



# A Context Analysis

On status of water, trees and wood fuel systems in Kibwezi East and Mbooni East sub-counties, Makueni County

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## About this context analysis brief

This context analysis study was conducted in Makueni County. It targets policymakers both at county and national levels, practitioners and relevant stakeholders implementing land restoration projects on the need to have a sound understanting of the context of the area to help design the appropriate interventions in Makueni County.



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# Introduction

## Over 80% of the landmass in Kenya is Arid and Semi-Arid Lands (ASALs)<sup>[1]</sup> covering 29 counties and home to about 36% of the population, 70% of the national livestock, and 90% of wildlife.

ASALs are the main sources of wood charcoal which is a key livelihood strategy and over 80% of the producers source wood from trees on farm. Makueni is among the top three charcoal producer counties<sup>[2]</sup>. The annual rainfall in arid areas ranges between 150 mm and 550 mm, and semi-arid between 550 mm and 850 mm per year, while temperatures are high throughout the year, with high rates of evapotranspiration. Climate change, increasing frequency and severity of droughts, flooding and low investment in sustainable and resilient agriculture have exacerbated these challenges.

Makueni is one of the counties that experiences semi-arid climatic conditions with an average temperature range between 15°C – 26°C and annual rainfall of 250mm to 400mm per annum in the lower regions of the county and 800mm to 900mm [3] in the higher regions of the county and hence facing these challenges. The situation can, however be addressed through nature-based solutions, including context-appropriate and gender-responsive approaches of growing the right trees in the right place for the right purpose and sustainable water and woodfuel (charcoal and firewood) management practices.

Trees are introduced into farms for a particular reason(s)<sup>[3]</sup> or are selectively retained after land-use change, where farmers raise and manage a mix of exotic and indigenous trees in different ways to provide a variety of ecosystem services (ESs). Trees require adequate soil moisture<sup>[3]</sup> to establish and in return, enhance groundwater recharge, support water balance for crop use through hydraulic processes, especially during dry spells, and help recycle green water. Therefore, a key challenge for agroforestry in dryland areas is to identify species<sup>[5]</sup> that optimize the capture and use of scarce

- 3 Nyaga J, Barrios E, Muthuri CW, Öborn I, Matiru V, Sinclair FL. 2015. Evaluating factors influencing heterogeneity in agroforestry adoption and practices within smallholder farms in Rift Valley, Kenya. Agriculture, Ecosystems and Environ. 212, 106-118, https://doi.org/10.1016/j.agee.2015.06.013,
- 4 Bayala J, Prieto I. 2020. Water acquisition, sharing and redistribution by roots: applications to agroforestry systems. Plant and Soil, 453(1–2), 17–28. <u>https://doi.org/10.1007/s11104-019-04173-z</u>
- 5 Muthuri CW, Ong CK, Mati BM, Ngumi VW, Black CR. 2009. "Chlorophyll content, gas exchange and water use efficiency of trees and crops in agroforestry systems in semi-arid Kenya". Agriculture, Ecosystems and Environment 129, pp. 497-507,



<sup>1</sup> GOK. ASALs Categorization. https://www.asals.go.ke/asal-info/.

<sup>2</sup> Ndegwa G, Sola P, Siko I, Kirimi M, Wanjira EO, Koech G, Ihalainen M, liyama M, Muriuki J, Njenga M. 2021. The charcoal value chain in Kenya: Actors, practices and trade flows in selected sites. Technical Report. Nairobi, Kenya: World Agroforestry. <u>https://worldagroforestry.org/publication/charcoal-value-chain-kenya-actors-practices-and-trade-flowsselected-sites</u>



