



THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF NATURAL RESOURCES AND TOURISM
FORESTRY AND BEEKEEPING DIVISION

THE POTENTIAL AND OPTIMAL STRATEGIES FOR CHARCOAL SUB-SECTOR DEVELOPMENT IN TANZANIA



JUNE, 2019



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EXECUTIVE SUMMARY

Background

Charcoal is the largest source of household energy in urban areas for cooking and heating in Tanzania, as it is considered relatively affordable and available. It is estimated that 85% of the total Tanzania's population rely on biomass energy. Cooking energy is the leading usage of biomass in household compared to other sectors such as building, and agro based industry. Inefficient production, marketing and use of charcoal are identified as the key drivers of forest degradation and deforestation nationally. Considering that the annual deforestation rate is estimated to be approximately 460,000 ha/year, the environmental costs due to inefficient charcoal production and use are enormous. In light of this serious situation, in March, 2018, the Permanent Secretary of Ministry of Natural Resources and Tourism formed a National Task Force (TF) to assess options that could address challenges in charcoal production, trade, and use and that support sustainable management of forest resources in Tanzania. Specifically, the TF was tasked to:

- (i) Evaluate the sustainability of existing charcoal production and use models within Tanzania, and beyond, and their potential application along the value chain in the Country;
- (ii) Identify barriers and gaps that hinder the sustainability of the charcoal sub-sector in Tanzania;
- (iii) Identify and engage relevant stakeholders and draw lessons for the improved development of the charcoal sub-sector in the country; and

- (iv) Put forward policy recommendations towards improving the sustainability of the charcoal sub-sector in Tanzania.

Methodology

Field survey for data collection was carried out in the 7 zones that have been established by the Tanzania Forestry Services Agency (TFS) in the country, for the purpose of increasing diversity in terms of charcoal business scenarios and geographical coverage. The TF was divided into three groups and assigned the following zones: (i) Group 1 covered Northern, Central and Eastern Zones. (ii) Group 2 covered Western and Lake Zones; and (iii) Group 3 covered Southern Highland and Southern zones. In each zone, data was collected to respond to the Task Force objectives.

Key findings

Findings show that most of the produced charcoal comes from the carbonization of trees from all types of land ownership classifications, namely village, private, and reserved lands. Charcoal production technologies are dominated by the use of the Traditional Earth Mound Kilns (TEMK). This type of the kiln has low recovery rate, thus causing significant amount of wood wastage. In general lands, charcoal is produced largely using wood from natural forests while on private lands, charcoal is largely produced from trees on farms often managed as fallows (including from natural forest trees of the Miombo type), but also from planted trees such as cashew trees and wattle plantations. Small amounts of briquettes from agro and forest residues, charcoal dust and paper are produced by various stakeholders using briquetting machines. Unfortunately, briquettes have not made significant contribution in increasing the supply of alternative source of energy in the market. The TF noted that there are charcoal briquettes produced from coal dust in Ruvuma Region. However, there is no information to ascertain the quality, potential health hazards and calorific value of the briquettes

The TF noted that the revenue collection system on charcoal at district level use a variety of approaches including Point of Sale (POS), Government Electronic Payment Gateway (GePG) (bill first and then pay), and Electronic Fiscal Device (EFD). Charcoal value chain mapping was done where key factors and their roles in influencing charcoal business at various nodes were identified. Three value chain models were identified in Tanzania. These include the *Common value chain* which is the most frequently encountered in the surveyed regions. All nodes were involved in the charcoal production and trade but the charcoal is traded only within the country. The second type is the *Shortened value chain* which was found in some villages, where the target of the producer was to look for external markets in developed towns, municipalities and big cities. This was reported to be profitable to the producers compared to the common value chain because prices per unit were higher than that of on-site market. The third type is the *Export value chain* where charcoal is traded outside the country although charcoal export is illegal in Tanzania Mainland. Revenue data for five years indicate fluctuations in revenue with a slight decline in 2017/18 that may be associated with an increase in the illegal charcoal trade and/or enhancement in law enforcement. It is also possible that charcoal consumption is decreasing because of existing alternatives.

District level stakeholders including District Forest Officers (DFOs) and District Forest Managers (DFM) revealed the possibility to establish plantations or woodlots for charcoal production subject to having integrated land use plans at community level. In 2016, Vice President's Office gave a directive that each district should plant 1.5 million trees each year. However, implementation of this directive is not linked to charcoal production. In fact, the presence of increasingly significant amounts of charcoal from farm sourced black wattle in the market appears to confirm this. The TF identified the presence of numerous permits, fees, levies and taxes to be one of the major obstacles to the sustainability of the charcoal sub-sector and compliance to regulations.

Recommendations

Integrated Sustainable Charcoal Model (ISCM) is put forward by the TF for consideration in improving charcoal business. The model was developed after extensive consultations with stakeholders including some development partners. The framework model has several elements and key features that it is presumed will result to sustainable charcoal sub-sector in the country if adopted as best practice. The TF recommends that the model should be demonstrated through pilot projects and updated where necessary through research, followed by its eventual scaling up country wide.

TF puts forward additional recommendations in terms of policy, operations and specific interventions relevant to various nodes in the value chain as follows:

Policy Recommendations:

Sustainability of charcoal sub-sector in the country could be improved by making use of ideas of various actors including previous recommendations from extensive reports that have been generated in the country. The following policies need to be revised and harmonised in order to make the charcoal sub sector more sustainable; National Forest Policy of 1998, National Energy Policy 2015, National Environmental Policy 1997, National Agriculture Policy of 2013 and National Land Policy of 1997 in addition to the policy framework around decentralization. Need for having a common vision for the charcoal sub sector should be emphasized during the revision process. The policies should explicitly support the principle of sustainability of the charcoal sub-sector in the country.

Specifically, the following recommendations can be embedded in various legislations including a revised Forest Act or through its subsidiary regulations:

- (i) Establishment of formal charcoal marketing centres in rural and urban areas (Depots) with high production. Charcoal should not

- be allowed to enter urban areas from points other than formally recognized marketing centres;
- (ii) Compounding illegal charcoal as a penalty should be followed with legal charges using Amendment of 2016 Section 88 and 89 of Forest Act;
 - (iii) Formalization of the charcoal sub-sector, along its entire value chain, is in progress. However, more effort is required so as to have effective formalization. This includes identification of existing gaps in the laws and regulations, packaging materials, and tracking system. This should include formalization of transporters, such as trucks, motorcycles, and bicycles, while intensifying formal private sector engagement in the sub-sector;
 - (iv) Stakeholders in the field suggested that charcoal royalty could be reduced from TZS 12,500 to TZS 7,500 per bag of 50kg. This will encourage compliance; however, should be accompanied with enhancement of law enforcement, sustainable resource management, production and utilization;
 - (v) There is a need to have uniform packaging material of specified size and with a capacity of carrying 50kg of charcoal as required by regulations. This will be useful in charging royalty payments and monitoring compliance; and
 - (vi) Efficient production and utilization of charcoal at the households, Institutions and Small and Medium Enterprises (SMEs) should be institutionalized in regulations.

Operation recommendations:

At operational level, much as the proposed charcoal business best practice model presents a summary and framework of the key elements that need to be taken into consideration for the sustainability of the charcoal sub-sector, the following specific recommendations are put forward to partially unpack some of the elements in the model. The

recommendations are grouped into immediate, medium and long terms as follows:

Immediate Recommendations

- (i) Develop National Charcoal Policy to oversee production, marketing and utilization of charcoal in the country and the required strategy, regulations and institutional framework for implementation;
- (ii) Scale up CBFM in line with the recommended integrated model in this report for sustainable charcoal production, trade and utilization;
- (iii) Intensify use of improved kilns that match with local situation and incorporate them into laws;
- (iv) There is a need for continued awareness raising on efficient cooking technologies, kitchen energy management, legislation, guidelines, and other aspects relevant to the charcoal sub-sector;
- (v) Need to re-visit the values of royalties, fees and taxes along the charcoal value chain. These constitute production and trade costs which threaten the economic viability of investments in charcoal business and encourage illegal business which makes the government to lose substantial revenues;
- (vi) In areas where development partners in collaboration with local institutions are piloting some models of integrated charcoal production, it is recommended that they adjust and accommodate proposed interventions in the Integrated Sustainable Charcoal Model (ISCM) for harmonization countrywide. Further, research should be applied to investigate the performance of the models in terms of natural regeneration (which trees regenerate faster, tree cutting and height of stumps and its impact on regeneration), and governance of resources including money and forest management against fire, grazing and agriculture encroachment, improved kilns, optimal kitchen management models, and value chain impacts of the of the integrated model.

- (vii) The Task Force recognises results revealed by the TFS brief research (TFS, 2019) which generally proposed to ban charcoal transportation using motorcycles. However, the proposal does not conform to existing Policy and laws. It is hereby proposed that motorcycles involved in charcoal transportation should be identified and registered to formalize them. In addition, during transportation special charcoal bags should be used. It is very important to establish the number of bags that a motorcycle can safely carry at a go. Control of motorcycles and use of special bags for charcoal transportation should be piloted in selected regions in the country including Dar es Salaam.
- (viii) Charcoal utilization technologies have low efficiency causing gratuitous high amount of charcoal consumption. However, use of Charcoal Saving Stoves has increased particularly in big cities such as Dar es Salaam. Awareness and increased production of the energy saving stoves should be done in the rest of cities and small towns in the country. Other technologies that reduce consumption of charcoal (e.g. Efficient Electric Pressure cooker) and LPG stoves should also be included in the awareness raising initiatives and increase their availability.
- (ix) There is an electronic tracking system which is under construction by TFS to control charcoal transportation. This idea is good. Although the system is still under construction, it is found to be very useful to control charcoal transportation within and outside the country. The system should be improved to enable controlling areas where charcoal is produced and how the charcoal is transported.

Medium Term Recommendation

- (i) Ensure sustainable management and harvesting of wood resources from different sources;
- (ii) Scale up production and utilization of biomass alternatives (briquettes, ethanol and biogas);

- (iii) Scale up promotion and utilization of non-biomass alternatives (LPG, Kerosene, electricity, and natural gas);
- (iv) It is very important to have a best system for managing charcoal production including use of ISCM so that its implementation should not be a cause for increase in charcoal production and utilization. Therefore, it is important to formulate a National Charcoal Policy which will manage formalization, identification and registration of charcoal traders and install a plan to monitor implementation of ISCM;
- (v) Improve management of charcoal producing areas. The village forests where charcoal is produced should be formally registered and gazetted; and
- (vi) Harmonize policies, legislations and guidelines to reduce conflicting actions. For example, encroaching forests for agriculture activities and then produce charcoal without consideration of land use plans. Harmonize policies, legislations and guidelines.

Long Term Recommendations

- (i) There is need for integrated charcoal production, trade and utilization at community level involving all the key stakeholders in order to set aside land for charcoal production (potentially woodlots and plantations) in a sustainable manner;
- (ii) All forests established by the Government for woodfuel production e.g. Ruvu, Morogoro, Korogwe, Mbeya na Songea should be refurbished and abide to earlier intentions and produce charcoal;
- (iii) Encourage private sector to establish and develop forest plantations for charcoal production;
- (iv) Each region should identify suitable areas for establishing forest for purpose of charcoal production. Identification of the areas should adhere to the following criteria: (a) Land availability, (b) Ensure existence of intended tree species flourishing in the

area and suit the weather of that place in accordance to the Tanzania Forestry Research Institute (TAFORI) Guidelines, (c) The land where a forest plantation(s) will be established should be nearby charcoal markets, (d) Forest plantation size should depend on ability of the region to acquire land, (e) Ownership and management of the forest plantation(s) could be inform of Public Private Partnership, district authority, private ownership, company or and individual ownership; and

- (v) Research the use of alternative raw materials for charcoal production.

Specific recommendations to the nodes along the chain:

As the TF puts forward these specific policy recommendations along the value chain, note is taken of the fact that some cross cutting demands exist as pre-requisites for the proposed policy options to serve their purpose. Such cross cutting requirements include for example good and genuine political will to transform the charcoal sub-sector, existence of supportive legal frameworks, intensified research and development in all the segments of the value chain and finally control of corruption in the natural resources sector. The specific recommendations are summarised in the following matrix:

Elements of charcoal value chain	Policy recommendations
Sources of raw materials	<ul style="list-style-type: none"> • Widen sources of raw materials e.g. establishment of plantation, wattle woodlots and agroforestry for charcoal production (e.g. in Njombe district) and briquette. • Enhance forest tenure and governance systems (e.g. establishment of Community Based Forest Management (CBFM)). • Cost efficient land use plans need to be instituted. • Scale up best practices of charcoal production.
Harvesting practices	<ul style="list-style-type: none"> • Need for compliance to forest management and harvesting plan requirement to forests. • Harvesting guidelines should be developed and instituted to include regeneration in natural forest. • Management of the harvested areas to ensure forest regeneration should be done.
Charcoal production	<ul style="list-style-type: none"> • Need to have technologies of choice in the country that will be supported by the law. • Formation of (registration) of charcoal producers associations. • Establish /designate areas for charcoal production. • Assign value to unreserved forest trees resources on village lands which are prone to conversion to other land uses. • Reduce number of fees/taxes in the charcoal sub-sector.

Elements of charcoal value chain	Policy recommendations
Local market	<ul style="list-style-type: none"> • Establish and institute charcoal market centres. • Establish regulating organ that will check charcoal business at different levels. • Introduce standard and peculiar packaging material.
Transport	<ul style="list-style-type: none"> • Review the current royalty rate to affordable level. • Need for standardising licensing procedure and associated costs. • Formalise and register transporters e.g. motorcycles (e.g. some Morogoro motorcycles have been registered). • Harmonise and enforce transportation regulations (e.g. motorcycles and bicycles) . • Establish and institute electronic tracking in check points. • Improve infrastructure of the checkpoints. • Reduce number of fees/taxes.
Wholesalers	<ul style="list-style-type: none"> • Formalise and protect them from illegal dealers. • Reduce number of fees/taxes.
Retails	<ul style="list-style-type: none"> • Formalise and protect them from illegal dealers.
End use/consumers	<ul style="list-style-type: none"> • Use efficient technologies of choice in the countries that are supported by the law. • Encourage energy mix and switching to reduce over dependence on charcoal. • Government to provide enabling environment for charcoal substitution and subsidise alternative energy.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS.....	xiii
LIST OF TABLES	xvi
LIST OF FIGURES.....	xvi
LIST OF BOXES	xvii
LIST OF APPENDICES	xvii
ABBREVIATIONS AND ACRONYMS.....	xixxviii
PREFACE	xxiii
ACKNOWLEDGEMENTS.....	xxv
CHAPTER ONE.....	1
INTRODUCTION AND BACKGROUND OF THE STUDY.....	1
1.1 Background	1
1.2 Objectives of the study	4
1.2.1 Overall objective	4
1.2.2 Specific Objectives.....	4
1.3 Scope of the study	4
CHAPTER TWO	7
METHODOLOGY.....	7
2.1 Study Area and Design.....	7

2.2 Data Collection.....	8
CHAPTER THREE	15
DESK STUDY AND ANALYSIS OF LITERATURE	15
3.1 Analytical Overview.....	15
3.2 Validity of research methodologies and the quality of data.....	16
3.3 Charcoal contribution to deforestation.....	20
3.4 Capacity to regulate the charcoal value chain and collect revenues.....	23
3.5 Governance challenges in the charcoal sub sector.....	31
3.6 Some Insights from the Biomass Energy Strategy.....	31
3.7 Barriers to Alternative Energy Switching in the Country	35
3.7.1 Biomass based alternative energy options.....	36
3.7.1.1 Briquettes	40
3.7.1.2 Biogas	42
3.7.1.3 Ethanol	43
3.7.2 Electricity.....	44
3.7.3 Solar	45
3.7.4 Liquefied Petroleum Gas (LPG)	45
3.7.5 Natural Gas for cooking.....	48
3.7.6 Improved technologies in production and use of biomass energy	50
3.8 Past Recommendations from Evaluations of the Charcoal Industry	55
CHAPTER FOUR.....	58
MAIN FINDINGS AND DISCUSSION.....	58
4.1 Charcoal Production Models and Value Chain	58
4.1.1 Sources of raw material.....	60
4.1.2 Harvesting practices.....	62

4.1.3 Charcoal production technologies and efficiency	63
4.1.4 Charcoal trade	66
4.2 Mapping of the Actors along value chain	69
4.3 Revenues along charcoal value chain	74
4.4 Benefit sharing along the value chain.....	77
4.5 Revenue collection system	77
4.6 Charcoal taxation, barriers and improvement required	79
4.7 Revenues re-invested in to forest management.....	81
4.8 Conflict management arrangement.....	81
4.9 Sustainability of existing charcoal production and models used in Tanzania	82
4.10 Possibility of Establishing Plantations for Charcoal Production	85
4.11 Legal and Institutional Frameworks Limiting Sustainable Charcoal Sub-sector.....	89
4.12 Weaknesses of the Existing Legal Frameworks	97
4.12.1 Lack of awareness.....	97
4.12.2 Roles and coordination of charcoal sub-sector	99
CHAPTER FIVE.....	100
CONCLUSIONS AND RECOMMENDATIONS	100
5.1 CONCLUSIONS	100
5.2 RECOMMENDATIONS.....	103
REFERENCES	112
APPENDICES	117

LIST OF TABLES

Table 1: Kiln technologies in use and their ranked performance.....	64
Table 2: Cooking energy mix in surveyed cities and town	68
Table 3: Estimates of charcoal consumption in the surveyed regions	69
Table 4: Stakeholders involved in charcoal Sub-sector in the surveyed areas.	71
Table 5: Revenues along charcoal value chain	76

LIST OF FIGURES

Figure 1: Commercial Charcoal & Wood Energy Supply & Value Chain (Source: BEST, 2014)	33
Figure 2: LPG imports/consumption and into Tanzania (source EWURA 2017)	46
Figure 3: Assembling of improved cookstoves in Vingunguti, Dar es Salaam ...	55
Figure 4: Value chain models observed in the surveyed regions.....	58
Figure 5: Encountered arrangement of logs in traditional kilns in studied areas	63
Figure 6: Charcoal revenue trend from all zones	68
Figure 7: Revenue collection by zones.....	76
Figure 8: Blackwattle charcoal from Njombe Region ready for use in different parts of the country	86
Figure 9: Integrated Sustainable Charcoal Model (ISCM) for Tanzania	100

LIST OF BOXES

Box 1: Shara charcoal stove producers in Vingunguti - Dar es Salaam.....	54
Box 2: Charcoal from Mainland to Zanzibar	59
Box 3: Charcoal taxes and fees.....	80
Box 4: Examples of tree harvesting in intervened forests.....	86

LIST OF APPENDICES

Appendix I: Checklists Used to Collect Data from Stakeholders	117
Appendix II: Checklists for Data Collection from End-Users	129
Appendix III: Charcoal Revenues at Zonal Level	133
Appendix IV: Transforming Tanzania's Charcoal Sector Project	136
Appendix V: List of Contacted Stakeholders.....	141

ABBREVIATIONS AND ACRONYMS

AMCOS	Agricultural Marketing Cooperative Societies
BAU	Business as Usual
BEST	Biomass Energy Strategy
CA	Concerted Actions
CAMARTCH	Centre for Agricultural Mechanization and Rural Technology
CBFM	Community Based Forest Management
CHAPOSA	Charcoal Potential in Southern Africa project
CNG	Compressed Natural Gas
CPS	Custom Preventive Service
CSO	Civil Society Organization
DC	District Commissioner
DED	District Executive Director
DFM(s)	District Forest Manager(s)
DFO(s)	District Forest Officer(s)
DFoB	Director of Forestry and Beekeeping
DNRO(s)	District Natural Resources Officer(s)
EFD	Electronic Fiscal Device
EITI	Extractive Industries Transparency Initiative
ERV	Exchequer Receipt Vouchers

EU	European Union
EWURA	Energy and Water Utilities Regulatory Authority
FBD	Forest and Beekeeping Division
FDT	Forest Development Trust
FGDs	Focused Group Discussions
FREL	Forest Reference Emission Level
FSUs	Forest Surveillance Units
GePG	Government Electronic Payment Gateway
GIIP	Gas Initially in Place
GTF	Global Tracking Framework
IBEMK	Basic Earth Mound Kiln
ICS	Improved Cook Stoves
IM-FLEG	Independent Monitoring of Forest Law Enforcement and Governance
ISCM	Integrated Sustainable Charcoal Model
KIIs	Key informants interviews
LPG	Liquid Petroleum Gas
MAI	Mean Annual Increments
MCDI	Mpingo Conservation Development Initiative
MEM	Ministry of Energy and Minerals
MJUMITA	<i>Mtandao wa Jamii ya Usimamizi wa Misitu Tanzania</i>
MMC	Mama Misitu Campaign
MNRT	Ministry of Natural Resources and Tourism
MoE	Ministry of Energy

MoFP	Ministry of Finance and Planning
MoU	Memorandum of Understanding
MSNFI	Multi Source National Forest Inventory
MTI	Ministry of Trade and Industries
NAFORMA	National Forest Resources Monitoring and Assessment
NBTF	National Biofuels Taskforce
NLUPC	National Land Use Planning Commission
PFM	Participatory Forest Management
PORALG	President's Office Regional Administration and Local Government authorities
POS	Point of Sale
RASs	Regional Administrative Secretaries
RCs	Regional Commissioners
REA	Rural Energy Agency
REDD	Reducing Emissions from Forest Degradation and Deforestation
RNROs	Regional Natural Resource Officers
SDC	Swiss Agency for Development and Cooperation
SE4ALL	Sustainable Energy For All
SHS	Solar Home Systems
SMEs	Small and Medium Sized Enterprises
SUA	Sokoine University of Agriculture
SUMATRA	Surface and Marine Transport Regulatory Authority
TaFF	Tanzania Forest Fund

TAFORI	Tanzania Forest Research Institute
TANESCO	Tanzania Electrical Supply Company
TANROAD	Tanzania National Roads Agency
TARURA	Tanzania Rural Road Agency
TaTEDO	Tanzania Traditional Energy Development Organization
TBS	Tanzania Bureau of Standards
TDBP	Tanzania Domestic Biogas Programme
TEITI	Tanzania Extractive Industries Transparency Initiative
TEMK	Traditional Earth Mound Kilns
TF	National Task Force
TFCG	Tanzania Forest Conservation Group
TFS	Tanzania Forestry Services Agency
TFWG	Tanzania Forestry Working Group
TIN	Tax Payer Identification Number
TIRDO	Tanzania Industrial Research and Development Organization
TNRF	Tanzania Natural Resources Foundation
TP	Transit Pass
TPDC	Tanzania Petroleum Development Corporation
TRA	Tanzania Revenue Authority
TTCS	Transforming Tanzania's charcoal sub sector project
UNFCCC	United Nation Framework Convention for Climate Change
USD	United State Dollar

VLA	Village Land Act
VLFRs	Village Land Forest Reserves
VNRCs	Natural Resources Committees
VPO	Vice President's Office
WMA	Weight and Measures Agency
WWF	World Wide Fund for Nature
ZMs	Zonal Managers

PREFACE

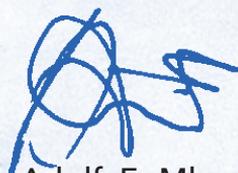
Charcoal is among the forest sub-sectors which have significant contribution to the economy and livelihoods of the people. Charcoal is the largest source of household energy in urban areas for cooking and heating in Tanzania. Inefficient charcoal production, utilization and trade is known to contribute significantly to deforestation and forest degradation in Tanzania where the annual deforestation rate is estimated to be 460,000ha/year. Paradoxically, charcoal as a product contributes more than 40% of the forest sector GDP in Tanzania. It is therefore implied that with good management and control of the charcoal business in the country, it is possible to reduce the negative environmental consequences associated with charcoal production and still increase the contribution of charcoal to the national economy. In light of this situation, a National Task Force (TF) to assess options that could address challenges in charcoal production, trade, and use and that support the sustainable management of forest resources in Tanzania was formed by the Ministry and supported to undertake detailed situational analysis to provide technical guidance to the government.

This Charcoal Situation Analysis covers key important issues that could improve the charcoal value chains in the country: These are: Sustainability of existing charcoal production and use models within Tanzania, and beyond, and their potential application along the value chain in the Country; Barriers and gaps that hinder the sustainability of the charcoal sub-sector in Tanzania; Relevant stakeholders; Lessons for the improved development of the charcoal sub-sector in the country; and Policy applications towards improving the sustainability of the charcoal sub-sector in Tanzania.

Sustainability of charcoal sub-sector in the country could be improved by making use of ideas of various stakeholders including previous rec-

ommendations from research reports that have been generated in the country. Issues related to coordination are of paramount as charcoal value chains cuts across various actors from the supply to demand point of view. Therefore, implementation of recommendations raised from this study could lead to improved charcoal value chains in the country and in the long run lead to significant reduction of deforestation rate that is directly linked to charcoal production.

I call upon for all stakeholders piloting some models of integrated charcoal production and use, to apply or accommodate proposed interventions in the Integrated Sustainable Charcoal Model (ISCM) for harmonization countrywide. Further, research should be applied to investigate the performance of the models in various charcoal value chain nodes. Moreover, it is my sincere hope that the Director of Forest and Beekeeping will ensure this document is available to all relevant stakeholders as well as instituting effective coordination of the charcoal sub-sector in the country.



Prof. Adolf F. Mkenda

PERMANENT SECRETARY

MINISTRY OF NATURAL RESOURCES AND TOURISM

ACKNOWLEDGEMENTS

Development of the Charcoal Situation Analysis for Tanzania that focused on “Assessing Potential and Identifying Optimal Strategies for National Charcoal Sub-Sector Development in Tanzania” was an initiative of the Ministry of Natural Resources and Tourism (MNRT) through the Forestry and Beekeeping Division (FBD). The Ministry (MNRT) established a National Task Force in March, 2018 with representation of various disciplines relating to the Charcoal Value Chains to lead the process.

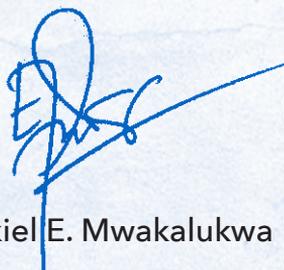
The team consisted of Prof. John F. Kessy from the College of Forestry, Wildlife and Tourism of Sokoine University of Agriculture (SUA), who was the Chairperson; Mr. Deusidedit Bwoyo from FBD (Secretary); Prof. Jumanne M. Abdallah (SUA); Dr. Chelestino Balama (Tanzania Forestry Research Institute-TAFORI); Mr. Kahana Lukumbuzya (Private Consultant); Eng. Estomih N. Sawe (Tanzania Traditional Energy Development Organisation-TaTEDO); Mr. Jasper Makala (Mpingo Conservation Development Initiative - MCDI), Mr. Leonard Charles (Tanzania Forest Conservation Group -TFCG); Mr. Kiiza Julius (President’s Office-Regional Administration and Local Government-PORALG); Prof. Rogers Malimbwi (SUA); Mr. Mathias Lema (Tanzania Forest Services Agency - TFS); Ms. Gisela Ngoo (National Gender and Sustainable Energy Networks-NGSEN); Mr. Isaac Malugu (World Wide Fund for Nature - WWF) and Mr. Paul M. Kiwele from the Ministry of Energy (MoE). I would like to thank the Task Force members for their commitments and tireless efforts that contributed to the successful completion of this important task.

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Dr. Ezekiel E. Mwakalukwa

DIRECTOR OF FORESTRY AND BEEKEEPING DIVISION

MINISTRY OF NATURAL RESOURCES AND TOURISM

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Background

Biomass is Tanzania's major energy source accounting for approximately 90% of total energy consumption. Charcoal is the single largest source of household cooking and heating energy in urban areas, as it is considered affordable, available and easy to transport, distribute, and store (National Bureau of Statistics, 2013). Between 2001 and 2007, the proportion of households in Dar es Salaam using charcoal rose from 47% to 71% (World Bank, 2009). More recent studies indicate that the percentage has increased further to 88.2% (NBS, 2017). Over 2.3 million tonnes of charcoal were consumed in 2012, a quantity predicted to double by 2030 (Ministry of Energy and Minerals, 2014) in the absence of introducing appropriate interventions. Charcoal generates at least USD 1 billion per annum in revenues, supporting the livelihoods of hundreds of thousands of suppliers, transporters and traders (MEM, 2014). However, central and local governments are estimated to lose about USD 100 million per year due to a failure to effectively regulate the charcoal sub sector and to collect associated tax and non-tax revenues (World Bank, 2009).

The charcoal sub sector in Tanzania employs hundreds of thousands of rural and urban people who supply an essential energy to about million urban households, Small and Medium Enterprises (SMEs) and institutions. Harvesting trees for charcoal production affect environment, causing high rates of forest land degradation, deforestation, carbon dioxide emissions, watershed destruction, and biodiversity losses. While cooking on charcoal adds flavour to food, the soot (Carbon monoxide) poses risk to health. It is predicted that charcoal consumption will increase in absolute and relative terms in the near and medium-term future due to three

main factors: (a) rapid population growth; (b) urbanization; and (c) price increases of alternative energies (MEM, 2014). These trends are likely to apply particularly to the major cities, particularly Dar es Salaam where more than 50% of all charcoal in the country is consumed.

Due to a number of factors, switching to alternative fuels will only be an option for a few, better-off and wealthier households. Even with large natural gas discoveries, which may one day in the future, provide affordable alternatives for cooking energy, charcoal use is likely to persist due to socio-cultural influences and the high cost of alternatives. As such, there is need to develop and promote alternative models of producing and using wood-based energy that can demonstrate the potential for a win-win scenario. Any alternative charcoal model must involve increased incomes for the women and men who are producers, relative to the traders, and for the reinvestment of revenues by all stakeholders in support of appropriate interventions along the entire value chain that will secure forests for present and future generations. The alternative must also aim at promoting clean cooking solutions.

