 85% and 80 for Mtwara, Lindi and Pwani respectively while in rural areas is 10, 15 and 20 for Mtwara, Lindi and Pwani respectively. Pwani is among the top three charcoal regions producers in Tanzania, after Morogoro and Tanga. Considering the demand in urban areas the rate of deforestation in unlikely to decrease if woodfuel systems are not transformed into sustainable systems.

2.0 WOODFUEL SYSTEMS APPROACH

2.1 Woodfuel systems and changes over time

The woodfuel system in this project was defined during stakeholders engagement processes held in Mtawa, Lindi and Pwani beteen 1-10th November 2017 with the participation of 81 stakeholders and 7 project team members. The Stakeholder Approach to Risk-informed and Evidence based Decision-making process (SHARED) a methodology developed by World Agroforestry Centre (ICRAF) was applied. Woodfuel systems were defined to include four key stages from sourcing of wood through to consumption (Figure 1.). The stakeholders during the workshop gave their perception on woodfuel systems (fgure 2.) and stated that over time there has been changes occurring in the woodfuel systems (table 2) and there are concerns on sustainable (table 3).

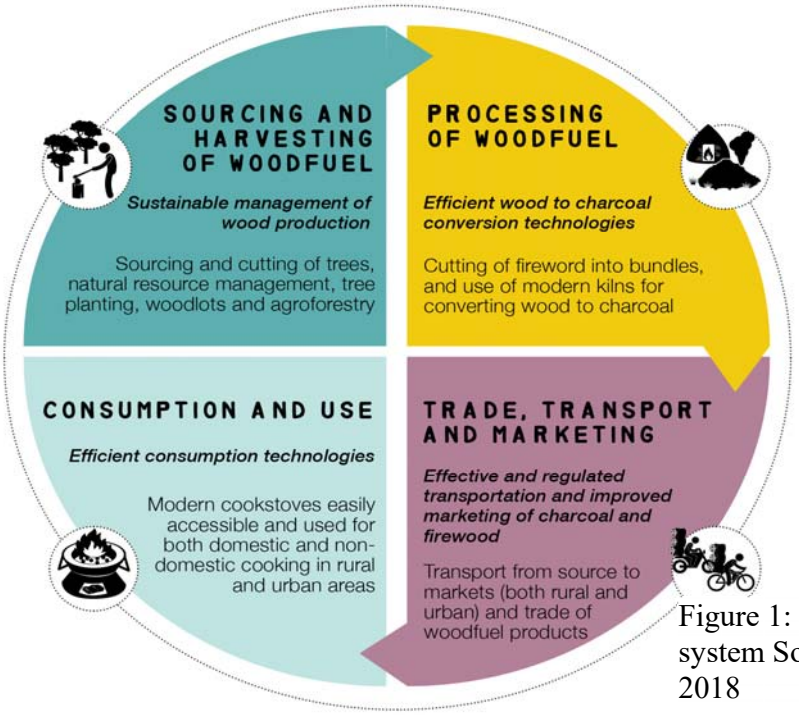


Figure 1: Definition of the woodfuel system Source: Chesterman et al., 2018

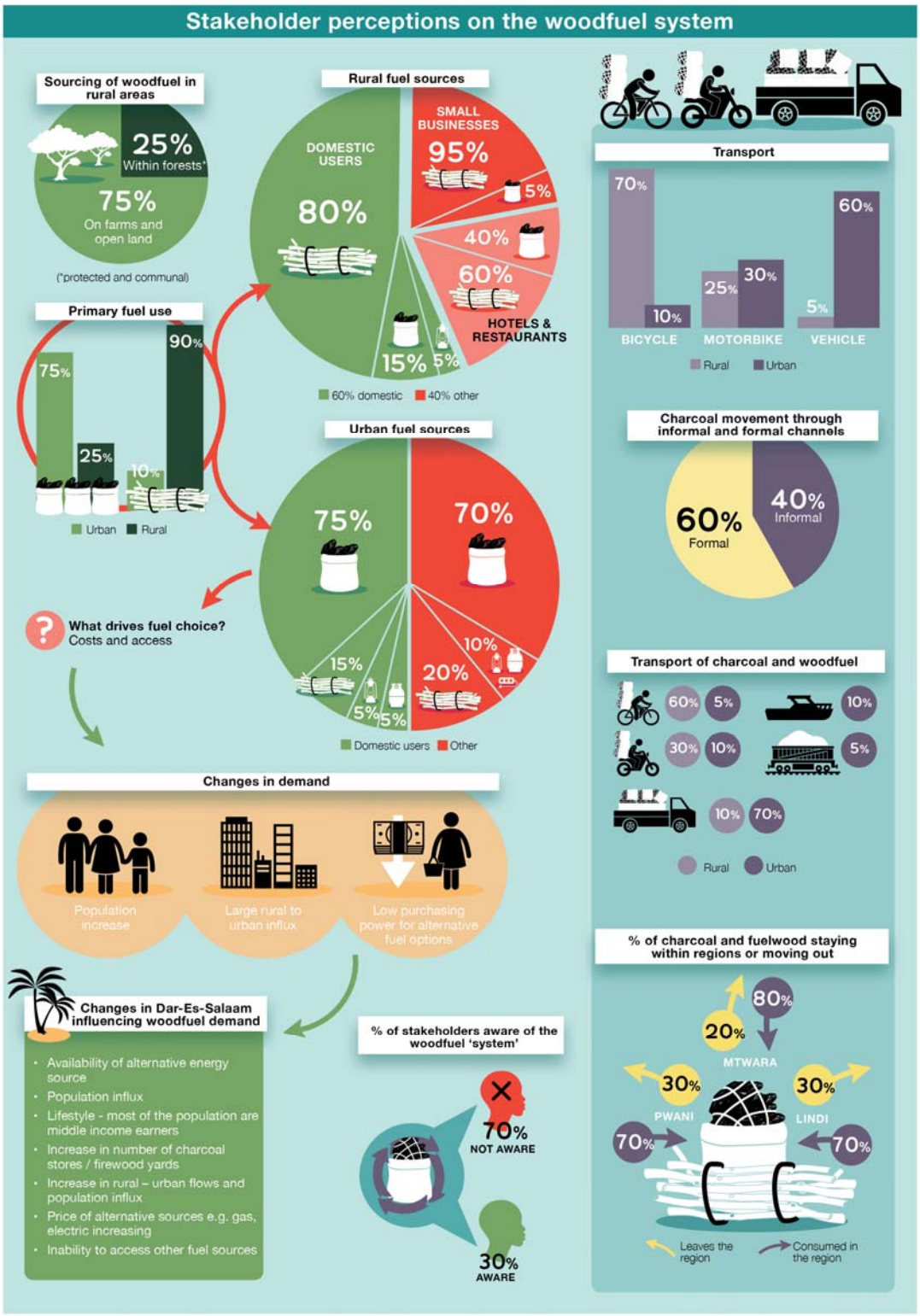


Figure 2. Stakeholders' perceptions on the woodfuel systems in Mtwara, Lindi and Pwani: Source: Chesterman et al., 2018.

Table 2. Stakeholders' perceptions on changes over time on woodfuel systems in Pwani, Lindi and Pwani. Source: Chesterman et al., 2018.

		CHANGE/TREND	EFFECTS	EFFECTS BY 2030
SOCIAL, ENVIRONMENTAL AND ECONOMIC SYSTEM	Population and rural-urban trends	⊕ Rapid increase in rural to urban migration and large increase in overall population numbers	Informal and illegal movement of woodfuel to meet the demand	
	Food security status	⊖ Reduce food production due to shifting cultivation	• Land degradation • Food insecurity at household level	
		⊖ Dependence on imported food from outside the regions, rather than local production for example Mtwara importation of food from Ruvuma, Mbeya and Morogoro region		
	Poverty levels	⊕ Decrease of poverty levels due to additional income and livelihood options.	Diminishing natural resource base	Increased natural resource degradation, with livelihoods dependent on natural resource extraction
		⊖ Livelihood options heavily dependent on natural resource extraction		
	Gender roles	⊕ Women are engaged in the woodfuel system and have roles across all stages		Women fully integrated and equal participation within the woodfuel system
	Governance	⊕ Decentralisation of power to local government and community	• More administrative areas created e.g. Mtwara from 3 councils to 9 councils in 2017 • Increased control within local administrative areas • Engagement of community on the use of resources e.g. village owned forests	• If by-laws adequately implemented and monitored it ensures effective supervision of resources e.g. cut trees, plant trees • Increase in supervision on the planning and the use of wood fuel resources
		⊖ By-laws not implemented or adequate controls in place		
		⊖ Weak enforcement due to corruption and inadequate staff which leads to contradiction of laws and regulations		
	Landscape and agriculture	⊖ Rivers changes from permanent to seasonal, decreased level of water flow	• Decrease of soil nutrients due to the decrease /degradation of forest cover • Land degradation and erosion due to unsustainable harvesting practices • Destruction of water catchment areas • Wind and soil erosion leading to reduced land quality • Increase of production costs due to the need for manure and industrial fertilizers	• Continued erosion and severely depleted land quality • Low land productivity and food insecurity • Severely degraded and deforested landscape • Drought occurrence increased and inter-annual issues with sufficient rainfall and access to water resources • Water conflicts between farmers & livestock keepers
		⊖ Scarcity of water, resulting in a decrease of fishing activities		
		⊖ Reduced fertility of soil - e.g. Mtwara - Makonde plateau		
		⊖ Shifting cultivation has increased		
		⊖ Tree cover and density have significantly declined eg Mtwara - along Makonde escarpment. Decrease in number of different species eg mninga, mpingo		
		⊕ Commercial farming activities, with positive impacts from employment, but negative impacts from increased pressure on the land and reduced fallow periods		
		⊖ Minimal uptake and practice of agroforestry activities on farms		
		⊕ Arable land changed to non-agriculture activities due to urban expansion		
WOODFUEL SYSTEM	Harvesting methods	⊕ Introduction of new technology in harvesting (chain saw) and improved accessibility	Due to harvesting of many trees in a short period of time	• Drought • Desertification • Disappearance of water sources • Water use conflicts
	Processing technologies	⊕ Low uptake but slowly growing to share knowledge on modern kilns		Reduced local ecosystem degradation and efficient production processes with the progression to modern kiln technology
	Transportation of woodfuel	⊕ Transportation changes (motorbike and trucks in urban areas and motorbike and bicycle in rural areas)	• Huge increases in urban demand and use of motorbikes for transport. large volumes of charcoal and woodfuel transported to urban areas. • increased access to forest and demand of urban consumers being met has led to rapid increase in rates of deforestation.	
		⊖ Large quantities of woodfuel can be transported by motorbike and bicycle, and more areas of forest (including protected forest areas) are accessible illegally by motorbike leading.		
		⊕ Increase in job creation for motorbike drivers and bicycle transporters		
	Home energy use and cooking technology	⊕ Transition from using more wood for three base stone cooling stoves to use of brick built stoves, and modern charcoal and gas stoves, up to 60% in urban areas.	Health impacts from air pollution within households, and burden of labour for carrying and fetching firewood for women.	• Reduction in over dependence of fuel wood and use of alternative energy forms electricity, gas and improved cooking technologies. • Women's empowerment with increased time (less time spent sourcing wood and cooking) for other income earning and child care activities.
		⊖ Use of improved cook-stoves not widespread. Many households still use three stone stoves and depend entirely on wood fuel		
		⊖ Lack of adequate access to alternative sources of energy to woodfuel		

⊕ positive change ⊖ negative change ⊕⊖ neutral change

2.2. Gender differentiated roles in the woodfuel system

In order to understand woodfuel systems well and effectively plan interventions that equitably address the need of key stakeholders within the woodfuel system it is impacts to consider gender differentiated roles and decision-making power. The stakeholders during the SHARED workshops described gender roles in the woodfuel systems as illustrated in Figure 3.

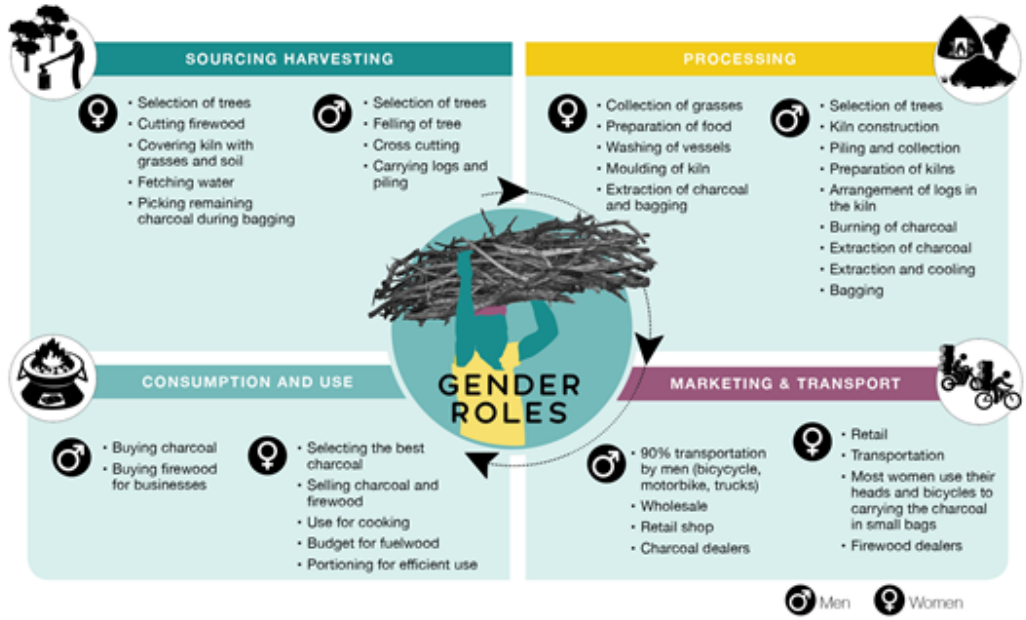


Figure 3: Gender differentiated roles in the woodfuel system Source: Chesterman et al., 2018.

