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Research Article

Market Chain Analysis of Highland Bamboo Poles in Three Districts of the Sidama National Region, Ethiopia

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Abstract

Ethiopia is one of the countries well-endowed with bamboo (Arundinaria alpine, and Oxytenanthera abyssinica). As compared to its potential, however, the contribution of bamboo to producers' livelihoods and the national economy is very low. This is partly attributed to limited information on the market chain of standing bamboo its products. This study was, therefore, initiated to analyze the market chain of highland bamboo poles and its determinants in the main production areas of three selected districts of Sidama National Region, Ethiopia. In total, 120 sample households were selected based on a random sampling technique due to the homogeneity of the bamboo producers' population. The two-stage least-square regression model was used to analyze the determinants of the bamboo market supply. The results of the study revealed that primary value chain actors were input suppliers, producers, collectors, wholesalers, retailers, cooperatives, and end-users. Secondary actors were Trade and Industry and Cooperative Bureaus. Bamboo in the study area country used for construction material and household furniture, for firewood and source of income and livelihood. Harvesting of non-mature culm and lack of knowledge on modern silvicultural practices were identified as the main production constraints. While lack of support and training, lack of bamboo-based factories or firms or industries were related to processing constraints. Marketing constraints included a lack of market for bamboo poles and licensing. Measures of market concentration ratio showed that the top four biggest traders controlled 62.43 % of the bamboo market, indicating that the structure of the market was strongly oligopolistic in the study area. According to the survey result, 70.5% of the respondents reported that the bamboo pole's price decision was set by traders. The marketing margin of producers was highest in channel V (42.86%). The number of bamboo culms harvested, sex of the household head, education level of the household head, membership in the farmers-based association, and lagged price were significant determinants of the market supply of bamboo. It was revealed that the market chain of bamboo should consider socioeconomic factors favoring and disfavoring highland bamboo market as well as the knowledge gaps to management of bamboo in the study region.

Keywords: Bamboo, Bamboo Culm, Ethiopia, Market Chain, Oligopolistic

1 Introduction

Ethiopia accounts the largest bamboo resources in Africa, which is estimated to 1.5 million hectares, and sharing approximately 4.2% of the global bamboo resource and 8.3% of the country's total forest area (Sebrala, 2021). Bamboo, as one of the fastest growing, annually regenerating species, is proven to provide climate change mitigation and adaptation benefits. Bamboo (the "green gold") is a perennial woody grass from the family Poaceae under the subfamily Bambusoideae (Zhao et al., 2018). Ethiopia is one of the countries well-endowed with bamboo, mainly, Arundinaria alpine (referred as highland bamboo) and Oxytenanthera abyssinica (lowland bamboo). The Yushania alpine grow naturally in highland agro-ecological zones of 2,200-3,500 meters above sea level. It plays a very essential role socially, economically, and ecologically in areas where it occurs in both naturally and planted. Bamboos play a great role in delivering ecosystem services, biodiversity conservation, soil and water conservation, and socio-economic development (Sebrala, 2021).

Highland bamboo is also grown on farms in small patches or as farm boundaries under cultivation in various regions of Ethiopia (Zhao et al., 2018). Among other services, bamboo plays important role in supporting smallholder households. However, the non-timber forest products trade such as bamboo is often constrained by conditions that typify underdeveloped areas, including isolation, limited local buying power, inadequate infrastructure, poor exposure and access to markets, weak political power, high transportation costs, communication problems, and inadequate education and levels of organization amongst producers and traders (Pérez, 2005 cited in Solomon et al.,2016). Solomon et al. (2016) found that there exists oligopolistic nature of the bamboo market. Moreover, marketing margins also indicate that the producers get much lower benefits than any other market chain actors. The major problems of the production identified by bamboo producers in the study area arise from road infrastructure and market information. The market for bamboo in Ethiopia is not well developed and bamboo marketing as a viable alternative for farmers has become a very challenging issue (Fayera et al., 2017). Due to a lack of machines and tools, the production process relies on manual labor, and bamboo products are perceived as inferior when compared to timber products. The quality of products is inconsistent due to a lack of knowledge on the proper timing of harvesting which is related to little attention given to the cultivation and propagation of bamboo. Lack of proper storage facilities also creates the problem of insect infestation before bamboo culms are processed into desired products (Jessie et al., 2019). Tirusew et al. (2017) found in their study that the major limiting factors for bamboo poles in the present study region were the absence of value-added production and poor market linkage.

The market chain of bamboo in Arbegona, Hula, and Bursa districts of Sidama region is constrained by production not strengthened by modern silviculture, traditional marketing, and not well established or rudimentary level processing which made the sector unused despite the potential of bamboo resources. In addition, the previous studies failed to incorporate major highland bamboo production areas of Arbegona and Bursa, addressed partial areas of bamboo poles marketing route, and failed to address the overall value chain. Therefore, this study aimed to analyze the market chain of highland bamboo in the main production areas of the Sidama region in Arbegona, Hula, and Bursa districts. It was focusing on mapping the market chain of highland bamboo and its functions, identifying the socioeconomic contribution of bamboo and constraints in the production, processing, and marketing of highland bamboo, and analyzing determinants of bamboo market supply.

