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Research Article

Value Chain Analysis of Highland Bamboo (*Yushania alpina*) in Banja District, Awi Zone, Ethiopia

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Bamboo is one of the most important vegetation resources in highlands of Ethiopia. In Ethiopia, understanding the socioeconomic significance of bamboo resources and linkages between policy makers and other organizations is a persistent issue for the expansion of bamboo industry. This study aims at analyzing the value chain of highland bamboo originating from Banja district, Awi zone, Ethiopia. Specifically, it investigates the current value chain structure of highland bamboo and the role of actors and identifies the existing upgrading strategies along the chain, estimates the market performance, analyzes the determinants that affect the market supply of highland bamboo, and analyzes the governance structure along the highland bamboo value chain. Primary data were collected from direct value chain actors such as 122 sampled households, 13 traders, 16 processors, and 30 final users through semistructured interview schedules, key informant interviews, focus group discussions, and personal observation. Descriptive statistics, multiple linear regression, and value chain analysis were employed to analyze the data. Government offices and international network of bamboo and rattan and micro and small enterprises were support service providers. The governance structures in the bamboo value chain differ from one stage to the other stage. The result of multiple linear regression model indicated that the land size allocated for bamboo plantation, number of culm harvested, access of market information, and silviculture management practice positively affected the market supply of bamboo culm, whereas distance to the market affected the market supply of bamboo culm negatively and significantly. Based on the findings of this study, designing policies help to increase farmers' knowledge and skills through capacity building and help to improve information access, silviculture management practice, and market supply of culm.

1. Introduction

Bamboo is one of the most important vegetation resources in highlands of Ethiopia with diverse local and national importance in terms of filling subsistence needs and cash income [1]. Ethiopia is the largest bamboo producer in Africa, which is estimated to 1.5 million hectares, and it accounts 4.2% of the world bamboo resource and 8.3% of the country's total forest area [2]. Mainly, *Yushania alpine* (referred as highland bamboo) and *Oxytenanthera abyssinica* (lowland bamboo) are the dominant bamboo species in the country. *Yushania alpine* can grow naturally in highland agroecological zones of 2,200–3,500 meters above sea level. Bamboos resource is important for ecosystem services, biodiversity conservation, soil and water conservation, and socioeconomic development [2]. *Yushania alpina and Oxytenanthera abyssinica* (A.Rich Munro) are distributed in South, South West, and the central parts of Ethiopia, which includes Benishangule Gumuz, Oromia region, southern nationalities, and Amhara region [3]. The demand and supply of bamboo is limited at local market and the market system is on a small base related to the market connections with geographic locations, distribution, and customers [4].

In Ethiopia, the production and use of bamboo resource is not developed and its socioeconomic and ecological importance have not yet been fully realized [5, 6]. In Ethiopia, understanding the socio economic significance of bamboo resources and linkages between policy makers and other organizations is a persistent issue for the expansion of bamboo industries [4, 7, 8]. Absence of market information, uneven laws and regulations, and the locations of craft stores near to the bamboo resource are the main obstacles for Ethiopian bamboo value chain [9].

Due to the lack of scientific information about the production to consumption system of bamboo products and its role for the improvement of rural livelihoods and national economy, the bamboo production, processing, and its marketing remain under developed [6]. Due to the abundant resource base and the growth of domestic and global markets for the traditional and industrial bamboo products, its commercialization in Ethiopia holds immense potential for promoting rural development and national economy. However, there is lack of an enabling value chain, technological and institutional innovation, and efficient marketing system to link smallholder bamboo producers with the growing markets [6, 10].

The quality of bamboo product is not consistent due to proper harvesting and lack of proper storage facilities before bamboo culms processed in to desired value added products [5]. Absence of value added production system and poor market linkage, low participation of actors along the chain, and low value addition practice were the major limiting factors for bamboo poles [6, 11].

Mostly value chain research on investment focuses on upgrading and development [12], specifically supporting small scale farmers in rural areas, where these producers categorized as disadvantaged actors in the chain. Value chain analysis is a typical methodology and which helps to improve livelihood and poverty reduction [13, 14]. Understanding the interactions of actors within a value chain helps to identify various factors that influence how the chain works [15]. Upgrading in agricultural value chains is related to changing the production process to improve the productivity and to meet the standards of domestic and international market and food safety measures [16, 17]. In Awi zone, bamboo producers sell their bamboo culms to local collectors and these collectors sell the bamboo to bamboo processors [18]. Low knowledge about the creation of value to the product, irregular market demand and existence of weak markets relationship for bamboo culms and its products, and poor infrastructural facility affect the benefit distribution among actors. Policy design and make intervention helps to improve the contribution of bamboo products, which needs understanding of the existing value chain structure, performance, and benefit distribution along the chain. Therefore, based on cross-sectional study design, conducting this research is an imperative to identify actors and value share distribution, analyze the governance structure, upgrading strategies in bamboo value chain and analyze the determinants for smallholder market supply of highland bamboo culms in the study area.

2. Research Methodology

2.1. Description of the Area. Banja district was selected for this study (Figure 1). It has 25 rural and 1 urban kebeles. From the total kebeles, highland bamboo is produced in 20 kebeles. From north-west of Addis Ababa and Bahirdar city, it is around 442 kms and 116 km, respectively. The total population of the Woreda is estimated at about 315,271, 5% in towns and 95% in rural areas. From the above population, 187,213 are females and 128,058 are males, respectively, and average family size is 7 people as per [19].

