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Integrating Small-Scale Tree Farmers Into Wood Markets: A Case of Tree Farmers in Central Uganda

Justine Namaalwa | Antonny Tugaineyo | Scovia Akello | Patrick Byakagaba

Department of Environmental Management, School of Forestry, Environmental and Geographical Sciences, Makerere University, Kampala, Uganda

Correspondence: Justine Namaalwa (namaalwa.justine@gmail.com)

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ABSTRACT

Small-scale tree farmers are increasingly recognized as important producers of wood resources, yet their integration into wood markets remains limited in many developing countries. Integration is conceptualized as farmers' ability to access target markets, participate in price-setting, and compete favorably for fair prices. In sub-Saharan Africa, tree growing has often been promoted for conservation or subsistence, with little emphasis on commercialization. This study was motivated by the underrepresentation of small-scale farmers in wood markets despite their potential to supply significant wood resources and by the lack of empirical evidence on their degree of integration into markets. The study contributes to a deeper understanding of how small-scale tree farmers are integrated into wood markets by addressing two questions. (i) Which sociodemographic and tree farm attributes influence access to target and final selling points? (ii) What factors influence participation in price-setting? The research was conducted in Mubende District, Central Uganda, using a mixed-methods approach. Data were collected through participant and key informant interviews and focus group discussions. Quantitative data were analyzed using descriptive statistics, chi-square tests, and binary logistic regression, while qualitative data were processed using thematic content analysis. Findings showed that most farmers failed to sell from their target markets due to high transport costs, limited market information, and reliance on intermediaries. Participation in price-setting was also limited, with many farmers accepting prices offered by buyers, especially in cases of distress sales linked to urgent household needs. The study recommends that governments and development partners strengthen business support services, including technical training, value addition, and improved market information systems, to enable small-scales' transition from subsistence-oriented production to effective participation in wood markets.

1 | Introduction

Forests, which are sources of wood, declined globally at an annual rate of about 4.7 million hectares in the period between 2010 and 2020 [1]. This reduction in forest cover was generally attributed to the growing population pressure, weak forestry policies, wildfires, inadequately developed institutions, competing land uses, and weak forest law enforcement and governance [2]. In many developing countries, small-scale tree farmers are increasingly engaging in tree growing not only for the ecosystem services it provides but also to meet the rising demand for forest products [3–5]. In sub-Saharan Africa, however, government and civil society initiatives have often promoted tree growing among small-scale farmers with limited attention to market dynamics and commercialization [6, 7]. This has largely stemmed from the entrenched perception that small-scale tree planting and farm forestry serve primarily environmental or aesthetic functions, rather than being viable economic enterprises [8–12].

Nonetheless, emerging evidence indicates that small-scale wood production can generate tangible livelihood benefits and reduce

reliance on natural forests for wood supply [3, 13–17]. Several studies have demonstrated that the benefits derived from small-scale forestry are largely hinged on farmers' ability to participate in wood markets [3, 18–20]. For small-scale tree farmers to integrate into wood markets, there is need for them to identify a target market that can offer them competitive prices while incurring the lowest transaction costs [3, 21]. Thus, realizing long-term economic viability among small-scale tree farmers requires development strategies that are based on small-scale tree farmers' market comparative advantage [17, 21]. Small-scale tree farming thrives when commercial rights are decentralized, licensing and processing are accessible, and farmers receive strong business, organizational, and market support services [21–24].

Forest management in sub-Saharan Africa has traditionally emphasized silvicultural practices, conservation, and regulatory compliance, with limited attention to the marketing and commercialization of wood products [8, 25, 26]. Majority of small-scale tree farmers focus on tree cultivation without adequate planning for integration into markets, which inadvertently results in low bargaining power, reliance on intermediaries, and suboptimal prices for their products [3, 20]. Incorporating market dynamics into forest management frameworks is therefore essential for ensuring that small-scale tree planting contributes not only to environmental goals but also to viable and sustainable rural economies. Small-scale tree farmers frequently encounter market barriers, including limited access to high-value markets due to the dominance of traders, inadequate market information, and weak bargaining power [3, 20, 21]. However, a general lack of clear documented information about the marketing of wood produced by small-scale farmers persists, despite increasing trends in small-scale production across many developing countries. This information gap limits the design and implementation of effective interventions that can enhance small-scale wood production and improve financial returns for the producers.

The overall objective of this study was to contribute to a better understanding of how small-scale tree farmers are integrated into wood markets based on the experience from Central Uganda. This objective was addressed through the following research questions:

1. What sociodemographic and tree farm attributes influence small-scale tree farmer access to target and final wood selling points?
2. What factors influence small-scale tree farmers' participation in setting wood prices?

This study was motivated by the recognition that small-scale tree farmers in many developing countries, including Uganda, remain underrepresented in formal wood markets despite their potential to supply wood resources. Their marginalization is compounded by the historical underemphasis on the commercialization of forest products within forest management, alongside a persistent lack of empirical evidence on the extent of their integration into market. The knowledge generated can inform tree-planting initiatives and guide policymakers in designing targeted interventions that improve the profitable integration of small-scale tree farmers into wood markets, thereby contributing to local and national economic development.

This paper starts with an introduction that reviews relevant literature, identifies key knowledge gaps, and sets out the research objectives and questions. The conceptual framework then situates the study within existing literature and clarifies the relationship between variables in the study. The methods section outlines the study design, methodological framework, sampling strategy, and data analysis procedures, followed by the presentation of findings organized around the research questions. The discussion interprets these findings in relation to the broader literature and debates, drawing out their implications for both policy and practice. The paper concludes by synthesizing the main insights and offering strategic recommendations.

1.1 | Conceptual Framework

This study is anchored on the transaction cost theory (TCT), which provides a framework for understanding how the costs associated with market exchanges shape the degree to which small-scale tree farmers integrate into wood markets. The TCT posits that participation in markets is shaped by the costs incurred when searching for information, identifying and negotiating with buyers, monitoring exchange partners, and transporting products [27, 28]. These costs, both visible and hidden, affect producers' ability to engage effectively in markets. For small-scale farmers, these transaction costs are particularly significant due to underlying structural characteristics of markets, including information asymmetry, dominance of intermediaries, weak institutional support, and high transport burdens [3, 29].

