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Striking a Balance between Livelihood and Forest Conservation in a Forest Farm Facility in Choma, Zambia

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Abstract: Charcoal production is an essential energy source and income source for many people in low-income countries, such as Africa. Charcoal production is also associated with deforestation—a global issue that significantly affects the environment and ecosystems. Therefore, promoting strategies that can balance forestry protection and people's livelihoods in low-income countries is critical. This study investigated the factors affecting Zambia's rural households' participation in the natural regeneration (NR) program—the program initiated by the Forest and Farm Facility program (FFF) of the United Nations Food and Agricultural Organization (FAO) in Zambia in 2015. Using household survey data collected from Choma District in Southern Zambia, this study used descriptive statistical analysis and a logit model to detect the factors that affect the use of the NR program. The results indicate that charcoal production enhances the livelihoods of rural households when forest conservation is reconciled with household income and forest-management methods that abandon traditional practices. Participation in the NR program seems to be mainly driven by household income. The results indicated that the relationship between forest-resource utilization and conservation in Choma is encouraging. The implementation of the Forest and Farm Facility program is recommended to be spread to other communities to improve both livelihoods in local communities and forest conservation.

Keywords: Forest Farm Facility; deforestation; charcoal production; natural regeneration; livelihood promotion

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1. Introduction

Forests provide essential ecosystem benefits, such as wildlife habitats, watershed protection, and soil conservation. They are also an important energy source and income generator for local communities in many low-income countries. Charcoal derived from local forests is an essential source of energy for many indigenous peoples across the globe. Charcoal is a common commercial enterprise in Sub-Saharan Africa (SSA) [1]. Charcoal derived from extant forests is often the cause of severe environmental degradation in vast forested areas. Policies and regulations intended to effectively manage the forest sector are absent in many countries [2].

Widespread forest degradation is exacerbated by the high numbers of poverty-stricken local people living in and around forests who depend on them for their survival [1,3]. Charcoal is arguably among the least-examined forest products, despite being an important energy and income source for hundreds of millions of people in the tropics as well as some other developing countries [3,4].

Charcoal is an important source of employment and income for many poor rural dwellers across SSA [5,6]. Revenue from charcoal ranges from USD 20–350 million in Uganda, Kenya, Malawi, and Tanzania. Similar trends are evident in many other SSA countries [7]. The potential for charcoal to generate significant revenue contributions for individual, family, and community livelihoods is huge.

Africa ranks fourth in the extent of forest cover among Europe and South, Central, and North America. Africa's total forest area is estimated to be 510 million hectares (21.03% of the land area), with other wooded lands (trees outside forests) accounting for 13% (350 million hectares). The total forested area of Africa comprises 18% of the global forest area [7]. In SSA, forests cover an area of 487.65 million hectares (including 162 million hectares of Congo Basin rainforest, 218 million hectares of Miombo (open-canopy) woodlands, and 106 million hectares of dry forests; Figure 1). The forest cover of SSA was 24.07% as of 2018. (Note: Data source: https://data.worldbank.org, accessed on 12 March 2021).