2.2. Sampling Procedures. Initially, potential bamboo producer kebeles were identified and four kebeles were selected from 20 bamboo producer kebeles randomly. Kessa Chewusa, Gashena Akayta, Ledeta, and Surta were the sample kebeles. Then, populations were listed out and 122 sample producers were selected randomly. Yamane [20] was used to determine the producer sample size. In the study area, totally 6,690 farmers produce high land bamboo.

$$n = \frac{N}{1 + N(e)^2}, \tag{1}$$

where N is the target population, n denoted the number of sample size, and e is the level of precision which is 9%

$$n = \frac{N}{1 + N(e)^2} = \frac{6,690}{1 + 6,690(0.09)^2} = 122\,\text{HHS}. \tag{2}$$

In addition to the bamboo producers, other actors were interviewed during the survey time. From the district trade permission and registration office, there is no clear and accurate data in order to select bamboo traders. Therefore, by using snowball sampling technique, three wholesalers, five retailers, and five local traders were selected and sixteen processors were selected purposively, i.e., three modern furniture enterprises and thirteen traditional bamboo processors were selected based on their location because bamboo processors were found at Kessa town near to Injibara and in Injibara town. Finally, 30 bamboo product users were selected purposively based on their business type.

2.3. Method of Data Collection. In this study, both primary and secondary data sources were used during data collection. Primary data were collected from bamboo producers, traders, processors, and craftsmen, through semistructured interview schedule, field observation, and four focus group discussions with 10 members in each group also conducted to triangulate the data. Key informant interview was also conducted with experienced farmers, traders, and experts at different government administrative systems and nongovernmental organizations. In-person interview was conducted with key informants. Checklists were prepared and used for key informants and focus group discussions. Rapid market survey was conducted to collect primary data. During the household survey, the following issues were included: Households socioeconomic characteristics, bamboo production system, variables affecting bamboo production and the market supply

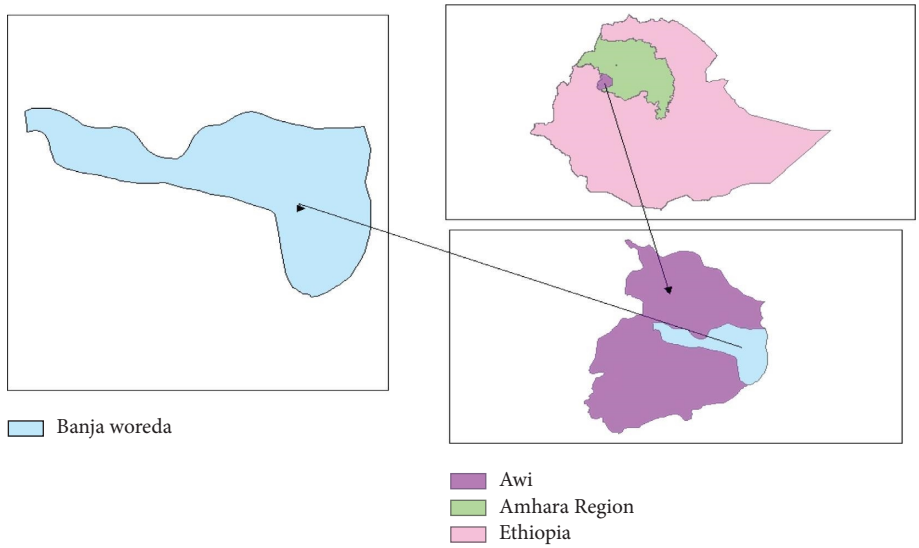

Figure 1: Map of study area. Source: manipulated from Ethiopian map.

of bamboo culms, annual bamboo culms produced, used, and sold, price of bamboo culms and other bamboo products, amount of income gained from different bamboo products, bamboo trading issues, and value chain actors and their roles. To support the primary data, secondary data were collected from different office reports and published materials and books. Four data collectors who have diploma and degree were selected and trained for data collection. Pretests were conducted by asking few respondents to assess the relevance of the questionnaire, clarity, and its contents.

2.4. Methods of Data Analysis

2.4.1. Descriptive Analysis. Descriptive analysis, value chain analysis, qualitative analysis, and econometric analysis were the method of data analysis used in this study. Descriptive statistics includes tables, means, standard deviation, and percentages were used to summarize the distribution of numeric data. In qualitative analysis, data were analyzed by using thematic analysis. It was conducted by identifying concepts, relationships, and patterns from the texts as themes. The data obtained from focus group discussions and key informants were narrated through interpretations. The most common value chain studies include value chain mapping, analyzing the benefit distribution for each actor, identifying the practice of value chain upgrading, and identify the governance structure along the chain [3]. Value chain analysis helps to identify chain actors with their roles and analyze the horizontal and vertical linkages among bamboo value chain actors, product, money and information flow, upgrading strategies, and governance structure and value addition at different stages of value chain.

2.4.2. Market Performance Analysis. Marketing margin is the percentage of the final weighted average selling price taken by each stage of the marketing chain. It is the difference between what consumers paid what producers received for their goods [21]. Marketing margin analysis focuses on the share of the final selling price that a certain agent in the market chain can obtain [22].

Estimating the market margins helps to analyze the performance of bamboo market. The total gross marketing margin (TGMM) is linked to the end price paid by the end buyer and which can be expressed as a percentage of consumer price [23].

$$\text{TGMM} = \frac{\text{Consumer price} - \text{producer price}}{\text{Consumer price}} * 100. \quad (3)$$

(1) Gross Marketing Margin of Producers (GMMP). It is the proportion of the price paid by consumers that goes to the farmers.

Mathematically, producers' share can be expressed as follows:

$$\text{GMMP} = \frac{\text{Consumer price} - \text{gross marketing margin}}{\text{Consumer price}} * 100,$$
$$\text{Or GMMP} = 1 - \text{TGMM}, \quad (4)$$

where TGMM represents the total gross marketing margin of bamboo market and GMMP represents the gross marketing margin of bamboo producer.

In order to analyze the margins, first total gross marketing margin (TGMM) should be calculated as depicted in (3). Then, marketing margin at a given stage "i" (GMMi) can be calculated as follows:

$$\text{GMMi} = \frac{\text{SPi} - \text{PPi}}{\text{TGMM}}, \quad (5)$$

where SPi denoted the selling price at i^{th} and PPi is the purchasing price at ith link.

