



## Research Article

# Charcoal Value Chain Dynamics and Livelihood Implications in Post-Conflict Northeast Nigeria: Evidence from Maiduguri, Borno State

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### ABSTRACT

In post-conflict Maiduguri, Borno State, Nigeria, charcoal remains the dominant household cooking fuel due to persistent energy poverty, insecurity, and limited access to modern energy alternatives. This study examined charcoal value chain dynamics and their livelihood implications using a mixed-methods approach. Primary data were collected from 150 respondents across five actor categories (producers, transporters, wholesalers, retailers, and consumers) using structured questionnaires, key informant interviews, and field observations. Data were analyzed using descriptive statistics and value chain analysis techniques. Results revealed significant inequities in value distribution, with producers capturing only 38% of the final retail price despite bearing the highest production burden. Charcoal activities contributed between 58% and 72% of household income across actors, highlighting its central role in livelihood sustenance. Although 70% of producers were aware of environmental impacts, only 15% adopted conservation practices, indicating a substantial knowledge–practice gap. Charcoal remained the dominant cooking fuel (54%), with 68% of consumers willing to transition to cleaner alternatives if affordable and accessible. The study concludes that charcoal trade is both a critical livelihood source and a driver of environmental degradation, necessitating balanced policy interventions focused on market formalization, energy transition, and sustainable resource management.

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## 1.0 INTRODUCTION

Energy poverty remains a defining challenge in sub-Saharan Africa, where over 900 million people rely on solid biomass fuels for household cooking (FAO, 2022). In Northeast Nigeria, this

challenge is compounded by over a decade of armed conflict driven by Boko Haram insurgency, which has severely degraded infrastructure, displaced millions of persons, and destroyed alternative livelihood structures.

Within this context, charcoal has emerged not merely as a cooking fuel but as an economic lifeline for producers, traders, and consumers alike.

Maiduguri, the capital of Borno State, presents a compelling case for studying charcoal value chain dynamics. With more than 70% of households depending on firewood or charcoal for daily cooking (Chima, 2021) and an estimated 600 firewood-laden trucks entering the city daily (Omirin, 2024), the scale of biomass dependence reflects systemic failures in energy governance, rural development, and post-conflict reconstruction. Despite this, the economic architecture of the charcoal trade: its actors, price formation, value distribution, and governance gaps, remains poorly understood in empirical literature.

This study addresses that gap by analysing the structure of charcoal marketing in Maiduguri and quantifying its socioeconomic and environmental implications. Specifically, it profiles key actors in the charcoal supply chain, examines pricing mechanisms and value capture, assesses income contributions across households, evaluates environmental knowledge and practice, and documents consumer energy preferences. The findings are framed to inform policy reforms aimed at balancing livelihood imperatives with forest conservation in a fragile, post-conflict setting.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was conducted in Maiduguri Metropolitan Council (MMC) and two adjacent local government areas: Jere and Konduga, Borno State, Nigeria. Maiduguri is the state capital and the commercial hub of Northeast Nigeria. The city hosts a significant proportion of the estimated 2 million internally displaced persons from across Borno State, making it a critical site for examining post-conflict livelihood dynamics. The study area is characterised by a semi-arid Sahelian climate (rainfall <600 mm annually), high temperatures, and fragile dryland forest ecosystems that are acutely sensitive to overexploitation.

### 2.2 Research Design and Sampling

A concurrent mixed-methods research design was adopted, integrating quantitative surveys

with qualitative data collection to triangulate findings and enhance analytical robustness. The study population comprised all actors engaged in charcoal marketing and consumption within the defined area. Stratified random sampling was employed to select 150 respondents distributed proportionally across five actor categories: producers (n=40), transporters (n=25), wholesalers (n=20), retailers (n=35), and consumers (n=30).

Strata were delineated based on established charcoal market points, IDP settlement zones, and rural production clusters identified through preliminary key informant mapping. Sample size was determined using the Yamane (1967) formula with a 95% confidence level and a  $\pm 8\%$  margin of error, yielding a minimum required sample of 138 respondents; 150 were targeted to allow for non-responses.