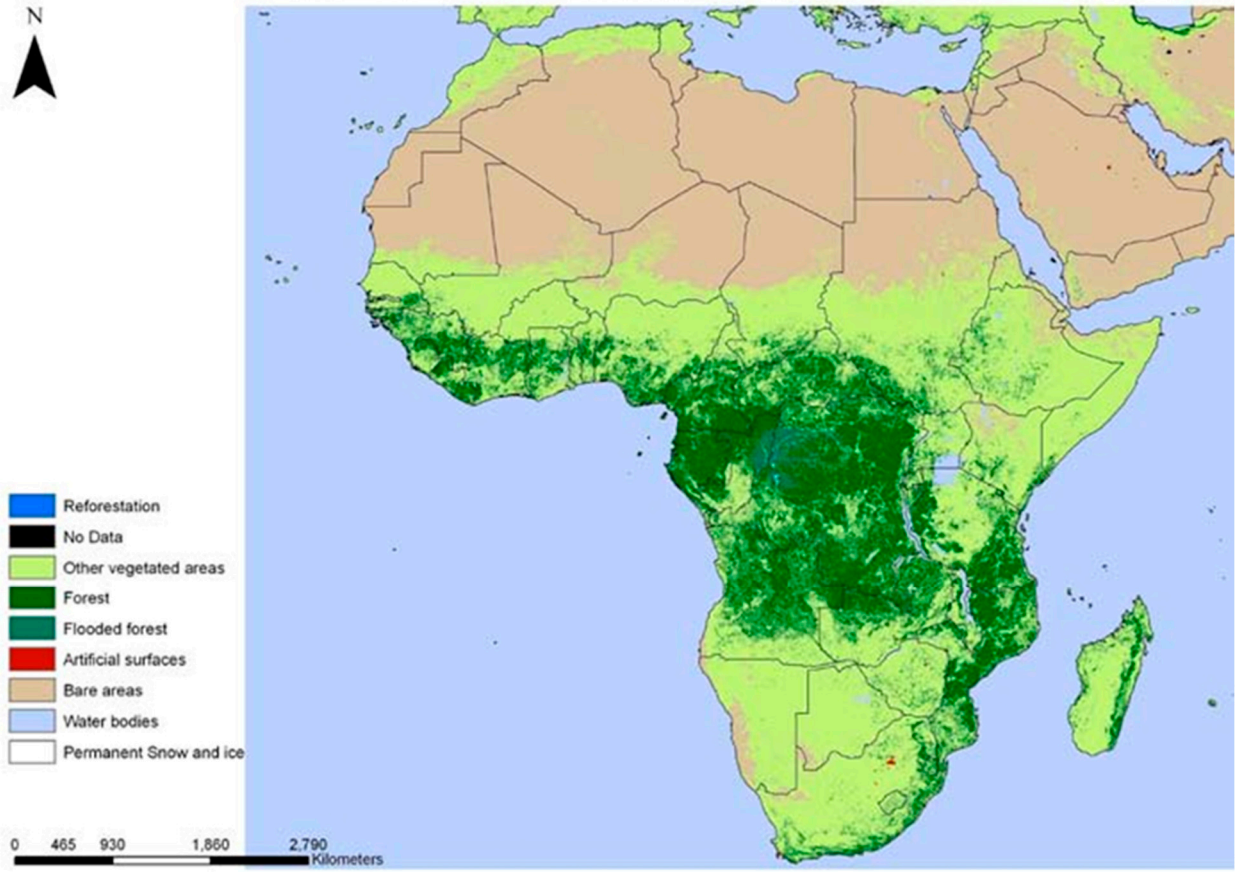

Figure 1. Forest cover in Sub-Saharan Africa. (Source: World Agroforestry Centre 2019.)

Meanwhile, 90% of fuelwood (charcoal and firewood) harvested in Africa is used for heating and cooking in 60%–70% of households [7]. Africa ranks first in charcoal production, and charcoal provides important energy and income sources for many rural communities [8,9]. Africa accounts for 57.6% of the world's charcoal production, and 5 of the top 10 charcoal-producing countries are in Africa (Figure 2a,b). Three African countries (Somalia, Nigeria, and Namibia) are also among the top 10 charcoal exporters in the world (Figure 2c). Not surprisingly, none of the African countries are major charcoal importers. Germany and Japan are the largest charcoal importers, each importing more than 120,000 tons annually between 1993 and 2017 (Figure 2d).

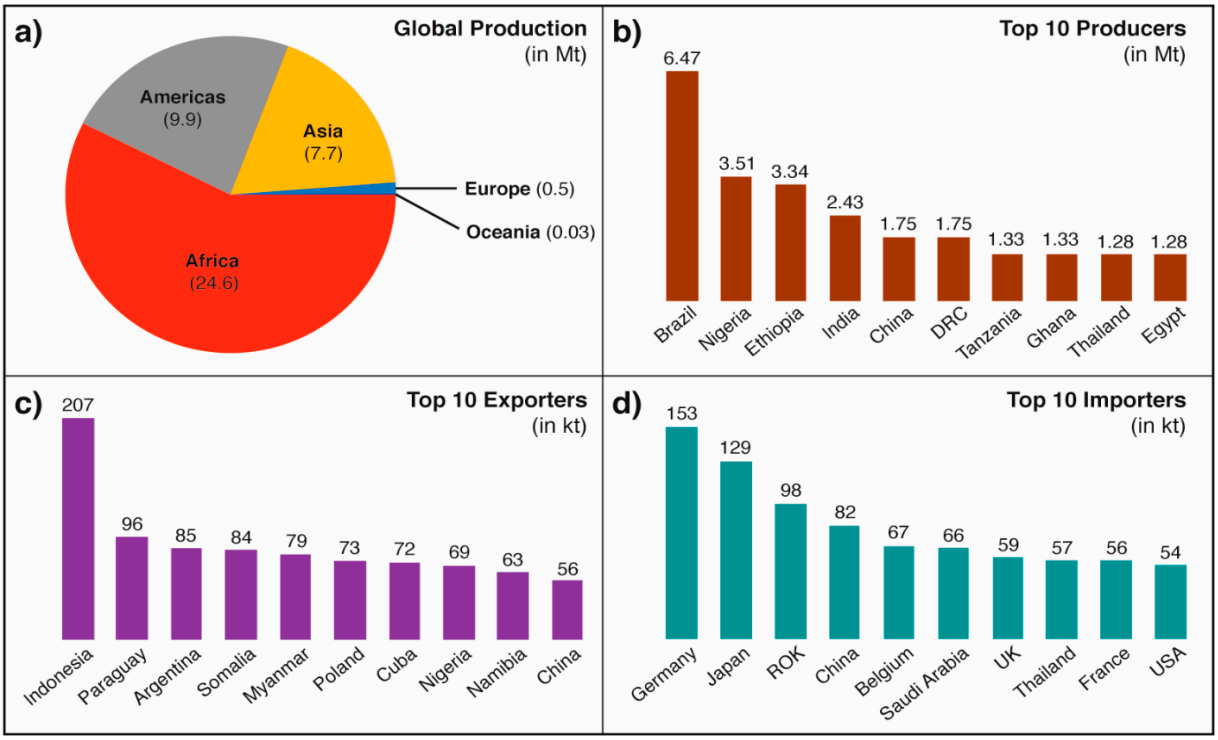

Figure 2. Global charcoal production, import, and export. (**a**) Production by region; (**b**) top producers; (**c**) top exporters; (**d**) top importers. DRC = Democratic Republic of the Congo; China = Mainland China; ROK = Republic of Korea. All data represent annual averages, 1993–2017.