Charcoal production is identified as one of the key drivers of forest degradation and deforestation nationally, and there exist a relatively small number of piecemeal interventions that are being implemented to address the key issues related to the charcoal sub-sector. From a social perspective, the production and marketing of charcoal has frequently resulted in the exploitation of producers, who being weaker members of the value chain often receive little benefits for their resources and labour. Considering the deforestation rate of about 460,000 ha/year (URT, 2017) the environmental cost of the deforestation due to charcoal is enormous. It is therefore critically important to identify national mechanisms that will transform the charcoal trade in a more sustainable manner. These mechanisms must include financial tools that can ensure the sustainable management of forests, the efficient production of charcoal at its source, organized marketing in rural and urban areas and the increased efficiency of charcoal cooking stoves. Specifically, the establishment of procedures that channel royalties and taxes from verifiably sustainable charcoal back

to local communities and other stakeholders participating in sustainable forest management is crucial. Roles for each stakeholder along the value chain (resource owners, producers, on-site markets, transporters, wholesalers, retailers, end-users, governing institutions and regulatory authorities, including local and central government and its agencies) must be appropriately defined.

Some Non-Governmental Organizations have implemented pilot interventions that have attempted to address the challenges of charcoal production and use. Examples of these pilot projects include; a WWF Tanzania pilot project on sustainable charcoal production that began in 2010, and Tanzania Traditional Energy Development Organization (TaTEDO) supported integrated woodfuel development programme that was implemented during the period 2002 to 2009. Moreover, from 2015 to the present, the Tanzania Forest Conservation Group (TFCG), in collaboration with TaTEDO and *Mtandao wa Jamii ya Usimamizi wa Misititu Tanzania* (MJUMITA) are piloting the sustainable charcoal production project in Morogoro Region. Despite the lessons learned from these pilot projects, there has not been a coordinated national effort to make sure the charcoal production and trade is sustainable and that its benefits are also realised by lower actors in the value chain and to the nation as a whole. A major constraint to a sustainable charcoal trade has been insufficient coordination across sectors involved in charcoal production and trade. It is within the interest of government and stakeholders to ensure that charcoal does not only become more sustainable but also contributes to welfare of actors and communities, national economy and overall sustainable development.

The Task Force on Charcoal Sub-Sector was formed in March, 2018 to assess the existing limitations in policy, production models, value chain elements, and identify viable options for sustainable charcoal production and trade while providing an enabling environment that leads to beneficiation along the value chain and ultimately to forest conservation.

1.2 Objectives of the study

1.2.1 Overall objective

To assess options that address challenges in charcoal production, trade and use for the sustainable management of forest resources in Tanzania.

1.2.2 Specific Objectives

- (i) To evaluate the sustainability of existing charcoal production and use models within Tanzania, and beyond, and their potential application along the value chain in the country;
- (ii) To identify barriers and gaps that hinder the sustainability of the charcoal sub-sector in Tanzania;
- (iii) To identify and engage relevant stakeholders and draw lessons for the improved development of the charcoal sub-sector in the country; and
- (iv) Recommend policy and practical interventions towards improving the sustainability of the charcoal sub-sector in Tanzania.

1.3 Scope of the study

For each specific objective, the following specific tasks were undertaken;

Specific objective i:

- (i) Assess the current charcoal production and use models in the charcoal sub-sector;
- (ii) Review and assess existing current charcoal model(s) and advise on their relevancy, efficiency and adoption;
- (iii) Evaluate the charcoal value chain of the models;
- (iv) Assess the possibility of establishing plantations, woodlots, and agroforestry technologies for charcoal production; and
- (v) Propose an optimal model(s) for scaling-up in the country that considers policy, environmental and socioeconomic factors.

Specific objective ii:

- (i) Assess how the existing legal and institutional framework limits the sustainability of the charcoal sub-sector;
- (ii) Identify and document weaknesses in the current control mechanisms in the charcoal sub-sector, taking into consideration exportation and importation of charcoal;
- (iii) Assess weaknesses of the legal framework towards supporting the incentive structure in the charcoal sub-sector, and propose improvement mechanisms; and
- (iv) Identify the barriers affecting alternative energy switching in the country.

Specific objective iii:

- (i) Map/Identify key stakeholders, their current and potential roles in the charcoal sub-sector;
- (ii) Assess factors influencing investment opportunities in the charcoal subsector;
- (iii) Assess the role of the transport sector and propose mechanisms that will help government to control illegality;
- (iv) Assess current revenue collection methods and areas of improvement to enhance compliance; and
- (v) Establish the relevance and justification for an independent charcoal policy.

Specific objective iv:

The assessment focused on:

- (i) Appropriate charcoal production and use models;
- (ii) Policy, legal framework and compliance;
- (iii) Value chain improvement;
- (iv) Revenue collection;

- (v) Energy switching to clean, affordable, reliable and efficient alternatives;
- (vi) Investment on charcoal production and use;
- (vii) Capacity building of key stakeholders, individuals and institutions;
- (viii) Stakeholders' involvement, awareness and outreach; and
- (ix) Possibility to access global green climate funding.

CHAPTER TWO

METHODOLOGY

2.1 Study Area and Design

Field surveys were conducted in all the seven zones of the Tanzania Forest Services (TFS) Agency covering the following regions: Eastern zone (Dar es Salaam, Morogoro and Pwani Regions), Northern Zone (Tanga and Kilimanjaro Regions), Western zone (Tabora, Kigoma and Shinyanga Regions), Southern Zone (Mtwara, Lindi and Ruvuma Regions), Southern Highlands Zone (Njombe, Mbeya and Songwe Regions), Lake Zone (Mwanza Region) and Central Zone (Dodoma Region). Selection of the regions was done to ensure adequate coverage for national representation.

The TF was divided into three groups in order to efficiently collect data for all specific objectives: (i) Group 1 covered Northern, Central and Eastern Zones. (ii) Group 2 covered Western and Lake Zones; and (iii) Group 3 covered Southern Highland and Southern Zones. Consultative meetings were conducted in the following levels:

National Level: At this level, the TF visited and conducted discussions in Dar es Salaam and Dodoma with representatives from the FBD, TFS, Development partners (European Union - EU, Embassies of Finland and Norway), NGOs (e.g. TaTEDO) and private sector (e.g. Sahara improved charcoal stove producers and ORYX Oil Company).

Regional level: The main method for data collection at this level was presentations, round table discussions and consultative meetings. Stakeholders involved in the discussions were: Regional Commissioners

(RCs), Regional Administrative Secretaries (RASs), Regional Natural Resource Officers (RNROs), TFS-Zonal Managers (ZMs), TFS-District Forest Managers (DFMs), DNROs and District Forest Officers (DFOs). These stakeholders were invited to consultative meetings that were conducted in the regions visited.

District level: The methods used in data collection at this level were interviews and discussions using checklist. Stakeholders involved in the meeting included: Village leaders, charcoal producers, transporters, whole-sellers, retailers, end-users, private sectors, NGOs (e.g. Tanzania Forest Conservation Group - TFCG) and civil society organizations.

Cross border and harbours: The TF visited a number of ports and borders of exports including regions of Kigoma (Kibirizi port), Songwe (Tunduma border), Lindi (Kilwa port), Tanga (Tanga harbour) and interviewed key stakeholders including Tanzania Revenue Authority (TRA) officials, charcoal traders, Custom Preventive Service (CPS), to collect data cross border trade on charcoal and compliance to laws and regulations.

End-user level: The TF administered questionnaire to households in selected major cities in the country in order to assess characteristics and behaviour of charcoal end users, current consumption patterns, technologies in use and encountered challenges. The surveyed cities included Dar es Salaam, Dodoma, Mwanza and Mbeya. Additionally Njombe Town was also surveyed due to its uniqueness in terms of charcoal production and trade from plantation and woodlots.

2.2 Data Collection

Data collection was closely linked with the specific objectives as described in the subsequent paragraphs:

Specific Objective I:

Task 1: Assess the current charcoal production and use models in the charcoal sub-sector: Current charcoal production and use models/ approaches available in the seven zones were identified, purposively selected and visited. Checklists for data collection from stakeholders (Appendix I) and field visits/observation were used to collect data. The following data were collected for each model: Sources of raw materials for charcoal production; charcoal production technologies in use; productivity of the system; local marketing of charcoal, revenue collection and benefit sharing among key stakeholders; involved institutions and guidelines governing the system.

Task 2: Review and assess existing charcoal model(s) and advice on relevancy, efficiency and adoption: Existing charcoal models was assessed based on data collected under Task 1.

Task 3: Review the charcoal value chain of the models: The value chain within the production system was assessed by tracing and mapping the value chain. To achieve this Checklists for data collection from stakeholders (Appendix I), unstructured interviews and field visits/observation were used. Data collected include: costs involved in production and prices of charcoal; value addition at various stages in the chain; gender roles in the value chain; and market value of charcoal. The data were provided by key stakeholders (including RNRO, DFMs, DFOs and NGOs), charcoal producers, traders and transporters and improved charcoal stoves producers. In addition, actors along the value chain were mapped to determine the implication of their roles and practices on the sustainability of charcoal sub-sector.

Assessment of data availed by different stakeholders enabled the TF to examine trend of the number of permits issued and charcoal bags produced; charcoal revenues collected relative to all revenues; revenues invested in natural forest management, improved charcoal stoves relative

to charcoal users. The data were collected from various stakeholders for triangulation purposes.

Task 4: Assess the possibility of establishing plantations, woodlots and agroforestry for charcoal production: Checklists for data collection from stakeholders (Appendix I and II), field visits/observation and literature review were the methods used to obtain information on the possibilities of establishing plantations, woodlots and agroforestry for charcoal production. Important data collected included: suitable tree species for charcoal production; land tenure arrangements; land availability; suitable charcoal production technologies/practices; gender roles in the establishment processes; lessons and best practices from neighbouring countries.

Data were collected from RNROs, DFMs, and DFOs during the regional consultative meetings. Additionally more location specific information was gathered from charcoal producers, traders and transporters. Unstructured interviews were conducted with key Informants particularly individuals who had interests on charcoal production.

Task 5: Propose an optimal model(s) for scaling-up in the country that consider policy, environmental and socioeconomic factors: The achievement of this task depended on findings obtained from all objectives.

Specific Objective II:

The aim of this objective was to identify and review recommendations from past studies regarding measures to overcome barriers that hinder the sustainability of the charcoal sub-sector. The purpose of the assessment was to create better understanding of the gaps in implementation of the recommendations and develop options for effective implementation of sustainable charcoal interventions.

Task 1: Assess how the existing policies, strategies, legal and institutional framework limits the sustainable charcoal sub sector:

This entailed a review and analysis of the existing policies, laws, regulations, guidelines and institutional framework. The methodology involved review of literature; particularly on past recommendations from evaluations of the charcoal sub-sector.

Task 2: Identify and document weaknesses of the current control mechanisms in the charcoal sub-sector taking into consideration exportation and importation of charcoal:

Discussions with ZMs, DFMs, DFOs and VNRCs were held focusing on understanding collected revenues, permits and license applications and number issued, targets for charcoal trade, charcoal confiscated and revenues from disposition through auctions at TFS headquarters, selected district offices, TFS zonal offices and check points.

Focused Group Discussions (FGDs) with ZMs, DFMs, DFOs and RNROs were conducted. The focus of the consultations was to identify constraints which have weakened controls over forest resources as well as revenue collection system. Information of interest included staffing levels, existing facilities, infrastructure and e-Governance. In addition, consultations aimed to get insight on forest officers' access to and understanding of policies, laws, rules, guidelines, and directives governing charcoal production and trade. Discussion with TFS zonal and TRA managers at border posts were conducted to review movement of charcoal across borders and ports.

Task 3: Assess weaknesses of legal frameworks supporting the incentive structure in the charcoal sub-sector, and propose improvement mechanism:

Key stakeholders along the value chain were consulted to solicit their opinion on constraints to the existing charcoal trade and explore possibilities of trading in sustainable charcoal. It was also of interest

to establish their understanding of existing regulations (i.e. licensing procedure), guidelines, taxation, as well as propose improvement of laws and regulations to support charcoal production and trade.

Task 4: Identify the barriers affecting alternative energy switching in the country:

An assessment of the existing options for energy switching was conducted during data collection. Among the explored possibilities included use of alternative biomass energy (briquettes, ethanol, biogas), and non-biomass energy (LPGs, natural gas, and electricity) in the country. Furthermore, information on the use of energy efficient technologies was also solicited. The assessment gave special attention to issues relating to affordability, availability, reliability and cultural acceptability of potential alternative energy.

Specific Objective III:

Stakeholders' mapping was done to capture relevant stakeholders, their roles and functions along the value chain (Appendix II). Specific methods and data collected under each task are explained below:

Task 1: Map/Identify key stakeholders, their current and potential roles in charcoal sub-sector:

Stakeholders were mapped based on their current and potential roles in charcoal sub-sector. The captured information included: Name of stakeholder involved in charcoal sub-sector; tasks of stakeholder in the sector; Level and extent of engagement with other stakeholders; inter-relationship between the stakeholders; power relations between the stakeholder and others in the charcoal sub-sector; potential conflicts and appropriate strategies for engaging the stakeholder to ensure sustainability of the charcoal sub-sector in the country.

Task 2: Assess role of transport sector and propose mechanisms that would help government to control illegality:

The TF assessed transportation system of charcoal from production to the collection centres, and onward to retail markets along the value chain. This task involved key informant interviews with transporters (drivers, trader/owners of vehicles), and forest officers from districts and TFS who are involved in regulating the charcoal trade. Checklists for data collection from stakeholders (Appendix I) was used to collect data under this task. Data collected included: Dominant transportation modes used along the value chain; challenges embedded in charcoal transportation; regulations (such as SUMATRA Act, Forest Act 2002 Cap 323; R.E. 2002], Road Traffic Act 2017, Weight and Measure Act- CAP 340) affecting charcoal value chain; weight and packaging; and level of compliance with rules and regulations.

Task 3: Assess current revenue collection methods and areas of improvement to enhance compliance:

Key methods for data collection included: literature collection and review, interviews with stakeholders (Appendix I). Key informant for interviews were: Regional Secretariat Officials, ZMs, DFMs, DFOs, TRA, private sector, transporters, wholesalers, and retailers, officers at check points, as well as communities involved in the charcoal sub-sector. Data collected included: Amount and trend of revenue collection per annum in the charcoal sub-sector; challenges facing revenue collection; effectiveness of revenue collection systems (e.g. use of EFD machines, GePG and bank payments), reporting frequencies - returns, and submission of the revenue to the relevant authorities); perception of stakeholders on the approved royalty rates and fees and alternative selling mechanism on charcoal.

Task 5: Establish relevance and justification for charcoal policy and related implementation instruments:

Data were collected from key informants (RNROs, ZMs, DFMs, DFOs, private sector, NGOs, transporters, wholesalers and retailers in the charcoal sub-sector) using checklist in Appendix I. The following data

were collected: key bottlenecks for the existing policy frameworks related to charcoal sub-sector; policy options to strengthen and formalize charcoal production, distribution, environmental impact and economic benefits; policy options for: protecting sustainable charcoal against unsustainable charcoal; collection of revenues from sustainably produced charcoal; protection of the areas sustainably harvested charcoal; ensure biodiversity conservation on the areas of sustainable charcoal production; dealing with charcoal benefit sharing (equitable distribution of benefits); and the strategies and regulatory framework that is required to ensure sustainability and governance compare with sectors already regulated by policies.

CHAPTER THREE

DESK STUDY AND ANALYSIS OF LITERATURE

3.1 Analytical Overview

A comprehensive review and analysis of literature regarding the charcoal value chain specifically, and governance of the forestry sector more generally, is presented in this chapter. An outline of important literature is described and a framework is defined for its analysis, within the context of the objective of this study. Due to its use of forest resources as raw materials during the production process, literature on the charcoal sub sector is intimately intertwined with literature on the state of forest resources. Several documents that deal with charcoal are in fact forest documents, in which the charcoal sub sector is referred to simply as one component. This is the case also with regards to the energy sector literature, although to a much lower extent.

Literature regarding the charcoal sub sector can be divided into 5 thematic areas: those documents that refer to the relative impact of charcoal production on forest resources; documents that describe the capacity to regulate trade and capture revenues; references about the governance of the forestry and charcoal sub sectors; reports regarding efficiencies in charcoal production and use; and documents about alternative energies and energy switching. A substantial amount of literature exists, not only for the charcoal sub sector in Tanzania, but also for the charcoal sub sector in the context of southern Africa. This literature is reviewed and placed into the above framework for the purpose of analysis and comparison. It is worth noting that many of these reports have generated recommendations that appear to have been ignored. The TF attempted to understand the underlying reasons as to why past recommendations have not received support at the highest decision making levels.

3.2 Validity of research methodologies and the quality of data

Among the main observations of the charcoal literature is the fact that, although many reports have been written, there are relatively few documents that are based on comprehensive assessments of the functions of the entire value chain. The most relevant document for a wide-ranging analysis of the sector remains CHAPOSA, 2002. CHAPOSA (Charcoal Potential in Southern Africa project) was generated from primary research that assessed the functions of the sector in its entirety, from production to retail sales in major urban areas. The objectives of the CHAPOSA project were to investigate the trends in deforestation and forest depletion in areas supplying three urban centres in Sub-Saharan Africa: Lusaka, Dar es Salaam, and Maputo. An additional objective was to understand the reasons for charcoal production. The CHAPOSA study was carried out for two years in the catchment area from source to consumption around Dar es Salaam, beginning in November 1999 until December 2001. Three university professors, 1 Lecturer and 3 research assistants from Tanzania were involved in the data collection and analysis. The Tanzanian team was assisted by a team of 5 researchers from the University of Stuttgart in Germany.

In connection with CHAPOSA, socio-economic data were collected by sampling 113 heads of households across 10 villages. Charcoal bag and vehicle counts were carried out at each of four major routes entering Dar es Salaam, namely Kilwa, Morogoro, Pugu (now called Nyerere) and Bagamoyo roads. Selected railway stations were also surveyed, including Mpiji, Soga, Ngeta, Kwala and Magindu on the TRC railway line and Kifuru, Mzenga and Gwata on the TAZARA railway line. As part of a consumption survey, the CHAPOSA team administered 929 semi-structured questionnaires, over three phases representing wet and dry seasons, in urban and peri-urban areas of Dar-es-Salaam. As part of collecting ecological data the CHAPOSA team also determined Mean Annual Increment; tree species through forest inventories; kiln efficiencies,

species and tree size preference; and woodland cover change using satellite images.

With the exception of studies and surveys conducted more recently, as part of the Transforming Tanzania's charcoal sub sector project (TTCS), a complete study of the charcoal sub sector in Tanzania has never been repeated since CHAPOSa. Other studies and reports are based on either more limited primary research, on secondary research, or on data collected from more limited catchment areas. For example, WWF Tanzania Country Office, in close contact with the World Bank, commissioned a team of researchers from Sokoine University of Agriculture (SUA) to undertake a study of the charcoal trade around the city of Dar es Salaam, which was carried out from April until June 2007 (WWF, 2007a). This study relied on Key Informant Interviews, Focus Group Discussions, and matrix analyses procedures but no direct measurements. The information gathered was used to develop a USD 6 million project proposal for dealing with unsustainable charcoal in areas surrounding Dar-es-Salaam (WWF 2007b). Another example is from May 2002, when the LPG Committee of the Tanzania Association of Oil Marketing Companies commissioned NORCONSULT Tanzania Ltd to undertake an appraisal of the potential economic and environmental benefits of substituting LPG or charcoal as an urban fuel in Tanzania (NORCONSULT, 2002). The NORCONSULT study also involved a consumption survey and vehicle counts being carried out in Dar es Salaam. However, production efficiency data, land cover change information and estimates of rail transported charcoal were all referenced from existing literature, including from CHAPOSa.

A TaTEDO study from 2004 conducted a review of literature and administered a questionnaire to 170 respondents in Coast and Dar es Salaam Regions (TaTEDO, 2004). Despite the fact that TaTEDO had been consulted for the CHAPOSa study in 2001, and the fact that the NGO were reputed for carrying out primary research on kiln and cook stove efficiencies, consumption surveys were not included in the 2004 report. From July 2008 until February 2009, the NGO, TASONABI, conducted the first transport based fee system study on the charcoal trade in Tanzania

(TASONABI, 2009). The methodology involved literature reviews and visits to check points in 5 key regions in eastern and western Tanzania. In addition, the study team conducted measurement of body volumes of different vehicles used for transporting charcoal; visits to charcoal and firewood production sites to collect data on weight of charcoal and volume of firewood; and visits to selling places of charcoal and firewood to obtain data on market prices and measurement units used. More recently, WWF commissioned another study, this time to undertake an Economic Valuation of the Coastal Forests of Tanzania (WWF, 2013), in which the methodology involved the administration of a questionnaire to 540 households in 18 villages and the conducting of key informant interviews with 180 forest products value chain actors from 7 Districts across 3 Regions (Tanga, Coast, and Lindi) of coastal Tanzania. Yet another study is the Charcoal Production and Consumption Value Chain in western Tanzania (Kaale, 2015), which was focused on the trade in Tabora Region, in western Tanzania. In this study only KIs and a questionnaire in sample areas was employed.

Most reports on the charcoal trade have therefore relied on either subjective information, collected from charcoal value chain actors themselves, or from data that has been recycled from previous studies. There is now a need for contemporary research to be carried out that can update the historic information that was collected from the CHAPOSA study. Replication of projects such as TTCS will help to improve the knowledge base that can be used for making more informed decisions. In particular, research needs to be carried out on kiln efficiencies from real world conditions; forest and woodland inventories, especially around regeneration; and vehicle counts that include cars, motorcycles, rail and even boats.

It is worth noting two other studies that although not focussed on the charcoal trade, in one case, and not based on primary data, in the other, have helped to advance the understanding and raised insights into the sector in the country. The first of these landmark studies is reflected in the report, *Forestry, Governance and National Development:*

Lessons Learned from A Logging Boom in Southern Tanzania, for which information was derived, over a 2 year period from 2005 until 2007, from official statistics, independent field research, stakeholder consultations and literature review (TRAFFIC, 2007). The field work for the study was focussed on Rufiji, Kilwa, Lindi, Nachingwea, Liwale, Ruangwa and Masasi Districts in south-eastern Tanzania. This study, although centred on the timber trade, was able to collect significant amount of data on charcoal. It was a ground breaking report in its access, analysis and presentation of official data from licenses and permits issued by forest officers at district and ministerial levels.

The other important report, was produced by the World Bank in 2009 and although it did not rely on specific primary data collection or research, it emphasized the review of relevant literature from inside and outside of Tanzania (World Bank, 2009). In addition, it documented the results of four stakeholder workshops that the Ministry of Natural Resources and Tourism (MNRT) organized together with the World Bank in Dar es Salaam between October 27 and October 30, 2008. The purpose of the workshops was to discuss policy measures with stakeholders, including charcoal producers, traders, district officials, representatives from different ministries (MNRT and Ministry of Energy and Minerals (MEM)), NGOs, and development partners.

Despite the differences in the quality and depth of information collected about the charcoal trade, all of the studies have all made similar conclusions about the charcoal value chain and its beneficiaries. All of the reports conclude that the charcoal industry has provided income opportunities to large numbers of poor rural people, and affordable and reliable energy supplies to the majority of poor urban people. Thus, changes to the system would affect a large number of poor people. Since the most realistic changes would include restrictions in either supply or price, such changes would be for the worse for most people included. Hence, policy interventions must be carefully deliberated. In all the study areas, forest management was found to be inadequate. There was a need in every instance to strengthen the capacity of forest authorities to

introduce management systems that benefit local communities and the natural resource availability. This could only come about with increased resources to the forestry and natural resource sectors. The collection of fees and licenses should have resulted in substantial amounts that could have been used for forest management requirements. However, the fiscal system has been inadequately enforced and revenue collection has continued to be but a fraction of what it should have been. Furthermore, the effects of improved forest management should have been able to provide sufficient income to rural communities through employment in the forestry sector.

3.3 Charcoal contribution to deforestation

Several documents have attempted to investigate the relative impact of various drivers, including charcoal, on the rate of deforestation. The major reports in this context are CHAPOSA, 2002; Malimbwi and Zahabu, 2008; World Bank, 2009; National REDD Strategy, 2013; NAFORMA, 2015; and FREL (URT, 2017). Although not directly about Tanzania, the pioneering documents produced by Chidumayo (2012), are equally relevant and have been reviewed here. Surprisingly, although deforestation has been studied for many years, there remains great uncertainty around the relative impact that can be attributed to charcoal production. This, in many ways, is a result of the challenge of assessing the status of regenerating natural woodlands, such as young, small-dimensioned saplings, while using satellite images. The literature points to the need for more resources for forest resources monitoring in order to make well informed decisions on forest management and resource allocations.

CHAPOSA was among the first documents to estimate the relative contribution of charcoal to deforestation and forest degradation (CHAPOSA, 2002). CHAPOSA calculated that the annual charcoal consumption for Dar es Salaam, in 2001, was 471,000 tonnes/year, when the population of the city was 3 million. This amount of charcoal would require that 2.3 million m³ of wood per year, for the city of Dar es Salaam alone. The authors reiterate the need for caution in interpreting these

figures because of the ability of natural woodlands to regenerate. Despite the fact that the World Bank study followed on 7 years later from the CHAPOSA report, it used CHAPOSA data to determine that Tanzanians consume roughly 1 million tons of charcoal per year. To produce that quantity using traditional methods, the daily wood requirement would be equivalent to that contained in 342.5 ha of forest. A full year of this consumption would equate to more than 125,000 ha of forest destroyed, or 12 square kilometres (World Bank, 2009). Assuming that the deforestation rate was approximately 400,000 ha/year, this would mean that charcoal was responsible for 30% of all deforestation in the country.

However, this same document cautioned against using this figure, since wood harvesting for charcoal most often results in a gradual degradation of forest resources over time, rather than clear-cutting, leading to real deforestation.

Chapter 3 of the National REDD Strategy identified firewood and charcoal production to be among the major direct causes of uncontrolled deforestation and forest degradation (VPO, 2013). Nonetheless, the REDD (Reducing Emissions from Forest Degradation and Deforestation) document provided no new data on the relative contribution of charcoal to either deforestation or degradation. The National Forest Resources Monitoring and Assessment (NAFORMA) were carried out between 2009 and 2013 (NAFORMA, 2015). A total of 32,660 field plots were established across all land cover types in Tanzania where more than 240,000 trees were measured to evaluate wood volume, species composition and other variables. In addition to the field inventory, NAFORMA produced a 2010 Land Use Cover map of Tanzania based on interpretation of satellite imagery with ground validation. NAFORMA determined the area of forest and woodlands of Tanzania mainland to be 48.1 million ha. This was 42% larger than earlier projected. NAFORMA was the first ever ground based national forest inventory in Tanzania and the differences with earlier estimates showed that ground measurements are essential for accurate forest inventories. Comparing the NAFORMA land cover map with the 1995 land use map produced an estimate for

forest cover loss of 372,816 ha per year. This rate was very similar (92%) to previous estimates reported by FAO (2010). In addition, the remaining forests were found to be more degraded than they were in the early 1980s (NAFORMA, 2015).

Furthermore, as part of wood balance analysis, NAFORMA calculated that out of 62.3 million m³/year of forests lost, a staggering 43.0 million m³/year resulted from household wood energy demand and a maximum of 2.1 million m³/year resulted from illegal felling for charcoal. Land use changes due to agriculture and other causes were calculated to be 14.9 million m³/year. Unfortunately, whereas the land cover data was calculated from relatively up to date satellite images, data used to calculate the wood energy demand was based on wood fuel consumption values referenced from almost 30 year old literature. Several reports have documented that fuelwood use as a proportion of the energy mix, and per capita use of fuelwood; have been declining, sometimes dramatically, over the past 20 years (Shanks, 1990; Hosier et. al., 1990; Johnsen, 1999; Malimbwi and Zahabu, 2008; NBS, 2014; NAFORMA, 2015).

However, within the NAFORMA document it states that any national forest inventory, provides the big picture and does not provide information to meet all the needs related to planning and management at district and forest management unit level. The Multi Source National Forest Inventory (MSNFI) methodology used by NAFORMA was being tested in Tanzania under tropical dry forest conditions for the first time. Efforts to develop NAFORMA further into a regular MSNFI needed to be continued. This is particularly true for regenerating woodlands, which are notoriously difficult to assess using satellite images alone. As a result, the risk of overestimating permanent forest loss is high and this may be one of the reasons why NAFORMA data differs from other forest resources assessments. This uncertainty means that determining the impact of charcoal on deforestation is extremely difficult because many logged forests possess the innate ability to regenerate, as was observed in CHAPOSA. In the absence of more extensive sample plots and ground data it is simply not possible to assess the "real" amount of forest loss, let

alone what the relative contribution of charcoal making to overall forest loss could be. NAFORMA quotes a 30% uncertainty for areas with less than 30 m³/ha, which means that the overestimating forest loss is likely (NAFORMA, 2015).

The annual deforestation rate was recently estimated by the National Carbon Monitoring Centre, as part of calculating Tanzania's Forest Reference Emission Level (FREL) submission to the United Nation Framework Convention for Climate Change (UNFCCC). The deforestation rate was estimated at 469,420 ha/year, a figure which is 25.9% higher than the NAFORMA deforestation estimation. The main drivers of deforestation are establishment of settlement, extraction of wood for energy and expansion of agriculture. The literature around the relative contribution of charcoal making to deforestation and degradation indicates that the relationship is complex and not easily determined. There is an obvious need for more sample plots and ground validation of areas where charcoal is taking place. Only by field assessments can the ability of different forest types in different ecological conditions to regenerate be evaluated.

3.4 Capacity to regulate the charcoal value chain and collect revenues

A large number of documents have reviewed the issue of trade within the forestry sector and the capacity ensure adherence to regulations and to collect revenue. The TRAFFIC Report 2007 is again mentioned here but additional studies include SAVCOR, 2005; MNRT's excellent 2010 report on enhancing revenue collection; TEITI, 2014; and TRAFFIC, 2016, among many others. The issue of revenue collection from charcoal is inextricably linked to governance and political will. The literature shows that revenue leakages exist and are substantial. The literature also shows the introduction of TFS as an executive agency has resulted in real progress, however, challenges remain.

CHAPOSA found that in all three countries, the government was a poor owner of wood resources. Resources assigned to enforcing the policies were always pitifully inadequate. Even the part of management which directly yields income to the treasury was inadequate, and the rules and regulations were overly complicated and opaque. Thus, it was estimated that only about 25% of the fees and licenses were actually collected for the woodfuel sector in Tanzania (CHAPOSA, 2002).

