Available online at https://journal.rescollacomm.com/index.php/ijbesd/index

e-ISSN 2722-1156

International Journal of Business, Economics and Social Development

Vol. 6, No. 1, pp. 28-36, 2025

Contribution of Highland Bamboo for Income of the Households and Challenges in Gurage zone, Central Ethiopia

Hiwot Hailu[1*], Gonche Girma[2], Tesfanesh Ababu[3], Tensaye Abate[4], Mister Abebe[5]

[1,2,3,4,5]*Ethiopian Forestry Development, Central Ethiopia Forestry Development Centre, Addis Ababa, Ethiopia*

**Corresponding author email: hiwinatht@gmail.com*

Abstract

Bamboo resource has numerous socioeconomic, ecological and cultural benefits. In Ethiopia, local farmers rely on bamboo as an alternative livelihood option. It provides a considerable share for the various household incomes. The main purpose of this study was to assess challenges and the contribution of bamboo for income of the households in Gurage Zone, across central Ethiopia. A sample of 216 households, were selected by using multistage sampling procedure. Data was collected through household survey, focus group discussion and review of reports. Descriptive, frequency and multiple linear regression model methods were used to estimate the contribution of bamboo and to identify determinants bamboo production. The finding revealed that respondents were highly relying on bamboo for household use, construction, fuel wood, fencing and fodder for livestock. The result of bamboo income share shows that, 14% Bamboo can contribute to the total income of the households. Income from bamboo ranks third next to crop and livestock production. The result of multiple linear regression model revealed that, educational level of household head and Distance to the market were negatively affect income generated from bamboo. In contrast, the culm price Bamboo was positively and significantly effect income generated from bamboo production. Market related and knowledge on bamboo production and processing were the most challenges identified by the households. Bamboo contributes a remarkable income share for households in the study area. Creating conducive production environment for the bamboo sector plays a vital role to improve the income and livelihood of farmers.

Keywords: Bamboo contribution, Income, Challenges, Households

1. Introduction

Bamboos are found all over the world; and covers 37 million hectares, approximately 1.0% of the world's forest area (Du et al., 2018). There are 115 kinds of bamboo found in Africa, which occupy 4.56 million hectares (Bahru & Ding, 2021). Ethiopia comes first on bamboo forest resources in Africa, which contains roughly 67% bamboo forests (INBAR), 2018). Ethiopia is a home for two native bamboo species: Oxytenanthera abyssinica Munro (lowland bamboo) and Oldeania alpina (K.Schum) highland bamboo(Kassahun et al., 2015;Feleke, 2013).

Bamboo resource has numerous socioeconomic, ecological and cultural benefits (Mulatu & Fetene, 2014; Kebede, 2018; Chen et al., 2016; Mera & Xu, 2014). In Ethiopia, local farmers rely on bamboo as an alternative livelihood option. It provides a considerable share of various household incomes which is vital to their day-to-day livelihood activities (Abebe et al., 2021; Guadie et al., 2019; Solomon et al., 2020; Addis, 2021). It has been cultivated for a variety of economic, social, environmental, and traditional purposes. Local communities can use bamboo as furniture, fuel wood, charcoal, cultural and medicinal values (Gebrekidan et al., 2018; Abebe et al., 2021). Many smallholder farmers in Ethiopia consider bamboo as a “safety net” and “Green Gold” (Mekonnen et al., 2014). Sustainable conservation and utilization of bamboo resources is vital for obtaining economic, social and ecological benefits. As a result, it is a resource with considerable economic potential that can enhance the living condition of both rural and urban communities. It also has environmental regeneration properties, such as the ability to sequester carbon, and it serves as a raw material for both large-scale industries like paper and pulp as well as cottage and handicraft industries.

This resource has overall ecological and economic values, but its socio-economic role and contributions have not yet been exhaustively investigated. In Ethiopia, bamboo has always been viewed as a plant with little value when compared to other forest products. Similar to other forest resources, most economic studies and development programs frequently undervalue its significance. Despite the great ecological and economic significance of bamboo, not enough research has been done on the relationship between bamboo and its actual socioeconomic role and contributions to the local livelihoods of the community.