environmental resources such as water and nutrients while fulfilling 'farmers' needs for timber, fuel, mulch, fodder, and staple food commodities such as fruits. In addition, tree management, especially pruning and appropriate spacing, is also required to minimize competition for resources between other crops and trees and, at the same time, produce other needed products like green manure, charcaol, firewood or stakes for fencing or supporting crops such as climbing beans or tomatoes. Tree growing for cooking energy production can sustainably be enhanced through on-farm management of planted trees and farmer-managed natural regeneration (FMNR) <sup>[6]</sup> through pruning and coppicing. Sustainable tree management enables farmers to utilize branches, unwanted stems, and twigs instead of cutting the whole tree for woodfuel (firewood and charcoal) and biochar for soil amendments and briquette making<sup>[7,§]</sup>. This approach does not only help farmers to sustain tree cover on farmlands but also adapt and mitigate against climate change.

Therefore, a study was conducted in Makueni County in two contrasting sites of Kibwezi East and Mbooni East sub-counties to help understand the prevailing context in these areas on sustainable water, tree, and woodfuel management so as to tailor the interventions appropriately. This was under the UK Partnering for Accelerated Climate Transitions (UK PACT) supported project, *'Promoting nature-based solutions for land restoration while strengthening national monitoring technical working group in Kenya*<sup>(\*)</sup><sup>w</sup> led by ICRAF. The study built on the previous work of the UK PACT project that focused on building the capacity of the communities on gender transformative approaches for land restoration and options by context.

https://doi.org/10.1016/j.agee.2008.11.001.

- 6 FMNR practice allows indigenous tree species to naturally regenerate from living stumps, roots, and seeds beneath the ground with minimal intervention thus a cheaper approach to revegetating the degraded landscape (Wanjira et al, 2020).
- 7 Wanjira EO, Muriuki J, Ojuok I. 2020. Farmer Managed Natural Regeneration for Kenya: A primer for development practitioners. Nairobi, Kenya: World Agroforestry (ICRAF), pg133.
- 8 Njenga M, Mendum R, Gitau J, liyama M, Jamnasdass R, Watson C. 2017. Trees on farms could satisfy household firewood needs. Tree Farmers Magazine, 33, 22–23.

9 https://www.worldagroforestry.org/project/promoting-nature-based-solutions-land-restoration-while-strengtheningnational-monitoring-phase2

## 1.1 Context analysis methodology

The context analysis study was conducted in Mbooni East (Kalawa ward) and Kibwezi East (Ivingoni/Nzambani and Masongaleni wards) sub-counties of Makueni County[<sup>10</sup>] and 212 households (135 female, 77 male) were interviewed using a semi-structured questionnaire. Eight focus group discussions (FGD) were held, that is, four FGDs in each site with two females only and two males only and 44 tree nurseries (12 in Mbooni East and 32 Kibwezi East). The households were randomly sampled by selecting every third household along road transects in the villages. Data was collected using Open Data Kit (ODK) enabled Android mobile phones, managed using an online data management platform. The data was analyzed descriptively by cross-tabulation using STATA. This was then synthesized and presented in the form of graphs and tables. The findings are presented below.



10 Wakaba D, Wanjira EO, Gitau JK, Koech G, Gachuiri A, Crossland M, Njoki C, Njenga M, Muthuri M. 2023. Context Analysis Report on Water, Trees and Woodfuel Systems in Makueni County. Nairobi, Kenya: World Agroforestry (ICRAF)

## **1.2 Household characteristics**

Results show that on average, 83% of the households are male-headed. On average households are composed of five members with a ratio of 1:1 of male to female. Most of the household heads only attained a primary level of education (63%), while a few have not attained any formal education. Households' investment in social capital, such as group, is critical as they stand to enjoy social, emotional, and cognitive benefits. Again, in rural settings, technologies and innovations are mostly passed on through group settings due to ease of diffusion among members. However, striking results revealed that less than half of the households had a member belonging to any group. For households with any member belonging to a group, they are mainly in self help group. To unlock the technological adoption capabilities, we assessed the knowledge access gap to equip farmers with the knowledge and resources required for economic development and food security. At least a quarter of the households have access to extension services. For fortunate households who had access to extension services, received training on; soil conservation, trees and their benefits, tree management practices, and cooking energy sources.



