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Research Article

Determinants of Highland Bamboo (*Yushania alpine*) Culm Market Supply in Semen Ari District, South Omo Zone of Southern Ethiopia

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Bamboo is among the most significant nontimber forest products that can potentially support Ethiopia's economic development and environmental protection. However, its potential is constrained by limited understanding of its importance and market development. Thus, this study was conducted to fill the knowledge gap by identifying factors affecting highland bamboo culm market supply in Semen Ari district of the South Omo zone. Multistage sampling technique was employed to draw 183 bamboo producer households from three randomly selected highland bamboo producing sites. Household surveys, focus group discussions, and key informant interviews were used to collect data. The data were analyzed by using descriptive statistics and multiple linear regression model. The result indicated that market information, extension service, land allocated for bamboo production, the experience of households in selling bamboo products, market distance, family size, sex of the respondent, and age of household head were variable that significantly affected the supply of bamboo culm to the market. Hence, enhancing the production and productivity of bamboo products through extension, regular training for farmers concerning the processing of bamboo products, improving the relationships of value chain actors, and improving infrastructure could increase producers' revenue as well as the marketed supply of highland bamboo culms.

1. Introduction

Forest resources yield both wood and nonwood forest products (NWFPs) in Ethiopia. NWFPs are important and valued resources in the country since they significantly improve the livelihoods of people by boosting household income and food security [1]. The most important nontimber forest products (NTFPs) found in Ethiopia are coffee, honey, wax, bamboo, reeds, natural gum, and resin [2]; among those, the most important NTFPs such as forest coffee, honey, beeswax, spices, bamboo, herbal cures, gums, and resins are the most commercial ones in the country [3]. One of the key NTFPs being recognized as a potential species for environmental preservation and poverty alleviation is bamboo [4, 5].

Ethiopia has two natural species of bamboo: highland bamboo (*Yushania alpina*) and lowland bamboo (*Oxythenanthera abyssinica*) [4–6]. The country has over one million hectares of highland and lowland bamboo resources, which account for about 67% of African bamboo resources and more than 7% of the world total area covered by bamboo [6]. The majority of bamboo resources are found in five regional states of Ethiopia such as Benishangul Gumuz, Oromia, Amhara, and Southern Nations Nationalities, and Peoples' Region (SNNPR) [7, 8].

Bamboo has historically been used as a building material, fences around the home and water pipes in rural areas of Ethiopia, furniture, handicrafts, and beehives in the villages; all of which support the local livelihoods of growers and traders in different ways [9–12]. The bamboo resource is

estimated to contribute an annual income of ETB 56,250,000 to the national GDP [3]. It has recently shown great commercialization potential in Ethiopia [13], and small-scale modern bamboo product processing workshops are expanding in big cities of the country [14].

The bamboo items that were given to the market were prepared and sold individually by each producer from the origin of production to the destination of sale. However, they were distributed through various marketing intermediaries from producers to consumers. The major actors in the bamboo value chain are producer farmers, village-level traders, town and city wholesalers, small-scale and medium-scale bamboo processing and marketing firms, and consumers [15]. The development of the bamboo value chain is at its infant stage, and it is practiced in a traditional way in which the farmers have the least marketing margin, the marketing system is relatively simple, and there is no large commercial need for the increased supply [5].

Production and use of bamboo in Ethiopia is underdeveloped, in contrast to other nations, and its socioeconomic and ecological potentials have not yet been fully realized [14, 15]. Despite few investigations, there is still a paucity of factual proof about bamboo's economic impact on the local, regional, and governmental levels. The majority of bamboo's current usage in Ethiopia is restricted to its traditional applications, which include hut construction, fencing, beehive construction, and the manufacture of home and office furniture [4, 5, 16].

There are persistent issues with the expansion of the bamboo industry in Ethiopia, including a lack of understanding of the socioeconomic significance of the country's bamboo resources among stakeholders and a lack of connections between policymakers and other organizations [12, 17, 18]. Likewise, the country has a weak bamboo value chain [9, 13], and the ones that are already in place have poor vertical and horizontal integration [15]. The main obstacles to the Ethiopian bamboo value chain are the absence of market information, uneven laws and regulations, and the location of craft stores near the resource [3]. Only one-third of Ethiopia's entire production of bamboo is made accessible to the market; the remainder is used by households [5, 15, 16, 19]. The socioeconomic and exogenous elements at the household level, such as the size of the leased land area, the number of household members, market access, knowledge, and livestock ownership, had the greatest impact on the contribution of bamboo to household income [15, 20].