In this study, small-scale tree farmer integration into wood markets is conceptualized as the farmers' ability to (i) access preferred wood market (eliminate brokers and monopolies for farmers to sell in the markets of their choice), (ii) influence the prices of their wood products through participation in price-setting processes, and (iii) compete favorably by bargaining for best market prices that reflect the true value of their products [3, 30, 31]. The study focuses specifically on two dimensions of integration into wood markets: ability to access target wood markets and participation in price-setting processes. These dimensions provide insights into the transactional conditions under which small-scale tree farmers operate and the degree to which they can influence economic outcomes derived from tree growing.

Access to target wood markets forms the foundation for farmers' economic participation and livelihood improvement [19, 32]. Such target market points may include farm gate, retail outlets, sawmills, and large company outlets [33, 34]. TCT posits that farmers' access to these wood markets is influenced by the magnitude of transaction costs. These costs include searching for market information, identifying reliable buyers, and negotiating favorable sales terms. Evidence from diverse contexts illustrates how wood producers have adopted innovative strategies to manage the costs in order to reach their target markets directly [35–38].

For small-scale tree farmers, transaction costs are shaped by household socioeconomic and demographic characteristics, including land size, sex of tree owner, education level, household size, experience in tree growing, and the array of household assets [18, 30, 34, 39]. Farmers with stronger asset bases, higher

levels of education, or diversified economic activities typically face lower transaction costs, thereby increasing their likelihood of reaching preferred markets.

Equally important is the small-scale tree farmers' participation in the price-setting process, which reflects small-scales' bargaining power [3, 40]. Participation in price-setting is also shaped by transaction costs, particularly those that are variable and linked to processing wood, loading, and transporting. These costs influence the volume of wood sold and the farmer's capacity to engage in price negotiation. Lower transaction costs enhance bargaining power by enabling farmers to transport higher volumes, compare alternative buyers, or postpone sales until favorable prices emerge. Participation in price-setting is further influenced by informational and cognitive transaction costs. These include knowledge of tree management practices, the ability to accurately estimate wood volumes, and awareness of quality and pricing standards [7, 39]. Limited access to market information, dominance of brokers, and inadequate skills in wood valuation can elevate these costs, thereby constraining farmers' bargaining power and reducing their ability to negotiate prices that reflect the true value of their products [3, 19, 40–42]. The graphical representation of the conceptual framework illustrating these dynamics is presented in Figure 1.

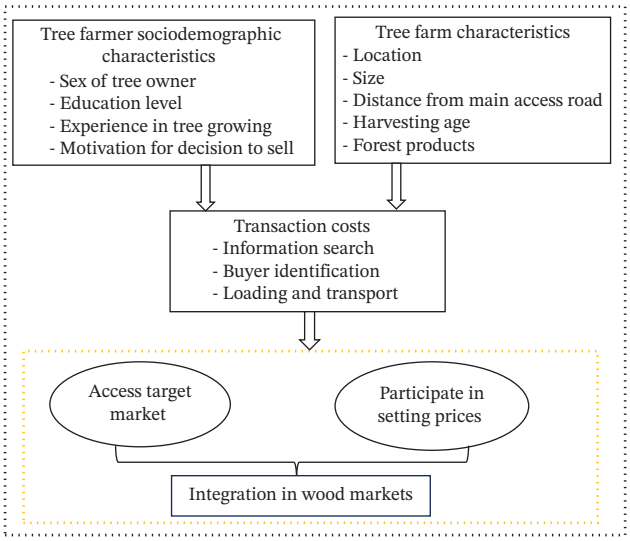

FIGURE 1 | Conceptual framework for the study.

2 | Materials and Methods

2.1 | Study Area

The study was conducted in Mubende District, located in the Central Region of Uganda, about 157 Kilometers west of Kampala, the capital city (Figure 2). Mubende District was purposively selected for the current study because of its longstanding practice of commercial tree growing on small, medium, and large scale.

Mubende District comprises 13 subcounties, and according to the National Population and Housing Census of 2024, the district had a total human population of 522,015, 52% of whom were females [43]. Most of the area has over time been under crop and livestock farming with about 91% of the households drawing their livelihood from agricultural activities [44]. In terms of accessibility, it has a road network of about 4308 km of which 6% of them are tarmac roads, and the rest are earth roads that are often impassable during the wet season [44].

2.2 | Small-Scale Tree Growing in Mubende

The scale of tree growing is largely determined by the total land holding for a given household and the competing land uses [18, 19, 45]. The average land holding in the area is 0.81 ha, and most of the households rely on on-farm activities for their livelihood. Given the small land holdings, farmers plant trees mainly as woodlots and scattered and boundary tree farming systems. Exotic tree species are the most grown with majority of the farmers preferring *Eucalyptus* species and *Pinus* species [46]. These tree species are preferred because they are fast-growing and are highly demanded by the market [47].

2.3 | Research Design and Methodological Framework

The study applied descriptive and interpretive research designs [48, 49] and employed a mixed approach of both qualitative and quantitative methods of data collection and analysis. Mixed methods enabled both deductive and inductive analysis [50, 51]. The mixed-methods approach has advantages: one can elaborate on quantitative results with subsequent qualitative data and compare quantitative and qualitative data to inform well-validated conclusions [52].

We applied descriptive research design to characterize small-scale tree farmers' integration into wood markets in their natural context while identifying associations between market integration dimensions and relevant socioeconomic and tree stand attributes [49]. This was achieved through conducting participant interviews with the small-scale tree farmers to capture their social economic, demographic, and tree farm characteristics and whether farmers were able to access and participate in determining prices for their wood products on the market. The collected data were analyzed using descriptive statistics and Pearson's chi-square test. The interpretive design aided the researchers to gain respondents' subjective reasoning and lived experience about the factors that influence farmer's level of integration in wood market [48]. This was mainly achieved through in-depth interactions during focus group discussions (FGDs) and key informant interviews (KIIs) where the researchers asked follow-up and probing questions aimed at attracting lived experience and the reason behind certain actions done by farmers to integrate into wood markets and thus allowing for a more nuanced interpretation of results. Qualitative data collected were analyzed using thematic content analysis to triangulate descriptive data. This ensured that the researchers gained a deeper understanding of the factors that influence access to markets and participation in determining prices for their wood products. The graphically represented methodological framework of the study is presented in Figure 3.