Assessing the contribution of bamboo and empirical information is critical for the country's bamboo resource development. The sector has received less attention than others for its potential contribution to the socio-economic development of the country (Desalegn & Tadesse, 2014; Guadie et al., 2019). In comparison to other resource, bamboo resource contribution was restricted, leading to underutilization of bamboo resource. Research has been done on the determinants, ecological services, community livelihood development, production and marketing of bamboo, and more (Gebrekidan et al., 2018; Guadie et al., 2019; Asfaw, 2019; Dule et al., 2020; Nigatu et al., 2020; Addis, 2021; Tsegaye et al., 2022). Previous studies focusess on estimation of bamboo for income share of the households (Mekonnen et al., 2014; Abebe et al., 2021; Asfaw, 2019; Addis, 2021; Obsa et al., 2015). But, these studies were limited to other geographical location. Therefore, quantifying bamboo contribution for the communities' income and livelihood and identifying its challenges assists for sustainable development of the sector. Provision of information is the key for decisions making in the areas of potential bamboo resource available. Thus, this study will investigate bamboo and bamboo product contribution for household income and its challenges for sustainable production in Gurage zone across central Ethiopia.

1.1 Objective of the Study

General objective

The general objective of the study is to investigate the contribution of bamboo and bamboo products for the household's income and its challenges in the study area.

Specific Objectives

a) To quantify the contribution of bamboo to household incomes in the study area;
b) To identify determinants of income from bamboo production/collection
c) To assess the challenges on sustainable bamboo production and marketing.

2. Materials and Methods

2.1 The Research design

The research design was relied on mixing of quantitative with qualitative approach in order to capture the data required to assess the contribution of bamboo for household income. Analyzing the contribution of bamboo and empirical information is critical for the country's bamboo resource development. To bring results together and validate the quantitative findings with qualitative concurrent triangulation research design was employed.

2.2 Sampling Design, Sample Size Determination and Procedure

The sampling design employed in this study was simple random sampling and probability proportional to sample size in order to have a reasonable sample size. The sampling design for the household survey followed multistage sampling technique. The probability sampling technique was employed to generate the desired sample size on the study sites. The required sample size was determined by using (Yamane, 1967)sample size determination formula where the exact number of households in each *Kebele* or the sampling frame is known. It was used to provide more accurate and estimate samples selected on the study area. A simplified formula provided by (Yamane, 1967)to determine the required sample size at 95% confidence level, degree of variability=0.5 and level of precision= 5% (0.05). The total sample size of the respondents was 216 households. From this, 113 respondents were from Ezha *Woreda* and 103 from Gumer Woreda selected with probability proportion to the sample size.

Where:

$\mathrm{n} = \text{the required sample size}$

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

N: population size
e: is the level of precision
n: $\frac{470}{1} + 470\ (0.05)^2 = 216$ households

The study was based on cross-sectional data of the production year 2015/2016 E.C. The sampling unit in the study was a household who produce/collect bamboo at *household* level. The procedures followed were three stages. At stage one, purposive selection of bamboo potential *Kebeles* of the *Woreda* was undertaken by using secondary data. At stage, two, out of identified bamboo producing *Kebeles o*f the *Woreda, households* who produce/collect bamboo were identified in collaboration with *Kebele* leaders and development agents. Finally, sample of households were selected randomly at *Kebele* level based on probability proportional to size of the sample. The actual sample of 216 households was selected from the sampling frame for the four *Kebeles* by Probability Proportional to the Size of the sample (PPS).

2.3 Source and Type of Data

The study utilized both qualitative and quantitative data from primary and secondary sources. The primary data is obtained through household survey and FGDs from sample respondents. Secondary data was collected from review of reports, published and unpublished materials like articles and related literatures.