2 Materials and Methods

2.1 Description of the Study Area

Arbegona district is one of the districts in the Sidama region, which is bordered on the south by Bona Zuria, on the southwest by Bursa, on the northwest by Gorche, on the north by the Oromia Region, and on the east by Bensa. The major town in Arbegona is Yaye. Based on the 2007 Census conducted by the CSA, this district has a total population of 135,862, of which 67,744 are men and 68,118 women; 6,745 or 4.97% of its population are urban dwellers. Hula district is bordered on the south by the Oromia Region, on the west by Dara, on the northwest by AletaWendo, on the north by Bursa, and on the east by Bona Zuria. The major town in Hula is Hageresselam. Districts of Bursa and Bona Zuria boarded with Hula. A survey of the land in this district shows that 59.6% is arable or cultivable, 36.2% pasture, 2.3% forest, and the remaining 1.8% are considered swampy, degraded, or otherwise unusable. Important crops include corn, wheat, barley, local varieties of cabbage, and potatoes. Based on the 2007 Census conducted by the CSA, this district has a total population of 129,263, of whom 64,551 are men and 64,712 women; 6,410 or 4.96% of its population are urban dwellers. Bursa district is bordered on the south by Hula, on the west by Aletawendo, on the northwest by Wensho, on the northeast by Arbegona, and on the southeast by Bona Zuria. Bursa district was separated from Hula district. Based on the 2007 Census conducted by the CSA, this district has a total population of 103,631, of whom 51,731 are men and 51,900 women; 2,304 or 2.22% of its population are urban dwellers.

2.2 Sampling Techniques

A multi-stage sampling technique was employed to draw the sample from the strata of producers, traders and end-users of highland bamboo. First, potential bamboo-producing kebeles were identified purposively from Hula, Arbegona, and Bursa districts on basis of their potential in bamboo production. Secondly, two kebeles were randomly identified from each district. Thirdly, total 120 bamboo producers households were randomly selected owing to the homogeneity of the bamboo pole producers. Head of the household was

communicated for the interview. Owing to lack of an organized list of actors across the market chain of bamboo, key informants were purposively selected including 11 informants from wholesalers, 14 retailers, 10 collectors, 16 processors, and 22 end-users to discuss and triangulate the opportunities and challenges.

2.3 Methods of Data Collection

To collect the primary data, both the household survey and participatory rural appraisal (PRA) tools were employed. The applied PRA techniques included focus group discussions (FGDs), the key informant interviews (KIIs), and observations. While the household survey was conducted using structured questionnaires. The household survey was conducted by trained enumerators. Besides, the household survey questionnaires were pre-tested to check the clarity of the contents, and hence, enabled us to modify the questions. Key informants' interviews were conducted with district experts of natural resources and one focus group discussion was held in each kebele with a group of eight persons.

2.4 Conceptual Framework

The demographic, socio economic and institutional factors affect bamboo market supply in the study area area as indicated in figure 1. It is in this framework that market supply is affected by constraints of production, processing and marketing.

2.4.1 Definition of Variables

Dependent Variable **Market supply of bamboo:** refers to the number of bamboo poles supplied to the market in one year. It is a continuous variable.

Independent Variables **Total harvest:** total number of bamboo poles or culms harvested in one year. It was expected to have a positive relationship with bamboo market supply.

Age of household head: continuous variable measured in years showing how old the household is. It was expected to have a negative relationship to bamboo market supply. It is a continuous variable.

Education level of household head: continuous variable referring to the number of years spent by the household head in formal education. It was expected to have a positive relationship with bamboo market supply.

Membership in associations: refers to membership in any agricultural associations. It is a dummy variable. It was expected to have a positive relationship with bamboo market supply.

Lagged price: It refers to the selling price of bamboo per culm of the previous year before the survey. It was expected to have a positive relationship with bamboo market supply. It is a continuous variable.

Distance to the market: continuous variable measured in kilometres. It was expected to have a negative relationship to bamboo market supply. It is a continuous variable.

Non-bamboo income: It is the total income of the household head in one year excluding income from the sale of bamboo. It was expected to have a negative relationship to bamboo market supply. It is a continuous variable.

Total family: refers to the total number of members of the household. It was expected to have a positive relationship with bamboo market supply. It is a continuous variable.

2.5 Data Analysis

Both descriptive statistics and econometric models were used to analyse the data. Mean, frequency and percentage were used to describe demographic and socioeconomic data. For the econometric analysis, a two-stage least square regression model was employed to analyse determinants of the bamboo market supply. The basic multiple regression model for the econometric part following Greene (2003):

$$Y = \beta X + \epsilon \tag{1}$$

Where Y = the bamboo market supply, β = a vector of estimated coefficient of the explanatory variables X = a vector of explanatory variables, ϵ = disturbance factor

Concentration ratio was used to measure the size of distribution of bamboo pole traders. The market concentration ratio is the common method of measuring market structure.

$$CR = \sum_{i=1}^{n} S_i \tag{2}$$

Where S_i represents the market share of i^{th} firm and n is the number of largest firms for which the ratio is going to be calculated.