Figure 4. Photo: Mr. Hassan transporting charcoal in Mtwara and SHARED workshop participant Ntuki Sambo packing charcoal at her house (Photos by- Mary Njenga, Jane Kajange and Sabrina Chesterman)

Decision making power over the roles

There has been significant change in the past 10 years with women being much more involved in harvesting, marketing and controlling many decisions regarding woodfuel usage and having better access to income.

Men make more decision in:

- Transportation
- Culturally and traditionally men have more control across the system
- Wholesale activities

Women make more decision in:

- Small scale-retailing and purchasing quantities
- Choice of stove

Land tenure and access

- Patrimonial land tenure system in place which negatively impacts woman's ability to access, own and have decision making power on the use of land and associated activities
- Men often own the main assets including land and the household

Recommendations for addressing gender aspects in scaling up sustainable woodfuel system

- Establish a fair-trade procedure to allow women equal access in the marketing and trade aspects
- Women to be engaged directly in trainings
- Women to be empowered especially in technologies in cooling charcoal during processing and efficient use of woodfuel
- Labour regulations to address women's inclusion and income parity

2.3 Definition of woodfuel sustainability

During the stakeholder engagement processes held in November 2018 sustainability. Stakeholders analyzed cause of unsustainability in woodfuel and resultant effects and impacts at shown in table 2 (Chesterman et al., 2018). The stakeholders considered sustainability across four key dimensions, namely economic, social, environmental and institutional

Social sustainability

- Charcoal and firewood fits well within the cooking practices including food types cooked and stoves used by communities.
- Conservation of trees is carried out through beliefs
- Need for communities to understand the need for minimization of domestic and commercial consumption of charcoal and firewood through use of efficient stoves and reduced wasage of trees by use of effeciciet kilns
- Its important to hold dialogue with the all stakeholders in the charcoal and firewood business
- Stakeholders education through social networks on how to conserve the tree for benefits of the environment and other resources such as water

Economic sustainability

- Introduction of modern forestry agricultural activities for increased producition of trees
- Alternative livelihoods and income sources to reduce pressure on tree resources
- Alternative activities such as cash and food crops to earn money for alternative sources to purchase other fuel types such as gas
- Poverty alleviation through job creation
- Prioritization in the national budget to address forestry issues including woodfuels
- Education and training for charcoal processers to enhance yield of charcaol hence more income
- Support with modern and efficient kilns to produce charcoal

Environmental sustainability

- Modern technology for charcoal processing i.e. efficient kilns to reduce wood waatage and emisions that cause air poluttion and produce more charcoal will less wood
- Increased tree plantations close to areas of demand for charcoal and firewood for example schools and prisons
- Awareness raising and support to communities on planting trees to replace the old ones or those harvested
- Afforestation programs and establishment of forest plantation for supply of woodfuel uses
- Sustainable harvesting of wood for fuel such as through resourcess assessment , invontroty and harvetsing plan for every district, cutting mature branches and leaving others to grow
- Modern farming and soil and water conservation for cash crops and vegetable gardens
- No cutting of trees near water sources
- Practice agroforestry by having trees interropped with crops or pasture or in a small piece of land in the farm as woodlots.
- Awareness raising on impact of deforestation and people will take urgent action

Institutional / political sustainability

- Preparation and reinforcement of by laws for sustinable woodfuel systems
- Awareness and trainings supported by government on sustinable woodfuel systems
- Training communities on how to raise awareness to others
- Certification of woodfuel production, transporation and marketing
- Increased access through subsidies for other sourcse of fuels
- Charcoal should be weighed according to actual weights and not in numbers of bags
- Reduction of long procedures /processes of getting transport passes

Participants during the SHARED workshops held in November 2018 analyzed the causes of unsustainability in woodfuel and resultant effects and impacts at shown in table 2. The stakeholder considered sustainability across the four key dimensions, namely economic, social, environmental and institutional/political

Table 3. Reasons for the unsustainability of woodfuel and resultant effects and impacts

Reasons the system is not sustainable	Effect	Impact
• Economic poverty among communities • Low education and high unemployment and poverty rates • No clear awareness among communities on effects of unsustainable practices • Harvesting and charcoal processing practices are not efficient • Communities do not adhere to government regulations • Low enforcement and corruption issues related to officers in implementation • Illegal harvesting of trees	• Forests are diminishing at a very alarming / high rate • Deforestation • Excessive destruction of forest • Soil erosion • Low quality soil and extensive degraded landed	• Climate change: frequent droughts, floods • Low agricultural production • Food shortage and hunger • Shifting cultivation practices due to low land productivity

3.0 IMPLICATIONS OF UNSUSTAINABLE WOODFUEL SYSTEMS ON NATURAL RESOURCE (NR), CLIMATE CHANGE AND LIVELIHOODS

This lesson will start with a question and answer session on implications of unsustainable woodfuel on natural resources, climate change and livelihoods

Use of woodfuel energy is not in itself a bad thing, However, there are some concerns: (i) sustainability due to the methods used to harvest wood; (ii) inefficiency of the methods used to convert wood into charcoal; and (iii) inefficiency in the use of woodfuel. These concerns can be resolved through technological development. The concerns about biomass energy have to some extent led to biomass energy being ignored in the global debates on sustainable clean energy. This has been despite the benefits they provide to livelihoods and the environment and the potential they have as a renewable energy. Using biomass energy globally for example saves the world about 8% of CO_2 emission from fossil fuels where SSA saved 2 Mt and India 121 Mt (IEA 2011). Fossil fuels, on the other hand, were formed from plants and animals hundreds of millions of years ago and are not renewable within human timescale.

(a) Unsustainability of harvesting of wood

Unsustainable harvesting of wood such as cutting down of trees and shrubs for woodfuel without replanting, degrades land and communities lose the benefits they derive/get from trees (Box 1). Charcoal has more impacts on trees than firewood as the latter is mainly sourced from tree branches or dead wood while the former is commonly through cutting down of trees.

What are the benefits of planting and harvesting trees sustainably for woodfuel (Box 1)

(i) provisioning of biological products such as fruits, nuts, vegetables and staples, feed for livestock, medicine and pesticides for people and livestock, oils, construction materials and wood fuel. E.g. in Embu, Kenya over 90% of farmer's source firewood from trees on-farm, for 65 % it is their main source and 40% exclusively depend on this source for firewood (Gitau and Njenga, 2015).

(ii) ecosystem supporting services e.g. through e.g. fixing atmospheric nitrogen (N) hence soil fertility management, soil moisture e.g. where deep roots bring water to the surface and biodiversity,

Faidherbia albida for soil fertility improvement in Tanzania. Photo by Mathew Mpanda

(iii) regulating services on micro and macro climate by providing shade, air quality through wind and dust control, water regulation and soil erosion by reducing speed of runoff and rain drops (iv) cultural services through ecotourism

(b) Burden on women and children in sourcing firewood from forests

Women and their children carry the burden of sourcing cooking fuel. Sourcing firewood is a time consuming and exhaustive exercise that requires around two day per family per week. It strains the female calorific energy balance and thus affects women's productivity. They are at risk of being attacked by wild animals and human beings. Young children involved in firewood collection often miss education opportunities, a situation that disproportionately affects girls. Carrying heavy firewood pieces loads on women and children's back or head risk spinal, head and leg injuries (Figure 5). Surprisingly women find firewood collection as an opportunity to socialize as they spend most of their time in farms while their male counterparts are able to spend time with friends in social places such as hotels and alcohol selling places.

Figure 5. Women from fetching firewood in Tanzania and Kenya.
Film on challenges in sourcing firewood: https://www.youtube.com/watch?v=QN0oFAMaabo

(c) Inefficiency in the methods of converting wood into charcoal

Wood or biomass wastage: One of the major challenges facing sustainable charcoal production is the use of traditional inefficient kilns (carbonization techniques which is burning biomass under controlled oxygen) that yield 10-20% charcoal in weight of original wood which implies that 100kg of wood produce 10-20kg of charcoal resulting into wood wastage and large areas of land required to produce charcoal (Figure 6). These traditional practices also result into land degradation.

Figure 6). Traditional earth kilns in Tanzania

Emissions: Inefficiency of kilns also results in heavy smoke containing greenhouse gases (GHG) and particles such as methane (CH_4), carbon monoxide (CO), nitrous oxide (N_2O), carbon dioxide (CO_2) particulate matter (PM) that are harmful to the environment and people. The GHG trap heat reflected from the ground and make the planet warmer. The resultant of these increase in global temperature include rise in sea levels, change in the amount and pattern of precipitation, floods, drought, water borne diseases (Jian et al., 2007, Figure 7).

Figure 7 Drought and floods in dry lands of Eastern Africa

http://www.ahmadiyyapost.com/2011/07/uk-52m-aid-for-africa-drought-crisis.html
http://www.travelagentcentral.com/east-africa/flash-floods-strike-kenya-20163

(c) Inefficient biomass utilization practices

Poor cooking techniques result in energy wastage and emissions. Traditional 3 stone stoves, for example consume more fuel compared to improved cooking stoves. The traditional stoves also produce more emissions than some of the improved stoves (Figure 8). Using wet firewood to cook consumes more wood and produces more smoke than dry wood. Kitchens with poor ventilation worsen the problem of smoke. There are serious adverse consequences for health when biomass energy is used in inefficient cooking practices. Household indoor air pollution from biomass causes 4 million annual deaths globally, with women and children being the most affected as they spend a lot of time in the kitchen (Lim et al., 2012). Some of the illnesses include chronic obstructive pulmonary, lung cancer, eye problems, head ache, asthma, pneumonia, and stroke.


Figure 8. Traditional cook stoves

4.0 INNOVATIONS TO MAKE WOODFUEL SYSTEMS SUSTAINABLE

The chapter presents options for making woodfuel systems sustainable. To make woodfuel systems sustainable it is critical to address the unsustainability's and inefficiencies in all the components of the systems as illustrated in figure 9. The interventions also need linkages across the components which will contribute to addressing the adverse effects of unsustainable woodfuel systems on the larger landscape. During the stakeholder consultation SHARED workshops priority interventions to make woodfuel systems were identified and this training covers some of them (Table 4.).

Table 4: Prioritized interventions across the three workshops

Pwani	Lindi	Mtwara
Forest Act Review	Use of modern kilns	Carrying out a land use plan
Tree Planting	Use of alternative methods of processing charcoal, briquette, sawdust, charcoal	Formation of village natural resource committees
Introduction of modern kilns	Improved processing by sharing experiences	Awareness creation
Reduced price of gas cookers by governments	Land use planning	Use of alternative sources of energy and awareness campaign
Charcoal fuel from alternative source of biomass e.g. sawdust, organic waste	Use offcuts from timber harvesters for making charcoal	Encourage use of forestry plantation
Awareness / education on benefits of energy efficient stoves	Identification and registration of harvesters and charcoal producers	Governance and management
Working facilities for effective control and regulation – weighing scales, database	Establishment of farm trees	Availability of permanent marketing centres
Facilitate alternative livelihoods	Formation of formal groups of woodfuel production	Awareness on forest policy, laws, regulation
Technical knowledge and working tools for harvesters	Training on improved cookstoves	Ease of access to transport permits and transit passes
Production of energy saving stove	Conduct exhibitions / shows on improved cookstoves	Government loans to producers of stoves
Establishment of tree plantations / woodlots	Awareness on transporting and marketing for the community	Provision of market centre
Provision of subsidy on alternative sources of energy	Improvement of rural road infrastructure	Enhancing communication and transportation

Source: Chesterman et al., 2018.