### 2.3 Data Collection Instruments

Quantitative data were obtained through pre-tested structured questionnaires covering: sociodemographic characteristics of respondents, marketing channel and price data, household income composition, environmental knowledge and practice indicators, and fuel-use preferences. Questionnaires were administered by trained enumerators in Hausa and English, the predominant languages of the study population.

Qualitative data were collected via 12 key informant interviews with charcoal market leaders, local government forestry officers, representatives of non-governmental organisations active in the energy sector, and community leaders. Six focused group discussions (FGDs) were conducted with producer and consumer groups. Field observations of charcoal production sites, transport routes, and retail markets provided complementary contextual data.

### 2.4 Data Analysis

Quantitative data were analysed using SPSS version 25.0. Descriptive statistics (frequencies, means, percentages) were used to characterise sociodemographic profiles, marketing channels, and income contributions. Value chain mapping followed the methodology outlined by Kaplinsky and Morris (2001), tracing product

flow, actor margins, and value capture ratios from producer to consumer. Environmental impact was assessed through composite scoring of producers' self-reported practices against documented indicators. Qualitative data were coded thematically and used to contextualise quantitative findings. All results were triangulated across data sources to ensure internal validity.

### 3. RESULTS

#### 3.1 Sociodemographic Profile of Respondents

The study sample was predominantly male (71.3%), with a mean age of 36.4 years. A majority of producers (67.5%) held only primary education, while retailers and wholesalers showed higher educational attainment (secondary level: 54.3%). Most charcoal actors (78.7%) had been engaged in charcoal-related activities for more than five years, indicating entrenched livelihood dependence. Household sizes averaged 7.2 persons across all actor categories, reflecting the extended family structures common in Borno State and the multiplier effect of charcoal income on household wellbeing.

#### 3.2 Value Chain Structure and Price Transmission

The charcoal value chain in Maiduguri comprises five distinct actor categories operating in a predominantly unregulated market environment. Producers, largely operating in rural woodlands in Konduga and Jere LGAs, sell 50 kg bags at an average farmgate price of NGN 1,500. Transporters purchase at this price and sell to wholesalers at NGN 2,600 per bag, retaining NGN 330 per bag after transport costs. Wholesalers in turn supply urban retailers at NGN 3,100, while retailers sell to consumers at an average of NGN 3,800 per bag.

Value capture analysis, presented in Figure 1, shows that producers retain only 38% of the final consumer price, the lowest share despite contributing the most labour-intensive stage of the chain. Retailers capture 25%, transporters 22%, and wholesalers 15%. This pattern is consistent with evidence from other Nigerian commodity markets in which intermediaries disproportionately benefit from information asymmetries and infrastructure bottlenecks.

