

## Article

# The Potentials and Challenges of Achieving Sustainability through Charcoal Producer Associations in Kenya: A Missed Opportunity?

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**Abstract:** The charcoal industry, specifically charcoal production, is tremendously valuable to Kenya for its contribution to economic, social and environmental nexus. Considering the degradation of ecosystems and charcoal production's critical role, the government established the Forest (charcoal) rules of 2009, assigning commercial charcoal production under Charcoal Producer Associations (CPAs). Identifying numerous bans in the recent past, this paper sets out to understand CPAs' potentials and challenges in attaining sustainability within the sector. Using focus group discussions with CPA members from Tana River and Kitui counties, the paper outlines analysed data within the functionality, governance and policy implications parameters of operation. The findings show high economic value for the members and an in-depth environmental significance to the communities within which these CPAs exist. Thus, we propose a schematic to enhance charcoal production processes to achieve sustainable ecosystems and livelihoods. There is high potential within the CPAs for the sector's sustainability through monitoring platforms, restoration plans, adopting sustainable practices, knowledge dissemination and societal advancement. To advance this untapped potential of these associations, we recommend building their technical, business and governance skills, exploring various restoration schemes, financial and regulatory support in implementation, and policy support.

**Keywords:** charcoal producer associations; Kenya; Tana River; Kitui; sustainability; society



**Citation:** Kamwilu, E.; Duguma, L.A.; Orero, L. The Potentials and Challenges of Achieving Sustainability through Charcoal Producer Associations in Kenya: A Missed Opportunity? *Sustainability* **2021**, *13*, 2288. <https://doi.org/10.3390/su13042288>

Academic Editor: Enrique-Javier Díez-Gutiérrez

Received: 16 January 2021

Accepted: 14 February 2021

Published: 20 February 2021

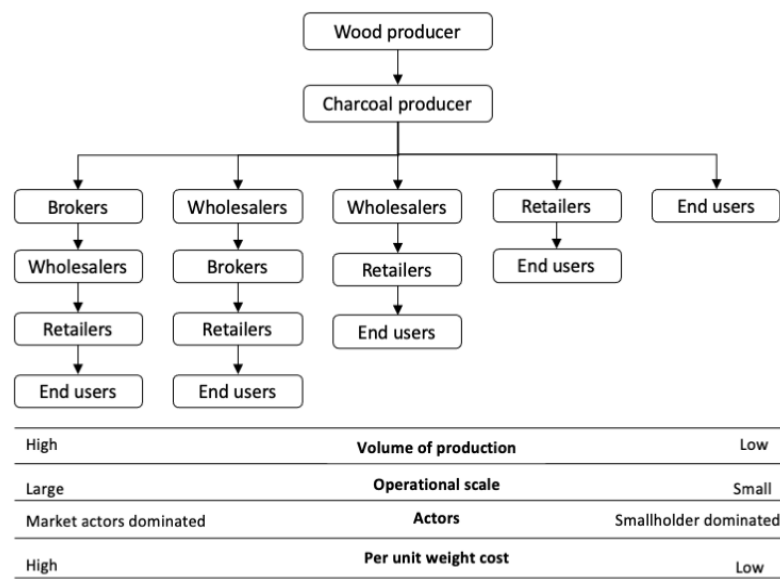
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## 1. Introduction

Charcoal continues to be an essential source of energy for millions of Kenyans with increased demand anchored to the increasing urbanisation. This sector has been attributed to appreciable economic, social, and environmental significance in the country. In 2013, charcoal's economic value was estimated at 135 billion KES [1]; thus, a key contributor to the economy. Additionally, high dependence on charcoal for energy is elaborated by 82% and 34% consumption in urban and rural households [1]. Consumption extends beyond the households into businesses and institutions such as hotels and schools. Ndegwa et al. [2] identify women as the highest consumers within the household and cottage industries. The charcoal value chain also offers a significant income contribution as wood producers, charcoal producers, transporters, brokers, wholesalers, retailers and consumers. Statistically, the sector has about 635,483 actors involved of whom 253,808 are identified as producers [1,3]. Above this, about 2.5 million people get support from those dependent on the sector for livelihood [1]. Therefore, despite the informality associated with the industry, it carries practical significance in the country's development [4]. This sector involves the interaction and cooperation of various sectors within the value chain at wood production, carbonisation, transportation, trading, and consumption. Figure 1 illustrates the six categories of actors with various operation channels varying with the generic elements and interactions among the actors.



**Figure 1.** A representation of the charcoal energy system flow. Source: Adapted from [1,5].

In Kenya, charcoal production begins with harvesting woody biomass from communal land, government forest and private land. The woody biomass is then carbonised by pyrolysis in a kiln to produce a type of charcoal with a typical kiln with a conversion efficiency of 10–14%. Transporters then move the charcoal in 50–90 kg sacks from production sites to urban and peri-urban sites. Afterwards, distribution to consumers is in a range of sizes, from whole sacks to 20-litre buckets to 2-litre tins. Efficiency in charcoal's final use for cooking depends on the stove technology that consumers own and prefer to use [6]. The majority of the charcoal is produced in arid and semi-arid lands (ASALS), accounting for about 40–75% [7,8]. Extensive production is reported in fragile ecosystems across Kitui, Makueni, Tana River, Kwale, Narok, and Baringo [3]. In Kitui, Baringo and Kajiado counties, most charcoal is produced from wood sourced from farmlands owned by the producers [1]. Reportedly, the use of wood from farmlands is at 44% and 38% from private land while in areas where livestock production is highly practised, charcoal is produced from the cleared wood for pasture production [9].

Commercial charcoal production in Kenya is facilitated through Charcoal Producer Associations (CPAs). Considering the degradation of ecosystems and the critical role of charcoal production, the government established the Forest (charcoal) rules of 2009. The associations are registered under the Societies Act, and each is required to: facilitate the sustainable production of charcoal by their members, ensure the members implement the reforestation or conservation plans, develop and implement a Code of Practice for its members and self-regulate her members. Further, they should assist the Service (Kenya Forest Service) in enforcing the provisions of the Act and any rules and regulations made under it, in particular relation to sustainable charcoal production, transportation and marketing and do any other act that is necessary for sustainable charcoal production and transportation [10].

The charcoal production phase provides a direct connection to the environment and its associated challenges. With the significant dependency on the charcoal sector for energy fulfilment among many people in the country, comes a threat to the environmental resources available. The charcoal sector has been attributed to significant environmental destruction mainly through forest deforestation. Excision of forest land is used for agricultural expansion, and the wood from these activities is used in charcoal production. However, this has negatively impacted the associated ecosystems through water catchment degradation, affecting river water levels, loss of biodiversity, land degradation, loss of ecosystem services and extreme weather events [2,11].