In 2005, the SAVCOR consulting company was commissioned on behalf of MNRT to undertake an audit of the performance and redesign of the revenue collection system of the Forestry and Beekeeping Division (SAVCOR, 2005). The authors reported that despite having a broad revenue base, revenue collection system and remarkable improvement in collection since 1997/98, the overall collection of revenues in forestry were still low. It was less than 30 % of the estimated potential for collection, showing that the system is neither efficient nor effective due to the following:

- (i) Low investment in terms of human and material resources on revenue collection.
- (ii) Licensing and supervision body (Local Government Authorities) is not answerable to FBD.
- (iii) Lack of a clear mechanism for sharing of accrued revenue to the districts from the royalty they collect from central government forest reserves on behalf of FBD.
- (iv) However, some districts charge cess amounting to 100% of royalty. This is a burden to the customer.
- (v) Licensing officers being too far from the reserves.
- (vi) Too much documentation, traveling and too many hands on the same product.
- (vii) Forest produce dealers scattered in a wide geographical area makes inspection expensive.
- (viii) Lack of effective monitoring.

- (ix) Low level of integrity among some of the staff responsible for issuing licenses, transit passes and manning the checkpoints.
- (x) Inadequate capacity.

The study found that the revenue collection system on charcoal was not functioning properly. There was too much evasion. Because production was scattered it was difficult to control. A transport-based fee system was recommended instead (SAVCOR, 2005).

The 2007 TRAFFIC report, although focussed on timber from southern Tanzania, found that the under-collection of forestry royalties affected charcoal as well and was a serious fiscal challenge to all levels of government. Revenue lost by central and district governments due to the under-collection of royalties reached up to 96% of the total amount of potential revenue due. At central government level, it was estimated that losses of revenue amounted to USD 58 million annually due to the under-collection of natural forest royalties in the districts. The TRAFFIC report authors reiterated that previous studies conducted in different parts of the country revealed similarly low figures for tax compliance for forestry products, ranging from 0.83% for timber, charcoal and fuel wood in Tabora, to 6% and 18% for charcoal in Mtwara and Tanga respectively (Kobb, 1999 ; Kobb and Koppers, 1999 cited in TRAFFIC, 2007). The quantities of charcoal and furniture traded from southern Tanzania, especially Rufiji District, increased markedly following greater restrictions on round and sawn wood.

Under a contract with the Tanzania Natural Resources Foundation (TNRF), on behalf of the Tanzania Forestry Working Group (TFWG), consultants were recruited to investigate what an Independent Monitoring of Forest Law Enforcement and Governance (IM-FLEG) process might look like in Tanzania (TNRF, 2009). The consultants used field visits, Key informants interviews (KIs), literature review, and consultations to conduct the study. The consultants also conducted field work and data collection in Dar es Salaam, Mwanza, Tabora, Itigi in Singida Region, 3 Regions in southern Tanzania and Zanzibar, during two field missions in March and July 2009.

The consultants found that since the publication of the TRAFFIC report, substantial reforms had been made within the Forestry and Beekeeping Division. There had been a strengthening of management responsibilities with regards to forest law enforcement; surveillance and monitoring of forest harvesting and trade; and revenue collection. Several Forest Surveillance Units (FSUs) had been established, in total of seven terrestrial zones and an additional marine unit existed in 2009. Data provided by FBD indicated that captured forest products, predominantly timber and charcoal, had increased with the establishment of the FSUs before declining again. Despite the positive results, the Forest Surveillance Units (FSUs) remained resource constrained.

The consultants found that there was a sufficient amount of adherence to regulations on licenses and permits to allow Tanzania to participate in an Independent Monitoring process. They recommended that a cross-sectoral committee be established that could guide the establishment of an IM-FLEG system in Tanzania. The consultants recommended that the process begin with timber from government forest reserves but that it should later be developed to include charcoal and PFM areas as well.

In 2010, MNRT established a task force with the objective of providing recommendations towards improved revenue collection in the MNRT and widening and enhancing its revenue resource base (MNRT, 2010a). This task force had access to official documents such as permits and licenses, which were analysed. In addition field visits to checkpoints and field stations were conducted and KIIs and FGDs were also utilized. The task force found that revenue collection had been increasing for the previous 5 year period. They also found that FBD did not sort their revenue data so that for most years it was not possible to determine from which product, and from which forest area, revenues were being generated. Some sorted data did exist for the year 2006, which showed that of FBD total revenues, about 44% was generated from charcoal and only 4% came from natural forest timber. The remaining revenue was generated mainly from plantations and teak auctions.

The task force concluded that the forestry licensing process was too lengthy and costly. There was too much documentation, travelling between different offices and too many hands on the same product. They also found that some District Authorities charge cess up to 100% of the prescribed royalties. Because overcharging encouraged evasion of paying royalties and other fees the division found that it was losing revenue.

Specifically with respect to charcoal, the task force concluded that the government was losing almost 100% of its revenue from charcoal due to excess weight, which was not charged according to the law. The task force recommended that regulations be reviewed to introduce standard bags that can be packaged to reflect 50 kg of charcoal. The bags would be marked "Charcoal Bag (Tanzania) 50 kg. "(Mfuko wa Mkaa (Tanzania) Kilo 50)". Among other recommendations of the task force were to:

- a. Forest Management Plans for each district should be prepared and approved by the Director of Forestry and Beekeeping before issuing harvesting licenses;
- b. Districts without approved Forest Management Plans should not be allowed to conduct forest harvesting or revenue collection for forest products; and
- c. Step up law enforcement in areas with no harvesting plans.

The work of the MNRT revenue collection task force did not end with the production of their report. Development Partner funds were later solicited in order to implement a consultancy exercise to advise the ministry on the most feasible recommendations and preparation of an action plan on improved revenue collection (MNRT, 2012b)

In 2011, the Tanzania Revenue Authority (TRA) commissioned JUHUDI Development Consultants to undertake a Risk Assessment Study in the Fishery and Forestry Sub-Sectors in order to examine the ways in which the sectors could increase their contribution to public revenues (JUHUDI, 2011). The consultants determined that because of the large proportions

of charcoal consumed in urban centres, annual revenue collection figures from charcoal were high. Revenue from the sale of charcoal constituted about 44% of total revenues collected (MNRT 2010). The study authors concluded that much of the forestry sector was controlled by some 2,000 to 2,500 wholesalers and investors who were financing and coordinating the charcoal and artisanal timber trades. Although these businesses had substantial turnover, up to TZS 500 million each, few of them were registered for tax. This group represented as much as 60% of the tax potential in the sector. The consultants also found that MNRT's system of unit royalties on produce (e.g. per bag of charcoal) backed by checkpoints at key junctions, provided a simple but effective means for raising revenue from the forestry sector. However, they concluded that strengthening the system offered significant revenue potential. There was a case for reviewing royalties, in particular, the possibility of introducing auctions for the allocation of 'area fee' concessions. The consultants also recommended that MNRT, alongside local governments, should tax charcoal bags during transport by using pre-printed bags with a mark to identify the zone of production and a date-deadline-stamp.

In February 2009, Tanzania joined the Extractive Industries Transparency Initiative (EITI) to improve transparency and accountability in the extractive sector. The Tanzania Extractive Industries Transparency Initiative (TEITI), is led by a sixteen-member Multi-Stakeholder Group (MSG) consisting of an independent chairperson and five members each from the government, extractive companies, and civil society organizations. In 2014, the Multi-stakeholder Group authorized the preparation of a scoping study on the forestry sector in Tanzania. The scoping study was designed to assist the MSG in assessing the possibility of including forestry in TEITI implementation in Tanzania (TEITI, 2014).

The consultants found that there were several thousands of forestry enterprises in Tanzania. The overwhelming majority of which were small and unregistered. Many of these small enterprises were operating either at the harvesting level or in the burning, and retail of charcoal. Another interesting observation was made that charcoal royalties in the Southern

Zone generated only 10% of total revenues but the volume of charcoal that generated these revenues represented more than 80% of the trees harvested (TEITI, 2014). This example illustrated a failure in the royalty system, where charcoal traders were subsidized by a low royalty rate that did not recognize the real cost of charcoal to the economy and the environment. A recommendation to move to a forestry wide auction and tender system, with corresponding high levels of transparency and accountability, was resisted by the many small and medium sized enterprises (SMEs) in the industry. SMEs in forestry were fearful that a move to an auction system would result in larger forestry companies being able to outbid them for forest resources that were becoming increasingly scarce.

The TEITI consultants also calculated that based on the World Bank, 2009, study of charcoal dynamics, the revenue due from charcoal should have resulted in revenues of TZS 160 billion/year. The TZS 70 billion that was collected by TFS from all revenue sources in 2013/2014 represents only 43% of the potential charcoal revenues. Based on the analysis and observations, the scoping study drew the following key conclusions:

- (i) Data on production, exports and payments for forestry exist, although very fragmented;
- (ii) The forestry sector is a key pillar of the Tanzanian economy, contributing 4% of the GDP;
- (iii) Capacity-building, particularly in data management and storage at TFS, is very crucial to the management and the sustainability of the sector;
- (iv) Coordination among key government agencies responsible for law enforcement and revenue collection from the forestry sector is lacking;
- (v) The sector will benefit from improved governance, and the EITI will add value, as it will help increase transparency around revenues to the government;

- (vi) Stakeholders from the government, industry and civil society supported the inclusion of forestry in EITI implementation in Tanzania.

In 2008, the Tanzania Forest Working Group (TFWG) launched the pilot phase of the Mama Mitsu Campaign (MMC) in response to the 2007 TRAFFIC report. The MMC developed into a five-year (2011-2016) communications campaign aimed at improving governance in the forestry sector. In 2015, MMC commissioned consultants with the overall objective of following up the status of implementation of the 2007 TRAFFIC report's recommendations on forestry trade (TRAFFIC, 2016).

The TRAFFIC follow up study found that forestry authorities had made commendable improvements, including the establishment of TFS in 2010. Reporting was standardized, lines of reporting were streamlined. Despite the improvements there was still a lack of scrutinized and analysed data on the volumes and species of traded produce by senior officers of TFS. It was difficult to obtain information on how much product contributed to overall revenues, and neither was it known how much revenue was contributed by natural forest reserves, general land natural forests and plantation forests. Even the relative share of charcoal, natural forest timber and plantation timber to revenue was not known. The information was available from ERV receipts and harvesting licenses issued at the district level but compliance to reporting schedules was not universally adhered to. Most worryingly was the fact that harvesting continued to take place in the absence of management and harvesting plans that were based on Annual Allowable Cut calculations.

The TRAFFIC follow up consultants discovered that despite conceding that IM-FLEG could be beneficial to Tanzania, in 2009 and again in 2015, MNRT responded that the time was not right for it to be introduced in Tanzania. It was also discovered that patrol boats were no longer sea worthy, and sea routes had been left to smugglers.

3.5 Governance challenges in the charcoal sub sector

Governance challenges have plagued the forest sector for many years. Because charcoal is produced overwhelmingly from forest resources, this means that those governance challenges also affect the charcoal sub sector. The most in depth investigation of the governance weaknesses in Tanzania's charcoal sub sector remains the World Bank's report on the Political Economy of the charcoal sub sector, 2009. However, the other landmark report on governance weaknesses in the forestry sector, namely TRAFFIC (2007), remains very relevant and continues to impact on the charcoal sub-sector. A study supported by TNRF (2009), to investigate Independent Forest Monitoring in Tanzania, also contains relevant information on governance and power relationships within the forestry sector and their impact on trade in charcoal. This report is one of the few that has attempted to include a look at the trade in forest products between the mainland and Zanzibar.

These 3 documents have already been referred in the sections above and will not be reviewed again here. It is sufficient to accept that shortfalls in governance are implicated in almost every document as being at the heart of the revenue collection weaknesses and the inability to better regulate the trade in forest produce, including charcoal. In the following section, the numerous recommendations that have been made throughout the years since the publication of CHAPOSA will be listed. It will be obvious that many of the recommendations have not been implemented.

3.6 Some Insights from the Biomass Energy Strategy

According to Tanzania Biomass Energy Strategy (BEST) the objective was to ensure that Tanzania and its people benefit from sustainable biomass energy management and utilization for sustainable development. This could be achieved through development of the policy and institutional framework; improve sustainability of biomass energy supply and efficient biomass energy utilisation; make available commercially competitive, non-subsidised biomass alternatives to wood energy supplies (e.g.,

biomass briquettes and biogas); and make available commercially competitive, non-subsidised non-biomass alternatives to wood energy supplies (e.g., LPG, electricity).

By using a rough assumption of rural firewood consumption (one cubic metre per person, per year), a similar assumption on consumption for the 20% of urban households who consume firewood, indicates that some 6 million rural and urban households (31.4 million people) were supplied with approximately 31.4 million cubic metres of fuel wood (firewood) in 2012 (TACAIDS, 2013, NBS, 2007, 2009, 2013).

Biomass has remained the chief energy resources in the country. Households sector is the leading sector in the biomass consumption mainly for cooking. Wood fuels, is accounting for some 85% of all energy demand. It is a major source of employment in rural and urban Tanzania and one of the most important sources of household revenue. Charcoal and commercial fuel wood are the least expensive energy sources for cooking and heating, relative to all other commercial energy sources.

Almost all charcoal and commercial fuel wood are produced unsustainably, causing considerable forest degradation and localised deforestation, leading to increasing local and national environmental damage, and reducing the country's ability to adapt to climate change.

BEST points out that there is great potential to put biomass energy on a sustainable footing. This will require giving biomass energy much more attention at a national and local level, developing and coordinating policy, and building up national and local capacity to manage the sector. Improving demand side management, energy efficiency and the development of alternative fuels is important particularly in the area of improved cook stoves (ICS) in households, household enterprises, and in commercial and institutional establishments using wood fuels. Additionally, attention needs to be paid to alternative sources of energy, including biomass alternatives such as briquettes and biogas. Non-biomass alternatives, such as electricity, LPG and kerosene, need to be

revisited with a view of searching for opportunities to support them without direct subsidies in order to reduce forestry biomass energy demand.

Stakeholders must be systematically engaged in all aspects of the biomass energy value chain (Figure 1). This requires review of policies and activities of Government and other stakeholders to determine ways to mainstream, organise, commercialise, coordinate and put in place support for actions to make biomass energy sustainable.

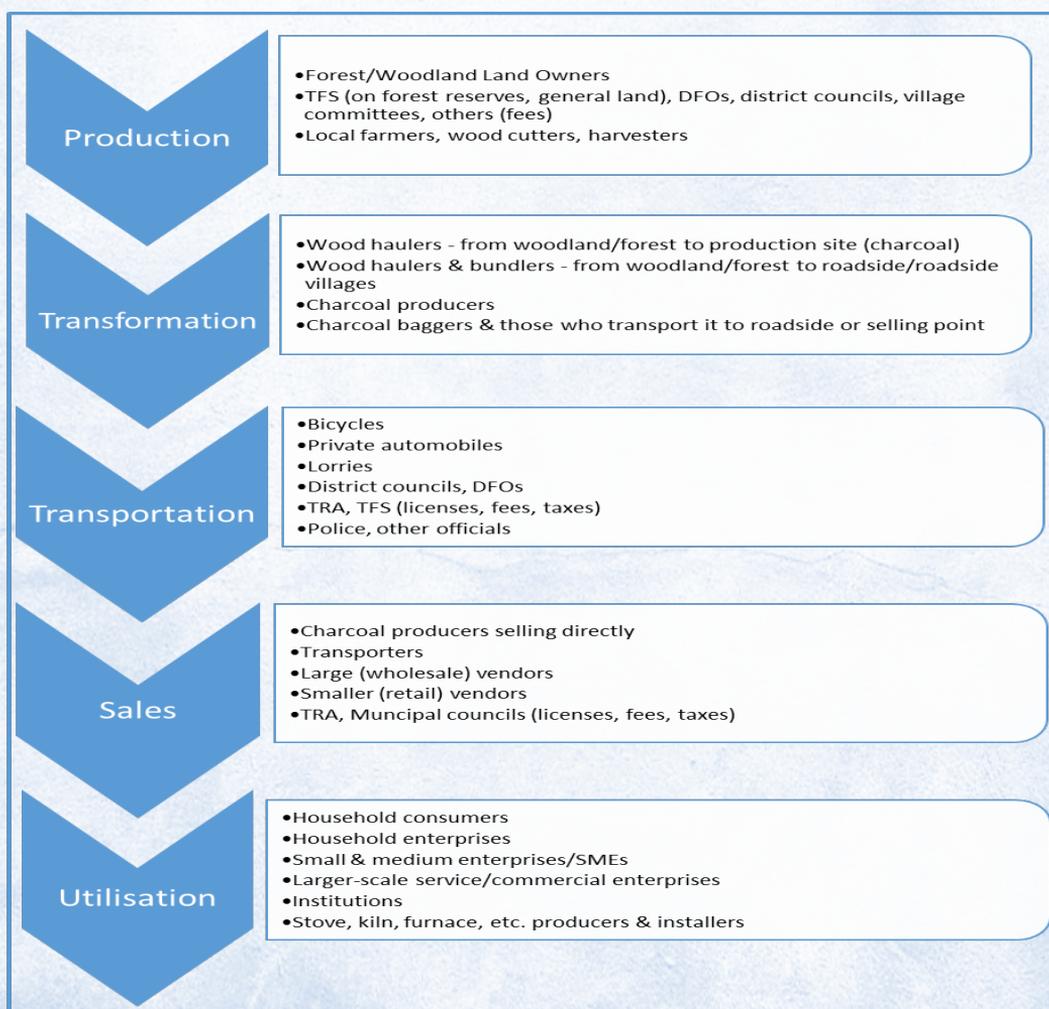


Figure 1: Commercial Charcoal & Wood Energy Supply & Value Chain (Source: BEST, 2014)

A baseline scenario and a set of three alternative scenarios are proposed (BEST, 2014): The alternative scenarios are based upon potential interventions (actions) that could relatively easily be made in the energy sector which would have fairly substantial impacts on reducing wood energy, particularly charcoal, demand, relatively quickly and at a relatively low cost both to consumers and to the country. These Include:

- (i) Business as Usual (BAU); and,
- (ii) Concerted Actions (CA), which focus on:
 - Improved Cook Stoves (ICS);
 - Alternative Biomass Energy Sources; and,
 - Alternative Non-Biomass Energy Sources.

Their primary focus is to examine the effects of actions (or no actions) on the short-, medium- and long-term prospects for wood energy (charcoal and fuel wood), and other biomass (i.e. biogas and biomass briquette) if actions are taken. The non-BAU scenarios provide one demand-side, energy efficiency option (a major programme for introducing improved cook stoves/ICS) and two supply-side options.

Draft Biomass Energy Strategy estimated that the number of people using charcoal (both urban and rural) nearly doubles from 2012 to 2030 under the BAU scenario, with charcoal rising as a percentage of total household consumption from approximately a quarter of all households today to nearly 30% in 2030. In absolute terms, this implies that, under the BAU scenario, household charcoal consumption will increase from just under 2 million tonnes in 2012 to nearly 4 million per year in 2030. Improved charcoal cook stoves are viewed as a key area for action to reduce charcoal energy demand in one of the quickest, least expensive ways.

Producing charcoal sustainably will easily double the consumer price for charcoal. Therefore, ICS with 50% efficiency improvements over traditional charcoal stoves are not only possible, but, have been shown

to be successful in reducing urban charcoal demand in a number of countries (e.g., Kenya, Ethiopia, Malawi, and Cambodia, among others).

Programme that seeks to achieve a 50% stove efficiency with 50% urban penetration (i.e. 50% of all urban households using ICS) by 2030 would actually reduce the total amount of household charcoal use from approximately 2 million tonnes today to less than 2 million tonnes in 2030. Experience in other countries show that this can be relatively easily achieved through government policy and promotion, development partner support, and, most fundamentally, significantly increased local production of high efficiency stoves at prices that all consumers can afford.

This scenario protects consumers from increasing prices of charcoal, while reducing consumption, with few negative distributional (rich-poor) or foreign exchange implications. It is for this reason that promoting a major commercial campaign for improved charcoal cook stoves is such a high priority in the BEST Tanzania Action Plan.

From a Business as Usual perspective, the scenario that shows the most significant effect on reducing wood energy consumption, specifically charcoal consumption, is the ICS scenario. It would take longer than a rapid increase in kerosene use, but, it would not require any major imports or any subsidies.

It will, however, require a major coordinated effort with significant public awareness raising, and a dramatically improved commercial perspective - i.e. commercially-led, rather than government, donor or NGO led as has been the case for most of the past 35 years.

3.7 Barriers to Alternative Energy Switching in the Country

In this report alternative energy for heating and cooking, is considered to be those energies with high energy density, high combustion efficiency and high heat-transfer efficiency with sufficient heat control

characteristics as compared to traditional ones (charcoal and firewood). These alternative energies can be categorized into biomass and non-biomass based fuels. For example, briquettes, biogas, ethanol, electricity, LPG etc. Transition to these alternative energies have huge potential of reducing charcoal consumption thereby resolving many of environmental and socio-economic negative impacts related charcoal production and use particularly emission of dangerous gases and degradation of forests resources.

From gender perspectives, alternative energies are means to liberate women and girls from drudgery associated with collection and use of inefficient cooking fuels and technologies because they are traditionally responsible for households cooking. By adopting alternative energies, they will be saving time, provided with new employment opportunities, improving health and socio economic wellbeing.

Despite the many advantages that alternative energies have over traditional fuels their use remain limited in Tanzania. The subsequent sections explain the status quo of some of these alternative energy options and related barrier for large scale adoption.

3.7.1 Biomass based alternative energy options

3.7.1.1 Briquettes

Biomass briquettes are compacted combustible material that are produced from biomass residue or charcoal dust, usually using a binder such as clay, starch (cassava flour, sweet potato paste, etc.), molasses and/or gum Arabic. The biomass raw materials can be compressed in its raw form or pyrolysed (charred or carbonised) which makes it comparable to charcoal. Biomass briquettes may reduce pressures on Tanzania's forestry resources and the current demand for unsustainable charcoal production. BEST document projected reduction of up to 5% forest charcoal by 2030 if scaling up production and sale of briquette continuous.

There are two main types of briquettes namely: carbonized and un-carbonized briquettes (palettes). Carbonized briquettes are made from biomass sources that have been processed through partial pyrolysis (which drives off volatile compounds and moisture leaving a higher concentration of carbon per unit). Hereafter, they are mixed with a binder, cast into appropriate shapes through pressing and finally dried.

Uncarbonised briquettes are processed directly from biomass sources through various casting and pressing processes, which is also known as solidification.

The biomass briquetting activities in Tanzania go way back to 1980s when CAMARTEC in Arusha tested several technologies and some have developed over time. Currently, as stated in BEST there are several enterprises emerged in the past thirty years without sufficient understanding of the markets, the costs, access to raw materials, the proper technologies and without commercial aspects. BEST also indicates that there are only few enterprises which have some success and mostly for niche markets such as supermarkets for high income consumers.

REA reports to have supported some briquetting initiatives in Shinyanga, Singida and Chalinze especially women but no further details could be obtained. Also during the Charcoal Task Force mission, a visit was made to a small company in Morogoro town producing briquettes from rice husks which are plenty available in the region. The equipment used for the briquetting is from Japan and the mission was told that the owner invested in total TZS 70 to 100 million (USD 30,000 - 45,000). There was a large stock of briquettes stored in a container on the site and more in Dar es Salaam, the mission was informed. There is a problem with marketing the briquettes which are not a replacement for charcoal as they are more difficult to ignite and also do smoke. This can be reduced with special stoves. However, non-carbonized rice briquettes are probably more suitable for large users using firewood such as school canteens, prisons etc.

The mission was informed further that a similar Japanese machine has been installed in Mbeya by SIDO. Normally these types of extruders are placed next to rice mills to minimize transport costs. And more market research is needed to find potential customers or introduce special cook stoves such as the fan assisted types which can burn rice husks briquettes without smoke development. The task force also visited TaTEDO who are producing briquettes though in small and informed that has started mechanizing production of briquettes from rice husks, saw mill waste and maize husks and opened a production centre in Mlandizi.

Barriers to larger scale briquettes production and use:

Currently, production and use of briquettes in Tanzania is currently at a low scale (EEP, 2013). The study reports by Mwampamba *et al.*, 2012; CAMCO, 2014 mention several factors limiting larger scale production and use of briquettes to include:

- (i) Prevailing low prices of wood charcoal, which make briquettes uncompetitive.
- (ii) Technological challenges: Weak or absent technological capacity to fabricate densification equipment in the country. Dependency on importation of equipment and spare parts along with lack of in-house technicians to service the equipment. All this make importation start-up costs for briquetting high and unattainable for most entrepreneurs especially for women who traditionally have less access to and control over key resources especially finance. This technological problem extends to the lack of appropriate stoves for burning of briquettes and exclusively affects women more than men.
- (iii) Production bottlenecks e.g. seasonal availability of raw materials and space for drying in all weather.
- (iv) Fuel handling habits such as shaking or poking the charcoal to improve aeration or using water to extinguish the fire are inappropriate for briquettes, which tend to disintegrate when

handled this way. If users (wife, girls, maids) are not aware of appropriate handling (either through demonstrations, instructions from retailers or information on the packaging), this can be a discouraging experience for a first-time user.

- (v) Absence of in-depth and thorough market analyses in the region lead to inadequate knowledge and understanding to the producer on what consumers (household and industry) are seeking in terms of energy requirements, whether existing needs are met by other fuel types, and what may be the appropriate entry point for briquettes into the market.
- (vi) Punitive legal and fiscal requirements for briquette producers, and; supply-driven (versus market-led) approaches to industry development. BEST states that formal organised briquette producers will have to pay local fees and licenses which put them at a disadvantage to the unsustainable charcoal producers, who manage to escape most licenses, taxes and fees.

To conclude this section, policy, technological, technical know-how and marketing interventions to address these barriers and stimulate more widespread production and use of charcoal briquettes have to be well established. This may also require a systematic analysis of gender roles and benefits along the entire briquettes production and use value chain in order to ensure the social and economic benefits are equally distributed to the beneficiaries who women and men. BEST concludes that without subsidies and subventions (e.g., donor funds, government subsidies, etc.) the briquetting industry is uncompetitive in the free charcoal market. Concerted efforts are therefore required to promote production of briquettes with acceptable quality standards by TBS in areas with suitable conditions. Impact of briquettes as sources of energy for cooking will depend on volumes produced to reduce the average annual charcoal consumption of 2,333,743 tonnes.

3.7.1.2 Biogas

Tanzania has over 44 million cattle that could contribute to biogas production to intensify availability of clean energy to the community and contribute to attainment of the Sustainable Development Goals. The *technical potential for domestic biogas*, based on the available substrate (manure) is estimated at 165,000 installations in a 10-year time frame.

Domestic biogas installations provide benefits in the fields of energy, agriculture, health, environment, natural resource, sanitation, education, and environment for enhancing improvement of community livelihood and poverty eradication. The biogas technology provides farming families with clean fuel for cooking. The bio-digester produces fertile organic remains (slurry) that can be used as fertilizer on the farm especially for horticulture and women are found to be among the main beneficiaries. The digesters save fuel costs and reduce the workload of collecting firewood, directly alleviating women and girls drudgery, contribute to reduction of deforestation and the gas can also be used for lighting. Nonetheless biogas provides a sustainable opportunity for individual households with livestock especially in peri-urban areas to reduce dependency on firewood and fossil fuels and benefit from modern and clean energy as well as a potential organic fertilizer. Consequently, socio-economic living conditions, employment rates and environmental sustainability are considerably boosted, while reducing emissions and contributing to mitigation of climate change. Most parts of Tanzania have good characteristics desired for effective construction of biogas digesters

Accurate data on existing and functional biogas digesters in Tanzania are not available. NBS and REA 2016 report indicates that contribution of biogas to the overall cooking energy in Tanzania is insignificant. However, at national level, the impact of biogas could be low, but at local level the impact of biogas is high hence the need for concerted efforts to intensify biogas production and utilization (MEM, 2015).

Key institutions supporting the promotion and use of biogas digesters as alternative cooking energy include: Tanzania Domestic Biogas Programme (TDBP), CAMARTEC, MIGESADO, TaTEDO, REA, SNV, Evangelical Lutheran Church of Tanzania (Arusha), the Ministry of Water, Ministry of Energy, Ministry of Fisheries and Livestock Development, Ministry of Agriculture and Vice President's Office Department of Environment. Support provided includes the dissemination of biogas technologies, training, building of demonstration plants, monitoring and evaluation.

Barriers:

Studies which have assessed the opportunities and challenges of promoting biogas in Tanzania identify several issues requiring in-depth assessment and strategic interventions to enable larger scale adoption (Wawa and Mwakalila, 2017; ESRF, 2015). Such factors include:

- (i) Inadequate data/information on existing biogas sub sector and especially those disaggregated by gender. Currently, it is not possible for instance to understand as how many biogas technicians have been employed in this subsector; and how many plants have been installed, functioning or not functioning.
- (ii) Public awareness and knowledge on biogas potentials, access to credit and subsidies, access to technical support,
- (iii) High initial investment costs.
- (iv) From adopters perceptions, unreliable technical services lead to poor performance of biogas plants which in turn discourage both biogas users in continual use of the technology also discourage potential adopters to adopt the technology.
- (v) Others include: inefficiency of existing biogas plants, unavailable feed stocks, not given a priority by the Government, water availability problems and availability of firewood as a competing source.

3.7.1.3 Ethanol

BEST discusses liquid biofuels but the focus seems to have been on biofuel to, partially, replace imported petroleum fuels. Ministry of Energy (MoE) by then Ministry of Energy and Mineral (MEM) established the National Biofuels Taskforce (NBTF) in March 2006 to formulate and propose an enabling environment to facilitate the development (promotion and utilization) of biofuels in Tanzania. However, the production of biofuels and in particular of the much hyped jatropha failed to take off in Tanzania and anywhere else in the world. Bioethanol was the other option to blend with petroleum as is practiced in Brasil, USA and other countries. But also, this fuel has not made much progress.

Ethanol has been promoted as a cooking fuel in a number of countries. Malawi had a programme many years ago but this seems to have faltered.