2.4 | Sampling Strategy

The focal study areas were Kiyuni subcounty and South Division of Mubende municipality which are the jurisdictions with the highest number of small-scale tree farmers in Mubende District [53]. Kiyuni subcounty was selected to represent the rural part of Mubende while South Division represented peri-urban areas.

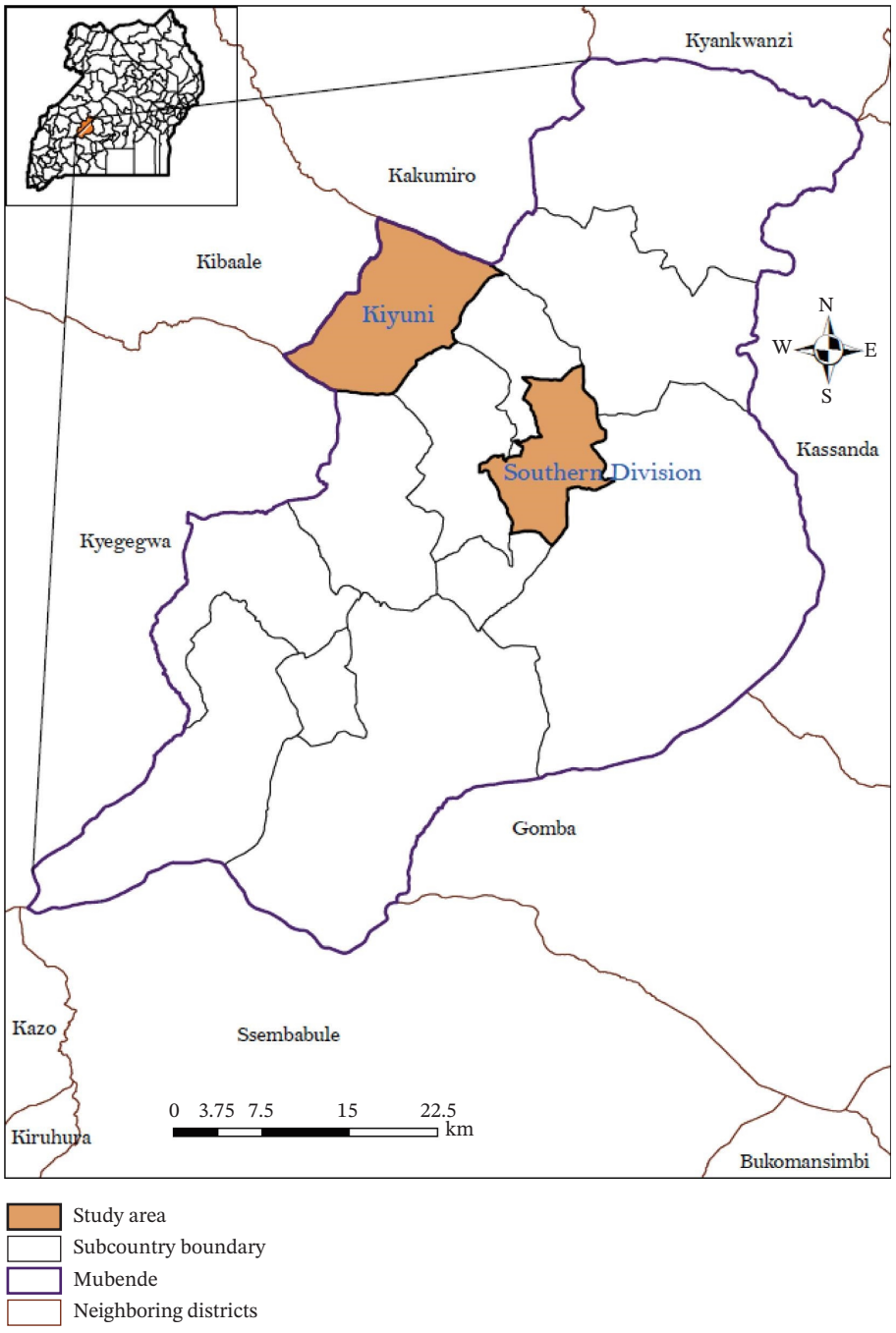

FIGURE 2 | Map of the study area.

Rural and peri-urban sites were considered in order to establish whether the location of forests relative to Mubende township influenced integration into wood markets as observed by Randela et al. [54]. A small-scale tree farmer was defined by a land holding of 0.2–2 ha. Selection of the participants was also limited to those who were growing indigenous or/and exotic tree species for wood production. Additionally, the study only considered farmers that had sold their forest products before because it was assumed they had knowledge of the research questions on integration into wood markets. With the support of the local field guides, all small-scale tree farmers that had sold their forest products before were enlisted from the selected parishes and wards (Table 1). Using the fishbowl randomization method [55], a sample of 131 farmers (Table 1—metadata provided in Supporting Information 1) was selected following Krejcie and Morgan's [56] formula.

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}, \quad (1)$$

where S is the required sample size, X^2 is the table value of chi-square for 1° freedom at the desired confidence level (3.841), N is the population size, P is the population proportion (assumed to be 0.50 since this would provide the maximum sample size), and d is the degree of accuracy expressed as a proportion (0.50).