In February 2018, a charcoal ban was enforced due to the fueled forest cover decrease in the country. The government banned illegal logging and charcoal production as it was viewed that charcoal production had contributed to the increased deforestation and degradation of natural ecosystems [2,12]. However, according to the charcoal regulations under the forest act 2009, charcoal production under the CPAs should present a plan that ensures these ecosystems' reforestation. Despite the associations' position at the core of the sector, there are numerous gaps within these associations, thus presenting barriers that interrupt the optimum functionality of the associations. Some of these include minimal awareness of information and understanding regarding the role of the CPAs, ineffective technologies used for charcoal production and forest resources management, unsustainable use of raw materials, limited authority in law enforcement, and weak associations and producers that are not registered with the CPA. The strategic aim in CPA formation is to facilitate sustainable charcoal production, thus cohesively contributing to sustainability in the sector. However, charcoal production is overly associated with deforestation and degradation of natural ecosystems. Hence, this presents the question; can Charcoal Producer Associations bring about sustainability within the charcoal sector?

This paper explores an actors' perspective in accentuating the charcoal sector's significance in Kenya for sustainable development. It seeks to further develop and understand sustainable charcoal production in Kenya by examining the role and opportunities within CPAs. Based on focus group discussions and supplemented by literature, the study explores three aspects that characterise the institutions and influence their functionality. These are,

Governance

Functionality

Policy implications—Charcoal ban

By exploring these areas, the paper portrays the vital sustainable areas of operation with critical steps to best harness these institutions' potential.

## 2. Materials and Methods

### 2.1. Selection of CPAs

To find out the number of Charcoal Producer Associations (CPAs) within these counties, the research team held a conversation with the CPA Umbrella Chairman. He is the overall chairperson of all these associations in Kenya. This shed light on the production statistics, with Tana River and Kitui Counties notably having the highest number of CPAs. With the above information, the next step entailed conversing with both county umbrella chairpersons to map out the CPAs' locations and determine the appropriate schedules to visit each CPA. The team then prepared to guide questions to use in the focus group discussions based on the areas of focus and the research question. Using the questions, a mock discussion was held to determine the suitability of the questions and create a cohesive flow in the focus group sessions.

### 2.2. Sampling and Data Collection

Qualitative research applies purposeful sampling to identify and select information-rich cases related to the subject of interest [13]. Out of a purposed target population of seven arid and semi-arid charcoal producing counties, we set a one-stage cluster sample frame of two counties with the highest number of registered CPAs. According to the Kenya Umbrella Chairman, Tana River and Kitui counties host 14 and 11 CPAs respectively, representing 52% of the CPAs in Kenya. In these counties, data was collected from 14 CPAs in Tana River and 4 CPAs in Kitui because they were easily accessible. From consultations with the contact persons, the CPAs were grouped based on their locations and proximity to each other. Those in proximity were selected for discussions within a common meeting place and allocated a similar time for the discussions. Most CPAs, especially in Tana River County, are clustered in densely populated areas along the county's boundary with Garissa county. However, in Kitui county, two focus group discussions were held each day due to the sparsity of the CPAs' locations across the county.

Using the sampled CPAs list, the first step for the research team was to hold focus-group discussions (FGDs) with respondents in the two counties to understand how CPAs work. Representation of attendees in the discussions included 7–14 members of the CPA, focusing on both members and leaders to understand the CPA's system of operation. Open discussions were encouraged to accommodate gender and youth representation. The research team also included female interviewers because they often have better access to female participants [14]. Several tools were elaborated to guide the FGDs on the research questions. For instance, the team prepared a detailed list of 30 questions to guide the discussion sessions (see Appendix A). Before the discussions, the participants received information on the discussion, and the team asked for their informed consent [15].

The meetings were held in either open grounds, members' homes or religious buildings. In both counties, the team conducted discussions in Kiswahili and English, and the contact person often switched to the local language if something was unclear. We transcribed the discussions and complemented the qualitative information with recordings for verification after the sessions. Some data could only be collected through observation. For instance, questions on how the charcoal ban affected their livelihoods were met by a shift in body language. This was noted down to express the severity of the economic situation of the participants. While travelling through the study sites, the team also took pictures of farms and charcoal production methods. Furthermore, the team conducted semi-structured and comprehensive interviews with a Kenya Forestry Service (KFS) representative in Kitui county. The latter were crucial as they gave a perspective of the government's involvement and local authorities with CPAs.

### 2.3. Data Analysis

CPAs were divided into two groups based on their county of location. Descriptive statistics formed the basis of describing the characteristics of the sampled associations. The analysis started from broad category to individual CPAs; overall, by county, and by CPA as the unit of analysis. The team transcribed each focus group meeting's audiotapes to text. The transcribed data were then examined alongside field notes plus any other notes extracted from the debriefing of the other members of the research team. The results of the group exercises conducted during the focus group discussions were examined with content analysis, descriptive statistics and frequency tables. First, we coded interview notes based on the theoretical framework and commonalities noted across answers by the different CPAs. During the second review, we selected the most relevant coded answers based on their distribution and importance to the overall analyses [16]. We use dichotomous responses (Yes/No) for most of these responses. The statistical analyses were supplemented by the qualitative information collected during the key informant interviews. The data from key informants and focus interviews were also represented as quotes, which includes the name of the key informant, name of CPA but excludes FGD participant names for privacy. We analysed the data using R statistical software [17] and Microsoft<sup>®</sup> Excel.

## 3. Results

### 3.1. CPA Composition

A description of the CPAs membership was not possible due to the ban imposed in both counties. Majority of the CPAs are mostly inactive with the majority of the members leaving while those remained such as in Kitui focusing on activities such as table banking to cope with the current situation. A total of 18 charcoal producer associations were included in this study. Out of those, four (22%) were from Kitui, and 14 (78%) were from Tana River county. The mean number of participants in an FGD was 9.1, with the largest focus group having 15 members. Women made up the minority of the group participants with each group having a mean of three women.

### 3.2. Governance within CPAs

#### 3.2.1. Motivation for Joining CPAs

CPA formations were initiated by the government, with the goal to preserve and conserve the forests following the massive destruction in charcoal producing areas. Therefore, the initial decision to join CPAs by the community was intrinsically driven by their desire to conserve the ecosystems that source their livelihood. Thereafter, benefits offered by the association besides the government's requirements under the law greatly influence members of the community to join a CPA. The results reveal that unlike the general perception that CPAs are primarily driven by charcoal income, there is a strong internal motivation for environmental conservation as this is their source of income. Table 1 shows the motivation expressed by the members in joining a CPA.