**Figure 1: Value Capture by Actor in the Charcoal Value Chain (Maiduguri, Borno State)**

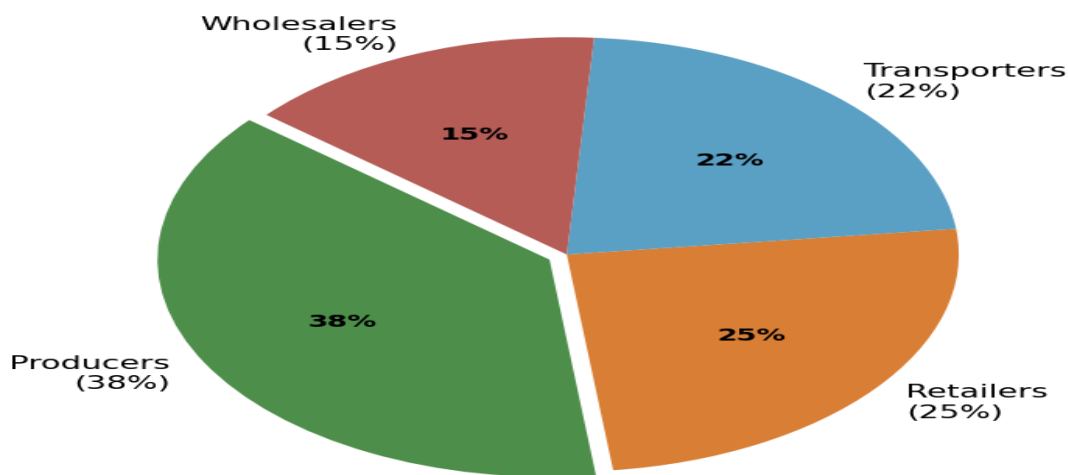


Figure 1: Value capture by actor in the charcoal value chain, Maiduguri (% of retail price, NGN 3,800/50 kg bag)

**Table 1:** Charcoal value chain price transmission in Maiduguri, Borno State

Actor	Buy Price (NGN)	Sell Price (NGN)	Gross Margin (NGN)	Value Share (%)
Producer	Input cost ~800	1,500	~700	38
Transporter	1,500	2,600	330 (net)	22
Wholesaler	2,600	3,100	500	15
Retailer	3,100	3,800	700	25

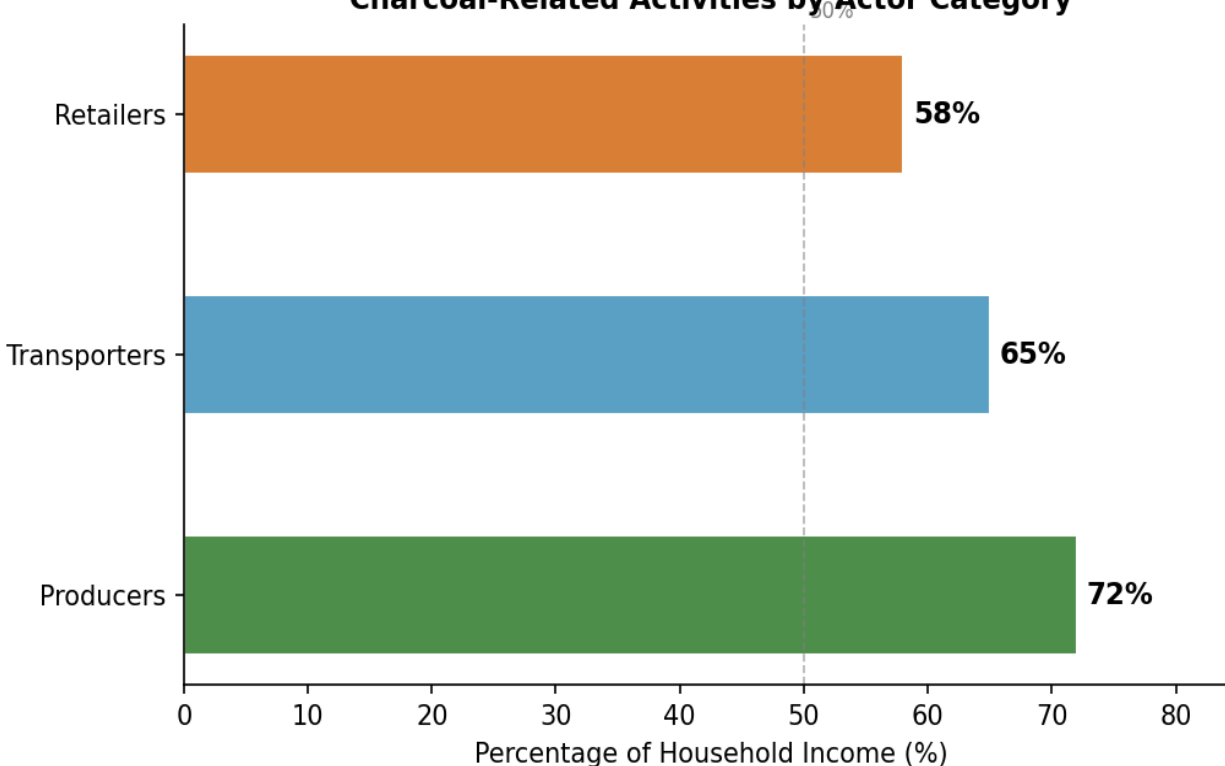
Source: Authors' field survey, 2024. Figures rounded to nearest NGN.