2.4.3. Econometric Analysis. All sampled producers supply bamboo culms to the local and district market. Therefore, the number of culms supplied to the market by each

producer is the dependent variable, which is a continuous variable measured in number of bamboo culms. Multiple linear regression model was used to analyze the factors that affect the market supply of highland bamboo culm. It is applied when all of the producers supply the bamboo product to the market [24]. Therefore, multiple linear regression model is fitted with the survey data to analyze the determinants of market supply of bamboo culms. The multiple linear regression model specification is as follows:

$$\begin{aligned} Y = {} & \beta o + \beta 1\text{Age} + \beta 2 \text{ education level} + \beta 3 \text{ Family size} + \beta 4 \text{ number of culm harvested} \\ & + \beta 5 \text{ access to market information} + \beta 6 \text{ price of bamboo culms} + \beta 7 \text{ silviculture management} \\ & + \beta 8 \text{ frequency of extension contact} + \beta 9 \text{ land allocation for bamboo plantation} \\ & + \beta 10 \text{ value addition} + \beta 11 \text{ distance to the market} + \varepsilon i, \end{aligned} \tag{6}$$

where Y is the number of bamboo culm in number supplied to the market, β_o denotes the intercept, β_1-β_{11} denote vectors of estimated coefficients of independent variables, and εi represents the unobserved disturbance term.

2.5. Description of Variables and Hypothesis

2.5.1. Quantity of Highland Bamboo Culms Supplied to the Market (QBCS). It is a continuous variable that represents the dependent variable and the actual supply of bamboo culms by individual households to the market, which is measured in number of culms supplied to the market. As indicated in Table 1, explanatory variables were hypothesized.

3. Results and Discussion

3.1. Highland Bamboo Value Chain Map. In the study area, the value chain of bamboo is complex due to the involvement of various intermediaries until the product reached to the final users. In each stage of bamboo value chain, information, product, and money flow from one actor to the other (Figure 2).

3.2. Bamboo Value Chain Actors, Their Roles, and Upgrading Initiatives. In bamboo value chain, main and supportive actors were identified. These main actors include: input suppliers, bamboo producers, traders (wholesalers, retailers, and local traders), traditional bamboo processors, private and cooperative bamboo furniture enterprises, and end users. Different support service providers also identified during the survey time. These are agriculture offices, non-governmental organizations, small and microenterprises, TVET, and others. The roles of these actors were analyzed as follows.

3.2.1. Input Suppliers. These are the actors who provide bamboo seedlings to producers. Majorly producers use their own seedlings. In addition, agricultural office provides bamboo seedlings for producers. Almost all farmers use their family labour for land preparation, weeding, transplanting, cutting, harvesting, and other farming activities. In the area, farmers purchase bamboo seedlings from bamboo seedling stations.

3.2.2. Bamboo Producers. The bamboo producers cultivate the bamboo in their private land (Figure 3). The major activities performed by bamboo producers include land preparation for planting of bamboo, practicing different silviculture management activities such as removing aged bamboo culm, thinning, fencing the bamboo production site to protect it from different attack or tending, weeding around the new bamboo shoot, properly cutting and harvesting, producing value added bamboo products such as basket, tables, and others, and participating in the marketing of bamboo and its products. These are some upgrading initiatives practiced at producer level. Generally, the silviculture management activity is very limited to improve the amount of culm production in the area. Producers sell the culm to different buyers at farm gate market, local market, and district market area.

3.2.3. Village Traders. These are the traders who purchased and collected bamboo culm from the producers. They sold bamboo culm to wholesalers and processors in the district. Purchasing, drying, and storing are the main functions of these traders. These traders on average handled 2,460 culms with standard deviation of 1,358.92 culms.

3.2.4. Retailers. These traders purchase bamboo culm from village traders and producers and sell to processors and end users of bamboo culm. On average, they handled 4,200 bamboo culms with a standard deviation of 2,136 culms per year. They purchase bamboo culms from local market and sold bamboo products for house construction, wholesaling, or processing purposes.

3.2.5. Wholesalers. These are the traders who purchase bamboo culms in large amount from producers and other traders and they sell in the district and out of the region. On average, they handled 9,667 bamboo culms per year and the standard deviation is 2,013.289 bamboo culms. Traders practiced some upgrading strategies to earn higher profit

Table 1: Descriptions of explanatory variables.

Variable	Type	Measurement/code	Expected sign	Source
Quantity of culm supplied	Continuous	Number of culm		
Age	Continuous	Years	−ve	[4]
Education level	Categorical	1 = can't read and write 2 = can read and write 3 = attend primary school 4 = attend 2ry school	+ve/−ve	[25]
Family size	Continuous	Man equivalent	+ve/−ve	[26]
Number of culm harvested	Continuous	Number of culm	+ve	[27]
Access to market information	Dummy	1 = yes, 0 = otherwise	+ve	[28]
Price of bamboo culm	Continuous	Birr per culm	+ve	[6]
Silviculture management	Dummy	1 = yes, 0 = otherwise	+ve	[27]
Frequency of extension contact	Continuous	Number of contact in a year	+ve	[4]
Land allocation for bamboo	Continuous	Land size allocated for bamboo plantation in hectare	+ve	[29]
Value addition	Dummy	1 = yes, 0 = otherwise	−ve	
Distance to the market	Continuous	Walking hour	−ve	[29]