According to the Woreda agricultural development office report in 2021, more than 900 hectares of land is covered by highland bamboo in Semen Ari district, and most of the people in the area use highland bamboo for different purposes such as house construction, fence, and fuel wood. Despite being important to many farmers' livelihoods and serving as a flexible crop and a source of income at the research site, highland bamboo has not received the attention it deserves. Additionally, there is little to no empirical data on the variables that affect the availability of bamboo items on the market. Thus, this study was carried out to provide empirical evidence regarding the factors that affect the supply of bamboo products to the market.

2. Research Methodology

2.1. Description of the Research Site. The study was conducted in Semen Ari district of South Omo, Southern Ethiopia. Semen Ari district is one of the 11 districts of South Omo zone. The total land area of Semen Ari district is 28,123 hectares. Altitude ranges between 1,470 meters to 3,300 meters above sea level (m.a.s.l). The administrative seat of the District is Gelila Town located 602 kilometer southwest of the national capital and 356 kilometer from the capital of Southern Ethiopia. In terms of traditional agro-ecology classification, the district is classified into four agro-ecology zones such as *dega* (50.3%), *woina dega* (8.3%), *kolla* (37.1%), and *wurch* (4.3%). Average annual rainfall and temperature in the district varies between 876 mm and 1763 mm and 11°C and 22°C, respectively. According to Central Statistical Agency (CSA) [21], the total population of the Semen Ari district is estimated to be 85,483 (41,884 male and 43,889 female). More than 75% of the overall population lives in rural regions, and crop-livestock farming is the predominant mode of subsistence in the research site. The map of the research site is shown in Figure 1.

2.2. Data Types and Source. Primary and secondary data sources were used to gather both qualitative and quantitative data types. Household surveys, focus group discussion, key informant interviews, and field observations were used to gather primary data from bamboo farmers. The main information gathered from bamboo farmers includes details on household demographics, socioeconomics, land characteristics, relative income dependence on highland bamboo, income from other forest products, actors in the highland bamboo production-to-consumption, and variables influencing bamboo production, and market supply of its products. Secondary data sources used were journals, pertinent textbooks, bulletins, and reports from various governmental organizations, zonal and district offices of environmental protection, and forest management. All the secondary data gathered were examined and used to supplement the primary data.

2.3. Sampling Technique. The study site was purposively selected based on the bamboo production and availability. Multistage stage sampling techniques were employed to draw sample household heads. In the first stage, 15 potential kebeles in bamboo production were identified based on district information and, of those, three kebeles were randomly selected, where a kebele is the smallest administrative unit in Ethiopia. In the second stage, the number of sample households from each sample kebele was determined from the recent lists of households using a probability proportional to the size sampling technique. Given the relative homogeneity of households in terms of their socioeconomic characteristics and livelihood styles, bamboo-growing sample households were drawn using a simple random sampling method from each kebele.