**3.3 Household Income Contributions**

Charcoal-related activities constitute a critical component of household income across all actor categories (Figure 2). Producers derive the highest proportional income from charcoal (72%), reflecting the absence of viable alternative livelihoods in rural production zones. Transporters report 65% income dependence,

while retailers derive 58% of household income from charcoal trade. These figures underscore the systemic integration of charcoal into the local economy and the significant social disruption that abrupt regulatory action without alternative livelihood provision would precipitate.

**Figure 2: Share of Household Income Derived from Charcoal-Related Activities by Actor Category**



**Figure 2:** Share of household income derived from charcoal-related activities by actor category (%)

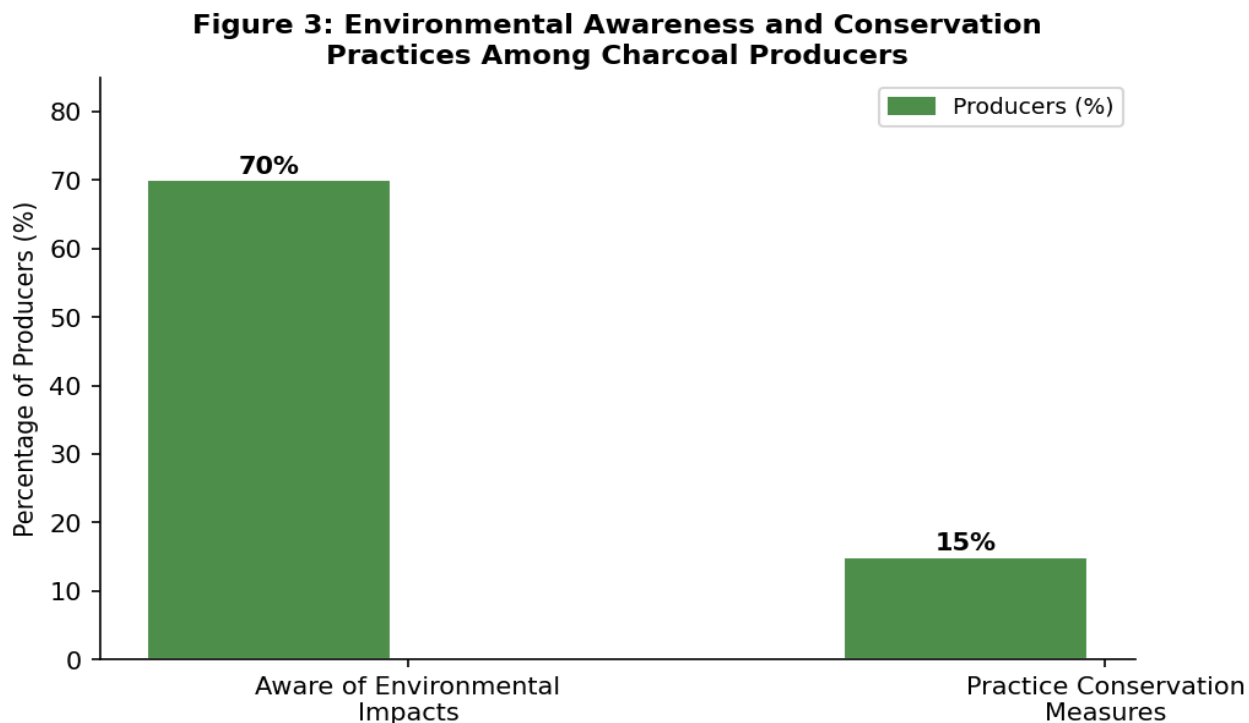
**3.4 Environmental Awareness and Conservation Practice**

Of the 40 producers surveyed, 70% (n=28) reported awareness of the environmental consequences of charcoal production, including

tree depletion, soil erosion, and contributions to desertification. However, only 15% (n=6) reported practising any form of conservation measure including selective harvesting, replanting, or kiln efficiency improvements.