Market conduct was evaluated in terms of payment mechanisms and pricing strategy. The market performance or marketing margin was calculated using consumer and producer (in this case bamboo growers) price and marketing cost. Mathematically margins can be calculated as follows:

$$TGMM = \frac{\text{End buyer price} - \text{First seller price}}{\text{End buyer price}} \times 100 \tag{3}$$

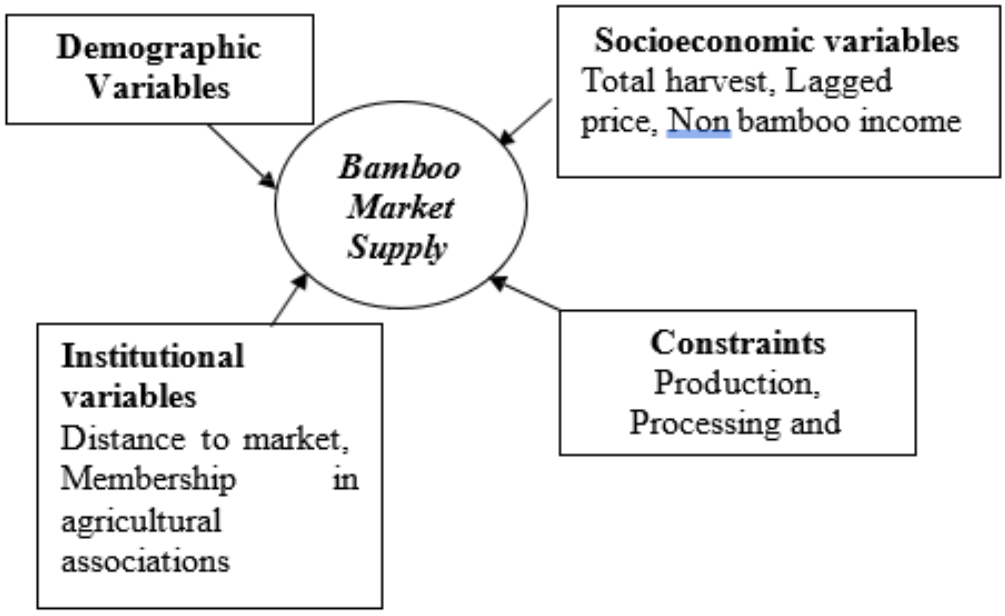

Figure 1: Bamboo market study conceptual framework

Where $TGMM$ = Total gross marketing margin

$$GMMp = \frac{\text{End buyer price} - \text{marketing gross margin}}{\text{End buyer price}} \times 100 \quad (4)$$

Where, $GMMp$ = the producer's gross marketing margins (producers share) from the consumer price

$$NMM = \frac{\text{Gross margin} - \text{Marketing costs}}{\text{End buyer price}} \times 100 \quad (5)$$

Where NMM = Net marketing margin

3 Results and Discussion

3.1 Demographic and Socio-economic Characteristics of Sample Respondents

Out of the total 120 sample respondents, 75% were males and the rest were female household heads. Concerning marital status, 82% were married, 8% were single and 10% were widowed (Table 1). This indicates that the majority of bamboo pole producers in the study area were males and married.

The average quantity of bamboo supplied to the market by sampled households in a year was 579 culms. It is taken as an alternative source of income in times of cash shortage. The average distance to the nearest market center was 4.25 km. The farmers take poles to the market mostly on foot. The average non-bamboo annual income excluding bamboo was estimated to 8715.67 ETB. This non-bamboo income is generated mostly during the agricultural production season. Bamboo harvesting was done twice in a year. The average age of surveyed bamboo producers was estimated to 41.93 years-old. Middle-aged members of households mostly engaged in harvesting. The average family size of households was 8 persons per household. The average year of experience in bamboo cultivation was 24.91 years. Experienced households in bamboo cultivation were better aware of problems related to bamboo value chain study. The average area of land allotted to bamboo cultivation was 0.32 hectares. The average lagged price of bamboo culms was 6.01 ETB per culm (Table 2). The lagged price was important in determining the number of culms or poles to be supplied to the market.

3.1.1 Farmers Based Association Membership

Membership in agricultural associations enabled farmers to engage in the market and supply more of their products to the market. Out of the total respondents, 16.7% were members of bamboo-based cooperatives in the study area (Table 3). These cooperative members were actively engaged in marketing bamboo poles to processors as they were well aware of marketing.