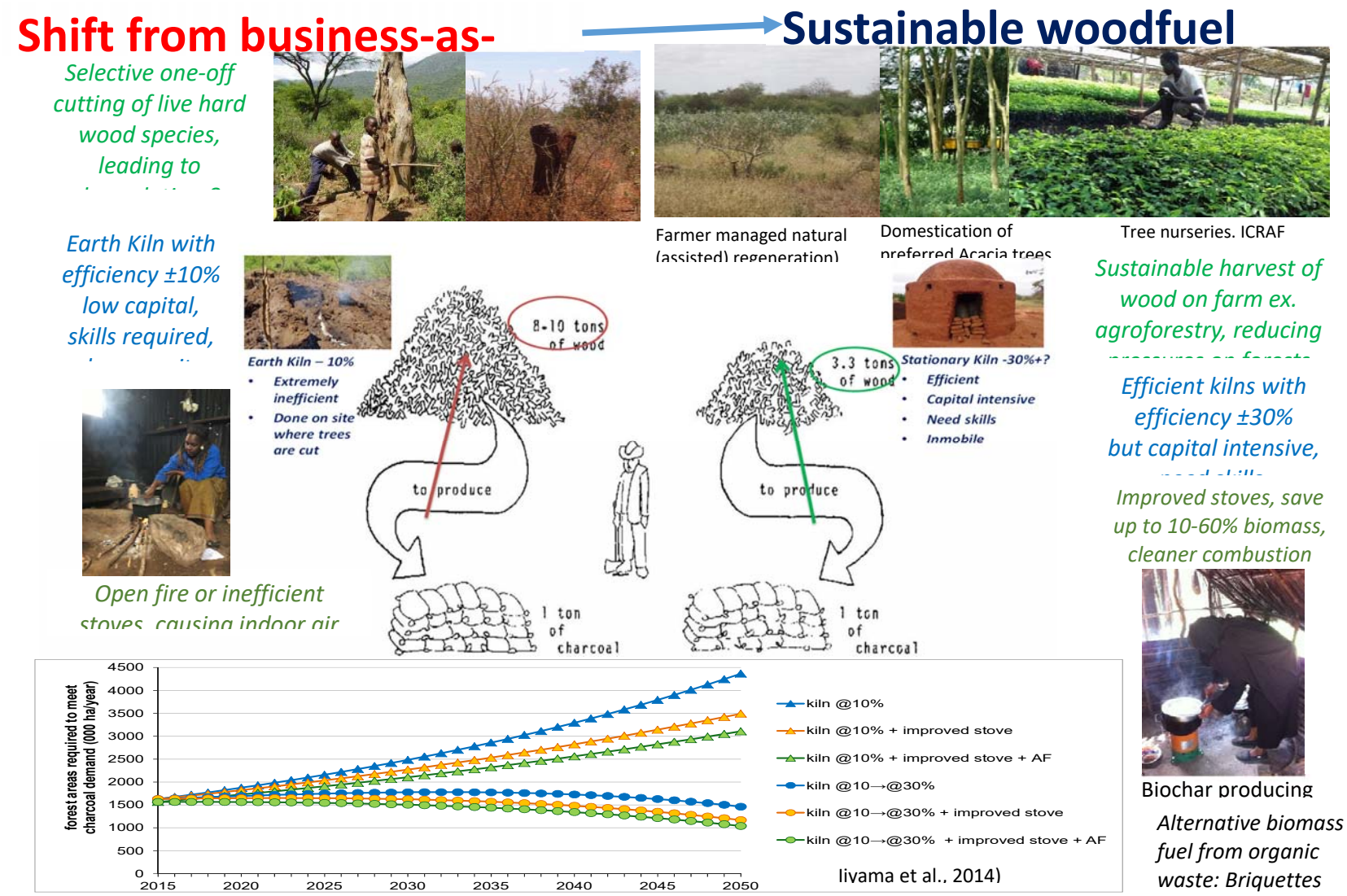


Figure 9. Making woodfuel systems sustainable. Source: Iiyama et al.2014, Njenga et al., 2017

4.1 Sustainable wood production

(i) Tree nursery establishment and tree growing.

The session covers:

- Agroforestry: benefits, types,
- Nursery establishment and management
- Tree seedlings planting in the field
- Record keeping for nursery and planted trees in the form

This session was delivered using the manual by Ogossy Gasaya, Mary Njenga and Anthony Kimaro (March, 2018). A simple guideline manual on designing and managing a basic tree nursery. World Agroforestry Centre (ICRAF), Nairobi, Kenya. This is provided as Annex 1.

Tree planting and awareness raising by Environmental Conservation for Wildlife and Community Enterprise (ECOWICE), presented by Ignatus J. Pesha. This is provided as Annex 2.

(ii) Farmer managed natural/assisted regeneration.

This session covers:

- Type of FMNR
- Practices in FMNR
- Benefits of FMNR

The session is delivered using: Kimaro, A.A., Kaale, K.B., Muriuki, J., and Mowo, J.G. 2017. Scaling Farmer Managed Natural Regeneration for Sustainable Land Restoration in Tanzania. A policy Brief. ICRAF, Nairobi, Kenya. This is provided as Annex 3.

4.2 Improved charcoal processing using more efficient kilns

One way of reducing wood wastage and emissions from charcoal production is by developing and adopting more efficient kilns. Work is going on in this field and improved kiln with about 30% yield are available (Odour et al., 2006, Figure 10). In developed countries such as Sweden wood to charcoal conversion methods applied by farmers have higher yields over 40% and the gases are used for heating the wood in the silos as well as heating houses. Some of the challenges however noted with adoption of improved kilns in developing countries are that they need more people to be operated and more capital to purchase as compared to traditional kilns.

Figure 10. Masonry high efficiency improved mound kiln used at Kakuzi Ltd, Thika, Kenya.

11. Steel ring
iln, Turkana
. Photo by J. Owino

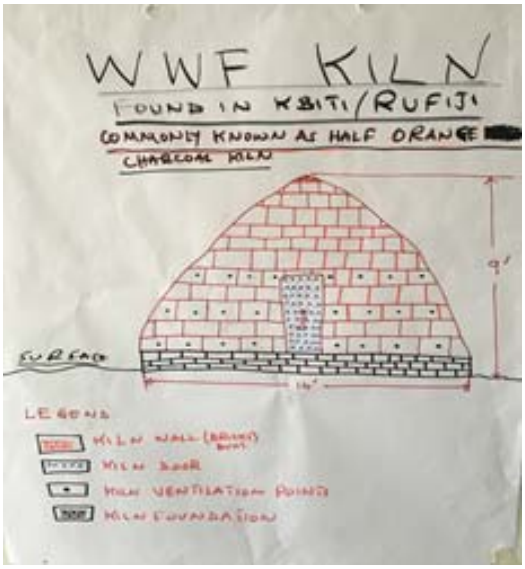


Figure 12. Illustration of modern kiln by charcoal producer in Pwani,

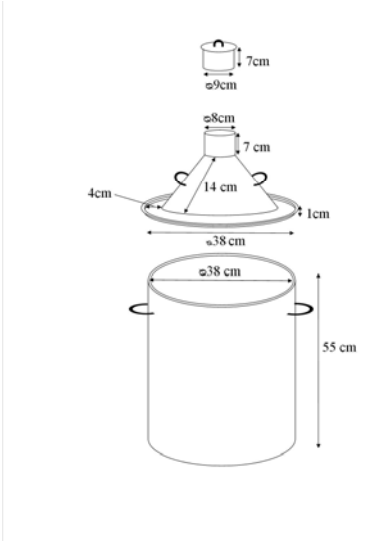


Figure 14: Drum Kiln by Cookswell Jiko. Technical Drawing by Barbara Njeri

Figure 13: Charcoal production in Sweden. Photo by Örberg

Pros: Reduce wood consumption, produce charcoal fast (steel ring drum kiln take24hrs), reduce emissions.

Cons: Expensive, require skills, some are stationery.

Discussions and presentation on different types of improved kilns and their benefits and challenges.

4.3 Improved cooking practices and stoves

Some practices that improve air quality in the kitchen during cooking with biomass:

- Use of improved cook stoves as compared to the traditional three stone which will be addressed later in the course
- Using well dried wood. Drying of firewood can be done under the sun or in the kitchen (Figure 15)
- Having a well-ventilated kitchen increases air circulation which drives away smoke.
- Lighting mobile cook stoves outside and bringing them into the kitchen when smoking stops and fuel has caught fire.

Figure 15: Rafter in a kitchen and a shed outside used to dry firewood

Improved cooking stoves use less wood, cook faster with reduced emissions. For example a gasifier cooking stove save 40% of fuel, reduce concentration of carbon monoxide by 45% and of fine particulate matter by 90% (Njenga et al., 2016.)

A gasifier burns biomass fuel e.g. firewood, maize cob, coconut husks under controlled oxygen, the gases energy are used as a source of cooking energy. It burns the fuel in low energy and hence produce charcoal as a by-product. The charcoal is used for another cooking or for soil improvement.

Figure 16: From left. Women cooking with gasifier charcoal produced from the gasifier and cooking with charcoal produced during cooking with gasifier.

Figure 17: An improved cooking stove in Mtwara, Tanzania.

Discussions and demonstration on different types of improved cooking stoves and possibilities of further improvement and advantages and challenges.

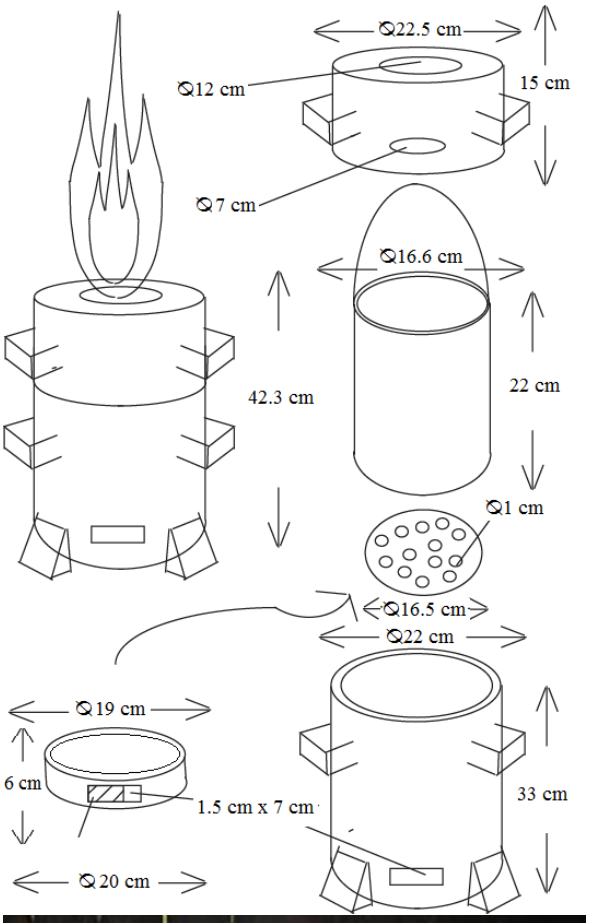


Figure 18. Galvanized steel gasifier fabricated in Nairobi. Technical drawing by Nemer Achour

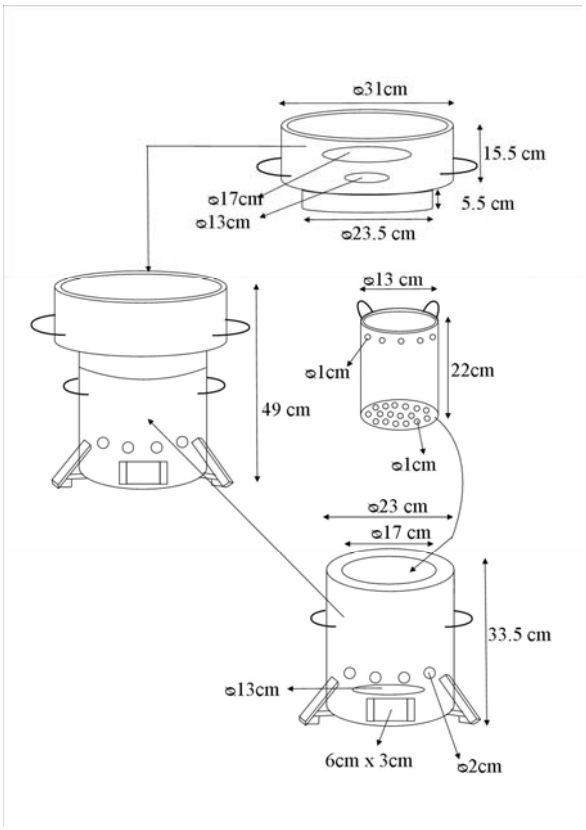


Figure 19 Ceramic lined gasifier by KIRDI. Technical drawing by Barbara Njeri

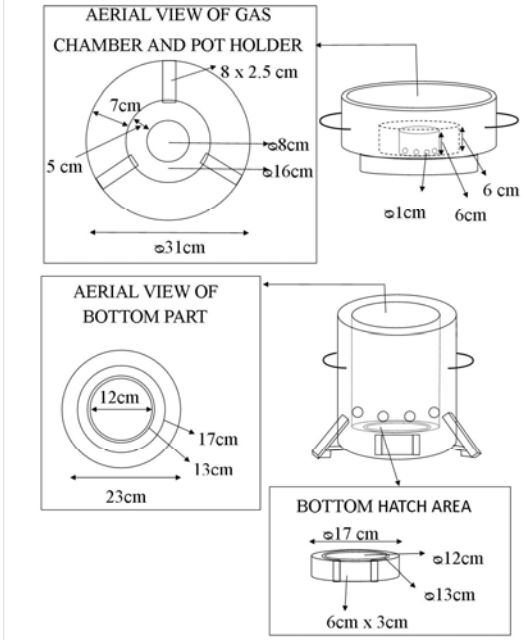


Figure 20. Ceramic lined gasifier by KIRDI. Technical drawing by Barbara Njeri

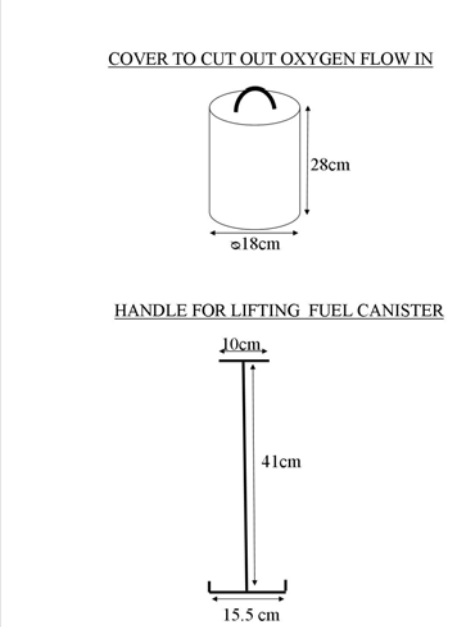


Figure 21. Charcoal cooling cover and canister holder by KIRDI. Technical drawing by Barbara Njeri

4.4 Alternative sources of biomass cooking fuel. Fuel briquettes

Briquettes are made from compacting dry biomass material into a solid unit that is used for cooking or heating just like charcoal or firewood. Some community members collect charcoal dust/fines from charcoal production sites or trading places. Some communities use a drum kiln to produce charcoal from weeds or tree branches. Others use saw dust, rice husks, coconut shells, maize cob among other crop residues. The raw material is ground using traditional motor and pestle like that used to grind maize. If the raw material has low sticking capacity a binding agent such as biodegradable paper, soil, cassava starch, corn starch, molasses a sugarcane waste is used. They are compacted using bare hands or manual and electric machines and then dried under shade for less than 5 days depending on weather as shown in table 4. After that they are ready for use to provide cooking and heating energy.