2.4 Method of Data Collection

Primary method of data collection used through incorporating quantitative and qualitative data. Those were household survey technique is applied to collect the quantitative data whereas; Focus Group Discussion and observation techniques were used for the qualitative one. Similarly, secondary data like review of reports, published and unpublished materials were used. Questionnaire was prepared, refined accordingly and finalized after incorporating the inputs of the survey. One supervisor and six enumerators were trained to collect relevant data from sample households. They also mentored on how to record the responses, and on detailed contents of the questionnaire before the start of the main survey.

2.4.1 Data Quality Controlling Procedure

To maintain data quality, data collectors were well trained, questionnaires were pretested and filled questionnaires reviewed daily. Multiple linear Regression measurement instruments used and regularly calibrated, and computer data cleanup is done appropriately. In order to control data biased, daily monitoring and supervision activities was done by the researchers.

2.5 Method of Data Analysis

Data analysis was employed quantitatively by using software like SPSS version 26 & STATA version 16. We use both analytical and descriptive statistics for data analysis. The frequency and percentages of descriptive statistics were used to summarize the socio demographic characteristics of households. The total income for every household was used to calculate household income. A household's total income is the sum of its cash and subsistence income. Five major categories comprise the total household income: off-farm, bamboo, crops, livestock, and other forest. Bamboo: includes income from the sale of bamboo and its products, as well as income from the subsistence use of bamboo. Crop: comprise earnings from the sale of crops or from their use for sustenance. Livestock: includes income from the sale of livestock assets or from using them as a source of food during the duration of the survey. The term "other forest" was revenue derived from the sale of forest and forest products and taken for subsistence use. Income from wages, home businesses, and transfers are all considered forms of off-farm income. An analytical model of Multiple Linear regression was used to determine factors affecting income from bamboo production within the households. In this study, income from bamboo production/ collection was influenced by its socioeconomic and demographic factors.

2.5.1 Quantitative Analysis

Specification of the model

In this study to identify factors affecting income from bamboo production/collection: socio economic characteristics of households and market related factors analysis was done by multiple linear regression model. We start our analysis with the case explanatory variables, and then extend this to the case of k-explanatory variables.
The multiple regression models are specified by:

$$Y = \beta 0 + \beta 1 X1i + \beta 2 X2i + ui \quad (2)$$

$$yi = \beta 0 + \beta 1\ xij + \ldots\ldots\ldots\ldots + \beta k\ xik + ui \quad (3)$$

Where
$\boldsymbol{i} = \mathbf{1}, , \ldots \boldsymbol{N}$ & $\boldsymbol{j} = \mathbf{1}, \mathbf{2}, \ldots \boldsymbol{k}$
For each observation, can be written as

$$y1 = \beta 0 + \beta 1\, x11 + \beta 2\, x12 + \ldots\ldots\ldots\ldots + \beta k\, x1k + u1 \quad (4)$$

$$y2 = \beta 0 + \beta 1\, x21 + \beta 2\, x22 + \ldots\ldots\ldots\ldots + \beta k\, x2k + u2 \quad (5)$$

In the multiple linear regressions, the dependent variable is income from bamboo. Therefore, the model was estimated through using multiple linear regression coefficients. So, the multiple linear regressions were represented by:

$$yn = \beta 0 + \beta 1\, xn1 + \beta 2\, xn2 + \ldots\ldots\ldots\ldots + \beta k\, xnk + u \quad (6)$$

$$yi = \mathrm{xi}\beta + ui \quad (7)$$

It can be compactly written as

$$Y = \mathrm{X}'\beta + U \quad (8)$$

Where:
Y: dependent variable explained by different explanatory variable, which is income derived from bamboo production
X': independent variable used to explain dependent variable,
B: is an intercept of the regression model, the parameters which measures the changes
U: the error term.