3.1.2 Sources of Major Income Bamboo Producer Households

The average annual income from crop production for the sampled household head was 6321 ETB. This indicates that crop production is a major source of income in the study area. The average annual

Table 2: Marital Status

Marital Status	Frequency	Percent
Married	98	82
Single	10	8
Divorced	-	-
Widowed	12	10
Total	120	100

Table 3: Responses for bamboo producers' cooperative membership status (n=120)

Variables	Response	Percent
Cooperative membership	Yes	20
16.7		
	No	100
83.3		
Total	120	100

income derived from non-farm activities was 580.46 ETB. A household heads obtained 462.27 ETB on average from Off-farm income per annum. The average incomes derived from livestock production and sale of bamboo were 1563.63 ETB and 2413.42 ETB respectively (Table 4). It can be inferred that the sale of bamboo was taken as an additional source of income as it is in the second rank based on average income.

3.2 Highland Bamboo Market Chain Actors and Their Roles

Primary actors were producers, collectors, retailers, and cooperatives. Secondary actors were input suppliers, Trade and Enterprise Development Bureau, and the Cooperative's Development Bureau.

3.2.1 Input Suppliers/Nurseries

Provided seedlings to farmers to enable them to use seedlings instead of vegetative propagation. The district office of agriculture played the role and also thought farmers the importance of applying compost to bamboo farmland.

3.2.2 Producers

Managed bamboo stands, harvested culms, and sold to customers who went the culms for different purposes, which were primarily related to construction purposes, trading, and processing.

3.2.3 Collectors

Sold bamboo after purchased. They came directly to the farm gate of bamboo producer farmers and collected the bamboo. The bamboo was either already cut or made ready by the farmers or the collectors or the collectors bring laborers along with them so that the price was negotiated to take into account the cost the collector incurred for the laborers.

3.2.4 Retailers

Sold bamboo culms after purchase. They attended the local market places at every weekday of the market. They sold bamboo to those who needed it for house construction, wholesaling, or processing purposes.

3.2.5 Wholesalers

Sold bamboo after purchase from retailers or collectors in large amounts to those who wanted it for retail or other purposes.

3.2.6 Cooperatives

Processed different bamboo commodities like a chair, bed, shelf, basket, light bulb embracer, mats. They were primarily organized by the district Trade and Enterprise Development Bureau and Cooperative's Development Bureau.

3.2.7 End Users

Purchased both raw culm and processed commodity.

3.2.8 Trade and Enterprise Development Bureau and Cooperative's Development Bureau

Acted as secondary actors. They organized bamboo-based processors cooperatives and provided licensing.

Table 4: Socio-demographic characteristics of sampled households (n=120)

Variable	Unit	Mean	Std. Dev.	Min	Max
Quantity of bamboo supplied to the market	number	578.5	232.4	300.0	1199.0
Distance to the market center	km	4.3	2.3	1.0	11.0
Non-bamboo income	birr	8715.7	5065.0	3100.0	22001.0
Total harvest	number	1040.2	460.7	400.0	2151.0
Age of household head	years	41.9	10.3	22.0	60.0
Total family size	number	7.5	2.2	3.0	12.0
Education level	year	5.3	2.1	2.0	10.0
Bamboo cultivation experience	year	24.9	7.9	14.0	44.0
Land allotted to bamboo cultivation	ha	0.32	0.15	0.10	0.86
Average lagged price per culm	birr	6.01	2.18	2.13	12.4

3.2.9 Storage

It took place for a maximum of one week because it would dry in a short time and the inconvenience of being flexible in the desired shape for processing. Bamboo needed proper treatment and dried time after harvest to better prevent problems, such as insect infestation. The lack of adequate storage facilities and space exacerbates this problem. These were major challenges that needed attention by organizations that provide merely skills training to the craftsmen.

3.2.10 Transportation

Donkey and horse carts were used in the most manners to transport bamboo culms to local market areas. Human/family labor was also used if the proximity of the marketplace from the household head's house is affordable.

3.2.11 Marketing

Held hand to hand with other retail commodities at the open marketplace on market days at village or woreda market, except wholesalers who take culms to other areas.

3.3 Market Chain Map of Bamboo in the Study Area

Identified market chain functions were described in terms of direct value chain actors and enablers. At the input supply stage, there exist kebele agricultural offices that provided seedlings to substitute the vegetative propagation method of bamboo culms production by producer farmers. At the production stage, farmers are prominent producers. The trading stage comprises wholesalers, retailers, and collectors as major forces linking producers with either local processors or furniture enterprises found in the study area. The processing stage embraced bamboo-based enterprises/cooperatives. Finally, the end-users stage included users who wanedt raw culms for house or fence construction and those who used processed bamboo commodities. Market chain enablers were microfinance institutions, Trade and Industry Bureau, and NGOs (Figure 2).

3.4 Bamboo Marketing Routes

The following figure below shows the marketing route of bamboo in the form of culms. From Hula, Bursa, and Arbegona channelled to major cities such as Hawassa, Shashemene, Adama (Nazareth), Asssa, Dodola, Zway, Meki, and Alentena (Figure 3).

3.5 Product Loss

The total number of culms harvested in 2020 was 124, 827, off which 56% culms were sold, 36% used for home consumption and 8% was lost. The major reasons for the culms loss included cutting in hope of getting purchaser indiscriminate amount, on-farm death of culms because of disease and pests as the culms getting older (Table 5).