UNIDO has developed a proposal "Promotion of Ethanol as Alternative Clean Fuel for Cooking" in collaboration with the VPO- Department of Environment. The project was piloted in Zanzibar where 150 stoves were distributed among interested households and were used for a period of 6 weeks. The product was well received in Zanzibar and it was decided to upscale the experience to Dar es Salaam and target 500,000 households there over a period of 5 years. The price of the fuel will be regulated and set at TZS 1600 per litre. The UNIDO proposal focuses mainly in the production and distribution of the ethanol stoves which costs about \$50 for a two-burner model. By establishing local production capacity and providing a subsidy per stove it is expected that household will adapt ethanol.

Barriers:

The proposal set a demand of 90m litres of ethanol per year needed and this will come from various sources. The sugar cane factories are claimed to have a potential of 22m litre per year which leaves large gap of 70 m litres and this was expected to be filled by mini distilleries using materials such as cassava and by-products of the cashew nuts. The supply

of ethanol fuel is an area that needs much more attention as this not very well elaborated in the proposal in terms of technical options, capital needed and from which sources.

3.7.2 Electricity

Access to electricity can be defined in terms of “connections to the grid” or in terms of “proximity to the grid. The Sustainable Energy For All (SE4ALL) uses connections (or equivalent when dealing with Solar Home Systems (SHS), distributed power or non-metered mini-grids) and is consistent with the Global Tracking Framework (GTF). The NBS and REA report (2016) on Energy Access Situation in Tanzania Mainland, shows that proportion of the population with access to electricity to have raise from 36% in 2012 (MEM, 2015), to 67.5% in 2016 (NBS, 2016). Likewise, there has been a significant increase in the percentage of households connected to electricity, to 32% of households in 2016 (NBS and REA 2016), from 20.7% in 2012 (SE4ALL Action Agenda 2015).

However, the increased access to electricity has not resulted in more households using this source of energy for the main cooking needs. For instance, in Dar es Salaam, the share of households connected to the electricity grid increased from 57% to 68% in the period 2001/01 to 2011/12 (Household Budget Survey data) but the share of electricity for cooking has declined by a factor four in Dar es Salaam from 4.8% to 1.2% and below 1% in 2016 (NBS and REA, 2016). BEST suggest that electricity has lost popularity as domestic electricity prices have increased sharply four-fold over the past years.

Barriers to electricity use:

Reliability of supply could be factors that may impact the willingness of households to increase the use of electricity. If a price per kWh drop, which is by no means assured despite the best of Government’s intentions, and reliability, improves more households might include electricity in their energy mix. However, this will also have implications for the national grid as cooking appliances are usually consuming 1000s of watts, far

more than is used for lighting, cooling (apart from Air Conditioners) and Television. That would add significantly to the peak load which determines TANESCO's investment plans for generation and distribution. Those investments can add hundreds of dollars per connection to upgrade the system by increasing wire and transformer capacities plus additional generation from gas, hydro and other sources. This has to be supported by Government of development partner funding. LPG requires much lower investments to deliver energy for cooking (less than \$100 per household) and this is funded through the private sector and households.

The Government can create awareness about more efficient cooking appliances and guide the public in deciding on best options to reduce the overall energy bill for cooking (and for other electrical applications at same time). This can be part of a wider energy efficiency programme for domestic users and small businesses such as small restaurants. TaTEDO is promoting efficient use of electricity cooking that has reduced significantly the electricity cooking bills for the household. The efficient cooking appliances promoted e.g. pressure cooker, insulation stove, and electrical pressure cooker for cooking. The findings from this study showed that it is possible to use electricity 100% by just 20 units of electricity which cost about TZS 18,000 only as compared to cost of charcoal. However, without financial subsidies such appliances are more suited to middle or high income class households as compared to low income class households. Awareness raising and capacity building to disseminate the experience is necessary for high uptake

3.7.3 Solar

Tanzania has enormous potential for solar energy with average monthly insolation ranging from 4.5 to 5.4 kWh/m²/day. Harnessing from this potential has mainly been for lighting and meeting low energy demands e.g. powering entertainment systems (TV and Radio) and charging mobile phones. These has made Tanzania among the countries with larger share of Solar Home Systems (185,000 units in the market by 2016) and pico-solar products.

Solar for cooking has not been able to grow into scale despite introduction of solar parabolic cookers and fireless cookers in the way back 1980s. These technologies required direct sunlight to produce heat energy which is retained for cooking; hence not suitable in a changing weather conditions. Likewise, the efficiency of parabolic and fireless cookers is questionable as they do not produce intense heat that can be generated by fossil-fuels based heat sources.

In recent years there have been efforts to make solar cooking more friendly and reliable through *solar e-cooking* which offer opportunity to use solar PV to charge and store converted energy in battery. This has proven to have big potential of larger scale market penetration. The experts proposition shows that by 2030 the cost involved in solar e-cooking by using battery will be comparable to cooking with charcoal and fuels in developing countries. Some of the issues which might plague solar e-cooking are: capacity bottleneck as the batteries have fixed power storage capacity not suitable for more dynamic usage. Likewise, upfront costs of buying equipment could be higher and unaffordable to many poor people.

3.7.4 Liquefied Petroleum Gas (LPG)

Liquefied Petroleum Gas (LPG) is a petroleum product (mostly butane and propane) and as such not a renewable fuel and is totally imported. LPG has been available in Tanzania for many decades but uptake has been limited. This seems to be changing as shown in the HBS and EWURA data (Figure 2). From 2000/01 to 2011/12 the number of households using LPG as main fuel rose from 0.1% to 0.8% in Tanzania a whole and from 0.4% to 4.8% in Dar es Salaam. In 2016 the proportion of households using LPG grew to 7.2% national wide and 26.7% in Dar Es Salaam (NBS and REA 2016). Even since the last survey, the number of companies selling LPG have increased (Oryx, Mihan, Lakegas, Camden, OilGas, Manji), while selling points have multiplied many times over. However, some of this gas is exported to neighboring countries (Rwanda, Burundi, DR Congo, Malawi and Kenya) and this could be as much as 30 -40% of the import volumes

according to industry sources. Official figures are not available. The data show that since 2011 the import of LPG has increase by more than 3 times

Regarding carbon foot print, the Global Alliance for Clean Cook stoves states in its LPG factsheet “, in contrast to LPG, raw biomass burning typically releases 19 times more emissions per meal”. The GACC does not provide the background on how it arrived at this figure and this deserves further study as this may change from country to country, depending the Non-Renewable Biomass factor.

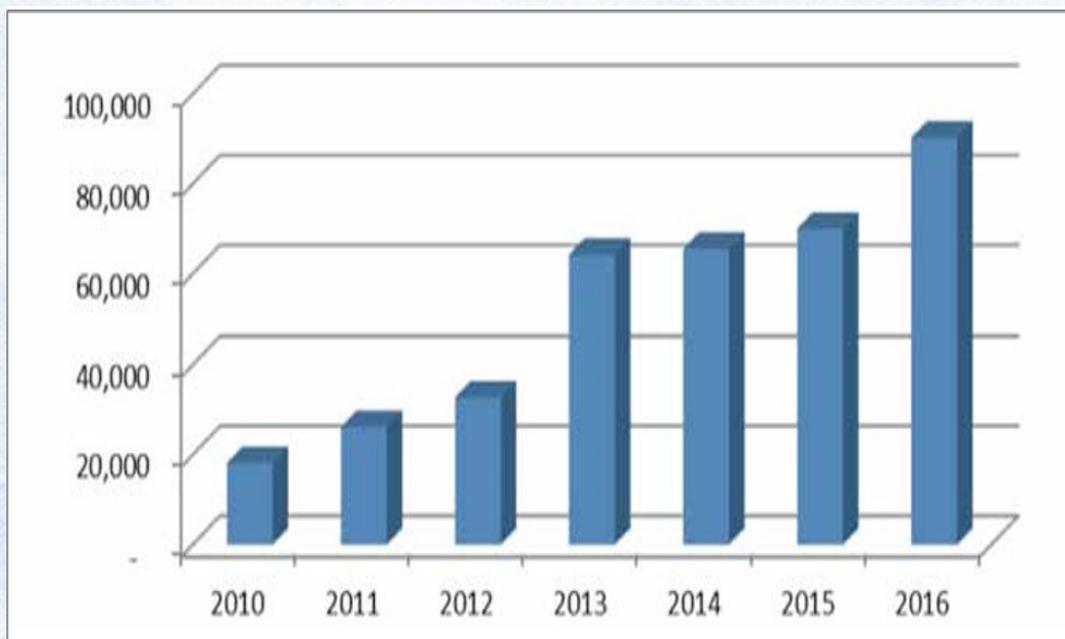


Figure 2: LPG imports/consumption and into Tanzania
(source EWURA 2017)

LPG is sold on the market in cylinders of 3 - 40 Kg. (the smallest type of 3 kg is mainly sold in Mwanza and Zanzibar where fishermen use the gas for light to attract fish at night). New customers pay a deposit for a cylinder (TZS 90,000 for 40 kg, TZS 50,000 for 15 kg, TZS 85,000 for 6 kg including cooker and TZS 65,000 for 3 kg including cooker). This is about

50% of the real value of the equipment; the balance is advanced by the gas company and recovered over time from the gas sales.

The price of gas fill is dynamic vary depending on the world market; usually vary between 48,000 to 56,000 for a 15kg cylinder (in 2018). LPG is subsidized; there are no import duties and VAT on the LPG gas and the cylinders. However, cookers are subjected to the normal import duties. A quick estimate for the cost per year based on annual consumption of 50,000 tonnes (based on import figures listed above minus re-exports) and an estimated average sales price of TZS 3,000/kg, the total sales value can be estimated at TZS 150 billion. If the Government would subsidize the fuel costs with 25%, then the contribution would be TZS 37.5 billion. However, once the market responds and households switch more to gas, the bill for the Government will increase rapidly and ultimately unaffordable. Another factor is that higher income groups benefit most from such subsidies as they are the first users.

Barriers to LPG adoption:

The initial costs of buying a cylinder and cooker is the main challenge for the uptake of LPG. A credit system could help to reduce this problem and this is already happening to some extent. In addition, many lower income groups lack the cash needed to buy a new filling. This is in contrast to charcoal (and kerosene as well) which can be bought in small quantities sufficient for one meal or one day. LPG is difficult to match with the cash flow from poor households. Another barrier is the fear for explosions which stops many families to make the step of buying LPG.

LPG is a capital expensive industry because of the high security standards which raise the costs of storage and handling facilities, tanker, lorries and refill stations. This makes LPG always more expensive than kerosene which is much simpler to store and handle. There is anecdotal evidence of decanting of large 40 kg cylinders into smaller ones because of the price difference per kg. This is a very dangerous practice and can result in serious accidents.

REA has supported the promotion of LPG to small rural towns. A pilot has taken place in Shinyanga and Singida with collaboration with Mihan and Oryx suppliers. Support was given for awareness rising (especially to reduce the fear for explosions) and a contribution given towards the costs of 6 kg cylinder. Suppliers faced high costs to reach such communities which still have access to “free” firewood supplies which is a competing energy source. Support from the Government towards the costs of a refill station (estimated at USD1m) and tanker lorries might help.

3.7.5 Natural Gas for cooking

Tanzania has huge natural gas reserves in Songo Songo and Mtwara/Lindi areas and off shore. The Government (especially MEM) has high expectations from natural gas as source of cooking for households in the medium to long term.

Natural gas has been used for many years to power electricity generation and some industries like the cement factories in Dar es Salaam are already connected via gas pipelines. The Government has invested in a new 500 km pipeline to increase the quantity of gas transported from Mtwara in the south to Dar es Salaam and this will open opportunities for natural gas as a source of cooking energy. SE4ALL refers to feasibility studies by TPDC to connect 30,000 households in Dar es Salaam and 3,500 in Mtwara/Lindi region. The Tanzania Petroleum Development Corporation (TPDC) has already connected a housing compound in Mikocheni area to the gas distribution grid as a pilot. There are no estimated costs of infrastructure from TPDC or other sources but these are likely to be very high, well above water distribution networks because of the high safety standards. TPDC has announced plans to build 25 new natural gas stations to support the transport sector. A \$65 million project, initiated by the government, aims to power 8,000 cars in Dar es Salaam, the capital city and commercial hub and supply 30,000 households with Compressed Natural Gas (CNG) for cooking . (Assuming that 50% of the USD 65m investment is needed for supplying the households, the costs would be about \$1000 per connection).

LNG and CNG are often compared to LPG. However, these products are very different. LNG is Liquefied Natural Gas and this needs to be stored at temperatures of minus 162° C, which makes the product very expensive, dangerous and beyond the reach of common households. CNG has gained popularity in some countries for fueling vehicles. It is stored as a gas under a pressure of 200 - 250 bar as compared to LPG which is stored at around 10 bar only. This technology can be adapted to household use but the main bottleneck will be the storage and handling of the special cylinders which are going to be heavy and costly. Also, safety standards will be higher than for LPG because of the extreme pressures.

Natural gas is being produced from Songo Songo and Mnazi Bay gas fields which are located onshore in Lindi and Mtwara regions respectively. Other discoveries located onshore and offshore are at various stages of development to establish economic viability. From 2010 to 2015, exploration efforts in the deep offshore basins resulted in discoveries of large quantities of natural gas. The discoveries have increased the total estimated Gas Initially in Place (GIIP) in Tanzania basins from 8 TCF in 2005 to 55.08 TCF which is equivalent to 9.91 billion barrels of oil by March 2015. The Government shall also promote extraction of unconventional natural gas including coal bed methane and shale gas in an environmental friendly manner. Despite explorations efforts, no oil had been discovered in the country so far the demand for petroleum products has been growing at an average rate of 15 percent per annum. In 2014, the total consumption of petroleum products was about 2.9 billion litres. Use of natural gas for domestic household cooking is at infancy stage hence not expected to contribute much in reducing consumption of charcoal in the near future (MEM 2016 & 2015).

3.7.6 Improved technologies in production and use of biomass energy

Improved Kiln technologies

Currently, charcoal earth kilns with average recovery of 15% on weight basis are commonly used in Tanzania. This means that around 10 kg of wood is used to produce 1.5 kg of charcoal. Field experience has shown that the efficiency of the earth kiln could be increased to 25% through introduction of a chimney that will facilitate carbonization process of the charcoal. Improved Basic earthmound kiln (promoted by TaTEDO) with around 25% efficiency is the most popular improved earth kiln used in East Africa (UNDP, 2012). With 10 kg of wood a producer can get 2.5 kg of charcoal by using the improved basic earth mound kilns. Concerted efforts are therefore required to intensify charcoal producers awareness on the economic and environmental value of using the improved basic earth mound kilns (TaTEDO, 2017, World Bank, 2011 & 2009).

However it should be noted that charcoal production technologies with recovery rate of beyond 25% exist namely: half orange brick kilns, metal kilns and retorts (TaTEDO, 2014). The main challenge of this type of kilns is that wood has to be transported to a central area that could be a constraint to the small scale charcoal producers in Tanzania.

Programmes to introduce improved charcoal production technologies in Tanzania were started in early 1970s but with little success. A pilot programme was implemented by the Ministry of Energy with funding from the World Bank (1988 to 1992). The efforts were continued by TaTEDO who have implemented a number of programmes with support from different development partners including, EU, Hivos, NORAD and UNDP and now working in collaboration with TFCG and MJUMITA supported by the Swiss Development Agency.

Unfortunately wood used for charcoal production from the existing forest reserves is regarded as a free commodity by the majority of charcoal producers; as a result the producers have shown little interest in adopting

improved charcoal production technologies. This is mainly due to low enforcement of forest rules and regulations. The proposed increase of forest manpower if implemented could enable foresters to manage forests on sustainable basis.

By using traditional earth kilns with 15% efficiency, the average annual consumption of charcoal of 2,333,743 tonnes were produced by using 15,558,287 tonnes of wood equivalent to 22,226,124 m³ (at 70% density - one tonne of wood is about 700 kg) which was obtained by clearing an equivalent of 444,522 ha of natural forests with a standing wood volume of 50m³ per ha.

By using improved basic earth mound kilns with 25% efficiency the average annual consumption of charcoal of 2,333,743 tonnes could be produced by using of 9,334,972 tonnes of wood equivalent to 13,335,674 m³ (at 70% density) which could be obtained from clearing an equivalent of 266,713 ha of natural forests with a standing wood volume of 50m³ per ha. Use of improved charcoal kilns with 25% efficiency could reduce annual deforestation by 177,809 ha

Extension services on existing improved charcoal production technologies and benefits to be accrued by the community for adopting the improved technologies should be intensified. After effective extension services the use of the in-efficient charcoal production technologies should be prohibited and enforced by village government by-laws through community participation.

Improved Cook stoves:

Improved Cook Stoves (ICS) have been developed, studied, promoted and commercialized in Tanzania since the 1980s to address major environmental problems, specifically forest degradation and deforestation resulting from increasing wood energy use. In spite of those efforts still, inefficient charcoal stoves are widely used in Tanzania. Most rural and low income urban and peri-urban households use the low quality charcoal stoves with energy efficiency of less than 15% (Ishengoma, 2015).

Institutions, such as secondary schools, canteens and restaurants fair no better, often using cooking devices that are substandard.

Adoption of improved cook stoves as an efficient cooking technology could reduce current charcoal consumption by 40% to 50%. By using an average of 15% efficiency of biomass cook stoves, Tanzania is annually consuming 62.3 million m³ of wood for cooking. If improved cook stoves with 25% efficiency will be adopted, the annual consumption of biomass fuels will be 37.4 million m³ instead of the 62.3 million m³. The improved stoves will provide an annual saving of 24.9 million m³. In addition to that, successful development and use of improved cook stoves (ICS) could create thousands of "green jobs", improve community health, create a source of income for the government and could make households cleaner and safer for families. In broad perspective improved Cook Stoves are intended to facilitate clean cooking practices that address environmental and health impacts. However, ICS should not only improve indoor air pollution and reduce deforestation but it must also meet the basic needs of the users taking into account convenience, availability, affordability, acceptability, durability, easy to use and opportunities of producing the stoves locally to provide income and employment to the local community. Also a variety of clean cooking stoves have to be promoted and disseminated to meet consumers' demand as there can never be one improved cooking stove type which will be liked by all households and institutions (Rajabu and Ndilanha, 2013).

Development and promotion of improved cook stoves and fuels in Tanzania has been conducted mainly by the NGOs with TaTEDO at the forefront and some private sector initiatives (e.g. Imported ICS by Envirofit).

Barriers:

Inadequate availability of data on the extent and national coverage on production and use of improved cook stoves is not available (VPO,2016b).

- (i) Development of ICS initiatives in Tanzania lack adequate funding, coordination and certification of quality. As a result, dissemination of poor quality charcoal stoves has created some bad perception and negative impact to ongoing promotion of real improved cook stoves (Rajabu and Ndilanha, 2013).
- (ii) Quality standard for improved cook stoves are not established for both imported ones and those which are locally made.
- (iii) Production of ICS is mostly in informal sector and producers/artisans of improved cook stoves are not registered and assisted to produce desired quality of improved charcoal stoves through periodic training (See example from as explained Sahara ICS manufacturers in Box 1.
- (iv) Gender power relations is also a potential barrier to upgrading to 'better' energy or stoves as it is less likely if the direct beneficiaries of the improvements are limited to low-ranking household members such as women, children or maids. Conversely, households in which cooking responsibilities are transferred to maids are less likely to shift from fire wood to charcoal or from charcoal to other clean and efficient energies because the direct benefits of doing so are felt by a low-ranking (and dispensable) member (Mwampamba *et al.*, 2012)

Box 1: Shara charcoal stove producers in Vingunguti - Dar es Salaam

The Charcoal Task Force Interview with the Chairman Mr. Hamisi Nassor revealed that the group started manufacturing charcoal stoves (Figure 3) with ceramic liners since 1990 under the programme by MoE and later got training support from TaTEDO. Mr. Hamisi said that the group consists of small-scale factories (production points) owned by about 500 artisans but all operating individually and informally. Women constitute 1/3 of the artisan, dominating the clay liner production factories while men are majority in the metal part of stove production. In average production of stoves is around 6200 - 6300 per month. He said we manufacture after receiving orders. Normally after getting orders each start manufacturing different parts of the stove and then we assemble and supply accordingly. The raw materials are rejected iron sheets obtained from the factories (e.g. Kiboko) and scrap metals e.g. tins; iron bars. The unit price per stove range from TZS 2500 to 16,000 depending on size. Our Market is all over the country and we are sometimes exporting to Zimbabwe, Zambia, and Mozambique. He said further that the low business season is between September and October, because they sometimes fail to sell all the stove.

Mentioning the challenges, he said metal sheets are not easily accessible; we face difficulties in purchasing directly from the industries due to long bureaucratic procedures. Instead we are forced to buy rejects form middle men which also lowers the quality of the stove. We would like to get permit to buy directly from the factories with such iron sheets. Another, challenges the lack of durable steel (anvil) as working tool to fold different parts of the stove. Working premises was also mentioned as a big challenge, as currently their production centres are within the residential areas and the area is small. They were promised to be given Vingunguti waste dump area but they learned later that it is now sold to an investor and they don't have more hope. They would like to get a bigger space where they will work without disturbances.



Figure 3: Assembling of improved cookstoves in Vingunguti, Dar es Salaam

3.8 Past Recommendations from Evaluations of the Charcoal Industry

In this section are listed the past recommendations from evaluations of the charcoal industry. Next to each recommendation is the list of references that produced the recommendation.

However, here below is a list of just some of the recommendations that already exist in various reports and documents:

- (i) Auctioning of forest products is more transparent and has become popular in most developing countries including Tanzania. It is recommended that the MNRT review the potential to introduce auctions (MNRT, 2010a; MNRT, 2010b; JUHUDI, 2011; TRAFFIC, 2016; TRAFFIC, 2017)

- (ii) MNRT, alongside local government, should tax charcoal bags during transport. It is suggested that bags are pre-printed with a mark to identify the zone of production and a date-deadline-stamp. Thus, transporters would purchase a bag printed by the TFS with the tax already included (SAVCOR, 2005; MNRT 2010a; MNRT 2010b; JUHUDI, 2012; TRAFFIC, 2016; TRAFFIC 2017);
- (iii) MNRT should consider introducing SMART card and electronic tracking technologies to better track forest products (in real time) (MNRT 2010a; MNRT 2010b; JUHUDI, 2012; TRAFFIC, 2016; TRAFFIC 2017);
- (iv) TRA to make an immediate start on sharing data with MNRT, working to develop a database of all enterprises registered with any one of the agencies. In the longer term, extend this to Local Government (JUHUDI, 2012);
- (v) Promote Community Based Forest Management (CBFM) and Participatory Forest Management (PFM) to empower rural communities and producers to make charcoal production more sustainable and give them a more reliable source of income (CHAPOSA, 2002; TRAFFIC, 2007; WWF, 2007; World Bank, 2009; Kaale, 2015);
- (vi) Raise awareness among consumers, especially women, about more efficient ways of using charcoal (e.g. through improved cook stoves) and promote the use of improved stoves and alternative energy sources (such as LPG or biomass briquettes), for example by increasing their availability or subsidizing their use through a targeted scheme (BEST, 2014);
- (vii) The mandate for TFS broadened to work with local authorities and the private sector to increase PFM, and overall sustainable wood energy production;
- (viii) TFS, MEM and other national agencies work with local authorities to rationalize and simplify biomass energy production and trade to increase local and national revenues (BEST, 2014);

- (ix) Charcoal producers organized commercially, their activities licensed, their wood supplies sourced sustainably and production efficiencies increased (CHAPOSA, 2002);
- (x) Simultaneously, a major, commercially-oriented, improved cook stove programme funded and launched, prioritizing urban households, and commercial and institutional consumers; and
- (xi) Make non-biomass charcoal and commercial fuel wood alternatives, particularly kerosene (LPG and electricity), competitive on a non-subsidized basis (BEST, 2014).

CHAPTER FOUR

MAIN FINDINGS AND DISCUSSION

4.1 Charcoal Production Models and Value Chain

In the context of this study, charcoal production model refers to simplified aggregation of all variables involved in the charcoal value chain. The key variables include; source of raw materials, harvesting practices, production technology, local market, transportation, wholesale, retailers, end uses, governance and its contribution to human welfare. These variables determine sustainability of the model.

Three value chain option models were observed in the area; these are 1) Common value chain; 2) shortened value chain; and 3) Export value chain.

Common value chain: This is the most frequently encountered value chain in the surveyed regions. As presented in Figure 4, all nodes were involved in the charcoal production and trade. However, the charcoal in this chain is traded only within the country.



(a) Most common value chain model



(b) Shortened value chain model



(c) Export value chain model

Figure 4: Value chain models observed in the surveyed regions

Shortened value chain: This was found in some villages, where the target of the producer was to look for external markets in developed towns, municipalities and big cities such as Dar es Salaam and Mwanza. It was reported to be profitable to the producers compared to the common value chain because prices per unit were higher than that of on-site market. The chain was dominant in Masasi, Kilwa, Mkinga and Handeni districts.

Export value chain: Although charcoal export is illegal in Tanzania Mainland (The Export control Act Cap 381) an export value chain exists. Charcoal is traded to outside the country (e.g. Democratic Republic of Congo, Burundi, Kenya, Zanzibar, Oman and Comoro). Charcoal is produced and transported illegally across borders (using trucks and motorbikes) and harbours (using ships, canoe and other vessels). For example, the team observed that most charcoal produced in Mkinga district is traded to Kenya via informal boarder routes. Charcoal produced in some areas in Mtwara region and Pangani and Bagamoyo districts was reported to be traded to Zanzibar through informal harbours (*Bandari bubu*). Tanga Region was reported to have about 180 informal harbours used for trading products including charcoal. Examples of informal harbours in Pangani District, Tanga region were Mkwaja, Stahabu and Kipumbwi. Uniquely charcoal is imported from Zambia through Tunduma border as a result of banning tree felling in Songwe Region. Box 2 illustrates the convenience of charcoal trade from Zanzibar.

Box 2: Charcoal from Mainland to Zanzibar

About 70% of charcoal used in Zanzibar comes from the Mainland. The total amount of charcoal transported to Zanzibar daily is 10,500 bags out of which 7,500 bags enters the island illegally. Most of the charcoal sources to Zanzibar are from regions of Tanga (Pangani District), Pwani (Bagamoyo), Dar es Salaam (Mbweni, Bunju), Lindi and Mtwara. These sources are out of reach of the taxation system making charcoal rather cheap. The distance to Zanzibar is only around 50 km from most of the unofficial ports, transporters charge are very low compared to road transportation to urban areas such as Dar es Salaam or Tanga. This is justified by the means of transport used i.e. by dhows which use no fuel. Charcoal dealers transport charcoal using dhows to Zanzibar because relatively small capital is needed compared to road transport to urban centres in the mainland whereby one is also required to acquire the necessary permits.

Source: WWF (2007)

Explanations of the nodes along the value chains (Figure 4) are provided here below:

4.1.1 Sources of raw material

Three sources of raw materials were encountered in the surveyed regions. These included natural forests, planted trees/woodlots and briquettes from various sources as detailed in the forthcoming paragraphs.

Charcoal from natural forest and woodland: This is the main sources of raw material for charcoal production in all surveyed areas. They are obtained from general lands, village land forest reserves, private lands in villages and reserves in Central and Local Governments. Often the raw materials are sourced illegally from reserves. Clear-felling (land preparation for farming) and selective harvesting are both used. The species used are indeterminate¹. If left unchecked, the sustainability of this approach is very low because of various reasons including inadequate management skills, depletion of resources base, inadequate knowledge of regeneration of raw materials, inefficient technologies, low contribution to welfare, ineffective governance and inadequate enabling environment for sustainable charcoal.

There are limited value additions activities on the resource base. Regarding gender, involvement of women and men in forest management was high in Village Land Forest Reserves (VLFRs) and private woodlots. However, some decisions e.g. harvesting of trees from private woodlots for various use including charcoal was domineering by men.

Charcoal from planted trees/woodlots: In some places raw materials are obtained from planted trees/woodlots. Blackwattle (*Acacia mearnsii*) is the main species used for charcoal production especially in Njombe, Kilolo and Ludewa. This charcoal is now considered to be the main business in these areas and the charcoal is sold in Dar es Salaam and other cities. The quality, weight per unit and burning time are relatively low compared to

1 Non considerate of valuable timber and medicinal species except in areas with on-going interventions

charcoal from natural forests. The rotation age is short (about 6 years) compared to natural woodlots, low management costs and intensity (high seeds proliferation potential) and there are varieties of products that can be harvested before charcoal is produced. However, charcoal from black wattles has created a lot of competition in the markets with charcoal from natural forest because its prices are low and traders are required not to pay royalty (pay Transit Pass, income tax and Cess only). Available knowledge suggests that other species can be used to produce charcoal such as *Eucalyptus* (wide coverage), *Senna siamea* (wide coverage), *Prosopis juliflora* (semi-arid areas e.g. Dodoma and Same), *Acacia* spp (semi-arid) and Bamboo (potential species). Although there is huge potential to produce charcoal from planted trees on sustainable basis, the concept is threatened by limited awareness of the potential, limited knowledge on production efficiency, limited tree planting and tending culture, competitions from illegal charcoal from natural forests, and in some places there is competition from other land uses practices. Low ecological diversity due to mono-cropping is another limitation. Limitations withholding, this production approach has great potential to increase sustainable supply of charcoal in the country.

Briquettes: There are uncarbonised and carbonised briquettes. Uncarbonised briquettes are made by compressing appropriate biomass. The carbonised briquette is made of compressing appropriate biomass and carbonised to charcoal briquette. All these are potential substitutes to charcoal from natural forests and other sources. Most of the briquettes are made using varieties of materials including crop residues, saw dusts, and coal fines. Majority of briquetting process require binding materials such as cassava flour, clay, molasses and others.

The TF encountered briquetting technologies in Tabora, Kilimanjaro, Mufindi (Forest and Wood Industries Training Centre and Sao Hill Industries) and at TaTEDO). Production of briquettes is challenged by availability of binding materials, high operation costs (e.g. use electricity and distance to the sources of raw materials), availability of raw materials, low awareness of potentials, price and quality compared to existing

charcoal. Despite the challenges the numbers of briquette producers have been increasing for the last ten years. To encourage briquetting, TFS charges no royalty for briquette charcoal. Coal briquetting was encountered in Ngaka in Ruvuma Region and in the markets in various areas in Tanzania. However available information has confirmed that coal briquettes have carcinogenic and other health hazards hence jeopardizing its promotion.