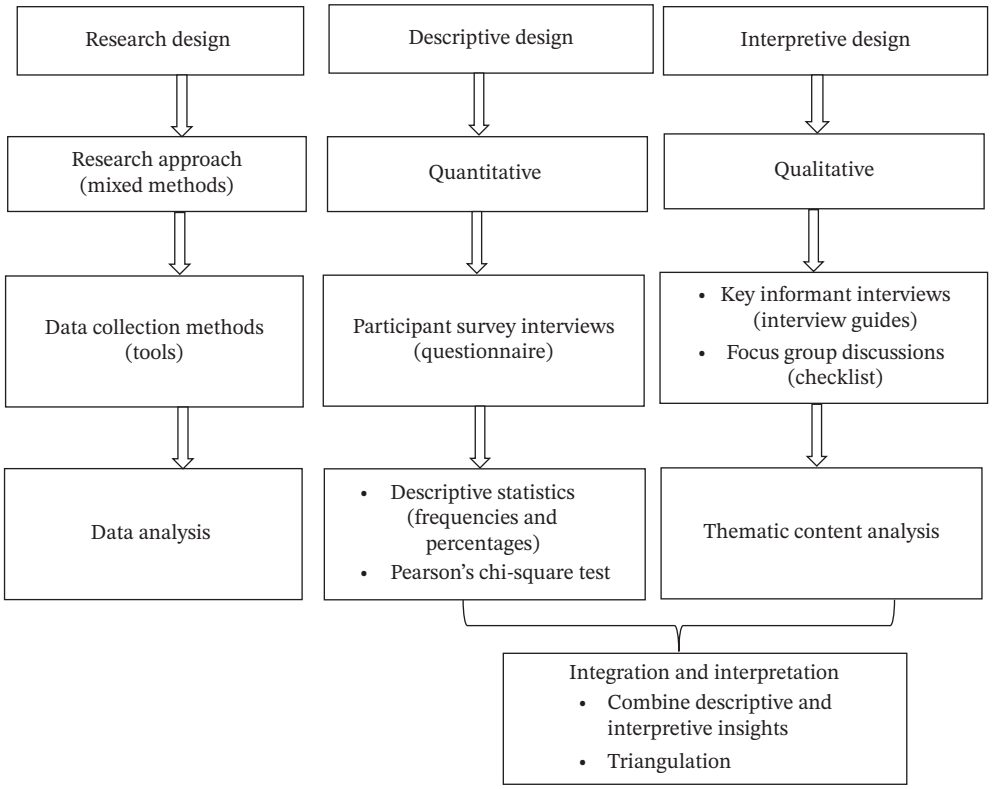

FIGURE 3 | Methodological framework for the study.

2.5 | Data Collection Methods

2.5.1 | Participant Interviews

Participant interviews were guided by a semistructured questionnaire (Supporting Information 5) in a face-to-face interaction to obtain information on socioeconomic characteristics, tree stand attributes and experience with accessing target markets, and participation in wood price-setting. It was important during the data collection to engage the participants in face-to-face interviews to probe and clarify responses [57]. Prior to actual data collection, the interview guide was pretested with 20 participants sharing similar characteristics with the target population. This was done to assess clarity, relevance, and sequencing of questions, and the tool was refined based on the feedback received. To understand access to target markets, respondents were asked to name the market points they targeted to sell their wood products. Furthermore, farmers also named the wood market points where they finally sold their wood products. Data were also collected on whether tree farmers participated in the price-setting process. Data collection was carried out in two phases over a 2-month period, spanning September to October 2020.

2.5.2 | KIIs

Using interview guide (Supporting Information 6), KIIs were conducted with selected individuals to gather context-specific and expert insights on the tree farmers' access to target markets and participation in the price-setting processes. Key informants (number interviewed in parenthesis) were selected based on any of the following criteria: participated in wood brokerage (6), held leadership positions in the subcounty (5), participated in forestry-related decision making at the district level (2), and were technical staff of National Forestry Authority (NFA) in the district (3) and Forestry Sector Support Department (FSSD) under Ministry of Water and Environment (MWE) (5). Additionally, wood value chain experts (4), actors from tree planting initiatives (initiatives such as Sawlog Production Grant Scheme (SPGS) (2) and Uganda Timber Growers Association (UTGA) (3)), and academia (3) were interviewed.

TABLE 1 | Sample of small-scale tree farmers in the respective parishes.

Subcounty	Parish/ward	SSTF* population	Sample size
Kiyuni (rural)	Mijinwa	32	29
	Katente	53	44
South Division (peri-urban)	Rwabagabo	37	31
	Kirungi	20	10
	Gayaza	27	17
Total		169	131

*SSTF, small-scale tree farmer.

2.5.3 | FGDs

Five FGDs were conducted with different categories of tree farmers, and the participants were purposively selected with guidance from local leaders and a field guide. The farmers were categorized into those that owned trees on land holding of 0.2–0.4 ha and those with 0.5–2 ha. The purpose for selecting these categories of farmers was to identify and explore any existing variations in the ability to integrate into wood markets that could be associated with acreage of planted forests. Given the limited number of women involved in tree growing, FGDs were dominated by male participants and were comprised of 8–12 participants. Each FGD was moderated by the authors using a checklist (Supporting Information 7). The FGDs were used to generate collective understanding of how different sociodemographic and marketing aspects such as access to market information, distance of the forest from access roads, forest product quality influenced small-scale tree farmers' integration into wood markets.

2.6 | Data Analysis

2.6.1 | Descriptive Statistics and Bivariate Associations

Data were analyzed using IBM SPSS Statistics Version 26. All statistical tests were performed at a 5% significance level ($\alpha = 0.05$), with p values less than 0.05 considered statistically significant. Data from participant interviews were analyzed using descriptive statistics (percentages) to establish the proportion of small-scale tree farmers that were able to access target markets and participate in the wood price-setting process. Descriptive statistics (percentages) were also used to categorize respondents by their target and final wood selling points. To examine the association between wood selling points (target and final) and farmers' sociodemographic and tree farm attributes, Pearson's chi-square tests were applied; where expected counts were small, Fisher's exact test was used.