3.6 Market Chain Governance

The relationship between producers, traders, and processors not integrated and unorganized. This is manifested by complaints on unlicensed traders who sell bamboo in the unregulated market. The Trade and Industry, and Cooperatives Development Bureaus were in charge of regulating only known cooperatives and traders. Many unlicensed traders become a challenge for licensed cooperatives and traders.

3.7 Socioeconomic Contribution of Bamboo

Owing to their easy workability, strength, straightness, lightness, combined with extraordinary hardness, range of size, abundance, a short period in which they attain maturity, they are suitable for several purposes and uses. The broad category of bamboo benefit is described as follows in the study area.

Table 5: The number of culms harvested, consumed and lost in the study areas

Description	Culms in number	Percent
Sold amount	69,422	55.61
Lost amount	9,944	7.97
Consumed	45,461	36.42
Total	124,827	100

3.7.1 As a Source of Firewood

Dried bamboo poles in the farmland were used as firewood and this slightly decreases the trend of deforestation.

3.7.2 Bamboo as a Source of Income and Livelihood

In comparison with other forms of natural resource utilization, bamboo is highly profitable and requires proportionally little capital investment. In the study area, the average income obtained from the sale of bamboo was 2,413.42 ETB which signifies its visible benefit.

3.7.3 Construction Material and Household Furniture

Rural houses in the study area almost entirely constructed their houses using bamboo poles. Additionally, walls of trade purpose kiosks were constructed using bamboo poles. Chairs, shelves, mats, and toilet walls were also commonly constructed using bamboo poles in Hula, Arbegona, and Bursa districts.

3.8 Constraints in the Bamboo Market Chain

3.8.1 Production Constraints

Cutting of non-mature culm to fulfil cash needs was identified as a constraint. This needs to be corrected by creating awareness to farmers on the age of harvesting the bamboo culms. There is a lack of knowledge on modern silvicultural practices. For example, the timing of the bamboo harvest is crucial in determining the quality of culms. Many farmers harvested the culms in the study areas when they needed income. In addition, without proper storage, especially in the rainy season, culms become prone to insect attacks. The suitability of bamboo to make products, such as furniture, also differs by the age of the culm. For example, younger bamboo contains a higher starch and glucose content than mature bamboo, leading to pest infestations.

3.8.2 Processing Constraints

Lack of bamboo-based factories or firms was taken as a problem since many farmers practiced traditional methods of processing bamboo. The products were primarily traditional furniture, such as benches and stools, and also bamboo mats. Due to the lack of machines and tools required to make the products, the production process relied on largely manual labor. In addition, the quality of bamboo products was inconsistent because of the lack of knowledge on the timing of harvest.

3.8.3 Marketing Constraints

Lack of market for bamboo was a common problem in the study area. The loss of bamboo was customary in the study area and market linkage, allowing the sale of bamboo at a retailer level only. Licensing problem was a challenge since many bamboo traders complained that although they paid taxes, their license was not being renewed while unlicensed traders were conducting illegal trading.

3.9 Existing Bamboo Market Channels

The following seven major bamboo market channels were identified. Of which the first, sixth, and seventh channels were relatively dominant in terms of the volume of bamboo culms. The possible reasons for the dominance of these channels were the involvement of the high number of collectors and the demand of cooperatives to get bamboo poles from producers in a sufficient magnitude.

1. Producer–Retailer–Collector—End User (22%)
2. Producer—Wholesaler—Retailer–Cooperative—End User (3%)
3. Producer—Wholesaler—Retailer—End User (5%)
4. Producer—Collector—Wholesaler—End User (10%)
5. Producer—Cooperative—End User (11%)
6. Producer—Retailer—Cooperative—End User (24%)
7. Producer—Collector—Cooperative—End User (25%)

3.10 Market Structure

The market concentration ratio was calculated to analyze the type of market structure prevailed in the study area. The calculation was conducted by taking the annual or total volume of bamboo purchased by sample traders. As indicated in Table 6, the bamboo

Table 6: Market structure and volume of bamboo in the study area

S.No	Frequency of Traders	Cumulative frequency	% of Cumulative	Total volume of Purchase	% Share of Purchase	Cumu
1	3	3	18.8	38,125	54.9	
2	1	4	25.0	5,213	7.5	
3	1	5	31.3	2,979	4.3	
4	2	7	43.8	2,113	3.0	
5	2	9	56.3	4,156	6.0	
6	3	12	75.0	9,844	14.2	
7	4	16	100	6,992	10.1	
Total	16	16	100	69,422	100	