4.1.2 Harvesting practices

Major practice of harvesting of trees in most surveyed areas is clear-felling and selective harvesting in the un-intervened natural forests. Harvesting is done without forest management plan and or harvesting plans. Trees are harvested without observing recommended harvesting techniques and considerations including for example harvesting height that favours regeneration. Optimal harvesting height still require more research to inform harvesting techniques for charcoal. Other limitations include many producers harvest without considering regeneration capacity of the trees, harvested places are not managed and therefore frequently encountered by agricultural encroachment, grazing and wild fires causing degradation and deforestation. Harvesting of trees for charcoal in many places is not sustainable in the country.

In few intervened areas where Community Based Forest Management (CBFM) and VLFR are established, deliberate interventions have been introduced to enhance regeneration. Some of these interventions include use of harvesting plans and introduction of coppicing technologies regeneration(e.g. in Kilosa, Bahi and Mpwapwa). In Kilosa in TFCG/TTCS project areas land use plans, forest management plans, harvesting plans and bylaws are used to regulate harvesting. In Bahi and Mpwapwa District about 25% of the villages have land use plans and this has tremendously reduced illegal production of charcoal. In-line with land use plans there is a church programme to train villagers on how to stimulate stump sprouting (*visiki hai*) in those villages. The *visiki hai* programme is being carried out in collaboration with DFO. Examples of such villages are Kongogo village, Ibugule, village.

Harvesting of trees in planted woodlots is frequently done through clear-felling followed by natural seed regeneration that is enhanced by fire (for Blackwattle trees). The TF noted that most of the woodlots had no forest management plans and or harvesting plans. Selective harvesting dominates in agroforestry systems.

Value addition is realized throughout cutting and piling operations. These include felling, de-limbing, drying and arranging billets in kiln. Slight drying (seasoning) of wood billets was reported to decrease moisture content of wood therefore reducing labour time during production. Arrangement of billets in kiln is a very important component in reducing wastage of wood into ash, consequently improve recovery hence value addition. Felling, de-limbing, drying and arranging billets in kiln was reported to be tedious operations that scared women involvement in this node.

4.1.3 Charcoal production technologies and efficiency

In terms of technology used in surveyed regions; Traditional Earth Mound Kilns and Traditional Pit Kilns with varied size and shapes are dominant (Figure 5). Arrangement of billets in a kiln influences recovery since it affects air circulation.

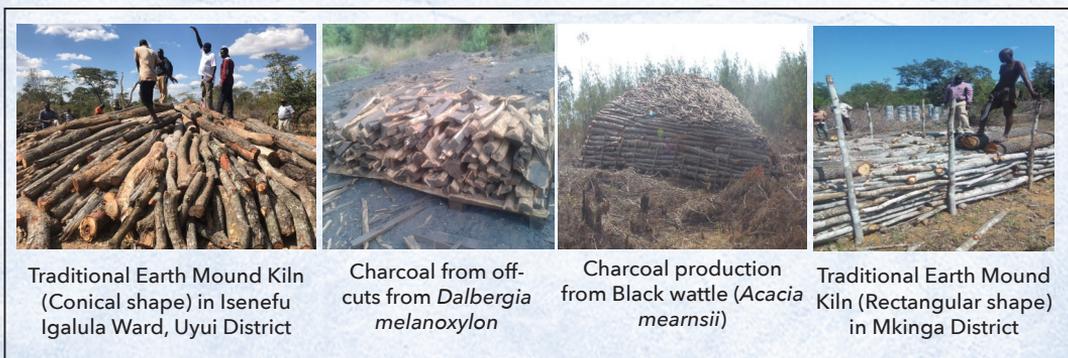


Figure 5: Encountered arrangement of logs in traditional kilns in studied areas

The size of the kilns ranged from 1 to 3 m heights and width of up to 10 m. Reported reasons for adopting traditional earth kilns included ease of construction, ability to utilize different sizes of wood billets, and ability to be used in all seasons.

While assessing stakeholders perceptions regarding kiln performance in Tabora, Shinyanga and Tanga regions, respondents in focused group discussions ranked efficiency, recovery and sustainability of the technologies used based on a scale of 1 to 4 (1 high, 2 moderate, 3 poor and 4 worse). Findings are presented in Table 1.

Table 1: Kiln technologies in use and their ranked performance

Types of Kiln	Ranking		
	Efficiency	Recovery	Sustainability
Traditional Earth Mound Kiln (Pit Kilns)	2	2	2
Traditional Earth Mound Kiln (Conical Structure)	4	4	4 uses tree of small dimension
Traditional Earth Mound Kiln (Rectangular)	3	3	3 Use lot of trees (clear-felling, non-selective)
Improved Kilns	1	1	1

TaTEDO pioneered improved basic earth mound kilns charcoal production methods and has trained several charcoal producers with the aim of reducing wood wastage (the amount of ash when carbonizing the logs) and production time. According to CHAPOS (2002), one m³ of wood yields 2.6 bags of about 53 kg of charcoal using the traditional kiln of estimated efficiency of 19%. Other calculations using a conversion rate of 1:0.85 volume to biomass in m³ and tonnes, respectively show yield of 3.0 charcoal bags of 53 kg each from a cubic meter of wood. The Improved Earth Mound Kilns, with efficiencies up to 25% (Van Beuker, 2007) were reported in six villages in Urambo District by Miombo project and there were three groups trained by TaTEDO in Kibaha and Kilindi

Districts. However, there is no evidence on continuing using modern technology at that current period. It is assumed that adoption of modern kilns is faced with the problem of additional investment costs especially for the corrugated iron sheet chimney in constructing the kilns.

Although efficient technologies with high recovery and sustainability exist in the country there is low adoption because of various reasons including low awareness, high costs of the technology, high production time and low skills. In addition, the perception of forest resources being abundant and free goods, serves as disincentive to optimise use of wood resources in the production of charcoal. Unfortunately, efficient technologies with high recovery are not instituted by existing law.

Types of technology used and its management influence efficiency, recovery and sustainability of charcoal production. This is an important node in the charcoal value chain. Value addition is assumed to be influenced by type of technology used. For example, most charcoal production in the surveyed regions deploys Traditional Earth Mound Kilns with low recovery rate and limited value addition. Some of the producers are not keen to monitor kilns during carbonization, cooling process, unloading and packaging leading to high wastage which lower recovery. Gender inclusion in this node was noted to be low because the process is labour intensive and often nocturnal hence discouraging women participation.

Findings confirm that improved charcoal production technologies have been introduced in various parts in the country (e.g. Morogoro, Mbeya, Tanga, Pwani, Kilimanjaro, Songwe, Manyara and Tabora regions) by some stakeholders² including TaTEDO however, it was also confirmed that continued use of the improved technologies did not go beyond the project period. The main reasons for low adoption include high cost of some components of the technology and time involved in arranging

² Half orange kilns were promoted in sawmill industries; Improved Earth mound kilns were promoted to small scale charcoal producers and forest officers at district level; Simple retort for carbonizing loose biomass was promoted to SMEs for agro-processing.

billets in the kilns. During field survey, Improved Basic Earth Mound Kiln technology was observed being implemented by TFCG/TTCS which is on-going project in Kilosa.

4.1.4 Charcoal trade

On-site marketing: Although TFS has directed that all charcoal should be sold in charcoal selling centres; charcoal is sold haphazardly limiting monitoring of the charcoal business countrywide. Value addition activities which take place at this node include packaging and marketing. In the surveyed regions, types and quality of packaging materials were found to be not important because they have no bearing on price differentiation. Traders used sacks made of sisal fibre and woven polypropylene bags (*viroba/sandarusi*) of various sizes. Although, identification of sustainable charcoal by using specified packaging material could improve marketing, this has not been done in the charcoal sub-sector in Tanzania. Both men and women were involved in on-site marketing.

Transportation: Transportation of charcoal involves trucks/vehicles, motorcycles, railway, bicycles, draught animals, head-loads, boats and dhows. The main means of transport from previous studies were vehicles, the TF observed that the use of motorcycles and bicycles (in Shinyanga) have increased significantly. Motorcycles are the main violators of regulations (e.g. SUMATRA, Forest Act 2002, Road Traffic Act 2017). Most of them transport charcoal beyond the allowable time, the load and size of charcoal bag is bigger than the allowed (50 kg), and majority of the transporters are not registered. Motorcycles evade check points. For example about 30% of charcoal is passing Bwawani check point near Kibaha Township by using motorcycles. Mode of transport and distance to be covered to the market or customer determines value of charcoal. The Task Force recognises results revealed by the TFS brief research (TFS, 2019) which generally proposed to ban charcoal transportation using motorcycles. However, the proposal does not conform with existing Policy and laws. It is hereby proposed that motorcycles charcoal transportation should be identified, registered so as to formalize them. In addition,

during transportation special charcoal bags should be used. It is very important to have amount of bags a motorcycle can carry at a go. Control of motorcycles and use of special bags for charcoal transportation should be piloted in Dar es Salaam.

Value addition at this node was improved by transporting charcoal to towns, municipalities, cities (e.g. Dar es Salaam and Mwanza), Zanzibar and beyond country borders. In these places charcoal fetched high prices compared to when sold at on-site market. In this node men were relatively observed to be highly involved as compared to women in the surveyed regions.

Whole-selling: This is practiced by charcoal stockists who sell charcoal in a bag. However, some wholesalers are selling in small quantities to increase market niches. Value addition activities at this node involve stocking of charcoal in large quantities. This increases availability of charcoal even during wet season which is a low production season. Stocking improves prices and consequently value of charcoal. Whole selling is mainly encountered in towns, municipalities and cities and is done by both men and women and in unorganized manner. The main challenges mentioned by the wholesalers include motor-cycles and bicycles that are making home delivery. Majority of the transporters using motor-cycles and bicycles evade taxes and are selling at lower prices.

Retailing: This node was mainly observed in town, municipalities and cities. Value addition activities were mainly through repacking into smaller quantities (tin-kopo, plastics buckets, and plastic bags-Rambo) for purpose of attracting customers of various income brackets. This activity was dominated by women.

End user/consumers: This is the final node where charcoal as product is consumed. Around 70% of the households in Dar es Salaam use charcoal as the first-choice cooking fuel. Value addition supposed to contain efficient utilization of charcoal. Survey results in Dar es Salaam showed that still few households use efficient cooking stoves affecting sustainability

of the resources. In a separate study Mwandosya and Meena (1999) and NBS (2016) reported that only 4.9% of the urban households use energy efficient stoves. Cooking and vending of food is mostly done by women.

Generally (Table 2) households in the surveyed cities and towns are using diversities of energy for cooking but in combinations of varied proportion. The major combination is charcoal and LPG. The LPG was reported to be used for light cooking. The ration of combination of charcoal to other energies is averaged to 0.91 and ranged from 0.32 to 1.32. Njombe has lowest combination ration (0.32) because the amount of firewood used is high. Most of the firewood in Njombe reported was used for house heating.

Table 2: Cooking energy mix in surveyed cities and town

Types of energy	Responses (%)				
	Dar es Salaam	Mwanza	Mbeya	Dodoma	Njombe
Charcoal	48.9	50	49.4	56.9	24.6
LPG	27.1	25	23.9	18.9	13.2
Kerosene	12.8	7.2	8.6	2.1	2.6
Firewood	5.3	15.1	15.6	20.9	52.6
Electricity	6.0	2.6	2.5	0.9	7.0
Paddy dust	-	-	-	0.3	-

Table 3 present estimates of charcoal consumption in Dar es Salaam, Mwanza, Mbeya, Dodoma and Njombe. The estimates are based on number of households as generated from 2012 population census and field surveys. Dar es Salaam consumes about 985,585.5 million bags of charcoal per month. The rest of the cities and town consumed between 90,410.23 and 102,483 bags. This implies that any intervention in Dar es Salaam would have significant impacts on amount of charcoal bags used in Tanzania.

Table 3: Estimates of charcoal consumption in the surveyed regions

Variables	City/Town			
	Dar es Salaam	Mwanza (Nyamagana and Ilemela Municipal Council)	Mbeya (City Council)	Dodoma (Municipal Council)
Average Household size	4	4.7	4.1	4.4
Number Households	1,095,095	148,788	96,319	93,399
Estimated quantity of charcoal (kg) use per household per month	45	31.6	53.2	48.4
Total amount of charcoal in kg use by households per month	49,279,275	4,701,701	5,124,171	4,520,512
Estimates amount of charcoal bags of 50 kg use by households per month	985,585.5	94,034.02	102,483.42	90,410.23

4.2 Mapping of the Actors along value chain

Determination of proportion of actors along the value chains forms an important element in determining the charcoal value chain. Findings from surveyed regions revealed that the proportions of actors involved in the charcoal business along the value chain are as follows: Majority of the resource base are managed by the villages. Producers ranged from 60% to 70% of charcoal actors, transporters are 10% to 25% (excluding motorcycles), and wholesalers were between 5% and 10%, while retailers

were between 6 and 15%. In some cases, producers are contracted by charcoal dealers in town to produce charcoal at agreed prices and number of bags to be produced. Charcoal dealers usually advance a certain amount of money to the producers. The prices paid to the producers were very little compared to what was received by transporters and wholesalers. Regarding gender involvement in the charcoal sub-sector, producers is dominated by men; some women were involved in wholeselling and transportation while retailing was mainly done by women. In Tabora there was a Tabora Charcoal Association but it was not effective due to mushrooming of illegal business around the area.

In Dar es salaam, a more balanced gender division of labour was observed in the production of improved charcoal stoves where women dominate production of clay part of the stove (80% of the factory owners) and men the metal part of the charcoal stove production (90% of the factory owners). In charcoal stove wholesale, retail trade and dealers business, men are the majority.

It was revealed that charcoal sub-sector involves stakeholders at district, regional and national levels with various roles as shown in Table 4.

Table 4: Stakeholders involved in charcoal Sub-sector in the surveyed areas

Name of Stakeholder	Role in charcoal sub-sector
Central Government and its institutions e.g.VPO, MoF,MNRT (FBD), MTI, MoE	<ul style="list-style-type: none"> - Formulation, implementation and enforcement of relevant policies, laws, regulation and guidelines; - Custodians of forests; - Oversee forest management; - Develop strong institutional framework to effectively formalize and manage the charcoal industry
PORALG (Regional Secretariat and Local Government authorities)	<ul style="list-style-type: none"> - Custodians of forests and hammer including that aimed to be used in the Village Land Forest Reserves; - Oversee forest management, provides licence for the business; - Formulate by-laws and contracts/MoUs; - Facilitate land use planning; and - Safeguard environmental ethics; educate (land rights, extension services) communities.
Regulators and enforcers (TFS, TRA, TARURA , TANROAD, REA, EWURA)	<ul style="list-style-type: none"> - Custodians of forests; - Laws, regulation and guidelines; - Oversee forest management; - Issue permit and registrations; - Collect revenues; and
Researchers and Technocrats (TIRDO, CAMARTEC, SIDO)	<ul style="list-style-type: none"> - Technology design, development and transfer

Name of Stakeholder	Role in charcoal sub-sector
PORALG (Regional Secretariat and Local Government authorities)	<ul style="list-style-type: none"> - Custodians of forests and hamper including that aimed to be used in the Village Land Forest Reserves; - Oversee forest management, provides licence for the business; - Formulate by-laws and contracts/MoUs; - Facilitate land use planning; and - Safeguard environmental ethics; educate (land rights, extension services) communities.
SUMATRA	<ul style="list-style-type: none"> - laws and regulation, guidelines, and regulate transportation including charcoal
Police Force	<ul style="list-style-type: none"> - Oversees compliance to Road Traffic Act and Regulations
WMA (Weight and Measures Agency)	<ul style="list-style-type: none"> - Oversees compliance to packaging and measurements of LPGs, charcoal and other fuels
Tanzania Revenue Authority (TRA)	<ul style="list-style-type: none"> - Implement fiscal policies, laws and regulations and guidelines and collects tax including on charcoal trading
Development partners (e.g. SDC, UNIDO, EU, Embassy of Finland, Royal Norwegian Embassy, HIVOS, GEF, UNDP)	<ul style="list-style-type: none"> - Mutual cooperation, financial and technical support; transfer of technology; facilitate policy formulation and facilitate investments. - Currently supporting Forest Value Chain Programme (FORVAC), support TTCS, scaling up of Kilosa model to Kilindi and Handeni,
NGOs (e.g. TaTEDO, TFCG, MJUMITA, MCDI) and CSO (VICOPA/VSL)	<ul style="list-style-type: none"> - Oversee forest management and including sustainable harvesting, production and use of charcoal, - Advocate and create awareness on the benefits available in charcoal industry; - Assist local communities in the formulation of by-laws and contracts; - Capacity building and developing networking;

Name of Stakeholder	Role in charcoal sub-sector
	<ul style="list-style-type: none"> - Provide advisory services; - Encourage active involvement of stakeholders; promote policy and legislation implementation; conduct research; - Facilitate fora, public debates and discussions; and - Defend interests of vulnerable and disadvantaged groups.
Private sector (e.g. Oil Companies), SEECO and private entrepreneurs (Sahara Group in Vingunguti), ARTI, Mkaa Endelevu Company, WF Renewable Resource Ltd (Mafinga)	<ul style="list-style-type: none"> - Supply alternative energy (LPG, electricity and ethanol), ICS, briquettes - Market networks of ICS, LPG and briquettes - Industrial production of ICS, LPG and briquettes - Industrial production of feedstock (charcoal, brequettes and Liquid biofuels), processing and marketing/trading - create employment in the charcoal sub-sector
Transporters	<ul style="list-style-type: none"> - Transporting of charcoal and other sources of energy
Electricity Suppliers e.g. TANESCO, Off Grid Entrepreneurs,	<ul style="list-style-type: none"> - Supply of affordable alternative energy (electricity)
Communities	<ul style="list-style-type: none"> - Participate in charcoal value chain; - Formulation by-laws and contract agreement; - Raising awareness; - Form charcoal cooperatives or associations for charcoal production industry; and - Abide with policies and legislations.

Name of Stakeholder	Role in charcoal sub-sector
Academic and Research Institutions	<ul style="list-style-type: none"> - Produce technical and professional experts; - Provide technical expertise; - Conduct research and disseminate findings; - Capacity building; - Outreach activities; - Participate in policy and legal process; and - Provide consultancy services.
Media	<ul style="list-style-type: none"> - Provide information to the public; - Raise awareness; - Facilitate public debates and discussions; and - Play a role of watchdogs.

CHAPOSA (2002), and World Bank (2009), reported that charcoal producers at community level and charcoal vendors in the urban areas were the weakest actors in terms of influencing decisions along the charcoal value chain. On the other hand, the TF has confirmed that transporters and traders at the wholesale level are the power brokers of the charcoal trade.

4.3 Revenues along charcoal value chain

The reported amount of charcoal produced per year varied with actors. Large producers were reported to produce between 55 to 150 bags per month, medium producers ranged between 15 to 55 bags per month, while the small producers produced about 5 to 14 bags. The range depended on seasonality. In dry season production is high and low in wet season. Revenues along the value chain are presented in Table 5. Although costs were not included in the estimations; the results showed that transporters and whole-sellers accrued higher revenue as compared to producers. Revenue from forest owner is not reported here because

majority of charcoal harvesting is done in the natural forests which unfortunately are considered as free goods. Moreover, there is no enough data/information regarding ICS business.

Costs of charcoal transportation by trucks depend on the size of a vehicle, distances to be covered, road condition, season and the sizes of the load. For example, a five tonne lorry carrying 100 to 120 bag of charcoal was hired at about TZS 700,000 from Handeni to Dar es Salam (a distance of about 280 km).

Table 5: Revenues along charcoal value chain

Actor	Number of bags	Prices (TZS)	Average revenue per month
Producer	5 to 150 bags	5000	25,000 to 515,000
Transporter	Bicycle 1 to 3 bags, motor-bike 8 to 20 bags	3,000/= to 5,000/=	300000 to 2,100,000
Wholesaler	50 to 200 bags	12,000 to 60,000/	600000 to 12,000,000
Retailer		5000 to 6000 per 10ltr bucket	

The TF endeavoured to investigate on revenue generation at TFS zones. Findings indicate that charcoal revenue trend in the country is increasing yearly (Figure 6). The decrease in the 2017/18 is plausibly explained by an increase in illegal producers and traders as result of enhanced controls and law enforcement. Number of charcoal bags and revenues showed increasing trend in central, northern and southern highlands while the figures in western, southern and lake zone showed decreasing trend (Appendix III).

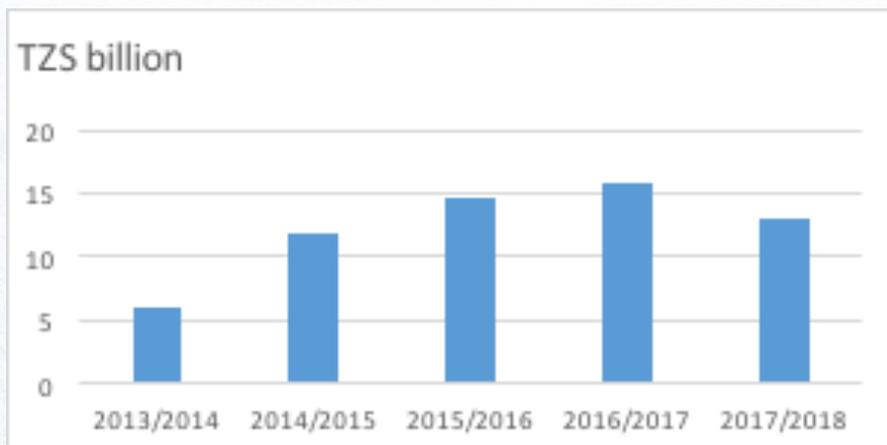


Figure 6: Charcoal revenue trend from all zones

The reported revenue trend included both legal and impounded charcoal. Illegally produced charcoal in Tabora, Shinyanga, Tanga and Kilimanjaro regions was reported by stakeholders to range between 90 and 95%. Impounded charcoal was sold through auctioning to registered charcoal traders and was given permits for transportation. The Eastern zone collects the highest revenue (47% of all the charcoal revenue), a reflection of the importance of the highly populated Dar es Salaam with approximately 10% of the Tanzanian population (Figure 7).

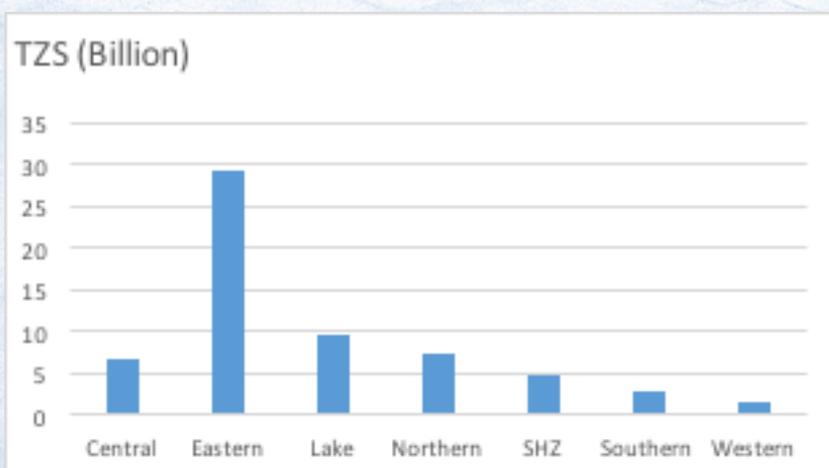


Figure 7: Revenue collection by zones

4.4 Benefit sharing along the value chain

Benefit sharing along the value chain differs from one actor to another in the Central, Local and Village Governments. The royalty is TZS 12,500 per bag (50 kg) of which 97% is paid to TFS and 3% paid to Tanzania Forest Fund (TaFF). In addition, traders are required to pay 5% of the royalty to TaFF as tree planting levy for districts with harvesting plan and charcoal has been legally produced.

Depending on the village bylaws, producers normally provide some amount of money to the village authority. The amount of money paid to the village authorities differ from one village to another depending on existing bylaws and in most cases it is not above local government charges. In Katavi region producers were reported to pay TZS 50,000 per year to village authorities where charcoal is produced. In Kilwa District, producers were reported to pay TZS 1000 per bag of charcoal to the village authorities where charcoal is produced. District councils are paid Cess, however the amount paid varied from one area to another. In Handeni, Mkinga, Uyui, Moshi, Msalala and Ushetu district councils, transporters paid TZS 1000 per bag of charcoal. Cess in Morogoro Region and Ludewa District is TZS 2000 while Njombe District it is TZS 500 per bag (50 kg) of charcoal. In Chunya District producers were reported to pay TZS 100,000 per trip of truck of 100 to 150 bags paid to the village government. In places where charcoal is harvested from CBFM (TTCS project in Morogoro) TZS 6750 per 50 kg bag is paid by charcoal producer to Village Council as royalty.

4.5 Revenue collection system

Charcoal dealers are required to register and pay registration fees through bank. In addition, they are required to have Tax Payer Identification Number (TIN) and tax clearance from TRA. The TF noted that there was no revenue collection system in villages with regard to charcoal production and trade. Villages used fees set in the by-laws. At district level, the system used by Central Government and Local Government for

revenue collections include POS, GePG (Government Electronic Payment Gateway), Electronic Fiscal Devices (EFD) and bank payments. The equipment is online therefore presumably traceable by TRA. The main challenges include the POS reports by LGAs which was on aggregate form showing all forest produces. It is therefore, difficult to trace charcoal sales. As a result that caused low or higher estimates and the equipment especially the ones involving bill first and then pay delayed payments particularly when internet connection signals were low. At district level with TFS, it was possible to get revenue reports on charcoal but District Council Accounts were not structured to show charcoal, instead showed forest produce in general.

Stakeholders proposed improvement in the following areas:

- (i) Initiation of charcoal central markets or auctions at a strategic location in both rural and urban areas. For example, Mtwara Region is piloting a central charcoal market where all sales are carried out, all vendors in town must show a legal receipt from the central market when inspected;
- (ii) Introduction of special/unique charcoal bags in order to curb illegal charcoal;
- (iii) Abandon the weight requirement and use a charcoal bag system only; this will increase compliance; weight requirement is unworkable;
- (iv) Ensure that all revenue collection are conducted through POS, GePG, EFD and bank;
- (v) Provide extension services on fiscal policies and laws to charcoal dealers;
- (vi) Establish an electronic monitoring system to reduce time of inspections at check points; and
- (vii) Enforce the laws, regulations and by laws.

4.6 Charcoal taxation, barriers and improvement required

Various taxes were reported to be charged on charcoal production and trade. These are summarised in Box 3.

The fees and taxes were reported to be numerous and eroding charcoal dealers profits which is a disincentive to legal charcoal trade. Therefore, the fees and taxes were identified as one of the obstacles to charcoal dealers' compliance to legal business.

In addition to the fees and taxes, the charcoal producers and dealers were required to meet operational costs. For example, estimates in most of the zones revealed the following operational costs along the value chain:

- (i) Charcoal production cost paid to casual labours ranged from TZS 7,000 to 13,000 per bag;
- (ii) Cost for packaging materials (heavy duty plastic bags) was TZS 1,500 per bag;
- (iii) Cost for loading charcoal into bags was TZS 1,000 per bag;
- (iv) Cost of loading and unloading into vehicle was TZS 2,000 per bag; and
- (v) Transportation costs from production site to roadside/town ranged from TZS 3,000 to 5,000 per bag depending on distance to be covered.

Box 3: Charcoal taxes and fees

- Registration fee of TZS 256,000 of charcoal dealers and traders for each site per year. In case the charcoal dealer is also whole-seller is required to pay TZS 256,000 for the store;
- Application fee of TZS 100,000 to be paid to Village Government;
- Application fees of TZS 50,000 paid to District Council;
- Fees for a 50 kg bag of charcoal is TZS 12,500 as royalty in which 97% retained at TFS and 3% is for TaFF;
- Five per cent on top of TZS 12,500 (royalty) per bag of 50 kg as tree planting levy is paid to TaFF;
- Transits pass application fee of TZS 7,700 and 15,400 for a vehicle of 7 tonne or below and above 7 tonne respectively paid to TFS;
- A fee of TZS 1000 per bag is paid to village where charcoal produced. The amount varies depending on village by-law; and
- A Cess is paid to District Council where charcoal produced. The amount vary depending on district by-law

Source: Field data and The Forest (Amendments) Regulations (2017)

Based on the above taxes and production costs, it was revealed that legal charcoal dealers cannot realise profits. This is among the factors contributing to high rate of illegal charcoal in the surveyed regions and reducing government earnings. This high tax Opinion of charcoal stakeholders consulted advised to reduce the number of fees and taxes in charcoal sub-sector. Some stakeholders suggested reducing the amount of charcoal royalty from TZS 12,500 to TZS 3000 per bag because some fees and taxes are charged as per cent of the amount of royalty. Although the government Also, stakeholders were not happy with royalty being paid based on weight of the charcoal (50 kg), provided charcoal is produced from different tree species with different density. Stakeholders proposed the introduction packaging material of same size that could be sold to at affordable prices instead of weight. This was in line with previous recommendations cited in literature section 3.7 of this report.

4.7 Revenues re-invested in to forest management

Re-investment is mainly through Government subversion in annual budgets and TaFF. Money from auctioned confiscated charcoal by TFS is normally submitted to TaFF after deduction of censure costs. Districts and villages use local by laws in dealing with confiscated charcoal. However, it is not possible for local authorities to recoup censure costs because of the existing electronic payment system. Funds from TaFF provide another avenue for re-investment. TaFF funds are accessed after submission and approval of project proposals by respective applicants including individuals and institutions. Normally, five per cent of collected royalty is submitted to TaFF as tree planting levy. However, policy improvement and awareness creation regarding to utilisation of the funds from TaFF is pertinent. Improved proposal writing skills at community level is likely to enhance access to TaFF funds through submission of good quality proposals.