3. Results and Discussion

3.1 Socio-Demographic Characteristics of sample of households

In this section, we provide an overview of the basic socio-demographic characteristics of sample households. Gender of household head, marital status, educational status and occupation of households were presented in Table 1. The result indicated that 83% of the respondents were male-headed households and 17 % were female-headed households. Marital status of the household head revealed that 81% were married while 11% were single. The remains 4% and 4% were widowed and divorced respectively. Education gives an opportunity to get information and use the information of bamboo technologies in a better way. 29%, household heads had completed primary school and 40 %them completed secondary school. Furthermore, 4%has arrived at tericiary level. Crop production is the main source of livelihood in the study area. Almost all respondents stated that their main occupation was agriculture. Furthermore, all but 94% households cultivated crop, while 59% of them raised livestock, and 5 % had incomes from business and government related activities. 58% of respondent's participated bamboo related activities.

The mean age of all respondents was 48 Years. The minimum and maximum household sizes for all respondents were 1 and 10 respectively. Average mean household size was 4. In rural households higher number of household (working group) can contribute to collect higher bamboo resource which can lead to higher income. Land is one of the most important resources for any economic and social activities mainly in rural areas since, the livelihood of people highly dependent on it. It was assumed that a farmer having access to land could lead to the higher possibility to cultivate bamboo resources. The mean land size was 2.11 hectare. The study area was also characterized by livestock rearing activities that include cattle, sheep, goats, pack animals, and poultry. The result of the study shows households own 3.34 average mean of livestock in Tropical Livestock Unit (TLU). The average mean years of living in the area indicated 40 years.

Table 1: Socio-demographic characteristics of the respondents

Variables	Category	Fre	Per
Sex	Female	37	17.1
	Male	179	82.9
Marital Status	Married	174	80.6
	Single	23	10.6
	Divorced	10	4.6
	Widow/ed	9	4.2
Educational status	Illiterate	47	21.8
	Primary (1-8)	56	25.9
	Read and write	86	39.8
	Secondary (9-12)	19	8.8
	Tertiary	8	3.7
Occupation	Crop production	203	94
	Livestock rearing	127	58.8
	Forest production	12	5.6
	Daily laborer	42	19
	Government and business	10	4.6

(Source field survey, 2024)

Table 2: Household characteristics on continuous variables

Variables	Mean	SD	Min	Max
Age (in Years)	48	11	24	80
Number of households	4	2	1	10
Total size of land(ha)	2.11	1.2	0.3	8
Livestock holding in (TLU)	3.34	1.96	0.14	8.6
Years of experience	40	17	1	79
Land for bamboo (in ha)	0.173	0.152	0	0.9

(Source field survey, 2024)

Access to market information plays an important role for income generation from bamboo. The result indicated that 76% of households had access to market information.

Table 3: Access to market information

Variables	Category	Fre	Per
Access to market information	Yes	164	75.9
	No	52	24.1

(Source field survey, 2024)

The average mean distance to the market shows 52 minutes. Distance to the market can affect the income generated from bamboo, as distance to the market is directly related to the cost of transport. Proxy distance to the markets was positively correlated with high income generation from bamboo. The result on the price of bamboo shows that bamboo producer sell their product averagely at 36 Ethiopian Birr per culm.

Table 4: Market related information

Variables	Mean	SD	Min	Max
Distance to the market (in minutes)	52	37	2	160
Distance to the collection area(in minutes)	18	20	0	130
Price of bamboo culm(ETB)	36	17	10	100

(Source field survey, 2024)

3.2 The contribution of bamboo to household income

Bamboo can be used for many purposes. According the result, highland bamboo can be used for construction of fences and houses, firewood, and livestock feed. Figure1 demonstrates the primary use of highland bamboo. The result shows highland bamboo used mainly for house construction (31%) followed for fencing and fuel wood (25%) and (24%) respectively.

Bamboo is useful not only for house construction but also for firewood and wood substitute. These days, bamboo is widely used in Ethiopia as a key alternative to wood. It also indirectly contributes to reducing the loss of timber forests through deforestation. Other major household items made up of bamboo includes: bee hives, mats, beds, baskets. These bamboo products were frequently used for many purposes in the study area.