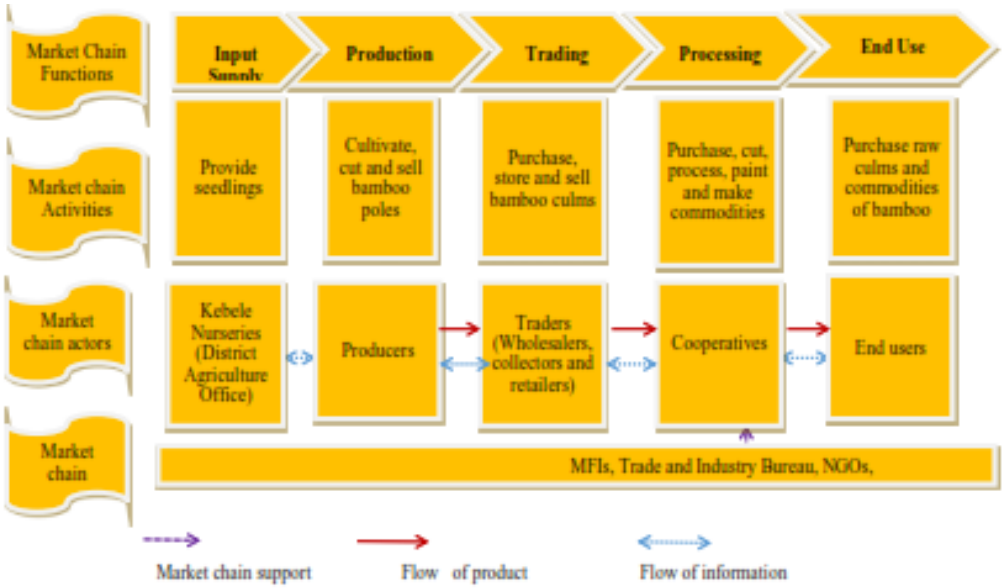

Figure 2: Market chain map of bamboo in the study area

market in the study area was a strong oligopoly. Measures of market concentration ratio showed that the top four biggest traders controlled 62.43 % of the bamboo market, indicating that the structure of the market was strongly oligopolistic in the study area.

3.11 Market Conduct

According to the survey result, 70.5% of the respondents reported that the bamboo pole's price decision was set by traders. About 20.5% of the respondents reported that market price was through the negotiation of producers and traders. The remaining 9% reported that they decide on the price of their product taken to market themselves. This result indicates the lower bargaining power of bamboo producers. All respondents indicated that the payment mechanism was cash hands-based transactions.

3.12 Market Performance

3.12.1 Marketing Margin

The gross marketing margin of actors is summarized in Table 7. The marketing margin of producers was highest in channel V (42.86%). This means they get better when they sell through cooperatives. The highest gross marketing margin (GMM) of wholesalers was 30.04% in channel II. The retailers in this channel give a better price to wholesalers bearing in mind they are going to sell to cooperatives. Retailers derived the highest GMM relative to other actors in Channel I, which was 32.32%. This was because collectors intervene in the middle and sell to users who want the culms badly for construction purposes. The GMM obtained by collectors was highest in channel IV, which was 39.70%. This is because wholesalers pay a high price to collectors than in other channels. Cooperatives share of GMM was highest Channel V (57.14%). This was related to direct access to bamboo culms from producers themselves.

3.13 Econometric Model Results for Determinants of Bamboo Market Supply

Before embarking on the model, different tests were conducted to check the validity of variables. The multicollinearity test of vari-