Key highlights of the context analysis study

## 2.1 Water management

The water management survey focused on key broad areas that include water access, seasonal availability and uses of the water, distance to the water sources, challenges faced during water collection and barriers to water harvesting.



#### 2.1.1 Access to water

Results from the analysis identified two main sources of water in the Kibwezi East and Mbooni East sub-counties as water kiosks and rivers respectively (Figure 1). Water in the kiosks is supplied from groundwater sources, mainly boreholes, swamps, and oases. However, while groundwater was the major source of water in Kibwezi East, rivers comprised the main source of water in Mbooni East.

Figure 1: Sources of water in Kibwezi east East and Mbooni East sub-counties.



Inter and intra-sub-county variation in access to water was reported by households in Kibwezi East and Mbooni East sub-counties. Specific variations in access to water in each sub-county are presented in Table 1 below.

Table 1: Specific variation in access to water in Kibwezi East and Mbooni East sub-counties.

SOURCE	KIBWEZI EAST	MBOONI EAST	
Groundwater	Intra sub-county variation observed. In one ward, water is abstracted from boreholes; in the other, swamps/ oases supply water. 6% of households reported access to piped water.	One percent of households collect water from ground sources, including home-dug wells and boreholes. Among the interviewed households none reported having access to piped water.	
Rivers and streams	Rivers are the second most common source of water.	The main water source for households are rivers.	
Rainwater harvesting	Most households practice rooftop rainwater harvesting. Other techniques include harvesting water on farm and from the roads. Water is harvested using tanks/ drums, soil and water conservation structures, farm ponds, and water pans. The tanks are small, few soil and water conservation structures are installed on farm, most farm ponds lack lining, and most water pans are silted.	Most households practice rooftop rainwater harvesting. Other techniques include harvesting water on farm and from the roads. Water is harvested using tanks/drums, farm ponds, and water pans. The tanks are small, few soil and water conservation structures are installed on farm , most farm ponds lack lining, and most water pans are silted.	

### 2.1.2 Seasonality of water sources

Households collect water from more than one source depending on the seasonal availability and uses (Figure 2 and 3). During both rainy and dry seasons (ALL) water is accessed from all sources with the majority of households accessing water from piped water, followed by water kiosk while those accessing from private boreholes, rivers, home-dug wells coming in third and the lowest from farm ponds.



On the other hand, in the dry season, most households access water from farm ponds, rivers, private boreholes, water pans in that order from highest respectively and none from water tank.

During the rainy season, household water sources are water tanks, waterpans and home-dug wells and private boreholes

**Figure 2:** Seasonal variation of access access to water in Kibwezi East and Mbooni East sub-counties in Makueni County





The various uses of water from Makueni county include drinking, domestic uses mainly cooking and washing. The other major uses of water are making bricks, watering livestock, crops, and watering trees. Water for drinking is obtained mainly from the rivers, water kiosk, water tanks and home dug wells.

## 2.1.3. Distance to the water sources- seasonal variation in distances to the water sources

The distance to the different sources of water varied. On a daily basis, households collect water from three main sources- rivers, water kiosk and water pan. In Kibwezi East, 76.62% of the households reported that everyday, depending on the season, they walk for 3-12km to fetch water while 74.31% of households in Mbooni East mentioned that they walk for 3-14km everyday to collect water.

#### 2.1.4 Water collection schedules and storage options

Four main schedules for water collection were pointed out by the interviewed households, none, daily, after two days and weekly. Most households collect water daily during both the dry season (56.15% Kibwezi East and 71.14% Mbooni East) and rainy season (25.49% Kibwezi East and 26.26% Mbooni East) with fewer households collect water daily during the rainy season in both sub-counties (Figure 3).

Figure 3: Water collection schedules during dry and rainy season.



