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FORVAC

FORESTRY AND VALUE CHAINS DEVELOPMENT PROGRAMME

DEVELOPING INTENSIFIED CHARCOAL PRODUCTION MODEL IN VILLAGE LAND FOREST RESERVES FOR CONSERVATION AND LIVELIHOODS IMPROVEMENT IN HANDENI DISTRICT, TANGA REGION

Tanzania Forestry Research Institute &
Sokoine University of Agriculture

May 2022

UHURU NA UMOJA

The United Republic of Tanzania
MINISTRY OF NATURAL RESOURCES
AND TOURISM

SUOMI
FINLAND

Forestry and Value Chains Development Programme

Tanzania – Finland Cooperation

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DEVELOPING INTENSIFIED CHARCOAL PRODUCTION MODEL IN VILLAGE LAND FOREST RESERVES FOR CONSERVATION AND LIVELIHOODS IMPROVEMENT IN HANDENI DISTRICT, TANGA REGION

FINAL CONSULTANCY REPORT

SUBMITED TO

FORESTRY AND VALUE CHAINS DEVELOPMENT PROGRAMME (FORVAC), DODOMA

BY

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MAY, 2022

EXECUTIVE SUMMARY

Background

Charcoal is among the forest sub-sectors which have significant contribution to the economy and livelihoods of the people in Tanzania. In 2020, charcoal production in Tanzania was estimated to be about 1.9 million tonnes per year with a Gross Value Added (GVA) of TZS 2.1 trillion contributing about 50% of the total income in the forest sector (MNRT, 2021). Despite the high economic value of charcoal, its supply value chain has not been efficiently developed. As results, charcoal is considered unclean and unsustainable energy source. Therefore, development of the model for enhancing sustainable forest management and efficient charcoal production particularly in the Village Land Forest Reserves (VNRCs) is an urgent need. The developed model aims on sacrificing and subjecting part of the VLFR (maximum 15%) under intensive charcoal production through selective cutting for trees suitable for charcoal production (i.e. with diameter at breast height (DBH) ≥ 5 cm) in order to provide finance for protection and management of the remaining VLFR (minimum 85%). Among other benefits, the model will enhance sustainable forest management in the Village Land Forest Reserves but at the same time provide employment, contribute to poverty alleviation and in improving the living standards of people.

Objectives

The main objective was to develop an intensified charcoal production model in VLFRs for increasing VLFR financial viability and improving livelihoods of the adjacent communities. The assignment was guided by the following specific objectives:

i. Facilitating the necessary awareness meetings about development of the model at the district and village levels and formulation of Charcoal Maker Groups (CMGs) at village levels;
ii. Updating the Forest Management Plans (FMP) and Harvesting Plans (HP) for the sampled project villages;
iii. Developing an intensified charcoal production model in VLFRs for increasing VLFR financial viability and livelihoods; and
iv. Developing inclusive charcoal value chain in VLFRs under intensified charcoal production model.

Methodology

The study was conducted in Kwedikabu and Mazingara VLFRs located in Handeni District, Tanga Region, Northern Tanzania. Kwedikabu VLFR has about 3,472.3 ha. In Mazingara Village, the study was carried out at Majali Mkulumilo which initially had about 1,339.64 ha after boundary re-survey, the forest area is established to be 1,049.11 ha. The development of intensive CBFM charcoal production model involved two main activities. These included: 1) preparation of the CBFM charcoal model (preparation stage involving the set up for charcoal production pilot), and 2) model development.

In setting the basis of the model development, the following activities were undertaken:

i. Awareness creation to local communities on the sustainable charcoal production model;
ii. Assessment of current status of charcoal production and utilization in selected villages;
iii. Formation and registration of Charcoal Maker Groups (CMGs);
iv. Production of current VLFRs cover maps;
v. Participatory forest resources assessment and development of forest management and harvesting plans; and
vi. Demarcation of charcoal FMU and coupes.

While, model development involved the following aspects:

i. Setting experiment area;
ii. Charcoal production, recovery and trade;
iii. Effects of stump height on regeneration;
iv. Effect of charcoal pricing systems on production efficiency and economic returns;
v. Assessment and development of an inclusive charcoal value chain in VLFRs under intensified charcoal production model; and
vi. Financial viability of the charcoal production model.

Model Results and Other Achievements

Awareness meetings

Awareness meetings on charcoal project were carried out at the district level whereby the District Executive Director (DED) introduced Consultants to the Council Management Team (CMT) members. Consultants explained objectives and activities to be carried out during the first phase of the project. At village level, awareness meetings were carried out at two levels: (i) Village Government and Village Natural Resources Committee (VNRC) and (ii) Village General Meeting. Together with awareness creation about the project, other issues discussed were opportunities and challenges in management of Village Land Forest Reserves as well as charcoal business. Village leaders in both villages were much impressed with the charcoal production technologies to be introduced in the area.

On the other hand, as part of awareness creation, Consultants conducted reconnaissance survey to the forests under study (Majali Mkulumilo – Mazingara, and Kwedikabu). During the reconnaissance survey, Consultants were accompanied by representatives of the respective VNRCs and the Handeni District Forest Officer. The trip to the forest aimed to understand the location of the forests, boundaries as well as forest resources in place.

Formation of Charcoal Makers' Groups

Two Charcoal Makers' Groups (CMGs) were formed in each village. The formed CMGs were categorized into two types: one was for all people in the village (mixed age and gender) while the other one was only for youths. The youth group was formed in order to capture other socio-economic opportunities apart from charcoal marking activities. The group members were later trained to formulate their constitutions, which was among the requirements for Group registration at the District Office. All formed groups have been formalized through registration at the District level. The CMGs have also been registered to the Tanzania Forest Services Agency (TFS) hence allowed to deal with charcoal business in Handeni District.

Study visit to Kilosa for Village Leaders, VNRC and CMGs members

Twenty participants i.e. ten people from each village visited Kilosa District where Sustainable Charcoal Project is being implemented by Tanzania Forest Conservation Group (TFCG). The participants comprised of (i) 4 Village Leaders (Village Chairman and Village Executive Officer (VEO) from each village); (ii) 8 VNRC representatives (iii) 8 CMGs representatives. The main objective of this visit was to enable participants from Handeni District to acquire/share experiences, knowledge and skills on sustainable forest management, charcoal business along its value chains, as well as opportunities and challenges in charcoal trading.

Production of current VLFRs cover maps

VLFRs cover maps showing various Land Use/ Land Cover (LULC) classes for the two study sites have been produced. The LULC maps indicate distribution and coverage of different vegetation types as well as presence of other land covers attributed by anthropogenic activities going on within the VLFRs. For instance, in Kwedikabu VLFR mining conducted by two companies is going on. On the other hand, Majali Mkulumilo VRFR of Mazingara Village has also a large area with human activities including farming, human settlements and livestock keeping. This forest has been reduced by 203.53 ha (19.4%) of the previous area to enable/accommodate farmers and pastoralists to re-settle in the forest.

Participatory forest resources assessment and development of forest management and harvesting plans

Participatory Forest Resources Assessment (PFRA) was carried out in the two forest reserves with different objectives. Forest management plan is in place in Kwedikabu Village Land Forest Reserve, therefore PRFA was carried in areas (blocks) prioritized for charcoal production for development of forest harvesting plan. On the other hand, at Mazingara Village, Consultants carried out PFRA at Majali Mkulumilo VLFR, for the purpose of producing proper Forest Management and Harvesting plans. The development of the two documents was done.

Unfortunately, during the first days of PFRA at Mazingara Village, consultants were detained by illegal farmers and pastoralists found in the forest for reason that they

are not aware of what was going on in their farms. The Consultants were rescued by the Honourable District Commissioner (DC) together with her team including the District Natural Resources Officer.

Demarcation of charcoal forest management unit (FMU) and harvesting coupes

Two blocks have been set at Kwedikabu VLFR for charcoal production. The blocks have a total of 507 ha, which is about 15% of the total area of the forest. Initially, it was expected to demarcate 20% of the total area but this has not been possible because the forest has been degraded to some extent. One of the block has 275.8 ha, while the second one has 231.9 ha. The two blocks have been divided into 20 harvesting compartments with about 25 ha each which will be harvested every year starting from 2021/22 for a period of 20 years. In each of the compartment, 100 small harvesting units (coupes) of 50 x 50 m have been set, that will be used for harvesting.

In accessing the harvesting coupes, the VNRCs (Plate 8) have been trained on how to locate the harvesting coupes in the forest at Kwedikabu Village using Avenza Maps App in the Android smartphones. One Android smartphone was bought for Kwedikabu Village and a map showing harvesting coupes was downloaded into the smartphones which were then opened with Avenza Maps App.

Regarding the research component, setting of experiment areas and initial charcoal production at Kwedikabu Forest Management Units has been initiated. An experiment area has been set on 9 harvesting coupes of 50 x 50 m, which are marked as the Permanent Sample Plots (PSPs). These permanent plots will be monitored for 10 consecutive years. The objective of this experiment is to study the coppicing ability of stumps at 15, 30 and 60 cm height.

Charcoal production and trade

Currently charcoal production is being done by the two charcoal making groups (Nguvumali and Songambele) in Kwendikabu Village. Charcoal has been produced from the wood harvested in the PSPs. In January 2022, a total of 75 bags weighing

25 - 30 kg each were produced by both groups from few woods that were used during training. The charcoal was sold locally in the village, and fetched about TZS 187,500.00. In May 2022, Nguvumali Charcoal Making Group produced about 88 bags weighing about 25 - 30 kg each from two kilns, which valued about TZS 440,000.00. While Songambele Charcoal Making Group produced 82 bags weighing about 25 - 30 kg each from two kilns and fetched about TZS 410,000.00. From the latter production, the village government (Kwedikabu) received TZS 512,500.00 as revenue.

Effect of moisture contents on recovery rate

Optimal duration for wood seasoning (air drying) was 14 days for reducing wood moisture for charcoal production at Kwedikabu Village Land Forest Reserve. Kiln efficient for 14 days was 47.2% which was not significantly different from 21 and 30 seasoning days. Average wood billet moisture loss at 14 days of air drying was 9%.

Effect of stump height on regeneration

First monitoring on regeneration on PSPs indicate that most of the tree stumps were regenerating. *Combretum* spp. (*C. zeyheri* - mlama mweupe and *C. molle* – mlama mweusi) was observed to regenerate highly regardless of stump height and diameter. The tree species has high coppicing ability. Other species observed to have high coppicing ability were *Senegalia nigrescens* (mkambala)*, Dombeya shupangae* (mlwati)*, Spirostachys africana* (msalaka) and *Vachellia robusta* (mkongowe). Coppicing occurred either at the top or side of the stump, but also others from roots (root suckers). Also regeneration from seeds as seedlings was observed. Monitoring of tree regeneration in the PSPs will continue for 10 years since establishment.

Effect of charcoal pricing systems on production efficiency and economic returns

Pricing technique for charcoal traded in Tanzania is an important component for ensuring sustainability in forest management. The sustainability in forest use depends on how best we utilize the existing resources. Charging appropriate prices for both raw materials and charcoal itself as final product is therefore crucial. The

efficiency use of raw materials used in charcoal production will depend on the pricing strategy employed. It is understood that charcoal is main source of energy for cooking in urban Tanzania but at the same time we need to ensure its sources are extracted sustainably. The current charcoal pricing method which is based on the weight of a bag is weak and does not promote efficiency and sustainable use of charcoal producing raw materials especially charcoal from the Miombo woodland. Charcoal producers does not care about the efficient use of the raw materials because they are charged per bag of charcoal traded or transported. This leads to unnecessary deforestation and land degradation in many areas.

Charcoal traders also tend to set charcoal selling prices based on the total costs incurred during the production process. The royalties, levies and taxes paid by charcoal traders are also based on the size, volume and weight of the bag of charcoal. These pricing techniques as narrated earlier does not account for the amount of raw materials and the technology used in the production process. It was observed that in Mazingara, Kwedikabu, Mkwaja, Pangani Town, Tanga Town, Dar es Salaam and Zanzibar no traders have invested in efficient charcoal production technologies or is willing to invest in future. They perceive that, it is too expensive and there is no reward for doing such an investment while they still make the same profit with the existing technology. Probably one of the reason for not investing in the efficient technologies is that in most cases, charcoal makers don't pay for raw material.

Regarding the charcoal production efficiency and economic returns by pricing charcoal using the stumpage or standing tree volume, there is scant information to justify whether this system is efficient or not because of lack of enough data to support it. This new pricing technique for charcoal production raw materials may need more research, awareness creation and advocacy to all charcoal stakeholders along the value chain. The markets for charcoal are the same, there is no market segmentations, therefore any charcoal production technology that affect the profits earned by charcoal producers and traders will definitely be avoided unless it is subsidized by the Government. The assumption in this study was that if charcoal producers and traders will be charged per amount of wood as a standing volume in

the forest, he will use the raw materials more efficiently to maximize profit. This in turn will motivate such a charcoal trader to invest in some more efficient charcoal production technologies hence reducing the amount of wood harvested from the forests. More research is needed to test for the stumpage or standing tree volume charcoal pricing techniques and on the use of the Improved Basic Earth Kilns (IBEK) and Mobile Metal Kilns.

Inclusive charcoal value chain in VLFRs under intensified charcoal production model

Charcoal value chain comprise of many stakeholders including farm/ forest owners, producers, large scale and small scale traders, transporters, whole sellers, retailer, and consumers. Supporting stakeholders include the Village Governments, TFS and District Councils. A strong charcoal value chain is therefore important for helping people adjacent to forest reserves in rural areas to alleviate poverty and improve their standards of living. This is because, majority of the rural people are highly dependent on forest related products. A strong charcoal value chain will assist local communities in providing employment for the poor, increasing wages to rural communities, providing continued income throughout the year especially to those with limited access to other income generating activities, strengthening rural labour markets and reducing unemployment. Among other observations in both Kwedikabu and Mazingara villages is the high rate of charcoal production. The Village Governments, VNRCs, TFS and District Council are also important stakeholders especially in as regulators and laws enforcers along the value chain. Traders from Dar es Salaam or Tanga do bring working capital to producers who in a way are their labourers.

Access to efficient technology is an important segment for ensuring sustainable charcoal production in Kwedikabu and Mazingara Villages and other villages which are adjacent to forest reserves. However, the ability to access forest resources differ among households. This will result into variation of benefits accrued from charcoal trading among the rural poor households involved in the charcoal value chain. The current model invested a significant amount of time in training members of the charcoal makers' association to build capacity to all stakeholders. The trainings

aimed to build capacity on access to forest land, charcoal production knowledge and skills, access to charcoal inputs and capital, advanced charcoal production technologies, skills in group formulation and administration issues.

There is still high rate of illegal charcoal production and transportation. Some traders revealed that this is due to the high taxes or royalty charged per bag of charcoal. As results, there is high rate of charcoal tax/royalty aversion by charcoal traders and transporters which then reduce the total collection by the Government hence reduced contribution to the national income (GDP). Consumers in the following areas; Dar es Salaam, Mkwaja, Pangani Town, Tanga City, Zanzibar, Bagamoyo, Chalinze and Mkata had no preferences on the source of charcoal. They consume what is available in the market. Compared to other sources of energies (Gas, Electricity and LPGs) the price of charcoal is relatively low but customers were of the opinion that charcoal price should be lowered.

There domestic market for charcoal is potentially still very high. A large amount of charcoal produced in Kwedikabu Village is transported to Mkwaja (Pangani) and then Zanzibar. It was observed at Ngalawa and Mkokotoni harbours in Zanzibar that more than 95% of the charcoal traded in Zanzibar was from Mainland Tanzania, Handeni District in particular. Charcoal from other regions of Tanzania such as Iringa and Njombe is also transported to Zanzibar. Additionally, some traders in Zanzibar advance capital to charcoal producers in Handeni District to make charcoal which is eventually transported to Zanzibar. The way charcoal is transported from Mkwaja to Zanzibar, there is a very high chance of transporting illegally produced charcoal. The price of charcoal however tends to vary between rainy and dry seasons because of the challenges associated with the transportation.

Financial viability of the charcoal production model

The proposed charcoal production model is viable and profitable and can contribute to the sustainable forest management in the villages. Charcoal producers tend to have three potential markets with different profit margins. They can sell the produced charcoal at the (i) production site (ii) village market (iii) Mkwaja or Mkata market (iv) Dar es Salaam, Tanga, Zanzibar or other places. Depending on where

they sell the produced charcoal they will have variable costs of TZS 9,450.00; 13,450.00; 17,450.00 and 21,450.00 for production site, village market, Mkwaja or Mkata market and Dar es Salaam/Tanga/Zanzibar/other places markets, respectively. The break-even quantities at these markets are 1,120; 242; 184 and 65 bags of charcoal, respectively. This means that, a charcoal producer who have access to Dar es Salaam, Tanga or Zanzibar Market, will break-even at shorter period than those selling charcoal at the local markets. However, charcoal traders were concerned with the royalty amounting to TZS 14,500.00; (i.e. TZS 12,500.00 for TFS and 2,000.00 for village) charged per bag of charcoal traded. To ensure sustainability, there is a need to strengthen the Village Government capacities in monitoring charcoal production in their villages. Once Village Governments are capacitated, illegal charcoal production may be minimized in many places and will in way increase the royalty collection by the Government.

Conclusion and Recommendations

Generally, there has been positive acceptance of the project at the study sites. All the planned activities are progressing well at Kwedikabu VLFR. However, at Mazingara Village, the implementation of project activities has gone half way. This is due to the delays caused by the conflicts between the village and illegal farmers and pastoralists who were found to be residing in the forest reserves. Charcoal Making Groups have started producing from the wood in the PSPs. It has been observed that, the ability to harvest large number of coupes in time is limited, more dealers outside the groups should be encouraged. Most regenerating stumps were from *Combretum* spp. (*C. zeyheri* - mlama mweupe and *C. molle* – mlama mweusi) was observed to regenerate highly followed by *Senegalia nigrescens* (mkambala), and *Dombeya shupangae* (mlwati). Monitoring of tree regeneration in the PSPs to be continued for 10 years.

Capacity building to VNRCs members on Global Positioning Systems (GPS) need to be done in order them to use the system for various purposes including patrols. Optimal duration for wood seasoning (air drying) for charcoal production is 14 days. A stump of 30 cm height is recommended as optimal height for tree harvesting aimed for charcoal production in areas where tree regeneration is encouraged.

Coppicing management e.g. thinning in some tree species is important in order to maintain few coppices which will have large wood biomass in the next harvesting rotation. Capacity building on good governance aspects like management of charcoal revenues and equal participation of members in forest resources management is recommended.

Majority of the charcoal producers and traders use total costing pricing technique in setting charcoal selling prices. Charcoal traders on the other hand use buying price, transport costs and other associated costs to set the charcoal selling price. The market price for charcoal in different regions will therefore depend on the costs incurred during production process. Charcoal producers, traders, transporters, whole sellers and retailers are among the important stakeholders in the value chain. However, supporting functions such as Village Government, TFS and District Officers are also important along the charcoal value chain.

Furthermore, the royalties charged per bag of charcoal produced or transported was perceived to be very high to majority of the producers and traders, therefore needs revision. Inclusive charcoal value chain requires participation and engagement of all stakeholders in the charcoal value chain in order to have an inclusive plans and decisions regarding charcoal business. Last but not least, more research on different aspects including use of different charcoal production technologies, initial investment costs, efficiency of these new technologies and the sustainability of those technologies is of paramount.

ACKNOWLEDGEMENTS

The Consultants would like to thank the Forestry and Value Chains Development Programme (FORVAC), of the Ministry of Natural Resources and Tourisms (MNRT) for contracting the Tanzania Forestry Research Institute (TAFORI) and Sokoine University of Agriculture (SUA) - Colleague of Forestry, Wildlife and Tourism (CFWT) to carry out this consultancy service.

Sincere appreciations are directed to the office of Handeni District Commissioner (DC) for ensuring security to consultants since the beginning of the study. In similar weight, much gratitude goes to the office of the Handeni District Executive Director (DED) for accepting the project and allowing the Consultants to work in Kwedikabu and Mazingara Villages. The DED office provided officers who worked together with the Consultants in different steps of the project implementation. In this regard, we thank Mr. Napoleon Mlowe (District Natural Resources Officer), Ms. Rachel Mbelwa (District Community Development Officer), Mr. Elinihaki Hashim Mdee (District Forest Officer), Ms. Joyce Lukumay (Community Development Officer) and Athumani Kambi (Forest Officer) for their willingness, support and assistance from when the project started.

Kwedikadu and Mazingara Village Leaders, Village Natural Resources Committees (VNRCs), Charcoal Makers' Groups (CMGs) and villagers are also acknowledged for their immeasurable support during implementation of the project in their areas. Timely organisation of village meetings and building enthusiasm to people about the benefits of the project is appreciated.

Cooperation from the Kilosa District Officials particularly the District Natural Resources Officer (Mr. John A. Mtimbanjayo), Chabima and Ulaya Mbuyuni villages' Government Leaders as well as their respective VNRCs for their remarkable cooperation during the study visit to their district.

Lastly, but not least, our appreciation goes to Mr. Rashid A. Kazeuka from Ulaya Mbuyuni Village, Kilosa District for accepting to travel to Handeni District to provide field experience on charcoal making at Kwedikabu Village. Mr. Kazeuka delivered his

knowledge and skills to CMGs on various stages of charcoal making in a short period of time.

ABBREVIATIONS AND ACRONYMS

DBH	Diameter at Breast Height
CBFM	Community Based Forest Management
CMGs	Charcoal Makers' Groups
CMT	Council Management Team
DC	District Commissioner
DED	District Executive Director
DFC	District Forest Conservator
DFO	District Forest Officer
DNRO	District Natural Resources Officer
FMHP	Forest Management Harvesting Plan
FMU	Forest Management Unit
FORVAC	Forestry and Value Chains Development Programme
GPS	Global Positioning System
ha	Hectare
Ek	kiln efficient
LULC	Land Use/ Land Cover
MNRT	Ministry of Natural Resources and Tourism
PFM	Participatory Forest Management
PFRA	Participatory Forest Resources Assessment
PSPs	Permanent Sample Plots
SUA	Sokoine University of Agriculture
TAFORI	Tanzania Forestry Research Institute
TFCG	Tanzania Forest Conservation Group
URT	United Republic of Tanzania
VEO	Village Executive Officer
VLFR	Village Land Forest Reserve
VNRC	Village Natural Resources Committee
WEO	Ward Executive Officer

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1.0 INTRODUCTION

1.1 Background Information

Charcoal is among the forest sub-sectors which have significant contribution to the economy and livelihoods of the people. In 2020, charcoal production in Tanzania was estimated at 1.9 million tonnes per year with a Gross Value Added (GVA) of TZS 2.1 trillion contributing about 50% of the forest sector (MNRT, 2020). Most of the charcoal is produced in the so called 'general lands', which is natural Miombo forests with different levels of degradation from none, moderate to heavy because of lacking legal forest reserve status. Some of these areas are partly under low intensity agricultural use mostly shifting cultivation or grazing land for cattle. In some villages, these lands are in Village Land Use Plans allocated under 'future agricultural land' or Village Land Forest Reserves (VLFRs). However, as per the recent Participatory Forest Management (PFM) Facts and Figures study of 2020, most of the so-called VLFRs are subjected to different levels of encroachment. Encroachment is usually a combination of illegal selective logging for timber, in some areas burning for charcoal and agricultural expansion and/or grazing of livestock (URT, 2020).

Encroachment is very typical especially in the forest reserves close to town centers such as Dar es Salaam, Arusha, Mbeya and Tanga (Treue *et al.,* 2014). These forests are prone to encroachment hence fragmentation and disappearing on an increasing speed. Empirical evidences indicate that in the Forestry and Value Chains Development Programme (FORVAC) operational areas, especially the Handeni Cluster, most of the VLFRs have been much affected by forest degradation and deforestation due to booming charcoal demand in populated cities like Dar es Salaam, Zanzibar and sometimes abroad via Zanzibar and Tanga ports.

Deforestation and forest degradation in VLFRs is caused by several factors but the principal one is insufficient financial resources to cover management costs. To manage these VLFRs in accordance to forest management plan, Village Governments should have funds to cover costs of purchasing equipment and materials needed for the implementation of the planned activities (e.g., forest patrols, simple inventories,

boundary mapping) and provision of incentives to members of Village Natural Resource Committee (VNRCs). Unfortunately, villages with VLFRs have no reliable sources of fund to cater for forest management costs. Even in villages where timber is their main source of income, they are severely challenged by the difficulties of attracting reliable timber buyers (Sungusia, 2018; Amanzi, 2020).

Despite the high economic value of charcoal, its supply value chain has not been efficiently developed. As a results charcoal is considered to be unclean and unsustainable energy source. Therefore, to enhance sustainable forest management and efficient charcoal production particularly in the VLFRs, there is an urgent need to develop a model that suits the need. The developed model aims on sacrificing and subjecting part of the VLFR (max 15%) under intensive charcoal production (through selective tree cutting for trees suitable for charcoal production with diameter at breast height (DBH) of five centimeters and above) in order to provide finance for protection and management of the remaining VLFR (min 85%). Hence, the objectives of the developed model were to:

1) Protect VLFR by setting aside at most 15% of the intensively utilized charcoal production Forest Management Unit (FMU) in order to provide finance for the remaining 85% of the VLFR management and income for villagers;
2) Provide sustainably produced charcoal to feed the large market demand especially in urban areas; and
3) Provide sustainable livelihoods to charcoal makers in a setting where investment in technology improvement is encouraged through payment terms and long-term sustainability in terms of biomass availability.