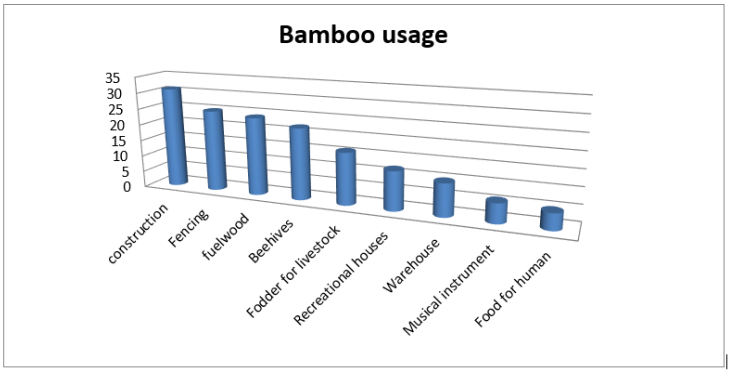

Figure 1: Primary use of highland Bamboo

Bamboo can be used for income and subsistence as well. It was demonstrated in figure 2 below. Bamboo accounted 14% to the total revenue, from this 93% was in cash. The result of the study revealed that is was the third most significant source of income. Similarly, the result of the study shows 85% of household bamboo income derived from bamboo culms. This indicated that more than 73% of the harvested bamboo was used in raw form on the farm. The result of the study shows still farmers were not in the mode of bamboo processing and getting additional income. This indicates that still there is a need to work on bamboo processing sector to change the life farmers. Majority of respondents (89%) sell bamboo and its products annually. 60% of them sell to wholesalers and retailers. 40% of respondents transport the bamboo, by manpower, which is quite expensive and time-consuming.

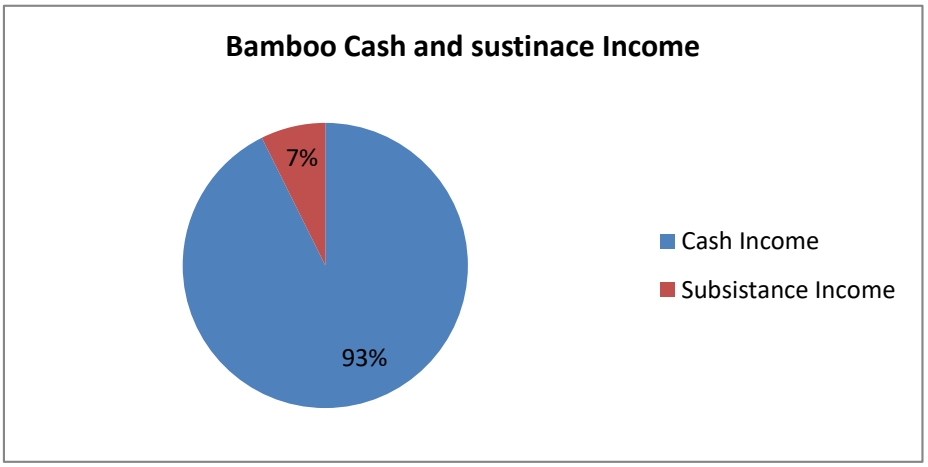

Figure 2: Bamboo cash and Subsistence Income

The contribution of each source of income to the total income of the sample households was displayed in Figure 3. Crop income contributed the largest share to the total income of the household (41%), while livestock contributed 23% which was the second income source in the study area. Bamboo makes a remarkable contribution to the entire cash component of household income. Bamboo's overall contribution to the total income was significantly greater than both 13% nonfarm income and 8% income from forests.