After collecting the water, 53% of the households in Mbooni East and 47% in Kibwezi East store it. 20 litre jerrican used in collecting water is the main method of storing water in Kibwezi (68%) and Mbooni East (45%). Drums/tanks (50-200 litres) were the most common methods of storing water 41.35% in Mbooni East followed by 18.52% in Kibwezi East. Fewer households use tanks (500-10,000 litres) to store water 23.75% in Mbooni East and 12% in Kibwezi East (Figure 4).



Figure 4: Type of storage materials used by households in Mbooni East and Kibwezi East sub counties.

## **Figure 5:** challenges faced by households when collecting water in Kibwezi East and Mbooni East sub counties



#### 2.1.5 Challenges faced in collecting water

The main challenges faced by households in collecting water in Mbooni East were water contamination and distance to the water source while in Kibwezi East it was distance and high cost of water (Figure 5).



#### 2.1.6 Barriers to water harvesting in the two sub counties

The interviewed households indicated that 95% of them harvest rainwater. Three main technologies used in harvesting water include rooftop catchment (100% in Kibwezi East and 89.22% in Mbooni East), insitu technologies at 39% in both sub-counties and farm pond/water pans at 20% (Figure 6). The capacity of the storage tank ranges from 20 litres to 10,000 litres. Majority of households have storage capacity of 200 litres.

Three main barriers to water harvesting reported by the interviewed households were lack of finances, limited skills in design and constructing water harvesting structures, and limited knowledge on water harvesting. More households in Mbooni East than Kibwezi East highlighted the barriers mentioned above to hinder rainwater harvesting at household level.



### 2.1.7 Gendered dynamics on water

- Women primarily collect water for household use, often carrying it long distances using various means such as their backs, bicycles or donkeys. This daily task consumes a substantial amount of their time and energy.
- Men primarily construct water harvesting systems and storage structures, which
  require significant physical effort and expertise, indicating a division of labour based
  on physical capabilities.
- Men are involved in decisions related to installing water harvesting structures and purchasing materials. Their spouses often support them with money they get from women's self-help groups.
- Women play a crucial role in maintaining water harvesting structures and ensuring their proper functioning. They also take charge of managing household water resources, including decisions related to storage, rationing, and distribution, considering the needs of family members. Men assist in case of major repairs or breakages. In addition, they lead in design, layout and installation of water management technologies.

Despite women's central role in water-related activities, they often face challenges due to limited access to resources, competing tasks, education, and decision-making power. This gender disparity hampers their ability to participate in water management at the community and policy levels.

## 2.2. Tree growing and tree nurseries

## 2.2.1 Tree growing, motivation to grow, and dominant trees grown on-farm

The study's findings indicate that approximately 96% and 85% of respondents in Mbooni East and Kibwezi East sub-counties respectively, engage in tree growing on their farms. The highest proportion of farmers grow trees as a sustainable and reliable source of shade, followed by income, food, and timber, among other benefits (Figure 7). In Kibwezi East, a higher proportion of households grow trees for shade, income, food, and ecosystem services compared to Mbooni East, while the converse is true for timber, soil fertility, intercropping, fastgrowing, and firewood, which are higher in sites in Mbooni East sub-county.





The study identified 55 tree species cultivated by farmers in both project sites, with the most dominant species being *Mangifera indica, Azadirachta indica, Melia volkensii, Carica papaya, Acacia tortilis, Tamarindus indica and Euphorbia tirucalli* (Figure 8). Further analysis revealed that farmers expressed the desire to grow more of fruit trees like *M. indica, Citrus sinensis, C. papaya, Citrus limon, Persea americana, Psidium guajava,* and *Passiflora edulis* as well as a few high-value trees with medicinal value, and timber such as *A. indica* and *Moringa oleifera,* and *M. volkensii* respectively (Figure 9). However, the study noted that many of these high-value tree species were absent from several tree nurseries surveyed in the project sites.