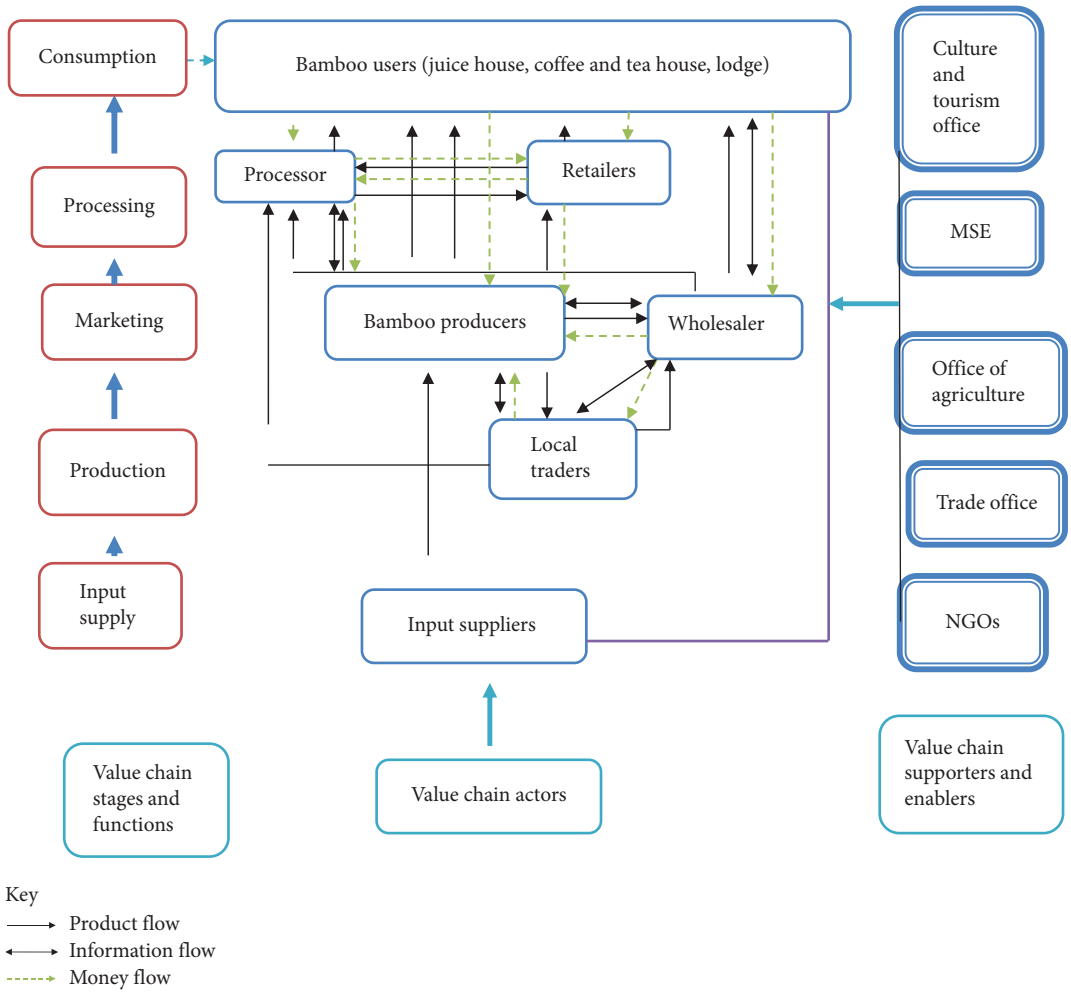

Figure 2: Highland bamboo value chain map in Banja district. Source: field survey, 2020.

margin along the chain. Some traders take factor of production from Awi zone and they produce different value added bamboo products at the different parts of the country. The recent upgrading initiatives include collective marketing, i.e., group transportation to reduce the cost transportation.

Figure 3: Bamboo production.

3.2.6. Bamboo Processors. The bamboo product produced by the processor includes traditional and modern bamboo chair, bed for children and adult person, shelves, rattan, TV stand, umbrella, book rack, cloth hanger, baskets, food containers, flower pots, and beehives. Processors on average produce 637 and 823 three-legged seaters and single seater modern bamboo chairs, respectively (Figures 4 and 5). Bamboo processors practice different combinations of upgrading initiatives to get competitive advantage in bamboo market. For example, processors made an effort to improve their linkage with buyers of the value added bamboo products. It enables them to reduce the cost of processing and obtain quality raw materials from the suppliers; in addition to this, the bamboo processors especially the furniture enterprises have good relationship with the buyers of processed products even if it is seasonal. In addition, processors attempt to develop new products and resource development to improve production and quality of the product.

3.2.7. Consumers. These are the final users of bamboo and its products. Consumers purchase bamboo and its products from producers and traders and directly from bamboo product processors. In the district, the users of bamboo product include coffee and tea house, loges, and youth dodgem center and juice hut. Youth dodgem center and lodges are the users of raw bamboo culms to build a bamboo hut for coffee and tea house. The users of bamboo culms reported that the bamboo culm is a preferable product to build different lodge and youth dodgem centers. Bamboo culm is used to make attractive lodge by combining with tin and other materials. Bamboo product users purchased raw bamboo culms and other processed bamboo products.

3.2.8. Support Service Providers. These are people and organisations that provide different services to the other value chain actors. The service provided by these actors include providing training to improve the capacities of producers and small agro businesses, providing market information, and linking small scale producers with markets. In the study area, district agricultural office and governmental and nongovernmental organizations such as International Network of Bamboo and Rattan (INBAR), German Society for International Cooperation (GIZ) and district culture and custom office, district trade office, small and microenterprise office, and Injibara Technical

Figure 4: Traditional bamboo product producer.

Figure 5: Adding value by using blower.

and Vocational Education (TVET) College support bamboo producers in different ways.

3.2.9. Agriculture Office. It provides extension service in the form of training to increase the production of bamboo products. The office also provides bamboo seedlings to farmers.

3.2.10. International Network of Bamboo and Rattan (INBAR) and German Society for International Cooperation (GIZ). These are nongovernmental organizations which provide trainings for the bamboo producers and processors about bamboo propagation and utilization and these organizations also provide different services for the craft persons in the study area to improve their skill and knowledge in bamboo processing activities.

3.2.11. District Culture and Tourism Office. It has its own role in bamboo value chain. The office tries to make promotion activities to create awareness for the city as a source of potential bamboo raw material and to link the value added bamboo products to the market. It uses an umbrella which is made from bamboo for advertising the culture of the community and multipurpose of bamboo products (Figure 6).

3.2.12. The District Trade Permission and Registrations Office. It plays a great role in bamboo production and utilization. The office registers traders, gives permission, and renews the trade license. The offices also punish unlicensed bamboo traders to keep the security of licensed bamboo traders.