This study is in line with the National Forest Policy of 1998 and its Implementation Strategy of 2021; Forest Act No. 14 of 2002; Forest Regulations of 2004; National Energy Policy of 2015; National Research Master Plan III (2021 – 2031); Biomass Energy Strategy of 2013; and Chama cha Mapinduzi (CCM) Election Manifesto (2020 – 2025). It is also in line with East African Forest Policy and its Implementation Strategy of 2021; Sustainable Development Goals (SDGs); and other relevant Regional and Global Frameworks.

1.4 Objective of the Study

1.4.1 Main objective

The main objective of consultancy service was to develop an intensified charcoal production model in VLFRs for increasing VLFR financial viability and livelihoods of the adjacent communities.

1.4.2 Specific objectives

The consultancy service was guided by the following specific objectives:

i. Facilitating the necessary awareness meetings about development of the model at the district and village levels and form Charcoal Maker Groups (CMGs) at village levels;
ii. Update forest management plan (FMP) and harvesting plans (HP) for the sampled project villages;
iii. Developing an intensified charcoal production model in VLFRs for increasing VLFR financial viability and livelihoods; and
iv. Developing inclusive charcoal value chain in VLFRs under intensified charcoal production model.

1.4.4 Expected deliverables

The following were the expected deliverables from the assignment:

i. Inception report;
ii. Bi-monthly progress reports and financial reports;
iii. Final report, also including cost-benefit and other financial analysis of implementation of the model;
iv. Model development set up related documents:
    a. Forest management plan updates for Kwedikabu and Mazingara to include charcoal production area,
    b. Harvesting plan / annual operations plan for charcoal FMUs,
    c. Charcoal makers' groups (legal documents),
    d. Initial compilation of the Charcoal makers' & VNRC rules and responsibilities,
    e. MoU between VNRC and CMGs to cooperate in the pilot,

f. Draft contract between VNRC and Charcoal makers to have a starting point for the negotiations in the phase II (association or individuals), and
g. Pilot concept developed further, draft plan for the phase II of the pilot.

v. Research component related deliverables

Research is needed to effects of pricing system of charcoal-on-charcoal production, effects of cutting heights on regeneration and effects of wood moisture contents on recovery. Other deliverables under research components include:

a. Permanent sample plot data (coordinates etc.), baseline information at least from the year 1 coupe;
b. Quick charcoal value chain assessment in the two villages: market existing market situation, existing pricing, production cost, possible currently unpaid licenses, fees;
c. Recovery rate (kiln design, moisture content of biomass, sizing); and
d. Financial viability of the charcoal production model.

2.0 METHODOLOGY

2.1 Study Sites

The study was conducted in Kwedikabu and Mazingara VLFRs located in Handeni District, Tanga Region, Northern Tanzania (Fig. 1). Kwedikabu Village has about 3,472.3 ha VLFR. Mazingara Village, the study was carried out in a VLFR known as Majali Mkulumilo with an area of 1049.11 ha.

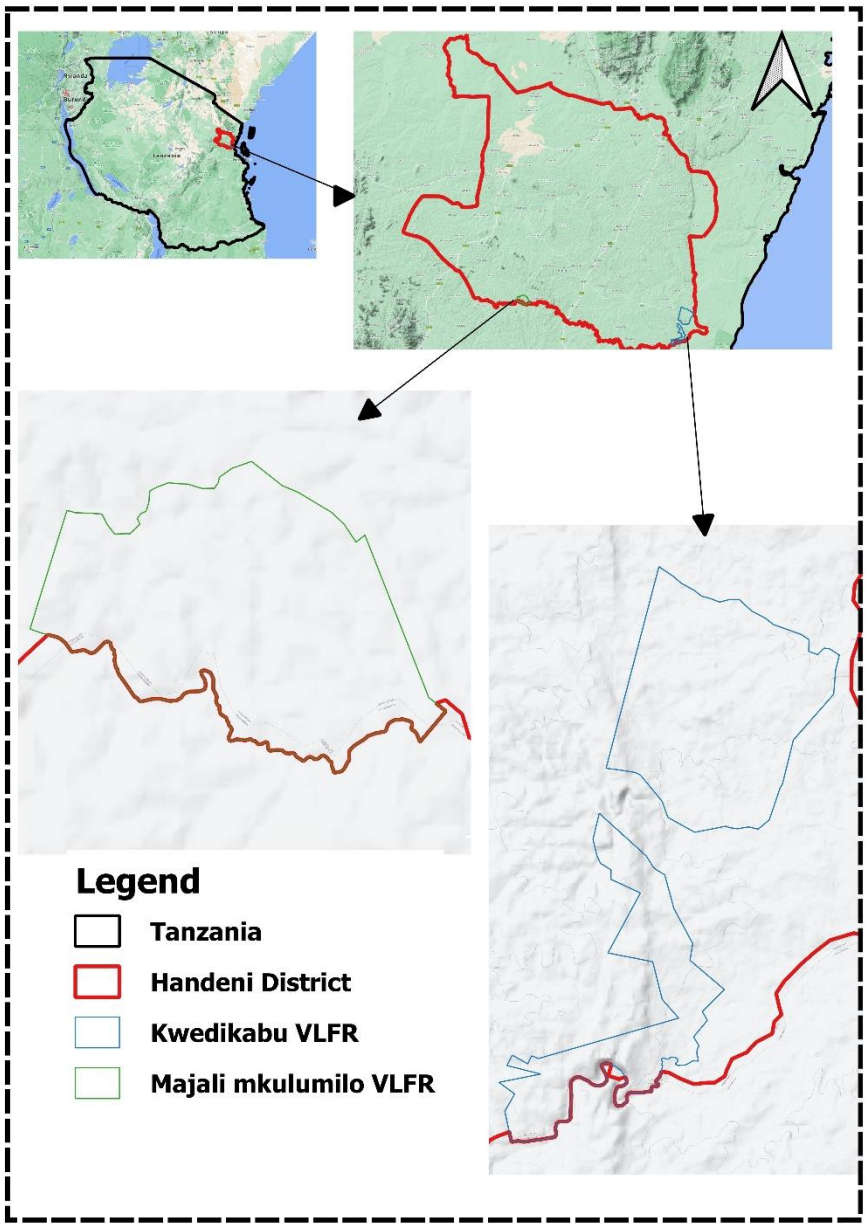

Figure 1: Study area map indicating Kwedikabu and Majali Mkulumilo VLFRs in Handeni District, Tanga Region.

2.2 Approach of Developing Intensive Charcoal Production Model

Development of intensive charcoal production model involved community members in the selected villages. Different types of community involvement were adopted in different situations including formal consultations with village governments, village natural resources committee (VNRC), and charcoal makers.

The community involvement in the development of intensive charcoal production model was opted due to the following reasons: 1) to build mutual trust with the community in the study villages; 2) to improve dissemination, uptake, and implementation of research findings; and 3) to reduce risks of limited adoption of the charcoal production model after completion of the study.

2.3 Implementation design

The development of intensive CBFM charcoal production model involved two main activities: 1) preparation of the CBFM charcoal model (preparation stage involving the set up for charcoal production pilot), and 2) model development (research part).

2.3.1 Preparation of model development (setting a basis of the study)

In setting the basis of the model development, the following activities were undertaken: 1) awareness creation to local communities on the sustainable charcoal production model; 2) assessment of current status of charcoal production and utilization in selected villages; 3) formation and registration of Charcoal Maker Groups (CMGs); 4) production of current VLFRs cover maps; and 5) participatory forest resources assessment and development of forest management and harvesting plans; and 6) demarcation of charcoal FMU and coupes.

2.3.1.1 Awareness creation to local communities on development of intensive charcoal production model

Awareness creation about development of intensive charcoal production model involved district staff, village leaders, VNRC members and entire community members. Table 1 presents dates, participants and activity conducted during awareness creation.

Table 1: Project awareness creation, at Handeni District, Tanga Region.

SN	Date	Place	Participants	Activity
1	28.09 2021	Mkata – Handeni DC HQ	DED – Handeni DC, DNRO, and DFO	Courtesy call to DED office – Project introduction
2	28.09 2021	Mkata – Handeni DC HQ	Council Management Team (CMT) members	Project introduction
3	29.09.2021	Mazingara Village	Village Leaders, Village Councilors and VNRC	Project introduction and discussion on modality of project implementation
4	28.09.2021	Kwedikabu Village	Village Leaders, Village Councilors and VNRC	Project introduction and discussion on modality of project implementation
5	30.09.2021	Kwamsisi Ward	Ward Executive Officer (WEO)	Project introduction
6	30.09.2021	Saadan National Park – Maunde Post	Game Post	Project introduction
7	30.09.2021	Kwedikabu Village	All community members	Village special meeting to introduce the project and mobilize villagers to prepare them to form charcoal making groups
8	01.10.2021	Handeni Township	TFS – DFC Handeni	Project introduction
9	02.10.2021	Mazingara Village	All community members	Village special meeting to introduce the project and mobilize villagers to form charcoal making groups; and training on development of constitutions
10	04.10.2021	Kwedikabu Village	All community members	Formation of charcoal making groups and training on development of constitutions

2.3.1.2 Assessment of current status of charcoal production and utilization in study villages

The consultants conducted focus group discussion and in-depth interviews with village leaders, VNRC and charcoal makers to assess current status of charcoal production and utilization in the project villages. The aim of the assessment was to get a general understanding on extent of charcoal production in the selected villages, including annual charcoal production, identifying households/people involved in charcoal production, charcoal business operation, charcoal production methods used, and procedures of charcoal production. In addition, charcoal makers' interest in forming a CMG to run the charcoal business from the VLFR was also assessed.

2.3.1.3 Formation and registration of Charcoal Makers Groups (CMGs)

The consultants in collaboration with village leaders convened the village special meeting to mobilize charcoal makers and people interested in charcoal production in order to form Charcoal Makers Groups (CMGs). In each village, two groups were formed. Among the guiding criteria during selection of the group members were: experience in charcoal making, one member from the household, age of 18 – 35 years for youths, not engaged in other socio-economic groups supported by FORVAC, and one indicating interest and commitment. Thereafter, District Community Development Officer (DCDO) guided each CMG to prepare its constitution, to register the group and opening bank account. Finally, the consultants guided each CMG to register through TFS as charcoal traders.

2.3.1.4 Production of current cover maps of VLFRs

Land cover maps for the study VLFRs were produced in order to facilitate participatory forest resources assessment (PFRA), identification of charcoal FMU, establishment of annual coupes, and to monitor cover change over time. Sentinel 2 satellite images from European Space Agency (ESA) were used. Care was taken such that only Images with cloud cover <10% were obtained; thus Images sensed on 24/7/2021 for Mazingara and 06/11/2021 for Kwedikabu were downloaded and used.

Quantum GIS (QGIS) software aided by Semi-Automatic Classification Plugin (SCP) was used during analysis of the spectral signatures of the downloaded Images to determine different LULC classes. From the satellite image data only 10 bands out of 13 bands were used in formulating band set prior Image classification, the bands used during the exercise were B2, B3, B4, B5, B6, B7, B8, B8A, B11 and B12. After creation of band set colour manipulation technique was deployed to enhance identification of various LULC classes during image classification.

Ground truthing was carried out during PFRA exercise. The initial LULC map was verified in the field by comparing the mapped classes to those appearing on actual

ground. The maps developed were loaded in android mobile phones via Avenza map (android phone software) to aid navigation in the field. With Avenza it was possible to precisely locate any point of the forest and verify if there were any errors during image classification. After field verification of the spatial distribution of different land use land cover classes, poorly mapped classes were reclassified to match with those determined during ground truthing to produce final land use land cover maps for targeted VLFR.

2.3.1.5 Participatory Forest resources assessment, development of forest management and harvesting plans

Participatory forest resources assessment

Participatory forest resources assessment (PFRA) was carried out with involvement of local communities to identify available resources and opportunities, to get biophysical data for preparation of the Forest Management and Harvesting Plans (FMHPs). The FMHP contains the description of the forest, management objectives and goals, prescriptions and activities for a set period of at least five years. The FMHPs served as guidelines for sustainable forest management by defining forest management prescriptions and utilization, and milestones for monitoring and evaluation of the management practices. In addition, the FMHP is a pre-requisite for villages to start harvesting forest products like timber and charcoal (as in case of pilot villages) in the VLFR.

Forest resource assessment was participatory as it actively involved VNRC members in PFRA team. This was +done purposively to empower VNRCs that are responsible for implementation and coordination of most of the project activities. The PFRA team was comprised of members of VNRC and few ordinary villagers to serve as local botanists and charcoal makers. In each sampled village for model development, PFRA team had 10 people of which five were VNRCs, two village councilors and three charcoal makers. In addition, seven were male and three females.

PFRA - Sampling procedures

In Mazingara VLFR, the whole forest was assessed to get data that was used to develop management and harvesting plans. In Kwedikabu VLFR, only FMU for charcoal production was assessed to obtain data for development of harvesting plan.

In both sites, a systematic sampling design was used to lay out plots. The sampling unit was a concentric circular plot of 0.071 ha. The sampling intensity in Mazingara was 1.05% that generated 200 plots while that of Kwedikabu was 0.5% that generated 37 plots. All sample plots were distributed in clusters, each cluster had 5 plots. That means, Mazingara VLFR had 40 clusters while Kwedikabu had 7 clusters. In each forest, clusters were systematically located along transects (Figure 2 and 3). A distance between plots was 100 m while inter-cluster distance in Mazingara was 550 m while that of Kwedikabu was 1000 m. Inter-transect distance in Mazingara was 600 m while that of Kwedikabu was 1100 m.

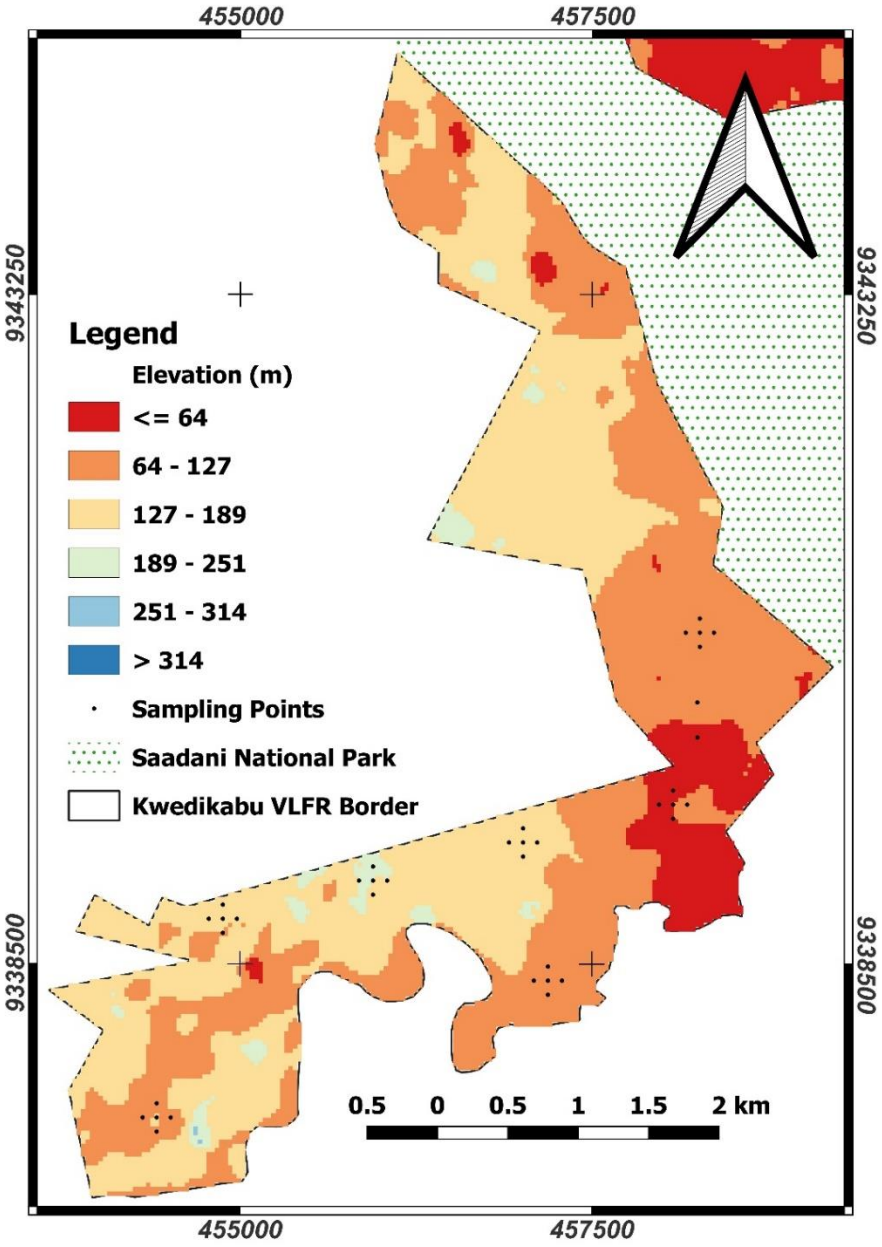

Figure 2: Layout of plot clusters at Kwedikabu VLFR, Handeni District.

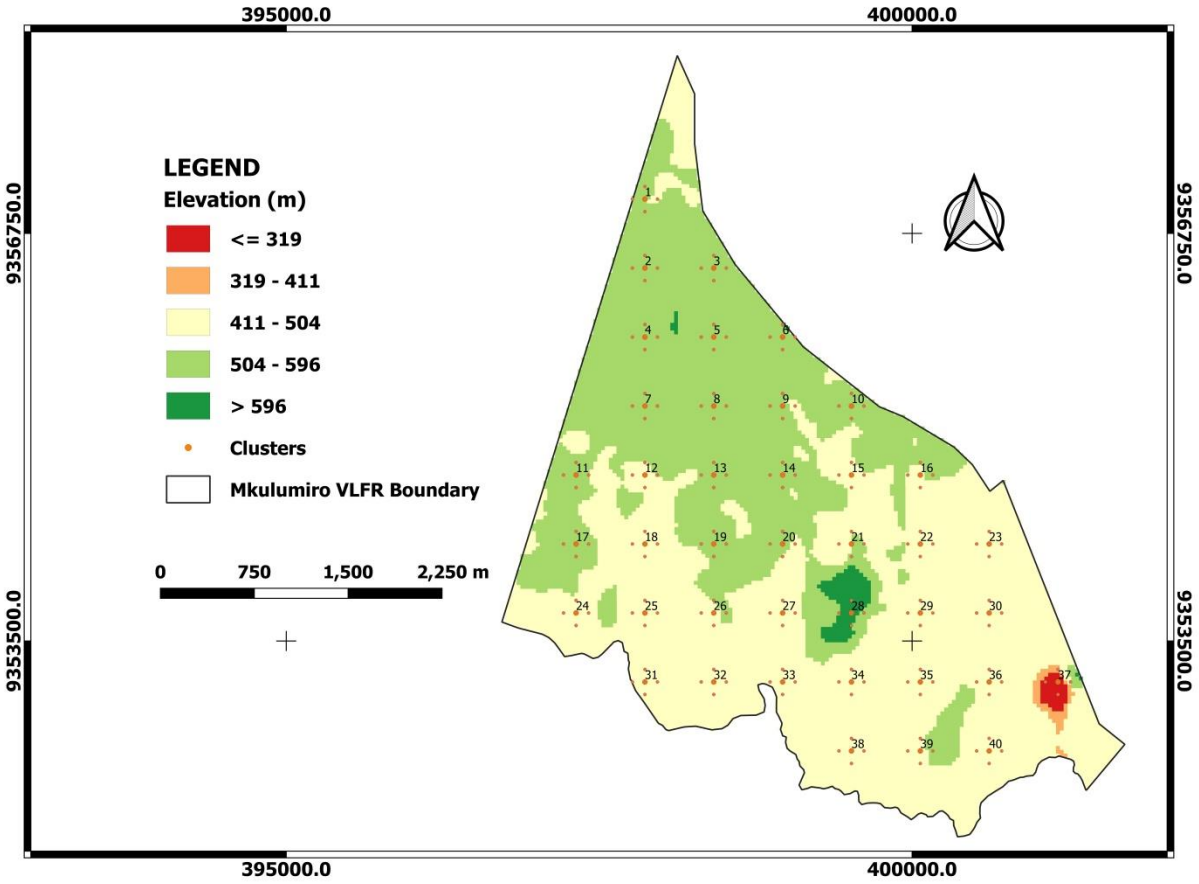

Figure 3: Layout of plot clusters at Mazingara VLFR, Handeni District, Tanga Region.

PFRA - data collection

Nested circular plots were used. Data collected in each sub-plot are presented in Table 2. Other information recorded in every plot include plot location, species name (local and scientific), physical characteristics of soil (texture), characteristics of forest ecosystem, forest disturbances, risks and pressures.

Table 2: Measurement to be taken in subplots

Sub-plot Diameter (m)	Tree measurements
2	Identification of herbs and grasses as well as count of trees (regenerants) less than 5 cm DBH
5	Measurement of all trees with DBH ≥ 5 cm
10	Measurement of all trees with DBH ≥10 cm
15	Measurement of all trees with DBH ≥ 20 cm

PFRA - Data analysis

Each tree species recorded during PFRA was coded with numbers to ease the analysis work in computer spread sheet programs i.e., Ms Excel Computer program. Number of stems per hectare was determined using equation 1 while general single parameter volume equation (Equations 2 and 3) was used to calculate the volume of standing trees.

Number of stems per hectare

$$N = \frac{(\sum n_i / a_i)}{u} \qquad \text{Equation 1}$$

Where:

n_i = Tree counts in a plot

a_i = Area of plot in Ha (See Table 1)

u = Number of plots

N = Number of stems per Ha

Tree volume per hectare

$$\text{Vh} = \frac{0.00016 \times DBH^{2.463}}{Plot\ Area} \qquad \text{Equation 2}$$

However, to obtain volume per ha for every tree species (Vsp)

$$Vsp = \frac{\sum Vh}{u} \qquad \text{Equation 3}$$

Where: $u = Number\ of\ plots$

Development of forest management and harvesting plans

FMHPs were prepared based on the results were obtained after analysis of biophysical data. The plans have several sections, including description of the forest and community, management objectives, quantity of charcoal to be harvested and Annual Plan of Operation.

2.3.1.6 Demarcation of charcoal FMU and harvesting coupes

After forest resources assessment, the next was demarcation of charcoal FMU and harvesting coupes. However, because of conflict that emerged in Mazingara over

VLFR, the demarcation of charcoal FMU and harvesting coupes was done only in Kwedikabu VLFR.

Demarcation of charcoal FMU in Kwedikabu VLFR

Demarcation of charcoal FMU and harvesting coupes at Kwedikabu VLFR was done in participatory manner. It involved one meeting with village leaders and VNRC members to identify FMU in the VLFR where charcoal can be produced. The meeting was organized and facilitated by the consultants in collaboration with DFO. Some criteria used to guide setting aside of charcoal FMU were:

i. Area that was prone to deforestation and forest degradation;
ii. Area that was slightly degraded in the VLFR because of charcoal or timber production;
iii. Potential of the area for charcoal production, including presence of sufficient stock and accessibility; and
iv. Area that was far from water sources, steep slopes, wetlands, river banks, and biodiversity hotspots.

2.3.2 Research Component - Development of intensive charcoal production model

To further refine the intensive charcoal production model for CBFM context, four studies were conducted:

i. Effects of charcoal pricing systems on production efficiency and economic returns;
ii. Effects of stump height on regeneration;
iii. Effects of moisture content of logs on recovery rate/charcoal kiln efficient of charcoal;
iv. Financial viability of the charcoal production model; and
v. Assessment and development of inclusive charcoal value chain in the study villages.

2.3.2.1 Study on the effect of stump height on regeneration

Permanent Sample Plots (PSPs) were established in Kwedikabu VLFR to assess regeneration potential of Miombo in charcoal production area. Randomized blocks design was adopted. The block was divided into nine equal sized PSPs of 50 m x 50 m. During this study three treatments which are stump height of 15, 30 and 60 cm (Plate 1) were deployed for monitoring of stumps' regeneration/coppicing potential. Each PSPs received one of the three treatments in a random manner, and every treatment being replicated three times. On the other hand, data on tree counts on regenerants was collected in a rectangular plot of 5 m x 5m from each corner of the PSPs. This data was important for generating baseline information to be used during monitoring.

Plate 1: Trees cut at 30 cm (a) and 60 cm (b) at Kwedikabu VLFR for regeneration study

2.3.2.2 Effects of moisture contents of logs on recovery rate of charcoal

Experiment to assess effects of moisture content (MCs) of logs on recovery rate of charcoal was established. Three sample billets from dominant tree species

representing small, medium and large size were prepared and their weight loss was monitored (measured using portable electronic hanging scale) over the varying drying duration (Plate 2). Recorded weight loss was used to estimate moisture contents of the logs that was related to recovery rate of charcoal at particularly log drying duration. The wood drying duration were 14, 21 and 30 days.