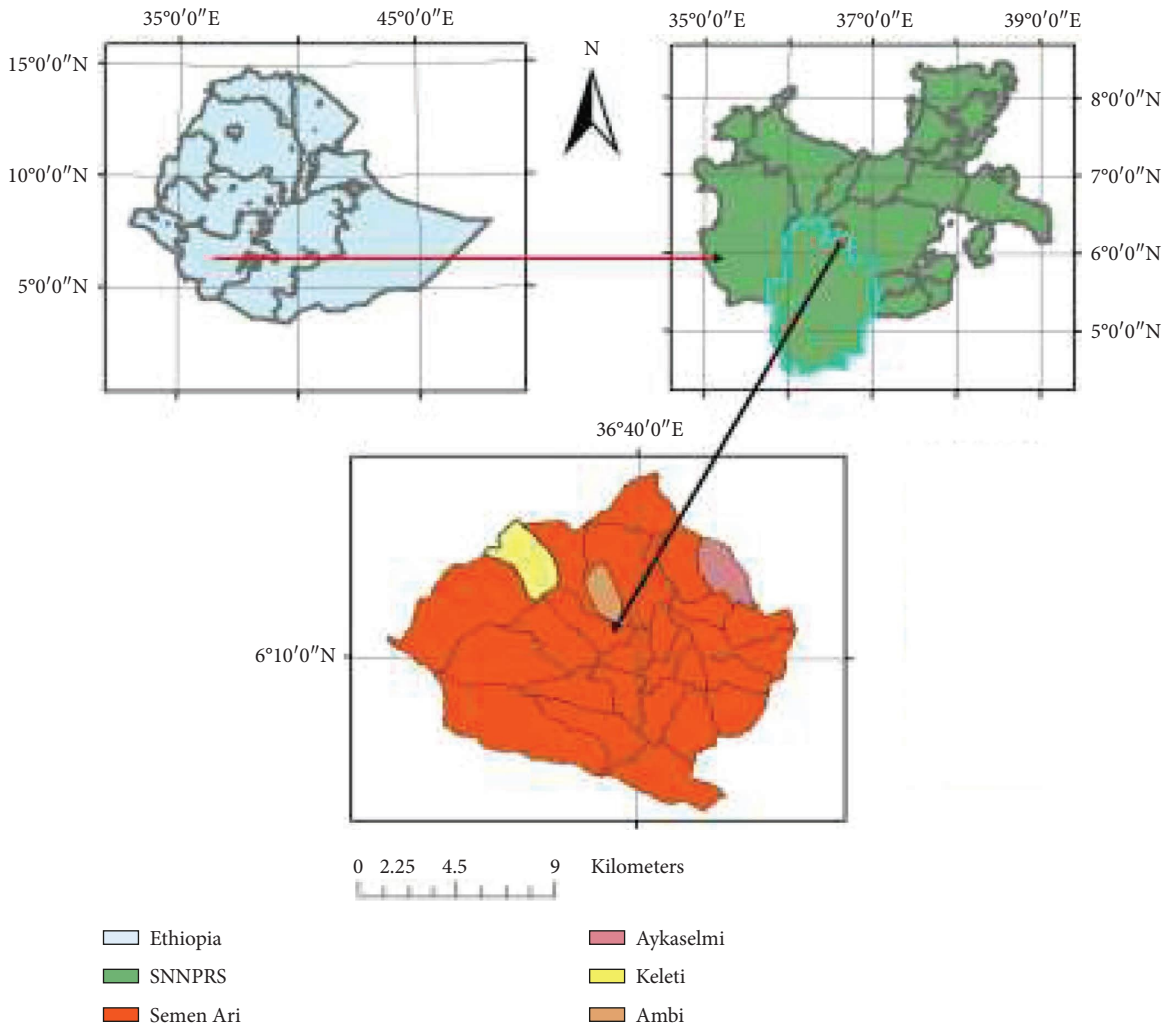

Figure 1: Map of the research site.

2.4. Sample Size Determination

2.4.1. Bamboo Producers Sampling. The degree of variability, intended confidence level, and level of precision demanded by users should all be taken into account when choosing the right sample size. Consequently, it was decided using a formula that has been provided by Kothari [22]:

$$n = \frac{z2pqN}{e2(N-1) + z2pq},$$

$$N = 2775\,HHds,$$

$$n = \frac{(1.96\text{x}1.96)\text{x}(0.5\text{x}0.5)\text{x}(2775)}{(0.07x0.07)x2775 + (1.96x1.96)x(0.5x0.5)} = 183, \quad (1)$$

where the sample size for a limited population is n. P is the population reliability (or frequency calculated for a sample of size n), where p is 0.5 which is taken for all developing countries population, and $p + q = 1$, and e is the margin of error considered which is 7% for this study. N is the size of the population, which is the total number of households. Z $\alpha/2$ is at the 0.05 level of significance, and the normal reduced variable Z is equal to 1.96.

The total households in the 15 bamboo potential kebeles are 3022, and from this, 2775 household produce bamboo.

2.5. Methods of Data Collection. All the pertinent primary data were collected using formal and informal procedures. Observing the market for bamboo products in the research site through a transact walk, conducting focus group discussions with members of predetermined social groups (elders, women, producers of bamboo, nonproducers of bamboo, traders, processors, consumers, and people with various levels of expertise) and conducting key informant interviews with residents of the research site who have lived there for a long time (the key informants were chosen using the snowball method) were among the informal data collection tools used. For household interviews, semistructured questions and checklists were employed. After completing a pretest with five sample subjects from chosen sample kebeles (kebele means the smallest administrative unit in Ethiopia),

Table 1: Variables in the multiple linear regression (MLR) model.