2.6.2 | Binary Logistic Regression

Binary logit regression (BLR) was used to determine factors (socioeconomic, wood production, and marketing attributes) that influence small-scale tree farmers' participation in setting wood prices. BLR was selected given that it offers the advantage of directly estimating odds ratios, which are widely regarded as easily interpretable in various research contexts [58, 59]. By contrast, probit regression coefficients are expressed in terms of z-scores from a normal distribution, which are less straightforward for interpretation and often less useful for informing decision-making. Additionally, probit regression assumes that the latent variable underlying the binary outcome follows a normal distribution [60], an assumption that was not met. Before multivariable modeling, we assessed collinearity among candidate predictors using variance inflation factors (VIFs) and tolerance. All VIF values were below 10 (maximum VIF = 1.43), and tolerance values exceeded 0.1, indicating no multicollinearity concerns [61, 62]. The choice of the explanatory variables (Table 2—metadata provided in Supporting Information 2) was informed by; previous related studies [54, 63–65], data availability, and bivariate correlation results.

2.6.2.1 | Variable Construction and Coding. The dependent variable Q, the tree farmers participating in wood price-setting, was dichotomous (1 = tree farmer participated in wood price-setting; 0 = otherwise). Explanatory variables considered were sex (Sex), subcounty location (Location), education level (Educ), tree-growing experience in years (ExpTr), distance from woodlot to the main access road in kilometers (FstDist), access to market information (MktInfo), harvesting age in years (HrvstAge), primary reason for selling (Decn), woodlot size in hectares (WdltSize), approach of accessing the buyer (AccBuyer), and type of forest product sold (PdtSold) (see Table 2 for interpretation and summary statistics). FstDist and WdltSize were captured as continuous variables at data collection (Table 2). For bivariate association tests only, these variables were categorized to satisfy test assumptions and facilitate interpretation; the original continuous measures were retained for use in the BLR.

The probability of a respondent participating in wood price-setting (denoted by 1) or otherwise (denoted by 0) was assumed to be a logit function of the enlisted explanatory attributes. $\beta_1, ..., \beta_{11}$ are factors of the coefficient on each of the independent variables, β_0 is a constant, and ε is the error term as indicated in the following equation:

$$\begin{aligned} PQ(0,1) = {} & \beta_0 + \beta_1 Sex + \beta_2 Urban + \beta_3 Educ + \beta_4 ExpTr \\ & + \beta_5 FstDist + \beta_6 MktInfo + \beta_7 HrvstAge \\ & + \beta_8 Decn + \beta_9 WdltSize + \beta_{10} AccBuyer \\ & + \beta_{11} PdtSold + \varepsilon. \end{aligned} \tag{2}$$

The explanatory variables used in the model and their expected effect are presented in Table 2.

Sex represented the differences in how being male or female influences participation in the price-setting process. Given that male tree farmers are likely to be more involved in forestry-related activities than females [66, 67], male tree farmers are expected to participate in price-setting much more compared to their female counterparts who may have less experience.

The variable location indicated where the respondent's forest/woodlot was located (rural or peri-urban). According to Makhura [68] and Randela et al. [54], farmers close to towns have easy access to market information and product markets. Consequently, farmers whose forest/woodlot was located in peri-urban (South Division) were assumed to be more likely to participate in setting wood prices compared to those in rural (Kiyuni) subcounty which is relatively far from town where the demand is expected to be relatively high.

Intellectual capital was captured by the tree owner's level of education. Since farmer integration in wood markets is shaped by the access to and interpretation of market information [21], the level of education is predicted to have a positive influence on the farmers' likelihood of participating in setting wood prices. According to Randela et al. [54], the level of education gives an indication of the farmer's ability to understand and interpret information which is applied in price-setting.

Experience in tree growing was captured as the number of years the respondent had been engaged in tree growing. This is expected to increase the likelihood for tree farmers to participate in price-setting [65]. It is suggested that farmers with more tree

TABLE 2 | Description of the variables used in the empirical models.

Explanatory variable	Definition	Summary statistics	Expected effect
Sex	Sex of tree owner (0 for male and 1 for female)	% male = 74	±
Location	Subcounty: 0 for Kiyuni (rural) and 1 for South Division (peri-urban)	% peri-urban = 44	±
Educ	Level of formal education: 0 for primary level and below, 1 for secondary, and 2 for tertiary	% primary level and below = 46 % secondary = 31 % tertiary = 23	+
ExpTr	Experience in tree growing measured in years	Mean = 15.3 SD = 10.4	+
FstDist	Distance between the forest and access road in kilometers	Mean = 1.3 SD = 0.86	−
MktInfo	Access to market information: 0 for tree farmers that had not received market information and 1 for those that had received market information	% for those that had received market information = 45	±
HrvstAge	Age of harvesting the trees measured in years	Mean = 7.1 SD = 2.41	+
Decn	Reason for selling trees: 0 for household financial need, 1 for tree maturity, 2 for poor stand performance	% household financial need = 37 % tree maturity = 23 % poor stand performance = 40	±
WdltSize	Size of the area under trees in Ha	Mean = 1.8 SD = 1.25	+
AccBuyer	The approach of accessing buyer: 0 for seller looked for a buyer, 1 for buyer looked for a seller	% buyer looked for a seller = 60	±
PdtSold	Type of forest product sold (0—firewood, 1—sawlogs, 2—building pole, 3—timber)	% firewood = 5 % sawlogs = 49.5 % building pole = 18.5 % timber = 27	±

growing experience tend to have more personal contacts with market actors, allowing discovery of trading opportunities at a low cost compared to the new market entrants [69].

Forest distance from an access road was estimated in kilometers. The shorter the distance from the forest/woodlot to the main access road, the better the farmer's participation in produce markets due to its effect of reducing transport costs [70].

Farmers were asked whether they had access to market information in form of prevailing wood prices, wood buyers' contacts, and most preferred/demanded tree species. Since marketing efficiency is hindered by informational bottlenecks which increase transaction costs by raising search, screening, and bargaining costs [54], access to market information is predicted to have a positive influence on farmers' likelihood to participate in price-setting.

The study captured the age of the trees at the time of harvesting for different products. Since tree age influences wood quality [71, 72], the age at which farmers harvested their trees was predicted to influence the strength quality properties of wood. Therefore, tree harvesting age was predicted to positively affect the farmers' likelihood to participate in price-setting.