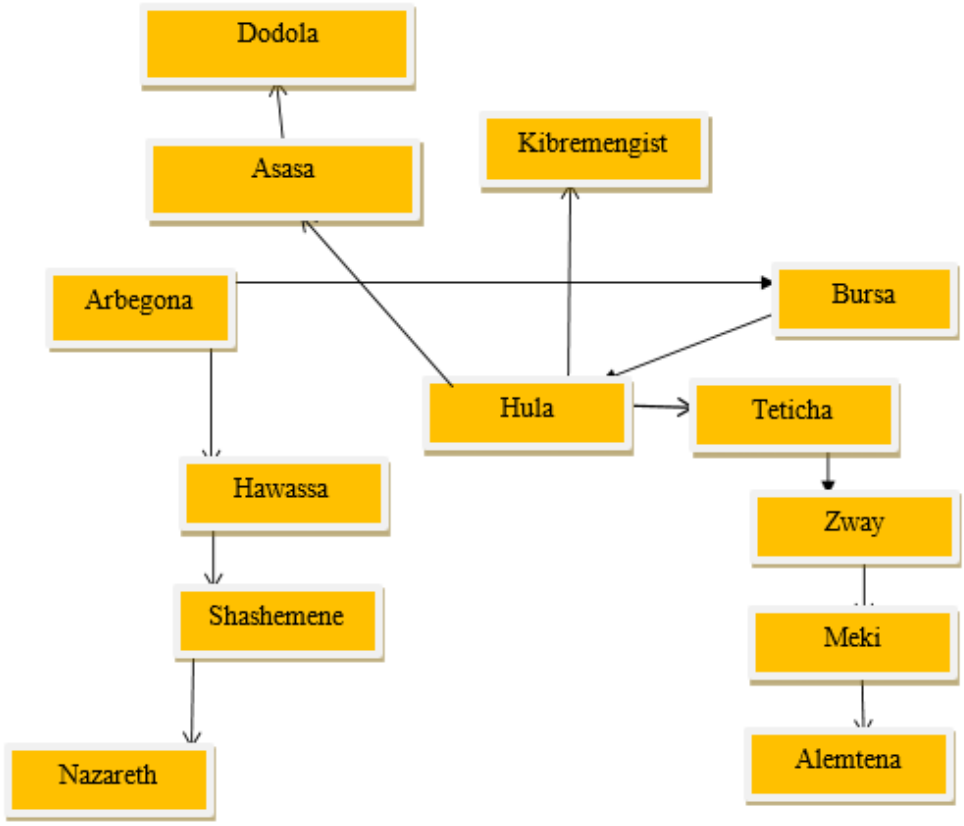

Figure 3: Marketing routes of highland bamboo originated from Sidama region

ance inflation factor result shows that the mean variance inflation factor was 1.42, which suggests no such problem. Also Breusch-Pagan / Cook-Weisberg test for heteroscedasticity showed no problem of such with chi² (1) =0.32, Prob¿chi² = 0.5693. Two-stage least square regression was used because an endogeneity problem was found. The number of bamboo culms harvested when it was tested using cultivation experience of farmers and area allotted to bamboo production with test statistics values: Durbin (score) chi2 (1) =3.27395, (p = 0.0704) and Wu-Hausman F(1,109)= 3.05725, (p = 0.0832). After running two stages least square regression model, the number of bamboo culms harvested, sex of the household head, education level of the household head, membership in farmers based agricultural association, and lagged price were found to be statistically significant.

The number of bamboo culms harvested was positively related to the number of bamboo culms supplied for sale at 1%. This shows that as the number of harvested bamboo increases by one culm, the number of culms supplied for sale increases by 0.18 culms. This indicates the harvest amount increases, more is supplied to the market as a market surplus. This result is in line with the finding of Fayera et al. (2017) who stated that the number of harvested bamboo culms was positively related to the number of bamboo culm supplied for sale.

Sex of the household head had a positive effect on the market supply of bamboo to the market at a 1% significance level. Being a male household increased the number of culms supplied to the market by 146.17 culms per year. The probable reason is males have better access and control over resources than females, and produce and supply more to the market. This result is in line with the research result of Desalegn (2018) who conducted maize value chain analysis in Demebecha district, North West of Ethiopia.

Education level of the household head showed a positive effect on the number of bamboos supplied to market with a significance level of 5%. The survey results revealed that if bamboo producer gets educated, the amount of bamboo supplied to the market increased by 16.12 culms, keeping other factors constant. The probable implication here is those who can read and write stood a better chance of understanding things faster and were well encouraged to produce and market. Amare (2013) also reported that the education level of farmers exhibited a significant and positive effect on the marketed surplus of pepper. Addisu (2016) also found that Education has shown a positive effect on onion quantity supplied to the market.

Membership in farmers-based agricultural association showed a cooperative membership had a significant impact on the market supply of bamboo at 1% significant level. Those who had access to market information increased their yearly bamboo Culm supply