Plate 2: A billet being measured for weight (a) using portable electronic hanging scale (b)

Moisture loss in wood billets was calculated using Equation 4, as follows:

$(W_1 – W_2/W_2) *100$ Equation 4

Where:

W_1 = Initial weight of wood billet at time 0

W_2 = Weight of wood billet after air dry (seasoning) at time t_1

Charcoal production efficient based on different wood drying durations was calculated in terms of kiln efficient (E_k) (%) using Equation 5, as follows:

$$E_k = M_C/M_W \qquad \text{Equation 5}$$

Where: E_k = kiln efficiency (%)

M_C = Mass of charcoal produced

M_W = Mass of wood (charge) put into the kiln (Air dried wood)

2.4 Effect of charcoal pricing systems on production efficiency and economic returns

We used literature review, field visits and key informant interview to identify the pricing technique used in the two study villages. We checked the pricing techniques for both raw materials and charcoal as a final product. It was necessary to review these techniques because efficiency in any business is linked to how effective such a business utilize the existing resources. In our case, the efficient use of logs in the forest will depend much on how these resources are being priced. Based on our experiences and literature, we think that, sustainability of charcoal production in the Country will depend on how best we utilize the existing resources through proper prices allocated to the raw materials and charcoal itself. We assume here that, any investment in advanced efficient technologies for charcoal production will be influenced by the pricing strategy used. If the pricing technology does not encourage efficiency in the utilization of raw materials for charcoal production, then sustainable use of raw of our forest will be questionable.

It was also assumed that, the current system where charcoal is priced based on the estimated (average) weight of the bag of charcoal does not and will never influence charcoal producers to invest on efficient technologies. Compared to other markets, Dar es Salaam market for instance prefer the large sized charcoal bags which are charged the same royalties as for the medium sized bags. This therefore seems to be the source of inefficiency in the production process.

2.5 Assessment and development of an inclusive charcoal value chain in VLFRs under intensified charcoal production model

Value-chain development (VCD) is among the important aspects for combating poverty in the society, stimulating economic growth and development. The value-chain indicates relationships among different stakeholders in the chain. According to Horton *et al*. (2016) a value chain refers to the sequence of interlinked agents and markets that transforms inputs and services into products with attributes that consumers are prepared to purchase. We therefore use the value chain analysis to identify key stakeholders in the value chain and how they influence the charcoal business, who is more powerful than the other and the effect of such power on the charcoal price. A strong charcoal value chain is thought to be important for helping people adjacent to forest reserves in rural areas to alleviate poverty hence improving their standards of living because majority of the rural people are poor and highly dependent on forest related products. Developing a stronger charcoal value chain will therefore benefit majority of the people in the study villages. With a stronger charcoal value chain, it is hoped that the charcoal business will benefit not only traders but also all other stakeholders along the chain indulging the landowners. Therefore, to assess the inclusive value chain systems, besides visiting the villages and talking to charcoal producers, we also visited the different markets to check who is involved in the value chain and the prices charged for different selling units. We visited Mkata, Chalinze, Tanga, Mkwaja, Dar es Salaam and Zanzibar. We talked to charcoal traders, transporters and consumers. Other important stakeholders that we interviewed are Village Leaders and charcoal makers' groups.

2.6 Financial viability of the charcoal production model

This is defined as the ability of the business to generate sufficient income through sustainable production and supply of the products or services. It is the income in any business that will assist the firm to meet its operating costs and debt payments. The financial viability of the business is determined by assessing the general economic factors in the market. It is also determined by the conditions guiding the labour market, the levels of demand for the required products or services, the profit

margins in the business, maturity of the sector or business and the capacity of businesses to supply the products in question, in this case charcoal.

Although financial viability of the business can be evaluated using different techniques, but in this study we use the Break Even Analysis (BEA). Using the break-even analysis, it will be possible to tell if the business will break even or be able to generate enough money by selling the products we intend to produce. The costs incurred during implementation of the trial model are divided into fixed and variable costs. Fixed costs are those which does not vary with the level of production while variable costs tend to vary with the level of production. In our present model, one of the example of the fixed costs will be the annual registration fee for charcoal trading which is paid annually and does not depend on the number of charcoal bags produced. We will therefore use the costs to estimate how much charcoal need to be produced for an individual to break even. We therefore used the following formula (Equation 6) to calculate the quantity of bags that need to be produced to be break-even:

$$\boldsymbol{Q = \frac{FC}{P - VC}} \qquad \text{Equation 6}$$

Where:

Q = Quantity to be produce in order to break even

FC = Fixed Costs

P = Price of charcoal

VC = Variable Costs

2.4 Limitations of the Study

The following are some limitations encountered during undertaking of this consultancy service:

(i) Conflict over land ownership between the illegal farmers/pastoralists and Mazingara Village Government over the proposed Majali Mkulumilo VLFR, led to researchers to be detained by the illegal farmers. The process delayed the forest resource assessment activity to proceeds as was planned. This had

negative implication on financial resources and safety of the researchers. The conflict has also led to delayed demarcation of charcoal FMU.

(ii) Long traveling distances from Village Centre to the VLFRs had negative implications on financial resources (budget).

3.0 MODEL RESULTS AND OTHER ACHIEVEMENTS

3.1 Awareness meetings at various levels and establishment of charcoal maker's groups

Awareness meetings about the charcoal project were carried out at the district level. It started with District Forest Officer (DFO), who then introduced the consultants to District Natural Resource Officer (DNRO). After introduction of the project to the DFO and DNRO, they accompanied the consultants to the District Executive Director (DED) for courtesy call and project introduction. Thereafter, DNRO introduced the Consultants to the Council Management Team (CMT) members. This was a short meeting that enabled Technical Officers in the District to get aware of what activities were planned to be implemented. Consultants explained objectives and activities to be carried out during the first phase of the project. Formation of Charcoal Maker's Groups was among the activities that drew much attention to the CMT members.

Since charcoal production and trade in the district is regulated by Tanzania Forest Services Agency (TFS) through District Forest Conservator (DFC) of Handeni District, the consultant and DFO paid a visit to DFC office in Handeni Township. The main objective of the visit to DFC was to introduce the project to get information about registration of CMG as a business entity that deals with production and trading of charcoal.

At village level, awareness meetings were carried out into two levels: (i) Village Government and Village Natural Resources Committee (VNRC); and (ii) entire villagers through Village Assembly. Awareness meeting for Village Government and VNRC involved 15 people including the Chairman, Village Executive Officer (VEO) and as well as the VNRCs (Plate 3). The meeting with village leaders and VNRC had the following objectives: 1) awareness creation, and 2) discussing existing opportunities and challenges in management of Village Land Forest Reserves as well as charcoal business. During the meeting, consultant explained how PFRA will be carried out, modality and technology for charcoal production. Village leaders were much impressed by charcoal production technologies to be introduced in their area.

Plate 3: Awareness meeting to Village Government and VNRC at Kwedikabu Village, Handeni District, Tanga Region.

On the other hand, Village Assembly was organized to all members of the village who were able to attend. Majority of the villagers attended the meeting (Plate 4). Objectives of the meeting were to introduce the project, and to mobilize charcoal makers and those interested to engage in charcoal production to form groups. Generally, the proposal of forming charcoal groups was accepted by the villagers.

Plate 4: Some members of the Village Assembly at Mazingara Village in Handeni District, Tanga Region.

After awareness meeting at village levels; the Consultants conducted reconnaissance survey to the forests under study (Majali Mkulumilo – Mazingara, and Kwedikabu) in assisted by representatives of the respective VNRCs. The trip to the forest aimed to understand where the forest is located, as well as aspects of the forest (Plate 5). This enables consultants to endorse field execution plan that was prepared before. It was noted that, Majali Mkulumilo Village Land Forest Reserve was relatively far (about 25 km) from the village centre. Such a distance was among the challenges faced by the VNRC at Mazingara Village as they have no transport to enable them conduct regular patrols and forest monitoring.

Plate 5: Reconnaissance survey at Kwedikabu (photograph A) and Mazingara (Photograph B) at Handeni District, Tanga Region.

3.1.2 The current status of charcoal production and utilization in the study villages

3.1.2.1 Charcoal production rates at Kwedikabu and Mazingara villages

Despite lack of official information on the rate of charcoal production, preliminary data indicated the presence of significant levels in both Mazingara and Kwedikabu Villages. Most of the charcoal does originate from the individual farms. Local people engage in charcoal production as a means of clearing forested land for farming activities. There was a little variation in tree species preferred for charcoal production but Mkambala, Mlama, Mkwaju and Mtondolo were common in both villages (Table 3). In terms of the local kiln technologies used in the villages, msonge and box kilns were found to be common. The Chanuo Kiln was also mentioned to be used in Kwedikabu Village. Charcoal producers seemed to have not undertaken formalized procedures required for them to be recognized as important stakeholders in the charcoal value chains. This made it difficult to have a formal and accurate data on the number of charcoal producers in each village. In both villages, there were no formal groups for charcoal production before the intervention of this assignment. However, in Kwedikabu Village, they estimated a total of about 30 charcoal producers. Village Leaders at Mazingara Village narrated that the normal procedure in order to engage in charcoal production in their village starts with the producer to notify the Village or Sub-Village Government and request the Village Authority to provide an official permit to the producer. Later the Village Natural Resources Committee (VNRC) will have to monitor the production process.

Table 3: Tree species preferred for charcoal production in Kwedikabu and Mazingara villages, Handeni District, Tanga Region.

Kwedikabu Village		Mazingara Village	
Local name	Scientific name	Local name	Scientific name
Mguluka	*Boscia salicifolia*	Miombo	*Brachystegia spp*
Mhande	*Craibia zimmermannii*	Mkambala	*Senegalia nigrescens*
Mkambala	*Senegalia nigrescens*	Mkonga	*Balanites aegyptiaca*
Mkongowe	*Vachellia robusta*	Mkwaju	*Tamarindus indica*
Mkwaju	*Tamarindus indica*	Mlama	*Combretum molle / C. zeyheri/ C. fragrans*
Mlama mweusi/mweupe	*Combretum molle / C. zeyheri/ C. fragrans*	Mseni	*Brachystegia microphylla*
Mngogi	*Pteleopsis myrtifolia*	Mtondoro	*Brachystegia speciformis*
Mtondoro	*Brachystegia speciformis*		
Mkonga	*Balanites aegyptiaca*		

3.1.2.2 Participation in charcoal production and consumption

It was observed that, there were no clear statistics on the differences in the participation of people on charcoal production process based on age or gender. People of different ages and gender categories were participating in charcoal production activities. There are low and high production months in the two villages which varied as indicated in the Table 4. Mazingara Village has two low and high charcoal productions seasons while Kwedikabu has only one each. The difference in charcoal production between the two villages was associated with characteristics of charcoal producers; in Kwedikabu most of the charcoal producers were not permanent residents, they do mostly during dry season when involvement in agricultural activities is low. While at Mazingara Village, some of the charcoal producers are permanent residents and have marked charcoal business as main sources of income apart from agriculture.

Table 4: Low and high charcoal production months at Handeni District, Tanga Region.

Aspect		Village	
		Kwedikabu	Mazingara
Production Seasons	Low	March – June	January – April August – October
	High	July – October	May – June November – December

Despite the perception that rural communities are using firewood as their main source of energy for cooking but it was observed that 50% and 70% of the households are using charcoal for cooking in Kwedikabu and Mazingara Villages, respectively. Both Kwedikabu and Mazingara Villages are modernized and therefore may transform into small townships in the very near future. The two villages are modernized for different reasons. While Mazingara is along the Handeni Highway, Kwedikabu is close to the Saadan National Park.

The Village Governments in both Kwedikabu and Mazingara Villages seems to be partially engaged in the charcoal production process. They narrated that, the only way they are engaged in the charcoal value chain is through tax collection when the traders want to transport charcoal to other places mainly Zanzibar and Dar es

Salaam. The amount charged for each bag at the Village level varies from TZS 500.00 to 2,000.00 depending on the size or weight of the bag.

Although there was potential of composing strong CMGs in the villages but currently there is no existing group. When interviewed, charcoal producers and other villagers thought that having a group is important and potential for accessing loans from the Banks, Government and other lending Institutions. The villagers were aware about Government Loans provided to formalized groups so they thought that establishing those groups will assist them to access those kind of opportunities.

Several stakeholders were involved in the charcoal value chains in both villages (Table 5). Mazingara Village had many stakeholders compared to Kwedikabu Village may be due to long time involvement in charcoal production, but also being near to Mkata Town Centre. Threats that are caused by unsustainable charcoal making were also mentioned as seen in Table 5.

Table 5: Stakeholders involved in charcoal production value chain and main threats, Handeni District, Tanga Region.

Aspect	Villages	
	Mazingara	Kwedikabu
Stakeholders	➢ Producers ➢ Labourers (Packaging and loading) ➢ Tanzania Forest Services Agency (TFS) ➢ Transporters ➢ Village Government ➢ Whole Sellers	➢ Farm Owners ➢ Charcoal Makers ➢ Transporters ➢ Labourers ➢ Village Government
Main threats caused by charcoal production	➢ Environmental degradation ➢ Health problems to charcoal producers and consumers ➢ Deforestation ➢ Desertification	➢ Deforestation ➢ Desertification ➢ Hunger ➢ Loss of rainfall ➢ Destruction of Water Sources ➢ Increased Carbon in the atmosphere ➢ Loss of Soil fertility ➢ Health problems to human being

3.1.2.3 Charcoal value chains, packaging, transportation and prices

Different charcoal value chains exist in the two Villages. In Kwedikabu Village, the charcoal produced is sold straight to various buyers in bags varying from 75 to 150 kg. The main buyers of charcoal from Kwedikabu are wholesalers from Dar es

Salaam, Unguja and Zanzibar. The price in this village ranges from TZS 6,000 to 8,000 at the kiln site during the dry season when production is high. The price then increases to about TZS 10,000 to 12,000 during the rainy season when production is low.

On the other hand, the charcoal value chain in Mazingara Village starts from the producers and straight to various buyers at retail prices and some sold to store owners who are mainly based in Dar es Salaam in different bag sizes ranging from 80 to 90 kg. The price at Mazingara Villages ranges from TZS 7,000 to 8,000 during dry season and sometimes it increases up to TZS 14,000 to 15,000 depending on the size of bags used. During rainy season (low production season), the price of charcoal at Mazingara Village normally increases to TZS 16,000 to 20,000. The local charcoal buyers at Mazingara Village are individuals, restaurant owners and middlemen. The means for charcoal transportation differ depending on the destinations and distances but it is mainly through motorcycles, vehicles and ships especially charcoal going to Zanzibar. Zanzibar seems to be the best market for charcoal from Kwedikabu while those at Mazingara are taking their charcoal to Dar es Salaam. Charcoal packaging also differs for charcoal that goes to Zanzibar (30 kg) and Dar es Salaam (80 – 90 kg). The difference in charcoal weight was due to transport means used, for instance regulations at the harbour only allows charcoal bags of that weight.

3.1.3 Formation of Charcoal Maker Groups

Two Charcoal Makers' Groups (CMGs) were formed in each village with about 19 to 60 members (Appendix 1). Initially it was planned to have charcoal makers' associations, but that is a high level, at the time it was impossible. The formed MGs, one was for all people (mix of youths and older people) (Plate 6) while the other one was only for youths (Plate 7).

Plate 6: Members of charcoal makers' group (general group) at Kwedikabu Village, Handeni District, Tanga Region.

Plate 7: Some Charcoal makers' group of youths at Kwedikabu Village, Handeni District, Tanga Region.

The CMGs were formed and given a name, and elected leaders as a requirement by regulations governing groups. In Kwedikabu Village, formed two CMGs namely Nguvumali (for elders with 36 members of which 11% were female), and Songambele (for youth with 60 members, of which 38% are female). Also in Mazingara Village, two CMGs were formed namely Mchakamchaka (for elders with 43 members, of which 28% were female) and Matanuru for only youths with19 members of which 21% are female. The gender composition of CMGs is illustrated in Fig. 4. The group members were trained to formulate their constitutions, which is among the requirements during registration of the group. The groups have been

registered at District level to make them formal (Appendix 2). Also they opened bank accounts, which will enable them not only to safe keep money earned from charcoal making and other socio-economic activities but also to access other opportunities from the financial sector.

Furthermore, all CMGs have been registered to the TFS as forest produce dealer/trader under the provision of Section 106 of the Forest Act, 2002 (Appendix 3). Their registration at TFS expires on 30th June 2022.

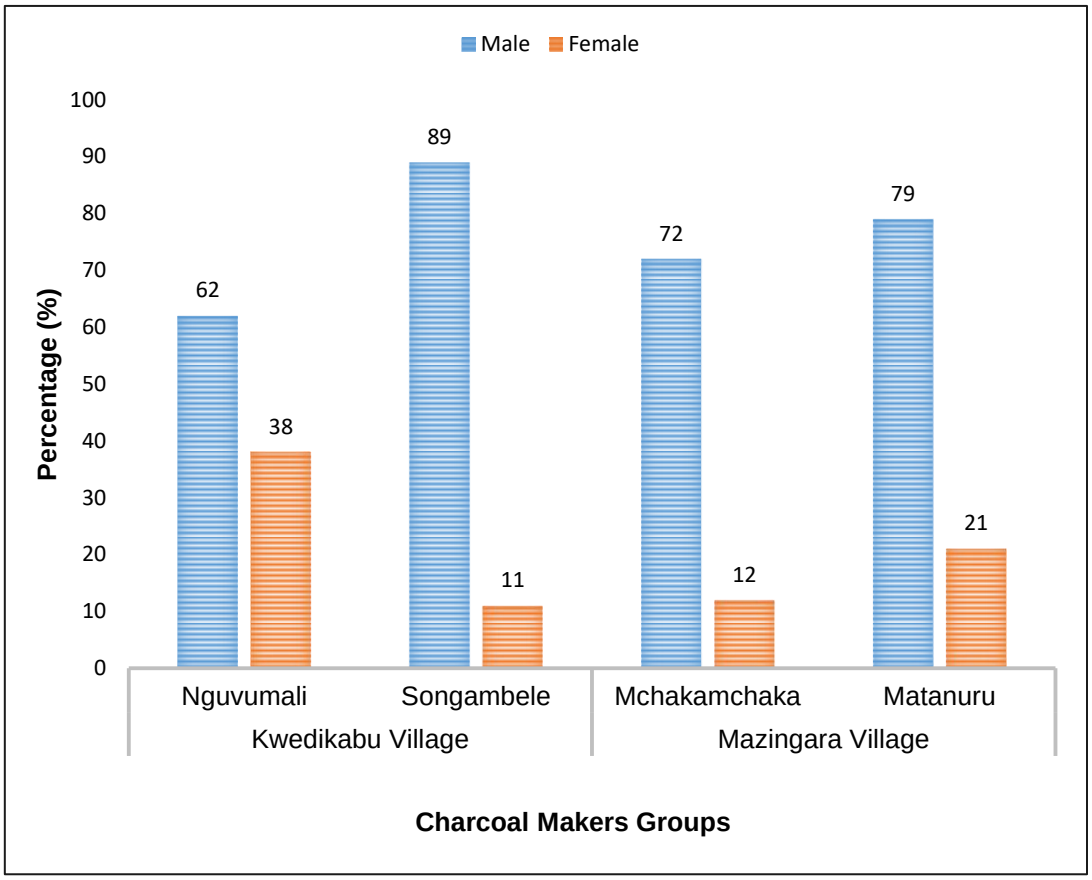

Figure 4: Gender composition of charcoal markers groups at Kwedikabu and Mazingara Villages, Handeni District, Tanga Region.

3.1.4 Study visit to Kilosa for Village Leaders; VNRC members CMGs members

Twenty participants i.e. 10 people from each village visited two villages in Kilosa District to share experiences and learn from the Sustainable Charcoal Project that is being implemented by the Tanzania Forest Conservation Group (TFCG). The participants were categorized as follows; (i) 4 Village Leaders (Village Chairman and Village Executive Officer (VEO) from each village)) (ii) 8 VNRC representatives (iii) 8

CMGs representatives. Figure 5 shows distribution of male and female visited Kilosa District. Selection of participants was gender sensitive.

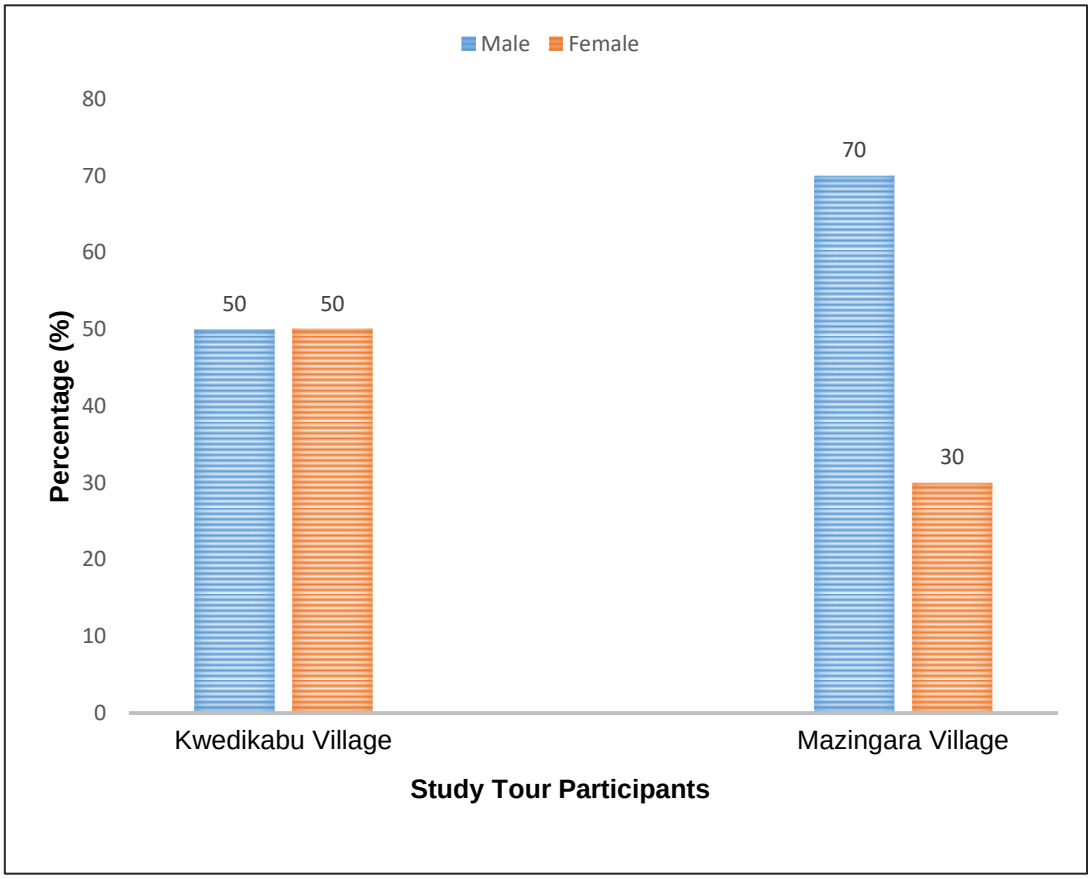

Figure 5: Distribution of participants of the study tour in Kilosa District, Morogoro Region.

While in Kilosa, participants visited two villages namely; Chabima and Ulaya-Mbuyuni. Chabima Village was visited on the first day of the tour while the second day participants went to Ulaya-Mbuyuni. The main objective of the visit was to enable participants from Handeni to acquire knowledge and skills on sustainable forest management, management of charcoal business along its value chains, as well as opportunities and challenges of the charcoal business. In addition, each group category (village leaders, VNRC and CMGs) also learnt various issues from their counterpart related to their position. Detailed checklist of issues discussed is provided in Appendix 4.

In Ulaya-Mbuyuni village, discussions were held at the charcoal production site within the FMU in VLFR. In this case, participants were able to get explanation on all charcoal production steps as well as sharing experiences on charcoal production including billet arrangement in the kiln and production of by products (Plate 8).

Plate 8: Study visit participants (photograph A&B) getting explanation on how charcoal is produced sustainably at Ulaya Mbuyuni Village Land Forest Reserve, Kilosa District, Tanga Region.

3.1.5 Production of current VLFRs LULC maps

VLFRs LULC cover maps for both Mazingara and Kwedikabu VLFRs have been produced showing variation in vegetation cover types and land uses. Figure 6 shows the Kwedikabu Village Land Forest Cover map. Some areas in the forest have been leased to a mining company that has been conducting its activities in the VLFR. The analysis of the satellite Image shows that about 6.66 ha i.e. (0.2%) of the forest has been affected by exploration activities (Table 3). Generally, vegetation cover of the forest is dominated by three vegetation types: 1) scattered Miombo woodlands on

the south and eastern part, near the Saadan National Park (33.18%), 2)*Vachellia/Terminalia* woodlands in western and northern part of the forest (32.02%) and 3) riverine forest (21.01%). Others were water pond and bare lands, the later mainly occurring valley shoulders and other places with poor soil structure (Figure 6; Table 6).