Variables	Measurement	Expected sign
Dependent variables		
Market supply of bamboo culm	Number of bamboo culms supplied to market	
Explanatory variables		
Sex	1 if male, 0 if female	+
Age	Years	+
Education	Years of schooling	+
Family size	Family size above 15 years (number)	+
Land cover by bamboo	Land size covered by bamboo (ha)	+
Market information	1 if market information available, 0 unless	
Extension contact	1 if have extension contact, 0 otherwise	+
Annual household income	Annual income except from bamboo sale (birr)	+
Experience	Supplying bamboo culm to market (years)	+
Market distance	Distance from home to market center (minute)	−
Price of bamboo culm	Market price of bamboo culm (birr)	+

Source: own description after extensive literature review.

the questionnaire was modified as needed. Based on their educational background and knowledge of the local language, four enumerators were chosen and provided by the researcher on the contents of the questionnaire for enumerators. Then enumerators managed data collection with the intensive supervision of the researcher.

2.6. Data Analysis. The collected data were analyzed using descriptive statistics and multiple linear regression analysis by using STATA software version 14.2.

2.6.1. Descriptive Analysis. Descriptive statistics such as mean, standard deviation, frequency, percentage, minimum, and maximum values of variables were computed to describe bamboo production in the research area.

2.6.2. Econometric Analysis. Multiple linear regression models were used to identify the factors that affect the supply of bamboo products to the market.

(1) Model Specification. The multiple linear regression (MLR) model was used to investigate the variables that influence supply to market. Because the quantity of bamboo culms supplied to the market by growers were the dependent variable and continuous variables, an OLS model was applied [23]. The details of the OLS regression are as follows:

$$\begin{aligned} Y = {} & \beta_o + \beta_1 \text{Sex} + \beta_2 \text{Age} + \beta_3 \text{Edu cation} + \beta_4 \text{Family size} \\ & + \beta_5 \text{ Experience} + \beta_6 \text{ Annual income } \beta_7 \text{ Extension contact} \\ & + \beta_8 \text{ land covered by bamboo} + \beta_9 \text{ Market information} \\ & + \beta_{10} \text{Market di stance} + \beta_{11} \text{Price of Bamboo} + Ui, \end{aligned} \quad (2)$$

where Y is the quantity of bamboo culm supplied to the market, $\beta_o$is the intercept, $\boldsymbol{\beta}_{1-11}$ is a vector of estimated coefficients of the explanatory variables, and U_i is the disturbance term.

2.7. Determinants of Bamboo Culm Market Supply

2.7.1. Descriptions of Variables and Hypothesis

(1) Dependent Variable. Marketed supply of bamboo culms which is a continuous variable reflects the quantity of bamboo culms that each household really sells on the market. Table 1 describes variables, measurement, and expected signs in the multiple linear regression (MLR) model.

3. Results and Discussion

3.1. Household and Socioeconomic Characteristics of Respondents. It is crucial to understand the essential characteristics of the sample bamboo growers. Consequently, the analysis considered factors such as marital status, market information sources, extension services, family size, experience with bamboo production, land ownership, age, sex, family size, and educational background of the respondents.

Out of the total sample households, 86.3% and 13.7% of respondents were male and female-headed, respectively. The majority of the respondents (85.7%) were married, followed by 8.7%, 4.9%, and 0.5% of widowed, divorced, and single household heads, respectively (Table 2). One of the crucial aspects of the household characteristics is age as it affects the general state of health in the community; it has an impact on the productivity of the people.

The respondents' maximum age was 69, while their minimum age was 21. The average family size of the entire sample of respondents was 7, ranging from 2 to 15, and this might help the families participate more effectively in the production and sale of bamboo (Table 2). The respondents are 44 years old on average, with a 12 year standard deviation.

The other characteristic of the sample households is the education level that the respondents attended in a number of years in school following the country curriculum. The educational background of the household heads is believed to

Table 2: Household and socioeconomics characteristic of sampled producer households.