Figure 8: Dominant tree species were found on farms in Kibwezi East and Mbooni East subcounties



Dombeya burgessiae Passiflora edulis Psidium guajava Banana Persea americana Melia vokensii Azadirachta indica Citrus limon Carica papaya Citrus sinensis Mangifera indica 10 20 30 40 50 60 70 80 Mbooni East Kibwezi East % households

90

## 2.2.2 Tree establishment method and sourcing of planting materials

Most farmers interviewed established trees on-farm by planting (70%) while a smaller percentage (27%) used farmer-managed natural regeneration (FMNR)<sup>[<sup>11</sup>]</sup> practice to bring trees on their farms (Figure 10). Analysis revealed that the majority of farmers in Kibwezi East (79%) established trees by planting compared to farmers in Mbooni East (63%) while more farmers in Mbooni East used the FMNR approach (33%). FMNR approach is particularly suitable for drylands with low and unreliable rainfall, where direct tree planting may face challenges and result in low survival or failure. In this case the higher proportion of farmers practicing FMNR was expected to be at Kibwezi East compared to Mbooni East sites but the converse is true. This is probably because households in Mbooni East have been more exposed to FMNR than those in Kibwezi East. In addition, low uptake of FMNR in comparison to planting in the study area can be attributed to the fact that most high value and fast growing tree species farmers are already growing or would like to grow more as reported in section 2.2.1 can only be established by planting.

11 FMNR practice allows indigenous tree species to naturally regenerate from living stumps, roots, and seeds beneath the ground with minimal intervention thus a cheaper approach to revegetating the degraded landscape (Wanjira et al, 2020).





In Mbooni East, farmers mainly sourced planting materials from their own collections (79%), their own tree nursery (23%), and donations (23%), while in Kibwezi East, they relied more on on-farm collections (50%), purchase from private tree nurseries (37%) and their own tree nursery (28%) (Figure 11). The prevalence of own collection as a source of planting materials raises concerns about the genetic diversity of trees grown by farmers in the project sites, especially where they are yet to be capacity built on quality seed sourcing.



Figure 11: Primary sources of planting materials by farmers in Kibwezi East and Mbooni East sub-



#### 2.2.3 Challenges faced by farmers when sourcing planting materials and growing trees

Despite the enthusiasm to grow trees, farmers face challenges in sourcing quality planting materials and growing trees in the project sites. The main challenges associated with sourcing planting materials across the two sites in Kibwezi East and Mbooni East are limited access to desired and quality planting materials, competing income uses, and the high cost of desired tree species (Figure 12). Regarding tree growing, farmers in the project sites face challenges of drought and water scarcity, lack of knowledge on tree growing, and pests and diseases (Figure 13). These challenges were corroborated by results from focus group discussions, which also identified insecure land tenure as a factor. Additional challenges mentioned included women's labour burden, lack of adequate knowledge/skills on tree management, women's limited decision-making authority, and financial limitation by women and youth. These challenges can impede the restoration of degraded farmlands with trees and the growing of high-value tree species.

**Figure 12:** Main challenges farmers face when sourcing planting materials in Kibwezi East and Mbooni East sub-counties.



Figure 13: Main challenges facing tree growing in Kibwezi East and Mbooni East sub-counties