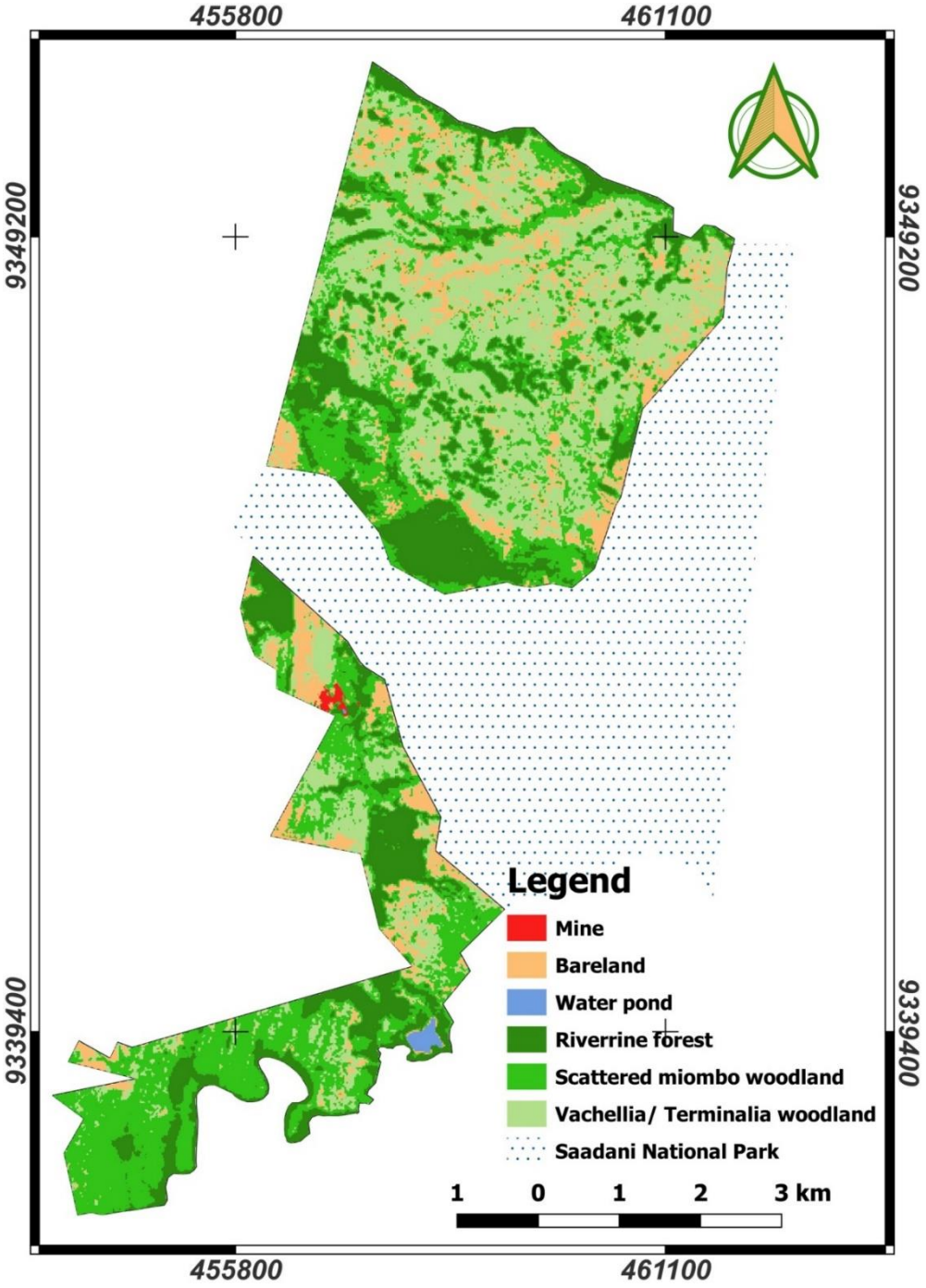

Figure 6: LULC map of Kwedikabu VLFR, Handeni District, Tanga Region.

Table 6: Coverage of different LULC classes at Kwedikabu VLFR, Handeni District, Tanga Region.

Land forest cover	Pixel Sum	Area (m^2)	Area (ha)	Percentage %
Riverine forest	74,196	7419600	741.96	21.01489
Scattered Miombo woodland	117,136	11713600	1171.36	33.17699
Vachellia / Terminalia woodlands	113,048	11,304,800	1130.48	32.01912
Bare land	46,718	4,671,800	470.06	13.31373
Mine	954	95,400	6.66	0.188634
Water pond	1,012	101,200	10.12	0.286634
Total	353,064	35,306,400	3,530.64	100

Similarly, the LULC maps for Majali Mkulumilo VLFR (Fig. 7 and 8) shows areas (24%) of the forest have been converted into farmlands by the encroachers, on which settlements and livestock yards are established. The invaders have posed conflicts with the village government so that they could continue living in the forest and proceed with human activities

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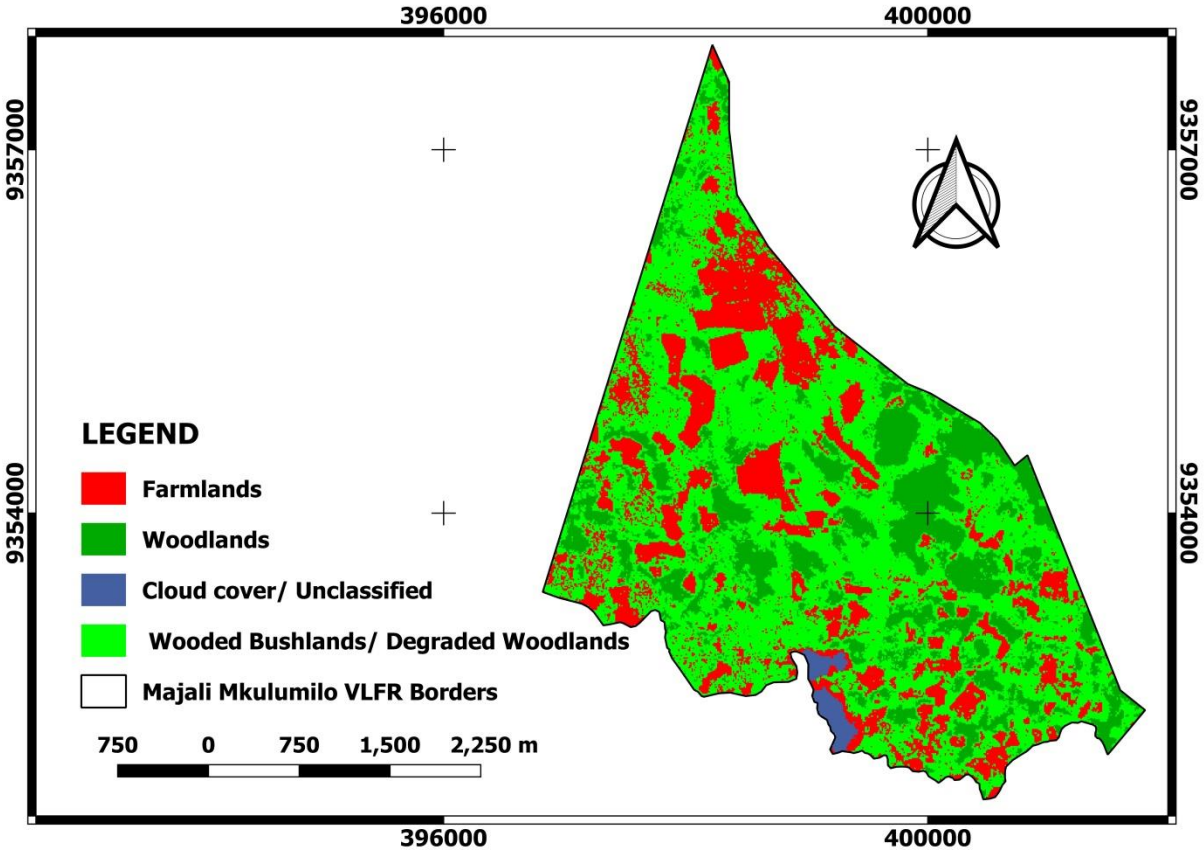


Figure 7: Land forest cover of Majali Mkulumilo before boundary resurvey at Mazingara Village, Handeni District, Tanga Region.

This necessitated to the District Commissioner (DC) to intervene and ordered setting aside some forest land (203.53 ha, 19.4%) to relocate the invaders and settle the conflict once and for all. This led to VLFR boundary re-survey during which the southern part (Fig. 8) of the forest was retained and the northern part being left for resettlement of the invaders. Care was taken such that side of the forest which was mostly affected by human/ agriculture activities was set aside for resettlement. Consequently, the current area of the forest is 1,049.11 ha, with 203.53 ha less after boundary consolidation (Table 7).

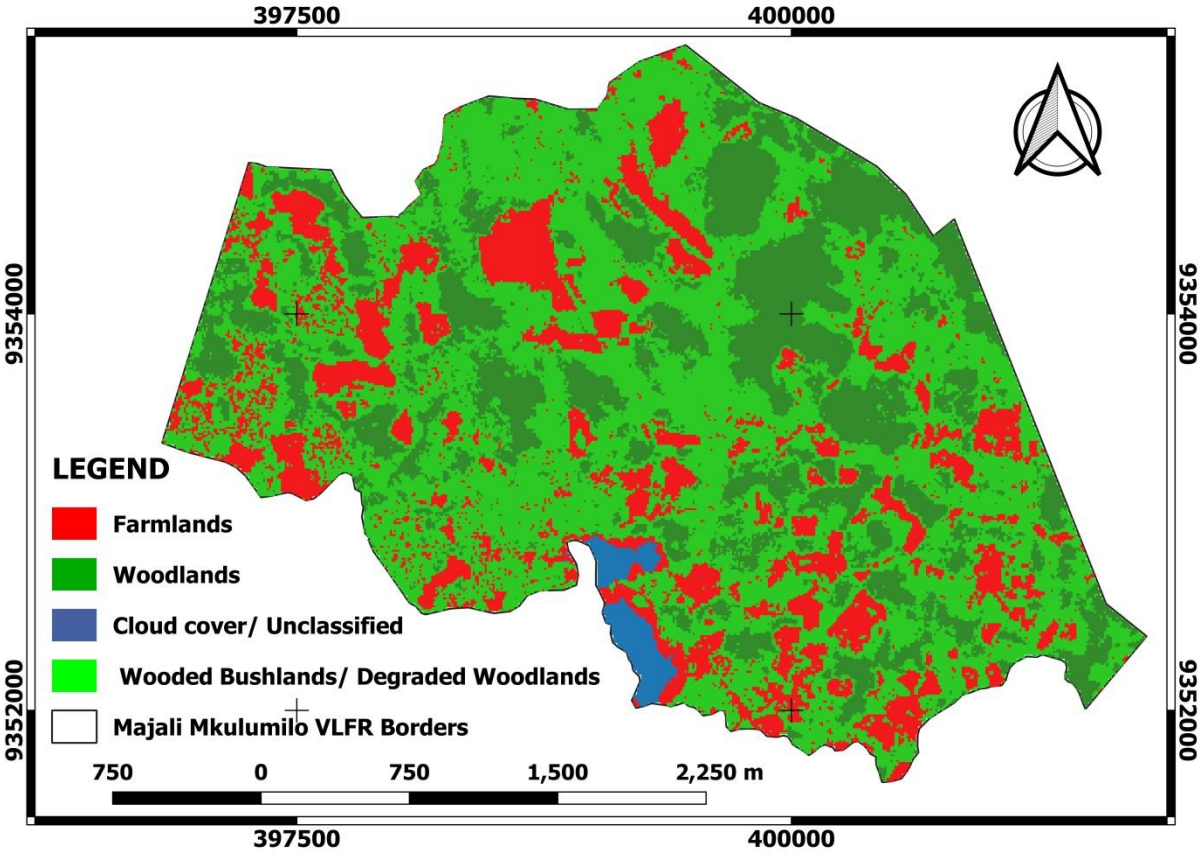


Figure 8: Land forest cover of Majali Mkulumilo after boundary resurvey at Mazingara Village, Handeni District, Tanga Region.

Table 7: Coverage of different LULC classes at Mazingara VLFR, Handeni District, Tanga Region.

Land forest cover	Before boundary consolidation		After boundary consolidation	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Wooded bushland/ Degraded woodland	726.11	54.20	570.34	54.36
Woodland	279.76	20.88	261.1	24.89
Farmlands	319.62	23.86	203.53	19.40
Cloud cover	14.15	1.06	14.14	1.35
Total	1,339.64	100	1,049.11	100

The resurveyed LULC map shows that Majali Mkulumilo VLFR is dominated by Wooded bushland/Degraded woodlands by 54.36% while the remaining part of the forest is covered by Miombo woodlands and farmlands.

3.1.6 Participatory forest resources assessment and development of harvesting plan in Kwedikabu

Participatory Forest Resources Assessment (PFRA) was carried out in the two forest reserves with different objectives. For the Kwedikabu VLFR, forest management plan is in place, therefore PFRA was carried in FMU prioritized for charcoal production for production of forest harvesting plan. Initially, the VNRCs marked three areas in the forest as suitable for charcoal production, but all of them had challenges including Area 1 in northern part of the reserve being dominated by *Vachellia* and *Terminalia* species, which are small in size. Area 2 located in central part of the reserve had mining activities therefore, could cause conflict with the investor. Area 3 which had some scattered small and big trees was adopted. The Consultants resurveyed the Area 3 located in southern part of the VLFR. The area is about 20 km from the village centre and has some scattered Miombo woodlands. Thereafter, the area was divided into two blocks (Fig. 9).

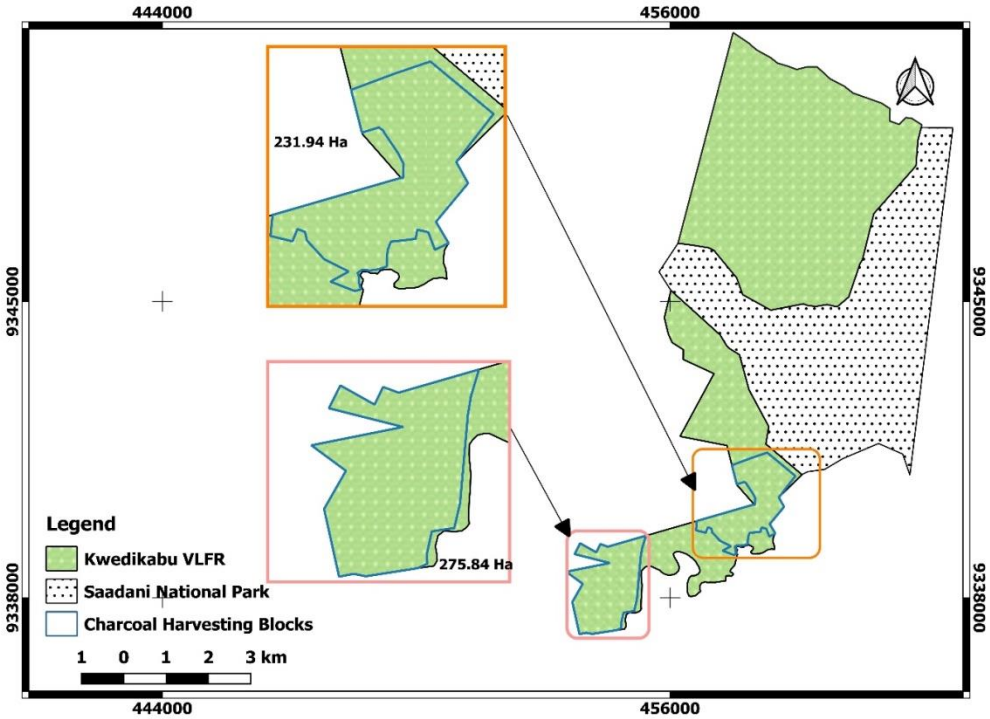


Figure 9: A map of Kwedikabu VLFR showing two blocks for sustainable charcoal harvesting.

The forest resource assessment results showed that on average one hectare had about 550 stems, most (89%) of dbh of trees were between 5 to 19.9 cm. The average volume per ha in Kwedikabu VLFR was estimated at 78.7m3. Table 8 presents a summary of stand parameters results from the forest assessment.

Table 8: Stand parameters in FMU for charcoal production at Kwedikabu VLFR, Handeni District, Tanga Region.

DBH classes (cm)	Number of stems per ha (N)	Volume per ha (V)
5 - 9.9	389.1	7.9
10 - 19.9	103.2	11.7
20 - 29.9	32.0	13.2
30 - 39.9	13.7	13.9
40 - 49.9	7.2	13.1
50 - 59.9	2.3	6.7
> 60	2.7	12.2
Total	550.1	78.7

The FMU for charcoal production is dominated by Miombo vegetation. However, there are a few areas with coastal forest. It has 54 different tree species. Five tree species out of the 54 species were found to contribute a tree volume of approximately 44.1 m^3/ha which is equivalent to 56% of the average volume per hectare (Table 7). The most dominant tree species are: *Combretum zeyheri* (mlama mweupe), *Tamarindus indica* (mkwaju/mkwazu), *Spirostachys africana* (msaraka), *Sclerocarya birrea* (mngongo) and *Senegalia nigrescens* (mkambala). The remaining 49 tree species contribute 34.9 m^3/ha equivalent to 44% of the average volume per hectare.

The PFRA in the FMU for charcoal production showed the presence of trees that can be harvested for charcoal production. It has been found that every 1 hectare of FMU for charcoal production has 78.7 m^3 of wood which is equivalent to 236 bags of charcoal, which is also equivalent to 11,812.5 kilograms or 11.8 tons of charcoal per hectare. However, not all the volume of trees per hectare will be harvested for charcoal.

Estimation of the amount of charcoal per hectare has taken into account two main factors: 1) only 70% of the total volume of trees will be harvested for charcoal, and 2) only 85% of the volume of wood will be used for charcoal. Thus, based on these two factors, it is estimated that the average volume of trees per hectare to be harvested for charcoal is 46.9 m^3. The volume is equivalent to 141 bags of charcoal, which is equivalent to 7,028.5 kilogram of charcoal which is also equivalent to 7.03 tons of charcoal per hectare. Actual production from the coupes indicated a minimum of 23 bags of charcoal of 50 kg.

3.1.7 Demarcation of charcoal forest management unit (FMU) and harvesting coupes

The FMU for charcoal production has been divided into two blocks. The blocks have a total of 507 ha, which is about 15% of the total area of the forest. It was expected to demarcate 20%, this was not possible because the VLFR had been degraded with some anthropogenic activities including mining. One of the blocks has 275.8 ha, while the second one has 231.9 ha. The two blocks have been divided into 20 harvesting compartments with about 25 ha each (Fig. 10). One compartment will be harvested each year starting from 2021/22, of which after 20 years (i.e. in 2041/42) the circle will have rotated back to compartment that was harvested in 2021/22.

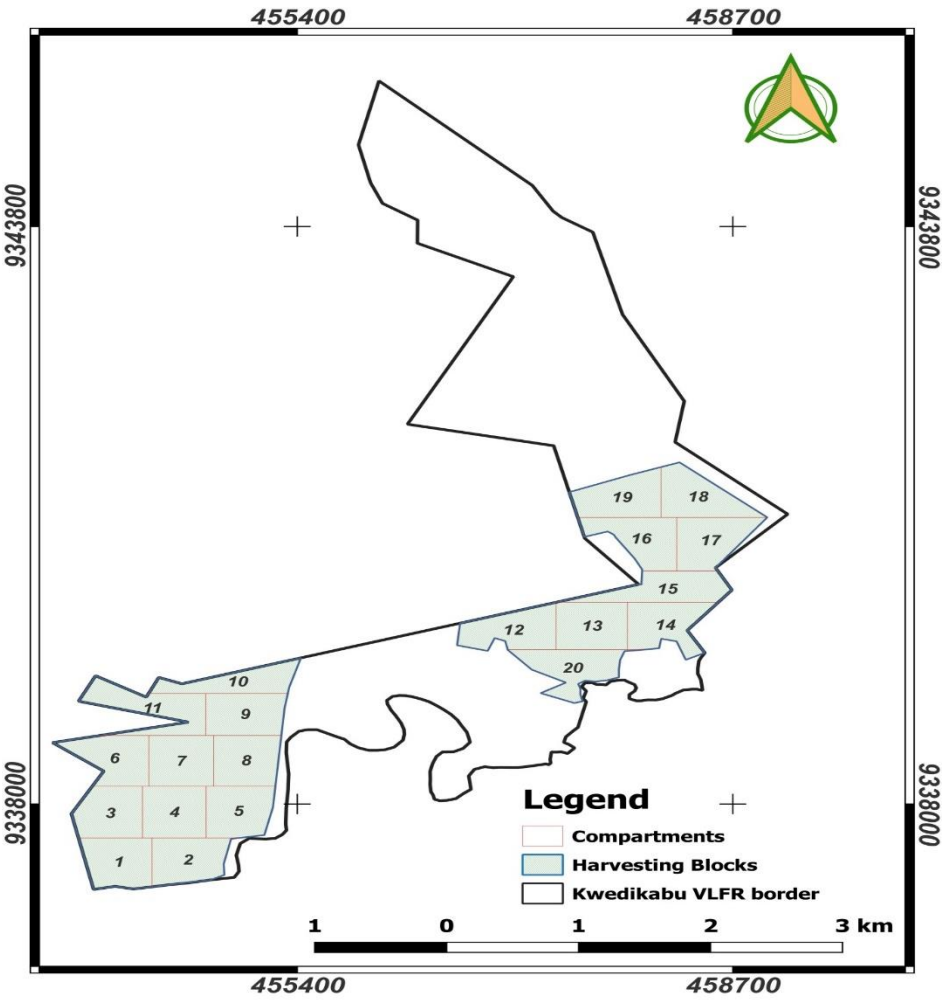


Figure 10: Harvesting compartments at Kwedikabu VLFR, Handeni District, Tanga Region.

Harvesting for the first five years will be carried out in block 1. However, the harvesting will not take place on the whole block, so the first block is divided into 11 compartments with the same size of 25 ha each (Fig. 10, 11). Each compartment will be harvested for one year, so 5 compartments will be harvested during the implementation of the harvesting plan of 2021/22 to 2025/26. The layout of the five compartments that will be harvested are as follows: compartment number 2 for 2021/22, compartment number 7 for 2022/23, compartment number 3 for 2023/24, compartment number 10 for 2024/25 and compartment number 5 for 2025/26. Figure 11 shows arrangement of compartments selected for charcoal production for the next five years from 2021/22.

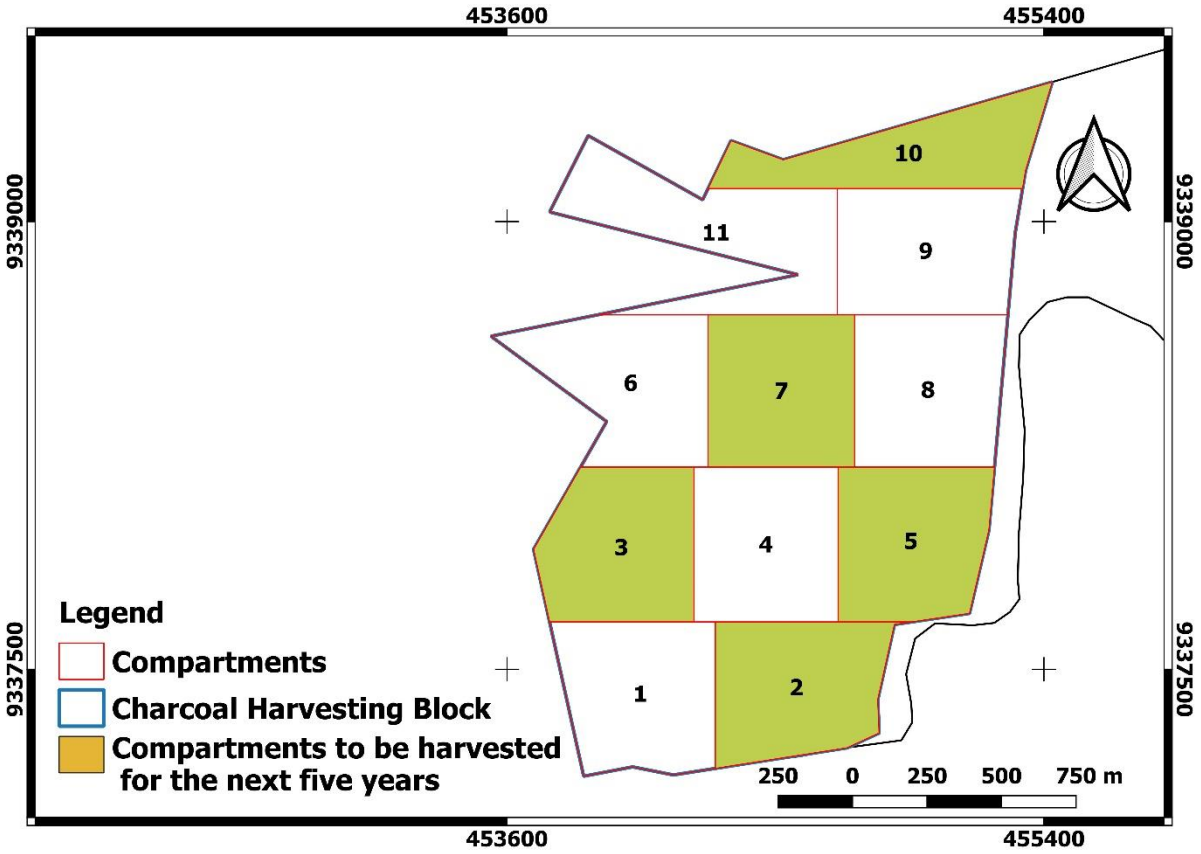


Figure 11: Layout of compartments that will be harvested within the five years from 2021/22 at Kwedikabu VLFR, Handeni District, Tanga Region.