In the TTCS project areas in Morogoro certain amount of money as a percentage of royalty is used to support Village Natural Resources Committees (VNRCs) activities especially monitoring and patrol the CBFM where charcoal is harvested. In most cases VNRCs are required to monitor and patrol CBFM forests which do not have sustainable funding for their activities. They depend only on incomes on impounded goods that decrease with compliance.

4.8 Conflict management arrangement

In some districts, conflicts between Local Government Authorities and the Central Government were reported concerning forest revenue collections. The MoU signed between MNRT and PORALG in year 2016 was to some extent used in resolving some of the frictions between DFOs and DFMs. However, lack of financial resources limit implementation of the MoU especially on the DFOs side. Another conflict was noted at the determination of weight of the charcoal bags at check points. It was reported by the transporters that weighing of charcoal bags was

not properly done at check points. At times weights were just estimated without actual weighing of bags causing discontents.

4.9 Sustainability of existing charcoal production and models used in Tanzania

It is a requirement by the Forest Harvesting Guideline of the year 2017 that each district with forest resources should have forest management and harvesting plans. Some villages in Tabora, Shinyanga, Katavi, Songwe, Mbeya, Morogoro, Lindi regions have harvesting plans and some areas were demarcated for charcoal production. The same applied to Gole VLFR in Handeni District. However, it was observed that preparation of harvesting plans was not based on forest resource assessment data. The validity of the harvesting plans is therefore questionable. This was evidenced in places such as Isenefu Village (Igalula Ward), Isuri Village (Kizengi Ward) in Uyui District which had harvesting plans but did not have enough forest resources for charcoal production. Harvesting plans in some villages were not followed effectively. For places without harvesting plans, lack of financial resource for conducting forest resources assessment was mentioned as the main bottleneck. As best practice, allowable cut presented in harvesting plans are supposed to be a prerequisite variable in allocating harvesting quotas. However, this is not realized in the surveyed regions, thereby posing sustainability challenges.

It was noted that about 90% of the produced charcoal is illegal, while the remaining small proportion was legal. In Tanga and Shinyanga regions only 40% of charcoal was perceived to be legal charcoal but they did not pay royalty, they only paid TZS 1000 per bag to local government. In the Eastern zone legal charcoal production and trade is estimated at only 30% (had license and transit pass). In Dodoma, Lindi, Mtwara and Ruvuma regions 70% of the charcoal was reported to be illegal.

It is the opinion of the Task Force Team that MNRT and PORALG provide sufficient budget to allow for forest resource assessments ahead of

producing harvesting plans. Additionally, continued awareness raising on efficient production and use technology legislation, guidelines, and other relevant aspects to charcoal subsector need to be sustained.

The TF visited TFCG Kilosa Office to discuss the Project “Transforming Tanzania’s Charcoal Sector” which operates in 30 villages in three districts: Kilosa, Mvomero and Morogoro (Appendix V). The TF observed that, apart from the charcoal produced from VLFRs through the sustainable charcoal project, within the Kilosa District charcoal is also produced from farm clearance. However there are village bylaws that restrict charcoal production from farm clearance to avoid competition with TTCS charcoal. The Village bylaws need to be reviewed. It was further noted that the TTCS Charcoal produced from VLRF was not sold in Kilosa or Morogoro as it cannot compete with charcoal from elsewhere. It is sold in Dar es Salaam. Producers pay TZS 6,750 per 50kg bag to the village. In other areas in the district producers are required to pay TZS 12,500 per bag to TFS, which in most cases is evaded resulting in cheaper illegal charcoal. District levy is TZS 2,000 per bag of charcoal.

The approach is aimed to integrate charcoal forest management units in the Village Forest Reserves i.e. areas designated for sustainable charcoal production which are 10% of the forest area (Box 4). The harvesting cycle is 24 years (1/24 is cut each year). Some felled trees in the first plot of 2014 were observed to be regenerating. However, since regeneration of mature Miombo takes a long time (up to 80 years) more research is still needed in this area. The project has established rules to limit the environmental impact of charcoal harvesting:

- Checker board pattern of harvesting 50x50 meter coups to prevent erosion
- Minimum harvesting diameter for charcoal producing trees is 15cm.
- Timber trees within the coups are not harvested for charcoal and managed on longer rotation

- No harvesting is permitted near streams and in a slope of more than 40% gradient.
- Improved Kiln Technology is used, with recovery of 15-25%. The project has trained over 500 producers to use the improved kilns.

The TF learnt that while the Project has resulted to revenues generation to local communities, the model still need to be researched further regarding regeneration. The exit model is not well aligned to the Government structure, for monitoring purposes the Project needs to be institutionalized into the Government system. Discussion with DFM, Assistant DFM and TFCG Staff in Kilosa showed that:

- (i) There is weak capacity of the villagers to manage their forests. Involvement of the Government is key for sustainability and monitoring.
- (ii) There seems to be clear disharmony between TFS and TFCG. This is not a healthy situation. In some villages TFCG are instigating communities not to listen to TFS staff because the later has not brought significant economic change to the village.

The TF observed that further research in the project is needed regarding; cutting height, minimum size to cut, structure and species composition of regenerating stock compared to former crop; length of felling cycle to allow adequate recovery of annual coupe. Some literature claim clear-felling results in better regeneration than selective cutting. Properly laid out research plots are needed to answer these questions. When these questions are answered the project will have addressed the issue of regeneration after making charcoal. The issue of sustainable charcoal production will still be pending since the charcoal produced is never enough to satisfy the demand for charcoal. The project should therefore be treated more as research endeavour rather than an already proven technology. It is dangerous to promote immature technology. It is even more dangerous to instigate communities to be dependent on charcoal from woodlands. Lastly there is need for TFCG and TFS to work together

as the latter is the government technical arm to promote sustainable management of forests. TFCG should invest more on this rather than struggling to get political support

Box 4: Examples of tree harvesting in intervened forests

In Kilosa District, TFCG is implementing a project 'the Transforming Tanzania's Charcoal Sector (TTCS)'. This project was visited by the TF. The TTCS project has charcoal production model called a Sustainable Charcoal Model which is being implemented in Community Based Forest Management. Through the model, the villages have management plans, bylaws and harvesting plans for their VLFRs. The villages have well trained Village Natural Resources Committees (VNRC) who oversee the implementation of the model including checking compliance including issuing harvesting licenses to charcoal producers. Harvesting is conducted in harvesting coupes of 50 square metres through selective harvesting with a felling rotation of 24 years. Tree harvesting is conducted by trained charcoal producers to ecologically sound harvesting principles (including leaving a tree stump of 50 cm long) and are monitored by the VNRC. Tree regeneration in the harvested areas occurs naturally through coppicing, sprouting from root suckers and from seedlings. The VNRC oversees the harvested areas so as to monitor the regeneration and ensures that no disturbances which will detriment the regeneration.

4.10 Possibility of Establishing Plantations for Charcoal Production

This study has noted high dependence on biomass energy all over the country. This has resulted in huge pressures on the natural forests, which have been the primary source of wood energy. Linking the continued rise in human population in Tanzania with biomass energy consumption, and the reduction in forest cover over time, dedicated efforts on plantation development for bioenergy production is inevitable and needs to be supported and prioritized.

Estimates indicate that five tonnes of wood produce one tonnes of charcoal (FAO, 1987). Charcoal production can only be sustainable when the wood raw material resource is managed to provide a continuing supply. For every person in a community who uses charcoal for heating and cooking about 0.5 ha of natural forest has to be set aside to provide that wood

supply in perpetuity (FAO, 1987). If the wood comes from well managed fuelwood plantations a tenth of the above area would be adequate. However, plantations require a commitment to proper management and the allocation of better quality land which may be needed for food production. Where plantations are established and managed correctly on suitable sites, growth can be rapid. Mean Annual Increments (MAI) of 15-20 m³ per ha over 12-20 year rotations are common.

There is high possibility that forest plantations for charcoal using various tenure systems could be established in many places in Tanzania. This will be achieved through sensitizing and building the capacity of charcoal and firewood producers in the regions and districts to plant and/or manage woodfuel plantations sustainably. Participatory approaches will have to be employed at all stages to ensure that stakeholder needs are adequately incorporated in the choice and design of plantation regimes. In some places e.g. in Tanga Region, stakeholders reported that there is high possibility to establish forest plantations because of conducive climate (e.g. Mkinga and Muheza districts) have three rain seasons. In Njombe Region establishment woodlots and plantations for charcoal production is a common practices and process adequate charcoal for the region and external market in Arusha, Mwanza and Dar es Salaam (Figure 8).



Figure 8: Blackwattle charcoal from Njombe Region ready for use in different parts of the country

The TF further established that some communities in Karatu, Mbulu, Babati, Hanang, Iringa, Kondoa, Kibaha and Kishapu districts have already introduced designated woodlots for production. With these observations, there is adequate experience in woodlots establishment in the country which can be scaled up and replicated in other areas of similar climatic conditions. It is also necessary to conduct research on site-species suitability, plantation management and charcoal production in order to demonstrate best practices in establishment of plantations for charcoal production in a successful and profitable manner. For example, TAFORI and Forest Development Trust (FDT) have established trial plots for some tree species (*Albizia lebeck*, *A. nilotica*, *A. polyacantha*, *A. tortilis*) relevant for charcoal production in Tabora for assessing forest plantation establishment.

Generally, tree species recommended for charcoal plantations should have the following properties;-

- (i) Fast growing;
- (ii) Yield high volume in short rotations;
- (iii) Coppice or sprout well;
- (iv) Require minimum management cost;
- (v) Produce dense wood;
- (vi) Produce charcoal that does not spark when burning; and
- (vii) Have multipurpose characteristics.

Tree species proven suitable for charcoal production in Tanzania include: *Acacia melanoxylon*, *A. polyacantha*, *A. mearnsii*, *A. nilotica*, *A. senegalensis*, *Eucalyptus camaldulensis*, *Senna siamea* and *Azadirachta indica*. Furthermore, TFS, SUA and TAFORI are piloting bamboo growing for charcoal production in various parts of the country. The plantations for charcoal are an important solution to reduce deforestation and pull people out of poverty at the same time.

The plantations can be established at village, family or institutional level such as Agricultural Marketing Cooperative Societies (AMCOS). Government and social institution such as prisons, schools, and churches could also be used to raise tree seedlings for distribution to communities for planting. With exception of few districts (e.g. In Kilimanjaro and Dar es salaam regions), the land for establishment of plantations for charcoal production is available on village lands, private owned land and general land as the case deem fit. The TF identified some potential areas for establishment of plantations for charcoal including degraded Kahe I Forest Reserve (884.2 ha) in Moshi District, Morogoro Forest Plantation (12,950 ha), vast land available in Buhigwe District in Kigoma Region, and Ngiritis in Shinyanga and Mwanza regions.

Consulted stakeholders in Shinyanga and Njombe suggested that establishment of plantations for charcoal production is economically viable; however more detailed studies and site specific are required. The practices suggested that establishment of plantations for charcoal production requires use of fast growing species, clones of suitable species and moisture retainers.

Lessons for plantations for charcoal production could be learnt from Malawi *Eucalyptus camaldulensis* plantations for charcoal and *Acacia mearnsii* (Blackwattle) in Njombe. Kenya planted *Acacia* species using famers' associations. The fast-growing *Acacia* matured in 6 years in which one acre produced 1000 bags in Kajiado and Kwale Counties. In Ethiopia have about 1 million ha have been planted and used for production of various products including charcoal. Enrichment planting in the degraded natural forests areas could also be the option to increase regeneration.

These observations suggest that it is possible to adopt a model whereby tree planting in the form of plantations (with preferred selected species) can be used to supply raw materials for sustainable charcoal production.

Another efficient approach especially in semi-arid areas is the use of natural regeneration. Field observation revealed that natural regeneration is the

most efficient way of recovering trees in deforested areas as opposed to planting new ones. Literature shows that most tree species in Miombo woodlands are able to coppice/regenerate naturally. The stakeholders were of the opinion that natural regeneration is possible in Morogoro, Tabora, Shinyanga, Tanga, Mtwara, Ruvuma, Mbeya and Lindi regions. Some of the degraded forests could be regenerated using this approach. There are numerous advantages of natural regeneration against other approaches. These include: low cost of forest establishment, less labour and equipment required, no problem with geographical origin of seed, good early root development by natural seedlings, less visual impact compared to tree planting and less soil erosion. Forest management required to be implemented include: to protect the degraded area against livestock grazing, wildfires and agricultural activities. TF noted that high intensity livestock and agriculture can seriously limit regeneration of the trees particularly in the Miombo woodlands.

4.11 Legal and Institutional Frameworks Limiting Sustainable Charcoal Sub-sector

In this section relationship is established between existing legislation in the country and sustainable charcoal production and trade. It was of interest to see how existing legal and institutional frameworks are either supportive to the concept of sustainable charcoal sub sector or otherwise. In the forthcoming subsections, key findings from the analysis are presented.

Land legislation doesn't recognize sustainable forest management:

The Village Land Act (VLA) in part II, which outlines the fundamental principles of the land policy, under article "f" of section 3, states that land is to be used productively and that any such use must comply with principles of sustainable development. At the same time, the VLA, under part IV, section 14, requires any forest area, in order to be recognized, must be lawfully declared to be a forest reserve.

These statements in the National Land Policy and VLA have been

interpreted by many to lower the status of forests on village lands that are not in village forest reserves. It is perceived by many that forests on village lands, outside reserves, are deemed to be unproductive lands and can lead to appropriation of that land. As a result, villagers feel encouraged to clear these forested lands and to cultivate them as a way of showing that they are being used productively, thereby confirming their right to occupy them.

Without legislation that specifically recognizes sustainable forest management as a productive land use, villagers will prefer to clear forests and cultivate or construct buildings on the land as a way of claiming their rights of occupancy over these lands.

Weak provisions for enforcing land use planning laws:

Under section 57, sub-sections 1 and 2, of the Land Use Planning Act of 2007, the National Land Use Planning Commission (NLUPC), in consultation with relevant land use planning authorities, is identified as having responsibility to monitor and evaluate all land use and environmental phenomena with a view to making assessment of any possible change in the environment and the possible impacts.

The legislation provides for the NLUPC and district councils, as land use planning authorities, to monitor adherence to land use plans. However, both of these institutions are typically not in a position financially to fulfil this mandate. Furthermore, the law does not specify what penalties can be taken by the NLUPC and district councils against a village, or villages that do not comply with a village land use plan.

The weak monitoring and enforcement of land use plans by a national authority are seen by many as a major reason why forests on village lands cannot be protected effectively. Although, Village Land Use Plans are supported by bylaws that are enforceable in a court of law, without additional and regular monitoring of adherence by a national body, they are deemed to be largely insufficient.

Insufficient provision for funds to support forest extension by districts:

The Local Government Finances Act, 1982, under part II, which refers to the sources of revenue of district councils, under section 7, sub-section 1 article "r", revenues, funds and resources of a district council are defined to consist of moneys derived from fees for forest produce and licences accruing to the district council under section 10 of the Forests Ordinance. Under article "g" of the same section, district councils are allowed all moneys derived from any cess payable on any agricultural or other produce produced in the area of the district council. Finally, sub-section 3 and 4 require that all revenues of a district council, unless otherwise stated, be paid into the general fund of the district council. District councils can only charge cess on forest produce but cannot receive funds directly from forestry royalties.

Because the district cess for forest produce has been set at only 5%, and because all the cess funds must be paid into the council's general fund and cannot be earmarked for the district's forest department, the result is that the district is constantly underfunded for forest extension activities. This is unfortunate because districts are responsible for providing extension services and supporting forest management on all forested areas on village lands. An assessment of the costs involved in establishing Village Land Forest Reserves (VLFRs), through district facilitation under the conditions of donor supported projects, showed that TZS 6,145/ha were needed to bring natural forest under improved management (DANIDA, 2011). At this level of expenditure, it would cost TZS 129 billion to establish 21 million ha of forest reserves under PFM arrangements throughout all forested village lands. These funds do not include the costs of monitoring adherence to the Participatory Forest Management (PFM) plans, supporting conflict resolution and governance at village level, and the costs of supporting TFS to enforce forest laws and regulations in the districts.

In the absence of financial incentives to district councils, probably generated in the form of a share of royalties or new taxation on the sales of forest produce, in order to invest in supporting sustainable forest management at village level, it's unlikely that non-reserved forested lands will come under improved management. Harvesting for timber and charcoal will continue to be produced under conditions of informality and even illegality. District councils cannot generate sufficient revenues from cess to pay for the costs of expanding PFM. Experience shows that even the cess payments, once paid into the district's general funds, are not reinvested in forestry activities.

Royalties as forest revenues can be inefficient and lack transparency:

Part X of the Forest Act, 2002 refers to financial provisions, wherein section 78 provides the minister the power to set and collect royalties. In determining the level of royalties, in connection with any particular produce, the minister must consider the:

- a) the potential market value of the produce;
- b) the accessibility of the produce;
- c) the Profitability of the enterprise, due regard being paid to the expenses and capital investment of the enterprise;
- d) principles of sustainability in connection with harvesting of the produce;

In reality, royalty rates are reviewed after every two years by a committee in MNRT. The committee, rather than observing the criteria referred to in the law, usually just raises the royalty rate without looking at prevailing market conditions. In fact, examples exist that illustrate how charcoal traders were being subsidized by a low royalty rate that did not recognize the real cost of charcoal to the economy and the environment (TEITI, 2014).A recommendation to move to a forestry wide auction and tender system, with corresponding high levels of transparency and accountability, has

been resisted by the many small and medium sized enterprises in the industry. Small and medium sized forestry enterprises are fearful that a move to an auction system will result in larger forestry companies being able to outbid them for forest resources that are becoming increasingly scarce.

There are no provisions for royalties to be re-invested in village land forests:

According to Section 54 sub-section 2, article "b", of the Forest Act, any fees, royalties or other imposts are owed to the Government of Tanzania. This provision means that all royalties are central government revenues and cannot be paid to district or village governments. These sub national levels of government can only on cess but not from royalties directly.

In addition, the TFS was established as an executive agency under the Ministry of Natural Resources and Tourism in accordance with the Executive Agencies Act Cap. 245 (Revised Edition 2009). TFS took over some of the core functions of the Forestry and Beekeeping Division among which were;

- I. Enforcing Forest and Beekeeping legislation in areas of TFS jurisdiction;
- II. Providing forest and beekeeping extension services in areas of TFS jurisdiction;
- III. Collecting Forestry and Beekeeping revenue.

TFS was given the mandate for the management of national forest reserves (natural and plantations), bee reserves, and forest and bee resources on general lands. The TFS resources requirement was designed to be met from the revenue collected from the sales of forest and bee products and from charges for services rendered. The setting of user prices for products and services for the recovery of operational costs plus a reasonable development margin. The TFS establishment order further

reinforced the fact that revenues from forests can be spent on TFS areas of jurisdiction, which do not include village land forests.

Section 78, sub-section 3, further provides that no royalties shall be required for the harvesting or extraction of forest produce within a village forest reserve or a community forest reserve, by the resident of the village or the members of a group. It has been argued that village forests being exempt from royalties has resulted in a lack of TFS attention. However, the establishment order makes it clear that the TFS mandate is over central government forests. Even if royalties were paid by villagers to TFS, a mechanism for reinvesting in forest management in villages would still be lacking.

Insufficient capacity to monitor forest management:

Section 6, sub-section 1, of the Forest Act provides for the director of forestry to appoint officers who shall supervise the efficient, effective and economical management of forests in accordance with the provisions of the law. All officers appointed under this section are answerable to the director. Furthermore, under section 41, sub-section 1, local authorities are required to exercise a general supervision over the exercise of village councils over the management of declared village land forest reserves.

As has been noted earlier, the district councils are institutions with weak capacity, particularly with regards to funding for forestry. It is generally accepted that district councils are unable to fulfil their role to monitor the adherence of forest management plans by villages. It is regrettable that there are no provisions in the forestry law for district councils to monitor the management of non-reserved forests on village lands. Equally regrettable is the fact that the law appears clear that the responsibility to monitor TFS rests with the director. However, the TFS establishment order requires only that TFS expenditures be subject to monthly, quarterly and annual monitoring and review. The adherence of TFS to forest laws and their own forest management plans is essentially not monitored by any independent entity. In the absence of the regular monitoring of adherence

to forest management plans, at both central and village levels, it cannot be surprising that forest harvesting continues to be unsustainable.

This situation is perhaps a unique situation in the government's institutional arrangements, where for several sectors there are independent regulatory bodies to monitor the performance of both private and public institutions (e.g. SUMATRA regulates private operators in addition to UDA and UDARTS; EWURA regulates DAWASA; and TCRA regulates both private TV and cell phone companies in addition to TBC and TTCL). An independent monitor in forestry, answerable to the director of forestry, is even more critical because the current regulator, TFS, is also acting as a participant in the value chain and is seen to be in a conflict of interest situation. In order for compliance to the law to be enhanced in forestry, the forestry authority must be seen to be acting ethically.

Inadequate protection and arbitration of disputes:

Under Part VII of the Forest Act are several provisions referring to the trade of forest products. Specifically section 63 provides for the minister, by order published in the gazette, to prohibit or restrict the movement of forest produce, both within Tanzania and from Tanzania. Under article "e" of the same section, before issuing the ban the minister must regard such factors as the sustainability of forests and the welfare of those obtaining a livelihood from the trade, as it will appear to be relevant and appropriate.

In reality, charcoal bans are routinely issued by authorities other than the minister responsible for forests, and without any publishing in the government gazette. Livelihoods of traders are rarely considered and compensation is usually not forthcoming, even to traders with valid permits and licenses as issued by government officers. Traders who feel that their trade disputes with government are not subject to objective arbitration are more likely to participate in opportunistic charcoal practices that are not aimed at sustainability.

The National Forest Policy, Act and regulations aim to oversee/control charcoal production and trade in the country. However, many charcoal

actors along the chain had little knowledge on laws and regulations regarding charcoal production and trade. For monitoring purpose charcoal production and trade records supposed to be kept through established data base. Stakeholders in the surveyed regions had opinion that National Forest Policy, National Energy Policy, National Environmental Policy and National Land Policy and SUMATRA regulations contradicts on issues of sustainable charcoal production and trade. The policies and regulations needs to be harmonised in order to make charcoal sub sector sustainable.

Districts are supposed to have a harvesting plan and Forest Management Plan (FMP). Many districts have forest harvesting plans but are not specifically for charcoal production. Charcoal producers and traders supposed to have licences but many operate without the required documents with exception of large-scale producer (e.g. in Igalula and Urambo). Monitoring of implementation of FMP and harvesting plan was infrequently done due to lack of resources by local government authorities as compared to central government. Some weakness of the laws mentioned include double penalty i.e. excess charcoal is impounded and fined. In addition, they reported that there were no monitoring schedule and in places the M&E existence was not organized according to MoU.

Issuing of permits, licenses, transit pass and registration of traders is stipulated in the MoU between MNRT and PORALG. This to a greater extent has not reduced the confusion and friction that existed in the past. The main problem with the MoU is that it still does not define the separation of roles between DFOs and DFMs, beyond the TFS being given powers over the hammer. Registration and issuing permits still continues under DFOs and almost all extension is carried out by DFOs. There remains confusion within MNRT about how it wishes to maintain control over regulations while understanding the need for checks and balances within the system.

Various constraints were mentioned by stakeholders in the surveyed regions. The constraints include: competition from illegal charcoal, low awareness of existing laws and regulations of charcoal trade and banning (especially in Tabora) of charcoal transportation outside the region.

In many places, especially in Tabora and Tanga Regions, charcoal traders acquire forest land pretending to invest on agriculture instead they clear fell the forest for charcoal production and here after abandon the land. This could be attributed by: weak village governance to manage forest lands; Village boundary conflicts; and Immigrants from Kenya (Waduruma tribe) came with intention to engage in charcoal production.

In order to improve legal environment for sustainable charcoal production the following were suggested by stakeholders:

- Charcoal should have own regulations and guidelines and be enforced;
- Charcoal harvesting should be in areas with harvesting plan;
- Charcoal demand is higher than what is available for supply, energy mix is required; and
- Charcoal ban is not realistic, instead sustainable model of production and trade is required.

4.12 Weaknesses of the Existing Legal Frameworks

4.12.1 Lack of awareness

Awareness on various laws and regulations regarding charcoal production was reported to be low to charcoal producers. Charcoal dealers who were aware on laws/regulations reported that double penalty i.e. excess charcoal is impounded and fined was main problem in charcoal trade. Environmental Management Act is not known in the villages visited. Mechanisms used to raise awareness on laws and regulations by DFOs and Central Government was through meetings with harvesters/traders, Village Government and assembly. It was reported that, the awareness

level was measured by the number of people appearing for licence application.

Efforts done by different stakeholders in order to improve laws and regulations include:

- (i) Norway had supported REDD in TZ, including strategy and implementation plan to address drivers of deforestation and degradation. The strategy and implementation plan have addressed charcoal issues, and provided implementable actions to address unregulated charcoal production. NCMC through VPO coordination assisted Tanzania in developing Forest Reference Emission Level (FREL) as initial stages on REDD implementation;
- (ii) BEST finalized in 2014; however, it was observed to have some shortcomings that needs to be addressed before public consumption. The efforts to finalize are underway. BEST was supported and not yet supported by GoT; entire effort was support by European Union Energy Initiative Partnership Dialogue Facility EU, (EUEI PDF) focussed on coming up with a national common vision on biomass energy including biomass energy policy, sustainable management of resources, clean cooking solutions and support sustainable charcoal focusing on demand and supply sides. Promoting efficient stoves will reduce charcoal use. In addition, the strategy intended to support alternative to charcoal as part of gradual shifting process from charcoal. Implications of energy switching depend on affordability, availability and awareness. Other activities proposed by the strategy were to support entrepreneurs on LPG distribution, electricity, briquettes, ethanol and ethanol stove production. Activities proposed by BEST could be implemented as some of them provide incentives for sustainable charcoal; and
- (iii) Tax revenues should be re-invested to increase incentives; and the royalty rate should be by area.

4.12.2 Roles and coordination of charcoal sub-sector

Regarding roles of VPO/MoE/PORALG/MNRT in the charcoal subsector, the stakeholders in the surveyed regions reported that VPO were raising awareness and coordinate environmental awards. Ministry of Energy were raising awareness on alternative energies, efficient conversion of wood to charcoal and efficient use of woodfuel (charcoal and firewood) technologies. PORALG supervised conservation, collection of revenues through license and were custodians of some forests that were under District councils. TFS were custodian of forest resources that are under central government and general lands, provided TP, registration and implement patrol.

Harmonization of charcoal sub-sector coordination was one of the requirements proposed by the stakeholders. The harmonization suggested include: charcoal should be coordinated by MNRT because they are custodian of high amount of forests and is the one responsible for forest management. Charcoal should be a sub-sector with desk officers in various levels such as district and MNRT. Like Beekeeping sub-sector, charcoal supply should have a Charcoal Policy

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

After conducting thorough analysis, the task force puts forward an integrated model which can improve the conduct of charcoal business in the country and institute sustainability elements in the business (figure 9).

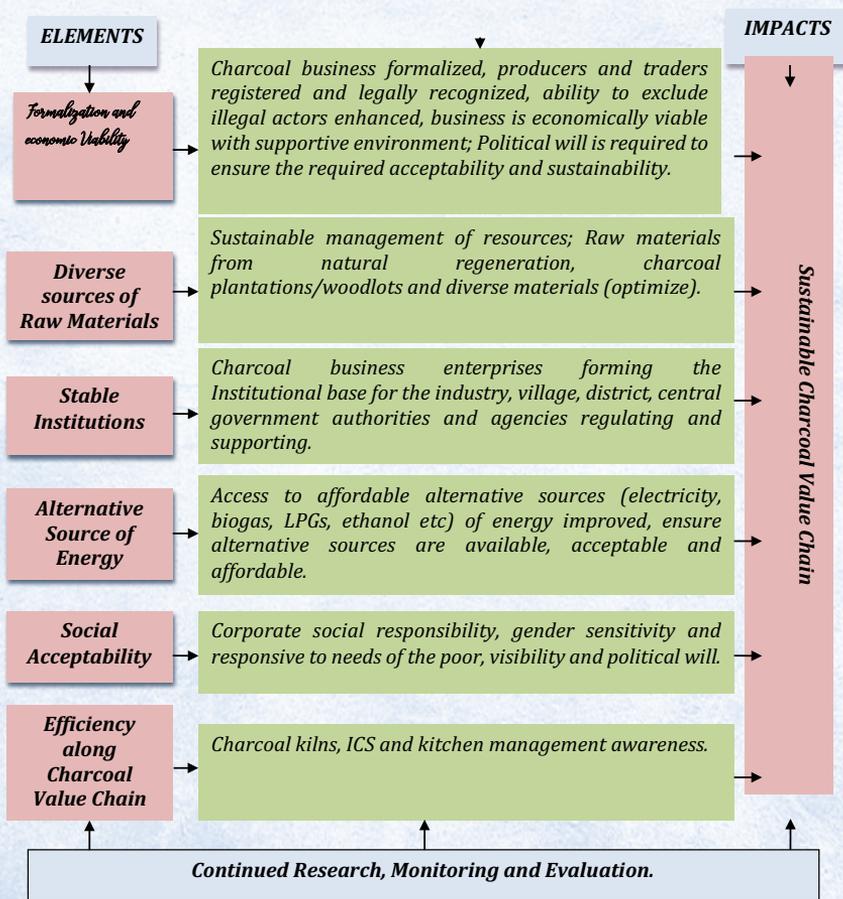


Figure 9: Integrated Sustainable Charcoal Model (ISCM) for Tanzania

The model advocates an integrated approach embracing issues of policy, strategies, and regulations formalization of charcoal business, reduction in dependence on natural forests, reduction in dependence on charcoal for cooking, increased use of clean cooking solutions, increase gender inclusion, socio-economic development and render efficiencies in production, trade and utilization along charcoal value chain. Elements and key features of the ISCM model are described herein.

Formalized Charcoal producers and traders with legal recognition: The model emphasizes producers and traders to be formalized and legally recognized as legal business entities. The legal recognition and formalization would enable FBD and other actors (lower level institutions at district and village levels) to enforce the exclusion principle. The legal recognition provides incentives for producers to operate with confidence and comply with the laws that govern the charcoal sub-sector. Formalization would also include transporters (e.g. trucks, motorcycles and bicycles) on carrying charcoal.