Variables	*N*	Description	Frequency	Percent
Sex	183	Female	25	13.7
		Male	158	86.3
Marital status	183	Single	1	0.5
		Married	157	85.7
		Divorced	9	4.9
		Windowed	16	8.7
		N	Min (max)	Mean ± std
Age (years)		183	21(69)	44 ± 12
Family size (number)		183	2(15)	7 ± 4
Education level (grade)		183	0(7)	3 ± 2
Experience of in bamboo selling		183	2(13)	6 ± 3

Source: own survey, 2021.

be an important feature because as the number of grades to be attended increases, the household head may enable to accept new ideas and innovations such as various value-adding activities. Their average education level was grade 3 with a minimum of illiterate (i.e., unable to follow formal education) and a maximum of grade 7. Education and training increase work efficiency, which boosts income and food security. Additionally, education is crucial for managing a business because it affects one's capacity for decision-making [24].

3.1.1. Land Allocation. In the research area, households use their land mostly for food and cash crop production, animal grazing, bamboo production, and tree plantations. The respondents' average landholding size was 3.94 ha (i.e., between 0.625 and 10 ha), which is greater than the 1.25 ha national average for holding size per household [21]. Averaging 2.645 hectares out of the total holding, the respondents allocated the bulk of their plots for the production of agricultural crops. Bamboo plantations (0.447 ± 0.277) and eucalyptus plantations (0.651 ± 0.293) are spread across the remaining land holding (Table 3). This suggests that in comparison to the size of the ordinary landholding, the average quantity of land set aside for the cultivation of bamboo is quite tiny.

3.1.2. Extension Service and Market Information. The provision of adequate extension services for the communities improves the socioeconomic development of the communities generally and the wellbeing of the people in the communities specifically. Agricultural and natural resource offices at the zonal and district levels are in charge of offering extension services. In fact, Table 4 shows that of the total sample of bamboo producers, 14.8% of the farmers reported having extension services throughout the 2021 growing season, while 85.2% of the farmers said they did not.

All producers and traders are able to openly communicate with one another while determining pricing with the aid of a well-organized market information system. Families that have access to trustworthy market data can choose from a variety of transaction methods that will facilitate them to sell their excess bamboo and gain a variety of benefits [7]. In order to systematically gather, analyze, and distribute information pertinent to the needs of various actors, there is no structure in place, as is evident from a closer examination of market information. Despite this, more than half (56.8%) of sample respondents said they had market data from several sources (Table 4). The major sources of information were provided by traders, friends, and other market participants, with proportions of 53.6%, 6.6%, and 39.9%, respectively. This indicates that the use of alternative sources such as radio and television is lacking.

Table 3: Land allocation of the respondents.

Allocated land in hectare	*N*	Min (max)	Mean ± std
Crop production	183	0.375 (8)	2.645 ± 1.488
Bamboo production	183	0.075 (1)	0.447 ± 0.277
Tree plantation excluding *Eucalyptus*	176	0.12 (0.25)	0.148 ± 0.037
Eucalyptus plantation only	176	0.07 (1.5)	0.651 ± 0.293
Grazing land	122	0.02 (0.25)	0.124 ± 0.037
Total land size (hectare)	183	0.625 (10)	3.94 ± 1.84

Source: Own survey, 2021.

3.1.3. Highland Bamboo Supply Chain in the Semen Ari District. The market chain of bamboo products in Semen Ari highlighted the involvement of diverse actors who participated directly in the chain. According to Faida [25], the direct actors are those involved in commercial activities in the chain (i.e., input suppliers, producers, traders, and consumers). Bamboo value chain actors in the study area include bamboo producers, traders, bamboo product processors, and product consumers and as well as considered to show the relationships and integrations of the processes and activities performed along the chain. Thus, the highland bamboo supply chain is responsible for the production and distribution of bamboo culms and products in the area as presented in (Figure 2).

3.2. Determinants of Bamboo Culm Market Supply. Analyses of factors affecting the quantity of bamboo culm supply were found to be important for policy implications

Table 4: Households access for market information and extension service.

Variables	N	Descriptions	Frequency	Percent
Market information	183	No	79	43.2
		Yes	104	56.8
Source of market information	183	Traders	56	53.6
		Friends	7	6.6
		Market participant	41	39.9
Extension service	183	No	156	85.2
		Yes	27	14.8

Source: own survey, 2021.