In each of the compartment, 100 small harvesting units of 50 x 50 m have been set, which will be used for harvesting (Fig. 12). Harvesters may harvest several harvesting units depending on the number of bags of charcoal to be harvested. One harvesting unit is estimated to produce 11.7 m^3 which is equivalent to 35 bags of charcoal of 50 kg. Within the harvesting block, there are trees that will not be harvested including fruits trees like *Sclerocarya birrea* (Mng'ongo), *Strychynos cocculoides* (Mtonga), *Strychynos innocua* (Mkwakwa), *Tamarindus indica* (Mkwaju), and *Ximenia caffra* (Mtundwi). Also valuable and endangered species like *Dalbergia melanoxylon* (Mpingo), *Pterocarpus angolensis* (Mninga) and others will be reserved.

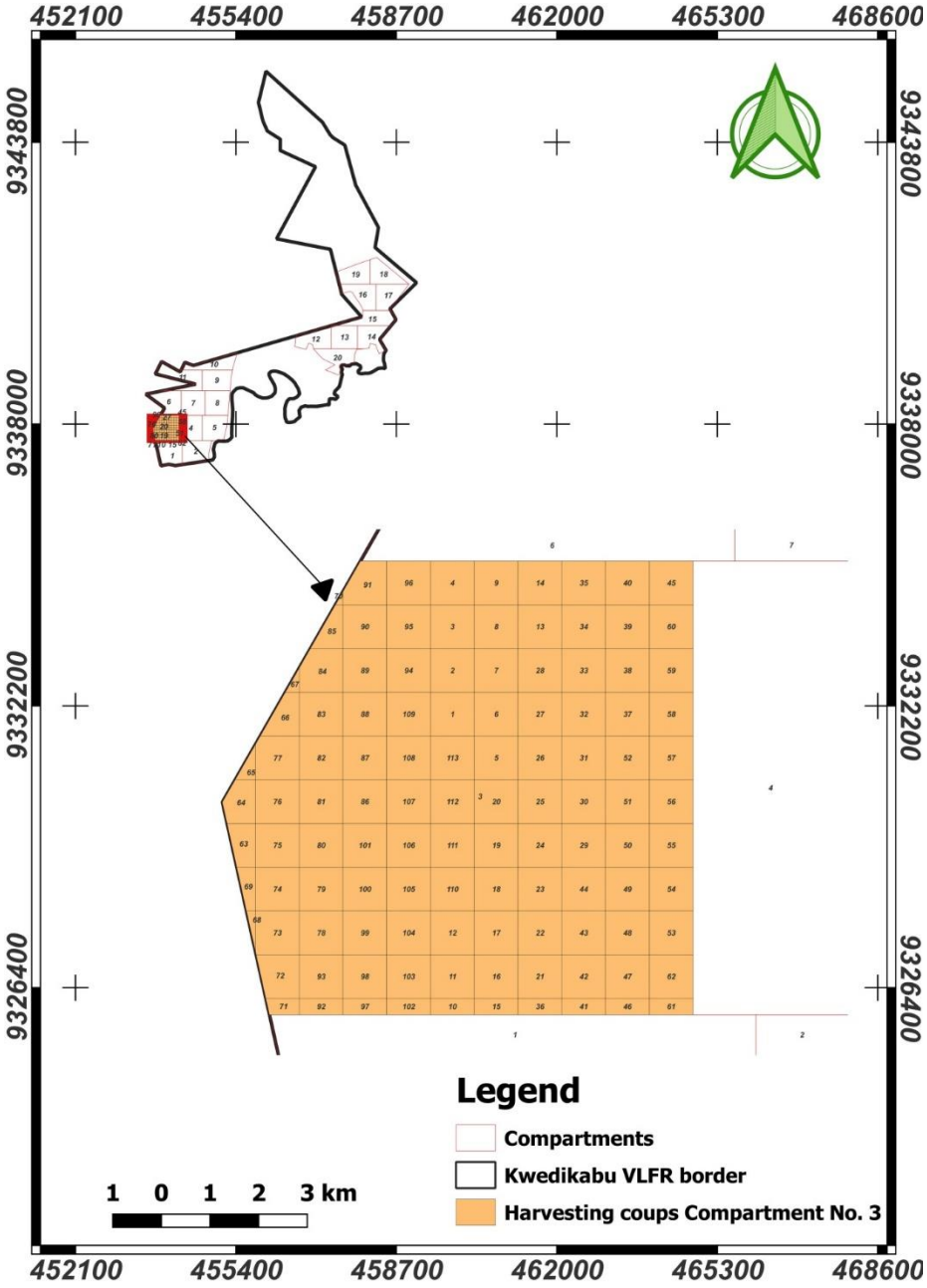
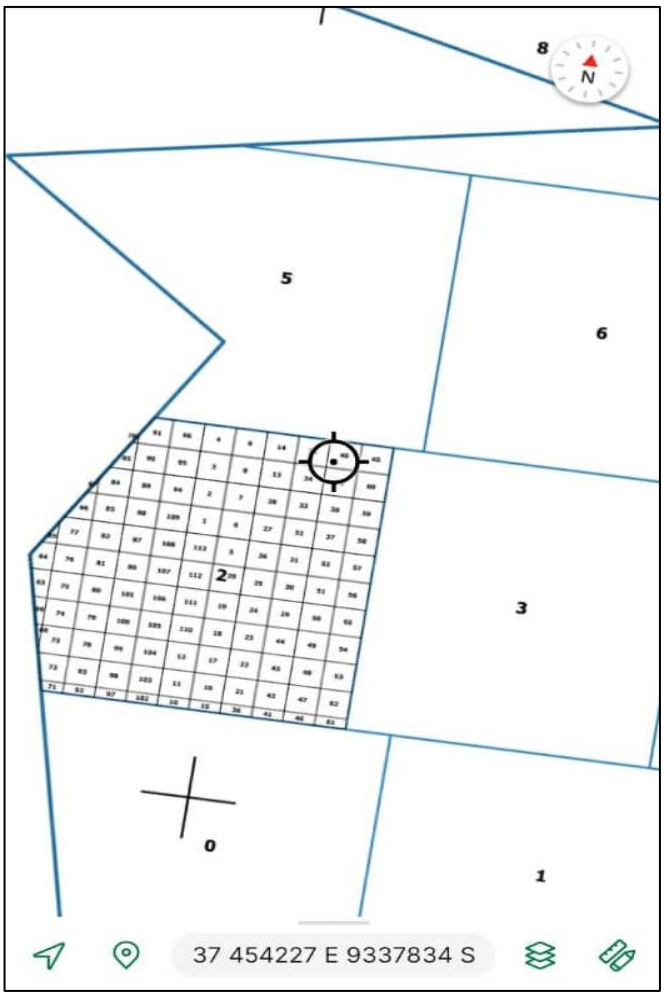


Figure 12: Arrangement of tree harvesting coupes for charcoal production at Kwedikabu VLFR, Handeni District, Tanga Region.

In identifying the harvesting coupes, the Kwedikabu VNRCs (Plate 9) have been trained on how to locate the harvesting coupes in the forest using Avenza Maps App in the Android smartphones (Plate 10). In using the App., a map with harvesting coupes was downloaded into the smartphones which were then opened with Avenza Maps App.

Plate 9: VNRC members training to use Avenza Maps App in the Android smartphones at Kwedikabu Village, Handeni District.

Plate 10: Avenza Maps App that is used to locate charcoal harvesting compartments and coupes at Kwedikabu Village Land Forest Reserve, Handeni District, Tanga Region.



During training VNRCs members were given little assistance to locate the harvesting coupes alone. To ensure effective participation, the VNRCs worked into groups with three to four people. This method of locating the harvesting coupes was observed to be simple and accurate. What seemed to be important was members of the VNRCs to have several smartphones installed with Avenza Maps App (Plate 10). So far, one Android smartphone has been bought for the VNRC at Kwedikabu Village to enable them access to take off.

3.2 Research component - Development of intensive charcoal production model

Under the research component of this assignment, the following activities have been done: setting experiment area and initial charcoal production in Kwedikabu Forest Management Units.

3.2.1 Setting experiment area

Experiment area has been set on 9 harvesting coupes of 50 x 50 m, which are marked as the PSPs, which will be monitored for 10 years. Table 6 show the coupes that have been set aside for the regeneration study. The PSPs were marked by directional trenches dug at all corners. The experiment will study coppicing ability of stumps at 15, 30 and 60 cm height. CMGs were guided on how to cut trees based on the study stump heights. Each treatment has been set in its own harvesting couple and replicated twice, that means there are three harvesting coupes per each stump height treatment. Table 9 presents number of coupes set as PSPs.

Table 9: PSPs established for assessment of coppicing ability of stumps at 15, 30 and 60 cm height at Kwedikabu VLFR, Handeni District, Tanga Region.

Coupe identification numbers	Cutting height (cm)	Treatment code
20, 48, & 89	15	T_1
17, 38, & 88	30	T_3
7, 51 & 87	60	T_2

3.2.2 Charcoal production, recovery and trade

Demonstration on sustainable charcoal production has been done at Kwedikabu Village using wood that was cut in the coupes (of 50 x 50 cm) under research in the Permanent Sample Plots (PSPs). Wood from five research coupes was used by Nguvumali Charcoal Making Group (CMG), while the remaining from four coupes was used by Songambele Charcoal Making Group. Each CMG cut down the trees with guidance from the Consultants. The trees were cut down using axes and a two man crosscut saw. Crossing cutting of logs (maximum length of 2 m) was done using powered chainsaw. The wood (logs) from the cut trees was left in the field (within the harvested areas) to air dry (seasoning) for a duration of 14, 21 and 30 days. Each CMG had three charcoal kilns each representing the seasoning duration of wood for 14, 21 and 30 days.

Charcoal making groups (elders and youths) worked in collaboration during charcoal kiln establishment using seasoned wood (Plate 11). Women (Plate 12) from both charcoal making groups were involved in charcoal kiln establishment, which is different phenomenon to some other areas, as only men are normally involved in these activities. This situation indicates that, the charcoal making groups are strong enough as all members are able to participate almost in all activities involved in the charcoal value chain. The VNRC members were also involved in checking/monitoring all processes of charcoal making (Plate 13).

Plate 11: Charcoal making group establishing a charcoal kiln at Kwedikabu Village, Handeni District, Tanga Region.

Plate 12: Women participating in charcoal kiln establishment at Kwedikabu Village, Handeni District, Tanga Region.

Plate 13: Some members of the VNRC following closely charcoal making process at Kwedikabu Village, Handeni, Tanga Region.

Demonstration on charcoal production continued which involved monitoring carbonisation of wood (Plate 14) as well as collecting crude wood vinegar (Plate 15). Carbonisation monitoring time varied from 5 to 7 days depending on the volume of wood being carbonized but also size (diameter) and number of the chimney. About 80 litres of crude wood vinegar were collected from a charcoal kiln that had kiln size of producing about 25 bags (50 Kgs each) of charcoal.

Plate 14: Charcoal making group establishing a charcoal kiln at Kwedikabu Village, Handeni District, Tanga Region.

Plate 15: Charcoal making group establishing a charcoal kiln at Kwedikabu Village, Handeni District, Tanga Region.

After kiln carbonation, charcoal was left for two days to get cool and assessed its quality (Plate 16). Charcoal that was observed to be cool (not hot) was filled into small bags which weighed about 30 kg ready for selling (Plate 17).

Plate 16: Sample of charcoal produced from one of the kilns at Kwedikabu Village, Handeni District, Tanga Region.

Plate 17: Charcoal makers group members filling charcoal into bags ready for use at Kwedikabu Village, Handeni District, Tanga Region.

Currently charcoal production is being undertaken done by the two charcoal making groups in Kwendikabu Village (Nguvumali and Songambele). In January 2022, a total of 75 bags weighing 25 - 30 kg each were produced by both groups from few woods that were used during training. The charcoal was sold locally at the village, and fetched about TZS 187,500.00. The money obtained from the sale of charcoal was divided equally to the two groups and was agreed to be as seed money for the groups to continue with charcoal business. In May 2022, the charcoal making groups have continued to produce charcoal in the research plots (PSPs). Nguvumali Charcoal Making Group has produced about 88 bags weighing about 25 - 30 kg each from two kilns, which valued about TZS 440,000.00 (this is yet sold). While Songambele Charcoal Making Group has produced 82 bags weighing about 25 - 30 Kg each from two kilns and fetched about TZS 410,000.00. The Village (Kwedikabu) has also received about TZS 512,500.00 as revenue (from 41 (82 bags/2) bags each weighing about 50 kg) the sold charcoal which was produced by Songambele Charcoal Making Group. The charcoal was sold to charcoal dears who bought it directly at the forest, and each charcoal bag weighing 30 kg was sold at TZS

5,000.00. Then after the charcoal buyers proceeded with other formal processes in different Government levels.

On the other hand, [1]optimal duration for wood seasoning (air drying) was 14 days for reducing wood moisture by 9% for charcoal production at Kwedikabu Village Land Forest Reserve. Kiln efficient for 14 days was 47.2% which was not significantly different from those for 21 and 30 seasoning days (Table 10). Similarly, the amount of moisture lost (9%) in the wood during the 14 days was sufficient for producing quality charcoal.

Table 10: Kiln efficient for wood seasoned for 14, 21 and 30 days at Kwedikabu VLFR, Handeni District, Tanga Region.

Kiln No.	Seasoning duration (days)	[b]Wood moisture loss (%)	Weight of uncarbonized wood (Kg)	Weight of produced charcoal (Kg)	Kiln efficient (%)
38	14	8.9	3,116.08	1,175	37.71
7			882.11	500	56.68
Average					**47.195**
89	21	12.77	1,636.02	750	45.84
48			1,526.34	750	49.14
Average					**47.49**
86	30	19.44	760.08	350	46.05
17			1,406.50	650	46.21
Average					**46.13**

[b]Average weight of sampled wood billets for estimating moisture loss was 14.91 Kg

3.2.2 Effects of stump height on regeneration

First monitoring on regeneration in PSPs which trees were cut for charcoal production was done after a duration of 90 days (in March 2022). It has been observed that most of the tree stumps were regenerating massively. *Combretum* spp. (*C. zeyheri* - mlama mweupe and *C. molle* – mlama mweusi) were observed to regenerate highly regardless of stump height and diameter (Plate 18).

[1] Optimal duration (time) that considers charcoal quality and reduced costs for production.

Plate 18: TAFORI Director General Dr. Revocatus Mushumbusi (on the right and Dr. Chelestino Balama (left) observing coppicing *Combretum zeyheri* at Kwedikabu Village Land Forest Reserve, Handeni District, Tanga Region.

These tree species have high coppicing ability. Other species observed to have high coppicing ability were *Senegalia nigrescens* (mkambala)*, Dombeya shupangae* (mlwati) (Plate 19)*, Spirostachys africana* (msalaka) and *Vachellia robusta* (mkongowe). Coppicing occurred either at the top or side of the stump, but also others from roots (root suckers). Other regeneration observed was from seeds as seedlings were also counted.

Plate 19: Tree species regenerating (90 days old) (*Senegalia nigrescens* (mkambala) – left and *Dombeya shupangae* (mlwati) – right) at Kwedikabu Village Land Forest Reserve, Handeni District, Tanga Region.

During consultation with different stakeholders especially those dealing with charcoal production; they said that if a tree is cut by power chain saw, it does not regenerate, unless is cut using hand axe. In that regards, in each coupe three trees were cut using power chain saw to see whether they can regenerate or not. Field observation after 90 days showed that most of the trees cut using power chain saw were also regenerated (Plate 20). Charcoal makers may use power chain saw for both tree felling and crosscutting in order to increase working efficient, and thus productivity.

The regeneration based on stump height so far indicates non-significant difference between stump height of 30 cm and 60 cm, as their regeneration (coppicing) percentage were 73.9 and 73.4, respectively. The 15 cm stump height had about 64.8% of regeneration (coppicing). In that regards, 30 cm stump height could be the best tree harvesting stump height for charcoal production that will ensure effective regeneration as well as maximizing wood biomass (removals), but also ergonomically feasible compared to that of 15 cm height.

Plate 20: Tree that were cut using power chain saw regenerating (90 days old) *Albizia versicolor* – left and *Combretum zeyheri* – right, at Kwedikabu Village Land Forest Reserve, Handeni District, Tanga Region.

3.2.3 Effect of charcoal pricing systems on production efficiency and economic returns

There are different pricing strategies used by traders and businesses when selling their products or services. The determination of which pricing strategies to use depends on many things including the pricing position, pricing segment, pricing capability and competitions by other actors. Therefore, overtime the pricing strategies and procedures will tend to vary between sectors, businesses, companies, countries, cultures and industries. The objectives of setting the prices may also be very different. Some businesses may set price for maximize profitability for each unit sold, others business may set price for restricting new entrants in the existing

market while others may set price that increases the market share or allow them to penetrate a new market. Any of the pricing strategies can have some advantages as well as disadvantages. It is therefore critical to select the best pricing strategy since the choice of a particular pricing system will have effects on the success or failure of a business.

The sustainability of charcoal production in Tanzania will depend on how best we utilize the existing resources by charging appropriate prices for both raw materials and charcoal itself as final product. The efficiency use of raw materials used in charcoal production will depend on the pricing strategy employed. Although we need charcoal as a main source of cooking energy but at the same time we also need to ensure that our natural resources from which charcoal is being produced are sustainably maintained. There is a strong weakness on the current charcoal pricing method which is based on a weight of charcoal i.e. TZS 250 per kg.

Most of the traders in Tanzania tend to set charcoal prices based on the total costs incurred during the production process. The royalties, levies and taxes paid by charcoal traders are also based on the size, volume and weight of the bag of charcoal produced. These charges do not account for the amount of raw materials and the technology used in the production process. During field visits in Mazingara, Kwedikabu, Mkwaja, Pangani Town, Tanga Town, Dar es Salaam and Zanzibar no traders have invested in efficient charcoal production technologies. They perceive that, it is too expensive and there is no reward for doing that since other producers and traders will continue with the business as usual systems. One of the reason for not investing in the efficient technologies is the pricing strategy used which does not encourage efficiency in the use of raw materials for charcoal production. Pricing of charcoal based on the weight of charcoal does not and will never influence charcoal producers to invest on efficient technologies because there are no motives for doing that. Dar es Salaam market for instance prefer larger weight (large sized charcoal bags) which in a way the royalties paid to the Government is the same as other medium sized bags. For traders, they tend to maximize profit selling these bags at a higher prices or by re-packaging them to increase the number of bags. The

implications of these process is the perpetuation of the inefficient use of raw materials leading to significant loss of wood during charcoal production process. Although literature mention an efficiency of 12-15% for the traditional earth kilns used in most places in Tanzania, but the efficiency can go even below that. Further research is needed to check on the current efficiency of the traditional earth kilns.

Among other specific objectives, this consultancy work aimed to assess the effects on charcoal production efficiency and economic returns by pricing charcoal using the stumpage or standing tree volume. Currently, there is scant information to justify whether this system is efficient or not because of lack of enough data to support it. Based on the conversations with different charcoal traders and producers, this may need a strong awareness and advocacy to all charcoal traders and producers. Since the markets for charcoal are the same and there are no market segmentations, any charcoal production technology that affect the profits earned by charcoal producers and traders will definitely be avoided unless the charcoal produced using such technologies are subsidized by the Government. There is a lot of noises from charcoal traders in the amount of royalties charged per kg of charcoal, this means that the motivations to invest in an expensive efficient technologies need some efforts. One of the assumption in this study was that if charcoal producers and traders will be charged per the amount of wood as a standing volume in the forest, he will ensure that the raw materials are used as efficiently as possible. It is the thinking on the efficiency use of raw materials that was thought will motivate an individual to invest in efficient charcoal production technologies in order to maximize profit. The efficiency is utilizing the allocated resources was also thought to have a significant effect in reducing the amount of harvested wood from the forests.

Further research is needed to test the stumpage or standing tree volume charcoal pricing systems using the Improved Basic Earth Kilns (IBEK) and Mobile Metal Kilns. This is because more reliable data on the production cost, other associated costs, productivity in terms of number of charcoal bags per areas and the revenue generated after selling charcoal. These data are still missing and it is early to make a robust conclusion for now.

3.2.4 Assessment and development of an inclusive charcoal value chain in VLFRs under intensified charcoal production model

The concept and term value chain means different things to different people and is used differently in different professionals and disciplines (Devaux *et al.,* 2018; Horton *et al*., 2016). Value-chain development (VCD) is crucial for stimulating economic growth, development and fighting against poverty in both rural and urban settings. According to Horton *et al.* (2016), the concepts of value-chain indicates an important change in thinking about development and the relationships among different stakeholders such as producers, traders, processors and consumers. Horton et al. (2016) indicates that, "*a value chain refers to the sequence of interlinked agents and markets that transforms inputs and services into products with attributes that consumers are prepared to purchase*". In the charcoal value chain, it will mean a linkage between the government in one side and charcoal producers, traders, transporters and other stakeholders along the chain. The charcoal value chain will also include farm or landowners in which charcoal is being produced.

It is important to note that, in most developing countries including Tanzania, the majority of the people who are poor in rural areas (landless and near-landless people) depend heavily forest resources for their survival. Most of these people engage themselves in agriculture and other non-farm activities such as charcoal production. Developing a strong charcoal value chain is therefore important for helping people adjacent to forest reserves in rural areas to alleviate poverty and improve their standards of living (Nang'ole *at al*., 2011). Since majority of the rural people are poor and highly dependent on forest related products, development of a stronger charcoal value chain will benefit large numbers of people in the villages. A strong charcoal value chain will assist local communities in providing employment for the poor, increasing wages to rural communities, providing continued income throughout the year especially to those with limited access to other income generating activities, strengthening rural labour markets and reducing unemployment (Tobin *et al*., 2016).

In this study, it was observed that in both Kwedikabu and Mazingara villages there is a high rate of charcoal production. The main actors in the value chain of the charcoal produced in Kwedikabu and Mazingara villages are farm owners, charcoal makers (producers), transporters, large scale traders, small scale traders, whole sellers, retailers and consumers. The Village Governments, VNRCs, TFS and District Council are also important stakeholders as business regulators, regulations and laws enforcers along the value chain. Some actors play more than a single role along the charcoal value chain. For instance, a transporter can also be a whole sell trader in Dar es Salaam or Tanga. In some cases, the same person can be a farm owner, trader, transporter, whole seller and retailer. Whole sellers were observed to be very powerful along the charcoal value chain. During focus group discussion in Mazingara Village, people narrated that traders from Dar es Salaam or Tanga do bring working capital to producers who in a way are their labourers. Once they have produced enough charcoal the whole sellers just come and load the bags into Lorries and take it to the Market.

For the rural communities to have sustainable charcoal production, they need access to the right technologies and financial supports. The ability to access various resources differ among local community members. Therefore, due to these differences in the ability to access resources, some of the rural poor households will have more benefits through accessing the charcoal value chains while others will have less benefits. However, with a strong value-chain participation of all the local community members, we expect that smallholder charcoal producers will be able to produce and deliver good quality charcoal demanded in the market. That is why the model development started with training the groups in the villages to ensure that charcoal produced will meet the necessary standards required. However, the charcoal makers' groups were also capacitated in order to have access to forest land, charcoal production knowledge and skills, access to charcoal inputs and capital, proper charcoal production technologies, skills in group formulation and administration and other required conditions.

The concept of inclusive value chain is therefore intended to ensure that all stakeholders especially the poor are fully engaged and involved in various activities along the value chain. Engaging them implies participation in the charcoal production and trading activities which therefore tend to reduce poverty among themselves. Engagement of all key stakeholders along the charcoal value chain production will have impacts on the demand and the supply sides. The demand side will benefit from the good quality and regulated stable price point of view while the supply side will ensure provision of employment, increased wages, sustainable income, strong rural labour markets and reduced unemployment.

During field visits, charcoal producers, traders, transporters and whole sellers complained about the high taxes that the Government have imposed on each bag of charcoal produced or transported. This is among the major source of illegal charcoal trading in many places. Small scale transporters who are using motor cycles (famous as *Boda-boda*) are mainly doing that illegally, except for very few who normally have proper documentation of the charcoal they are transporting. Based on field observations in Dar es Salaam, Tanga, Morogoro and Zanzibar, more than one-third of the charcoal are transported illegally meaning that the Government is losing that tax/royalty which could be used for various development projects. Charcoal tax/royalty aversion also causes the forest sector to have little contribution to the national income (GDP). Awareness creation in this context is very important to ensure that charcoal traders becomes friendly to both TFS and District Forest Officers.