Demonstration on briquette production at home by farmers

Table 4. Briquette production process

Sourcing raw materials

- Briquettes can be made using different materials such as charcoal dust, which can be sourced from charcoal traders, cow dung, and other organic waste.
- Sourcing binders such as soil, paper (newsprints, printing paper, old exercises books) from institutions such as schools, offices. It is good if paper is sourced while shredded, if not it can be shredded by hand or using manual machines.
- Sourcing water from wells, rivers, tap, and borehole.

Producing raw materials

- In case charcoal dust is not available fresh organic by-products such as sawdust, organic waste can be carbonized into charcoal dust using a drum kiln.
- In case a binder is not readily available, organic residues can be composted
- Producing briquettes
- Sort and sieve charcoal dust, cow dung and compost to remove impurities
- Grind coarse particles of charcoal dust

Mix materials for different types of briquettes

(a)Charcoal dust + paper + water.
-Soak the shredded paper for 3 hours
-Mix charcoal dust with the soaked paper at 7:1 ratio (dry weight). Ratio may change depending on type of paper and size of particles of charcoal dust
(b)Charcoal dust + soil or cow dung or compost
-Mix charcoal dust +soil + water at 4:1 ratio
-Mix charcoal dust + compost + water at 4:1 ratio
-Mix charcoal dust + cow dung + water at 2:1-1:1 ratio

Binding test

- Squeeze the mixed material in the hand and hold it between the index finger and the thumb and shake. If it holds the binding agent is enough, if it falls apart add some more binding material.

Pressing or compacting briquettes

- Press or compact mixed material or slurry in recycled cans or bare palms
- Press or compact mixed material or slurry using manual metal or wooden press

Drying and packaging and utilization

- Place the briquettes on shelves, rooftops, or on ground.
- Package the individual pieces in tins, sacks or polythene bags.
- Are used like firewood or charcoal

http://www.planetforward.org/2013/10/14/cheaper-safer-cooking-with-biomass-briquettes
https://www.youtube.com/watch?v=2Zo50W3-sxw
https://www.researchgate.net/publication/272367225_Charcoal_briquettes_production_A_practical_training_manual. Njenga 2014

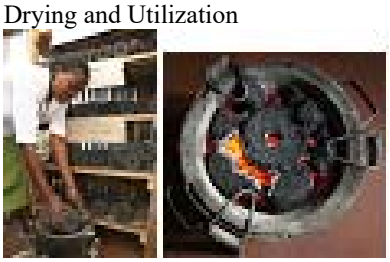
Shredding papers

Drum kiln for carbonizing

Sorting raw materials and (b) grinding

Mixing materials and pressing

Drying and Utilization



Discussions and illustration on examples in Tanzania

5.0 EFFECTIVE MARKETING OF WOODFUEL

This session covers:
Condition of internal trade

This session is delivered using materials developed by Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager).

6.0 POLICY AND REGULATORY FRAMEWORK ON WOODFUEL

This session covers:
- Harvesting of forest products
- Harvesting from village land and forest reserves
- Marketing and trade of charcoal

This session is delivered using materials prepared by Zawadi J. Jilala (Regional Natural Resource Officer) Lindi & Ronald N. Pangal (Regional Natural Resource Officer) Mtwara. (2018). Policy and Regulatory Framework on Woodfuel.

7.0 BENEFITS OF SUSTAINABLE WOODFUEL

Discussions led by one of the trainees on a list of benefits of sustainable cleaner energy innovations

Summary on benefits of sustainable clean energy innovations

Economic

a. Require low capital and the technology is easy to learn e.g. fuel briquette. Others such as biogas, solar and wind may require high capital and technological support.
b. Employment creation through the enterprise of disseminating skills, selling of appliances and production
c. Supply of cheaper and cleaner cooking and lighting energy
d. Foreign exchange saving on importation of fuel
e. Can be used to earn income through carbon credit
f. The lighting improves on education by allowing children to study in the evening
g. Income generation through sale of fuel.
h. Reduces cost of purchasing water to scrub utensils

Pots after cooking for three hours with (left) charcoal briquette (middle) lump charcoal and (right) Kerosene. Photos by Mary Njenga

i. They are decentralized conceding with dispersed nature of population

Social-cultural and human capital

a. Biomass fuel such as firewood, allow families to socialise around fire.
b. Community involvement
c. Create social networks through self-help groups which also get connected to other organizations- universities, non-governmental organizations, policy makers, donors.
d. Saves time, calorific energy spent in sourcing cooking fuel which is used on other productive activities
e. Technical skills improved
f. Improve communication

Environmental

(a) Improves soil through use of biochar.
(b) Reduce pollution. absorbing organic waste reduce waste from dry cell batteries
(c) Saves trees (d) Reduce risks of fires e.g. from kerosene lamp (e) Mitigate climate change

Health and nutrition

a. Health: Having lower emissions results into reduced health risks associated with smoke from kitchens.
b. Nutrition: Affordable fuel allows families to cook whatever food type they chose and cook it well, without worrying about the cost of energy. Boiling common beans *Phaseolus vulgaris* takes a long period of time and where poor families exclude them in their menu fail to cook them well. *'Cooking made us human'* (Wrangham, 2009). *Cooking improves, tenderness, texture and digestibility of food hence higher energy benefits. It also improves taste, smell, colour, makes food safer by reducing harmful bacteria and preserves it*

8.0 REFERENCES

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9.0 ANNEXES

Annex 1.
Ogossy Gasaya, Mary Njenga and Anthony Kimaro (March, 2018). A simple guideline manual on designing and managing a basic tree nursery. World Agroforestry Centre (ICRAF), Nairobi, Kenya.

Annex 2
Tree planting and awareness raising by Environmental Conservation for Wildlife and Community Enterprise (ECOWICE), presented by Ignatus J. Pesha.

Annex 3
Kimaro, A.A., Kaale, K.B., Muriuki, J., and Mowo, J.G. 2017. Scaling Farmer Managed Natural Regeneration for Sustainable Land Restoration in Tanzania. A policy Brief. ICRAF, Nairobi, Kenya.

Annex 4
Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager). Elimu ya masoko ya mkaa na kuni kwa wadau wa mazao ya misitu iliyofanyika lindi mjin

Annex 5.
Zawadi J. Jilala (Regional Natural Resource Officer) Lindi & Ronald N. Pangal (Regional Natural Resource Officer) Mtwara. (2018). Policy and Regulatory Framework on Woodfuel.

Annex 6.
Mary Njenga, Ogossy Gasaya and Anthony Kimaro. (April 2018) World Agroforestry Centre (ICRAF). Trainers course on scaling-up sustainable wood fuel (charcoal and firewood) systems in Pwani, Lindi and Mtwara regions, Tanzania. A brief.

Annex 7.
Inspiration story on impact on increased production of charcoal and income after participation in the trainer's course.

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A simple guideline manual on designing and managing a basic tree nursery

What is it about?

This simple guideline is for individuals and group of farmers with limited trees nursery knowledge but are interested with growing tree species for on-farm trees production and environmental conservation purposes through small scale-nurseries

"For any successful trees nursery technology, start with something small and simple but learn how to run it

Ogossy Gasaya, Mary Njenga and Anthony Kimaro. March 2018.

World Agroforestry Centre

CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

Contents

INTRODUCTION

Agroforestry (AF) is a farming system that integrates crops and livestock with trees and shrubs. The resulting biological interactions provide multiple benefits, including diversified income sources, increased biological production, better water quality, and improved habitat for both humans and wildlife. ICRAF developed participatory tree domestication techniques and strategies aimed at empowering local communities, promoting food self-sufficiency, generating income and employment,

and enhancing nutritional benefits in semiarid Tanzania through different agroforestry technologies. Tree nurseries are key success factor in many forestry and agriculture development interventions through agroforestry. Agroforestry technologies will be the delivery mechanism for multifunctional agriculture that help rural communities to be self-sufficient and to support their families as it plays an important role in the socio–economic development of these communities, as trees planted on farms provide timber, fuelwood, fodder, fruits, medicine, windbreaks, and other economic and environmental benefits. In order to meet present and future demand for tree related products, there is a need to promote tree nurseries which will be owned and managed by individual farmers of the selected villages for on-farm and other trees planting technologies including intercropping, contour, woodlots, shelterbelt, boundary and homestead.

AF Benefits: Agroforestry offers robust options to improve agricultural productivity, income and achieve environmental sustainability

Agroforestry technologies provide the following benefits:

- Provide protection for valuable topsoil, livestock, crops, and wildlife;
- Increase productivity of agricultural and horticultural crops;
- Reduce inputs of energy and chemicals;
- Improve water quality in nearby streams and other reservoirs;
- Diversify local economies by providing other valuable products harvested from agroforestry practices include wood for energy generation, fruits and nuts, wood shavings for animal bedding; saw logs for dimension lumber; high-value timber products; decorative florals, mushrooms, herbs, medicinal plants, and craft materials.
- Agroforestry practices combined with other practices such as contours and shelterbelts to control runoff from agricultural operations, protecting water quality and safeguarding water supplies for wildlife and people.

What is a Nursery?

A tree nursery is a managed site, designed to produce tree seedlings grown under favourable conditions until they are ready for planting. It can be an informal, small-scale arrangement or a large commercial enterprise. All nurseries primarily aim to produce sufficient quantities of high quality seedlings to satisfy the needs of users. The purpose of the nurseries include for commercial biomass production, land rehabilitation and forest conservation, local capacity building and livelihood enhancement.

Importance of Nursery and its Role

Seedlings and grafts are produced in nursery from which the fruit orchards and ornamental gardens can be established with minimum care, cost and maintenance**.** The nursery planting materials are available at the beginning of the planting season. This saves the time, money and efforts of the farmers to raise seedlings. Nurseries also ensures the production of genetically improved quality planting material, it provides employment opportunities for technical, skilled, semi-skilled, unskilled labour, they are an important source supplying the

seedlings for meeting the fruit, pulp and paper, fuel wood, timber and other demands of the industries.

Components of a Good Nursery

The nursery site should be located in the nutrient rich/medium soil, near to water source, free from soil pathogens and insects, availability of cheap and skilled labours and has good access to the main road for easy transportation. The site should be on gently sloping area and away from other tall crops: this is important for good drainage as well as to encourage air circulation. An appropriate site must be selected for the most effective, efficient, and economical design of a nursery. The purpose and target of plants to be produced will decide the site selection and its improvement. Careful observation of site conditions and an assessment of past and present climatic records are important. If desired, make a list of potential nursery sites and compare them using a decision matrix

Establishment of trees nursery

Site Selection

Factors to be considered for raising a nursery

1. Location of the nursery: The nursery should be located somewhere flat, sheltered and well-drained. Avoid placing your nursery in areas that are liable to flooding (e.g. at the bottom of a valley or in riverine areas), strong winds (e.g. at the top or a hill or in the middle of an exposed valley) or soil erosion (e.g. on a steep hill).
2. Near the house
3. Well exposed to the sun but protected against severe heat
4. Well protected against animal damage, strong winds.
5. Water sources
    1) Nursery has to be placed near the water source because reliable source of water is essential for continuous sustainable water supply
    2) Positioning the nursery close to a nearby spring, stream, pond, borehole or well will minimize the working time on looking and collecting water for the nursery.
6. Soil
    1) Soil should have a large quantity of organic matter
    2) Soil texture should be neither too coarse nor too fine
    3) Has a fair degree of water holding capacity
    4) Normally rich in all the necessary elements

Equipment requirements

Equipment checklist when establishing trees nursery includes the followings;

- Wheelbarrow or trolley for transporting materials within the nursery
- Spade or shovels for soil mixing

- A trowel for filling planting bags or pots with soil
- Polythene bags for germination of seeds and growth of seedlings
- Shading materials for covering nursery beds to protect seedlings from direct sun and strong winds
- Hosepipe with spray nozzle/a watering can for watering plants
- Spray bottles for irrigating very small, delicate seedlings.
- Cutters or scissors for pruning seedlings.
- Planting labels
- Notebooks for record keeping
- Pens and pencils

Nursery operations

Tree nursery operations involves various activities including seed sourcing, Seed bed preparation, Sowing seeds, Potting, Shading, Watering, Weeding, root pruning, application of additional fertilizers or manure whenever is necessary.

Seed sourcing and pre-treatments

Sourcing tree seed:

Seed zones and elevation are important to consider for most effective results, operator should order seedlings grown from seeds collected in the same seed zone and elevation in which they will be planted. It is also important to use good quality seed in planting. Seed can be obtained from matured trees found in local farms; forest or public land as long as one collects from at least quit number of trees to maintain diversity and or other seeds can be bought from local seed suppliers, from NGOs, and from institutions such as TTSA, TFS and TAFORI offices. During collection of seeds ensure that the seeds not immature and is not containing empty seed. Also more information for seeds sources can be obtained from nearby forestry officer available within the village.

Pre-treating seed:

Sometimes it is important to treat seed before it is planted, in order to improve on the level, speed and uniformity of germination. The common known treatment methods include;

(a) Soaking is either done using hot water or cold water.

- Seeds with very hard seed coats are soaked in hot water until the seeds look swollen. Trees species of which their seeds need the soaking method include *leucaena, albizia*, most acacias, tamarind, and *calliandra*. Soaking procedure for this is boil water and pours it over seeds in a container, and then leaves the seed in the water until the seeds look swollen. The hot water weakens the hardcover of these seeds for easy and speed germination process.
- Soaking seed in cold/cool water is recommended for those with soft seed coats such as *sesbania, tephrosia, dalbergia species*, *gmelina, Gliricidia, sesbania* and *Acacia augustissima*, etc. The time for soaking varies between 12-48 hours,

depending on the tree species. Procedure: Soak the seeds in cold water and make sure all seeds covered with water, and then remove the floating seeds that show poor germination.