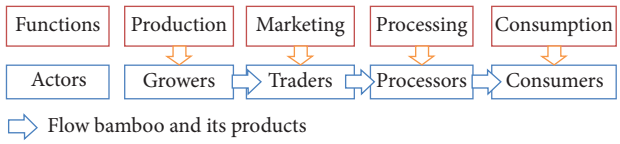

Figure 2: Bamboo supply chain in the study area.

on bamboo commercialization in the research site. In the research site, highland bamboo is produced mainly for the market and home consumption. It is one of the highest cash-earning NTFPs for producer households. According to the study findings, all the sample households supplied bamboo culms to the market during the survey period. Before running the OLS regression model, all the hypothesized explanatory variables were checked for the existence of multicollinearity and heteroscedasticity problems. The variance inflation factor (VIF) and contingency coefficients (CC) were used to check the existence of multicollinearity problems among continuous explanatory variables and dummy variables, respectively. The results for all VIF values ranged between 1.04 and 6.82, which is less than 10. Likewise, the values of CC ranged between 0.165 and 0.328, which is less than 0.75, and hence, multicollinearity was not a serious problem both among the continuous and discrete variables. The existence of heteroscedasticity was detected by the Breusch–Pagan–Godfrey test. Because the Prob > chi2 = 0.0033 or ($p = 0.0033$), i.e., the small p value (the lowest significance level) rejects the null of homoscedasticity, there is heteroscedasticity in the explanatory variables. The problem of heteroscedasticity was solved by undertaking robust ordinary least square (OLS), and hence, all the explanatory variables were included for the model analysis of factors affecting the market supply of bamboo culm.

The model was statistically significant at a 1% level of probability, as presented in Table 5, demonstrating the model's suitability for explaining the correlations between the predicted variables. The coefficient of determination evaluates the general goodness of fit of the regression model (adjusted R^2). It tells what proportion of the variation in the dependent variable, or regresses, is described by the explanatory variable. The number of explanatory variables is not very modest in comparison to the number of observations; adjusted R^2 has a tendency to present an unduly optimistic view of the regression's fit [26]. The overall model

Table 5: Determinants of bamboo culm market supply (MLR result).

Variables	Coeff.	Robust std. err.	T	$P > t$
AGEHH	3.124**	1.342671	2.33	0.021
SEHH	69.813***	24.80097	2.81	0.005
FAMSZ	20.950**	8.425674	2.49	0.014
EDULEV	−1.869	4.638269	−0.4	0.687
LACWB	316.754***	48.23972	6.57	0.001
APIOB	0.045	0.0307789	1.48	0.141
EXPHH	15.171***	5.043709	3.01	0.003
DSNMRK	−1.456**	0.5820745	−2.5	0.013
AEXSER	118.035***	33.06771	3.57	0.001
PRBC	−39.150	28.96659	−1.35	0.178
AMI	113.122***	27.14516	4.17	0.001
_cons	288.925	237.8929	1.21	0.226

Dependent variable = market supply of bamboo culm, $N = 183$, R-Squared = 0.777, Adjusted R-squared = 0.7627, and *** and ** show the values statistically significant at 1% and 5%, respectively, $p = 0.001$. Source: model output (own manipulation of survey data, 2021).

goodness of fit, represented by model count R-square, is good (76.27%). This result indicates that about 76.27% of the variation in the market supply of bamboo culm was attributed to the hypothesized variables.

Since all of the respondents included in this study delivered their bamboo culms to the market, factors affecting the supply of bamboo culms to the market were estimated using the OLS model. Only 8 out of the 11 variables (market information, extension services, allocated land for bamboo production, experience selling bamboo products, proximity to the market center, family size, sex, and age of household head) were found to be significantly affecting the household marketable supply of bamboo culms at the household level, as presented in Table 5. These findings are discussed in the sections that follows.

3.2.1. Age of Household Head (AGEHH). At the 5% level of probability, the age of the respondent had a positive and statistically significant relationship with the amount of bamboo culm delivered to the market. This means that older people contribute more than younger people do. The amount of bamboo culm offered for sale raises by three culms as the age of the respondent increases by one year while holding other variables constant. This is in line with the findings of Dessie et al. [27], who revealed a positive relationship between age of the household head and the commercialization of eucalyptus in Wogera district,

Northern Ethiopia. They concluded that due to the labor-intensive nature of the forestry industry, older households have a strong propensity to participate more in the production and selling of forest products.