On the other hand, charcoal consumers in Dar es Salaam, Mkwaja, Tanga, Zanzibar, Bagamoyo, Chalinze and Mkata did not have any preferences on the source of charcoal. They revealed that, sometimes charcoal retailers may mention a different source of charcoal just for marketing purposes while in reality the charcoal could have been from a different place. Therefore, most of the charcoal users in Town does not bother about the source of the charcoal or the trees species used to make it. It was observed that very few charcoal consumers have such a knowledge. Although compared to other clean energies the price of charcoal is relatively low, but

the interviewed charcoal consumers perceive that the price of the charcoal need to lowered because it is still high especially in Cities like Dar es Salaam and Tanga.

As indicated in sub-section 3.2.3 above, some stakeholders along the charcoal value chain in the two villages tend to use total costing technique for setting charcoal price per bag. However, producers in the villages did not have any formal criteria for setting selling price per bag of charcoal. They mostly rely on the production costs but they most of the time don't into account the labour charges and time they spend in producing one bag of charcoal. Although they don't have any formal rule for setting price but they charge different prices during rain and dry season implying that they consider some challenges encountered during charcoal production. When they were asked on whether they pay themselves for the time they spend, they had no clear answer for that. On the other hand, most of the traders ten to set selling price based on the estimated the average total production cost per bag. During focus group discussion, it was observed that majority of the charcoal traders are charging different prices based either on the production costs, buying price or transport costs. So, the market price tends to fluctuate depending on the season and the originality of the charcoal. It is however, important to have a proper pricing system which is fair to producers, traders and consumers for maintaining the welfare of the society.

A large amount of charcoal produced in Kwedikabu Village are transported to Mkwaja and then Zanzibar. An official visit to Ngalawa and Mkokotoni harbours in Zanzibar revealed that 98% of the charcoal traded in Zanzibar are from Mainland Tanzania. For traders in Zanzibar, they charge different prices depending on the source of the charcoal. However, buying price, transport costs, loading and unloading costs are among the elements used in setting the selling price per bag. The Chairperson of charcoal traders in Ngalawa Harbour in Zanzibar said that, during rainy season the price normally goes up because of the challenges associated with the transportation system. It was noted that, some traders in Zanzibar provide capital to charcoal producers in Handeni, Tanga. Traders suggested that, TFS need

to have frequent visits in all the centres where charcoal trading is taking place. This will allow them to present and discuss their challenges.

3.2.5 Financial viability of the charcoal production model

The financial viability of a business is the ability to generate sufficient income through sustainable production and supply of the products or services which in turn will assist the firm to meet its operating costs and debt payments. Financial viability is determined by assessing the general economic factors in the market, the conditions guiding the labour market, the levels of demand for the required products or services, the profit margins in the business, maturity of the sector or business and the capacity of businesses to supply the products in question, in this case charcoal. By assessing the financial viability of the charcoal business in the two villages, we can easily advice planners, policy and decision makers. Financial viability is important because it tells the growth and sustainability of the business. Without sustainable income generation, the village government will have no means of conserving the existing forest resources.

Despite the efforts by the Government of Tanzania to formalize charcoal business, majority of charcoal traders are still operating illegally either partially of fully. Some traders mentioned that they do that in order to maximize their profit because without doing so the profit they get is very little. The problem with many traders in Tanzania do not keep proper records and they would set a very high profit margin for each bag of charcoal. Traders mentioned that, they do some illegal things because of the high royalty fee they pay per bag of charcoal. On the other hand, it is clearly stated that illegal charcoal trading has denied the Government a significant amount of money. In 2020, charcoal production in Tanzania was estimated at 1.9 million tonnes per year with a Gross Value Added (GVA) of TZS 2.1 trillion contributing about 44% of the forest sector GDP (MNRT, 2021). However, the government collects only 0.5% of this (44%) as fees and taxes. This means that more than 90% of the royalty is lost. Understanding the financial viability of charcoal trading in these two villages will make charcoal traders aware of the entire business systems hence they may work efficiently to reduce unnecessary costs. By eliminating

all unnecessary costs, traders may be motivated to comply with the rules and regulations governing charcoal businesses in Tanzania.

Financial viability of the business can be evaluated using Break Even Analysis (BEA) or Net Present Value (NPV). Using the break-even analysis, we just ask ourselves if the business will break even or be able to generate enough money by selling the products we intend to produce, in our case is charcoal. In other words, we are assessing if the sales of charcoal will be sufficient enough to cover the costs of making each bag of charcoal. Using the NPV we want to determine whether our investment is justifiable using the expected sales, growth, and profit generated. Therefore, we want to know if the charcoal business will be profitable by undertaking what is called a profitability analysis. Therefore, an NPV is simply the current value of all cash flows (current and future) related to the product. NPV is calculated using the cash flows and their timing. So we compare the costs and benefits over a certain period of time and check whether the business is financially viable or not. In this study, we use the Break Even Analysis to check for the financial viability of the model.

The costs incurred during implementation of the trial model are divided into fixed and variable costs. Fixed costs are those which does not vary with the level of production while variable costs tend to vary with the level of production. In some businesses, some people call these fixed costs as sunk costs. In this model, one of the example of the fixed costs is the annual registration fee. This fee is paid annually so it does not matter how many bags of charcoal you are going to produce in that particular year. For an individual to break even in charcoal production, he need to produce a certain number of bags per year to recover both the fixed and average costs incurred. The detailed information on the costs incurred are indicated in Table 11 below. We will therefore use the costs to estimate how much charcoal need to be produced for an individual to break even.

Table 11: Average Charcoal Production Costs at Kwedikabu Village, Handeni District, Tanga Region.

S/No	Activity	Item	Number of Days	Quantity	Unit Cost	*Total Costs
VARIABLE COSTS						
1	Tree felling	Petrol	5	1	300,000	300,000
2	Kiln making and covering with the soil	People	10	10	200,000	200,000
3	Transport to the forest	People	2	10	20,000	40,000
4	Cost of food during tree felling	Various	10	10	10,000	100,000
5	Kiln lightning and check ups	People	7	1	50,000	50,000
6	Cost of food during kiln making	People	7	5	10,000	50,000
7	Unloading charcoal from the kiln	People	2	3	20,000	60,000
8	Charcoal packaging bags	Bags	1	150	500	75,000
9	Filling charcoal in the bags and covering	People	1	100	700	70,000
Sub Total						945,000
10	Transport cost from the production site (Forest) including the Transit Pass (TP)	Truck	1	100	400,000	400,000
11	Transport cost to the Market (Mkwaja/Mkata)	Truck	1	100	800,000	800,000
Sub Total						1,200,000
Grand Total						2,145,000
FIXED COSTS						
1	Hoe	Hoe		2	5,000	10,000
2	Rack	Rack		1	12,000	12,000
3	Spade	Spade		2	12,000	24,000
4	Machete	Machete		2	5,000	10,000
5	Axe	Axe		1	10,000	10,000
6	Charcoal Business Registration to TFS	TFS		1	300,000	300,000
7	Group Registration to the District Office	District		1	30,000	30,000
8	Group bank account opening	Account		1	200,000	200,000
9	Group Stamp and its Ink	Stamp		1	15,000	15,000
10	Guest Book	Book		1	5,000	5,000
Sub Total						616,000
Grand Total (Without Transport Costs)						1,561,000
Grand Total (Including the Transport Costs from the Production Site)						1,961,000
Grand Total (Including the Transport Costs from the Production Site and to the Market)						2,761,000

*Cost for producing 100 bags of charcoal (each 50 kg)

Based on the above costing data, we can have four scenarios for this business to break-even. The scenarios will depend on where Charcoal producers will prefer sending their products. The variable costs indicated in table 9 above are for 100 bags as observed in the field and based on experience from charcoal producers. So each bag of charcoal will have a variable cost of about TZS 9,450.00; 13450.00; 17,450.00 and 21,450.00 for the four different scenarios as indicated in Table 12 below.

Table 12: Break Even Points in the Four Market Scenarios in this study.

Scenario	Types Costs	Amount/Value	Computation	Break-Even Quantity
1. Selling charcoal at the production site	Variable Costs (VC)	9,450	$Q = \frac{FC}{P - VC}$ $= \frac{616{,}000}{10{,}000 - 9{,}450}$ $Q = \frac{616{,}000}{550} = 1{,}120$	1,120 Bags
	Fixed Costs (FC)	616,000		
	Price (P)	12,500		
2. Selling charcoal at the Village Market	Variable Costs (VC)	13,450	$Q = \frac{FC}{P - VC}$ $= \frac{616{,}000}{16{,}000 - 13450}$ $Q = \frac{616{,}000}{2{,}550} = 242$	242 Bags
	Fixed Costs (FC)	616,000		
	Price (P)	16,000		
3. Selling Charcoal at Mkwaja or Mkata Market	Variable Costs (VC)	17,450	$Q = \frac{FC}{P - VC}$ $= \frac{616{,}000}{21{,}000 - 17{,}450}$ $Q = \frac{616{,}000}{3{,}550} = 184$	184 Bags
	Fixed Costs (FC)	616,000		
	Price (P)	21,000		
4. Selling Charcoal at Dar es Salaam, Tanga or Zanzibar	Variable Costs (VC)	21,450	$Q = \frac{FC}{P - VC}$ $= \frac{616{,}000}{31{,}000 - 21{,}450}$ $Q = \frac{616{,}000}{9{,}550} = 65$	65 Bags
	Fixed Costs (FC)	616,000		
	Price (P)	31,000		

In Practice however, most of the charcoal producers never pay the registration fee and they don't have individual or group accounts. Therefore, they will have a very minimal fixed costs totalling hardly to about TZS 66,000.00 to 100,000.00. But they also sell charcoal at a relatively lower prices than the price indicated above (Table 13).

Table 13: De Facto Break Even Points in the Four Market Scenarios in this study.

Scenario	Types Costs	Amount/Value	Computation	Break-Even Quantity
1. Selling charcoal at the production site	Variable Costs (VC)	9,450	$Q = \frac{FC}{P - VC} = \frac{66{,}000}{10{,}000 - 9{,}450}$	120 Bags
	Fixed Costs (FC)	66,000		
	Price (P)	12,500	$Q = \frac{66{,}000}{550}$ = 120	
2. Selling charcoal at the Village Market	Variable Costs (VC)	13,450	$Q = \frac{FC}{P - VC} = \frac{66{,}000}{16{,}000 - 13{,}450}$	26 Bags
	Fixed Costs (FC)	66,000		
	Price (P)	16,000	$Q = \frac{66{,}000}{2{,}550}$ = 26	
3. Selling Charcoal at Mkwaja or Mkata Market	Variable Costs (VC)	17,450	$Q = \frac{FC}{P - VC} = \frac{66{,}000}{21{,}000 - 17{,}450}$	19 Bags
	Fixed Costs (FC)	66,000		
	Price (P)	21,000	$Q = \frac{66{,}000}{3{,}550}$ = 19	
4. Selling Charcoal at Dar es Salaam, Tanga or Zanzibar	Variable Costs (VC)	21,450	$Q = \frac{FC}{P - VC} = \frac{66{,}000}{31{,}000 - 21{,}450}$	7 Bags
	Fixed Costs (FC)	66,000		
	Price (P)	31,000	$Q = \frac{66{,}000}{9{,}550}$ = 7 Bags	

For the legal charcoal traders, he/she will have to pay for all the necessary royalties charged by the Village Government, District Council and TFS. In some places the royalty amounts to TZS 14,500.00 per bag of charcoal traded (TZS 12,500.00 for TFS and TZS 2,000.00 as village charges). Therefore, to break even this charcoal producer/trader may need more bags of charcoal than the one indicated in the two tables.

With such a low costs investment required, charcoal makers need a very short time to break even. Those practicing illegal charcoal production need even a much shorter time because they incur less costs as narrated above. It was observed in Dar es Salaam that a significant amount of charcoal bags is transported using Motorcycles. Most of these transporters tend to have no single document for the product they carry indicating that they do so illegally. This is an alarm to the Government to check whether the TFS charges of TZS 12,500.00 are practically possible or there is a way charcoal traders are doing to compensate for their profits. Similar conditions were observed in Ngalawa and Mkokotoni charcoal trading centres in the Zanzibar side.

There are several messages in this analysis that planners and decision makers may wish to digest. Firstly, we need to strengthen the Village Government for them to monitor properly charcoal production in their villages. Without capacitating them, it will be impossible for TFS and District Forest Officer to patrol all the areas all the time. Secondly, there is a lot of cheating in charcoal production businesses. Traders do so to maximize the profit. Probably the Government can revisit the royalty charged per bag to motivate charcoal traders to undertake legal charcoal trading. Without doing so, there will be a lot of cheating along the entire charcoal value chain in Tanzania. On the other hands, as the members of the charcoal makers' group get more experiences in the business, they will increase the possibility of getting more profit per bag or per kiln of charcoal produced. Therefore, supports to these charcoal makers' groups seems important in order to build more capacity to more people in the villages.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The following are some key concluding remarks:

(i) Awareness meetings about the charcoal project were carried out at various district levels including at the District Executive Director (DED) office and village government. At village level, awareness meetings were at Village Government, VNRC and Village Assembly. Similarly, as part of awareness creation, reconnaissance survey to the forests under study (Majali Mkulumilo – Mazingara, and Kwedikabu) in a company by representatives of the respective VNRCs and the Handeni District Forest Officer was conducted;

(ii) Two Charcoal Makers' Groups (CMGs) were formed in each village. The formed CMGs, one was for all people (mix of youths and elder people) while the other one was only for youths. The group members were later trained to formulate their constitutions in order to have guiding rules for the groups but also meet registration requirements;

(iii) Twenty participants i.e. 10 people from each village visited to Kilosa District to learn/get experience on the sustainable charcoal project, which is implemented by the Tanzania Forest Conservation Group (TFCG). In this visit, participants were acquired knowledge and skills on sustainable forest management, management of charcoal business along its value chains, as well as opportunities and challenges of the charcoal business;

(iv) VLFRs cover maps showing variation in vegetation cover types for the two study sites have been produced. The produced vegetation cover maps indicate extent of vegetation cover and presence of some anthropogenic activities going on within the VLFRs including mining, farming, human settlements and livestock keeping;

(v) Forest harvesting plan for both Kwedikabu and Majali Mkulumilo VLFRs have been developed that will guide harvesting of trees for charcoal production for the five years. Forest Management Plan for Majali Mkulumilo VLFR has also been developed, however specific area for charcoal production has yet set because of part of the forest still being occupied illegally by people;

(vi) Demarcation of charcoal forest management unit (FMU) and harvesting coupes has been done at Kwedikabu VLFR whereby two blocks have been set at Kwedikabu VLFR. The blocks have a total of 507 ha, which is about 15% of the total area of the forest. One of the block has 275.8 ha, while the second one has 231.9 ha. The two blocks have been divided into 20 harvesting compartments with about 25 ha which is comprised of 100 small harvesting units of 50 x 50 m;

(vii) Setting of experimental area and initial charcoal production has been initiated at Kwedikabu Forest Management Units. The experiment area has been set on nine harvesting coupes of 50 x 50 m, which are marked as the PSPs, which will be studied and monitored for coppicing ability of stumps at 15, 30 and 60 cm height for 10 years. Tree suitable for charcoal production were felled and wood (logs) from the cut trees was left in the field (within the harvested areas) for air dry (seasoning) for a duration of 14, 21 and 30 days;

(viii) Charcoal production was done from the wood harvested in the permanent sample plots (PSPs) by involving two charcoal makers' groups of youths and elders. A total of 245 charcoal bags (about 25 - 30 kg) has been produced from January to May 2022 from the PSPs. The two charcoal making groups have earned about TZS 1,225,000.00. The Kwedikabu Village has received revenue of TZS 512,500.00 from some of the produced charcoal. It has been observed that, the ability to harvest large number of coupes in time is not adequate;

(ix) Optimal duration for wood seasoning (air drying) is 14 days as had relatively high kiln efficient of 47.2%, with average wood billet moisture loss of 9%.

(x) Monitoring regeneration on tree stumps (90 days since cut down) indicated that stump height of 30 cm had high coppicing ability. Most regenerating stumps were

from *Combretum* spp. (*C. zeyheri* - mlama mweupe and *C. molle* – mlama mweusi) was observed to regenerate highly followed by *Senegalia nigrescens* (mkambala), and *Dombeya shupangae* (mlwati). Most of the stumps produced massive coppices which may result into small wood biomass due to completion, and therefore reduce expected wood volume for the next harvesting rotation. Monitoring of the tree regeneration will continue in the PSPs for 10 years;

(xi) Total costing technique is the most popular pricing technique used in Kwedikabu and Mazingara village. The selling price therefore depends on the total costs used in the production process. For charcoal traders, the buying price, transport and other associated costs are used for setting the charcoal selling price. The market price for charcoal in different areas will therefore depend on the costs incurred during production process;

(xii) Charcoal value chain in Kwedikabu Village entails a number of stakeholders with different capabilities and capacities. These stakeholders include charcoal producers, traders, transporters, whole sellers and retailers. Other supporting functions are Village Government, TFS and District Officers. There are many complains from charcoal traders on the high taxes that the Government charge per bag of charcoal produced or transported. To minimize illegal charcoal trading practices in Kwedikabu villages, these charges need to be re-visited. There is a need to include small scale transporters who are using motor cycles (famous as *Boda-boda*) in order reduce illegal charcoal trading; and

(xiii) This charcoal production model is potential, viable and can contribute significantly to conservation efforts in the Country but needs support from other supporting organs such as village leaders, TFS and District Officials. Law enforcement is vital to ensure that the model works perfect in the villages. Profitability will increase as the charcoal making groups gain more experiences in the charcoal businesses.

4.2 Recommendations

Based on the progress to date, the following are recommendations:

(i) There is a need for capacity building to VNRCs on Global Positioning Systems (GPS) navigation (i.e. training members and purchase of user friendly GPS) and good governance aspects like management of charcoal revenues and equal participation of members in forest resources management are recommended to be done immediately;

(ii) Optimal duration for wood seasoning (air drying) for charcoal production is 14 days;

(iii) A stump of 30 cm height is recommended as optimal height for tree harvesting aimed for charcoal production in areas where tree regeneration is encouraged;

(iv) Coppicing management e.g. thinning in some tree species is important in order to maintain few coppices which will have large wood biomass in the next harvesting rotation;

(v) Some modifications or changes on the amount of royalties charged per bag of charcoal may need revision in order to change the final price charged to end users. This will provide relief to charcoal users who majority of them are low and middle income people;

(vi) Plans and decisions regarding charcoal business need to ensure participation and engagement of all stakeholders in the charcoal value chain in order to have an inclusive charcoal value chain; and

(vii) More research are needed especially on the use of different charcoal production technologies for justifying the scaling up of the model in other places. The initial investment costs and the efficiency of these new technologies and the sustainability of the technology also need to be researched.

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APPENDICES

Appendix 1: Charcoal Markers Groups at Kwedikabu and Mazingara Villages, Handeni District, Tanga Region.

(b) Nguvumali Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.

LEADERSHIP					
CHAIRMANI:	SEFU IDI LUZILO				
VICE CHAIRMAN:	MWAJUMA MOHAMEDI SALEHE				
SECRETARY:	MARIAM ADAMU JUMA				
ASSISTANT SECRETARY:	ALI SALEHE SALIMU				
TREASURER:	MWANAHAMIS MAHAMUDI OMARI				
SN	**NAME**	**SEX**	**AGE**	**SUB-VILLAGE**	**PHONE**
1	AMINA SAIDI HATIBU	KE	48	KIMBUGULU	0684787253
2	AMIRI IBRAHIMU BUNTO	ME	66	KIMBUGULU	0787413449
3	ATHUMANI ABDALLAH	ME	60	KIMBUGULU	
4	BAKARI I. SELEMAN	ME	61	KIMBUGULU	0689074729
5	HAMIS ABDALLAH ATHUMANI	ME	45	KIMBUGULU	
6	HUSSEIN 'R' MSANGI	ME		KIMBUGULU	
7	KILANGO MOHAMEDI SEIFU	ME	39	KIMBUGULU	0789337696
8	MARIAMU ADAMU JUMA	KE	56	KIMBUGULU	0687665762
9	MARIAMU ALI SALIM	KE	36	KIMBUGULU	0692314935
10	MASALA JUMA SALEHE	KE	60	KIMBUGULU	0684504171
11	MHINA MOHAMED SEIFU	ME		KIMBUGULU	0686332237
12	MWANAHAMISI IDD JUMA	KE	38	KIMBUGULU	068440226
13	MWANAHAMISI MHIMBI	KE	45	KIMBUGULU	
14	MWANAHAMISI SALUM ZONGIRE	KE	35	KIMBUGULU	0786098348
15	NEKONDO MOHAMED SEIFU	KE	36	KIMBUGULU	0784451065
16	SALEHE MGANGA SALEHE	ME	41	KIMBUGULU	0786794816
17	SEFU A. SAMUGWA	ME	45	KIMBUGULU	0788058025
18	SUBIRA SHABAN RAJAB	KE	37	KIMBUGULU	0686332237
19	TATU SELEMANI MOHAMED	KE	30	KIMBUGULU	078260301
20	ANDREA KITUNDU NKOMA	ME	56	KWAMSENGA	0789475110
21	ABDALLAH ABUDU	ME		KWATIPUKA	0784781812
22	ALLY MWINYIJUMA LUDONDO	ME	64	KWATIPUKA	
23	AMIRI RAJAB SENTUMBI	ME	51	KWATIPUKA	0683010295
24	AYUBU AHMAD LUGENDO	ME	65	KWATIPUKA	0785274477
25	HAZIMA OMARY MOHAMED	KE		KWATIPUKA	0787274477
26	JUMANNE H. MAINI	ME	55	KWATIPUKA	0684013378
27	KARIMU ALLY SHEKIKA	ME	59	KWATIPUKA	0677603029
28	MARIAMU RAMADHAN SETUMSI	KE	59	KWATIPUKA	
29	MONAMU RAJABU SETUMBI	KE	60	KWATIPUKA	
30	MUSSA ABEDI YUSUFU	ME	52	KWATIPUKA	0789272474
31	SAIDI R. SETUMBI	ME	64	KWATIPUKA	
32	SEFU IDI LUZILO	ME	59	KWATIPUKA	0689714757
33	CHILO HASSAN MWENJUMA	ME	40	KWEDIKABU A	0692482499
34	FATUMA RAMADHAN MWALIMU	KE	70	KWEDIKABU A	
35	MGAZA H. LUGUNDA	ME	48	KWEDIKABU A	0689275873
36	MWAJUMA AHMED ABDALAH	KE	45	KWEDIKABU A	
37	MWAJUMA KHATIBU MWENYEHERI	KE	60	KWEDIKABU A	
38	SAIDA RAMADHAN HOSEMI	KE	64	KWEDIKABU A	0692390448

39	ALLY ABBAS JOHN	ME	50	KWEDIKABU B	078234467
40	ALLY SALEHE SALIMU	ME	41	KWEDIKABU B	0686573878
41	HASSANI ABDALLAH JUMA	ME	59	KWEDIKABU B	0673344676
42	JUMA KIZUA SAMILE	ME	52	KWEDIKABU B	0788415632
43	MASAIDI IDRISA HAJI	KE	59	KWEDIKABU B	
44	MUKSIN SALEHEMANYAU	ME	36	KWEDIKABU B	0788424527
45	SHABAN OMARI NASSORO	ME	42	KWEDIKABU B	0687062288
46	SOPHIA MWINYIHEN HEMED	KE	60	KWEDIKABU B	0786431740
47	STEVEN MADATA MNGELEKA	ME	60	KWEDIKABU B	0787228923
48	ZUBERI 'M' LUGUNDA	ME		KWEDIKABU B	
49	ATHUMAN A. HUSSEIN	ME	61	MAMBOGOLO	0685987223
50	HAMISI KOMBO OMARI	ME		MAMBOGOLO	
51	MHINA ZUBERI MASIMBA	ME	41	MAMBOGOLO	0689836133
52	MWANAHAMISI MAHAMUDI OMARI	KE	59	MAMBOGOLO	0784726805
53	REHEMA WAZIRI CHELEBU	KE	49	MAMBOGOLO	0788109365
54	SHABANI MWARABU MKUUTI	ME	38	MKWITI	0692124257
55	HABIBA ALLY HASSAN	KE	45	WANDANTA	06859566640
56	HIJA SELEMANI MSISI	ME	54	WANDANTA	0787120505
57	KOSIMAS HELASITA GAM	ME	59	WANDANTA	0653233993
58	MASHAKA WAZIRI MWESHAH	ME	42	WANDANTA	068239834
59	MWAJUMA MOHAMEDI SALEHE	KE	49	WANDANTA	0687404936
60	NJAMA MASHAKA MKUNJI	ME	45	WANDANTA	0682722253
	AVERAGE AGE		**50.93**		

(c) Songambele Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.