Typical charcoal production in Africa is not sustainable, partly because of uncoordinated legal frameworks and policies dedicated to protecting ecosystem integrity. Semi-arid areas, especially, where regeneration capacity is inherently low, present critical wood-supply problems for people [10]. As a major source of income for many rural households, charcoal demand in SSA is increasing due to population increase and the lack of access to electricity [11]. Increased charcoal demand is expected to exert strong pressure on African food systems and forest ecosystems in the future, considering that the population of SSA is projected to increase from 937 million in 2014 to 2.1 billion in 2050. Agricultural expansion has already led to the loss of forests. For instance, SSA lost 15.6 million hectares of forests from 2010 to 2015; and in Kenya, charcoal production depleted forest cover by 1264 hectares monthly and 15,168 hectares yearly and may account for 65.6% of forest loss by the year 2030 [12]. Due to the importance of forest conservation and environmental protection with respect to household livelihoods in many African countries, the trade-off between development, livelihood, and the need to conserve forest ecosystems must be acknowledged, and identifying ways to balance household livelihood and forest conservation is critical. Household participation in forest conservation is key to keeping a balance between forest utilization and regeneration [13].

This study aims to identify the factors affecting Zambia's rural households' participation in the natural regeneration (NR) program. The NR program is an important part of the Forest and Farm Facility (FFF), which was initiated by the Food and Agriculture Organization (FAO) of the United Nations (UN) in 2015. This program aims to identify a forest-exploitation practice that will both enhance household incomes and ensure forest conservation in Africa. The results of this research might identify strategies that would better support rural household livelihoods with little or no deforestation. This defines the purpose of the natural regeneration program.

2. Study Site and Relevant Literature

2.1. Deforestation in Zambia

The deforestation rate in Zambia is well above the global and regional average and is closely linked to other key environmental problems, such as land degradation, wildlife depletion, and loss of biodiversity and ecosystem services [14]. Charcoal production for urban energy consumption is the main driver of forest degradation in SSA [15]. Zambia's forests were degraded at annual rates of 276,026 hectares during the 1990s and 250,000–300,000 hectares during the 2000s [16]. Forests in Zambia have been drastically reduced in area due to agricultural expansion, infrastructure development, illegal settlements, charcoal production, and unsustainable timber extraction. Wood fuel (charcoal and firewood) is the main source of energy for cooking in >90% of households in Zambia. Seventy percent of households in Zambia rely on charcoal for cooking and heating [17]. Charcoal production was ranked as the highest household-income-generating activity [13], and charcoal was among the top 10 forest products contributing to household income in 2015 [18]. The fuelwood and charcoal sub-sector employs the second-highest number of people in the formal and informal forest sectors in Zambia due to accelerated demand for charcoal in peri-urban areas [13,19]. Large-scale production of charcoal, especially in regions serving major urban areas, may have significant adverse impacts on forests and other natural resources, putting their sustainability at risk [9,20]. Reduced forest productivity and forest degradation affect economic activity and threaten the livelihoods of forest-dependent people [21,22].

Deforestation and forest degradation in Zambia became prominent during and after structural adjustment programs in the 1990s and early 2000s. These caused many people to lose formal employment and turn to forests for survival, either through charcoal production or illegal timber production. The forest-management and forest-resource-utilization system was centralized at that time and excluded the local community and other stakeholder participation. In 2004, ground-based foot soldiers critical for forest protection were scrapped from the government system, leading to encroachment into protected forest reserves for settlements, agricultural production, and other developments. This was compounded by outdated legislation (the Forest Act of 1973 and the National Forestry Policy of 1998) governing forestry-related matters [23]. Over the years, global natural-resource management has evolved and focused on the participation of communities and indigenous peoples. Zambia has similarly evolved in terms of forest-management practice, developing a more inclusive practice that culminated in the National Forestry Policy Act of 2014 [24]. This policy promoted an integrated approach toward forest management, with key stakeholders, such as local communities and private institutions, as partners in forest management.

Forests in Zambia continue to provide goods and services to most rural communities. However, illegal charcoal production and firewood collection, climate-change mitigation, forest clearing for agriculture and settlements, forest fires, and lack of a synergetic approach to natural-resource management remain challenging. The sector must address these issues in order to ensure that forest benefits are available for present and future generations.