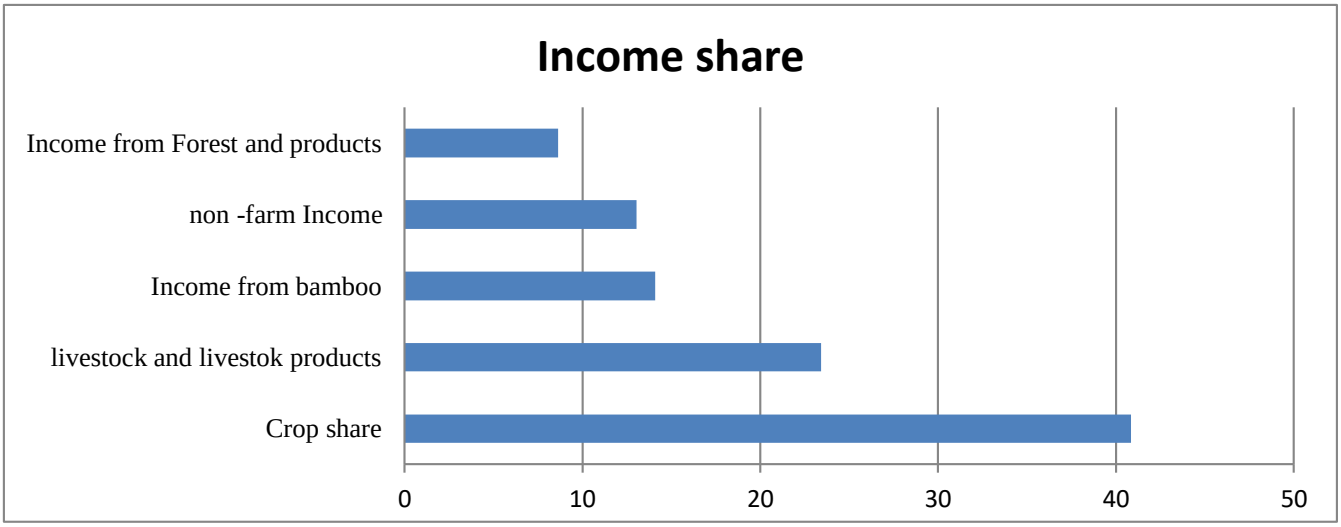

Figure 3: Share of household income

3.3 Determinants of bamboo income of the households

To determine factors affecting bamboo income of the households, a multiple linear regression model is estimated. Based on the analysis, a model containing 12 selected predictor interaction variables were included in the model. Using multiple linear regression method, three of the twelve predictor variables (Educational level of household head, Distance to the market and price of bamboo culm) have a significant joint influence in determining household bamboo income.

The overall model is proven, as it is statically significant at a p-value of 0.000. The R-squared is found about 0.352, meaning all explanatory variables included in the model explain 35% of bamboo income of the household. The P-value (Prob>ch2) 0.000 also shows that the model was statically significant. The signs of the regression coefficients (Table: 3) fulfill the underlying assumption and the corresponding p-values implies that the predictor variables included in the model have a significant joint influence on the outcome variable. The estimation of variance inflation factor was done to test whether multi-collinearity problem exist or not. The result shows problem of multi-collinearity does not exist. There were no explanatory variable dropped from the estimation model since no series problem of multi-collinearity. The Variance Inflation Factor (VIF) result were very far less than 10 and again those of the tolerance level (1/VIF) were greater than 0.2 which further revealed no problem of multi collinearity (see Appendix).

Table 3: Determinants of income derived from bamboo production: Result from multiple linear regression model

Variables	Coef	t	Sig.
Sex of HH	-.133	-1.480	.142
Marital status	-.004	-.040	.968
Age of HH	-.077	-.650	.517
Total family size	-.097	-1.005	.317
Education level of HH	-.163	-1.741	.084***
Livestock holding (in TLU)	-.088	-.976	.331
Total size of land	-.097	-1.005	.317
Years of living in the area	.026	.233	.816
Distance of bamboo collection area	.004	.045	.964
Distance to the nearest market	-.179	-2.015	.046**
Access to market information	.172	1.395	.166
Price of bamboo culm	.560	4.784	.000*
Total Income of HH	.084	1.062	.291

Source: Field Survey, 2024

Prob > F = 0.0000 R-squared = 0.352 Adj R-squared = 0.275

Note that *, **and *** are statically Significant at 1, 5 and 10 % respectively.