This pronounced knowledge–practice gap (Figure 3) is attributable to a combination of economic desperation, lack of regulatory

enforcement, absence of institutional support, and the pressing demands of household subsistence in a post-conflict environment



**Figure 3:** Environmental awareness and conservation practice among charcoal producers (% of producer respondents, n=40)

### 3.5 Consumer Energy Use and Preferences

Survey data revealed that charcoal is the dominant primary cooking fuel among Maiduguri households, accounting for 54% of respondents, followed by firewood (28%), LPG (10%), and other sources including crop residues and kerosene (8%) (Figure 4). The principal drivers of charcoal preference were affordability (cited by 79% of charcoal users), immediate availability (67%), and familiarity with use

(53%). Unreliable electricity supply was cited as a barrier to adoption of electric cooking by 91% of respondents.

Critically, 68% of respondents expressed conditional willingness to switch to cleaner cooking fuels, primarily LPG and improved biomass stoves, if these were made affordable and consistently available. This signals meaningful latent demand for energy transition initiatives and provides a substantial opening for targeted subsidy and infrastructure programmes.

**Figure 4: Distribution of Primary Cooking Fuel Among Surveyed Households in Maiduguri**

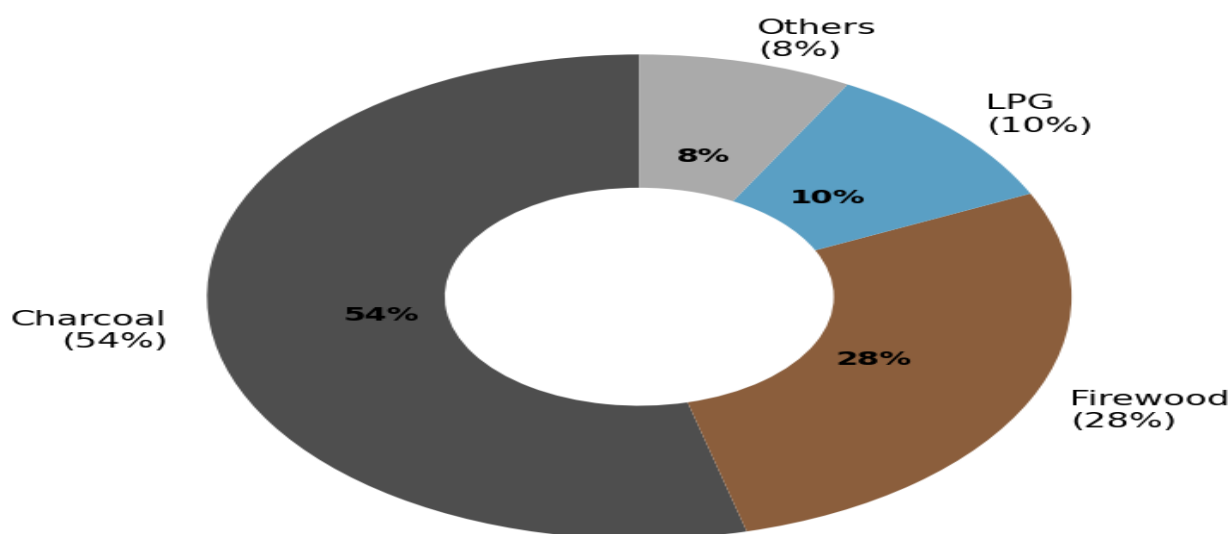


Figure 4: Distribution of primary cooking fuel among surveyed households in Maiduguri (% , n=150)

### 3.6 Policy and Governance Environment

The charcoal market in Maiduguri operates in a regulatory vacuum. No formal licensing or permitting system exists for charcoal producers or traders. Multiple informal levies are imposed at roadway checkpoints by unidentified agents, adding transaction costs that are largely absorbed by producers and consumers. Although Borno State has enacted forest protection regulations, enforcement is severely limited by insecurity and institutional capacity deficits. No functional charcoal producer cooperative or formal trade association was identified in the study area, leaving producers individually exposed to market power exerted by transporters and wholesalers.