Economic viability: The charcoal production and trade should be economically viable. The government and other actors along the value chain should have to oversee the business environment to enable the trade to be profitable. Profitability element will enable producers and traders to be supportive to sustainability of the charcoal production and trade i.e. reduces illegal charcoal trade.

Stable institutional framework: Charcoal production and trade should be based and supported by stable and robust institutional arrangements. The proposed model needs to be anchored on economically viable business institutions with in-built entrepreneur skills as one of incentive mechanism for sustainability. The institutions need to be owned by the forest resource owners, producers, transporters, whole-sellers, retailers and end-users but be regulated and controlled by the government and its agencies from national to local levels. Initially intensive regulation of these business institutions will be needed but with time market forces of demand and supply (with the right enabling environment by the state) should regulate the business.

Sustainable sources of raw materials: Current models have so far over depended on natural regeneration in community woodlots/forests/general land /farms as the main sources of raw materials with little forest management. The models have further over-depended on village level institutions and district authorities as controllers of the natural forests for sustainable supply of raw materials. This has failed in many parts of the country and deforestation has increased. It is emphasized that the charcoal wood from natural regeneration alone is not enough to satisfy the charcoal demand and hence unsustainable. The proposed model suggests that forest natural regeneration, sustainable harvesting techniques and protection of harvested areas against fire, grazing and agriculture should also be combined with establishment of charcoal plantations for sustainable supply of raw materials. This requires integrated land use planning at community level involving the entire key stakeholder. It is a pre-requisite that professional foresters provide constant technical backstopping to the producers. The model will also encourage the use of alternative materials for charcoal production including for example various types of briquettes. Finally the proposed model shall focus on both supply and demand sides of charcoal. A good number of models in operation today have often separated these two important aspects in relation to charcoal production and trade. That means interventions to ensure charcoal is utilized efficiently by end-users is paramount.

Access to alternative sources of energy and improved technology: The proposed model should consider improved access to alternative sources of energy and improved production and utilization technologies to reduce pressure on forests. Modern clean cooking alternatives such as biogas, availability of cost efficient electricity, LPGs and natural gas should be promoted at community level. Producers of alternative energy sources should be encouraged to come up with special packages and options affordable by urban poor segments of the society where charcoal is used.

Social acceptability: The model encouraged stakeholder involvement in the form of actor's platforms which need to be designed and instituted. Gender inclusive consideration and support to marginalized members of the society

shall be given due weight. Corporate social responsibility at producer level (e.g. charcoal incomes to support improvement of basic social services as incentives to sustainable production such as provision of National Health Insurance Fund, education, health infrastructures and support sustainable forest based enterprises) shall be observed by the charcoal economic entities at community level.

Efficiencies in charcoal production, trade and utilization along charcoal value chain: Charcoal kilns and stoves should be more efficient and communities should be more sensitive to wastage. Reducing wastage in production will lead to using less wood to produce charcoal. The model is emphasizing use of Improved Basic Earth Mound Kiln (IBEMK). This kiln has high yield with low time duration use little time in production. In places that have high biomass density with very short transportation of biomass use Half Orange Kiln is one of the requirements in this model. In areas with high amount of rice husks and saw dust use Simple Retort Kilns to carbonize loose materials (rice husks and saw dust) to charcoal. Reducing wastage by using Improved Cook Stoves (ICS) and home economics will lead to using less charcoal. Recommended ICS are Metal Ceramic Charcoal Stove with correct specifications.

Research, Monitoring and Evaluation: New information and lessons of experience need to be systematically studied, documented and used to improve integration in the charcoal sub-sector. Researchers should be supported to study the performance of the model in the field and recommend improvements. Equally, practitioners need to engage in effective monitoring and evaluation in order to perfect the model.

5.2 RECOMMENDATIONS

TF puts forward additional recommendations in terms of policy, operations and specific interventions relevant to various nodes in the value chain as follows:

Policy Recommendations:

Sustainability of charcoal sub-sector in the country could be improved by making use of ideas of various actors including previous recommendations from extensive reports that have been generated in the country. The following policies need to be revised and harmonised in order to make the charcoal sub sector more sustainable; National Forest Policy of 1998, National Energy Policy 2015, National Environmental Policy 1997, National Agriculture Policy of 2013 and National Land Policy of 1997 in addition to the policy framework around decentralization. Need for having a common vision for the charcoal sub sector should be emphasized during the revision process. The policies should explicitly support the principle of sustainability of the charcoal sub-sector in the country.

Specifically, the following recommendations can be embedded in various legislations including a revised Forest Act or through its subsidiary regulations:

- (i) Establishment of formal charcoal marketing centres in rural and urban areas (Depots) with high production. Charcoal should not be allowed to enter urban areas from points other than formally recognized marketing centres;
- (ii) Compounding illegal charcoal as a penalty should be followed with legal charges using Amendment of 2016 Section 88 and 89 of Forest Act;
- (iii) Formalization of the charcoal sub-sector, along its entire value chain, is in progress. However, more effort is required so as to have effective formalization. This includes identification of existing gaps in the laws and regulations, packaging materials, and tracking system. This should include formalization of transporters, such as trucks, motorcycles, and bicycles, while intensifying formal private sector engagement in the sub-sector;

- (iv) Stakeholders in the field suggested that charcoal royalty could be reduced from TZS 12,500 to TZS 7,500 per bag of 50kg. This will encourage compliance; however, should be accompanied with enhancement of law enforcement, sustainable resource management, production and utilization;
- (v) There is a need to have uniform packaging material of specified size and with a capacity of carrying 50kg of charcoal as required by regulations. This will be useful in charging royalty payments and monitoring compliances; and
- (vi) Efficient production and utilization of charcoal at the households, Institutions and Small and Medium Enterprises (SMEs) should be institutionalized in regulations.

Operation recommendations:

At operational level, much as the proposed charcoal business best practice model presents a summary and framework of the key elements that need to be taken into consideration for the sustainability of the charcoal sub-sector, the following specific recommendations are put forward to partially unpack some of the elements in the model. The recommendations are grouped into immediate, medium and long terms as follows:

Immediate Recommendations

- (i) Develop National Charcoal Policy to oversee production, marketing and utilization of charcoal in the country and the required strategy, regulations and institutional framework for implementation;
- (ii) Scale up CBFM in line with the recommended integrated model in this report for sustainable charcoal production, trade and utilization;

- (iii) Intensify use of improved kilns that match with local situation and incorporate them into laws;
- (iv) There is a need for continued awareness raising on efficient cooking technologies, kitchen energy management, legislation, guidelines, and other aspects relevant to the charcoal sub-sector;
- (v) Need to re-visit the values of royalties, fees and taxes along the charcoal value chain. These constitute production and trade costs which threaten the economic viability of investments in charcoal business and encourage illegal business which makes the government to lose substantial revenues; and
- (vi) In areas where development partners in collaboration with local institutions are piloting some models of integrated charcoal production, it is recommended that they adjust and accommodate proposed interventions in the Integrated Sustainable Charcoal Model (ISCM) for harmonization countrywide. Further, research should be applied to investigate the performance of the models in terms of natural regeneration (which trees regenerate faster, tree cutting and height of stumps and its impact on regeneration), and governance of resources including money and forest management against fire, grazing and agriculture encroachment, improved kilns, optimal kitchen management models, and value chain impacts of the of the integrated model.
- (vii) The Task Force recognises results revealed by the TFS brief research (TFS, 2019) which generally proposed to ban charcoal transportation using motorcycles. However, the proposal does not conform to existing Policy and laws. It is hereby proposed that motorcycles involved in charcoal transportation should be identified and registered to formalize them. In addition, during transportation special charcoal bags should be used. It is very important to establish the number of bags that a motorcycle can safely carry at a go. Control of motorcycles and use of special bags for charcoal transportation should be piloted in selected regions in the country including Dar es Salaam.

- (viii) Charcoal utilization technologies have low efficiency causing gratuitous high amount of charcoal consumption. However, use of Charcoal Saving Stoves has increased particularly in big cities such as Dar es Salaam. Awareness and increased production of the energy saving stoves should be done in the rest of cities and small towns in the country. Other technologies that reduce consumption of charcoal (e.g. Efficient Electric Pressure cooker) and LPG stoves should also be included in the awareness raising initiatives and increase their availability.
- (ix) There is an electronic tracking system which is under construction by TFS to control charcoal transportation. This idea is good. Although the system is still under construction, it is found to be very useful to control charcoal transportation within and outside the country. The system should be improved to enable controlling areas where charcoal is produced and how the charcoal is transported.
- (x) TATEDO prepared proposals of samples of types of improved cooking stoves and submitted to Tanzania Bureau of Standards in 2005. The purpose of this submission was for the TBS to legally approve standards for the improved cooking stoves. It is important that the Ministry of Natural Resources and Tourism, Ministry of Energy, Ministry of Industries and Trade and Vice President's Office Division of Environment to make follow up with TBS to ensure standards become available.
- (xi) All charcoal producers should use Improved Basic Earth Mound Kiln. This should legally enforced in the country. The kilns produces relatively high amount of charcoal for a short period of time and use fewer trees. In areas with high biomass density and low costs of transportation the MNRT should legally emphasize use of Half Orange Kiln as they are efficient. Although adoption and use of the improved cooking stoves and efficient kilns is very low in the country since their inventions, enabling policies that will ensured high production, marketing and adoption is inevitable

- (xii) In areas that have high amount of rice husks and saw dusts use of Simple Retort Kilns for charcoal production is a must and legislations should be formulated to enforce this.

Medium Term Recommendation

- (i) Ensure sustainable management and harvesting of wood resources from different sources;
- (ii) Scale up production and utilization of biomass alternatives (briquettes, ethanol and biogas);
- (iii) Scale up promotion and utilization of non-biomass alternatives (LPG, Kerosene, electricity, and natural gas);
- (iv) It is very important to have a best system for managing charcoal production including use of ISCM so that its implementation should not be a cause for increase in charcoal production and utilization. Therefore, it is important to formulate a National Charcoal Policy which will manage formalization, identification and registration of charcoal traders and install a plan to monitor implementation of ISCM;
- (v) Improve management of charcoal producing areas. The village forests where charcoal is produced should be formally registered and gazetted; and
- (vi) Harmonize policies, legislations and guidelines to reduce conflicting actions. For example, encroaching forests for agriculture activities and then produce charcoal without consideration of land use plans. Harmonize policies, legislations and guidelines.

Long Term Recommendations

- (i) There is need for integrated charcoal production, trade and utilization at community level involving all the key stakeholders in order to set aside land for charcoal production (potentially woodlots and plantations) in a sustainable manner;

- (ii) All forests established by the Government for woodfuel production e.g. Ruvu, Morogoro, Korogwe, Mbeya na Songea should be refurbished and abide to earlier intentions and produce charcaol;
- (iii) Encourage private sector to establish and develop forest plantations for charcoal production;
- (iv) Each region should identify suitable areas for establishing forest for purpose of charcoal production. Identification of the areas should adhere to the following criteria: (a) Land availability (b) Ensure existence of intended tree species flourishing in the area and suit the weather of that place in accordance to the TAFORI Guidelines (c) The land where a forest plantation(s) will be established should be nearby charcoal markets (d) Forest plantation size should depend on ability of the region to acquire land (e) Ownership and management of the forest plantation(s) could be inform of Public Private Partnership, district authority, private ownership, company or an individual ownership; and
- (v) Research the use of alternative raw materials for charcoal production.

Specific recommendations to the nodes along the chain:

As the TF puts forward these specific policy recommendations along the value chain, note is taken of the fact that some cross cutting demands exist as pre-requisites for the proposed policy options to serve their purpose. Such cross cutting requirements include for example good and genuine political will to transform the charcoal sub-sector, existence of supportive legal frameworks, intensified research and development in all the segments of the value chain and finally control of corruption in the natural resources sector. The specific recommendations are summarised in the following matrix:

Elements of charcoal value chain	Policy recommendations
Sources of raw materials	<ul style="list-style-type: none"> • Widen sources of raw materials e.g. establishment of plantation, wattle woodlots and agroforestry for charcoal production (e.g. in Njombe district) and briquette. • Enhance forest tenure and governance systems (e.g. establishment of CBFM). • Cost efficient land use plans need to be instituted. • Scale up best practices of charcoal production.
Harvesting practices	<ul style="list-style-type: none"> • Need for compliance to forest management and harvesting plan requirement to forests. • Harvesting guidelines should be developed and instituted to include regeneration in natural forest. • Management of the harvested areas to ensure forest regeneration should be done.
Charcoal production	<ul style="list-style-type: none"> • Need to have technologies of choice in the country that will be supported by the law. • Formation of (registration) of charcoal producers associations. • Establish /designate areas for charcoal production. • Assign value to unreserved forest trees resources on village lands which are prone to conversion to other land uses. • Reduce number of fees/taxes in the charcoal sub-sector.
Local market	<ul style="list-style-type: none"> • Establish and institute charcoal market centres. • Establish regulating organ that will check charcoal business at different levels. • Introduce standard and peculiar packaging material.

Elements of charcoal value chain	Policy recommendations
Transport	<ul style="list-style-type: none"> • Review the current royalty rate to affordable level. • Need for standardising licensing procedure and associated costs. • Formalise and register transporters e.g. motorcycles (e.g. some Morogoro motorcycles have been registered). • Harmonise and enforce transportation regulations (e.g. motorcycles and bicycles). • Establish and institute electronic tracking in check points. • Improve infrastructure of the checkpoints. • Reduce number of fees/taxes.
Wholesalers	<ul style="list-style-type: none"> • Formalise and protect them from illegal dealers. • Reduce number of fees/taxes.
Retailers	<ul style="list-style-type: none"> • Formalise and protect them from illegal dealers.
End use/consumers	<ul style="list-style-type: none"> • Use efficient technologies of choice in the countries that are supported by the law. • Encourage energy mix and switching to reduce over dependence on charcoal. • Government to provide enabling environment for charcoal substitution ins subsidise alternative energy.

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APPENDICES

Appendix I: Checklists Used to Collect Data from Stakeholders

A1: Assessment of the charcoal production system(s) (models)

- 0.1 List the charcoal production models available in your area
- 0.2 What is the sources of raw materials for charcoal production:
- 0.3 Which raw materials is used
- 0.4 Is there areas designated for charcoal production,
- 0.5 Is there management plans and or harvesting plans?
- 0.6 Which technologies is used
- 0.7 What is the efficiency, recovery and sustainability of the technology?
- 0.8 What is the productivity of the system i.e. amount of charcoal produced per year by various actors within the system,
- 0.9 What is the percentage of legally and illegally produced charcoal,
- 0.10 What is the proportion of actors involved in charcoal business along the value chain?
- 0.11 How much is generated as revenue from charcoal
- 0.12 Is there benefit sharing among key stakeholders:
- 0.13 Is there revenue collection system including issuance of receipts and bookkeeping, presence of bank account with dual signatory protocols and monitoring of revenues

- 0.14 How the distribution of collected revenues among actors is done
- 0.15 What percentage of the revenues re-invested in to forest management;
- 0.16 How is conflict management arranged
- 0.17 How is the institutional arrangements/governance structures supporting the system: Involved institutions in the process,
- 0.18 What are the strengths and weaknesses of the guidelines governing the system?

B1: Assess existing charcoal model(s) and advice on relevancy, efficiency and adoption

Existing charcoal models will be assessed based on data collected under Task 1.

C1: Charcoal value chain of the models

- 0.1 Please map the value chain of charcoal?
- 0.2 List value addition activities at various stages in the chain?
- 0.3 What gender roles in the value chain?
- 0.4 What is the price of charcoal at each node?
- 0.5 Provide statistics of charcoal bags and revenue collect for five years starting 2013/2014
- 0.6 Compare charcoal revenues collected relative to all revenues in the district council
- 0.7 What is the amount of revenues invested in natural forest management relative to all revenues invested in forest plantations management

D1: Possibility of establishing plantations for charcoal production

- 0.1 Which suitable tree species for charcoal production advice
- 0.2 Proposal land tenure arrangements for the plantation/woodlots;
- 0.3 Is there land available for the plantation establishment
- 0.4 Which suitable production technologies can be used;
- 0.5 Provide gender roles in the establishment of woodlots/plantation
- 0.6 Are there any lessons from neighbouring countries on establishment of charcoal plantation?

E1: Propose an optimal model(s) for scaling-up in the country that consider policy, environmental and socioeconomic factors

This objective will be achieved based on objectives 1 to 4 findings.

A2: Legal and institutional frameworks limit sustainable charcoal sub-sector

- 0.1 How charcoal production and trade records are kept i.e. is there records specific on productions of charcoal?
- 0.2 Do the forest management plans have itemized harvesting zones?
- 0.3 Does the village own Village Land Forest Reserve (VLFR)?
- 0.4 As charcoal producer, do you have licence?
- 0.5 Do the villages discuss applications for charcoal production in meetings?
- 0.6 How many times in a year does forest officer monitor implementation of the forest management plans?
- 0.7 Is there sustainable charcoal production initiative in the village?

- 0.8 Who issues permits, licenses, who registers traders, who issues TPs;
- 0.9 What is the source of charcoal,
- 0.10 Do you have any constraints to charcoal trade?
- 0.11 What is the level of taxation to village and state how best to improve
- 0.12 List all past recommendations from evaluations of the charcoal industry (ask districts, regional and national level stakeholders)?
- 0.13 Explain applicability of the MoU regarding local government and central government regulation of the forestry sector

B2: Weaknesses of the current control mechanisms in the charcoal sub-sector taking into consideration illegal exportation and importation of charcoal¹

- 0.1 What do literatures say about forest trade and revenue collection and assessments, focusing on recommendations made and understanding the constraints to timely and effective implementation (this is not for asking stakeholder but get information from literature review)?
- 0.2 Do you have documentation regarding revenue collected, permits and licenses applications and number issued, targets for charcoal trade, charcoal confiscated and revenues from disposition through auctions at TFS headquarters, selected district offices, TFS zonal offices and check points

¹ Assess the extent to which current controls (including documentation) on charcoal export to neighbouring countries (and imports) respond to controlling illegality (Reference should be made to agreements has with other countries).

- 0.3 What constraints have prevented recommendations from several reports regarding improvements to the control and revenue collection system being implemented in a timely manner?
- 0.4 What is the procedure for charcoal crossing border trade?
- 0.5 What amount of charcoal recorded crossing borders
- 0.6 What amount of charcoal cross border to Mozambique, Zambia and DRC?
- 0.7 What amount of ocean based charcoal trade to Zanzibar and beyond

D2: Weaknesses of legal frameworks supporting the incentive structure in the charcoal sub-sector, and propose improvement mechanism

Charcoal producers

- 0.1 a) Do you know laws/regulations regarding charcoal production?
- 0.2 b) If yes, how do they affect your production? Suggest improvement
- 0.3 c) If No, do you prefer to know them? Will they help you?

Charcoal dealers

- 0.4 Do you know laws/regulations regarding charcoal business?
- 0.5 b) If yes, how do they affect your business? Suggest improvement
- 0.6 c) If No, do you prefer to know them? Will they help you?

DFOs and Central Government (MNRT, VPO, ME, PORALG etc.)

- 0.7 What are the existing regulations
- 0.8 How to you ensure laws, regulations and guidelines reach the audience with the same interpretations?
- 0.9 How do you collect reflections from the audience on the laws, regulations etc
- 0.10 How do you ensure that strategies and regulations are adapted to local realities for implementation purposes?
- 0.11 How is the EMMA having impact on charcoal sub sector?
- 0.12 What is the role of VPO/ME/PORALG/MNRT in the charcoal subsector?
- 0.13 What has been done to harmonize the charcoal sub sector coordination?

CSOs, Development Partners, Academia/research institutions

- 0.14 Do you know laws/regulations regarding charcoal sub sector?
- 0.15 If yes, how do they affect your work? Suggest improvement
- 0.16 If No, do you prefer to know them? Will they help you?
- 0.17 What efforts have you taken to improve them?
- 0.18 What is the constraints to the existing charcoal trade and to possibilities of trading in sustainable charcoal
- 0.19 Please suggest incentives to ensure sustainable charcoal

E2: Barriers affecting alternative energy switching in the country

Household

- 0.1 What type of energy/s is used for cooking and other needs?
- 0.2 What influences your decision to use the type of cooking energy?
- 0.3 What is the cost of cooking energy?
- 0.4 What amount of the cooking energy do you use in a month (charcoal, LPG etc)
- 0.5 Which one do you prefer and why?
- 0.6 How long have you been using the energy source? Has been any shift over time?
- 0.7 What types of cooking stoves have you being using?
- 0.8 Would you prefer to use alternative energy sources?
- 0.9 Do you have any recommendations on energy switch?

Institutions

- 0.10 What type of energy/s is used for cooking and other needs?
- 0.11 What influences your decision to use the type of cooking energy?
- 0.12 How and where do you get cooking energy and at what cost?
- 0.13 How long have you been using the energy source? Has it been any shift over time?
- 0.14 What type of cooking stove have you being using?
- 0.15 What is your preference on cooking energy use and why?
- 0.16 Would you prefer to use alternative energy sources?
- 0.17 Do you have any recommendations on energy switch?

SMEs

0.18 What type of energy/s is used for cooking and other needs?.

0.19 What influences your decision to use the type of cooking energy?

0.20 How and where do you get cooking energy and at what cost?

0.21 How long have you been using the energy source? Has it been any shift over time?

0.22 What type of cooking stoves have you being using?

0.23 What is your preference on cooking energy use and why?

0.24 Would you prefer to use alternative energy sources?

0.25 Do you have any recommendations on energy switch?

Local and Central Authorities (DFOs, DFM, MNRT, ME, VPO, PORALG)

0.26 Are there any laws/regulations/policy instruments which encourage fuel switch?

0.27 How do you implement the policy instruments to ensure they have impacts?

0.28 What have been the impact of control mechanisms (e.g. charcoal and transportation bans)

0.29 There have been several recommendations on energy switch. How have been the implementations of such recommendations?

0.30 Are there existing programmes and budgets to ensure energy switch?

0.31 Do you have any recommendations on energy switch?

CSOs/Academicians/Research Institutions

- 0.32 Are you aware of the policies/strategies/regulations which facilitate energy switch?
- 0.33 If yes, what are your roles to ensure implementation of energy switch?
- 0.34 What are the challenges encountered and how do you address them?
- 0.35 Do you have any recommendations on energy switch? And talk on: Affordable, Availability, Reliability and Cultural acceptability
- 0.36 What do you recommend on best ways to ensure energy switching and fuel tree plantations establishment?
- 0.37 Provide your insights on energy for cooking, retail sellers of LPG and solar panels

A3: Stakeholders' mapping/identification

- 0.1 Name of stakeholder involved in charcoal sub sector in your area.....
- 0.2 Location and address of the stakeholder.....
- 0.3 List activities² perform by the stakeholder in the charcoal sub sector.....
- 0.4 Which other stakeholders are you engaging with.....
- 0.5 What is the inter-relation³ with other the stakeholders.....

2 Law enforcer, transporter, forest owner, facilitator, trainer, agent/middleman etc

3 How they are connected and affectone another

- 0.6 What is the power relations between the stakeholder and others i.e. the strength of the stakeholder in the charcoal sub sector or level of importance of the stakeholder in the charcoal sub sector: 1= High, 2 = Moderate and 3 = Low
- 0.7 What are the potential conflicts of interest and risks for implementation of sustainable charcoal initiatives.....
- 0.8 How can we engage the stakeholder to ensure sustainability of the charcoal sub sector.....

B3: Factors influencing investment opportunities in the charcoal sub sector

- 0.8.1 List the investment opportunities within the charcoal sub sector.....
- 0.9 What limits stakeholders to engage in sustainable charcoal?.....
- 0.10 What is the level of investment required e.g. capital goods - for example, machines, offices; new technology for one to engage in sustainable charcoal
- 0.11 How sustainable charcoal versus those produced unsustainably can be distinguished to win the market niche.....
- 0.12 List strategies that needs to be in place to ensure that sustainable charcoal contributes to the socio-economic of actors along the value chain.....

C3: Role of transport sector and propose mechanisms that would help government to control illegality

- 0.13 What is the dominant transportation modes used along the value chain.....
- 0.14 List challenges embedded in the charcoal transportation mode.....
- 0.15 What do the regulations (e.g. SUMATRA, Forest Act 2002, Road Traffic Act 2017) say regarding transportation of charcoal and mode of transport.....
- 0.16 What is the level of compliance on rules and regulations regarding transportation of charcoal.....
- 0.17 How sustainable charcoal can be transported without affecting its market prices.....

D3: Revenue collection methods and areas of improvement to enhance compliance

- 0.18 Please share with us the amount and trend (five years) of revenue collection per annum in the charcoal sub sector.....
- 0.19 What challenges facing revenue collections in the charcoal sub sector.....
- 0.20 List revenues collection systems in your area.....
- 0.21 Are the revenue collection systems effective?.....
- 0.22 To what extent are you using EFD machines, TIN numbers, payment through bank and other e-payment system.....
- 0.23 What is your perception on the approved royalty rates and fees and alternative selling mechanism on charcoal.....
- 0.24 How can revenue collection be improved.....

- 0.25 List constraints/challenges preventing adoption of the past studies recommendations and best practices on charcoal.....
- 0.26 How should the marketing structure of charcoal be in order to increase control and benefit the producers.....

E3: Establish relevance and justification for charcoal policy

- 0.27 List key limitations of existing policies and its related instruments (policies, acts, regulations and guidelines) on charcoal sub sector.....
- 0.28 Do we need a Charcoal specific Policy or Biomass Energy Policy?
- 0.29 If Yes, why?.....
- 0.30 If No, Why?.....
- 0.31 Suggest policy area for dealing with charcoal production, consumption (domestic use), distribution, environmental impact and economic benefits.....
- 0.32 Suggest policy area for protecting sustainable charcoal against unsustainable charcoal.....
- 0.33 Suggest policy area for ensuring efficient/effective collection of revenues from sustainably produced charcoal.....
- 0.34 Suggest policy area for protection of the forest area sustainably harvested charcoal.....
- 0.35 Suggest policy area for ensure biodiversity conservation in the area sustainable charcoal is produced.....
- 0.36 Suggest policy area for dealing with charcoal benefit sharing (equitable distribution of benefits.....
- 0.37 List strategies and regulatory framework that is required to ensure good governance on charcoal sub sector.....