In contrast to this study, Fayera et al. [18] revealed that in North Western Ethiopia, as age of household head increases, the number of bamboo culms supplied decreases by 0.091 culms, and they indicated that as age of household heads increases, fewer bamboo culms are being offered for sale. In the Illu Ababora zone, western Ethiopia, Asfaw and Lema [28] found that the possibility of households participating in NTFPs marketing was inversely connected with the age of household heads engaged in NTFP activities. The variable was predicted to have a detrimental impact on the amount of bamboo culm delivered to the market.

3.2.2. Sex of the Respondent (SEHH). The sex of the respondent was discovered to have a positive and significant impact on the market supply of bamboo culms at a 1% level of significance. The good news is that when all other factors are held constant, having a male head of household greatly improves the amount of bamboo delivered to the market by 69.8 culms. Traveling a distance to sell culms is the common practice in the research site, and this may encourage male-headed households to be more engaged in bamboo marketing. This supports Chukwuone [29] result that the gender of the respondent had a positive and significant impact on the market supply of NTFPs. The authors stated that as females often do not own land property, as a result of this, males are more likely to cultivate NTFPs than females. This will affect the amount of NTFPs that they supply to the market compared to male-headed households. In the research site, male-headed households have better economic power, land size, extension contacts, and market information compared to female-headed households. The sex of the household head had a positive and considerable impact on the quantities of papaya sold into the market [30].

3.2.3. Family Size Household (FAMSZ). The result demonstrates that family size has a positive relationship with the quantity of bamboo culm supplied for sale at a 5% significance level. An increase in family size by one individual increases the quantity of bamboo culm supplied for sale by 20.95 culms, keeping the other variables constant. This is because families with more household members tend to have more labor, which in turn increases bamboo production and then increases bamboo culm market supply. This outcome is consistent with Consult [6], who indicated that household participation in bamboo commercialization is positively correlated with family size. The study indicated that large family size is probably a factor owing to the presence of sufficient labor to transport bamboo culms from distant forests, which is required in excess for household consumption, and such families may be motivated to sell what is left over from their consumption. The outcome is consistent with research by Fikir et al. [31], who suggested that family size affects households' gross revenue from forest products positively.

3.2.4. Land Covered with Bamboo (LACWB). The result confirms the expected positive trend by demonstrating that land set aside for bamboo has a substantial impact on bamboo sales at a 1% significant level. The increase in area allotted to bamboo production is implied by the positive coefficient for this factor, which means that more culms will be available for sale. By increasing the bamboo production area by one hectare while holding all other variables constant, it was possible to raise the farm-level marketable supply of culms by 316. The idea is that if the farmers have a bigger area, they will have a better chance of allocating bigger areas for bamboo production and, as a result, will be able to produce a lot of goods that are sold on the market. This supports Toma Dilebo [32] results that coffee-growing land allocation had a positive impact on the amount of coffee provided to the market. Additionally, Kassahun and Emana [33] presented a comparable finding, demonstrating that a 0.1-hectare increase in bamboo production area led to an increase in the farm-level marketable supply of culms by 285.

3.2.5. Experience of Household Head (EXPHH). The result demonstrated that bamboo product selling experience has a significant effect at a 1% significant level on the number of bamboo culms to be sold with an expected positive sign. The result suggests that as producers have high bamboo culm production and selling experience, the number of bamboo culms supplied to the market increased as expected. One year of experience in bamboo culm selling and production increases the number of bamboo culms supplied for sale by 15.17 culms, citrus paribus. As a result of having access to more marketing networks and information, producers with more expertise in the sale of bamboo culms have a tendency to sell more bamboo culms on the market than producers with less experience. Marketing skills and experience are essential for buyers and sellers of NTFPs, and experience is an important asset for traders who remain surprisingly faithful to particular products [34]. Bamboo culm producing and selling experience significantly and positively affects the number of bamboo culms supplied to the market and households engaged in bamboo marketing for a longer time supplied more culms than new harvesters who recently started bamboo marketing [18, 33]. The study by Dessie et al. [27] shows that a household experience with *Eucalyptus* woodlot production gets more commercial benefits from it. This result was confirmed by the studies by Shumeta et al. [35] and Ayelech [36], as selling and production experience affected the amount of forest coffee and avocado delivered to the market positively.