(b) Cracking the seed shell and soak method

Cracking is done using a sharp knife, a nail cutter or stone and is mostly for leguminous seeds such as *Sesbania sesban* with thick and hard seed coats to allow water penetration to accelerate the germination.

Establishment and management of seedlings in the nursery

Seed bed preparation

The germination bed should be established on a flat or level area near a water source within the nursery site. Nursery beds can be arranged either by raised on a flat bed, or can be set into a sunken bed, which is a basin like excavation of about 1 m by 1 m and about 10 cm deep. Prepare a germination bed at most 1m wide, and its length will depend on the number of seeds to be sown, size of seeds and available space.

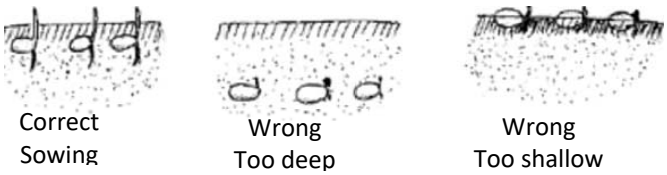
Potting

Before planting of sapling in the polythene tubes, the tubes should be filled up with proper potting mixture. The mixture (soil, sand and compost/manure) should be moistened before potting and then pressed into polythene tubes to a depth of about three-quarters of the height of tubes. Polythene tubes should then be topped up more loosely with mixture and pressed down lightly to about 2 cm below the top. Heavy compaction should be avoided at the top of pots because it will inhibit root penetration, then after filled all tubes with mixture, watered them lightly before sowing seeds into it.

Sowing seed

Sow large seeds 2cm to 3cm or twice of its thickness deep in the soil. Sow small seeds by broadcast and cover them with a small amount of fine soil. During planting more than one seed can be applied in a tube and then, if more than one germinates, seedlings can be pricked and transplanted to another tube to leave a single individual in each tube. The beds can also be covered with thatch or a plastic sheet till the seeds germinate. Sowing also can be done using polythene tubes that are around 4 inches in diameter and 10 cm deep or bigger, depending on the size of the given species seed in question and the time that seedlings will

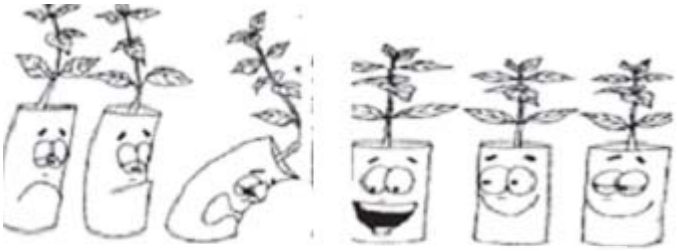
be in the nursery. Other locally available materials that can be used during seeds sowing include small open-bottomed tins, milk packets, cardboard boxes, calabashes and clay pots.



Proper sowing depth of seeds

Pricking Out

Pricking out is done to attain uniform growth and high survival rate in the field, and this is recommended for small seed, which normally sown by broadcasting and is best done when seedlings is two weeks old or when acquires two leaf set. It is performed by selecting and uprooting the germinated seeds carefully by hand using a hand trowel or chopped stick. During uprooting, hold seedlings at the base of the stem and pull it out gently from the mother beds and when transplanting make a deep and wide hole in the polythene bag or container for transplanting the seedlings.



Wrong: Tubes not straight **Correct pricking**

Watering

Water is the most important factor in germination and seedling production too much water can be just as harmful as too little water. The quantity of water required depends on the size of the nursery, the kind of soil, the species, the number of seedlings and the irrigation method practiced. More water is needed in arid region nurseries because the sandy soils have a low water holding capacity. To avoid drying of seedlings, a reliable and continuous supply of water should be ensured by the facility of storage of water for at least 3 days' supply. It is also necessary to ensure the quality of water used for irrigation. Normal pH water area the best suited, while water with more than pH of 7 favours attacks of 'damping off' fungi.
Watering preferably in the mornings and avoiding the mid-day period when the sun will cause excessive evaporation. The visible symptoms of over watering are slight to severe yellowing and stunted growth.

Shading

Use locally available materials such as grass, mats, or banana fibers for shade construction to protect the seedlings from direct sunlight for two to three weeks after pricking out.

Weeding

Weeds are any plants present in the cultivation area which is out of our interest. They normally compete with the seedlings for nutrients, water and light, and suppress the growth of young plants because the weeds are usually more vigorous and grow at a faster rate. The most troublesome are grasses or dicotyledonous plants that grow from a root stock. Remove all the weeds around the beds with a small garden hand hoe and don't leave any rubbish around unless you are sure that this can be converted to compost. Using hands gently pull out unwanted growth and this should be done continuously whenever weeds are observed. Frequently removing of weeds reduces competition of nutrients to the seedlings as known that weeds are a threat to healthy seedlings development.

Application of additional fertilizers (Nutrition)

Generally sufficient quantity of nutrients is not available in the soil used for seedbed. Hence, well rotten compost and leaf mould is added to soil. Rooted cuttings, layers or grafted plants till they are transferred to the permanent location, require fertilizers. Addition of fertilizers will give healthy and vigorous plants with good root and shoot system.

Seedling protection

Adoption of plant protection measures, well in advance and in a planned manner is necessary for the efficient raising of nursery plants. For better protection from pest and diseases regular observation is essential. The major disease of nursery stage plant is "damping off", and for its control is through good sanitation conditions are necessary.

Transportation from the Nursery to planting site

Make sure that the site where you are taking seedlings is ready to be planted. The followings are things to take into consideration during transporting seedlings to the site for planting.

- Cover seedlings during transport to shade and protect them.
- Take only as many seedlings to the field as can be planted that day.
- Handle bags gently and take precautions to minimize bouncing and sliding around on the bed of the truck.
- If weather is sunny, windy, dry, or warm, be sure to have something to keep seedlings protected (i.e. water, reflective tarp, damp mulch).
- Keep seedlings away from fuel and chemicals.
- Handle seedlings carefully at all times as physical abuse causes subsequent decline in seedling vigour

Seedlings planting in the field

Plant tree seedlings at the right time of year to avoid some post-planting problems, such as drought and transplant shock. Seedlings should be planted when they are dormant, generally December-April, depending on local conditions. However, the planting season may be extended in areas in which irrigation is possible into all year around. The number of trees per acre can be determined based on the spacing applied during planting (Figure 1).

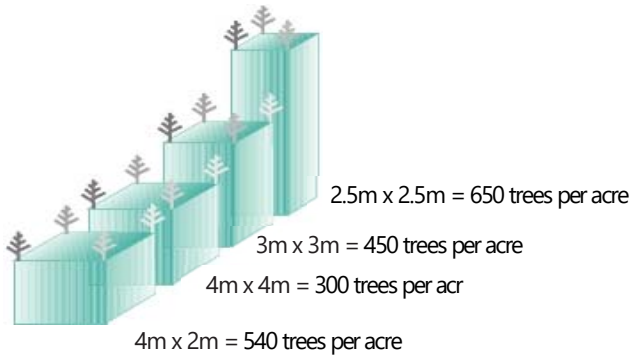


Figure 1: This figure helps to determine the desired number of trees per acre

Distribution of tree seedlings to the planting areas at Manyusi, Kongwa

Different Agroforestry planting systems

- Tree-Intercropping: Growing annual crops between rows of trees or shrubs. Examples of trees that can be intercropped with crops include legume plants such as *Leucaena leucocephala, Gliricidia sepium*
- Boundary Plantings: Trees planted along boundaries or property lines to mark them well. Examples of trees species suitable for this system are *Grevillea robusta, Albizia, fruits tree species,* and *Leucaena species.*
- Contours: Planting trees on constructions made of earth, usually to conserve or control water. Examples of trees species suitable for this system are *Gliricidia sepium and* Elephant grass.
- Woodlot: An area planted trees for fuel, or timber.
- Shelterbelts: trees planted as windbreaks to protect valuable topsoil during wind blow, this planting system can also increase crop yields through increased soil moisture. Examples of trees species suitable for this system are *Casuarina*, *Gliricidia sepium, Grevillea robusta*
- Living Fences: Fences made up of living trees, or in which the entire fence consists of closely-spaced trees or shrubs. Examples of trees species suitable for this system are *Erythrina, Yucca, Gliricidia*

Advantages of Agroforestry

- It can effectively leverage short-term cash-flow over time
- It can increase crop yields.
- It helps with energy savings.
- It can help sustain or even increase biodiversity.
- Climate change mitigation
  A**groforestry addresses climate change through a number of solutions**:
  - It reduces or eliminates the need for deforestation because it provides wood products from the farmland.
  - It also reduces the need to use soil nutrients and fertilizers by improving soil quality and maintaining good nutritional balance and fertility.
  - Finally, agroforestry strengthens agricultural resilience by increasing crop yields and offering better environment for farm animals

- The greenhouse effect is countered by the constitution of an efficient system for carbon sequestration, by integrating the stock maintenance of organic material in the soil and superimposing a net fixing wooded layer.

Disadvantages of Agroforestry

It requires a huge amount of time to reap products
It is cost as it requires intensive knowledge and technology during implementation.

Nursery inventory

A well-kept and up-to-date nursery inventory helps to assess whether the nursery is operating as planned, and whether demands are being met. Your inventory should list all plants currently in the nursery by bed or frame number, and details of delivery of seedlings, including the site, name of owner and site conditions. It can be an important tool to record feedback from the planting sites and can then help to determine whether seedlings have the right quality for the sites on which they are planted.

Record keeping

When the nursery has been established, there should be a decision on what methods, tools and records will be kept. The long-term success of the nursery depends on reliable information about how to efficiently grow your target species to a high standard. Obtaining this information requires regular record keeping that documents both failures and successes. Over time, these records can help to create a clear picture of best practice for the species of concern within the given nursery. Also it helps operators, researchers and other stakeholders in planning, monitoring, and decision-making for improved nursery operations.
The record keeping in the nursery helps to:

- Estimate how much seed is required to grow a given number of plants for each species. Estimate how long each seedling takes to grow to planting size.
- Develop and improve protocols for nursery workers to follow. Measure the performance of the nursery as a whole.

There are three types of records nursery group may choose to keep in the nursery:
1) Plant Development Records document how each species is performing within your nursery. Typically this involves having one separate datasheet for each batch of seed that comes into the nursery for each species, and recording data on seed source, germination, growth and planting. They are particularly useful for developing new protocols for each species in the nursery.
2) A nursery inventory can describe the performance of the whole nursery at one point in time. Typically.
This involves counting the number seedlings for each species in your nursery and their stage of development. Inventories should be completed at least every two months.
3) Plant supply records help to record the number and quality of plants supplied to different planting sites. They also contain information on dates of delivery, who received the saplings and which site they were sent to. These records will be vital if you want to follow-up and monitor survival of saplings in the wild.

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INTRODUCTION

ENVIRONMENTAL CONSERVATION FOR WILDLIFE

AND COMMUNITY ENTERPRISE (ECOWICE)

P.O.Box 2405 Morogoro-Tanzania,
Mob:+255 688 916 557 /+255 755 558 837
Email:savewild@ecowice.org
Web: www.ecowice.org

Introduction.....

- (ECOWICE) is a non-governmental organization which was established by the 2002 act of non-governmental organization Act of the united republic of Tanzania.
- ECOWICE Head Office is in Morogoro Municipality, with two centers located in Arusha Region in Karatu District and Pwani Region in Chalinze District.

❖Vision:

- Developed rural communities for biodiversity conservation

❖Mission:

- Increase rural community income and food security for biodiversity conservation

❑PROJECT INTERVENTION

- We have three project intervention which signify alternative income generating activities
- ❖ Tree planting
- ❖ Beekeeping
- ❖ Mushroom production

PROGRAM

❖ Agro-forestry farm operations and utilization

To promote and solicit establishment of agro-forestry farm and growing fruit trees, fodder trees and fuel wood trees by the economically disadvantaged rural communities.

❖ Socio-Economics, Agro-forestry extension

Fostering rural decision-making for establishment, management and conservation of agro-forestry resources for social and economic development, and reduce adverse environmental impacts

❖ Conservation education

Establishment of "Save wild club", at primary school, secondary school and universities, aiming for capacity building and increase awareness for biodiversity conservation.