Tree farmers were asked to indicate the reason for selling the trees. This ranged from desperate household financial needs, tree maturity, and poor performance of the tree stand regarding target product. As observed by Hellin and Higman [73] and Midgley et al. [15], tree farmers that sold their tree products due to desperate household financial needs and poor performance of tree stands were expected to have lower bargaining power and thus prices often not in their favor.

The size of the woodlot was the reported acreage of the land area on which trees were grown. According to Arvola et al. [3] and Anyonge and Roshetko [39], wood buyers prefer buying from tree farmers with larger forests/woodlots since they enjoy economies of scale for transportation costs. Therefore, the bigger-sized forests/woodlots were expected to have a positive effect on farmers' bargaining power because there would be many buyers interested in buying from them.

Farmers either looked for wood buyers or wood buyers often scouted around the villages for mature tree stands and thus approached farmers to sell. In circumstances where wood buyers scouted for tree farmers with a ready to harvest stand, the farmers are expected to have a higher bargaining power because it is assumed there is a high demand for their products [74].

The type of forest product sold varied among tree farmers, including firewood, sawlog, building poles, and timber. Tree farmers that sold locally demanded forest products such as firewood and building poles were expected to participate in the price-setting process compared to those that sold other wood products [5].

2.6.3 | Qualitative Data Analysis and Integration

All the data from KIIs and FGDs were transcribed and analyzed using thematic content analysis techniques to identify narratives associated with the questions of inquiry. Themes were generated from the responses to the research questions on access to target market and participation in price-setting. Statements in the form of narratives that described and explained the access to target markets and participation in the price-setting process were extracted from the themes and reported to contextualize and explain quantitative patterns [75].

3 | Results

3.1 | Access to Target Selling Points

Descriptive statistics analysis was conducted to classify respondents by their target and final wood selling points. The target selling points reported by the respondents included farm gate (26%), retail outlets (38%), sawmills (21%), and large company outlets (15%). A higher proportion (56%) of female respondents targeted to sell from farm gate. Other than a small proportion (26%) of saw logs that were sold at retail outlets and large-scale wood processing companies, all the other forest products were reported to have been sold at the farm gate (Table 3, metadata provided in Supporting Information 3). Findings revealed that the farm gate was the predominant final selling point for tree farmers (94%), while only a small proportion sold through retail outlets (3%) and large-scale processing companies (3%). Notably, none of the farmers reported sawmills as their final selling point, despite 21% having initially targeted them as preferred outlets. KIIs with local leaders and FGDs with tree farmers mainly attributed selling at the farm gate to wood brokers that scouted around villages in search of mature woodlots. The majority (53%) of the respondents indicated that they failed to access target markets. One wholesaler was quoted saying,

> "*... I deploy wood brokers across different Subcounties to scout for farmers with mature native trees species like Musambya (Markhamia lutea K. Schum.) and Mvule (Milicia excelsa (Welw.) C.C. Berg)*"

The farmers, conversely, alluded to being disadvantaged by the dominance of the wood brokers. A male farmer in Kiyuni subcounty was quoted saying,

> "*...We have no direct link to the big timber buyers in town. The brokers decide the price here in the village, and we accept because we cannot transport the timber ourselves. Even if we try to organize transport, they tell us we lack the required permits, so in the end we just give in.*"

This was corroborated by a female farmer in South Division who noted that,

> "*...Even when we know the market price in Kampala is higher, the middlemen pay us less. They say transport and licenses are too expensive, so we remain at their mercy. It feels like they benefit more from our trees than we do as the actual farmers.*"

The study also examined the association between wood selling points (target and final) and farmers' sociodemographic and tree farm attributes using Pearson's chi-square tests (Table 3).

The sex of respondents revealed a statistically significant association with the target markets, with majority (45%) of the male tree farmers targeting to sell at retail outlets while most female farmers targeted to sell at the farm gate. A female KI who was a tree farmer from a rural parish was quoted saying:

TABLE 3 | Target and actualized market points.

Attributes	Target selling point (% response)				Final selling point (% response)		
	Farm gate	Retail outlet	Sawmill	Large-scale wood processing companies	Farm gate	Retail outlet	Large-scale wood processing companies
Sex of tree owner							
Male ($n = 97$)	16	45	21	18	93	4	3
Female ($n = 34$)	56	19	22	4	96		4
p value			0.000*			0.559	
Location of tree farm							
Rural ($n = 73$)	32	38	18	12	95	5	
Peri-urban ($n = 58$)	19	37	26	19	93		7
p value			0.48			0.042*	
Distance of the tree farm from main access road (ranges in km)							
≤ 1.5 ($n = 77$)	29	33	21	17	97	3	
1.6–3 ($n = 54$)	22	44	22	11	89	9	2
p value			0.338			0.09	
Size of the tree farm (ranges in ha)							
≤ 0.2 ($n = 62$)	22	36	24	18	98	2	
0.45–1.2 ($n = 49$)	35	38	15	12	94	6	
1.3–2 ($n = 20$)	21	42	26	11	79	16	5
p value			0.402			0.006*	
Forest product sold							
Building poles ($n = 14$)	25	25	25	25	100		
Firewood ($n = 20$)	40	40	20		100		
Saw logs ($n = 41$)	20	43	25	12	88	6	6
Transmission poles ($n = 26$)	16	37	26	21	92	8	
Timber ($n = 30$)	46	32	9	14	100		
p value			0.624			0.534	

*Significant at 5%.