3.2.13. Injibara TVET College and Micro- and Small-Enterprise Office. The micro- and small-enterprise office together with the Injibara TVET provide industry extension service, training on entrepreneurship, awareness about bamboo products, technical support, working place for cooperative enterprises, and kaizen principle application mostly for bamboo processors and support the processors by delivering technology such as drill machine and other necessary materials. The TVET college and micro- and small-enterprise office perform different activities to change the job abnegate culture of the community.

3.2.14. Chain Influencers. These actors include regulatory service providers, land tenure security right, legal service, and security for actors. These conditions include property rights, business registration, transportation and communication system, and market place development and facilitate the market linkage of producers with the market.

3.3. Bamboo Market Channels and Performance Analysis

3.3.1. Bamboo Market Channels. The pattern of bamboo products value chain originating from Awi zone was relatively longer and complex. It is characterized by (1) bamboo culms which are produced by producers and sold to different market actors; (2) culms are processed by processors and sold to either retailers or end users; (3) raw bamboo culms and value added bamboo products are transported by traders to other parts of the country; (4) traders purchase bamboo culm, transport to other area of the country, and produce value added bamboo products. The total number of bamboo culms supplied by producer to the market was 45,746 culms. Market channel provides information about the distribution of goods and services from the production area to the final destination. Bamboo producers used different market channels to sell their product. In Banja district, bamboo products flow in the channels as shown in Figure 7.

3.3.2. Marketing Margin at Traditional Bamboo Processing and Furniture Enterprise Level. From the total gross marketing margin, the share of the producer is 18.56% and the processors share the largest value (40.47%) because more value adding activity is done at processing stage. Local traders share the lower value (11.44%) than wholesalers (14.11%) and retailers (15.42%) (Table 2). The variation of the market margin between producers and processors is directly linked with the practice of value addition on bamboo production and processing and the existence of weak linkage among value chain actors. As indicated, in this study, we found the existence of unfair and excessive margin captured by specific middlemen. Solomon et al. [8] indicated that producers marketing margin was 15.4% while traders and processors share 36% and 48% of total gross marketing margin, respectively.

From the total gross marketing margin, producers share the minimum value (4.11%) and the bamboo furniture enterprise shares the highest value (87.3%) (Table 3). It indicated the existence of unfair and excessive margin captured by a specific actor. It also indicated that more value added bamboo product leads higher price for the processor because it is required by customers. According to Tsadiku et al. [30], the producers marketing margin was 42.86%. As compared to this finding, the marketing margin of producers in the study area was 18.56% and 4.11% at traditional and modern furniture enterprise level. It indicated that absence of linkages among bamboo producers and processors.

Based on the results indicated in Tables 2 and 3, the gross marketing margin bamboo furniture enterprise (87.3%) is greater than the gross marketing margin of traditional bamboo product processors (40.47%).

3.4. Value Chain Governance in Bamboo Value Chain

3.4.1. Horizontal Coordination. Horizontal cooperation among actors in bamboo value chain was very weak because of the existence of limited cooperation for group marketing and collective action. Sometimes bamboo producers used informal cooperation for group marketing to transport bamboo culm by animal cart from distant area to the market. Due to the presence of competition among bamboo traders and processors, the collective trading and processing is very limited. Like bamboo producers, traders used informal

Figure 6: Umbrella made from bamboo which is used to advert the multipurpose of bamboo products in the area. Source: field survey result, 2020.

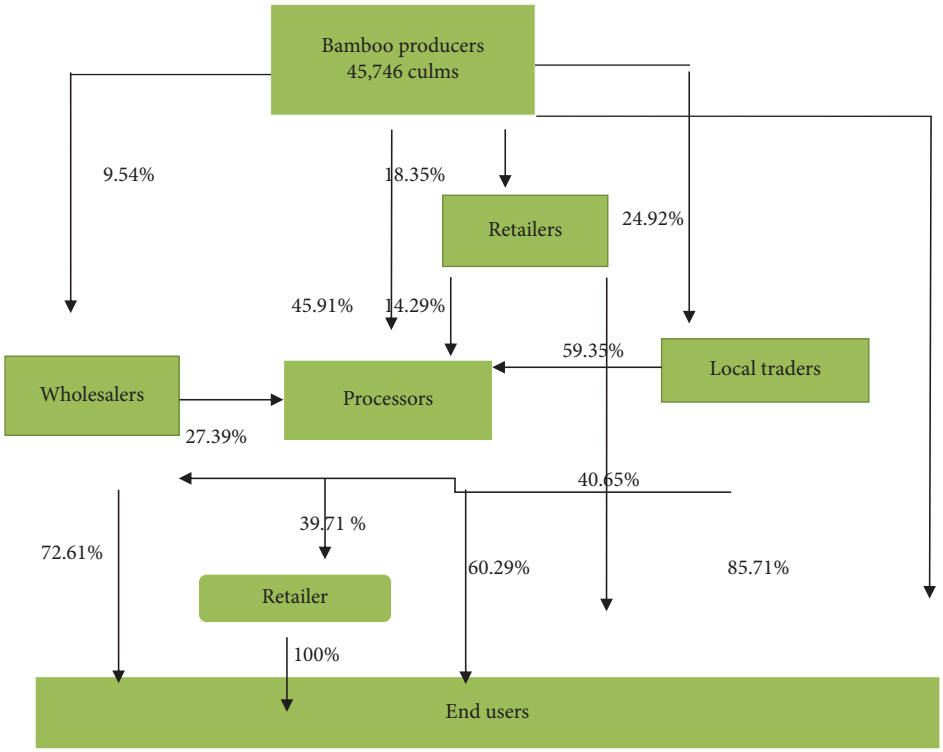

Figure 7: Marketing channels of bamboo. Source: field survey result, 2020.

Table 2: Estimating marketing margin for bamboo culm at traditional bamboo processing level.

Actors	Purchasing price per culm	Selling price per culm	Marketing margin (ETB)	Gross marketing margin (%)
Producers	—	20.34	—	18.56
Local traders	22.4	27	4.6	11.44
Wholesalers	23.33	29	5.67	14.11
Retailers	24.6	30.8	6.2	15.42
Processors	23.93	40.2	16.27	40.47

Source: field survey result, 2020. Note. TGMM = 40.2−20.34/40.2 ∗ 100 = 49.4%.