## 2.2.4. Tree nursery ownership, size and dominant tree species stocked

Tree nurseries provides seedlings required for land restoration efforts and high value tree species for the provision of food, medicine and timber among other benefits. Forty-four tree nurseries were surveyed with 32 and 12 tree nurseries mapped in study sites in Kibwezi East and Mbooni East sub-counties respectively. Figure 14 showed that majority of the tree nurseries in the project sites are owned by individuals both in Kibwezi East (53%) and Mbooni East (50%) sub-counties. About 33% and 22% of the tree nurseries in Mbooni East and Kibwezi East respectively, are group tree nurseries while 22% of tree nurseries in Kibwezi East were under family ownership. In context, the proliferation of the individual tree nurseries can be attributed to poor management of group tree nurseries. "The approach working for us is individual tree nursery ownership but we use the group as an umbrella body for purposes of seedlings marketing," said Kioko Musyoka, a respondent and tree nursery operator in Kalawa Ward. In terms of seedlings capacity, majority of tree nurseries in both sub-counties are medium -sized i.e. have 1000-5000 seedlings with Mbooni East hosting majority of such nurseries. Kibwezi East has the highest small tree nurseries(Figure 15) which are usually owned at family level (Figure 14).



Figure 14: Main types of Tree Nurseries in Kibwezi East and Mbooni East sub-counties.

**Figure 15:** Size of the tree nurseries surveyed in terms of seedlings capacity in Kibwezi East and Mbooni East sub-counties.



A total of 44 tree species were raised in the 44 tree nurseries surveyed where 15 tree species were found in at least 5 tree nurseries surveyed. The four most dominant tree species which were also found in at least 50% of the tree nurseries surveyed included ungrafted Mangifera indica (80%), Azadirachta indica (75%), Carica papaya (58%) and Citrus limon (55%) (see Figure 16). The results justify the challenges farmers mentioned that included limited access to desired and quality planting materials and high cost of desired seedlings. For instance, the M. indica and C. limon which are two of the most dominant in the tree nurseries were not grafted despite the high value farmers have attached to them due to their fast growth and early maturity, thus, a quick economic return within a short period. The dominance of ungrafted M. indica and C. limon can be attributed to farmers preference of ex-situ over in-situ grafting which is a common practice among many farmers in the study area. In addition, most of tree species that farmers want to grow more on their farms were less dominant or missing in most of the tree nurseries surveyed and this corroborate the findings from the household survey in *sub-section 2.1* of this paper that found some of the trees farmers wanted to grow more were missing in most of the tree nurseries they have had access to.

**Figure 16:** Dominant tree species across all tree nurseries surveyed in Kibwezi East and Mbooni East subcounties.



#### 2.2.5 Gendered dynamic on tree growing

- Women primarily engage in tree growing activities such as watering, weeding, carrying manure, and fruit harvesting. On the other hand, men, handle physically demanding tasks like propagating seedlings, planting, reflecting a division of labour based on physical capabilities
- Both men and women participate in discussions regarding tree species selection and planting locations. However, men's ownership of trees and land, influences their decision-making power, with men usually having the final say. Nevertheless, women often perceive their involvement in these decisions as being joint.
- Pruning decisions are predominantly made by men, even though women assist in collecting and transporting the wood.
- Fruit sales decisions require permission from husbands, particularly for high-value fruits. However, consumption decisions involve the whole family, and women play a significant role in fruit consumption choices.
- The allocation of proceeds from fruit sales is typically a joint decision. However, men tend to have more control over large-scale or peak-season fruit sales, while women make decisions regarding low-value fruits or small-scale sales.

## 2.3. Cooking energy

## 2.3.1 Types and sources of cooking energy in Kibwezi East and Mbooni East sub-counties

Households in Kibwezi East and Mbooni East mainly use firewood which is mainly sourced from on-farm and mostly used in three stone open fire (Table 2). To meet their cooking energy needs households use more than one type of fuel and charcoal is the second most used fuel. Charcoal and firewood are both referred to as woodfuel.