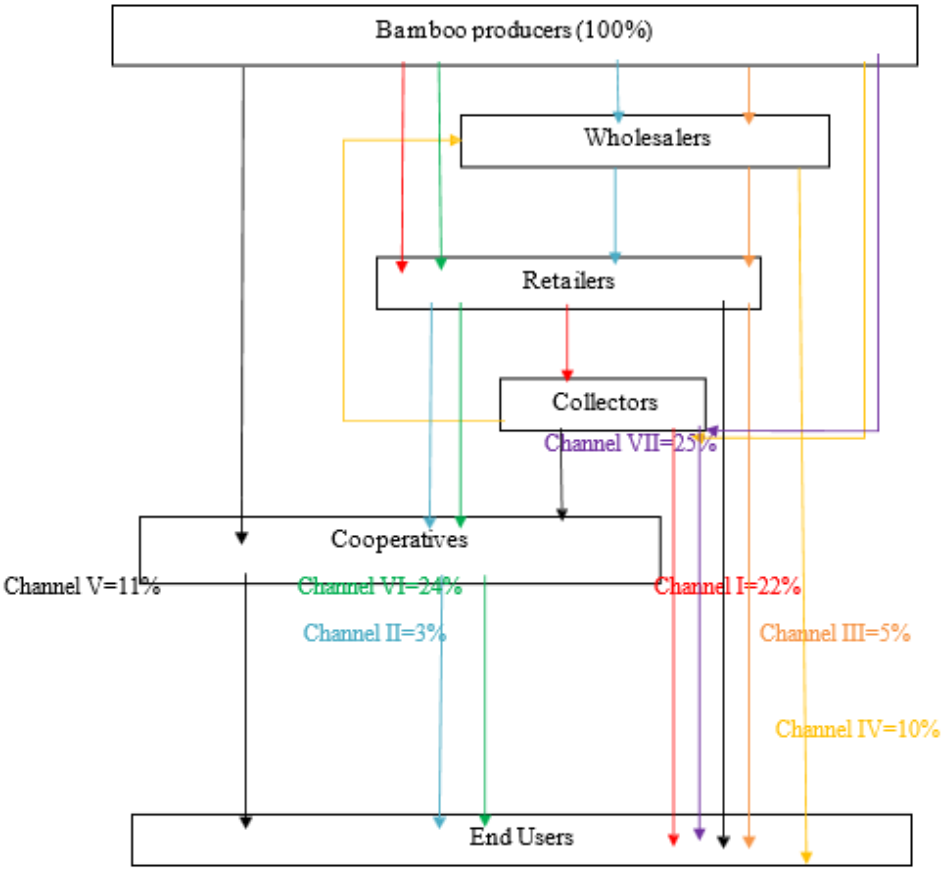

Figure 4: Bamboo Marketing Channels

by 149.61 culms. This finding supports the result in the study of Deepak (2007) who found that cooperatives had a positive impact not only on milk production but also on the marketed surplus of milk.

Lagged price was positively related to the number of bamboo culm supplied for sale at 1%. This shows that as the price of bamboo culm from the previous year increases by one birr, the number of culms supplied for sale increases by 34.19 bundles. The probable reason is the price of agricultural products in the past year/season motivates to produce more commodities in the coming year/season. Tomek and Robinson (1985) cited in Sultan (2016) argued that product price has direct relations with marketable supply in such a way that prices of commodities from the previous year can stimulate the current production of that specific commodity.

4 Conclusion

The market chain of bamboo in the Arbegona, Hula, and Bursa districts of Sidama region is constrained by the lack of modern silvicultural practices and improved seedlings. The primary actors in bamboo market chain were producers, collectors, retailers, and cooperatives. Secondary actors were input suppliers, Trade and Enterprise Development Bureau, and the Cooperative's Development Bureau. Bamboo uses for construction material and household furniture, used as firewood, and source of income and livelihood. Measures of market concentration ratio depicts the structure of the market in the study areas is strongly oligopolistic. The bamboo pole's price decision is largely made by traders. This result indicates the lower bargaining power of bamboo producers. The cash transaction is based on cash hands. Cutting of non-mature culm and lack of knowledge on modern silvicultural practices as well as lack of market for bamboo and licensing are the major challenges identified in bamboo marketing chain. Thus, capacity building on modern bamboo silvicultural practices and processing should be provided to enhance effectiveness and efficiency of bamboo market chain. The margin reaching to producers should be improved by minimizing middlemen as the producers' margin is below 50%. The establishment of bamboo-based associations is required to improve the bargaining power of producers.

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Table 7: Gross marketing margin of actors at different channels

Actors	Indicators	I	II	III	IV	V	VI	VII
Producers	Purchase Price	-	-	-	-	-	-	-
	Marketing Cost	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	Selling Price	7.67	8.33	8.33	7.50	7.50	7.67	7.50
	Gross Profit	6.72	7.38	7.38	6.55	6.55	6.72	6.55
	GMMp	32.28	34.00	39.95	32.89	42.86	31.31	29.53
Wholesalers	Purchase Price	-	7.50	6.65	15.06	-	-	-
	Marketing Cost	-	3.25	3.25	3.25	-	-	-
	Selling Price	-	15.69	14.50	22.80	-	-	-
	Gross Profit	-	4.94	4.60	4.49	-	-	-
	GMMws	-	30.04	29.59	27.41	-	-	-
Retailers	Purchase Price	7.30	13.66	13.66	-	-	7.47	-
	Marketing Cost	0.98	0.98	0.98	-	-	0.98	-
	Selling Price	15.35	20.85	20.85	-	-	15.20	-
	Gross Profit	6.73	6.21	6.21	-	-	6.75	-
	GMMr	32.32	21.06	30.46	-	-	30.73	-
Collectors	Purchase Price	15.20	-	-	7.50	-	-	7.50
	Marketing Cost	1.41	-	-	1.41	-	-	1.41
	Selling Price	23.76	-	-	16.55	-	-	16.60
	Gross Profit	7.15	-	-	7.64	-	-	7.69
	GMMcoll	35.40	-	-	39.70	-	-	35.83
Cooperatives	Purchase Price	-	15.20	-	-	7.50	15.20	16
	Marketing Cost	-	1.49	-	-	1.49	1.49	1.49
	Selling Price	-	24.50	-	-	17.50	24.50	25.40
	Gross Profit	-	7.81	-	-	8.51	7.81	7.91
	GMMcoop	-	14.90	-	-	57.14	37.96	34.64

able time for the study.

Competing interests

The authors declare that they have no competing interests.

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Table 8: Two-Stage Least Square Regression Results for determinants of bamboo market supply

Bamboo market supply	**Coef.**	**Std. Err.**	**P¿z**
Total harvest	0.179***	0.049	0.000
Age	-0.387	1.278	0.762
Sex	146.170***	28.919	0.000
Education level	16.120**	6.698	0.016
Membership in Associations	149.607***	39.668	0.000
Lagged price	34.192***	6.796	0.000
Distance to market	-2.473	5.097	0.628
Non bamboo income	0.002	0.002	0.379
Total family	-3.087	5.499	0.141
_Constant	37.998	95.451	0.691

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