Table 3: Estimating the marketing margin at bamboo furniture enterprise level.

Actors	Purchasing price/culm	Selling price/culm	Marketing margin (ETB)	Gross marketing margin (%)
Producers		20.34	—	4.11
Local traders	22.4	27	4.6	2.39
Wholesalers	23.33	29	5.67	2.96
Retailers	24.6	30.8	6.2	3.24
Furniture enterprises	24.34	191.67	167.33	87.3

Note. TGMM = 191.67−20.34/191.67 ∗ 100 = 89.39%. Source: field survey result, 2020.

cooperation to share the market information and to transport the product in group by a truck because the transportation cost is high for individual traders. Among the bamboo furniture enterprises, there is no formal and informal cooperation. They simply purchase raw materials from the market and produce different bamboo products and sell to their customers.

3.4.2. Vertical Coordination. The survey result shows that different forms of coordination were exist along the bamboo value chain. In the study area, bamboo producers sell the bamboo culm to traders and processors at the farm gate and local market both in the form of cash credit and advance payment. Among the sampled households, about 77.9% of the household sell the bamboo culm in cash and the remaining 22.1% of the household receive advance payment and credit to sell bamboo culm. It indicates the presence of market coordination governance structure (Figure 8).

Most of the bamboo producers (75.4%) have no form of relationship with the buyers and 24.6% of the bamboo producers have informal linkages with the buyer which is informal, verbal, and trust-based agreement; it also indicated the presence of spot market governance structure which is the dominant governance structure between the producers and buyer of the bamboo culm (Table 4). Similarly, a study conducted by Berihu et al. [31] found that market governance structure was existing between cotton producers and Ginners. In addition, Kodigehalli [32] also reported the existence of market coordination between coffee producers and the downstream buyers. Marcellinus et al. [33] found the existence of market-based governance structure between bamboo farmers and collectors.

About 53.8 and 46.2% of traders sold their products in the form of cash and both cash and credit payment forms, respectively. It indicates the presence of captive relationship between the traders and the downstream buyers because traders have informal trust-based contract with the downstream buyers (Figure 9). Berihu et al. [31] found the existence of captive governance structure among cotton value chain traders and buyers.

Most of the bamboo processors have better relationship with the downstream buyers of the bamboo products but it is informal based on verbal and trust-based agreement. Among the sampled producers, 53.8% of the bamboo processors have good relationship with the buyers of their product and 46.2% of bamboo processors have no relationship with buyers of the product. Processors sell their product in different forms of payment, i.e., 46.2% of the processors sell the

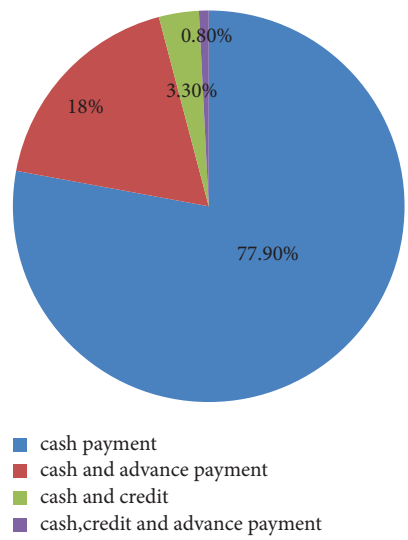

Figure 8: Form of payment or transactions between producers and buyers.

Table 4: Nature of relationship between producers and buyers.

Nature of relationship	Number	Percent
Informal, verbal, and trust-based agreement	30	24.6
No form of relationship	92	75.4

bamboo products in cash payment, 7.7% of the processors sell their product in cash and credit form, and the remaining 46.2% of the traders sell the bamboo products in the form of cash and advance payment. It indicates that most of the bamboo processors are linked to the downstream buyers of the product in advance payment and credit to operate their business properly. It indicates the presence of captive governance between the bamboo processors and buyers of bamboo products (Table 5). Captive governance exists when there is credit and advance payments form of transactions which creates interlocking mechanisms that often happen in all the value chain stages which is common in in agricultural value chains in less developed countries [34].

Most of the bamboo furniture enterprises (66.7%) have good relationship with the buyers of the product which is trust based and verbal agreement. All of the bamboo furniture enterprises receive advance payment and sell the product in cash and credit form. It indicates that bamboo furniture enterprises are linked with the downstream buyers by advance payment and credit and there is captive form of

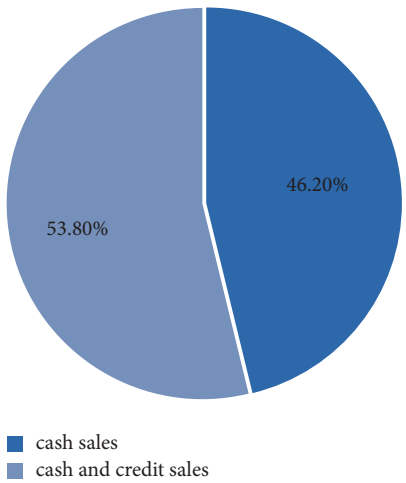

Figure 9: Form of transactions between traders and downstream buyers.

Table 5: Relationship and form of payment between bamboo processors and buyers.

	Number	Percent
Relationship		
Yes	7	53.8
No	6	46.2
Form of payment		
Cash payment	6	46.2
Cash and credit	1	7.7
Cash and advance payment	6	46.2

governance structure. Similarly, a study conducted by Asmamaw [35] reported the existence of captive governance structure in the vertical relationship of gum and resin value chin actors. The existence of captive governance structure between traders and downstream buyers helps to interlock actors via credit and advance payments. Berihu et al. [31] found the existence of captive governance structure among cotton value chain traders and buyers. Marcellinus et al. [33] found balanced network governance structure between traders and buyer. It helps to establish trust among actors. In this study, captive governance structure existed between bamboo processors and downstream buyers of the product. This relationship is informal and trust-based agreement between parties.