❖ Community enterprises

Ensure securing market for agricultural and agro-forestry products produced by rural communities which will contributes generating income for communities

Tree planting Project……

- Agro forestry farm operation and utilization
  - Assisting communities to identify specific sites for establishment of tree nurseries
  - Visiting community and schools, Providing training and facilities, educating them to grow modern tree species with high hybrid vigor
  - Supporting community to establish agro forest farm and planting trees which have double socio-economic impact such as
    - Providing shade
    - Source of firewood
    - Fruits production and medicinal purpose
    - Production of timber and furniture
    - Reduce wind impact and fencing
    - Soil retention during the rainfall period
    - Farms can be source of Apiary (place for bee hives)
    - Land improvement and soil conservation
    - Domestic items

Conservation education

✓Visiting schools and Universities

✓Wildlife and forestry Education awareness

✓Preparation of workshop and recreation activities

✓Preparation of tree nursery

✓Emphases tree planting

✓Reduce adverse Environmental impacts

- Some of secondary school around Morogoro Municipal and Chalinze District in Lugoba

✓Morogoro Sc. School

✓Mafiga Sc. School

✓Lugoba Sc. School

✓Mboga Sc. School

Tuwawezeshe watoto kukua huku wakitambua umuhimu wa kuhifadhi wanyamapori na mazingira

Preparation of tree nursery and propagation methods

- ✓ Source of income from selling seedlings and fruits
- ✓ Source of food when students are at school
- ✓ Decorate school environment (ever green)

- Some of mango tree species which are mostly grown

❖Mango tree

- ✓Apple mango tree
- ✓Red indians
- ✓White sopha
- ✓Alphonso
- ✓Tommy atkins
- ✓Keit

Some of other fruit tree spies

Type of tree sp		Implication
Custard apple tree	(Annona squamosa)	Edible Fruit and medicinal
Sour sop tree	(Annona muricata)	Edible fruit and medicinal
Avocado tree	(Persea americana)	Edible fruit
Guava tree	(Psidium guajava)	Edible fruit and medicinal
Jack tree	(Artocarpus heterophyllus)	Edible fruit
Orange tree	(Citrus sinensis)	Edible fruit
Papaya tree	(Carica papaya)	Edible fruit and medicinal

- Some of these tree species are source of firewood, timber and medicinal values, but also a source of apiary

C/name	Scientific name	Implication
Mvule	Milicia excelsa	Source of timber
Mkongo	Polyscias fulva	Source of timber & medicinal
Mtiki msaji	Tectona grandis	Building material, furniture, medicinal
Sedelea	Sedelea ordolata	Building material and living fence
Mbuyu	Adansonia digitata	Source of forage, timber and medicinal
Mwarobain Mwashoki	Azadirachta indica Polyalthia longifolia	Shade and medicinal Ornamental and fence

❑ Beekeeping and Mushroom production projects

Project activities and the outcomes

ACTIVITY	Outcome
Training	Ability to cultivate mushroom and beekeeping
Beehives and Mushroom house construction	Provides suitable environment for beekeeping and mushroom growth
Monitoring	Ensure sustainable production
Buying	Provide market
Processing	Add value
Transportation & Marketing	Ensure effective markets
Selling	Obtain profit

Mushroom project

✓Need small area
✓Environmental friendly
✓Manure retention
✓Easy to practice
✓High economic gain
✓Permanent adaptation
Completely eliminate
Logging and poaching

Provision of training for beekeeping and marketing of bee products

Honey processing and packaging

Challenges

- Inadequate finance and facilities to support community
- High government bureaucracies
- Inadequate commitment to communities
- Conservation is difficult under **corruption** and lack of **law enforcement**.

Scaling Farmer Managed Natural Regeneration for Sustainable Land Restoration in Tanzania

A Policy Brief

Key messages

- *Two-third (61%) of Tanzania's land area, especially arid and semi-arid lands, is degraded and pose challenges to conventional tree planting techniques for sustainable land restoration.*
- *At about US$ 9.56 Million per year, the cost of tree planting for land restoration in Tanzania can be prohibitive, if low-cost and ecologically viable approaches such as FMNR are not considered. Incorporating FMNR in the National Tree Planting Strategy is a step towards addressing this challenge and ensuring sustainability of land restoration programs.*
- *Building on previous multi-stakeholder and farmer oriented land restoration practices, such as Ngitili, is critical for contextualizing and promoting FMNR in Tanzania.*
- *FMNR is taken up rapidly by farmers and other stakeholders in pilot sites in Tanzania due to its multiple benefits to the society and the environment, at little or no cost. Unlocking the barriers of FMNR adoption by establishing a multi-sectoral national coordination body to institutionalize and mainstream FMNR will create a conducive enabling environment for out-scaling FMNR.*

Land Restoration Initiatives in Tanzania

Restoration of degraded forest and agricultural landscapes is a priority for Tanzania as noted by a series of integrated land restoration programs implemented in the 1990s. Among these include the Land Conservation in Shinyanga Region (including the current Shinyanga and Simuyu Regions), known as in Kiswahili as *Hifadhi Ardhi in Shinyanga* (*HASHI*). *HASHI* is renowned for promoting the restoration of *Ngitili*, a traditional fodder reserve system by the Sukuma tribe. Globally, Tanzania has expressed interests to join the African Forest Landscape Restoration Initiative (AFR100) and processes to set restoration targets are underway. The AFR100 Initiative, is a pan-African country-led effort to contribute to global land restoration programs such as the Bonn Challenge. Agroforestry, a system that promotes integration of trees in agricultural and degraded landscapes to restore land productivity and ecosystem services, is considered as one of the options to help African countries meet their restoration targets in a manner that generates economic and social benefits while enhancing climate change resilience and rural livelihoods. By adopting Farmer Managed Natural Regeneration (FMNR) as one of the major practice for regenerating trees under the National Tree Planting Strategy (URT, 2016), Tanzania set a stage to take advantage of agroforestry practices to meet land restoration targets. This strategy target to plant 185,000 ha (equivalent to 280 million trees) per annum over the next 5 years (2016 - 2021) at an estimated annual budget of US$ 9.56 Million. This huge running cost is a challenge to the government and other stakeholders and it underscores the need for a cost-effective and socially acceptable options to sustain the program. As noted in other countries (Rinaudo, 2012), the use of FMNR particularly in arid and semi-arid sites, reduces operational costs and hence can contribute to the effective implementation of the National Tree Planting Strategy. FMNR also holds promise to support other land restoration programs, which seek to integrate restoration objectives with improved rural livelihoods in the country.

Building on Traditional Land Restoration Practices in Tanzania

FMNR evolved in the early 1980s in Niger following limited success and minimal impacts of several attempts to reforest degraded farming landscapes using conventional tree planting approaches. It was noted that most planted tree species could not survive the harsh growing conditions. FMNR, the systematic regeneration and management of ecologically adapted trees from stumps, roots and/or seeds; was thus promoted as an alternative (Rinaudo 2012). Under this practice, naturally regenerating trees are allowed to grow and then managed (pruned and thinned) to minimize competition and produce desired quality of products, including fodder, firewood, poles, timber, fruits, medicines, shade and other ecosystem services at little or no operational costs. FMNR is promoted widely as a farmer driven, low cost and an easy-to-replicate approach to improve tree and shrub vegetation cover in degraded farmlands, rangelands and woodlands in various countries in Africa and Asia. Tanzania has traditional land restoration practices, such as Ngitili, with land restoration features and benefits (Pye-Smith, 2010; Duguma et al., 2013) similar to those reported for FMNR. *Ngitili* is a silvopastoral system of the Sukuma tribe

A dry season fodder reserve in Meatu District, Simiyu Region in Tanzania

in which farmers set aside a fodder reserve at the beginning of the rainy season for grazing when pasture is depleted. The management of *Ngitili* is governed by customary rules and regulations set by the traditional assembly (*Dangashida*) and implemented by the village guards (*Sungusungu*) (Kamwenda 2002). Like FMNR, this practice has successfully restored over 500,000 ha of degraded woodlands through a multi-stakeholder and farmer centered engagement process over a long period in Shinyanga and Simuyu regions of Tanzania (Pye-Smith, 2010). Lessons from the experience with promotion of *Ngitili* can be used to inform national program for scaling FMNR in Tanzania. Similarly, participatory forestry management practices in which local communities are actively involved to manage forest resources and share benefits accrued, provide additional experience in institutionalizing FMNR in the country.

FMNR Operating Principles

FMNR is based on encouraging the regrowth of trees from stumps and self-sown seeds. Where few stumps of natural regenerating tree remain, regeneration of trees from seeds in the soil has been the major means of trees establishment. Pruning and thinning are the main silvicultural management practices conducted to create favorable conditions for crop growth when FMNR is practiced on farmlands and to produce high value wood products. Usually, 3-5 tallest and straightest stems are retained. Best results are obtained when the farmer regularly prunes any

unwanted new stems and side branches as they appear. It is expected that the stems remaining after pruning and/or thinning will increase in size and value each year, and will continue to protect the environment. Each time a stem is harvested for wood supply, a younger stem is selected to replace it. The number of stumps varies widely but generally 50-100 stumps per ha is considered ideal when FMNR is practiced on cropland in the Sahel (Rinaudo, 2012). This recommended stump number is similar to 105 stumps per ha reported for FMNR pilot sites in Kongwa and Kilimatinde, Tanzania (Masanyiwa and Safari, 2017). To archive wider impacts, sites where FMNR is practiced are usually protected from further degradation through collective action by participating communities. Where necessary, local institutions and by-laws related to natural resource governance can be used to protect the sites to allow for successful regeneration and restorations of degraded landscapes.

Agro-ecological Impacts of FMNR

Integrating trees in agricultural systems helps rural communities to attain multiple objectives, including food security, land restoration, adaptation and mitigation to climate change and improved rural livelihoods. These benefits are achieved because of the diverse roles trees play in the agricultural landscape such as soil erosion control, modifying environments under the influence of tree canopy (microclimate amelioration) to reduce the impacts of extreme weather conditions (heat and moisture stress) on crops, improved soil fertility and land productivity and fuelwood supply (Sanou et al. 2011; Rinaudo, 2012). Duration of the piloted FMNR in Tanzania was too short to empirically quantify these agro-ecological benefits, but farmers perceptions at the end of the project confirmed that some of these benefits (e.g. improved soil fertility and reduced soil erosion) were already being realized (Masanyiwa and Safari, 2017).

Drivers of FMNR Adoption in Tanzania

World Vision, in collaboration with national partners and the World Agroforestry Centre (ICRAF), has been implementing the regional FMNR project in Kenya, Rwanda, Tanzania, and Uganda since October 2012. By the end of this project, it was noted that about three quarter (73%) of farmers in the project sites in Tanzania had adopted FMNR practice, with a higher proportion of male (75%) compared to female (67%) (Masanyiwa and Safari, 2017). The main factors driving FMNR adoption in these sites are farm size, training on FMNR practices, marital status and gender (Swamila et al. 2016). Farmers with larger farms and increased awareness from training (on tree and land management) and were more likely to adopt FMNR (retain and manage naturally regenerating trees or planted trees) than those with limited land and education. Land size was also noted to be a key driver of the household decision to plant and/or retain trees in their fields (Githioni et al., 2012). Training on FMNR and other land and crop management practices was provided by the World Vision staff and it was mostly attended by men because women need to get consent from their spouses to attend meetings (Swamila et al. 2016).

Improved millet growth under the canopy of a baobab tree in Dodoma, Tanzania. Baobab is one of tree species found in farmlands in FMNR sites in Tanzania

Although more men attended training and own more land than women, men participation in training did not correlate with FMNR adoption while low participation of women in training was associated with low adoption. This suggest that men did not transfer the knowledge of FMNR to women, who often provide labor for most farm operations, including tree planting and management. Thus, FMNR adoption may be affect if women are not integrated in training programs right from the beginning so as to improve their knowledge and practice of FMNR. While it is critical to target FMNR interventions appropriately by taking the advantage of land available and training, women empowerment to address gender inequality, especially in land ownership and access to training on new technologies, is a critical factor determining the success of FMNR in Tanzania (Swamila et al. 2016). Experience from the *Ngitili* traditions and FMNR practices elsewhere (Pye-Smith, 2010; Rinaudo, 2012; Duguma et al., 2013) indicate that the following factors are also critical for the successful scaling of FMNR:

- Change in mindset to overcome myths and stereotypes on land restoration practice and impacts of trees in agricultural landscapes. Development practitioners, scientists and farmers need to learn by experience that stump regeneration can be an alternative to conventional tree planting in harsh environment and that re-established trees can be managed well to optimize productivity of crops and livestock.
- Building on local knowledge and practices, especially on land with trees of known value and uses cultivate acceptance of the FMNR by farmers.

- Supporting policies and regulations on the protection of regenerating trees and on granting user right of trees on farm. In most agro-pastoralists communities, farmlands are open access grazing after crops harvest. However, in order to have wide-scaling and minimize heavy browsing pressure on regenerating trees in croplands, there should be locally accepted by-laws and regulations to protect trees rather than opting for private fencing, which may be costly on a large-scale. Where user right of trees on farm is restricted, there is little or no incentive for farmers to manage trees on-farm sustainably.
- Livelihood opportunities. Income accrued or saved as a result of benefits from implementing FMNR is one of the driving factors for rapid spread of FMNR is Niger.

Policy Implications and Recommendations

On-going work suggest that out scaling FMNR practices has multiple benefits to farmers, the nation and global community in terms of restoring degraded landscapes, enhancing crops production and adaptation and mitigation to climate change. There are a number of past and current integrated land restoration programs in the arid and semi-arid Tanzania which can provide lessons for successful FMNR scaling in Tanzania. The FMNR practice is rapidly being taken up by farmers in the pilot sites, suggesting that with the appropriate policy support and government led restoration programs like those of 1990s, large-scale adoption of FMNR in the country is possible. Already FMNR has been integrated in the National Tree Planting Program as a cost effective strategy to restore degraded semi-arid lands through natural regeneration of trees and other vegetation. However, more initiatives are needed to incorporate this approach in other ministries linked to natural resource management such as the Ministry of Natural Resources and Tourisms (MNRT) and the Ministry of Agriculture, Livestock and Fisheries (MALF). One of these initiatives is the national workshop on combating desertification and restoring degraded lands into food baskets, conducted to the Members of Parliament in June 2016. In his closing remarks, the Minister of State in the Vice President's Office responsible for Union Affairs and Environment, Hon. January Y. Makamba (MP), endorsed FMNR and called for national support to promote this farmer driven and cost effective method of land restoration. The following recommendations are drawn from this workshop and other fora to provide guidelines for scaling FMNR in Tanzania:

- Mainstreaming FMNR into relevant government programs and into school and college curricula at all levels from primary school.
- Formation of a national and an inter-ministerial coordinating body for land restoration in Tanzania. This body could consist of representatives from the Tanzanian government, civil society and other stakeholders. The body will also provide a platform for the government to take leadership and own restoration initiatives in the country.
- Support Tanzania to become a member of the AFR100 and establish a national target for restoration to be archived by 2030. Already other East Africa countries like Kenya and

Uganda has set targets, opening up opportunities to access funds directed towards helping African countries to meet their targets.