2.2. The Forest and Farm Facility and the NR Program in Zambia

To address the conflicts between poverty alleviation (food security) and forest conservation, the Food and Agriculture Organization of the United Nations, in 2015, piloted the Forest and Farm Facility (FFF) program, supported by the new Forestry Policy of 2014 and Forest Act No. 4 of 2015, in Choma District in the Southern Province of Zambia. (Note: In Zambia, the FFF was initiated through established institutions working with local communities, among them the Zambia National Farmers' Union and the Forestry Department.) The program aimed to organize local farmers who are both producers and traders and help them strike a balance between livelihood enhancement and forest utilization and conservation. The FFF is a catalyst, helping forest farmers in the Zambia National Farmers' Union (ZNFU) to develop new agroforestry business organizations. The FFF program was designed to (i) strengthen smallholder, women's community, and indigenous people's producer organizations for business/livelihood and policy engagement; (ii) catalyze

multi-sectoral stakeholder policy platforms with governments at local and country levels; and (iii) link local voices and knowledge to global processes through communication and information dissemination. The overarching vision of the FFF program is to improve the livelihoods and decision-making capacities and processes of rural and indigenous people with regard to forest and farm landscapes. The FFF program resulted in the formation of the Choma Tree Nursery Association (CTNA) and the Choma Charcoal Association (CCA). It increased support for Tubeleke and Masopo Women's Groups and the Mboole Youth Development Centre.

The CTNA was formed as a response to the challenges of climate change and deforestation and to contribute to livelihoods through the cultivation and selling of fruit and indigenous and cultivated trees to improve reforestation efforts at local levels. The CCA was formed to address the challenges surrounding charcoal production and trade and associated deforestation by forming charcoal groups and promoting sustainable forest management using new approaches and technologies in charcoal production, waste reduction, the establishment of community woodlots, and promotion of natural regeneration (NR). The CCA was the first program in Zambia to bring together charcoal producers and traders and other relevant stakeholders in the charcoal value chain. It was formed and registered in 2017 and promoted the NR program as a measure to promote sustainable wood harvesting and charcoal production in order to reduce deforestation. The objective is to ensure adequate protection and management of forests, seeking a balance between livelihoods and conservation.

The natural regeneration strategy promotes methods that stimulate natural trees and seedlings to reproduce, grow faster, and develop more mass. The NR program also enables local communities to participate by setting an area aside in order to allow the trees in that area to grow back naturally, with management prescriptions for the avoidance of fires, pests, disease intrusion, and rational cutting.

2.3. The Relevant Literature

Studies have investigated forest degradation, from charcoal production and the contribution of charcoal production to livelihood and poverty alleviation, especially in Africa. Chidumayo (1993) argued that the concern about land degradation due to deforestation caused by fuelwood harvesting for urban charcoal in the Miombo woodland region of Central and Southern Africa is not supported [5]. Sedano et al. (2016) used kiln maps and field information on charcoal making to describe the magnitude and intensity of forest degradation linked to charcoal production [17]. Khundi (2011) used household survey data and propensity-score-matching techniques to find positive and statistically significant correlations between participation in charcoal-related activities and household income and negative correlations between charcoal engagement and poverty levels [23]. Zulu C (2013) reviewed studies on the socioeconomic implications of charcoal production and use, focusing on the role of charcoal in poverty alleviation [13]. Kiruki et al. (2020) provided an example of the importance of charcoal for livelihoods in an agropastoralist community in a semi-arid region in Kenya [25]. Aabeyir R (2012) assessed the impacts of charcoal production on woodland in the Forest–Savannah Transition Zone of Ghana to facilitate policy formulation [26]. Mwitwa (2012) noted that the charcoal industry in Zambia impacts the social lives and livelihoods of not just the primary producers and traders but also of all the other players in the charcoal value chain (i.e., from production to marketing) [19]. Most studies in the literature have focused on environmental degradation and the livelihoods of local households.

However, sustainable charcoal production can be an element in global and regional efforts aimed at promoting forest and landscape restoration and sustainable development [14,27]. Little information has been published in relation to the relative statuses of rural livelihood and forest conservation. This study intended to investigate the contribution of the Forest Farm Facility and the influences of natural regeneration in Zambia in order to reconcile the conflict between livelihoods and conservation.

2.4. Study Area

The study was conducted in Choma District, located in the Southern Province of Zambia, approximately within 26°30′–27°30′ E and 16°–17°45′ N, south of the equator on the plateau of Southern Zambia, and its land area is 7296 square kilometers (Figure 3). The district forms the heart of the Southern Province because of its central location. In 2012, it was declared the provincial capital of the Southern Province due to its important role in the economy. Most of the population in Choma are engaged in agriculture (both commercial and subsistence farming) as a source of income. The main economic sectors in Choma District are driven by agriculture, trade, and tourism. Choma is one of the deforestation hotpots in Southern Zambia due to massive clearing of forests for tobacco curing, brick making, charcoal production, infrastructure development, land-use change, and the effects of climate change. The district was chosen for this study because it is the first district in Zambia to have piloted the FFF and the first in the country to have formed the CCA.

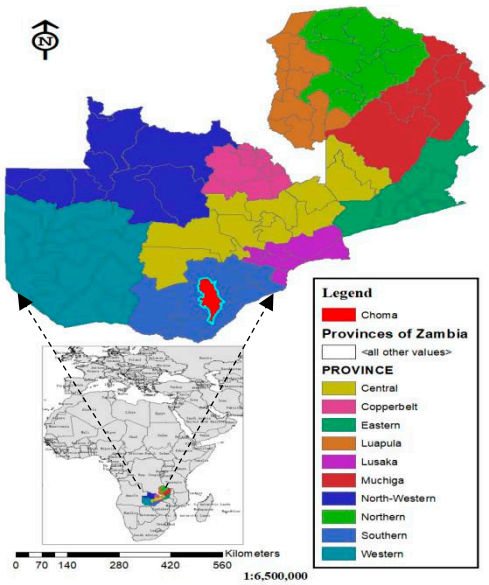

Figure 3. Location of Choma in Zambia.