3.5. Determinants of the Market Supply of Bamboo Culm. In Banja district, the community used bamboo products as major sources of cash income. Based on the survey result, all bamboo producers supplied bamboo culms to the village and district markets. Majority of the bamboo culm (63.7%) of harvested bamboo culm in the production season of 2018/19 was delivered to the market. Multiple linear regression model was employed to analyze the factors that affect the smallholder market supply of bamboo culms. The parameter estimates in multiple linear regression model should fulfil the BLUE (best-linear-unbiased estimator and the assumptions of classical linear regression (CLR). Therefore, the problems of multicollinearity, endogeneity, and heteroscedasticity and specification error for omitted variables were checked for proposed explanatory variables.

Multicollinearity: it was checked by using variance inflation factor (VIF) and contingency coefficient (CC). The test result indicated that mean VIF of 1.46 which was less than five and contingency coefficient for all dummy variables were ranged from 0.48 to 0.73. The VIF and CC test result indicated the absence of serious multicollinearity among explanatory variables (Table 6).

Tests of heteroscedasticity: the problem of heteroscedasticity was checked by Breusch–Pagan/Cook Weisberg test (Chi2 (1) = 30.52 and Prob > chi2 = 0.000). The test result indicated the presence of heteroscedasticity. So, robust ordinary least square (OLS) was used to solve the problem of heteroscedasticity (Table 7).

Tests for omitted variable: Ramsey RESET test was used to test the specification errors for omitted variables. The test result indicated the absence of omitted variables in the model ($F = 1.58$) ($P = 19.85$) (Table 8).

Test for endogeneity: test for endogeneity for quantity of culm produced or harvested was carried out by using Hausman and Durbin-Wu-Hausman (DWH) tests. The result of Hausman test indicated that the predicted amount of culm harvested was statistically insignificant with $P = 0.128$ when it is included as additional independent variable in multiple linear regression model; the result indicated that the hypothesized amount of culm harvested is not endogenous. The result of the Durbin-Wu-Hausman (DWH) test indicated that the null hypothesis of exogeneity of culm harvested was accepted ($\chi^2 = 0.146978$ and $P = 0.7014$) using estat endogenous STATA command after iv regress by using wealth status as instrumental variable. The test result indicated that the suspected endogenous variable (quantity culm harvested) was uncorrelated with structural equations dependent variable error term. Therefore, it indicates no need of using 2SLS using robust standard error rather it is better to use multiple linear regression model (Table 9).

In multiple linear regression models, eleven explanatory variables were proposed as determinants affecting the smallholder market supply of bamboo culms. Out of the hypothesized determinants, five variables were found to be significant and affected the market supply of bamboo culms. The model result indicated that land allocated for bamboo plantation, distance to the market, number of culm harvested, access of market information, and silviculture management affected the market supply of bamboo significantly. Except distance to the market, all other significant variables affected the market supply of bamboo positively. The coefficient of determination evaluates the overall goodness of fit of the regression model. It tells the proportion of variations in the dependent variable explained by explanatory variables. The numbers of independent variables

Table 6: The result of multicollinearity tests for continuous and dummy variables.

Variables	VIF	1/VIF
Number of culms harvested	2.40	0.42
Land for bamboo plantation	1.65	0.61
Age	1.40	0.71
Family size	1.33	0.75
Distance	1.18	0.85
Frequency of extension service	1.14	0.87
Price	1.06	0.95
Mean VIF	1.45	
Variables		**Contingency coefficient for dummy variables**
Education		0.73
Access to market information		0.59
Silviculture management		0.60
Value addition participation		0.48

Table 7: Test for heteroscedasticity.

Breusch–Pagan/Cook Weisberg test for heteroscedasticity
Ho: constant variance
Variables: fitted values of the market supply of bamboo culm
Chi2(1) = 30.52
Prob > chi2 = 0.000

Table 8: Test for the specifications of omitted variables.

Ramsey RESET tests using the power of the fitted values of the market supply of bamboo culm
Ho: model has no omitted variable
F (3, 105) = 1.58
Prob > F = 0.1985

Table 9: Test for endogeneity.

Test for endogeneity: estat endog
Ho: variables are exogenous
Durbin (score) chi2(1) = 0.146978 (p = 0.7014)
Wu-Hausman F (1, 107) = 0.129063 (p = 0.7201)

are not very modest as compared to the number of observations; adjusted R^2 has the tendency to present an unduly optimistic view of the regression's fit [24]. The fitness of the model (the coefficient of determination) indicated by adjusted R^2 is 88%. It means that 88% of the variation in the quantity supplied of bamboo culm was described by explanatory variables used in multiple linear regression model (Table 10).

Since all bamboo producers supplied bamboo culms to the market, the factors determining the supply of bamboo culms to the market were estimated by using OLS. Out of eleven variables included in the model, only five variables such as land allocated for bamboo plantation ($p = 0.083$), distance to the market ($p = 0.075$), quantity of culm harvested ($p \leq 0.001$), access of market information (($p = 0.08$), and silviculture management practice $p = 0.033$) were found significantly affecting the marketable supply of bamboo culms at producer level as presented in the above table. These findings were as follows.

As indicated in Table 10, the marketable supply of bamboo culms was significantly affected by the following explanatory variables.

3.5.1. Land Allocated for Bamboo Plantation. As hypothesized, it affected the market supply of bamboo culms positively at 10% level of significance. The coefficients of this variable revealed that, when the land allocated for bamboo plantation increases by one ha, the marketable supply of bamboo culm increases by 210 bamboo culm, keeping other factors constant. It means that if the farmers have large area of land, they will have a better chance of allocating higher land areas for bamboo production and, as a result, they can produce additional products that can be sold on the market. The result revealed the number of culms produced from additional hectares of land which is lower than those of other researchers. In line with this variable, Teshome et al. [27] found that land allocated for bamboo plantation affects the market supply of bamboo culms positively. He reported that one hectare of land increase for bamboo production helps to increase the marketable supply of highland bamboo culms by 285. Similarly, Tsegaye et al. [29] presented that for one hectare increase in land for bamboo production, the marketable supply of bamboo culms can be increased by 316 culms. Over all, the land size has positive impact on the marketable supply of bamboo culms but as indicated in the result.