- Identify and analyze previous and existing restoration programs to draw lessons to guide future interventions.
- Identify and analyze conflicting policy statements and regulations and address them accordingly to build conducive enabling environment for uptake of FMNR.

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ELIMU YA MASOKO YA MKAA NA KUNI KWA WADAU WA MAZAO YA MISITU ILIYOFANYIKA LINDI MJINI

TAREHE 28/03/2018 HADI 29/03/2018
FRUMENCE RM.

1. UTANGULIZI

- Mkaa na kuni ni miongoni mwa mazao ya misitu yanayotegemewa kwa kutoa nishati kwa matumizi mbalimbali kuanzia ngazi ya kaya mojamoja hadi viwandani.
- Karibu asilimia 97 ya wananchi wanaoishi katika maeneo ya vijijin hutegemea kuni kama nishati kwa matumizi mbalimbali na asilimia 95 ya wananchi wanaoishi mjini wanategemea mkaa kama nishati.

- Watu wengi huvuna mkaa na kuni kwa matumizi mbalimbali ikiwemo:-

i. Matumizi ya nyumbani

-kupikia

ii. Matumizi ya biashara

iii.Mkaa pia hutumika viwandani

Sababu za mkaa kutumika sana viwandani ni kama zifuatazo:

-Unakiasi kidogo sana cha salfa

-Una uwiano mdogo sana kati ya masizi na hewa ya ukaa.

-Hauna moshi.

-Hauharibu bidhaa nyingine za viwandani

-imara na pia huchukua eneo kubwa unapowaka.

iv. Mkaa hutumika kwa matumizi maalumu kama vile;

- ✓ Kilimo cha mbogamboga/matunda na maua.
- ✓ Kwaajili ya kuimarisha ukijani kibichi katika mimea
- ✓ Mkaa kwa matumizi ya chakula cha mifugo
- ✓ Pia hutumika kutengenezea baadhi ya madawa

v. mkaa kama nishati katika viwanda kwa ajili ya kuyeyusha vyuma

2. HATUA ZA KUFUATA KATIKA BIASHARA YA MKAA NA KUNI

Kuna hatua kumi za kufuata katika biashara ya mkaa na kuni

i. Chagua wateja kulingana na uwezo wako wa kuzalisha

✓ Tengeneza bidhaa yako kulingana na wateja tarajiwa au unalolenga. Mfano watumiaji wa nyumbani, taasisi au viwandani.

ii. Amua ni zao gani unauza kati ya mkaa na kuni au vyote kwa pamoja

iii. Tengeneza nembo yako ya kuuzia bidhaa yako iwe mkaa au kuni. Nembo huku tofautisha wewe na washindani/wapinzani wako kibiashara.

iv. Buni na tengeneza vifungashio vyako. Hii itasaidia wateja kuitambua bidhaa yako maramoja na hivyo kuamua kuinunua kama wanavutiwa nayo.

v. Tengeneza aina tofautishi ya alama ambayo inaweza kukutambulisha hata kwenye mfumo wa komputa na viweke kwenye vifungashio vyako.

vi. Chagua bei yako ya rejareja.Hii ni njia sahihi na inakusaidia kutathimini bei za wapinzani wako na kuweka yako kulingana na ubora wa bidhaa yako

Hapa unaweza kutumia kanuni ifuatayo(35-35-30)

✓ 35% gharama ya bidhaa inayouzwa

✓ 35% gharama ya usambazaji na bidhaa iliyobaki

✓ 30% hii ni faida unayotarajia kuipata

vii. Anzisha mtandao wako wa usambazaji wa bidhaa yako ili kuwafikia walengwa.

✓ Hii ni muhimu kwa vile wewe huwezi kufika sehemu zote waliko wateja.

viii. Rejea na kutathmini mafanikio ya zao lako mara kwa mara. Zao lisilofanya vizuri sokoni ni vizuri ukaliacha na kuweka zao jingine jipya lenye soko zuri.

ix. Zalisha zao lako kwa viwango tofauti vya wateja,ujazo na ubora wa bidhaa husika.

✓Kiwango cha wateja wa hali ya chini, kati na wa hali ya juu kulingana na uwezo wao wa kununua zao lako.

x. Kuwa mzalishaji wa muda mrefu ili uweze kupata na kutataua mahitaji ya wateja au bidhaa katika soko.

ii. Umoja ujitangaze vya kutosha katika maeneo kuliko na kule kunakotarajiwa kuuzia bidhaa ili ufahamike kwa wateja na wadau wengine.

iii. Wauzaji wawe na sehemu maalum ya kuuzi mkaa na kuni (charcoal/woodfuel selling centres) na visitembezwe mitaani.

iv. Biashara hii lazima ifanywe rasmi kwa kusajiliwa katika vyombo vyote vya serikali ili kuondoa ukinzani wa utekelezaji wa sera na taratibu za nchi kwa taasisi mbalimbali za serikali.

3. FURSA ZA SOKO

Kuna fursa nyingi katika soko la mkaa na kuni
Kwa kuwa vinaweza kutumika kwa matumizi mbalimbali:-
Zifuatazo ni fursa za soko muhimu kwa uzalishaji wa mkaa;

✓Migahawa na mabaa.
✓Mama lishe
✓Kuuzia mkaa kando kando ya barabara
✓Waokaji wa mikate
✓Kuuza mkaa nje ya nchi ni soko kubwa la kutengeza pesa ambalo watu wengi hawajalifikiria

v. Umoja uwe na akaunti ya biashara inayofanya kazi .

✓ Hii itasaidia biashara kutambulika katika taasisi za fedha hivyo kuwa rahisi kukopesheka bila kuhitaji udhamini wa mali kama vile hati za nyumba.

4. MAMBO YA KUZINGATIA KATIKA UPATIKANAJI WA SOKO LA UHAKIKA

Ili kupata mafanikio ya soko la uhakika kwa mkaa na kuni ni lazima mambo yafuatayo yaweze kuzingatiwa:-

i. Kuwa na umoja imara wenye sera na kanuni zinazotekelezwa kwa kila eneo la uzalishaji.

✓ Mfano umoja uweze kuishawishi serikali kuhakikisha kuwa hakuna mtu mwingine anayeruhusiwa kuuza mkaa na kuni katika wilaya husika isipokuwa wale waliosajiriwa na umoja tu.

5. ANGALIZO

Katika biashara ya mkaa na kuni ni lazima kuangalia yafuatayo:-

1. Uzalishaji kwa kiwango cha biashara na rejareja wa mkaa na kuni lazima uendane na sera na sheria za mahali husika.
2. Ni kwenye nchi tu zenye misitu mikubwa na upungufu wa makaa ya mawe hutumia mkaa kwenye viwanda vya kuyeyusha vyuma.
3. Bei isiwe tu kigezo cha uzalishaji na uuzaji wa mkaa na kuni lakini pia tuangalie madhara ya uharibifu wa misitu mazao hayo yanazalishwa.

5. HITIMISHO

Ili uzalishaji na uuzaji wa mkaa na kuni uwe endelevu ni vizuri wafanyabiashara na wadau wote kuzingatia kanuni za uhifadhi wa mazingira na upandaji miti.

Ahsanteni kwa kunisikiliza

POLICY AND REGULATORY FRAMEWORK ON WOOD FUEL

By
Zawadi J. Jilala (Regional Natural Resource Officer) Lindi
&
Ronald N. Pangal (Regional Natural Resource Officer) Mtwara

Introduction

- The Ministry of Natural Resources and Tourism is responsible for formulating policies, laws and regulations that govern the forestry sector in the country.
- The Ministry provides extension services related to forest management, evaluation and monitoring policy implementation, and coordinating all stakeholders involved in conservation activities.
- The Ministry through the Forestry and Beekeeping Department established a Forest Policy for the first time in 1998.

Introduction……..

- The National Forest Policy is implemented through the Act and the National Forestry Program that aims to develop, hold legal and sustainable use of forest resources by engaging in various stakeholders.
- Also Guidelines, Principles, Government Proclamations and Administrative Guidelines are being reviewed or reviewed and distributed at various times to clarify the implementation of the National Forestry Act and Program in managing and managing forest resources effectively and efficiently.
- Given the various challenges involved in forestry harvesting and harvesting operations, the Ministry of Natural Resources and Tourism supervised the harvesting of some trees or some forest products at different intervals between 1995 and 2000 for the purpose of evaluating existing resources.

Introduction…...

- Hence, the Sustainable Harvest Guidance and the First Forestry Trade was developed in 2007.
- Citizens and stakeholders in general should be committed to engaging in the implementation of this guide which has been provided for the purpose of
  - ensuring sustainable use of our resources for the benefit of current and future generations.

A guide for sustainable harvesting and forestry business that is harvested in natural forests

- The main framework for the preparation and implementation of the Guide is based on the Forest Management Plan.
- The FMP notes, among other things, the amount of trees allowed for the annual harvesting in each area and the amount of trees to be planted.
- In addition, every forest should have a harvesting plan to manage sustainable harvesting.
- It is emphasized that the harvesting of forest products will be carried out in accordance with the Rules, Principles and Guidelines.

Continue…….

- This guide focuses on stakeholders and the general public:
  - the process of harvesting and conducting forestry business;
  - conditions for establishing forestry processing industries;
  - Conditions of conducting forestry trade within and outside the country;
  - and various legal documents that are legally recognized during the harvesting, exporting and trading of forest products.

The harvesting process for forest products

- Harvesting Forests for energy such as Charcoal making; Drying tobacco; Drying fish; burning bricks; burning lime; and baking bread will be done in the following order:
  - Identify and allocate forest areas for charcoal, tobacco consumption, fisheries, bricks, mortar burning and baking each year.
  - Every person involved in the activities mentioned above will have to have a license.
  - Registration applications and licenses will be submitted to Forestry Officers or District Forest Managers and discussed and approved by the District Harvesting Committee.
  - Every Forestry Officer and District Forestry Manager will have to have a list of harvesters and traders of mentioned forest uses.
  - The Village Government will maintain a List of People who will be involved in mentioned forest uses.
  - The register will also contain a record of the number of charcoal pockets taken and signatures for each harvester.

Continue….

- Every tree harvester for fore mentioned uses or similar business should pay for the royalties as stipulated in the Table specified in the Forestry, Tender and Auction Code or Agreement specially based on the Forestry Law and its Regulations as well as the Procurement and Public Finance Act.
- In the same way, the producer will be required to contribute to the Tree planting fee by paying 5% of the royalties and the funds will be allocated to the Forestry Fund (TaFF).
- Wood cutting of wood, coal production, tobacco drying, frying, blasting, mortar burner and baking will be done by choosing suitable trees for the same activity just as it leads to Forestry Law 323.
- Manufacture of charcoal will be made using effective technics, such as semi-orange or Casamanse Kiln.
- The village government will ensure that environmental conservation is considered in the area of harvesting.
- The harvesting permit and the use of natural trees for industrial power generation will not be provided.

Harvesting in VLFR, Private owned forest

- The following procedure will apply:
  - Individuals will be required to provide validity for forest / tree management through the Village Government and District Forest Officer.
  - The harvesting applications will be sent to the relevant owner of the forest in writing and certified by the Village Government and Forestry Officer or District Forest Manager;
  - Harvesting will be permitted once a tree inspection is carried out and certified by Forestry Officers that the trees have reached the harvesting level. District Forest Officer or Manager District Forests will measure the diameter of the tree before it is shattered;
  - Harvesting will take place in accordance with the relevant forest management plan;
  - The Client shall have a Transit Pass - TP certification document recognized by the Forest Service Agency;
  - Putting a mark of an approved hammer by the Agent on the stumps of all the harvested trees;
  - Putting a hammer mark on both ends of the log;

alternative energy

- Various institutions such as forces, schools, industries and citizens generally live in urban areas,
  - should plant trees for use as energy according to their needs.
  - They are also advised to use renewable energy and gas stoves to reduce fuel consumption.

Charcoal Business

Conditions of Internal Trade

- Forestry traders will be required to fulfill the following conditions: -
  - Have a registration document (registration will be for individual, company or group);
  - have a certificate of export of forest products;
  - To have a license or certified copy of the forest harvest;
  - Have a permit to harvest trees in natural forests Form FD. 1C
  - Have a business license including the credit card number (TIN);
  - To pay for the state's and local government tariffs as stipulated by the law; with
  - Having a record of receipt and sale of forest products.

Charcoal business

- Traders will be required to pay the state tax for every 30 kg kg; at 60 kg; at 90 kg. A full over 90 kg of cash will pay fine in accordance with the Forestry Regulations and Regulations;
- All councils will be required to allocate special centers (magulio) for charcoal in their areas; with
- Every charcoal package to be transported with any instrument must be taxed by the Government and the vessel must allow the inspection to be carried out effectively and efficiently.

A brief on
Trainers course on scaling-up sustainable woodfuel (charcoal and firewood) systems in Pwani, Lindi and Mtwara regions, Tanzania

Figure 1. Nasma Kaburu Illustrating woodfuel flows in different elements of the systems from wood production to consumption.

Mary Njenga, Ogossy Gasaya and Anthony Kimaro. (April 2018) World Agroforestry Centre (ICRAF).