**Table 1.** Motivation of farmers to join a CPA.

Motivation Clusters	Descriptors Phrases Mentioned	Count of Mentions
Environmental conservation	environmental conservation; cutting of tree; tree; invasive species; tree planting; forest; lot of destruction; huge dust storm; importance of conservation; environment;	66
Benefits maximisation from charcoal sector	benefits; school fees; social benefits; income; standard of living; business/ generational business; means of income; number of trees; source of livelihood; allowed community advancement;	33
Boosting production of charcoal	charcoal production; amount of charcoal; quality of tree; <i>mathenge</i> charcoal production; sustainable charcoal (regular training, etc.)	15
Facilitation of charcoal supply chains	charcoal producer group, e.g., movement permit; area of jurisdiction; confines of law; ease of transportation; registrar of society; loan; supplies chain;	14
Better prices of charcoal	charcoal price; better price; price of charcoal; struggle of pricing;	6
Inclusivity of community members	different tribe; recognition of group; mixture of tribe;	4
Ecosystem goods	household need	2

The most common expectation among members within a CPA was to get income and credit opportunities through the charcoal sale. In each CPA, the members specify their sole dependence, if not majorly attached, to charcoal production for their livelihood. More than half of those interviewed joined to promote conservation, for self-development and to get a better market for the charcoal they produced.

#### 3.2.2. Expectations of the Members

Once the members join the CPAs, it is expected that the CPA will be beneficial to them and the community by fetching better prices for the members, organising welfare contributions, supplying credit and loans to members. They also expect the CPA to issue documentation and administer first aid during accidents if the members are injured during production processes. Table 2 shows the expectations that CPA members while operating within a CPA. Besides, 89% of the CPAs have welfare facilities to help contribute to school fees, bereavements, and other community issues.

**Table 2.** Expectations of CPA members.

Expectation Category	Expectations	Frequency
Benefits	Bonuses, income, loans, business opportunities, dividends, allowance, table banking, savings, celebration gifts, household needs	26
Welfare contributions	Bereaved members, school fees, medical fees, assist needy members, elderly, education	21
Better market pricing	Find market, sales, market access, good market, easy market, location based, constant prices, good prices, protects producers, direction from transporters, protect from fraudulent transporters	15
Environmental conservation	Reforestation funds, buying seedlings, tree planting, control usage of forest products, indigenous trees, grazing areas, afforestation, control production	11
Social projects	Hire and pay teachers in schools, sports equipment for the youth, roofed houses, support festivals, local development, build schools	9
Conflict resolution	Reduced conflicts, financial independence, reduced theft, reduced joblessness, reduced borrowing, control conflicts and wrangles, follow-ups	6
Production assistance	Accidents, labour, collection point link, overnight production, food, collection point, buy equipment, assist in farming activities	6
Government compliance	KFS, documentation, certificate of origin,	3
Capacity building	Training, workshops	3

### 3.2.3. Compliance

The Forest (charcoal) rules 2009 [10] as indicated above provide the CPAs requirements wherein the code of practice is developed and implemented with self-regulation. This, therefore, allows for the creation of elaborate laws and procedures within individual CPAs. The results show a lack of standardisation in the detailed laws and procedures used in functionality within the CPAs. For example, exclusively in Kitui, a member could be registered without farm ownership and is assigned to produce within the farm of another registered member within the same CPA. Uniquely in Tana River, the CPA is hired by the CPA to coordinate the collection centers and act as patrol officers within the CPA's jurisdiction. However, familiarity is shown within the registration, meeting, and payment descriptions across the CPAs in both Kitui and Tana River counties.

Interestingly, although the integral role in sustainable charcoal production that CPAs assume in the Forest (charcoal) rules 2009 [10], their understanding of sustainability is limited. This is portrayed by the practices discussed in achieving sustainability to tree planting, farm ownership and cutting of recommended species and mature trees. Table 3 outlines various compliance requirements within the CPAs in Tana River and Kitui counties. The compliance requirements also show the practices/laws that govern the sustainability of the environment within the CPA functions.

### 3.2.4. Leadership and Stakeholders

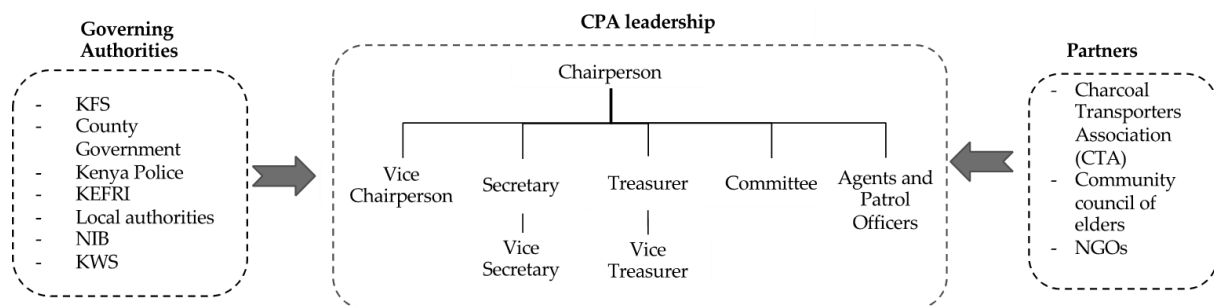
On average, CPAs in Tana River were smaller (in membership) than those in Kitui. Further, CPAs in Kitui self-organized into smaller charcoal producer groups (CPGs) to help in governance. The bigger CPAs in Kitui were aligned to their administrative boundaries (i.e., sub-county) and the CPGs to a location, while the CPAs in Tana River were recognised in the location area. The standard CPA structure had three positions that recurred in all groups in this study. Those were (a) the chairperson; (b) the secretary and (c) the treasurer. On the ground, the agents and field officers acted as a link between members and the buyers. They check the quality of the charcoal (species used), provide bags, and make payments to the members. They also liaise with members to have charcoal transported

to the collection centers, find markets, keep production records, and enforce oversight on production's legality.