3.5.2. Market Distance. The variation of number of bamboo culms supplied to the market was also determined by distance to the market. Solomon et al. [8] reported similar result. The authors indicated the market distance affected the market supply of bamboo culms negatively and significantly at 10%. When the market distance increased by one walking hour, the amount of bamboo culm supplied to the market become decreased by 42.504 bamboo culms at citrus paribus. This is because as the market distance increases, transportation costs raise. Similarly, Mintesenot et al. [29] indicated that the market distance increased by one walking minute leads to

Table 10: Determinants of the market supply of bamboo culms.

Variable	Coefficient	Robust std err	t-value	$P\|t\|$
Age	−0.328	0.947	−0.35	0.729
Education				
Can read and write	−0.841	22.705	−0.04	0.971
Attend primary school	32.498	27.759	1.17	0.244
Attend secondary school	−36.080	38.594	−0.93	0.352
Family size	−3.153	6.367	−0.50	0.621
Value addition	−11.128	19.192	−0.58	0.563
Land allocated for bamboo	209.705*	120.014	1.75	0.083
Distance to the market	−42.504*	23.622	−1.80	0.075
Quantity of culm harvested	0.556***	0.046	12.08	0.000
Price	1.359	1.501	0.91	0.367
Frequency of extension contact	4.179	5.821	0.72	0.474
Access of market information	49.588*	28.035	1.77	0.080
Silviculture management	52.886**	24.415	2.17	0.033
Constant	−16.24	108.794		0.882
R-squared		0.89		
Adj. R^2		0.88		
F (13, 108)		61.23		
Prob > F		0.000		
N		122		
Root MSE		97.601		

Source: field survey result, 2020.

a decrease in the amount of the market supply of bamboo by 1.5 culms at citrus paribus. This is due to the longer market distance which leads to higher transportation cost. The expansion of groundwork and better shipping facility improves the farmers' linkage with local and international market. Development of infrastructure and better transportation improve the farmers' access to market and also establishing bamboo culm collection center in rural areas would help bamboo producers to deliver bamboo culm in bulk form to the market.

3.5.3. Access of Market Information. As coefficient of this variable indicated the access of market information positively affected the market supply of bamboo culms at 10% significance level. The market information enables the producer to get information about the price and demand of bamboo culm. The result indicated that when the producer is able to get current market information and able to identify the market demand, they can deliver 50 additional bamboo culms than households who did not have access to the market information. Strong linkage among buyers and bamboo producers and distributing important information about the economic value of bamboo resource help to improve the information access and production of bamboo culms. Similarly, Solomon et al. [8] indicated that the access of market information and the market supply of bamboo culms were positively correlated.

3.5.4. Quantity of Culm Harvested. The market supply of bamboo culm positively affected the marketable supply of bamboo at 1% of significance level. The result revealed that when the number of culm harvested increased by one unit, the market supply of bamboo culm can be increased by 0.55 culm. It means households who have harvested more bamboo culms can supply additional bamboo culms. It is supported by Fayera et al. [4], who found the number of bamboo culm harvested had positive relation with market supply of bamboo culms. Similarly, Tsadiku et al. [30] found positive relationship between the number of culms harvested and number of culm supplied to the market.

3.5.5. Silviculture Management. As it was hypothesized, the practice of silviculture management and supply of bamboo culms have positive correlation with the dependent variable at 5% significance level. The coefficients of silviculture management practice indicated that, if bamboo producers practice good silviculture management at the bamboo farm such as good planting technique, protecting the culm from different attack and proper harvesting, market supply of bamboo culms can be increased by 53 culms compared to households who did not practice good silviculture practice keeping other factors constant. The implementation of good silviculture management activities enables culm production and supply of additional numbers of bamboo culms to the market. Collaboration work among development agents, research centers, farmers, and supportive institutions improve the practice of silviculture management practice and increase the amount of culm harvested and the market supply of bamboo. It is supported by Tefera et al. [26] who found that silviculture management is significantly correlated with the degree of bamboo commercialization.

4. Conclusion and Policy Implications

The direct actors involved in bamboo value chain include bamboo producers, traders, processors, and final users. Indirect actors that provide support services include agriculture office, trade and transport office, INBAR, GIZ, micro- and small-enterprise office, and TVET. The value chain governance structures vary from one node of value

chain to the other and are dominated by market-based and captive governance structure. At the district, bamboo value chain actors have attempted different upgrading initiatives in order to earn higher value share in the chain but these upgrading initiatives are not successful due to poor linkage between buyers and sellers of value added bamboo products and other constraints. The gross marketing margin of furniture enterprises is greater than the traditional bamboo product processors. It indicated that bamboo furniture enterprise business is better than traditional bamboo processing business. In terms of financial flow, the form of payments varies, including cash payment, credit, and advance payment. The coordination and collaboration among actors remain weak linkage; specifically market-based governance structure exists. The market supply of bamboo culm was positively affected by land allocated for bamboo plantation, number of culm harvested, access of market information, and silviculture management practice, whereas market distance negatively affected the market supply of bamboo culm.

Therefore, these variables require special attention to increase the margin of the producers from bamboo production and marketing. Policies that help to increase farmers' knowledge and skill through capacity building help to improve information access and silviculture management practice and market supply of culm should be designed. Strengthening the linkage among buyers and bamboo producers and distributing important information about the economic value of bamboo resource help to improve the information access and production of bamboo culms. Expansion of groundwork and better shipping facility improve the farmers' linkage with local and international market. Transforming traditional bamboo product producers to modern bamboo furniture enterprise enables to earn higher profit for processors. Government, micro-, and small-scale enterprises should make an effort to increase profitable bamboo furniture enterprises.

Data Availability

The data used to support the finding of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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