LEADERSHIP					
CHAIRMAN: RAJABU MOHAMED RUGUNDA					
VICE CHAIRMAN: PILI RAJABU OMARY					
SECRETARY: HARUNI DAUDI MOHAMED					
ASSITANT SECRETARY: ASHA MBELWA RAJABU					
TREASURER: JUMA ADAM JAHAZI					
SN	**NAME**	**SEX**	**AGE**	**SUB-VILLAGE**	**PHONE**
1	ALLY JUMA	ME	35	KIMBUGURU	0687646049
2	ATHUMAN RAMADHAN	ME	19	KIMBUGURU	0785100315
3	JUMA AMIRI IBRAHIMU	ME	28	KIMBUGURU	0685499837
4	JUMANNE BAKARI IBRAHIMU	ME	29	KIMBUGURU	0693872191
5	KABELWA AMIRI	ME	26	KIMBUGURU	0786794816
6	MARIAM SALIMU RAJABU	KE	29	KIMBUGURU	0694154793
7	MKOMBOZI IDDI JUMA	ME	18	KIMBUGURU	0685218180
8	MWANAHAMISI MBARAKA	ME	25	KIMBUGURU	
9	OMARY JUMA ALLY	ME	19	KIMBUGURU	0688531608
10	RAJABU MGOSI	ME	30	KIMBUGURU	0693761482
11	SAIDI ABDALLAH	ME	27	KIMBUGURU	0692424521
12	SUFI MOHAMED	ME	27	KIMBUGURU	0782772248
13	YAHAYA BAKARI IBRAHIM	ME	25	KIMBUGURU	0692138299
14	ELISHADONI BALAGAMISE	ME	29	KWAMSENGA	0688801946
15	KULWA GERVAS TANGAWIZI	ME	30	KWAMSENGA	0683012468
16	HASSAN MKUMBI	ME	26	KWATIPUKA	0786106426
17	HASSANI ALLY SEMENI	ME	32	KWATIPUKA	0716640193
18	HOSENI RAJABU	ME	30	KWATIPUKA	0689111671
19	JUMA I. SETEBE	ME		KWATIPUKA	

20	KABELWA ALI OMARI	ME	35	KWATIPUKA	0787614955
21	LUGENDO SAIDI	ME	27	KWATIPUKA	0692974928
22	ASHA MBELWA RAMADHANI	KE	30	KWEDIKABU A	0786441603
23	MOHAMED ADAMU JUMA	ME	24	KWEDIKABU A	0785893281
24	JUMA ADAMU	ME	32	KWEDIKABU B	0784091316
25	YAHAYA SPEIN HATIBU	ME	32	KWEDITABU B	0785746358
26	IKRAMU A. KIPACHA	ME	28	MAMBOGORO	0688637626
27	MWINYIJUMA ADAMU JUMA	ME	26	MAMBOGORO	0785335006
28	NIKI ABRAHAMANI	ME	30	MAMBOGORO	0718145823
29	PILI RAJAB OMAR	KE	25	MAMBOGORO	0686937567
30	SEIFU SALAEHE SALIMU	ME	27	MAMBOGORO	0753617349
31	FURAHA OMARI	ME	23	WANDANTA	0687364680
32	HARUNI DAUDI MOHAMED	ME	24	WANDANTA	0686323481
33	JUMA HIJA	ME	31	WANDANTA	0787119722
34	JUMANNE ALLY	ME	29	WANDANTA	0783824878
35	RAJABU HIJA	ME	23	WANDANTA	0685031814
36	ZAUDIA SHABANI MOHAMED	KE	24	WANDANTA	0677951659
	AVERAGE AGE		**27.26**		

(d) Mchamchaka Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.

LEADERSHIP					
CHAIRMAIN: BAKARI MUSA MUHUGWE					
VICE CHAIRMAN: MAGESA MAFURU					
SECRETARY: PILI MFAUME MAJUGWE					
ASSISTANT SECRETARY: WEMA JERALD MNDEWA					
TREASURER: BURHANI SELEMANI					
SN	**NAME**	**SEX**	**AGE**	**SUB-VILLAGE**	**PHONE**
1	BAHATI SAIMONI NJAMASI	KE	42	GOMBONEKA	0687424637
2	FATUMA ABDI MWANAMOGOLE	KE	42	GOMBONEKA	0624535475
3	HAMISI MALIMA CHIDOLE	ME	37	GOMBONEKA	
4	JUMANNE ATHUMANI KAVUNDE	ME	52	GOMBONEKA	0629993476
5	SAIDI OMARI BAKARI	ME	45	GOMBONEKA	0623247213
6	ATHUMANI OMARI DUKUZI	ME	58	KITINDILO	0674685100
7	HASSAN ZUBERI SEMKONDA	ME	85	KITINDILO	
8	JUMANNE RAMADHANI ATHUMANI	ME	45	KITINDILO	0789348913
9	ATHUMANI JUMA MAZIGE	ME	38	KIVUGA	0687224442
10	HAMIS VITABA MRISHO	ME	37	KIVUGA	
11	OMARI CHINAISI CHIPUZI	ME	60	KIVUGA	
12	BAKARI KHALID HASSAN	ME	64	KWAMAZUNGU	
13	BURHANI SELEMANI MUHUZA	ME	48	KWAMAZUNGU	0718028420
14	JUMA MOHAMED SHABANI	ME	50	KWANJEBE	0678789818
15	ALLY AHAMAD KLEY	ME	38	KWEDIKOME	0692428612
16	ATHUMANI KIPENJO MAKUMURO	ME	38	KWEDIKOME	0654774669
17	HOSEN AMADI MHATIGWA	ME	38	KWEDIKOME	
18	JUMA FADHILI MHANDENI	ME	38	KWEDIKOME	0782193219
19	JUMA OMARI MGWENO	ME	38	KWEDIKOME	0675422079
20	MAJUTO SIMANGO	ME	38	KWEDIKOME	0711773096
21	MSEKWA HUSENI MBANO	KE	42	KWEDIKOME	0626090974
22	MWANAHAMISI SUFIANI KILANGO	KE	41	KWEDIKOME	0675556585
23	MWINYIHERI OMARI BAKARI	ME	44	KWEDIKOME	0657832293
24	PILI MFAUME MAJUGWE	KE	43	KWEDIKOME	0622365670

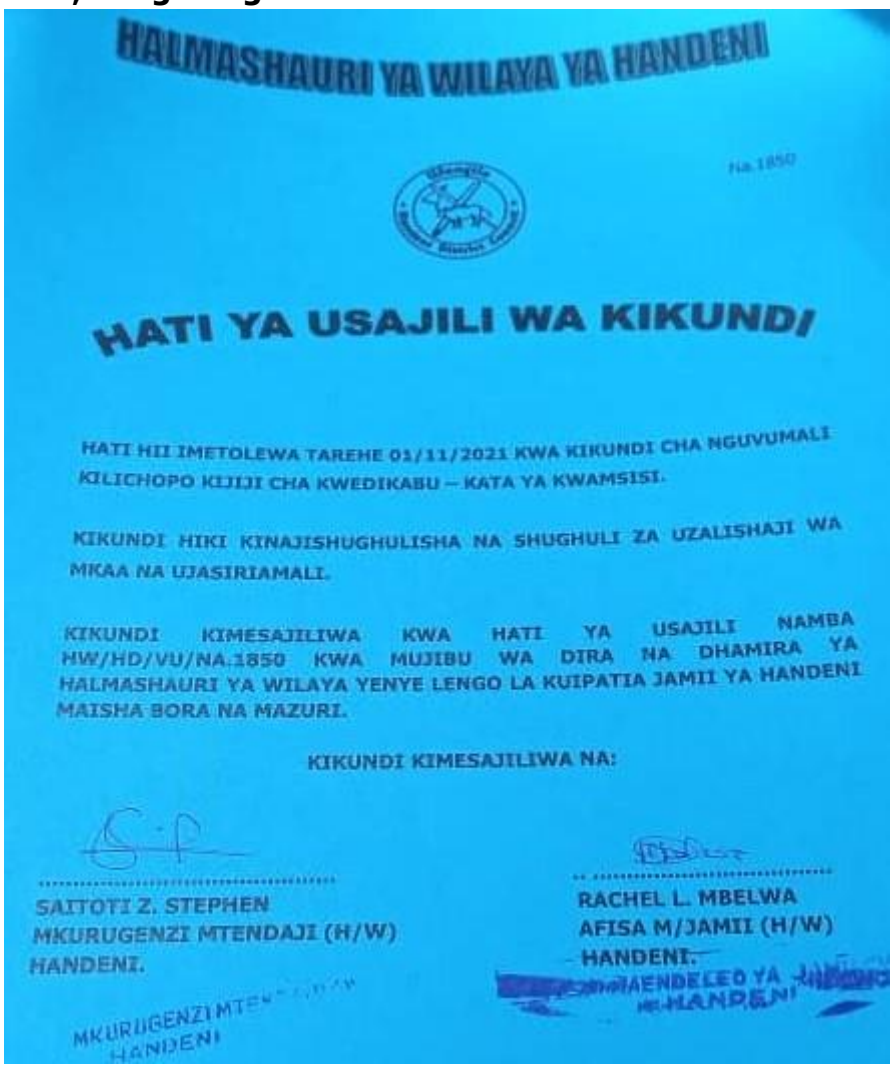
25	RASHID ATHUMANI KUNGWINI	ME	40	KWEDIKOME	0659101498
26	SHABANI BAKARI MTENGUZI	ME	52	KWEDIKOME	0715604257
27	TABU RASHIDI KOMANGU	KE	39	KWEDIKOME	0672595620
28	ZAKIA UWESO ABRAHAMANI	KE	38	KWEDIKOME	0656185341
29	PETRO BOAZI KERAMBO	ME	40	MKURUMILO	0629414964
30	JOHNBOSCO R. CLEMENCY	ME	50	MKURUMILO	0623334690
31	MASKO CHACHA WALEMA	ME	50	MKURUMILO	0621415000
32	ALLY JUMA MOHIZA	ME	52	TUNDILE	0626981309
33	ALLY SEFU MACHAKU	ME	60	TUNDILE	0719182352
34	AMIRI RAMADHANI MWEGOLE	ME	62	TUNDILE	0656560856
35	ATHUMANI MOHAMED MKOMENI	ME	46	TUNDILE	0686669108
36	CHARLES AMOSI MOSIGOSE	ME	36	TUNDILE	0678990321
37	FATUMA SALEHE NKOMANGU	KE	50	TUNDILE	0693847340
38	MADADIA RASHID KUI	KE	39	TUNDILE	0699208401
39	MAGESA MAFURU CHORA	ME	52	TUNDILE	0719750321
40	RIZIKI MOHAMEDI NKAVILAVYA	ME	53	TUNDILE	0719573748
41	SOFIA MSELEMU JUMA	KE	40	TUNDILE	0672962670
42	UPENDO FAHAMUELI MAHEDA	KE	35	TUNDILE	0629358211
43	WEMA GERALD MDEWA	KE	42	TUNDILE	0627225585
	AVERAGE		**45.98**		

(e) Matanuru Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.

LEADERSHIP					
CHAIRMAN: ISSA HUSEIN MAHIZA					
VICE CHAIRMAN: FATUMA MAJORA					
SECRETARY: SAIDI SENGULO					
ASSISTANT SECRETARY: ISSA MUSA ALI					
TREASURER: RAJABU ATHUMANI NGWATO					
SN	**NAME**	**SEX**	**AGE**	**SUB-VILLAGE**	**PHONE**
1	MAJOMBI H. MAJOMBI	ME	34	KITINDILO	0656035354
2	MOHAMED JUMA MAKONTA	ME	29	KITINDILO	0718966044
3	AMINA ALLY MAJOTA	KE	29	KIVUGA	0627250571
4	MOKIWA RASHIDI KIJAJI	ME	26	KIVUGA	0658992589
5	ISA MUSA ALI	ME	24	KWEDIKOME	0788461082
6	SAIDI SENGULO	ME	34	KWEDIKOME	0655867992
7	FRANK MARCELI KABUGABA	ME	35	MKURUMILO	0785161801
8	ISSA HUSEIN MAHIZA	ME	35	MKURUMILO	0713071923
9	ABDALLAH RAMADHANI SHABANI	ME	32	TUNDILE	0673851210
10	ALLY RAMADHANI OMARI	ME	26	TUNDILE	0679601233
11	AWESO RAMADHANI MNONDWA	ME	27	TUNDILE	0711799270
12	FATUMA ALLY MAJORA	KE	34	TUNDILE	0628438786
13	JUMA ZUBERI JUMA	ME	29	TUNDILE	0716005349
14	MAIKO REHE MNJEJA	ME	35	TUNDILE	0679016602
15	MOHAMED HAMIS MOHAMEDI	ME	28	TUNDILE	0652465939
16	MWAJABU BAKARI MWEJUMA	KE	20	TUNDILE	0688011212
17	RAJABU ATHUMANI NGWATO	ME	35	TUNDILE	0672159576
18	REHEMA HAMIRI MKOLOGWE	KE	31	TUNDILE	0715891611
19	SHABAN ATHUMANI NGWATU	ME	31	TUNDILE	0656572589
	AVERAGE		**30.21**		

Appendix 2: Certificates of Registration on Charcoal Makers Groups in Handeni District, Tanga Region.

(a) Nguvumali Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.



HALMASHAURI YA WILAYA YA HANDENI

Na.1850

HATI YA USAJILI WA KIKUNDI

HATI HII IMETOLEWA TAREHE 01/11/2021 KWA KIKUNDI CHA NGUVUMALI KILICHOPO KIJIJI CHA KWEDIKABU – KATA YA KWAMSISI.

KIKUNDI HIKI KINAJISHUGHULISHA NA SHUGHULI ZA UZALISHAJI WA MKAA NA UJASIRIAMALI.

KIKUNDI KIMESAJILIWA KWA HATI YA USAJILI NAMBA HW/HD/VU/NA.1850 KWA MUJIBU WA DIRA NA DHAMIRA YA HALMASHAURI YA WILAYA YENYE LENGO LA KUIPATIA JAMII YA HANDENI MAISHA BORA NA MAZURI.

KIKUNDI KIMESAJILIWA NA:

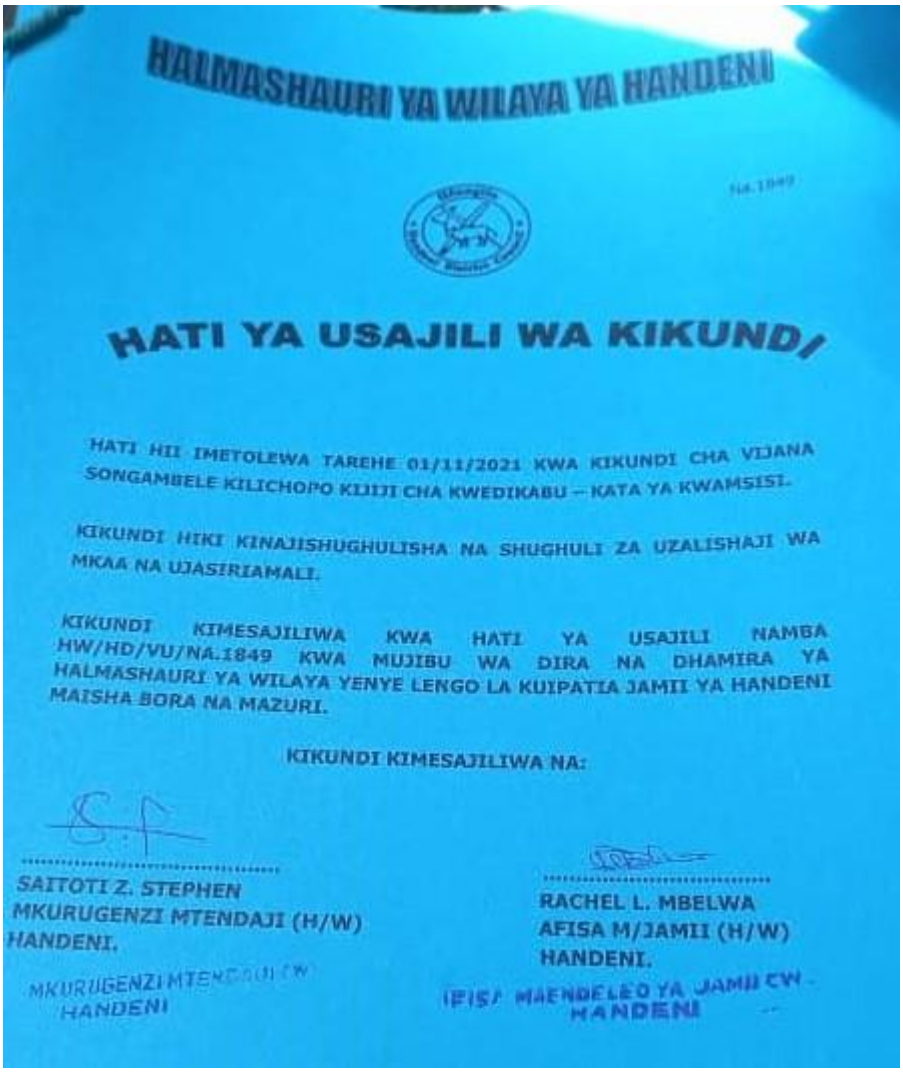
.....
SAITOTI Z. STEPHEN
MKURUGENZI MTENDAJI (H/W)
HANDENI.

MKURUGENZI MTE... HANDENI

.....
RACHEL L. MBELWA
AFISA M/JAMII (H/W)
HANDENI.

...HANDENI

(b) Songambele Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.



HALMASHAURI YA WILAYA YA HANDENI

Na.1849

HATI YA USAJILI WA KIKUNDI

HATI HII IMETOLEWA TAREHE 01/11/2021 KWA KIKUNDI CHA VIJANA SONGAMBELE KILICHOPO KIJIJI CHA KWEDIKABU – KATA YA KWAMSISI.

KIKUNDI HIKI KINAJISHUGHULISHA NA SHUGHULI ZA UZALISHAJI WA MKAA NA UJASIRIAMALI.

KIKUNDI KIMESAJILIWA KWA HATI YA USAJILI NAMBA HW/HD/VU/NA.1849 KWA MUJIBU WA DIRA NA DHAMIRA YA HALMASHAURI YA WILAYA YENYE LENGO LA KUIPATIA JAMII YA HANDENI MAISHA BORA NA MAZURI.

KIKUNDI KIMESAJILIWA NA:

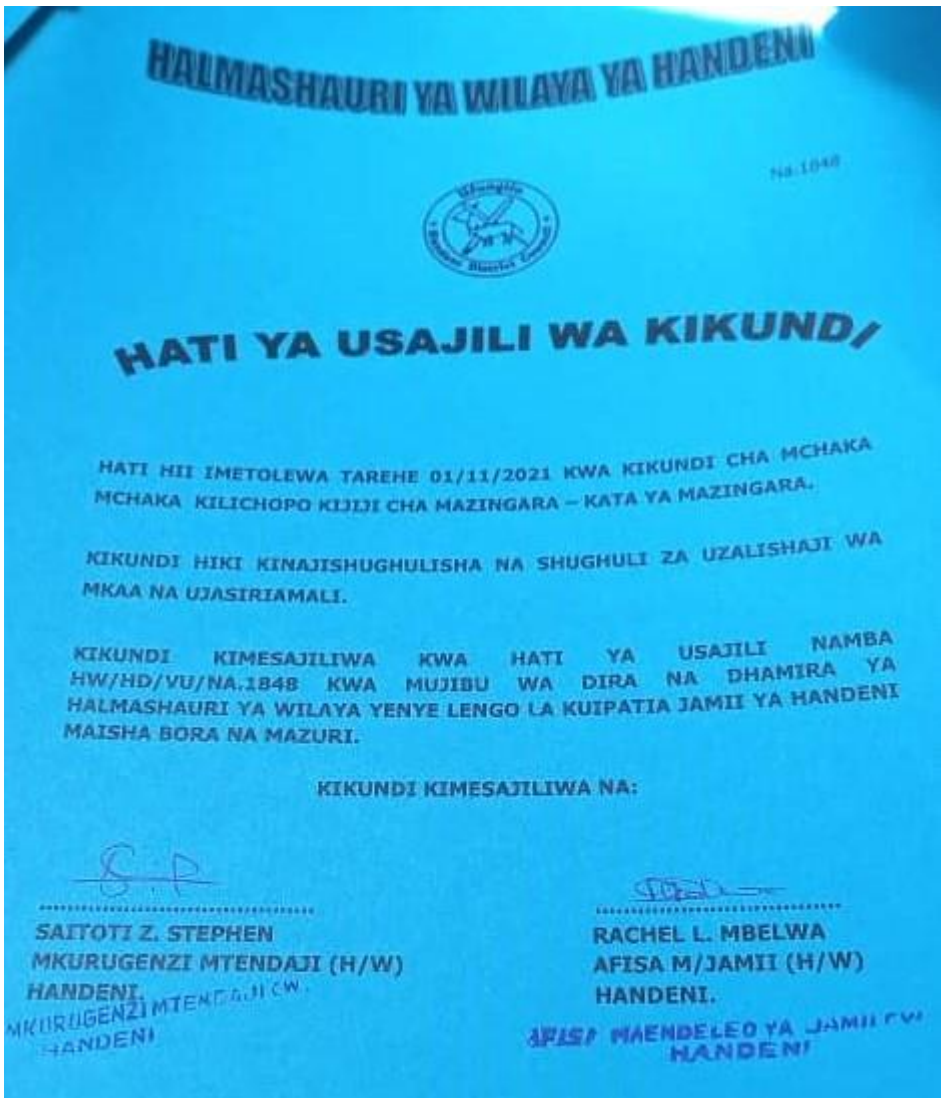
.....
SAITOTI Z. STEPHEN
MKURUGENZI MTENDAJI (H/W)
HANDENI.

MKURUGENZI MTENDAJI (W)
HANDENI

.....
RACHEL L. MBELWA
AFISA M/JAMII (H/W)
HANDENI.

AFISA MAENDELEO YA JAMII (W)
HANDENI

(c) Mchamchaka Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.



HALMASHAURI YA WILAYA YA HANDENI

Na:1848

HATI YA USAJILI WA KIKUNDI

HATI HII IMETOLEWA TAREHE 01/11/2021 KWA KIKUNDI CHA MCHAKA MCHAKA KILICHOPO KIJIJI CHA MAZINGARA – KATA YA MAZINGARA.

KIKUNDI HIKI KINAJISHUGHULISHA NA SHUGHULI ZA UZALISHAJI WA MKAA NA UJASIRIAMALI.

KIKUNDI KIMESAJILIWA KWA HATI YA USAJILI NAMBA HW/HD/VU/NA.1848 KWA MUJIBU WA DIRA NA DHAMIRA YA HALMASHAURI YA WILAYA YENYE LENGO LA KUIPATIA JAMII YA HANDENI MAISHA BORA NA MAZURI.

KIKUNDI KIMESAJILIWA NA:

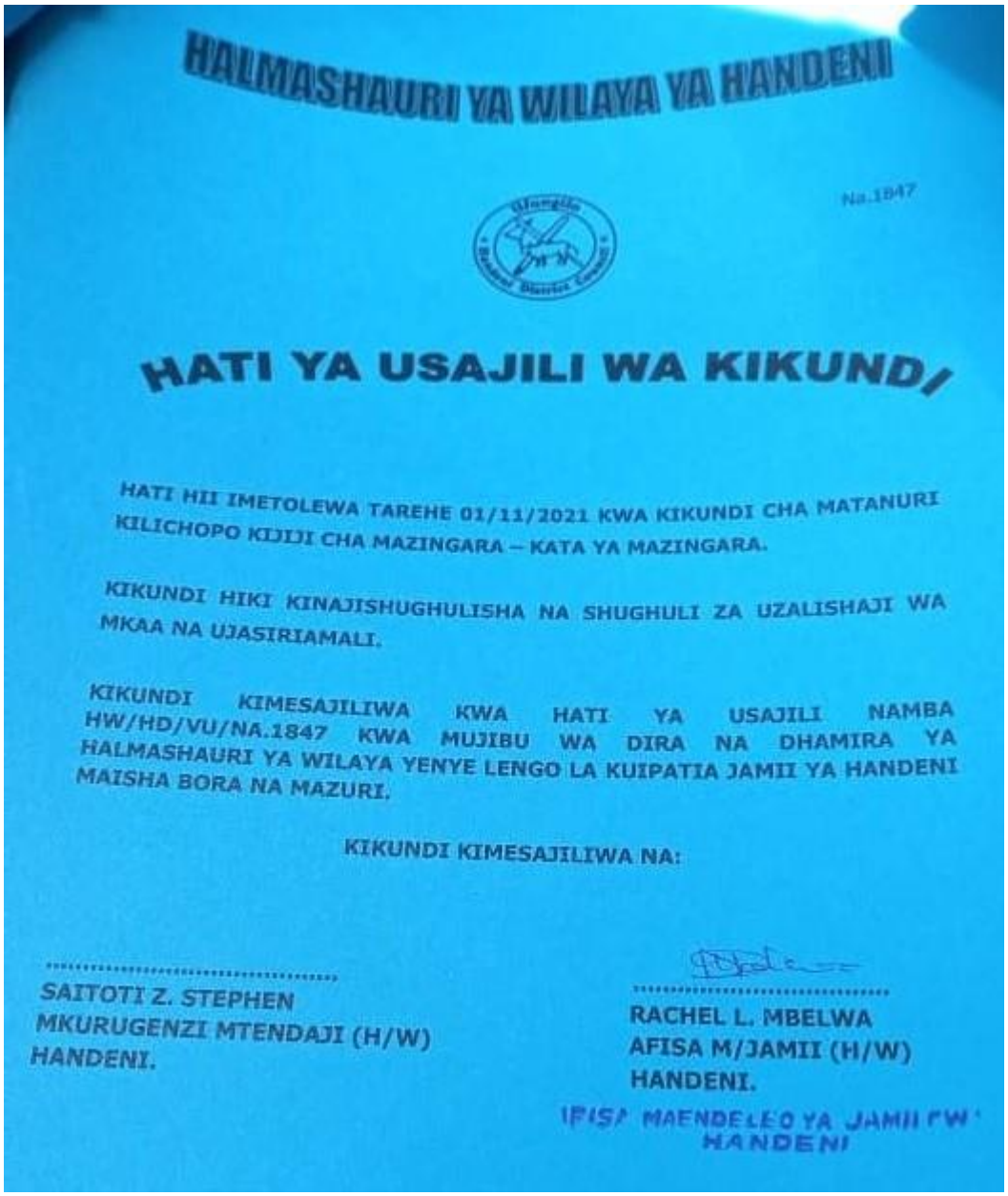
.....
SAITOTI Z. STEPHEN
MKURUGENZI MTENDAJI (H/W)
HANDENI.