The population in Choma has increased following the upgrading of the district to provincial status, and households in peri-urban areas have had 12 to 15 h without electricity daily. Therefore, people rely upon charcoal for cooking and heating, and the demand for charcoal is high. The charcoal is produced by local people (members of the CCA) and is transported to urban centers to be sold. Those who are not members of the CCA and produce charcoal do so illegally and are always at loggerheads with the law [28]. In the last five years, Zambia has faced challenges in the energy sector (particularly electricity generation) and has failed to meet the ever-increasing demand for electricity. As a result of this, many households across Zambia have resorted to using charcoal as an alternative energy source for electricity. This has made the charcoal trade very lucrative.

3. Methods and Materials

3.1. Data Collection

To identify the factors motivating participation in NR, this study employed both primary and secondary data-collection methods. First, the secondary data consisted of official statistics that were accessed via the Internet, public reports, and informant interviews. These are crucial to understanding policy history and how it affects livelihoods in Zambia. These secondary sources were obtained during August 2019, from government sources, such as Agriculture, Central Statistics Office, Offices of Forestry, Community Development, the Zambia National Farmers Union, and local authorities. The intent was to gather insight into the socio-economic patterns of Choma District and the FFF program, government

development plans, and forestry and other natural-resource policies. These official statistics were accessed via the Internet, publicly released government reports, and face-to-face key informant interviews, which are considered crucial to understanding policy history and how policy affects livelihoods in Zambia.

Next, primary data were obtained from households of interest in the study area using a structured questionnaire. Information of interest included name, gender, age, education level, income-generating activities, forestland area, household size, and household priority expenditures. Other requested information included access to forest resources, reasons for extracting forest resources, participation in forest regeneration, environmental shocks, and forest dependency.

The data were collected from the villages of the Choma chiefdom, and the areas where households were interviewed included six villages under the FFF program: Sibanyati Resettlement Scheme, Kabumbwe, Kabimba, Singuwa, Chuulu, and Hatimba. These are the villages where the Choma Charcoal Association (CCA) is active in terms of charcoal production, establishment of woodlots, and management of the natural regeneration strategy (NR). The data were collected in January and February of 2020. The number of households in Choma still engaged in charcoal production was 596 in total. The table below indicates the distribution of the households that were interviewed. The intended sample size was 80 households, with more than 50 observations needed to reach theoretical saturation, according to the central limit theorem [28–30]. The sub-sample in each village was proportioned to the population of that village. Households within each village were randomly selected by numbering the households and drawing random numbers. Due to seasonal challenges (raining and farming season), only 61 households (76% of the intended sample) were interviewed and shown in Table 1.

Table 1. Sampled households.

Village Name	Number of Households Interviewed
Sibanyati Resettlement Scheme	9
Kabumbwe	10
Kabimba	11
Singuwa	8
Chuulu	11
Hatimba	12
Total	61

3.2. Descriptive Statistics

The sample comprised of representatives from 61 households (30 males and 31 females). The average household size (people living and eating together) was 7.7 people (minimum 2, maximum 20). In terms of education level, 54.1% of respondents obtained primary (basic-level) education, 49.18% obtained secondary or high-school education, and 1.64% obtained college or tertiary education. Table 2 shows the descriptive statistics for the data set.

Table 2. Description of the data set.

Variable	Meaning	Mean	Std. Dev.	Min.	Max.
Age	Household head age	44.87	9.47	27	65
HH_Size	Household size	7.74	3.57	2	20
Inc_2014	Monthly income in 2014 (ZMK)	639.93	864.36	50	5000
Inc_2018	Monthly income in 2018 (ZMK)	1204.12	1541.97	50	11,000
Area_NR	natural regeneration area	4.21	13.23	0	100
Forestland	Forestland	4.35	8.46	1.21	130.5

Table 2 indicates that monthly income in 2018 was approximately twice that in 2014. The monetary income of 2018 was deflated by the inflation index in Zambia. (Note: Inflation rate of Zambia: https://www.ceicdata.com/en/zambia/inflation, accessed on 1 May 2021) The natural regeneration area per household was 4.21 hectares. Figure 4 shows the increase in income after the implementation of the NR program.