3.2.6. Market Distance (DSNMRK). It was found to have a negative and significant effect on the amount of bamboo culm supplied to the market at a 5% level of probability. As the market distance increased by one walking minute, it resulted in a decrease in the amount of bamboo supplied to the market by 1.5 culms, citrus paribus. This is because as the market distance increases, transportation costs also increase. The longer the market distance, the higher the transportation charges increase for walking kilometers, and other

marketing costs. In line with this result, Kassahun and Emana [33] demonstrated that market distance in the Dawuro zone significantly and negatively affected the amount of bamboo culm delivered to the market. A similar issue was studied by Erifo and Amanuel [17] on the amount of bamboo delivered to the market in the case study of Gedeo Zone, which indicated a negative relationship between the market distances from the respondent's home to the bamboo market and the amount of bamboo culm supplied. The results verified that an increase in distance from the market place resulted in a decrease of 44 culms per year per household. Market distance showed a significant and negative correlation with the degree of bamboo commercialization in Awi, Sidama, and Sheka [6]. Again, Ayelech [36] indicated that market distance caused a market surplus of avocados to decline in the Gomma district.

3.2.7. Extension Services (AEXSER). At a 1% level of probability, extension services had a positive and significant effect on the market supply of bamboo culms. This indicates that producers who get more knowledge during contact with the extension agents for bamboo production methods contribute to increase the amount of bamboo production. Getachew [37] and Ayantu et al. [38] indicated that cultivators who have extension services for honey production affect the farm-level market supply of each honey significantly and positively. Development of infrastructure for linking resources, consumer centers, and extension education among producers may enhance the commercial engagement of producers and improve the accessibility of bamboo resources for commercial production [6]. According to Fikir et al. [31], households having an extension of contact are more likely to earn higher forest income and to be more dependent on forest income. Similar to this finding, Gebrelibanos [39] indicated that the frequency of extension contact has a positive and significant effect on acquiring new information or adopting a certain technology.

3.2.8. Market Information (AMI). As hypothesized initial, the market information affected marketable supply of bamboo culm positively. As bamboo producers get better market information, the number of bamboo culms supplied to the market increases by 113 culms, citrus paribus. Market information helps to acquire new ideas and information related to the bamboo market and increases bamboo culms supplied for sale.

According to Marshall [34], effective coordination and connectivity among producers and processors of nontimber forest products results in better product quality and quantity, more economical transportation, and improved negotiation power. Kassahun and Emana [33] and Erifo and Amanuel [17] reported that market information influenced the marketable supply of bamboo culm in the Dawuro and Gedeo zones, respectively. Similarly, in Homosha district, when the harvesters have better market information, they have a better probability of getting better prices, which in turn increases the market supply of bamboo culms in the district [18]. In contrast to this finding, Shumeta et al. [35] found a negative and significant relation between market information and the amount of forest coffee supplied to the market. They found when the farmers have market information, the amount of supplied forest coffee to the market decreases by 0.4 kg. According to Carr and Hartl [40], forest dwellers have no awareness of how much a consumer in a city or a developed country will pay for the finished product because they lack market information. They also have limited or no ways of negotiating for a larger share of increasing earnings.

4. Conclusion and Implication

The study revealed that most of the households engage in bamboo production and marketing as one of the main livelihood practices in Semen Ari district. The main production location is the homestead and nearby farmlands. Moreover, bamboo has an important function as a coping strategy to fill income and subsistence gaps of different categories of people for cash and subsistence. Bamboo is perceived as highly valuable in the Ari culture above all because of its hand in domestic/traditional applications. The major use of highland bamboo is for fencing, house construction, fodder, local grain storehouse "Gotera," basketry, floor mats, fuel wood, agricultural tools, beehives, furniture, granary, and household utensils. In addition to being used for subsistence, bamboo is sold on the market and is transferred from the producer to the customer through a variety of marketing intermediaries. Producers, traders, processors, and consumers were the main players in the marketing of bamboo. Estimation of the determinants of marketable supply of bamboo using robust OLS regression analysis was employed using eleven hypothesized variables. Only eight variables such as market information, extension service, allocated land for bamboo production, the experience of household in selling bamboo products, market distance, family size, sex, and age of household head were found to be significantly affected the supply of bamboo to the market. Thus, enhancing the production and productivity of bamboo products through extension, regular training for farmers concerning the processing of bamboo products, improving the relationships of value chain actors, and improving infrastructure could increase producers' income as well as the marketed supply of highland bamboo.

Data Availability

The data used for the research was added to the manuscript and published in the paper.

Conflicts of Interest

All the authors declare that they have no conflicts of interest.

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