MKURUGENZI MTENDAJI (W)
HANDENI

.....
RACHEL L. MBELWA
AFISA M/JAMII (H/W)
HANDENI.

AFISA MAENDELEO YA JAMII (W)
HANDENI

(d) Matanuru Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.



HALMASHAURI YA WILAYA YA HANDENI

Na.1847

HATI YA USAJILI WA KIKUNDI

HATI HII IMETOLEWA TAREHE 01/11/2021 KWA KIKUNDI CHA MATANURI KILICHOPO KIJIJI CHA MAZINGARA – KATA YA MAZINGARA.

KIKUNDI HIKI KINAJISHUGHULISHA NA SHUGHULI ZA UZALISHAJI WA MKAA NA UJASIRIAMALI.

KIKUNDI KIMESAJILIWA KWA HATI YA USAJILI NAMBA HW/HD/VU/NA.1847 KWA MUJIBU WA DIRA NA DHAMIRA YA HALMASHAURI YA WILAYA YENYE LENGO LA KUIPATIA JAMII YA HANDENI MAISHA BORA NA MAZURI.

KIKUNDI KIMESAJILIWA NA:

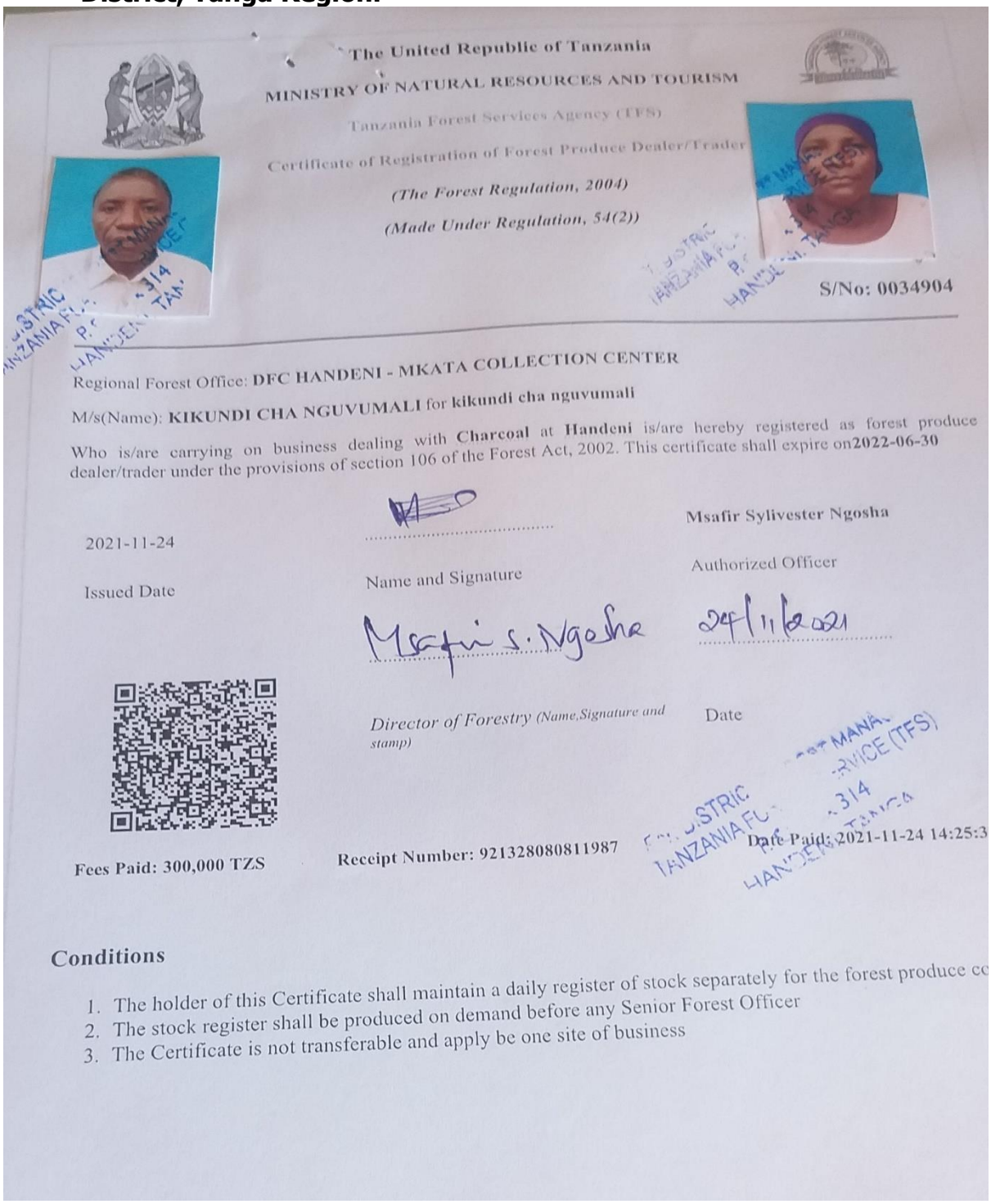
.....
SAITOTI Z. STEPHEN
MKURUGENZI MTENDAJI (H/W)
HANDENI.

.....
RACHEL L. MBELWA
AFISA M/JAMII (H/W)
HANDENI.

AFISA MAENDELEO YA JAMII (W)
HANDENI

Appendix 3: Certificates of Registration for Charcoal Business

(a) Nguvumali Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.



The United Republic of Tanzania

MINISTRY OF NATURAL RESOURCES AND TOURISM

Tanzania Forest Services Agency (TFS)

Certificate of Registration of Forest Produce Dealer/Trader

(The Forest Regulation, 2004)

(Made Under Regulation, 54(2))

S/No: 0034904

Regional Forest Office: **DFC HANDENI - MKATA COLLECTION CENTER**

M/s(Name): **KIKUNDI CHA NGUVUMALI** for **kikundi cha nguvumali**

Who is/are carrying on business dealing with **Charcoal** at **Handeni** is/are hereby registered as forest produce dealer/trader under the provisions of section 106 of the Forest Act, 2002. This certificate shall expire on **2022-06-30**

2021-11-24

Issued Date

Name and Signature

Msafir Sylivester Ngosha

Authorized Officer

24/11/2021

Director of Forestry (Name,Signature and stamp)

Date

Fees Paid: 300,000 TZS

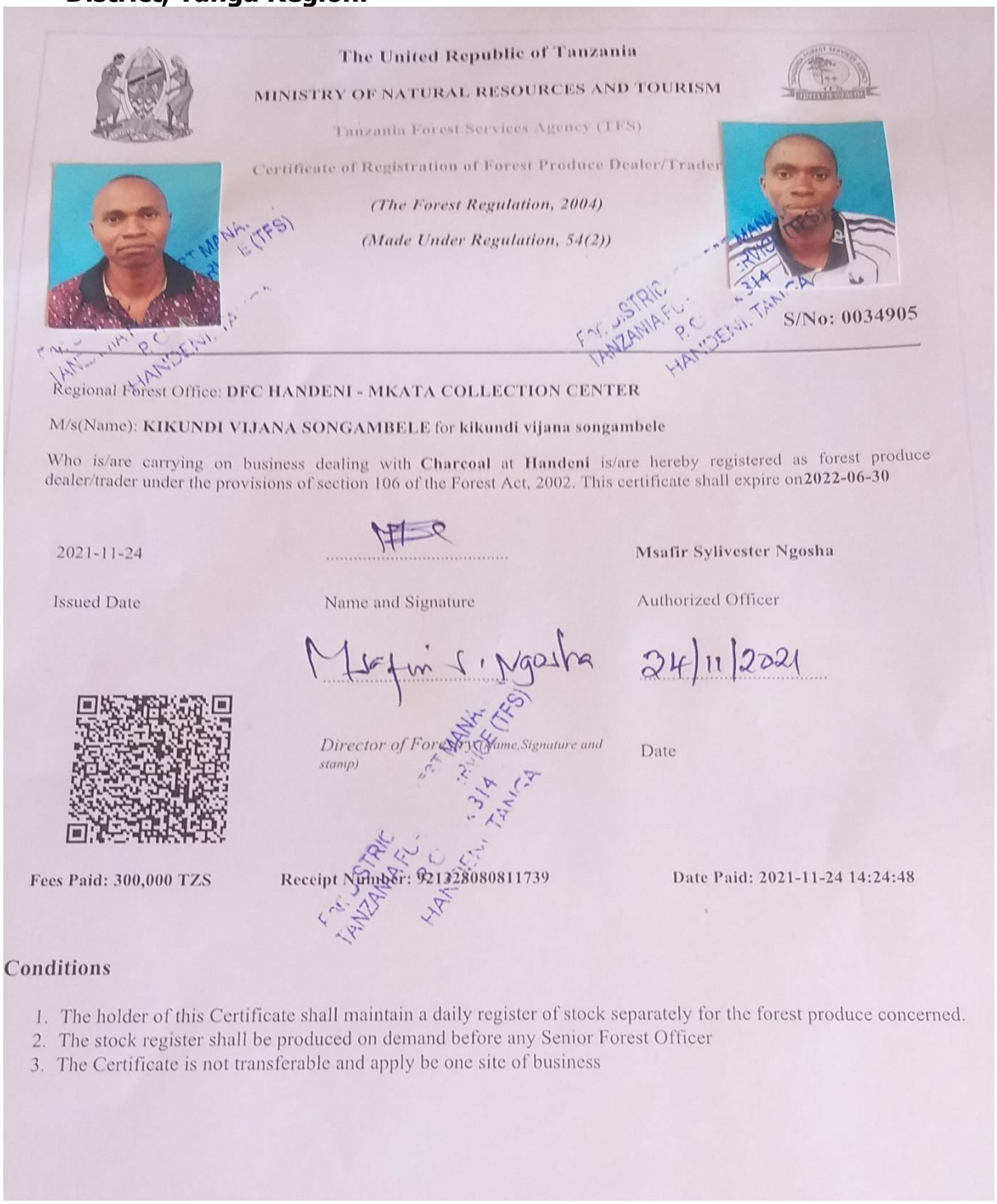
Receipt Number: 921328080811987

Date Paid: 2021-11-24 14:25:3

Conditions

1. The holder of this Certificate shall maintain a daily register of stock separately for the forest produce co
2. The stock register shall be produced on demand before any Senior Forest Officer
3. The Certificate is not transferable and apply be one site of business

(b) Songambele Charcoal Makers Group at Kwedikabu Village, Handeni District, Tanga Region.



The United Republic of Tanzania

MINISTRY OF NATURAL RESOURCES AND TOURISM

Tanzania Forest Services Agency (TFS)

Certificate of Registration of Forest Produce Dealer/Trader

(The Forest Regulation, 2004)

(Made Under Regulation, 54(2))

S/No: 0034905

Regional Forest Office: **DFC HANDENI - MKATA COLLECTION CENTER**

M/s(Name): **KIKUNDI VIJANA SONGAMBELE** for **kikundi vijana songambele**

Who is/are carrying on business dealing with **Charcoal** at **Handeni** is/are hereby registered as forest produce dealer/trader under the provisions of section 106 of the Forest Act, 2002. This certificate shall expire on**2022-06-30**

2021-11-24	.....	**Msafir Sylivester Ngosha**
Issued Date	Name and Signature	Authorized Officer

Msafiri S. Ngosha 24/11/2021

Director of Forestry (Name,Signature and stamp)

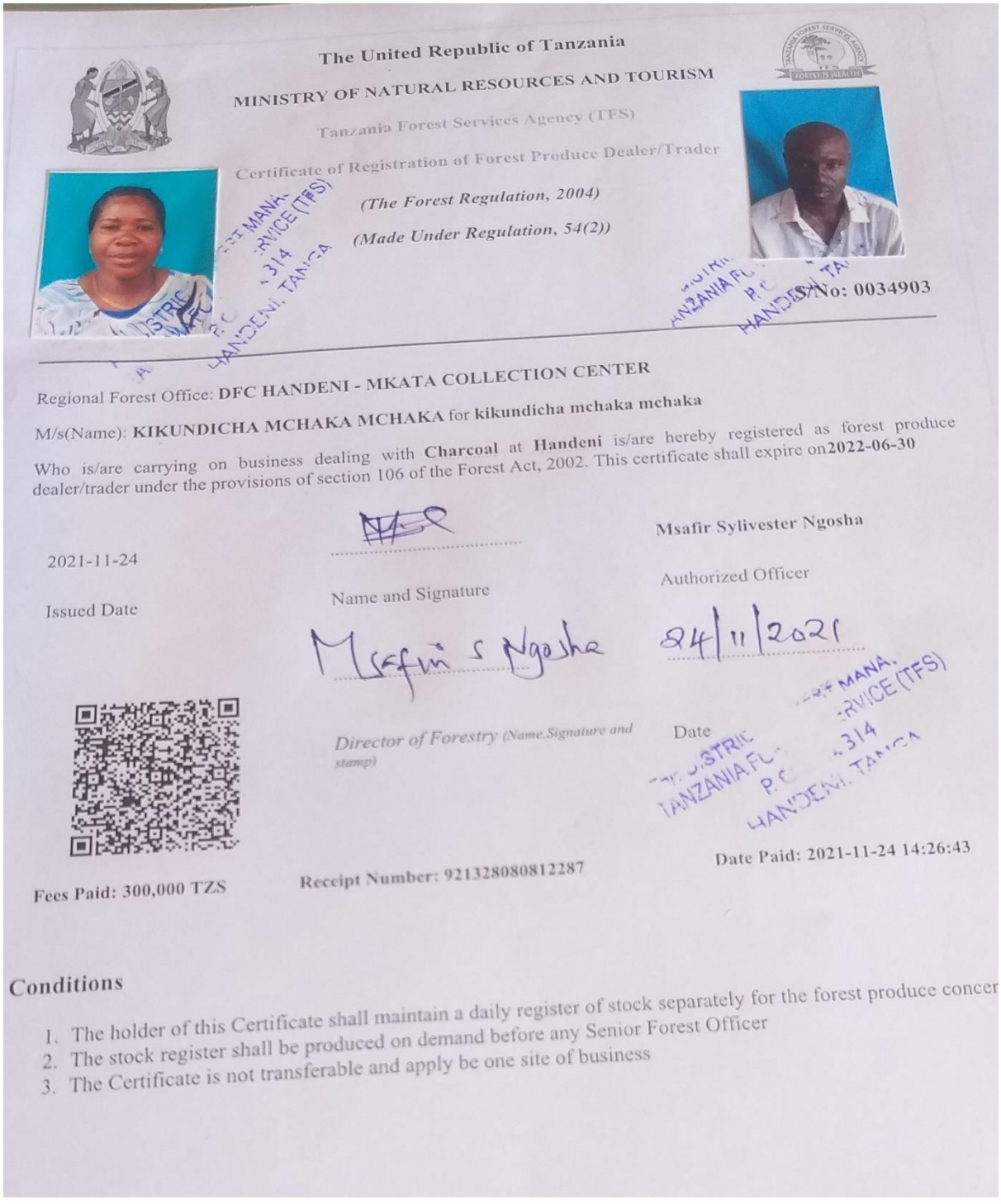
Date

Fees Paid: 300,000 TZS **Receipt Number: 921328080811739** **Date Paid: 2021-11-24 14:24:48**

Conditions

1. The holder of this Certificate shall maintain a daily register of stock separately for the forest produce concerned.
2. The stock register shall be produced on demand before any Senior Forest Officer
3. The Certificate is not transferable and apply be one site of business

(c) Mchamchaka Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.



The United Republic of Tanzania

MINISTRY OF NATURAL RESOURCES AND TOURISM

Tanzania Forest Services Agency (TFS)

Certificate of Registration of Forest Produce Dealer/Trader

(The Forest Regulation, 2004)

(Made Under Regulation, 54(2))

S/No: 0034903

Regional Forest Office: **DFC HANDENI - MKATA COLLECTION CENTER**

M/s(Name): **KIKUNDICHA MCHAKA MCHAKA** for **kikundicha mchaka mchaka**

Who is/are carrying on business dealing with **Charcoal** at **Handeni** is/are hereby registered as forest produce dealer/trader under the provisions of section 106 of the Forest Act, 2002. This certificate shall expire on**2022-06-30**

2021-11-24

Issued Date

Name and Signature

Msafir Sylivester Ngosha

Authorized Officer

24/11/2021

Date

Director of Forestry (Name,Signature and stamp)

Fees Paid: 300,000 TZS

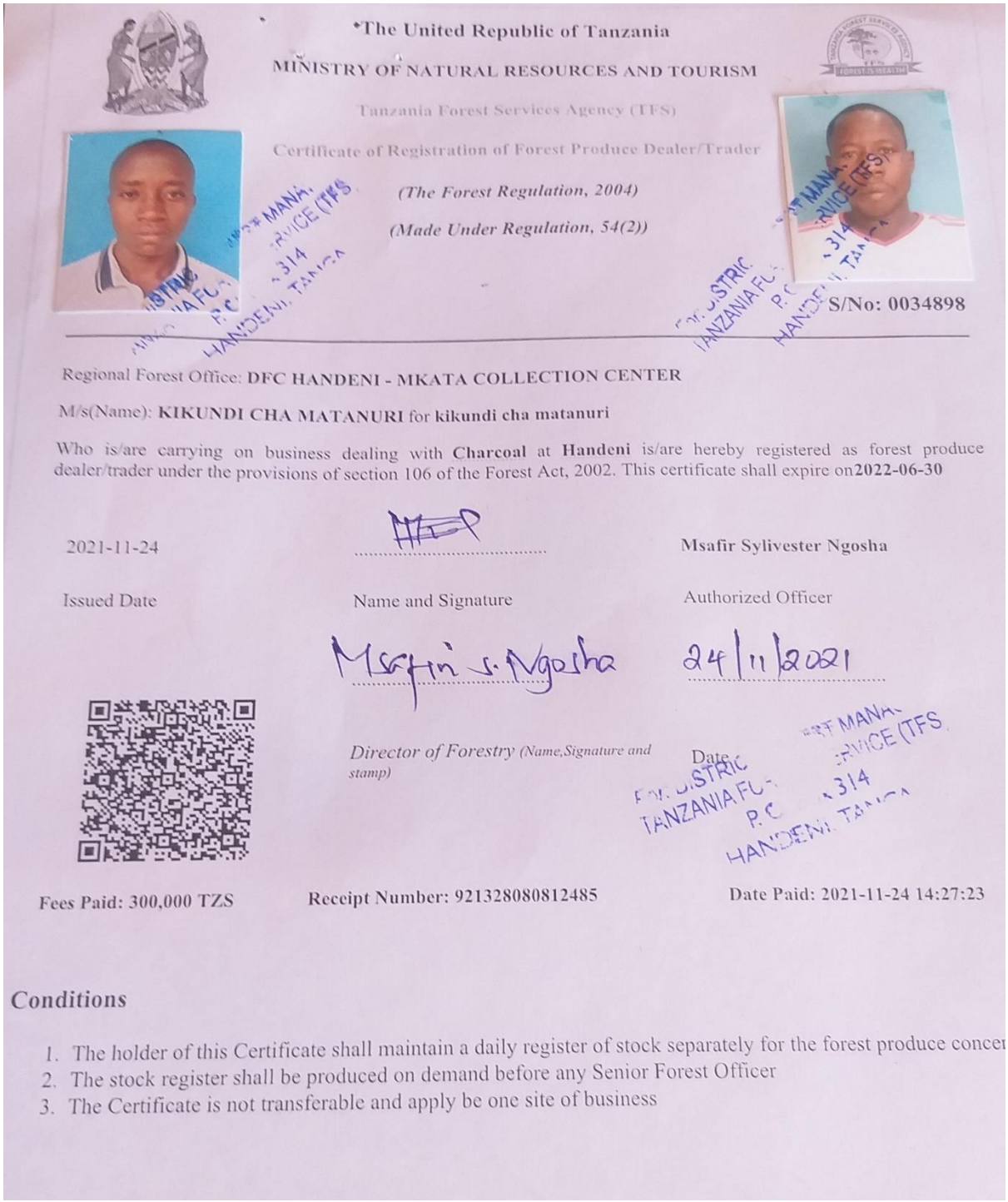
Receipt Number: 921328080812287

Date Paid: 2021-11-24 14:26:43

Conditions

1. The holder of this Certificate shall maintain a daily register of stock separately for the forest produce concer
2. The stock register shall be produced on demand before any Senior Forest Officer
3. The Certificate is not transferable and apply be one site of business

(d) Matanuru Charcoal Makers Group at Mazingara Village, Handeni District, Tanga Region.



*The United Republic of Tanzania

MINISTRY OF NATURAL RESOURCES AND TOURISM

Tanzania Forest Services Agency (TFS)

Certificate of Registration of Forest Produce Dealer/Trader

(The Forest Regulation, 2004)

(Made Under Regulation, 54(2))

S/No: 0034898

Regional Forest Office: **DFC HANDENI - MKATA COLLECTION CENTER**

M/s(Name): **KIKUNDI CHA MATANURI** for **kikundi cha matanuri**

Who is/are carrying on business dealing with **Charcoal** at **Handeni** is/are hereby registered as forest produce dealer/trader under the provisions of section 106 of the Forest Act, 2002. This certificate shall expire on**2022-06-30**

2021-11-24	.....	Msafiri Sylivester Ngosha
Issued Date	Name and Signature	Authorized Officer

Msafiri S. Ngosha 24/11/2021

Director of Forestry (Name,Signature and stamp) Date

Fees Paid: 300,000 TZS **Receipt Number: 921328080812485** **Date Paid: 2021-11-24 14:27:23**

Conditions

1. The holder of this Certificate shall maintain a daily register of stock separately for the forest produce concer
2. The stock register shall be produced on demand before any Senior Forest Officer
3. The Certificate is not transferable and apply be one site of business

Appendix 4: Checklist for Study Tour in Kilosa District, Tanga Region.

Section A: Introduction of sustainable charcoal production from host village

1. When the process to establish VLFR started in the village?
2. How the process began?
3. When sustainable charcoal production began?
4. How sustainable charcoal production began?
5. How much money has been earned from sustainable charcoal production?
6. How was it spent? And for what aspects??
7. What benefits accrued by ordinary villagers in village from sustainable charcoal production?
8. What is the current status of the VLFR?
9. What challenges do you face from sustainable charcoal production?

Section B: Village Leaders

1. What are the responsibilities of the village government in the management of sustainable charcoal production?
2. How VNRC members were elected, what its life span and what is the process of knowledge sharing?
3. How much money has been earned from sustainable charcoal production and how has it been spent?
4. What are procedures of spending money obtained from sustainable charcoal production?
5. How village government is coordinating sustainable charcoal production in the VLFR?
6. How is village government interacting with VNRC and ordinary villagers with regards to sustainable charcoal production?
7. What other forest based enterprises have been established by using funds from charcoal?
8. What challenges do you face from sustainable charcoal production?

Section C: Village Natural Resources Committee (VNRC)

1. How were you elected and when?
2. How many members are in the VNRC and what its leadership structure?
3. What are main roles and responsibilities in sustainable charcoal production?
4. How do VNRC work with village government (i.e. village assembly) and village council?
5. What are roles and responsibilities of VNRC in forest management and in sustainable charcoal production?
6. How forest is divided for charcoal production and what are charcoal production protocols?

7. What are procedures for issuing a charcoal harvesting license in the VLFR?
8. How funds from sustainable charcoal is collected, managed and distributed?
9. How much money has been earned from sustainable charcoal production and how has it been spent?
10. How are harvested areas managed?
11. What other activities are taking place within the village forest reserve?
12. What are the other roles of the committee apart from management of VLFR?
13. What challenges do you face from sustainable charcoal production?

Section D: Charcoal Makers' Groups

1. What is the history of charcoal production in the village?
2. Do you have charcoal makers' groups? How were they formulated?
3. How many charcoal-making groups are in the village (indicate age group, sex and previous occupation)?
4. What are roles of the group members to the group?
5. How the group is operating?
6. What charcoal production technology do you use?
7. What are procedures for obtaining a charcoal harvesting license?
8. How do you operate charcoal trade?
9. How do you differentiate charcoal you make from others?
10. How do you share costs and benefits of charcoal production?
11. How sustainable charcoal production has helped to improve livelihood of charcoal makers?
12. How do you participate in management of harvested area and other parts of the VLFR?
13. What challenges do you face from sustainable charcoal production?
14. What are future plans of the group?

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