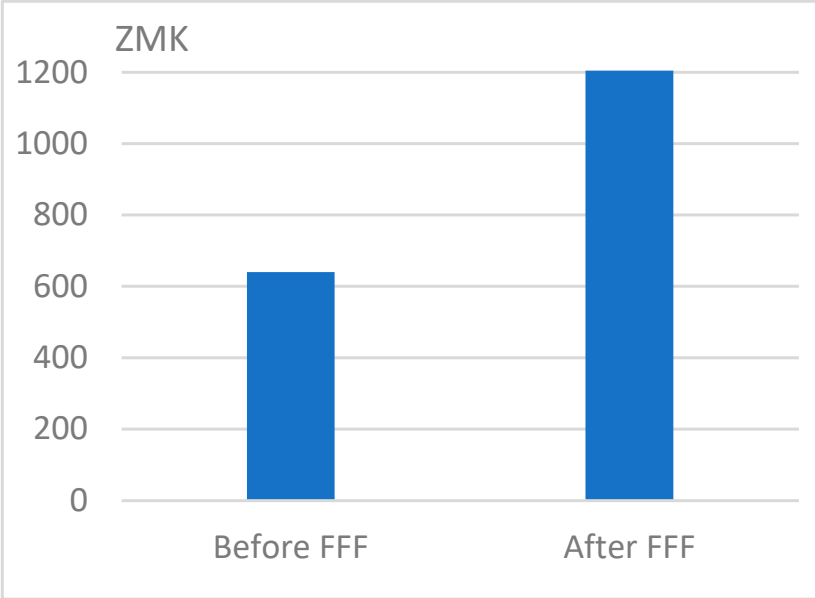

Figure 4. Income increase after FFF implementation.

3.3. Empirical Model

Forests are central to the lives of rural communities and provide a safety net during crucial moments when livelihoods are threatened. At the core of the community forestry policy is the proper management of natural resources to ensure a constant and continued supply of goods and services for present and future generations. To sustain the supply of charcoal and secure future livelihoods, NR management began in Choma District under the FFF. The NR program targeted households who were actively involved in charcoal production and aimed to make households and local farmers act responsibly and build a futuristic view of their present actions and decisions regarding the utilization of forest resources. The NR program is a strategy to enhance the growth of natural trees and seedlings and management protection from fire.

In this study, 81.97% of households (N = 50) were engaged and participated in the program. The average forestland area under the NR was 4.21 hectares, while the average forestland area of nonparticipant households (N = 11) was 3.83 hectares. In terms of household income, the average income for participant households was ZMK 1301.24, while for nonparticipant households it was ZMK 762.67. Since normality or homogeneity does not hold for the data set, two independent-sample Mann–Whitney U tests were used to test the differences between the two groups (Table 3). The results indicated that there were no significant differences in househead age, househead education, household size, or forestland area, but statistically significant differences in household income increase between the two groups.

Table 3. The Mann–Whitney U test results.

Variables	NR Participation	Number of Observations	Mann–Whitney U Statistics	*p*
HH_size	NR participants	50	287.00	0.205
	NR nonparticipants	11		
Age	NR participants	50	215.00	0.301
	NR nonparticipants	11		
Education	NR participants	50	91.00	0.127
	NR nonparticipants	11		
Inc_increase	NR participants	50	434.00 ***	0.000
	NR nonparticipants	11		
Forestland	NR participants	50	83.00	0.595
	NR nonparticipants	11		

Note: *** means significant at the 1% level.

Household size was positively correlated with forestland area, which was determined by the mechanism of the allocation of the forestland, according to the interviews with the village head. All scattered households are equally the suppliers of the charcoal market. The communities were engaged in NR management because their localities were previously exploited, resulting in localized moisture depletion due to deforestation, forest degradation, agricultural expansion, and unplanned settlement. Each household contributes a woodlot to be managed for future charcoal production and restoration of forest ecosystem functions.

The incentive to join the NR program was investigated using a logit model [31], denoted by Equation (1), where the dependent variable is a binary choice of participation in the program (yes = 1 or no = 0). NR participation may be motivated by household characteristics (household size) [32] and available resources, both monetary and intangible (e.g., education level of household head), since knowledge and labor are needed in the program, in view of the positive influence of education in resource-saving behavior [33–35]. The hypothesis is that the larger the household, the higher the household income, and the higher the education level, the more likely the household is to sustain the forest and participate in the NR program, which constitutes a virtuous cycle for the local communities.

Equation (1) establishes the relationship between NR participation and household size, education level and age of household head, and household income (total from all sources, including charcoal production). The area of NR was not included as a dependent variable because the regression did not reveal any statistically significant relationship between this variable and any of the independent variables. The variables are listed in Table 4.

$$p_{\mathrm{i}}(y_{\mathrm{i}}|x_{\mathrm{i}}) = \frac{1}{e^{\beta_0+\beta_1 Edu+\beta_2 HH_Size+\beta_3 Inc_increase+\beta_4 Age+\beta_5 Forestland+u}} \quad (1)$$

Equation (1) could be equally transformed to Equation (2):

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Edu + \beta_2 HH_Size + \beta_3 Inc_increase + \beta_4 Age + \beta_5 Forestland + u \quad (2)$$

Table 4. Variables list.

Variable	Explanation of the Variable	Data Type	Unit
y	NR participation	Binary dummy variable	1 for NR participants 0 for NR participants
HH-Size	Size of household	Quantitative	Person
Edu	Education level of the househead	Ordinal data 1 = primary education 2 = secondary education 3 = tertiary education	——
Inc_increase	Monthly disposable income increase of household from 2014 to 2018	Quantitative	ZMK 100
Age	Age of household head	Quantitative	Year
Forestland	The size of the forestland	Quantitative	Hectare