**Table 2:** Types and sources of household cooking energy

PARAMETER		KIBWEZI EAST %	MBOONI EAST %
Main energy type for cooking	Firewood	98	99
	Charcoal	70	65
	LPG	18	9
Other types of cooking energy	Crop residues	3	13
5	Kerosene	1	3
	Biogas	1	0
Main source of firewood	Own farm (pruning & dead wood)	80	97
Main firewood drying method	Under the sun	70	69
Primary people	Wife	68	73
in the household involved in	Husband	16	6
firewood collection	Female children (<18yrs)	1	1
	Male children (<18yrs)	1	1
	Daughters (>18yrs)	2	8
	Sons (>18yrs)	3	1
	Other females (employees, relatives, no relation)	3	9
	Other males (employees, relatives, no relation)	7	2
Time spent on firewood collection		1hr 38mins	1hr 31mins
Main sources of	Purchase	57	46
charcoal	Produced on-farm	57	63

#### 2.3.2 Challenges faced in firewood collection

Although most households source firewood from the trees on-farm, harvesting, sizing and carrying is hard work with multiple negative impacts such as physical injuries, risks and uncertainties (Figure 17). These challenges are experienced by women in other parts of the country such as in the highlands in Kiambu and Embu counties where women source firewood from protected government forests [<sup>12</sup>].

Figure 17: Burdens and risks in firewood collection



## 2.3.3 Characteristics considered when selecting tree for firewood

Burning period, time taken to dry and less smoke production when burning are the three main characteristics households consider when selecting type of tree species for firewood (Figure 18).

12 Njenga M, Gitau JK, Mendum R . 2021. Women's work is never done: Lifting the gendered burden of firewood collection and household energy use in Kenya. Energy Res. Soc. Sci 77, 1020271. <u>https://doi.org/10.1016/j.erss.2021.102071</u>





Figure 18: Characterization that households consider when selecting tree species for firewood

### 2.3.4 Type of cooking appliances/stove used by households

Households in both sites used various types of cooking appliances/ stoves with three stone open fire being the mainly used appliance by 61% and 41% of the households in Kibwezi East and Mbooni East respectively (Table 2)

**Table 2:** Cooking appliances/ stoves used by households

	KIBWEZI EAST	MBOONI EAST	
COOKING APPLIANCES/STOVE	% Households using the appliance/stove		
Three stone open fire -firewood	61	41	
Mud stove -firewood	3	20	
Mud stove-charcoal	12	9	
Ceramic stove- charcoal	16	3	
Metal stove -charcoal	5	13	
Improved branded stove -firewood	0	7	
Improved branded stove -charcoal	0	5	

High smoke production when cooking is the main challenge experienced with mainly used three stone open fire by 67% and 46% of the households in Kibwezi East and Mbooni East respectively (Figure 19)

Figure 19: Challenges experienced when cooking with three stone open fire







To solve the challenges faced while cooking, households suggested use of improved cooking stoves. According to respondent cost-effectiveness, ability to use locally available fuels and availability are the three main parameters that should be considered when selecting a stove (Figure 20).

Figure 20: Desirable features of improved stoves as stated by households



Approximately 41% and 21% of the households in Kibwezi East and Mbooni East respectively own an improved stove. About 75% and 62% out of the 59% and 79% of the households in Kibwezi East and Mbooni East respectively, without improved stove would like to have one but identified affordability as the main hindrance (Figure 21).

Figure 21: Challenges limiting access to improved woodfuel cooking appliances/stoves



#### 2.3.5 Gendered dynamics on woodfuel

- Women are primarily responsible for sourcing firewood, a critical energy source for cooking and heating in both sites. They often spend significant amount of their time and energy cutting and carrying it on their back or bicycle to the homestead.
- Charcoal production requires physical labour and although men dominate this activity women too are involved. Men often make decisions related to the establishment, charcoal production operations, and sales management. Women are mostly involved in sourcing and carrying wood to the charcoal production site which they mainly source from tree on-farms. Over 80% of charcoal producers in the drylands source wood from trees on farms[<sup>13</sup>]. Charcoal production also requires technical knowledge.
- Women's knowledge and preference of suitable wood types and sources are crucial in ensuring the quality and availability of wood for charcoal production.