**Table 3.** Compliance of CPA members.

Compliance Category	Compliance Descriptors	Frequency
Registration	Identification card, above 18 years, registration fee, sound or sober mind, same location, letter of request, membership card, receipt of payment	21
Meetings	Attendance, lateness, evacuation, annual general meeting, quarterly meetings, contribute thoughts and ideas, dedication and/or commitment to CPA	18
Payments	Monthly payments, yearly payments, shares, dues, contributions, penalties, fines	14
By-laws	Rules, regulations, follow by-laws, constitution, training, respect charcoal rules, limit, workshop, KFS officials,	9
Sustainability	Own a farm, prove sustainability of farm, assign members without farm to those with farms, tree planting, woodlots, rotation production, mature trees, buy trees, agent, river line, indigenous, patrol, diversify, seedlings, environment conservation, regenerate, supervision, nurseries, reforestation	9

Beyond the internal structure, the CPAs engage with other stakeholders as authorities and partners (Figure 2). They listed a total of 12 stakeholders. Figure 2 shows the stakeholders involved in the governance of a CPA and highlights the CPA leadership, governing authorities and partners. While most of these were cited for having a positive influence on the trade, some CPAs did not think the stakeholders did enough. For instance, at least one group mentioned that the Kenya Forest Association, Government of Kenya, County Government, and Transporter associations could do better.



**Figure 2.** Governance structure within a CPA.

### 3.3. Functionality within a CPA

#### 3.3.1. Guidelines and Requirements in Production

In both Tana River and Kitui, producers source the charcoal wood from farms, forest or communal land. During discussions in Tana River, producers indicated that the main species allowed is *Prosopis juliflora*, locally known as *mathenge*. While they might sometimes produce from other species, these were the exception rather than the norm. For instance, upon agreement, they can produce charcoal from an old mango tree or the unencouraged illegal cutting of native species such as *Spirostachys venenifera* (*worikon*), *Terminalia brevipes* (*Alango*), *Cordia sinensis* (*kote*), and *durura* (*a local species yet to be identified*). In Kitui, most species allowed are native and include *Acacia elatior* (*muswiswi/ murina*), *Acacia tortilis* (*muaa*), *Manilkara mochisia* (*kinako*), *Balanites aegyptiaca*, *Acacia tortolis* (*mugaa*), *Terminalia prunioides* (*kitoo*), *Dombeya rotundifolia* (*mutoo*), *Acacia gerrardii*, *Munina abbreviata* (*chalandethe*), *Tamarindus indica*, *Prosopis juliflora* (*Mathenge*), *Dalbergia melanoxylon* (*mpingi*) and unidentified local species by the names *kiluywa*, *syukuu*, and *miloku*. For production, one can buy a tree from a non-CPA member and produce from it.

### 3.3.2. Production

The majority of the members use a common way of producing charcoal. This consists of cleaning up the thorns from the tree using a file and chopping the trees and logs into pieces, depending on the technique intended (horizontal or vertical lay during production). Often, they offer someone payment or do the cutting by themselves from their farm. All through the groups, we noticed that producers cooperate between genders and have the men cut the branches high up on the trees, while the women gather the charcoal after production to put in sacks. Depending on the season, the charcoal may take up to 3 weeks to be ready. Estimated production time was a week in the dry season and even up to three weeks in the wet season. Some producers dig holes into the ground, while others choose to place and align the wood pieces on the ground into a heap. Then, the wood is covered with grass and leaves, and finally, the soil is added on top. After that, a fire is lit and left observing the woodpile by checking the smoke from the wood and replacing soil in any opening that produces smoke to prevent aeration.

The time taken to produce charcoal depends on the size of the tree/branch. The wood burns with white smoke during production and will give off black smoke when ready. The producer then spreads out the burning wood and cover it with fresh soil to cool it down. The cooling takes an average of one hour. Some producers say they can prepare wood enough for 10 bags (50 kg) and take 5 days to cut and make the logs. Significant similarity was found in the charcoal production process across the two counties. In terms of production technology, all the CPAs used traditional earth kilns while a few tested modern drum kilns but indicated that it was expensive.

### 3.3.3. Packaging and Pricing—Selling

The secretary informs the CPA members of the collections required and the agent at the collection point will record the number of bags brought by each producer. The producers carry their charcoal to a collection point themselves or use donkeys. The transporter will mostly bring their sacks and have loaders place the cool charcoal in 50 or 90 kg sacks and fasten them with rope. The agent will then negotiate with the transporter on the amount payable for each bag. Once the payment is made by the transporter; each member will receive their payment and the balance used for the required payments for the agent and the CPA itself. Across the two counties, all the CPAs sell their charcoal to individuals (i.e., transporters). However, some of the charcoal produced is sold to neighbours and the local market.

All prices listed in Kitui were for 90kg bags. The maximum peak price was higher in Tana River (KES 700) than the price in Kitui (KES 600). However, the minimum off-peak price of the 90kg bag was higher in Kitui. The same unit sold higher in Tana River during peak season with over half of the CPAs selling at prices going up to KES 575. The 50 kg bag sold at a maximum peak price of KES 500 and a minimum off-peak price of KES 150 in Tana River. Compared to Kitui, there was a huge variation in maximum peak price and minimum off-peak prices in Tana River. For instance, the price of a 90kg bag would drop from KES 700 to KES 300 in some areas.

### 3.3.4. Challenges Faced by the Charcoal Producer Associations

Results show that over a third of the CPAs have six significant challenges that they face while in the operation of charcoal production. The majority of the CPAs' challenges are experienced from the production process, relations with the government and transporters, and governance in the CPA. Table 4 shows the challenges faced by the CPA members during operation—Tana River and Kitui counties.