"*There is too much work involved in selling wood, for example, looking for chainsaw operators to fell trees, transport to deliver forest products to the market, and traveling a long distance to market points. As a breastfeeding woman, I prefer selling my trees from my forest and leave the rest of the work to the buyers.*"

A male farmer in South Division who targeted retail outlets was quoted saying,

"*...I prefer selling my timber at retail outlets in town because that is where I can negotiate a better price. It takes more effort to arrange transport and pay for the licenses, but the returns are higher than what brokers offer at the village.*"

The location ($p = 0.042$) and size ($p = 0.006$) of the tree farm revealed a statistically significant association with the final selling points. There was a proportion of farmers with woodlots more than 1.2 ha that actualized their target markets which were retail outlets (16%) and large-scale processing companies (5%). During KIIs with wood buyers, the aspects of location and size of the tree farm also emerged strongly as critical factors that influence access to target markets. One of the wood buyers was quoted as follows:

"*Forest products are expensive to transport due to high fuel prices and poor road network. As a result, we prefer buying from forests that are close to market points and when the forest is distant, we prioritize large holdings.*"

3.2 | Participation in the Price-Setting Process

The majority (58%) of the respondents did not participate in the price-setting process and thus accepted the price offered by the buyers. Majority of those that managed to negotiate a favorable product price (42%) were those that had their forests very close to access roads (64%) and those that were approached by the buyers to sell their products (76%). The study revealed that distance of the forest from main access road, motivation/reason for the decision to sell the tree stock, approach of accessing wood buyers, and the type of forest product sold had a significant effect on the farmers' likelihood to participate in the price-setting process (Table 4, metadata provided in Supporting Information 4).

Distance from the access road revealed a negative and significant effect ($p = 0.028$), with an odds ratio of 0.429 (95% CI: 0.213–0.848). Thus, a unit increase in the distance of the forest from the main access road reduced the odds of a tree farmer being able to participate in the price-setting process. Therefore, farmers that had their tree woodlots further away from access roads were less likely to sell their products at a price considered favorable to them. This also emerged strongly during the FGDs where participants emphasized that distance from accessible roads constrained their bargaining power, as buyers often cited high hauling costs to justify offering lower prices for wood products.

Selling forest products when the tree stand is mature enough for the target forest product increased the odds of a tree farmer being able to participate in the price-setting process by about 13 times (OR = 13.385, 95% CI: 1.215–37.471, $p = 0.011$) compared to selling forest products due to a household financial need. Farmers who reported that buyers approached them were significantly more likely to negotiate favorable prices (OR = 4.272, 95% CI: 1.014–12.437, $p = 0.034$) compared to those who sought buyers themselves. Existence of buyers that desperately need forest products would increase the odds of a farmer participating in the price-setting process by about 4 times compared to when a farmer searches for the wood buyer. This implies that when the sale was initiated by buyers, farmers gain leverage in price negotiations. A local council leader from Katente village, Kiyuni subcounty, was quoted saying:

"*The desperate situation under which farmers with urgent family financial needs look out for the buyers leaves them vulnerable to unfair prices ... there are some farmers in this village that wait for their trees to mature, this puts them in a better position to compare prices offered by different buyers which strengthens their bargaining power.*"

Wood product type also had a significant effect. Farmers selling sawlogs ($p = 0.048$, OR = 0.063, 95% CI: 0.006–1.474) and timber ($p = 0.041$, OR = 0.052, 95% CI: 0.004–0.995) were significantly less likely to participate in the price-setting process compared to those selling firewood (reference category). This means that selling timber and sawlogs reduces the odds of a tree farmer participating in the price-setting process compared to selling firewood. During an FGD with tree farmers from one of the rural parishes, it was reported that firewood was majorly sought and bought by many consumers within the vicinity of brick burning and cooking which reduces transport costs, and thus farmers were in better position to negotiate prices in their favor.

4 | Discussion

4.1 | Access to Target Selling Points

Most small-scale tree farmers reported to have targeted to sell their forest products to retailers' outlets in major towns close to their woodlots. This choice suggests that the farmers acknowledge that to maximize returns, it is important to reduce the transaction costs by eliminating intermediaries. Across regions, producers have adopted strategies to harness direct access of final consumers, including bamboo farmers in Southeast Asia engaging directly with urban markets [36, 37], timber producers in Nigeria targeting urban demand for construction and furniture [35], and small-scale farmers in Latin America leveraging cooperatives to connect with retailers and improve economic outcomes [38]. This suggests that tree farmers perceive intermediaries as barriers and not facilitators of wood product trade. Studies elsewhere show that farmers who sell their products through intermediaries often get lower prices [76]. Despite targeting to sell at retail outlets, most tree farmers were unable to realize their target selling points. This could be attributed to the high transaction costs associated with wood processing and transportation which has been reported by other studies as a necessity to sell to final consumers [77–79]. These studies generally indicate that most small-scale tree farmers sell their wood as stumpage because of the transaction costs involved in delivering forest products to distant markets. The higher transaction costs can further be explained by the diseconomies of scale since the small-scale tree farmers had not explored

TABLE 4 | Parameter estimates of the predictor variables in the model.

Explanatory variables	*B*	S.E.	Exp (*B*)	*p* value	95% C.I. for Exp (*B*)	
					Lower	Upper
Sex (female)	−1.161	0.767	0.313	0.15	0.086	1.743
Location (peri-urban)	0.003	0.631	1.003	0.996	0.284	3.373
Education level (secondary)	−0.013	0.679	0.987	0.985	0.200	2.871
Education level (tertiary)	−0.208	0.855	0.812	0.823	0.189	5.388
Tree growing experience	0.061	0.032	1.062	0.077	0.991	1.124
Forest distance from access road	−0.847	0.352	0.429	0.028*	0.213	0.848
Access to market information (yes)	−0.594	0.632	0.552	0.33	0.331	3.945
Harvesting age	−0.103	0.171	0.902	0.552	0.608	1.19
Motivation for decision to sell (tree maturity[1])	2.594	0.875	13.385	0.011*	1.215	7.471
Motivation for decision to sell (poor stand performance)	0.638	0.717	1.894	0.371	0.377	6.261
Tree farm-land size	−0.02	0.206	0.98	0.929	0.685	1.538
Approach of accessing buyer (buyer looked for me)	1.452	0.64	4.272	0.034*	1.014	12.437
Type of forest product sold (sawlogs)	−2.765	1.395	0.063	0.048*	0.006	1.474
Type of forest product sold (building poles)	−1.609	1.421	0.2	0.266	0.016	4.257
Type of forest product sold (timber)	−2.952	1.436	0.052	0.041*	0.004	0.995
Constant	1.841	2.523	6.306	0.248		