About the project

The trainers course was carried out as part of the capacity development and awareness raising under the response plan on scaling up sustainable wood fuel (charcoal and firewood) systems in Pwani, Lindi and Mtwara regions Tanzania supported by Climate Technology Centre and Network (CTCN). The response plan is being implemented by World Agroforestry Centre (ICRAF) and the request was made by Tanzania Renewable Energy Association (TAREA) through Tanzania Commission of Science and Technology (COSTECH). The trainers' course was held at The Vocational Education and Training Authority (VETA) Lindi on 28th and 29th March 2018. The trainees in the trainer's course comprised of 21 people 16 men and 5 women involved at different aspects of the wood fuel system. They were from local communities, NGO's and government departments in the three regions. There were 7 members of the organizing team from ICRAF, COSTECH and TAREA.

The objectives of the trainer's course include:

a) Compilation of training/knowledge resources from a "whole system" perspective;
b) Testing the available training materials for suitability for grassroots courses;
c) Co-learning on systems approach and innovations for sustainable woodfuel among researchers, practitioners and policy makers involved in various aspects of the wood fuel systems
d) Gathering ideas about the content and delivery options for grassroots courses;

The above objectives were met and bottlenecks included need for further synthesis of the training/knowledge resources and subsequent translations for grassroots courses.

Training modules and co-learning approach in knowledge sharing

The training materials used in the trainer's course were a compilation of existing resources from the Stakeholder Approach to Risk-informed and Evidence-based Decision making (SHARED) workshops held in November 2017 as part of the project and other works by ICRAF and partners and the trainees. Co-learning approach was applied in knowledge sharing as most trainees are involved in various aspects of the woodfuel system as shown in table 1.

The trainers' course comprised of the following modules and components of each are shown in table 1.

Table 1. Components of the trainer's course and facilitation

Module		Components and mode of delivery	Facilitator
1	Introduction to sustainable woodfuel systems	&1.0 Background information. Woodfuel situation and trend, 2.0 Woodfuel system approach. Wood production, efficient wood to charcoal conversion technologies-kilns, effective marketing and transportation, aspects of sustainability, 3.0 Implications of unsustainability woodfuel system on natural resources and climate change 4.0 Interventions to make woodfuel sustainable. Delivery: Lecture using printed notes plus discussions led by question and answer and examples from trainees. Video clip on challenges faced by women when collecting firewood.	Dr. Mary Njenga* (Research Scientist, Bioenergy, ICRAF), Ogossy Gasaya* (Environmental and Natural Resource Economist, ICRAF) Mandela Chikawe, Regional Agricultural Advisor (RAA), Lindi.
2	Sustainable wood production	4.1. i. Tree nursery establishment, benefits of agroforestry, tree planting, 4.1.ii. farmer managed natural regeneration or rotational harvesting of trees. Delivery: Lecture using pinted notes and plus discussions led by question and answer and an example using PowerPoint presentation from a community group (ECOCE).	Ogossy Gasaya* (ICRAF), Violet R. Byanjweli. (Upendo Halisi group), Ignatusi J. Pesha, (Environmental Conservation and Community Enterprise ECOCE), Tozini Azizi Ally (Kaza Moyo Group), Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager

3	Efficient charcoal processing and processing briquettes as alternative sources of biomass energy	4.2 Improved charcoal processing using more efficient kilns. Delivery: Discussions using printed notes on variety of kilns, benefits and disadvantages of improved vs. traditional kilns and management of the areas after charcoal production. Illustration by a farmer on briquettes production and use. Demonstration with drawings on flip charts on improved kilns by a farmer. Video clip on community based briquette production and use.	Uwesu Omary (Farmers, charcoal propducer and beneficiary of WWF project on improved kilns), Ogossy Gasaya* (ICRAF) Selemani M. Jullu (fuel briquette producer, Madendo Mtima Group,), Mary Njenga* (ICRAF).
	Module	**Components**	**Facilitation**
4	Efficient woodfuel consumption	4.3 Improved cooking practices and stoves. Benefits and disadvantages of a variety of improved stoves versus traditional cooking stoves. Delivery: Lecture with a powerpoint presentation with photos of the stoves. Demonstrations on a variety of improved stoves at VETA.	Ashiru S. Yusuph, Lecturer and stove manufacturer (VETA Lindi), Ogossy Gasaya* (ICRAF) Wasiya Abdallah (clay stove producer), Bardwin F. Mpunga and Bakari H. Kambale (metal stove producers)
5	Effective marketing and trade	5.0 Effective marketing of woodfuel. Different uses of woodfuel, setting objectives of the business, targeting type of customers, choice between charcoal and firewood, packaging and labelling, banking savings from sales. Delivery: Lecture using powerpoint presentation and discussion with examples from trainees.	Revocatus M. Frumence (District Tanzania Forest Services {TFS}-Manager), Hamisi O. Salum (Farmer/charcoal producer), Abdullah S. Mpape (Farmer/charcoal producer).
6	Policy and regulatory framework	6.0 Regulations in wood sourcing, charcoal processing, transportation and trade. Delivery: Lecture using powerpoint presentation and discussion with examples from trainees.	Zawadi J. Jilala (Regional Secretariat, Lindi), Ronald N. Pangah (Regional Secretariat, Mtwara)

*Organizing team. Module one and two were offered in day one and modules three to six in day two.
& Numbering in the manual.

Impact of the project shared during the training

Prior to the training Wasiya Abdallah a clay charcoal stove producer worked with Baldwin F. Mpunga who works on metal stoves worked with ICRAF and both developed a metal stove with a clay liner. Bakari H. Kambale a metal stove producer also worked with women clay charcoal stove producer and developed a metal stove with a clay liner. The teams presented the improved stoves during the training. The lesson was that the clay liner improves on energy saving hence reduced consumption. Also building the partnership helped to capitalize on specialization and jointly seek market for the finished product.

The head of VETA Mr Samuel Ng'andu, requested if the trainers course could be offered to some classes as part of environmental lessons. This could be offered as a lesson or a motivational talk. This can easily be followed up as one of the lecturers at VETA Mr. Ashiru S. Yusuph was one of the resource persons and trainer in the trainers' course.

Figure 2. Metal stove with a clay liner produced during the project by a female clay stove producer (Wasiya Abdallah) and male metal stove producer (Baldwin F. Mpunga).

Planning for grassroots trainings

The grassroots trainings will be facilitated by the graduates of the trainer's course supported by the project team. The trainees from each of the three regions developed a training schedule with shared responsibilities on facilitation. The compiled training resources used in the trainer's course will be adapted and synthesised into a simple grassroots training manual which will also be translated into Kiswahili.

Envisions impact on the ground by the graduates of the trainers course

- Increased awareness and self-motivated decision making on system approach to sustainable woodfuel
- Improved wood resource management including tree nursery establishment, tree planting woodlands management and sustainable harvesting for woodfuel
- Improved techniques in wood conversion into charcoal and consumption of woodfuel
- Increased gender equity and women involvement in profitable aspects of the woodfuel systems
- Increased income for households and the government
- Effective adherence to regulations for sustainable woodfuel systems

Table 2. Participants in the trainer's course on scaling-up sustainable woodfuel systems in Pwani, Lindi and Mtwara regions, Tanzania

	Name	Gender	Education	Designation /Organization	Mobile No.	Email Address
	Mtwara					
1	Jane Kajange	F	Diploma	Farmer, charcoal trader	0656625995	janejaja8597@gmail.com
2	Tozini A. Ally -	M	Primary	Farmer, charcoal trader	0686433502	uhifadhimazingirakazamoyo@gmail.com
3	Nasma A. Kaburu	F	Secondary	Hotel chef, small scale user	0718225770	nasmakaburu@yahoo.com
4	Ronald N. Pangah	M	Degree	Regional secretariat	0656045336	roniimaqamara@gmail.com
5	Revocatus M. Frumence	M	Degree	District TFS-Manager	0784341834	Mryanumburm68@gmail.com
	Lindi					
6	Baldwin F Mpunga	M	Primary	Farmer, stove producer	0654507421	
7	Wasiya Abdallah	F	Primary	Farmer, stove producer	0657083325	
8	Bakari H. Kambale	M	Primary	Farmer, stove producer	0684676724	
9	Violet R. Byanjweli	F	Degree	Tree nursery producer (DAICO)	0682005486	vai2009@yahoo.com
10	Amina Mandali	F	Degree	Secondary school manager, large scale firewood user	0782586468	aminamandali@gmail.com
11	Twahili Issa Sudi	M	Primary	Farmer, charcoal trader	0654101491	
12	Waziri A. Shaweji	M	Secondary	Farmer, charcoal trader	0689806599	
13	Zawadi J. Jilala	M	Degree	Regional secretariat	0788604192	zjilala@yahoo.com
14	Ashiru S. Yusuph	M	Degree	Lecturer VETA, Lindi	0754690918	ashym200@yahoo.co.uk
15	Mandela P. Chikawe	M	Degree	Officiated the training, Regional Agriculture Advisor (RAA) Lindi	0766923695	mandelachikawe@gmail.com
	Pwani					
16	Daniel M. Wangese	M	Secondary	Hotel operator, large scale charcoal user	0715669606	
17	Seleman M. Jullu	M	Primary	Farmer, charcoal producer	0717632074	
18	Hamisi O. Salum	M	Primary	Farmer charcoal trader	0715028704	Sakahamisi2017@gmail.com
19	Ignatus J. Pesha	M	Degree	Tree nursery producer (ECOCE)	0688916557	ignatus.pesha@gmail.com
20	Uwesu Omary	M	Primary	Farmer, smart kilns builder	0716894075	
21	Abdallah S. Mpape	M	Form II	Farmer charcoal trader	0717219355/0783818228	
	Facilitators					
22	Denis Saleko	M		Biomass energy expert (TAREA)	0763445827	Salekod62@gmail.com
23	Ogossy Gasaya	M	MSc	Environmental and Natural Resource Economist (ICRAF)	0784941220	gasayaogossy@gmail.com
24	Dr. Mary Njenga	F	PhD	Research Scientist, Bioenergy (ICRAF)	+254722331006	M.Njenga@cgiar.org
25	Gladys Francis	F	MSc	Administrative Assist (ICRAF)	0656020016	francisgladys06@gmail.com
26	Jimmy Sianga	M	Secondary	Logistical officer (ICRAF)	0713686486	J.Sianga@cgiar.org
27	Dr Gerald Kafuku	M	PhD	Principal Research Officer(COSTECH)	0766604977	kafukugm@gmail.com

IMPACT STORY ON SUSTAINABLE WOODFUELS SYSTEMS

By Darus Bin Jumah Abutwarib, S.L.P 64 Rahaleo, Lindi Municipal

WORD OF THANKS

I gave my sincerely thanks to the CTCN project management through ICRAF, COSTEC and TAREA Organization for the educative seminar I have received about sustainable woodfuels systems from 6 to 8.11.2017 conducted in Lindi. Also my special thanks to seminar facilitators specifically to;

1. DR MARY NJENGA
2. MS. SABRINA CHESTERMANI
3. MR. JOHN

To be sincerely, any one attended the seminar on sustainable woodfuels systems, I hope they are more aware and knowledgeable on how best to make the woodfuels system sustainable and we will be ambassador to the southern regions community who didn't attend this seminar.

After broad thinking about the woodfuels system and its sustainability I realized that we, charcoal processors have to agree that we are the major cause of deforestation in our working environment, which finally lead to desertification. This is because we were harvesting without proper plan, without been making any effort of replanting cleared trees and also sometimes unmanaged charcoal production may lead to wild fires.

Previously before the seminar, I was not aware that the charcoal production if not done careful can lead to environmental destruction including deforestation. But after the seminar, I promise to do my charcoal production in a sustainable way and to adhere all the forest rules and regulation concerning harvesting and trading. This include having all the relevance documents for charcoal production and trading such as license of the forest harvest, which costs Tshs 400,000/=

After got the forest harvest license by first time, I went to Mitonga village where normally I do conduct charcoal production to request for entrance to enter and harvest in the village forest. I presented my license to the village environmental committee for verification.

The village committee they discussed and agreed for me to continue harvesting in their forest as I have all the valid documents for me to conduct harvesting. They also informed me that they have already established special team to conduct patrol for those illegal harvester of the forest related products including charcoal producers. The patrol team is much focusing on three tree species that seems to be threatened due to their potentiality in charcoal quality, these species are *Tamarindus*, *Syzygium cordatum* and *Mnyakambi*. The village management gave me 10 villager to help me on selecting and cutting trees for charcoal production, where the recommended diameter for harvest is 10 to 18cm.

I signed a contracts with them to select, harvest, processes and produce 200 bags of charcoal at a cost of Tshs 2,000,000/. In each bag of 30kg I will be paying a village fee of Tshs 500.00 making a total of Tshs 113,500/= and Municipal fee Tshs 500/ @ bag =113,500/=

The production started on 06/01/2018 to 27/01/2018 where I managed to get 227 bags of charcoal. Other costs were as follows;
Vehicle hiring from Mitonga village to Lindi port Tshs 500,000/=
Municipal transit fees Tshs 80,000/=
Loading and unloading cost Tshs 1000/= per bag
Transportation cost from Lindi to Zanzibar by ship Tshs 80,000/=

On 14/02/2018 I arrived Zanzibar and managed to sale all 227 bags of charcoal at a price of Tshs 65,000/ @= Tshs 14,755,000/=
Total costs incurred Tshs 4,014,000/=
Other expenses Tshs 1,990,800/=
Net profit earned 8,750,200/=

The knowledge I got from the seminar helped to better plan of harvesting few trees but due to properly procedures on charcoal production taught in the seminar I managed to get more bags compared to previous before attending the seminar.

Again I thank the SHARED Management for the knowledge on Sustainable woodfuels system.

Darus Bin Jumah Abutwarib