**Table 4.** Challenges faced while operating within a CPA.

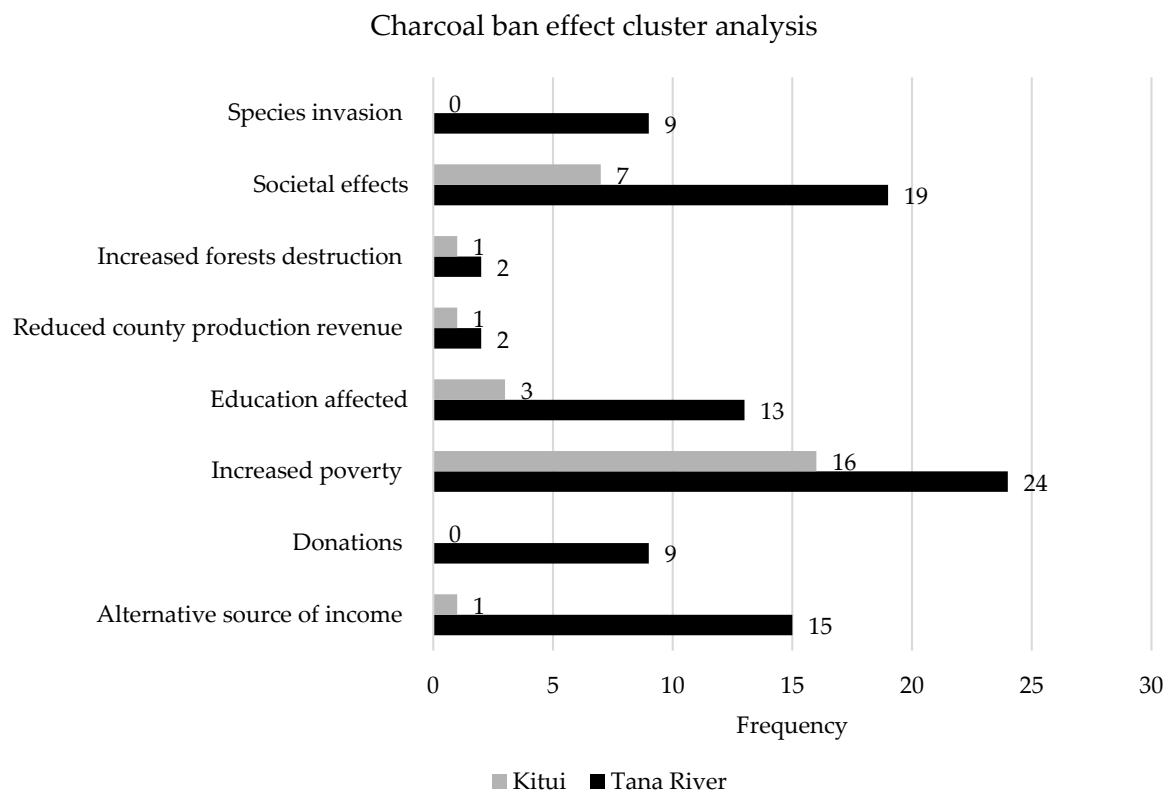
Challenges Category	Descriptors	Frequency
Production	Accidents, poison from <i>Prosopis juliflora</i> , low profits, low prices, <i>Prosopis juliflora</i> farm invasion, heavy rains, inaccessible roads, unsustainable harvesting, indigenous tree harvest, theft, untrained producers, ineffective production methods, price fluctuation, sickness from smoke and dust, charcoal burns, quality issues, poor infrastructure, unworthy roads	44
Government relations	Delayed transport permits, corruption, bans, taxes, numerous police checks/barriers, expired permits, unfulfilled promises, compensation for KFS visits, fines, required bribes, division between county and national governments	28
CPA governance	Limited funds, group differences, lack of capacity building, lack of support from government and other institutions, ignorant members, negligence, lack of funding, illiteracy, lack of capital, lack of money management skills, monitoring, disagreements, lack of understanding of the laws, regular arrests	26
Transporter relations	Environmental destruction, ruthlessness, unable to penetrate Nairobi market, price issues, cheating, illegal possessions, complaints, failed purchases	16
Societal challenges	Lack of job opportunities, drug and substance abuse, youth unemployment, high membership withdrawal	3

Notably, the weak cooperation between the National government (KFS) and the County government creates confusion in implementing policies such as the charcoal ban. Some challenges were unique to Tana River counties such as overexploitation of indigenous species, health risk during production, inefficient permits and licensing disagreements, inadequate food, inadequate jobs, substance abuse and inferior charcoal production methods. On the other hand, members dropping out and default of loans were unique to Kitui county.

#### 3.4. The Effects of the Charcoal Ban on the CPAs

The banning of charcoal production or trade is recognised as a national and county decision issue. Nationally, the current moratorium was imposed on 2018 and extended to 2019 by the Ministry of Environment and Forestry on logging and timber harvesting. Locally, in counties such as Kitui and Tana River, charcoal's commercial production and trade are still banned. However, these bans have been lifted in other counties, and charcoal and environment regulations set for efficient operations such as Narok [12]. In 2012, the KFS imposed a ban on charcoal production in Kitui county despite establishing a County Charcoal Management Bill in 2014 [12]. This was intended for the protection of government forests from deforestation for charcoal sourcing of wood. This, however, resulted in an increase in illegal production from the protected areas due to the lack of license and permit issuance that propelled the disregard for regulations. During the periodical charcoal bans, the corruption has worsened with producers bribing the police and county officials for enormous charcoal delivery to market. This gives room for economic exploitation of the producers and transporters, thus, depicting illegitimacy of the sector [1]. Despite the many attempts to ban charcoal production and transportation, the sector is fueled by cartels and rogue authority officers. Even with the perception that charcoal production and transportation are illegal, its use is legitimised across the country [3].

For the CPAs, the results show that these bans significantly affect both the individual producers and their communities in which they function. The CPAs functionality affects its members' ability to cater to household and personal needs and other needs within the community. Societal effects such as increased crime and theft, and increased poverty form the majority of the ban effects. Figure 3 highlights major clusters of challenges faced by the CPAs under the charcoal bans in Tana River and Kitui counties.