<sup>13</sup> Ndegwa G, Sola P, Siko I, Kirimi M, Wanjira EO, Koech G, Ihalainen M, Iiyama M, Muriuki J, Njenga M. 2021. The charcoal value chain in Kenya: Actors, practices and trade flows in selected sites. Technical Report. Nairobi, Kenya: World Agroforestry. https://worldagroforestry.org/publication/charcoal-value-chain-kenya-actors-practices-and-trade-flows-selected-sites



**Conclusions** 



**Communities have multiple** water sources with varied quality and quantity; however, access varies with the season. The distance and time taken to and from the water sources was 3-14km and 1.5-5 hours respectively. The means of transport also vary depending on the source and cost of water as well. Daily water collection by households from different water sources is majorly contributed in part by the lack of storage facilities for the collected water.

A higher volume of the water collected is put to consumptive use than to productive uses such as tree establishment and annual food crop growing, among others. The **capacity of communities to manage the available water for livelihood benefits** came out as a huge gap from the analysis.

Communities harvest water using technologies such as rooftop catchment, farm ponds, water pans and insitu technologies such as zai pits. However, the materials used to harvest water is small and can last the household for few days to weeks after the rain. Farmponds and water pans are limited by lack of lining and siltation while investment on insitu water harvesting technologies are hampered by limited skills to design and install and high labor costs.



The community preferred to grow more of high-value tree species for income, food, shade, and timber while also keeping other tree species for other uses, such as firewood on their farms. Besides tree establishment by planting, FMNR practice has also gained acceptance among some farmers.

This means that farmers can bring back trees on their farmlands, which is a plus to landscape restoration efforts and a simple, affordable, and faster way to establish sustainable sources of firewood and charcoal for household use and income generation. Farmers wanting to grow trees by planting, however still face the challenge of accessing quality and desired tree species in existing tree nurseries, while women and youth still have to contend with limited decision-making authority and financial limitations to grow trees.



**Firewood is the main fuel used by households** in Kibwezi East and Mbooni East which they get it through pruning of trees in their farms and/or collecting dead wood. Most households in both sites use inefficient **three-stone open fire** for household cooking and heating purposes, which uses more fuel and contributes to indoor air pollution. Households in Kibwezi East and Mbooni East without improved stoves aspire to own one but are hindered by cost, accessibility, and availability.



## Recommendations



### WATER MANAGEMENT



Build the capacity of communities on the water cycle and their roles in it

Build capacity of communities through

training and demonstration on water management for livelihoods and link with value chain development for socioeconomic and environmental outcomes.

Support communities with water storage facilities to enable them to reduce the burden on water collection and save time for other activities.



Strengthen community efforts on water harvesting by diversifying options, linking them to other initiatives such as village saving and loaning facilities for saving and loaning for water storage facilities.



### **TREE GROWING & TREE NURSERIES**



Enhance gender-responsive capacity building on tree nursery practices, planting materials sourcing and vegetative propagation to improve the quality of tree seedlings for onfarm tree growing.

Support upgrading of selected tree nurseries which are serving a wider catchment to enhance the accessibility of diverse tree species by farmers.



Target tree species prioritized by farmers to meet households' needs for shade, income, food, and timber for multiplication in the selected tree nurseries.

Prom chear resto

Promote FMNR practice as a simple and cheaper nature-based solutions (NbS) land restoration approach.



### **COOKING ENERGY**

From the context analysis study, the proposed intervention to address the challenges households in Kibwezi East and Mbooni East are:



Gender responsive sustainable biomass production, processing, and utilization



Resource recovery for fuel briquettes production and use



Improved wood fuel cooking stoves that respond to peoples needs and participatory installation and efficiency assessment





## **CIFOR-ICRAF**

The Center for International Forestry Research (CIFOR) and World Agroforestry (ICRAF) envision a more equitable world where trees in all landscapes, from drylands to the humid tropics, enhance the environment and well-being for all. CIFOR and ICRAF are CGIAR Research Centers.