Note: B, the coefficient; S.E., standard error; *p* value, probability value; Exp (*B*), exponentiation of the *B* coefficient (odds ratio—OR).
[1]Tree maturity was relative to target products.
*Significant at 5%.

collective marketing and transportation. Other constraints reported in literature include high storage costs, information asymmetries, and costly processing technologies [3, 15, 80]. The failure to sell to retail outlets may have been due to the relationship that exists between intermediaries and retailers. It is possible that retailers prefer to deal with intermediaries because of certainty of quality and supply. In our interviews with tree farmers, it was noted that the intermediaries are very powerful in determining wood product market. Some of them work as agents of wholesalers and benefit through commissions, hence hindering farmers from directly selling to wholesalers and retailers. Such barriers generally limit existing farmers and may discourage new farmers from engaging in tree farming for wood because of the fear of not being able to sell their forest products in the preferred markets. It is, thus, important to facilitate affordable technologies and improve market information systems to support farmers in accessing their preferred markets and capture better returns [15, 80].

Farmers that targeted to sell forest products from the farm gate were predominantly female. This could be attributed to gender-specific barriers that constrain women's access to markets, including limited access to resources, restrictive social norms and cultural expectations, and inadequate access to information and training. Furthermore, women are often excluded in decision-making forums which restricts their exposure to information that could support informed marketing decisions [81]. As a result, their capacity to actively seek out buyers is reduced. Despite recent progress toward gender inclusivity in forestry, the sector continues to be perceived as a masculine domain [82, 83]. Interventions should therefore support women's participation in tree farming and market engagement through training, improved access to resources, and inclusion in decision-making forums.

4.2 | Participation in the Price-Setting Process

Farmers differed in their ability to participate in the price-setting process. The majority of those that were able to participate in the wood price-setting process had forests located close to access roads or were directly approached by buyers. In contrast, farmers with tree stands farther from access roads had less bargaining power, as buyers were better positioned to set prices. Similar to findings elsewhere [63, 64], this can be explained by the higher transaction costs borne by buyers, particularly the expense of hauling wood to main roads for further transportation. Similarly, Getahun [70] observed that shorter distances to roads reduced farmers' transaction costs and increased bargaining power, while Anyonge and Roshetko [39] and Scherr [21] emphasized that high transport costs relative to product value are typically shifted to producers through lower prices. Moreover, few buyers are willing to incur the extra transaction costs of reaching remote woodlots, which reduces demand and further depresses prices for producers in such areas.

Tree farmers who sold due to stand maturity were more likely to participate in price-setting processes than those making distress sales driven by socioeconomic needs. Mature stands allowed farmers time to gather price information, seek buyers offering better returns, and access a wider range of product options. By contrast, distress sales reflected limited livelihood options and reliance on trees as financial safety nets during urgent needs such as weddings, funerals, illness, or education [15, 73]. In such cases, immediate cash requirements outweighed market considerations, leading farmers to accept any price offered [84–86]. This undermined their ability to obtain market information and weakened bargaining power. The findings indicate that farmers sought out by wood buyers were more likely to influence prices

than those who actively searched for buyers themselves. Farmers controlling supply during periods of scarcity were able to negotiate better prices, whereas those harvesting when demand was low had less bargaining power. In Kenya, for example, farmers who sought out buyers often received lower offers because they were perceived as desperate [80]. Conversely, buyers scouting villages for mature tree stands were seen as more desperate for wood, enabling farmers to negotiate favorable prices [87–89]. These findings highlight the central role of interaction between demand–supply dynamics and the TCT in determining farmers' ability to participate in setting prices for their products.

Farmers selling firewood were generally in a better position to influence prices than those selling timber or sawlogs. Firewood demand was high, driven by local consumers and enterprises such as brickmaking, schools, and bakeries, alongside widespread energy scarcity as over 80% of Ugandan households rely on biomass energy [90–92]. Similarly, Scherr [21] noted that small-scale farmers benefit most by producing products demanded locally. It is, therefore, important for farmers to align their management objectives with market trends, prioritizing high-demand products such as firewood rather than focusing solely on traditional timber products.

In this study, integration into wood markets was limited to access to target wood markets and participation in the price-setting process, as assessing competitiveness requires detailed record-keeping, which is uncommon among small-scale farmers in Uganda. Furthermore, product diversity and limited awareness of premium market prices constrained the ability to fully evaluate competitiveness. Despite this, the aspects studied provide valuable insights into small-scale farmer participation in wood markets.

5 | Conclusions

Following the findings, the study concludes that although many farmers targeted to sell at retail outlets in urban centers to maximize returns, most ended up selling at the farm gate. This outcome reflected barriers such as high transportation and processing costs, diseconomies of scale, weak collective marketing, and information asymmetries. These constraints reinforced dependence on intermediaries, limiting them from accessing target selling points. Gender disparities were evident, with female farmers disproportionately constrained to farm-gate sales due to limited access to resources, exclusion from decision-making forums, and information gaps. Participation in the price-setting process was equally not achieved by most of the farmers. Farmers located near access roads, or those approached directly by buyers, exhibited greater bargaining power than those in remote areas. Distress sales driven by urgent socioeconomic needs further weakened farmers' ability to participate in the price-setting process, while those selling mature stands were able to gather market information, compare offers, and influence prices. It is, therefore, important for government and non-governmental actors to emphasize provision and access of essential business support services such as technical support for wood production and value addition, market information, organizational support, and marketing assistance to small-scale tree farmers. This will enable them to access higher-value markets, participate more effectively in price negotiations, and reduce dependence on intermediaries. The long-term outcome is enhanced household incomes, stronger incentives for sustained tree growing, and more inclusive and sustainable forest management in sub-Saharan Africa.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data supporting this study are openly available upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. *(Supporting Information)*

Supporting Information provides additional data, methodological details, and research instruments that support the analyses presented in the main manuscript. Supporting Information 1–4 include metadata and analytical outputs related to the study sample, variables for binary logistic regression, and market access. Supporting Information 5–7 contain the data collection tools used during the study, including structured questionnaire and interview guide for different respondent categories.