**Figure 3.** Effects of the charcoal ban for CPAs within Tana River and Kitui counties.

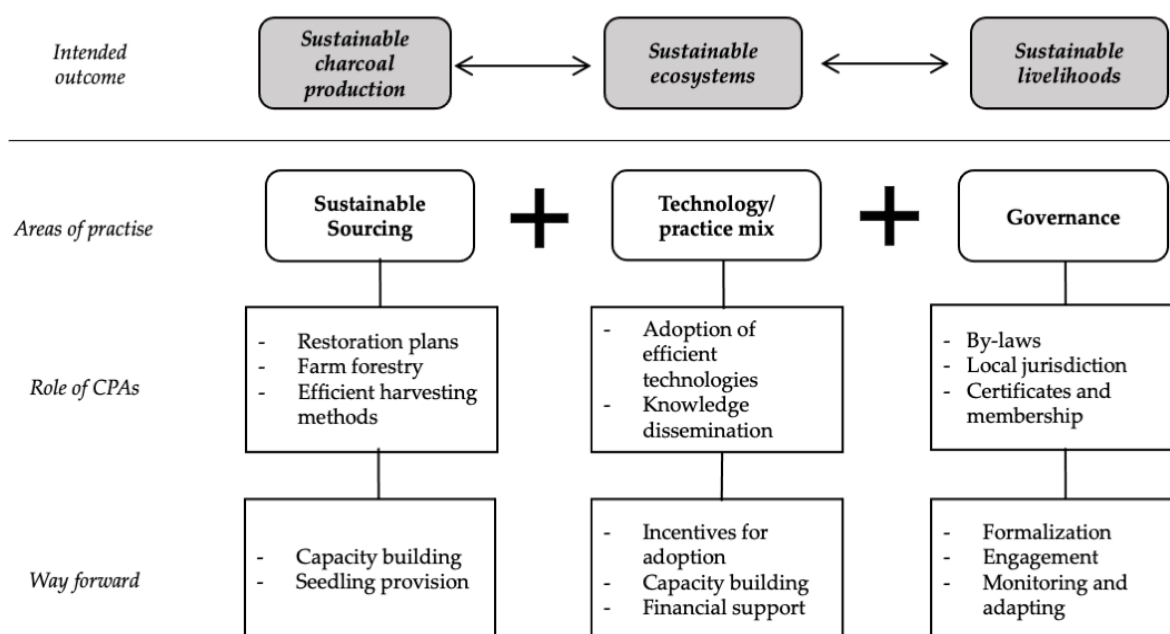
#### 4. Discussion

Sustainability in the Kenyan charcoal sector has been widely discussed across various platforms in exploring different areas of operation for sustainable charcoal production, transportation, marketing, and consumption. Various frameworks and approaches are recommended in reducing energy loss within the production process, charcoal briquetting [18], efficiency advancement through production technologies [5,19–21], sustainable biomass sourcing [5], value chain approach, modernisation [22] and policy and regulations schemes [5]. Kituyi [23] explores a system approach across the charcoal value chain that ensures sustainability in material consumption in each biomass life-cycle stage. Additionally, Schure et al. [20] elaborate on three aspects that contribute to the efficiency of the carbonisation process: capacities, technology and the enabling institutional context. Considering the above frameworks, this paper explores CPAs' role in the realisation of sustainable charcoal production by highlighting various findings and literature earlier published.

The detailed look into the CPA operations revealed insights that may not have been seen from a broader perspective in the past. The main underlying point being CPAs, if designed and implemented well, could derive sustainable environments and sustainable livelihoods, of course as a function of the production size and market conditions. To ease the discussion flow, we aggregated the results into a conceptual frame, as presented in Figure 4. Each element in the figure will be discussed in the subsequent sections.

##### 4.1. Role of CPAs

Within the functionality and governance of the CPAs, lies an opportunity in actualising sustainability in production, ecosystems and livelihoods. We explore the potential of sustainability in the CPAs' operational aspects from the practice of sustainable sourcing, technology and practice mix, and governance. From our findings, the role of CPAs can be explored in restoration plans, adoption of sustainable practices, knowledge dissemination, monitoring platforms and societal advancement as discussed below.



**Figure 4.** A conceptualisation of the sustainable areas of action to achieve a sustainable environment and livelihoods.

#### 4.1.1. Restoration Plans

The constitution requires that the associations develop a restoration plan and forest management plans while tracking the production's biomass resources utilised [6]. In our findings, the CPAs ensure the members participate in restoration activities in the community such as tree planting in social sites. The majority indicated of planting trees annually in schools, hospitals, government offices and communal lands within their areas of jurisdiction. Additionally, the members practice farm forestry where they plant trees when some are cut to produce charcoal. This practice is common in Tana River, where producers plant trees after using the invasive *Prosopis juliflora* tree in charcoal production to allow other species of trees to grow. In Kitui, members visit each other to assist in tree planting and ensuring that regeneration is practised in each farm. More significant results can be realised through capacity building, and partnership with associated environmental institutions since CPAs represent environmentally responsible grassroot institutions. Charcoal production can incentivise producers to manage woodlands better and invest in fuelwood plantations [24].

#### 4.1.2. Adoption of Sustainable Practices

Significantly identified in sustainable charcoal production are sustainable practices such as efficient harvesting methods and technological advancement. Vital to its implementation is the role of CPAs in the adoption of these practices. In Kitui, land ownership is compulsory for charcoal production, limiting the harvesting of wood to farms and encouraging agroforestry to increase the wood supply. The adoption of more efficient biomass harvesting practices through handsaws and smaller branches is also crucial in ensuring minimum loss of materials. Besides reducing desertification, sustainable production further enhances household energy security, increases food security through soil fertility enhancement and increases the carbon sink and moisture reservoirs [23].

Kilns with higher efficiencies above the current traditional earth kiln of 8–10% have been designed. Their adoption and efficient use could lead to important biomass conservation in the arid and semi-arid areas where over 80% of all the charcoal is sourced. It is estimated at 0.05 ha, one ton of charcoal is produced using an improved kiln while it takes 0.1 ha while using the traditional earth kiln [6]. The adoption and proper use of efficient kilns have significant potential in biomass conservation, leading to the preserva-

tion of a carbon sink and reduced desertification [23]. The CPAs can also implement the production of charcoal briquettes to reduce or avoid the 20% significant loss of crumbled particles [23,25]. In Kitui county, KEFRI has constructed several kilns, allowing CPAs to produce collectively on specific days. The practice, however, has minimal adoption despite its potential.

#### 4.1.3. Knowledge Dissemination

Apart from commercial production, charcoal is also produced for subsistence use among many rural communities. Our findings show that the majority of the CPAs outline regulations from the government and the CPA to govern their areas of jurisdiction to ensure uniformity of practices and reduce gaps. Therefore, the laws within the CPA become the governing laws in charcoal production and trade within their area of jurisdiction. The majority of the CPAs are identified to have jurisdiction over a location or sub-location in the two counties, therefore, presiding over the laws that govern production practices used in the areas. Moreover, the leaders are mandated to train community members (including CPA members) on the requirements and regulations. Beyond the by-laws, when training is conducted by the Kenya Forest Service and other NGOs, the same knowledge is shared within the community. They also inform the members on market availability for charcoal and agricultural products, improved technologies and practices, and various government instructions. CPAs, therefore, provide essential extension services to the communities around them.

#### 4.1.4. Monitoring Platforms

CPAs provide the foundation for monitoring platforms by the associated local institutions such as the County government and Kenya Forest Service. Based on the functionality within a CPA, the results position CPAs as the governing institutions controlling localised charcoal production. Furthermore, in joining a CPA, a member must go through vetting, learn the by-laws and own land within the specific location. To ensure the members abide by the rules, patrol officers/collection agents are assigned an area to monitor physically by taking rounds in their areas of jurisdiction. Any active individual not in the CPA within the area must follow the rules governing the location and report to the associated leaders, especially in subsistence production. In cases of destruction, the chairperson is accountable to the governing authorities operating within the area (commonly the KFS officers). To incentivise members to act within the regulations, CPAs offer interest-free loans and dividends, give welfare support during bereavement, train their members on the value of conservation or enforce fines and dismissals from the group.