### 4. DISCUSSION

The findings from this study make several important contributions to the agricultural economics literature on informal commodity markets in conflict-affected regions. First, they confirm and quantify the structural inequity in charcoal value distribution that has been hypothesised in qualitative literature (Olamide *et al.*, 2024a; Yusuf & Bakare, 2022b), showing that producers receive less than two-fifths of the retail price despite performing the most labour-

and risk-intensive stage of the value chain. This parallels well-documented patterns in smallholder agricultural markets across West Africa, where limited market information, spatial isolation, and absent institutional support systematically disadvantage primary producers.

Second, the level of household income dependence on charcoal (58–72%) documented across actor categories reveals that the charcoal economy functions as a *de facto* social protection mechanism in a region where formal safety nets are largely absent. This finding has significant policy implications: abrupt prohibition or heavy-handed regulation of the charcoal trade—without viable livelihood alternatives would constitute a severe income shock to some of the most vulnerable households in Nigeria. The agricultural economics literature consistently warns against such interventions in markets with high livelihood integration (FAO, 2022; UNDP, 2023a).

Third, the knowledge–practice gap documented among producers (70% awareness vs. 15% conservation practice) reflects a well-established pattern in natural resource economics where environmentally rational behaviour is precluded

by poverty traps and institutional failures (Olamide *et al.*, 2024b). Addressing this gap requires not awareness campaigns but rather economic incentives including access to affordable alternative fuels, subsidised improved kilns, and credible reforestation support programmes. The documented willingness of 68% of consumers to switch to cleaner fuels provides a market basis for such transitions, provided policy creates the necessary enabling environment.

Finally, the governance analysis reveals that the charcoal market suffers simultaneously from over-extraction through informal checkpoints and under-regulation in terms of forest management and market formalisation. This combination predatory informal levies alongside absent environmental oversight represents a structural pathology common to commodity markets in fragile states (UNDP, 2023b). Resolving it requires institutional reform at multiple levels: formalising the trade, strengthening producer cooperatives, reforming checkpoint governance, and building forestry enforcement capacity in tandem with conflict stabilisation.

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

This study provides the first systematic, empirical analysis of the charcoal value chain in post-conflict Maiduguri, Borno State, combining quantitative market data with qualitative governance assessment. The results establish that charcoal is simultaneously a critical livelihood resource and a major driver of environmental degradation, a duality that demands nuanced, graduated policy responses rather than prohibitionist approaches.

Based on the evidence, the following policy recommendations are advanced. First, the formalisation of the charcoal value chain through a licensing and registration framework should be prioritised. Formalisation would enhance transparency, reduce informal levies, and create a basis for environmental compliance requirements. Second, investment in producer cooperatives should be supported through government extension and NGO-facilitated capacity building, enabling collective bargaining, shared market information, and joint

access to credit. Third, a targeted subsidy programme for clean cooking fuels particularly LPG and improved biomass stoves should be designed to exploit the documented willingness-to-switch among 68% of consumers. Fourth, forest governance must be strengthened through community-based monitoring schemes, economically incentivised reforestation programmes, and integration of charcoal regulation into Borno State's post-conflict reconstruction frameworks. Fifth, future research should employ longitudinal methods to track the evolution of value chain dynamics as security conditions change and to evaluate the effectiveness of proposed interventions.

Collectively, these recommendations aim to transform the charcoal economy from an informal, environmentally destructive livelihood into a formalised, regulated, and progressively greener sector that continues to support vulnerable households while contributing to sustainable forest management.

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