Appendix II: Checklists for Data Collection from End-Users

QUESTIONNAIRE D: CHARCOAL USERS/ Consumer		Household
Telephone:		
Email:		
Completed by the enumerator	Questionnaire No:	Date: Time:
	Town:	District:
Details of the respondent	House No:	
	Respondent Name:	
	Telephone:	
	Email:	
	Resident:	
Part 1: Overview of Household		
i.	How long have you lived here? (years)	
ii.	Do you own this house? Yes/No	
iii.	Do you rent this house? Yes/No	
iv.	How many rooms does this house have? (number)	
v.	How many people sleep in this house regularly? (number)	
vi.	What energy sources do you use for cooking? (tick all appropriate) a) Electricity b) LPG c) Kerosene d) Charcoal e) Firewood f) Other (specify)	
vii.	What source of energy do you use primarily for cooking? (specify)	
Part 2: Charcoal Demand		
i.	How many bags of charcoal do you purchase per month? How often do you purchase charcoal? (tick appropriate) 1. Every day 2. Every few days 3. Once a week 4. Once more than a week	

ii.	How much charcoal do you buy each time you purchase charcoal (number) a) small debe b) medium debe c) large debe d) Bag (gunia/sisal bag) If bag, give estimated weight of bag: _____ kg
iii.	How much do you pay per bag? (Tshs) a) small debe b) medium debe c) large debe d) Bag (gunia/sisal bag)
iv.	Where do you purchase your charcoal? a) From door-to-door sellers b) From street sellers c) From small local shops (dukas) d) From large charcoal sellers e) Other (specify)
v.	How many charcoal suppliers do you buy from in any month? (tick appropriate) a) One b) Two c) More (specify)
Part 3: Charcoal Supply	
i.	a) Has charcoal price changed since this time last year? Yes/no b) If yes, how much has charcoal price changed since this time last year (estimate)?
ii.	Is charcoal supply reliable? Yes/no
Part 4: Sources of Charcoal Supply	
i.	Do you know where your charcoal comes from? Yes/no
ii.	If yes, where does the charcoal come from (district)
iii.	From what source does charcoal come from: a. Soft wood b. Hard wood c. Natural forest d. Planted forest e. Forest reserve f. Non-reserve forest g. Don't know
iv.	Do you have any idea how charcoal is produced (yes, no)

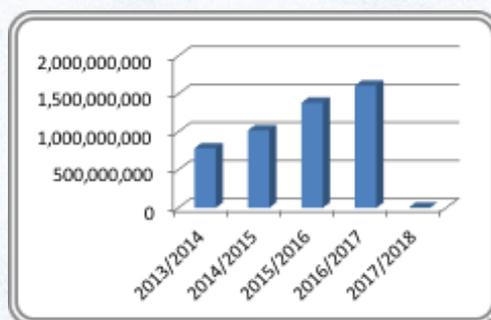
Part 5. Sustainable Charcoal (<i>Enumerator: Explain in more detail what sustainable charcoal is, what makes it "sustainable"</i>)	
i.	a) Have you ever heard of sustainable charcoal? Yes/No b) If yes, how did you learn about sustainable charcoal? (Tick one) <ul style="list-style-type: none"> • Radio/TV adverts • Workshop/seminar • Word of mouth • Brochures/posters • During a market visit • Other (please state)
ii.	a) Do you know whether the charcoal you currently buy is sustainably produced or not? Yes/no b) If yes, from whom do you buy it? (name, company) c) If yes, for how long have you been buying it? d) If yes, how much do you pay per bag (equivalent) for the sustainable charcoal? Tsh/bag e) If yes, are you happy with the sustainable charcoal? Yes/no f) If no, why are you are you not happy with sustainable charcoal (short answer)?
iii.	a) Have you ever bought sustainably produced charcoal in the past? Yes/no b) If yes, from whom did you buy it? (Name, company, etc.) c) If yes, when did you buy it? (year) d) If yes, were you satisfied with it? e) If you were not satisfied with the charcoal, why were you not satisfied? (short answer)
iv.	a) Do you know anyone who is using sustainably produced charcoal? b) If yes, please tell us who. (name)
Part 7: Other Questions	
	Please list three things that you would want to change to make the charcoal sector work better for you? 1 2 3

ii.	List three things that would make the charcoal sector work better overall? 1 2 3
iii.	The charcoal sector, from charcoal production to charcoal transport to charcoal selling is very “informal” (not organised). What do you think should be done or could be done to organise the entire charcoal sector?
	a) Do you care whether charcoal is sustainably-produced or not? Yes/no b) If you care, why do you care? (short answer)
	a) Do you think current charcoal production is good for the environment? Yes/no b) If no, why do you think it is not good for the environment? c) If no, how would you suggest making charcoal better for the environment?
	Do you think that “certifying” charcoal (e.g., where it is produced, from what sources it is produced, whether it is sustainably produced, etc would be a good thing? Yes/No
	If yes, why do you think charcoal certification would be a good thing? (short answer)
	What would convince you that “certified” charcoal was sustainably-produced? (tick each relevant box) 1. Tanzania Bureau of Standards (TBS) label saying charcoal was sustainably-produced 2. Label showing district authorities had certified charcoal as sustainable 3. Label from a non-government organisation (name the organisation) that the charcoal was sustainably-produced 4. Label from central government ministry or agency (name the agency) that the charcoal was sustainably-produced? 5. Other (please state): 6. 7. Nothing would convince me on a label that charcoal was sustainably produced? 8. If nothing, why would no label would convince you that charcoal was sustainably produced?
	Other – Please feel free to add any comments or questions

Appendix III: Charcoal Revenues at Zonal Level

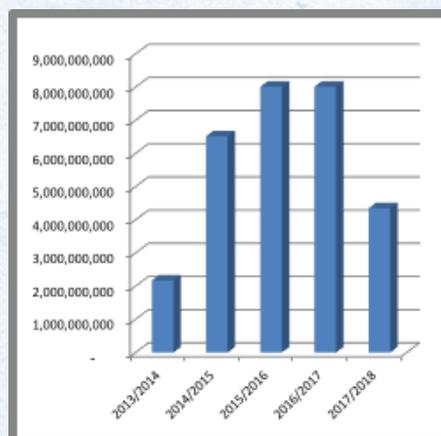
A. Central Zone

Year	Revenue in TZS	Bags (50 kg bag)
2013/2014	784,025,709	98,003
2014/2015	1,020,173,628.63	81,614
2015/2016	1,384,136,418.17	110,731
2016/2017	1,608,567,188.20	128,685
2017/2018	1,735,683,550.00	138,855
Total	4,798,638,627.55	557,888



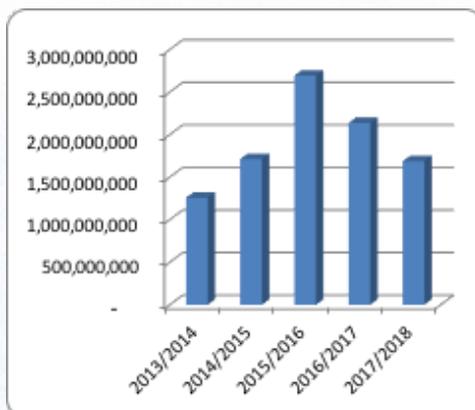
B. Eastern Zone

Year	Revenue in TZS	Bags (50 kg bag)
2013/2014	2,171,100,771.12	173,688
2014/2015	6,516,602,308.42	521,328
2015/2016	8,009,271,425.45	640,742
2016/2017	8,010,132,760.00	640,811
2017/2018	4,349,536,683.00	347,963
TOTAL	29,056,643,947.99	2,324,532



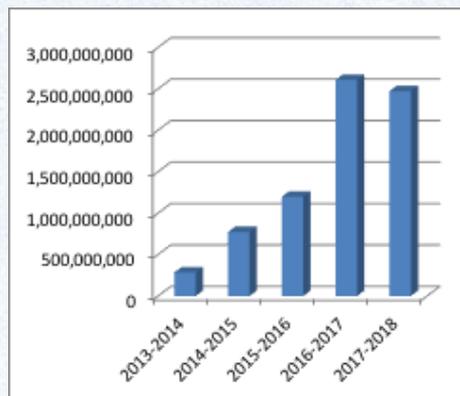
C. LAKE ZONE

Year	Revenue in TZS	Bags (50 kg bag)
2013/2014	1,258,588,536	157,324
2014/2015	1,712,135,730	214,017
2015/2016	2,693,175,014	243,359
2016/2017	2,136,343,788	193,043
2017/2018	1,686,933,940	134,955
TOTAL	9,487,177,008	942,698



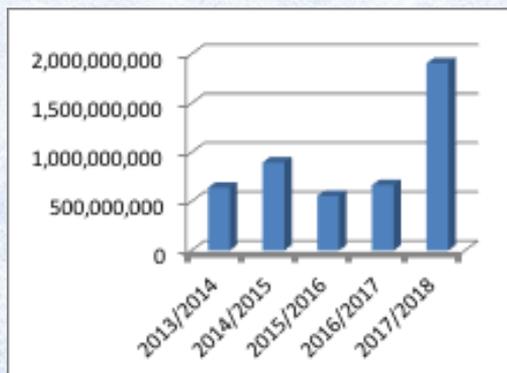
D. NORTHERN ZONE

Year	Revenue in TZS	Bags (50 kg bag)
2013-2014	283,768,163	20,269
2014-2015	773,038,932	48,315
2015-2016	1,197,699,545	74,856
2016-2017	2,606,975,316	162,936
2017-2018	2,470,588,958	197,647
TOTAL	7,332,070,914	504,023



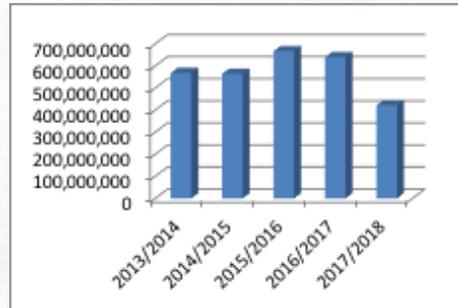
E. SOUTHERN HIGHLANDS

Year	Revenue in TZS	Bags (50 kg bag)
2013/2014	640,374,625	59,100
2014/2015	897,203,520	70,722
2015/2016	555,407,400	51,283
2016/2017	665,848,680	79,497
2017/2018	1,906,302,591	110,219
TOTAL	4,665,136,816	370,821



F. SOUTHERN ZONE

Year	Revenue in TZS	Bags (50 kg bag)
2013/2014	568,023,936	45,442
2014/2015	564,454,941.67	45,156.40
2015/2016	666,709,427.56	53,336.80
2016/2017	639,977,472.14	51,198.20
2017/2018	421,717,805.28	33,737.40
TOTAL	2,860,883,583	228,870.80



Appendix IV: Transforming Tanzania's Charcoal Sector Project

Introduction

With funding from Swiss Agency for Development and Cooperation (SDC), Transforming Tanzania's Charcoal Sector (TTCS) project is implemented by Tanzania Forest Conservation Group (TFCG) in partnership with *Mtandao wa Jamii wa Usimamizi wa Misitu Tanzania* (MJUMITA) and Tanzania Traditional Energy Development Organization (TaTEDO). The project started in March 2012 for its first phase which ended in November 2015 in 10 villages in Kilosa. The second phase started in December 2015 and will end up in November 2019. The second phase covers 30 villages: 20 villages in Kilosa District (including 10 phase 1 villages and 10 new additional villages), 5 villages each in Morogoro and Mvomero Districts.

The project goal is 'a pro-poor and climate resilient transformation of the economics and governance of charcoal and other forest product value chains'. The TTCS project has two interlinked outcomes:

Outcome 1: Sustainable and well governed value chains for charcoal and other forest products improve rural livelihoods, climate change resilience and social services in the three districts of Kilosa, Morogoro and Mvomero.

Outcome 2: An enabling and supportive policy and institutional framework exists for well-governed, environmentally sustainable and pro-poor charcoal and other forest product value chains.

The TTCS Sustainable Charcoal Model

The TTCS Sustainable Charcoal model aims to establish a real-life, pro-poor, sustainable charcoal value chain that provides self-employment opportunities; contributes to investment in community development; and incentivizes more sustainable management of natural woodlands.

How does the model work?

As a first step, a village prepares a village land use plan that includes a village land forest reserve. The reserve should be at least 1,000 hectares, and should include areas of mature woodland. The community prepares the management plan and by-laws for the village forest reserve. Procedures for doing this are well-established thanks to Tanzania's long history with community based forest management. The management plan designates 'forest management units' (FMUs) as areas for sustainable charcoal production. The number of FMUs varies between villages from one to three depending on the size and distribution of the reserve. In Kilosa, approximately 10% of the area of each village forest reserve is designated for charcoal production. The remaining 90% is for protection, beekeeping and in a few cases selective timber harvesting. The rotation period in Kilosa is 24 years. This means that an area harvested in the first year, will only be harvested again after 23 years. It also means that up to 1/24 or 4.17% of the harvestable area can be used in any one year. The charcoal FMUs are divided up into 50 m x 50 m blocks known as coupes. 4.17% of these coupes can be harvested each year. Care is taken to distribute harvesting across different parts of the FMU each year in order to avoid risks of environmental damage from 'clear-felling' a larger area. The average yield per coupe is calculated based on assessment of available biomass. The sustainable yield per coupe multiplied by the number of harvestable coupes per year establishes the annual charcoal quota and potential revenue for the village. Potential annual revenues range from TZS 13 million to TZS 73 million per village. The boundaries of the coupe are marked out by the Village Natural Resources Committee (VNRC) and producers are only permitted to produce charcoal within the coupe allocated to them. Importantly, all other coupes are protected in order to allow the woodland to regenerate. This means excluding fire for at least the first two years after harvesting. Grazing of livestock is controlled and agriculture is prohibited. Trees are cut at knee height (~50 cm) leaving behind the stump and roots. This encourages coppicing.

How does the permitting system work?

First, a prospective charcoal producer needs to join the village charcoal producer association. In order to join the association, a producer needs to demonstrate that s/he understands the rules guiding the model including the use of improved basic-earth kilns. The associations are registered with the Tanzania Forest Services Agency (TFS) and pay an annual registration fee to TFS. A producer will then agree with a trader on an amount of charcoal to be sold. Provided that this is within the annual quota for the village, the trader will then pay a fee to the VNRC per bag of charcoal to be produced. The VNRC then issues a receipt for the fee; and permits for the producer to enter the reserve; and to produce the charcoal. The fee per bag in Kilosa varies between villages from TZS 3,000 to TZS 6,750 per 50 kg bag. The producer then cuts the trees and prepares the kiln within the designated coupe. The VNRC check compliance. The District collects TZS 2,000 as Cess per 50 kg bag of sustainable charcoal.

The transporter then collects the charcoal from the reserve. Every transporter needs to get a transit permit from TFS prior to transportation. The bag is then transported, accompanied by a transit permit and production license. These permits indicate that the bag has come from a village forest reserve. This means that the TFS staff can recognize it as being exempt from royalties; and can allow it to pass through the natural resources check-points along the national highway.

So far the project has trained over 600 producers to produce charcoal using the more energy-efficient, improved basic-earth kilns. Since 2013 up to 2018, the producers have produced and sell over 6,500 tonnes of legal, sustainable charcoal and have obtained an income of more than TZS 800 million from the sale of the charcoal and the villages have obtained a royalty of more than TZS 1.1 billion from the sustainable charcoal sold. This brings the total sales to TZS 1.9 billion.

The TTCS model is supported by local and central government actors who recognize the validity of the village-issued permits. For example

FBD provided the communities with their official permit books, receipts and revenue tracking documents. Similarly Kilosa district forest officers have participated in every stage of piloting the model.

What happens to the money that is paid to the village?

The decisions about how the revenue to the village is spent are made in village assembly meetings. Some of the money is used to cover the costs of managing the village forest reserve and overseeing the sustainable charcoal model. Costs include patrols and equipment for the patrol teams and VNRC members. For example in Ihombwe village the VNRC have purchased a motorbike and uniforms for the patrol team. The remainder can be invested in community development projects. For example Ihombwe Village constructed a house for the Doctor working in their health clinic; whilst Ihombwe and Ulaya Mbuyuni villages purchased health insurance for all residents of the village.

Lessons learnt

- Charcoal and timber can be produced sustainably from well-managed village forest reserves.
- Sustainable charcoal and timber can contribute to national development priorities including high quality livelihoods; good governance; and economic growth.
- Scaling-up production from piloting sites in Morogoro, requires political support from PO RALG, LGAs and other Ministries.
- Cooperation, open dialogue and a solutions-oriented mindset are needed to bring about positive change and sustainability in the trade in charcoal and timber from village forests.

Major Challenges

- Absence of charcoal policy/biomass energy policy.
- Widespread presence of illegal charcoal affects scalability of the model.

- Privatization/illegal selling of village lands.
- Uncontrolled grazing of cattle which cannot be solved at local level as pastoralist bypass the legal systems.

Recommendations (Way Forward)

- Choosing a more sustainable production model is better than business as usual.
- Support more communities to establish sustainable charcoal production and CBFM.
- Engage with private sector.
- Support sustainable charcoal production as well as strategies to improve efficiency along the value chain, including in consumption.
- Support fuel-switching to high potential fuels including LPG and briquettes.
- Review the taxes / royalties and other government revenues on all types of cooking energy in order to 'level the playing field'.
- Rationalise TFS revenue target-setting to reflect potential revenues from legal, sustainable harvesting, rather than historical rates.

Appendix V: List of Contacted Stakeholders

No.	Name	Designation	Place	Phone Number
Tabora & Shinyanga Regions				
1	Antony Mbunda	Ag TFS Manager	Western Zone	0754529753
2	Aggrey Mwandry	Regional Commissioner	Tabora	
3	Yobu Kiyungo	Coordinator Miombo Woodlands Project	Tabora Regional Secretariat	0756239818
4	Kuja Na Kushoka Tools Manufactures Group Company	DIRECTOR	Tabora	0754431522
5	Maneno Keye	M/Kiti Kitongoji Barazani	Isenefu Village - Uyui DC	0786582492
6	Lewi Chiwani	VEO	Isenefu Village- Uyui DC	0787261413
7	Fauston Wilson Mpango	Charcoal Trader		0755417152
8	Alii Mtundu	Village Game Officer	Isenefu Village -Uyui DC	0784248622
9	Crispinus Ngaiza Kyobya	Charcoal Maker	Isenefu Village	0787044848
10	KIKUNDI CHA WATENGENEZA MKA MBADALA	Ilolangulu Village	Ilolangulu Village	
11	Elish A Bahiga	Charcoal Transporter	Urambo Town	0785749169
12	Aizak Matata	Wholesalers	Kitongoji Cha Tumaini -Tologo- Urambo Town	0685168251
13	Albert Msovela	Regional Administrative Secretary (RAS)	Shinyanga	0767415847
14	Elias Fabian	Charcoal Transporter	Nhimbo Village - Msalala DC	
15	Joakim Muhalikwa	Charcoal Transporter	Bukunda Village - Msalala DC	
16	Godfrey Nyerere	Charcoal Transporter Bicycle	Bukunda Village - Msalala DC	

No.	Name	Designation	Place	Phone Number
17	Adam Dalali	Charcoal Transporter Bicycle	Mhungula Village - Kahama	
18	Juma Daud	Charcoal Transporter Bicycle	Sofi Village - Ushetu DC	
19	Kashindeye Selasini	Charcoal Transporter Bicycle	Kwabwalule - Ushetu	
20	Dickson Elias	Charcoal Transporter Bicycle	Chona Village -Ushetu DC	
21	Moshi Shija	Charcoal Transporter Bicycle	Busoli Village -Ushetu DC	
22	Zuberi Moshi	Charcoal Transporter Bicycle	Mungula Village -Kahama	
23	Rachael Ernest	Charcoal Retailer	Mtaa Wa Nyahanga -Kahama TC	
24	Mbaji Frenk	Charcoal Retailer	Mtaa Wa Nyahanga -Kahama TC	
25	John Hamis	Charcoal Retailer	Mtaa Wa Nyahanga -Kahama TC	
26	Lusana C Shihuma	Superintendent Prisons (Sp)	District Prison -Kahama	0784760029
27	Kahama School Of Nursing	Charcoal Users	Kahama Town Council	028-2710039
28	Mariam Mesha	Charcoal User -Hotel Business	Kahama TC	0757588448

Lindi Region

1	Zawadi J. Jilala	Regional Natural Resources Officer	Lindi	0788 604192
2	James Kabuta	District Forest Officer	Ruangwa (DC)	0562 756063
3	Mary D. Maeda	Forest Assistant li	Ruangwa (TFS)	0654 544678
4	Richard Elibariki	District Forest Officer	Liwale (DC)	0753 781529
5	Gaudence F. Munga	District Forest Manager	Liwale (TFS)	0758 918390

No.	Name	Designation	Place	Phone Number
6	Joseph Denis Mwangwone	District Forest Manager	Nachingwea (TFS)	0677 452611
7	Paiton A. Kamnana	District Forest Officer	Nachingwea (DC)	0713 203703
8	Zephania A. Mayalla	Forest Assistant li	Lindi (TFS)	0714 360131
9	Jumbe A. Kawambwa	Ag. AAS-Uchumi	Lindi	0787 473666
10	Mohamed A. Chimbuli	Assistant Forest Officer	Lindi (MC)	0787 256229
11	Swaumu R. Sambala	Assistant Forest Officer li	Lindi (DC)	0682 230447
12	Ally Ismail	Charcoal Dealer	Lindi (MC)	0628 701552
13	Miza Salum	Charcoal Dealer	Lindi (MC)	0658 495584
14	Other names? Kashenge	District Forest Manager	Kilwa (TFS)	0784 503273
15	Danford Mwaiteleke	Forest Officer	Kilwa (TFS)	0784 664012
16	Abushiri H. Mbwana	District Beekeeping Office	Kilwa (DC)	0782 681216
17	Njabha Lyatura	Forest Officer	Kilwa (DC)	0762 512026
18	Raymond A. Ndumbalo	District Natural Resources Officer	Kilwa (DC)	0656 268539
19	Salama Dikson	Charcoal Dealer	Kilwa (DC)	0783 548398
20	Hemedi Mwichande	Chairman - Kiwawa Village	Kilwa (DC)	0688 335265
21	Bibie W. Shangwe	Veo - Kiwawa Village	Kilwa (DC)	0788 051609
22	Msangi Seleman	Manager - Mingoyo Saw Mill	Lindi (MC)	0715 525996
Mtwara Region				
23	Ronald N. Pangani	REGIONAL FOREST OFFICER	Mtwara	0656 045336
24	Libent R. Elizeus	FOREST OFFICER II	Mtwara (TFS)	0762 616617

No.	Name	Designation	Place	Phone Number
25	Lukumbuso J. Mbwilo	District Forest Officer	Newala (DC)	0784 594202
26	Anthony F. Mhame	Assistant Forest Officer	Newala (TFS)	0683 974502
27	Azizi Omari	District Forest Manager	Masasi (TFS)	0713 361670
28	Shabani A. Mkungwa	District Forest Officer	Masasi (DC)	0714 400265
29	Elibariki L. Muriatoi	District Forest Officer	Tandahimba (DC)	0767 143607
30	Revocatus M. Frumence	District Forest Manager	Tandahimba (TFS)	0784 341834
31	Ebrantino E. Mgiye	Tfs Southern Zone Manager	Masasi (TFS)	0754 817482
32	Azizi Omari	District Forest Manager	Masasi (TFS)	0713 361670
33	Agnes F. Namkodya	Charcoal Dealer	Masasi (DC)	0657 554855
34	Sigfried Millanzi	Forest Assistant	Masasi (TFS)	0787 141801
35	Omari Mdoka	Charcoal Dealer	Masasi (DC)	0652 756468
36	Nurudini Juma	Charcoal Dealer	Masasi (DC)	0656 461754
37	Hamisi Issa Selemani	Charcoal Dealer	Masasi (DC)	0684 157719
Ruvuma Region				
38	Africanus Chale	Regional Natural Resources Officer	Ruvuma	0713 772400
39	Cosmas Bernard	District Forest Officer	Madaba (DC)	
40	Vicent Mwafute	District Forest Officer	Mbinga (DC)	
41	Bugingo Bugingo	District Forest Officer	Nyasa (DC)	
42	Godrefy Luhimbo	District Forest Officer	Songea (MC)	
43	Kaunda	District Forest Officer	Songea (DC)	
44	Gervas Mwalilo	District Forest Officer	Namtumbo (DC)	

No.	Name	Designation	Place	Phone Number
45	Onesmo	District Forest Officer	Tunduru (DC)	
46	Omary Mbwambo	District Forest Manager	Songea (TFS)	
47	Festo Chaula	District Forest Manager	Mbinga (TFS)	
48	John Elisha	District Forest Manager	Nyasa (TFS)	
49	Debora Mwakasya	District Forest Manager	Tunduru (TFS)	
50	Elibedius Mutalemwa	District Forest Manager	Namtumbo (TFS)	
Eastern Zone				
1	Aloyce Kilemwa	DFO Temeke		0787566454
2	Ms Dyaga Mkomwa	DFM Temeke		0767415253
3	Emmanuel Maganga	DFO Ilala		0716228203
4	January Amos	AG DFO Kigamboni		0765277694
5	Ms Agnes Ngailo	AG DFO Ilala		0716669528
6	Ms Sikujua Mwapinga	DNRO Ubungo		0717063495
7	Peter M. Ishengoma	Accountant - TFS		0753665109
8	Mr. Arijanson Mloge	Surveillance Officer - TFS		0754588457
9	Mr. Said Magid	Head of Licensing Unit - TFS		0787 333181
10	Mr. John Selestine Ulomi	Revenue Officer - TFS		0783740777
11	Mr. Mohamed Kilongo	Director of Planning and Resource Utilization - TFS		0787863023
12	Dos Santos Silayo	Chief Executive		0784 402163
13	Mathew Mpanda	European Union		0713833441
14	Francis Songela	European Union		0783 492601
15	Ms. Mihalka Marko	Financial Instrument Officer - European Union		
16	Ms. Msanga Mabusi	Check Point Kiluvya Bwawani		0718372608
17	Ms. Sophia Gabriel	Check Point Kiluvya Bwawani		0759653153
18	Mr. Benoit Arama	Managing Director ORYX		
19	Mr. Lucas Banzi	Plant Manager - ORYX		0759195983
20	Mr. Enerst Lauo	Operations Manager- ORYX		0754389411

No.	Name	Designation	Place	Phone Number
21	Ms. Mandalo	EU Project Manager Titled "Integrated Approach To Sustainable Cooking Solutions"		0787772221
22	Ms. Engvild Langhus	Councillor For Environment - Norwegian Embassy		
23	Mr. Yassin Mkwizu	Programme Officer Environment Norwegian Embassy		0782 777025
24	Mr. Sephen Mwakifamba	SIDA-		
25	Ms. Benadeta Kadala	Assistant Zonal Manager - Kongowe Forest Plantation		0782515188
26	Mr. Kangero	Kibaha District Forest Manager		0653210700
27	Mr. Kari Leppanen	Councillor Finland Embassy		0754400046
28	Mihaela Marcu	Program Officer, European Union		+255 22 2164538
29	Federico Tarantini	Energy Program Officer, European Union		+255 22 2117476
30	Mr. William Nambiza	Coordinator Development Cooperation Embassy Of Finland		0767919916
31	Bahati Pascal	DFO - Kinondoni		0746042315
Kigoma Region				
1	Zephania M Yona	RNRO	Kigoma	0714512924
2	Mussa Ilanda	DNRO	Buhigwe	0752633232
3	Emanuel Mushi	FO	TFS Buhigwe	0763159003
4	Hamis Kasege	FO	Kasulu TC	0759343596
5	Bareth Neumbi	FO	TFS Kibondo	0754734073
6	Elishaphat Ruzemvya	FO	Kigoma Ujiji MC	0752213351
7	Ashery Petro	BO	Tfs Kigoma	0768025082
8	Hassan Omary	FO	Kasulu Dc	0766508195
9	Adam Harenga	DFO	Uvinza	0756423810
10	Deus Mwasalanga	DFM	Uvinza Tfs	0757028051
11	Medard Noohorya	FO	TFS Kakonko	0753483083
12	Franck Morice	FO	TFS Western Zone	0759978707
13	Medard Nzilayunde	DFO	Kigoma DC	07542750335

No.	Name	Designation	Place	Phone Number
14	Simon Maledo	DNRO	Kakonko DC	0757166032
15	Daniel Mpangama	DNRO	Kibondo DC	07588830
16	Modesta Macha	DFM	Kasulu	0762800519
17	Edwin Jonathan		BTC	0755682736
18	James Ruta		BTC	0755703452
19	Levania Shegela	Charcoal Whole Saler	Nazareti Sokoni Kigoma	0769506911
20	Gerald Evarist George	Charcoal Whole Saler	Nazareti Sokoni Kigoma	
21	Dr Lukindo Hiza	Director	Tuungane Kigoma	0789179365
22	Dr Apoloenela William	GIS Specialist	Tuungane Kigoma- Western Program	
23	Riziki Mathew Cleophas	Incharge Post	TRA Kibirizi Port Kigoma	0712526643
24	Mussa Msangi	In-charge	Customs Preventive Service Kigoma Port	0654522225
25	Rev Wilson Samson Nyakachewa	Program Coordinator	CEMDO Tanzania - Kigoma	0767133377
26	Donald Slaa	DFM	Tfs Kasulu	0766603171
27	Hamiton Missama	Head of Program	Cemdo Tanzania	0742789057
28	Fidelis Angelo	Program Team Leader -Environment & Energy	Cemdo	0754664170
29	Dr Teresia Olemako	Coordinator,	Landscape Conservation in Western Tanzania Programme, Jane Goodall Institute	0766680421
Mwanza Region				
1	Dr Sagange Yohana	AAS Economic & Production	Mwanza Rs	0767359246

No.	Name	Designation	Place	Phone Number
2	Mangabe Mnilago	RNRO	Mwanza Rs	0754539155
3	Paul Pontian	DFO	Sengerema	0754427608
4	John End Masam	DFM	Magu	0652799535
5	Emanuel Mgimwa	FO	TFS Lake Zone	0745170735
6	Khalifa Munis	SFO	TFS Lake Zone	0754758665
7	Emilan Alley	DFM	TFS Missungwi	0756404182
8	Hamis Mwangu	DFM	Nyamagana	0767910063
9	Paul Mafuru	DFM	Kwimba	0756257904
10	Julius Swai	DFO	Kwimba	0752680159
11	Petro Maganga Daudi	DFO	Kwimba	0752819581
12	Godluck Mtigandi	DFO	Ukerewe	0764759278
13	Deogratus Justus	CFO	Mwanza City Council	0767608002
14	Aliko Ndile	DFO	Buchosa	0764826802
15	Alex Julias	DFM	Ilemela	0767033626
16	Salima Miraji	DFM	Ukerewe	0673311184
17	Newton F Mlay	DFM	Sengerema	0758547312
18	Francisco Ndazi	DFO	Magu	0767004737
Mbeya Region				
1	Allen M. Miti	FO II	Mbarari	0764 864660
2	Lugano Ambakisye	FO II	Chunya	0753 088416
3	Godbless Stanley	FA	Mbeya DC	0754 693942
4	Jesca Mgata	Mhifadhi	Mrrr	0757 677704
5	Jambes Wumbura	FO II	Kyela	0765 631716
6	Lucas Theodori	DBO	Chunya	0754 852030
7	Philemon Chaula	DNRO	Busokelo DC	0755 623136

No.	Name	Designation	Place	Phone Number
8	James E. Mbagala	AG. DFO	Kyela DC	0755 178776
9	Castory Makenda	DFO	Rungwe	0763 641150
10	Marietha Kereti	RBO	RS - Mbeya	0766 111993
11	Regina Kamala	FO	Mbeya Jiji	0754 416869
12	Irene Thobias	PFA	TFS MBEYA	0754 644500
13	Patrick Charles	Afisa Misitu	H/W - Mbarali	0754 441358
14	Frank Msingwa	DEEVA	Kyela	0754 778878
15	Sylvia Mchalla	OS	RS - Mbeya	0754 310772
Songwe Region				
1	Silas S. Meshilieki	K/DFM Songwe	TFS	0765 123803
2	Omar A. Ali	DFM - Ileje	TFS	0654 821765
3	Elimelindi Tesha	DFO - Ileje	Ileje DC	0763 926269
4	Zakayo Mwamahonje	DFO - Mbozi	Mbozi DC	0752 021000
5	Fred Mgeni	DFM - Mbozi	TFS	0714 948430
6	Shida E. Mbwile	K/DFM - Momba	TFS	0754 387265
7	Joseph M. Mbogela	DFO - Momba	Momba DC	0763 580592
8	Hassan Mussa Kibwana	Kaimu AM - Tunduma	Tunduma TC	0752 342451
9	Elias Suiguremi	RFO - Songwe	TFS	0756 880768
10	Joshua E. Ng'onya	AG: AASG	RS - Songwe	0764 601213

No.	Name	Designation	Place	Phone Number
11	Raphael S. Samson	DFO - Songwe DC	Songwe DC	0763 009826
12	Fred Wanjala	FO - Momba	TFS	0762 638225
Njombe Region				
1	Gumbo B. Mvanda	RFO	RS - Njombe	0757 166181
2	Audatus Kashamakula	FO (DFM)	Njombe	0763 543153
3	Joha Mrua	FO	Njombe	0768 093175
4	Domitila Mwanyika	M/Misitu	Njombe Mji	0768 890224
5	Libenanga Paul	FO	Njombe	0762 696299
6	Phabian S. Balele	FO	TFS - Ludewa	0768 937884
7	Lucas D Makonope	Ludewa	Ludewa	0755 723844
8	Lulesu Naphely	DFO	Makete	0769 850681
9	Severine Mfuse	DFO	Wanging'ombe	0757 880768
10	Moses V. Ndiwu	FO (DFM)	Makete	0766 082961
11	Daudi M. Kumburu	RBKO	RS Njombe	0752 456688
12	Lusungu E. Mbede	RTO	RS Njombe	0764 934020
13	Lucas S. Nyambala	DFO	Makambako	0752 006161

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