The use of permits is highly associated with the production, transportation and sale of charcoal in Kenya as documented in the Forest Charcoal Rules 2009 [10]. When well enforced, these permits enable the local authorities to track the movement and source of commercially produced charcoal within and out of the counties. These permits include:

- (a) Certificate of origin—lowest county administrator (shows charcoal produced in the county)
- (b) Certificate of origin—ward administrator
- (c) Certificate of origin—Sub-county administrator
- (d) Movement permit (within county boundaries)—County Administrator
- (e) Movement permit (out of the county)—KFS

#### 4.1.5. Societal Advancement

The majority of the members within charcoal producing areas are considered poor and unable to provide essential household needs [26]. To assist one another, CPAs provide different plans of action to allow financial sourcing of their members. To increase cash flow into the association and increase savings, for example, several CPAs practice table banking. Additionally, CPAs financially support the vulnerable groups of the communities such as the elderly. Table 2 shows the relations between the CPAs and their associated

communities in improving their society through welfare contributions, social projects and conflict resolution. Besides driving unity in the community, they motivate the development of the society by providing employment to the youth as collection agents, patrol officers and loaders. In most of these communities, activity within the CPAs discourages theft and drug abuse as they provide both a sense of income and purpose to the youth. Moreover, women members are well known for their financial independence because they can earn an income without solely depending on their husbands for provision. Consequently, the rate of food security and education enrollment of children, even to university levels, is an attestation of the rise of income among CPA members. Disparate to other technically demanding energy sources, charcoal production offers employment and income to the disadvantaged and generally unskilled segments of society [24].

#### 4.2. Way Forward

Beyond the current operations, limitations are identified in the practices of the CPAs in Kitui and Tana River counties. This is acknowledged in the limited awareness, knowledge, skills and understanding of improved practices that can be utilised. Additionally, the informality of the sector and the overlapping government responsibilities pose a limitation to the development of the sector. In this section, we discuss five areas in recommending further development can be utilised in augmenting the capacities of the CPAs: capacity building, restoration schemes, policy support, financial and regulatory incentives and stakeholder engagement.

##### 4.2.1. Capacity Development

From our findings, the majority of the CPAs have limited understanding of sustainability. Johnson et al. [6] indicate that besides the availability of this knowledge in the country, the stakeholders in need of it the most (charcoal producers) are in shortfall. Our findings show that most producers are unaware of the benefits of advanced technologies while others, due to low literacy, are unable to understand the benefits. Despite the limited knowledge and offer to practise sustainability, the associations show great interest in the environmental conservation of their areas. Training to share information and build awareness about the significance of the communities in caring for the environment causes a sense of belonging and encourages the adoption of various practices [25]. Johnson et al. [6] identify the significant expertise required to implement sustainable practices such as biomass resource tracking and developing forest management plans thus the fundamental role in capacity building. This also informs harvesting practices and the management plans required to sustain the farm. As groups, the CPAs can be advised on tree management techniques and sustainable supply such as rotational methods by technical extension officers [4].

Pilot demonstrations of the technologies are significantly necessary to show the benefits of using improved kilns [25], incentivise technological advancement where CPAs use efficient kilns such as the Cassamance kiln and drum kiln, capacity building and construction is essential. Adam [27] recommends further exploration of further ways to disseminate new technology within rural areas effectively and the use of locally available materials to ensure the charcoal system's perpetuity. Through the NAMA concept, efficient charcoal production technologies would be implemented through dissemination to all commercial producers through the CPAs to ensure 90% of all large-scale production under efficient technologies [28].

##### 4.2.2. Restoration Schemes

Mutumba and Barasa [29] highlight that charcoal producers mostly rely on natural regeneration of the trees with few of them involved in tree planting. Therefore, a restoration plan is crucial to protect the natural ecosystems against deforestation and degradation significantly. One way to achieve this consists of agroforestry and farm forestry within the farms where producers' source for biomass stock. The Kitui County Integrated plan of 2013–2017 recognises agroforestry as a critical income pathway for fuelwood while

contributing to the conservation of soil and water [30]. To facilitate these practices, the provision of tree seedlings of species suited for the specific conditions of the area is highly essential while also suitable for charcoal production. The Ministry of Environment and Forestry [3] recommends exploring fast-growing tree varieties suitable for charcoal production to reduce the pressure on forests. Producers can be advised on the right tree and shrub species to plant. For example, the *Acacia xanthophloea* produces superior quality charcoal with a calorific value of 33 kJ/g. At the same time, the *Commiphora africana* is drought resistant, abundant in the arid and semi-arid areas and easily regenerates from cuttings could both be exploited for charcoal production [4].

#### 4.2.3. Policy Support

The informality of the sector creates loopholes of functionality within the value chain. It places the CPAs, who are legally recognised, at a vulnerable state of charge from other actors and governmental actions such as bans. Johnson et al. [6] specify the informal bribes system functions within the sector that the actors have accepted as an acceptable approach. Through legalisation, charcoal would be traded like any other commodity on the markets with specific regulations such as the required kilns of use and taxed as any other commodity. This perspective will also reduce harassment of the producers and traders by the police and other authorities despite the availability of the required permits. Regulations help address the lack of standards in the markets that affect all the actors in the sector [4]. To modernise charcoal production, it is imperative to formalise the sector and other necessary practices [31]. Formalisation can be achieved by reviewing the Forest Charcoal Rules in conjunction with the Forest Conservation and Management Act, 2016 (Acts No. 34) [3]. Formalisation for the community-based organisation in the industry encourages research and development interventions and with government coordination, ensuring a practical policy framework [4]. Through this and a scaled-up implementation of the Forest Charcoal Rules, the potential for massive income and revenue collection can be achieved. Kituyi [23] argues that banning charcoal would be ineffective if alternative sources of income are not offered to those profiting from the sector. Through legalisation, charcoal would be traded like any other commodity on the markets with specific regulations such as the required kilns of use and taxed as any other commodity. This perspective will also reduce harassment of the producers and traders by the police and other authorities despite the availability of the required permits.

Since the devolution of the government, the charcoal sector is structured under the county government [6]. However, the Ministry of Environment and Forestry [3] indicates that only 17 counties have signed the Transition Implementation Plans (TIPs) for full business regulation power. Charcoal production has been decentralised, yet the implementations and regulations and standards in the sector are centralised. This challenge worsens due to the lack of technical capacity within the county levels in performing the responsibilities [28]. In improving enforcement and compliance, the use of better governance and institutional mechanisms [2]. The KFS has the necessary expertise on natural resource conservation and is core to disseminating knowledge to the communities. Therefore, we recommend a division of the KFS would help this approach to facilitate collaboration and better coordination, hence improving the governance structures and implementing sustainability. Transparent and robust implementation structures should accompany local charcoal rules to transform simple and coherent policies into practice across various counties [20].