4. Results and Discussion

4.1. Contribution of Charcoal to Local Livelihoods in Choma

The sampled households were all engaged in some form of income-generating activities before and after the implementation of the community forestry policy. Crop production and gardening were the most prevalent activities. Forest activities, such as charcoal production, fuelwood gathering, timber harvesting, and collection of non-wood forest products also occurred, as well as trade in products other than agricultural or forestry-based commodities. The average income prior to policy implementation was ZMK 640 (USD 64.1), and the average income following policy implementation was ZMK 1204 (USD 120.6). Prior to the establishment of the FFF, farmers were not organized, and when they engaged in charcoal production, the charcoal was seized by law enforcement. After the establishment of the FFF, the charcoal association was formed as a registered entity with which charcoal producers and traders are affiliated. The association only promotes business for those with proper documentation and legal licenses from the forestry department. Furthermore, the FFF provided charcoal producers with improved kilns in order to promote more efficient utilization of materials so that charcoal producers do not need to cut down entire trees. Instead, branches or twigs can be used. This improvement uses available biomass more efficiently than does the traditional system, in which living trees, even fruit trees, were felled and used as raw materials in charcoal production.

The sustainably produced charcoal is packaged in special sacks that are clearly labeled and weighed, and a 10 kg bag fetches as much as ZMK 35 (USD 2). With this kind of initiative, the charcoal groups or communities are now targeting multi-national chain stores to sell their charcoal—a scenario that will significantly improve their livelihoods through increased income. In the past, a 25 kg bag of charcoal could sell for as little as ZMK 5, despite the intense labour involved in the production process and the damage done to the forests.

Furthermore, access to forest products is crucial to the income-generating potential of rural communities. Only 73.77% of households had access to charcoal, 19.67% to fuelwood, 1.64% to non-wood/timber forest products, and 4.92% to timber (Figure 5). After the FFF program was implemented, charcoal contributed 65.57% of household income, crops contributed 24.59%, and business contributed 9.84% (Figure 6). Charcoal produces more income than other activities because of the returns it gives to rural households; also, the demand for charcoal is high relative to other forest products in the area. In Choma, charcoal is easily sold, and producers do not delay to secure revenue. In addition, business is conducted throughout the year, peaking during the cold (April to August) and rainy seasons (December to March). Agriculture is season-based and much of the agricultural practices in Choma and in Zambia are determined by the rainy season, so communities depend on activities that can give them income throughout the year, making charcoal production a priority income-generating activity. Figure 6 shows the income structure change after the FFF program was implemented. The share of income from charcoal increased from 49.39% to 65.57%.

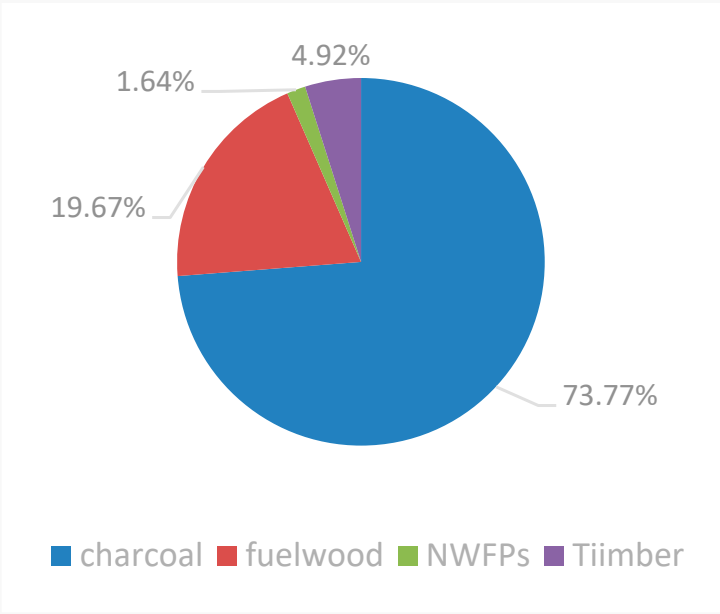

Figure 5. Forest-resource utilization.

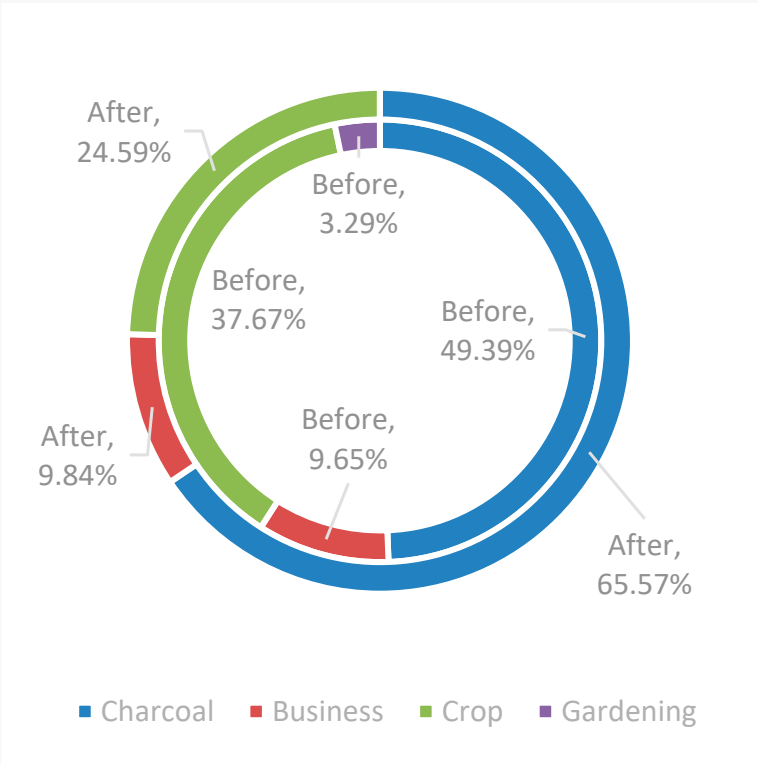

Figure 6. Forest-product access.