#### 4.2.4. Financial and Regulatory Incentives

The preferred technology used in charcoal production is the traditional earth kiln as it is easily mountable and the cheapest despite its low-efficiency rating [27]. Advancement into more efficient technologies such as the retort kiln, among others, will improve the recovery rating and yield. These technologies are available within the country; however, their affordability for the producers is extremely wanting [5]. Implementation will, therefore require funding availability; therefore, innovative funding mechanisms beyond donor

and domestic budget support are necessary on all levels [24]. Tax incentives would also be significant for private companies to encourage the growing of trees and the establishment of forests for charcoal production. Financial support would also motivate farmers to engage in restoration interventions such as establishing woodlots and on-farm forestry with appropriate species and adopting improved technologies [4,6]. Subsidies for CPAs would also motivate the acquisition and building of equipment that increases the efficiency in production technologies due to the high capital required in technological advancement.

#### 4.2.5. Stakeholder Engagement

Stakeholder engagement in the sector is vital to the achievement of sustainability in the charcoal value chain. Particularly to the production phase, the involvement of CPAs in the decision and policy-making spearheads transformative change in the practices and activities. Promotion of feedback from stakeholders facilitates monitoring of the frameworks, programs and interventions used in the advancement of the sector [24]. Participation and involvement of the CPAs in decision-making create a sense of ownership and belonging in the industry, thus motivating the members to implement sustainable practices. Additionally, communication within the enforcing and governing agencies is critical in addressing variable concerns in the value chain [6]. Establishing synergies such as working committees is critical for coordinating ecosystem conservation across different counties within the various initiatives. With the charcoal sector under the County Government, partnerships among the authorities and the CPAs leadership will ensure better monitoring structures and systems to reduce conflicts in Charcoal rules implementation [20].

## 5. Conclusions

The importance of charcoal is emphasised by the literature and the number of people who derive livelihoods from it either directly or indirectly. To a CPA member, charcoal means uninterrupted access to basic needs such as food, clothing, school and even more, among other things. On the other hand, CPAs are an essential part of charcoal production for they provide an integrated and centered platform in sustainability. Furthermore, CPAs create a platform for environmental headway into sustainability within the rural communities through their positioning at the value chain and dependence to trees for raw materials. They are critical implementers of sustainability practices as key actors directly linked to sources of wood such as farms, private woodlots and forests.

The role of CPAs in the realisation of sustainable charcoal production is evident in the functions and opportunities in the association. There is high potential within the CPAs for the sustainability of the sector through monitoring platforms, restoration plans, adoption of sustainable practices, knowledge dissemination and societal advancement. To advance this untapped potential of these associations, we recommend building their technical, business and governance skills, exploration of various restoration schemes, financial and regulatory support in implementation, and policy support. Additionally, CPAs are incredibly essential stakeholders in achieving sustainability and should be incorporated into decision making. To progress the policy frameworks and regulations, the authors recommend further studies into quantifying the biomass within the production hotspots and the sustainable charcoal production agenda.

**Author Contributions:** Conceptualisation, E.K. and L.A.D.; methodology, formal analysis, E.K., L.A.D. and L.O.; writing—original draft preparation, E.K.; writing—review and editing, E.K., L.A.D. and L.O. All authors have read and agreed to the published version of the manuscript.

**Funding:** The authors acknowledge the Forest, Trees and Agroforestry (FTA) Program of the CGIAR for the financial support.

**Institutional Review Board Statement:** Not Applicable.

**Informed Consent Statement:** Not Applicable.

**Data Availability Statement:** Data for this research is available from the authors upon request.

**Acknowledgments:** We are very grateful to the reviewers for the thoughtful and very useful inputs that helped improve the manuscript. The authors acknowledge the support the Forest, Trees and Agroforestry Program of the CGIAR for financial support. We are very grateful for the technical support from Anulisa Claire, Eunice Gituku and Priscilla Wainaina during the fieldwork. We also appreciate the CPA leaders and members, and the county leadership of Tana River and Kitui counties for the support offered during the fieldwork process.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A. Focus Group Discussion Research Questions

### Joining a Charcoal Producer Association

1. What is the motivation of joining a CPA?
2. What are the minimum criteria for joining a CPA?
3. What are the expectations for each CPA member? (payment, roles and responsibilities, knowledge, participation in meetings and decision-making etc.)
4. What are the fulfilments expected of the CPA to its members? (benefits, certificates etc.)

### Functionality/Framework of the CPA

1. How many members are in the CPA? (transporters, producers)
2. Are the members dependent on the CPAs for income generation?
3. What is the gender and youth composition within the CPA? (dormancy of gender/age)
4. What are the leadership roles and functions within the CPA? (dormancy of gender/age)
5. What is the charcoal production processes and guidelines within the CPA? (Production process from harvesting to sale)
6. Where do you source the wood used in charcoal production? (natural/planted forests)
7. What type of species of trees are harvested for wood production?
8. What technologies does CPA use in production?
9. How much charcoal is produced per week/month/year?
10. Are there specific days of production?
11. At what price do you sell the charcoal?
12. To whom does the CPA sell the charcoal to? (Individual, retailer, institution)
13. What are the profits and costs of charcoal production and transportation?
14. How are the profits and costs shared within the CPA?
15. What is the asset capacity and strategy plan (for production) of the CPA?
16. What challenges do the members and leaders face while operating within the CPA? (e.g., in production, relations within the CPA, relations with local authorities, transporters, traders)
17. How is the CPA affected by the importation of charcoal? Or the charcoal ban?
18. What is the involvement of the larger community and the local authorities? (Any other stakeholder)

### Awareness of the CPA specified functions

1. Are the CPA members aware of the Charcoal Regulations within the Forest Act, 2009?
2. Are the members following the regulations as stipulated?
3. How does the CPA incentivise the members to act under regulations set?
4. What challenges do the members encounter in operations within the regulations?
5. Are the members aware of the list of species that are prohibited from charcoal production?

### Sustainability in the CPA

1. What does sustainability mean for the CPA, and how are they exercising it? (harvesting, production, transportation and sale)
2. How does the institution ensure sustainability in its functions in respect to, participation, performance, representation, direction and vision, equity and accountability?
3. Are there incentives and disincentives at play within the CPA to ensure sustainability?



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