The sale of forest products helps rural communities generate income, which in turn supports many of their household priorities, such as paying school fees for their children and procuring farming implements, such as seed, fertilizers, and chemicals. Some are also able to invest forest income into business ventures outside of the forestry circle.

4.2. Empirical Model and Result Analysis

Stata 15 was used for model estimation using the maximum likelihood estimation method; the results are shown in Table 5.

Table 5. Estimated logit model results.

Variables	Coef.	z	$p > z$	(95% Conf.)	(Interval)
HH_Size	0.0218	0.34	0.735	0.014	0.037
Inc_increase	0.0469 *	3.05	0.003	−0.154	0.449
Forestland	0.405	0.846	0.401	−0.479	0.657
Edu	−0.321	−1.92	0.060	−0.349	−0.265
Cons	1.113	1.34	0.186	−0.831	1.677

Note: *** 1% level of significance; ** 5% level of significance; * 10% level of significance.

The empirical model results indicate that the increase in household income is the statistically significant variable at 10% critical level (Table 5.). However, participation in the NR is neither significantly affected by household size or the education level of the househead, nor by the forestland area. These results suggest that joining in the NR program is primarily affected by household monetary resources. More wealthy households are better able to invest in future production. The labor resources and education of the household head did not show any significant impact on NR program participation. Contrary to our hypothesis, household size did not affect participation. In addition, the education level of the household head also did not influence involvement in the NR program.

The results of this study imply that monetary stimulus motivates participation in the NR program. The average disposable monthly income of participating households increased from ZMK 639.92 in 2014 to ZMK 1204.12 in 2018 (approximately 23.45%), which is dramatic for Choma, where income for most residents is less than the world poverty standard [36]. Furthermore, the role of the FFF and NR programs suggests that it is possible to reverse the degradation of local forests caused by charcoal production by changing traditional practices and emphasizing improved, holistic stewardship. The FFF may represent a solution for forest-dependent communities to sustain their forest resources.

The results also indicate that household size (available labor resources), education level, and age of the househead (knowledge or experience capital) did not significantly affect NR participation. NR program participation is more responsive to potential income increase rather than to other resources. On the other hand, forest policy plays a critical role in addressing issues of poverty alleviation and deforestation at local levels [37,38]. The FFF program encourages different investment activities in different land-use zones in order to support the transition of local livelihoods and dampen environmental degradation. Community forest policy aids in decision making when considering the trade-offs between socio-economic development and environmental sustainability [39,40].

The case study of Choma indicates a successful example of balancing resource sustainability and promoting the livelihood of local communities with government policy support over a short period. Since forest growth takes many years, further refinement of the FFF program is anticipated.

5. Conclusions

Forest resources contribute to livelihoods by providing extra income to rural and indigenous people, thereby contributing to improved welfare and poverty alleviation. Traditionally, forests are considered freely available resources that can be used without regard for the future, as in the case of traditional charcoal production [41]. The results demonstrate that rural communities can balance conservation and livelihoods. Using improved charcoal-production technologies, for which only certain parts of the tree are used, is key to addressing the supply side of charcoal production. natural regeneration with community participation is equally important in ensuring forest restoration and contribution to the future stock of raw materials for charcoal and a good chain for sustainability.

The mutual advantages of forest conservation and livelihood promotion in Choma demonstrate the possibility of utilizing forest resources without degrading forestland. Economic motivations might inspire farmers to be more efficient in exploiting forest products, and farmers might thus have an incentive to improve the resource's sustainability [42].

Support from the local government played a key role in this program based on the experiences in Sub-Saharan Africa. The policy approach encourages good forest stewardship for long-term benefit [43,44].

Regarding the other countries involved in the FFF program in Africa, such as Kenya, Liberia, and Gambia, each has its unique features [45–47]. Zambia has focused on forest degradation and charcoal production, while Kenya has focused on the capacity of grassroots female leaders to engage, finance their business initiatives, and grow their business skills. Liberia has concentrated on the charcoal production chain as well, but the FFF in Liberia has focused on non-timber-forest-product (NTFP) collection. Gambia's FFF program's feature is sustainable upland rice cultivation that can be undertaken in forest landscapes without the felling of trees or the application of imported fertilizers, resulting in high yields after harvests and the promotion of natural forest regeneration. Compared with these FFF programs in Africa, Zambia's Choma model is one for the replenishment of resources and improvement of the sustainability of trade and deserves to spread to other Africa countries with similar situations.

The limitations of the current study are that our sample size was relatively small and the potential bias due to the minority of nonparticipants. Although these factors do not affect the statistical analysis or the main conclusions of the study, further research could be carried out with larger sample sizes in Choma or other areas of Africa to confirm the findings presented.

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