This study suggests that the educational level of the household head was determinant to household bamboo income and it influenced bamboo income negatively at a significant level. The result shows that holding the values of others constant, educational level of household head increases in one-unit, the bamboo income decreases by 16 ETB. It was negatively affect the bamboo income of the household and statically significant at 10 % probability level of significance. This might be occurring when a household head increases on educational level it may engages in other sectors, such as business and other governmental works to produce more income. This finding indicates that some farmers may shift from bamboo production to business or other sectors as the educational level is increased.

The result of the study also shows that keeping the values of others constant, an increase distance to the market by one- minutes decreases the bamboo income of the household by 18 ETB. Again, it is statically significant at 5 % significance level. Distance to the market had a negative and significant influence on the bamboo income of the households. The result of the study revealed that a one unit increases to price of bamboo culm increases the bamboo income by 56 Ethiopian birr. It was statically significant at 1% probability level of significance. This implies that price of the bamboo culm and its product highly motivates farmers to engage in bamboo production and generate more income from the sector**.**

3.4 Challenges of bamboo production / collection

Households were asked to identify and rank the challenges they had experienced on cultivating, collecting and selling of bamboo resources. The result in Figure 3 shows that challenges in bamboo production and marketing sector. Majority of respondents mentioned that market demand and market related difficulties were the first problem. Market problem was the big challenge on bamboo production sector. Access to market and market information were the big problem that constrain farmers from generating income from bamboo as intended. For rural households to properly manage bamboo resources and guarantee their livelihood, suitable market chains need to be established. Transportation of bamboo and its products was also a huge problematic in many rural areas of Ethiopia. Accessible and available transportation is essential for delivering bamboo and its products to the consumers. Market demand for bamboo and its products will also boost the profitability, which could lead to sustainable bamboo harvesting.

Growing consumer demand for bamboo goods could encourage product development, sustainable harvesting and value-added processing that will raise income derived bamboo of the rural households. The second most important difficulties, was knowledge on proper cultivation, harvesting and management of bamboo resource. The most significant challenge of bamboo producer faced was lack of proper knowledge on appropriate Cultivation, harvesting, management and processing practices of bamboo. The majority of respondents mentioned that the damage done to the bamboo culms throughout the cultivation process was the most challenging issue. Bamboo growers and collectors need to learn more about bamboo management and cultivation techniques in order to achieve sustainable growth. It is also crucial to understand the bamboo flowering and regeneration cycles and harvesting techniques. Addressing these knowledges will help for sustainable use and management of bamboo. The study further revealed that issues affecting income generated from bamboo were the bamboo quality and resource availability. The other barriers to process and make money from bamboo were lack of machine, tools, and storage facilities. Labor requirement and land scarcity were also mentioned as the most difficulties faced the bamboo sector. The attitude barrier and low product awareness were further difficulties faced the bamboo producers.

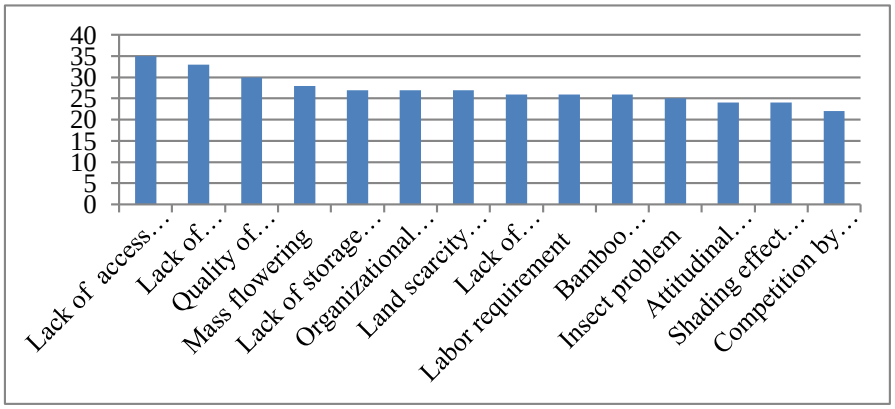

Figure 3: Challenges on bamboo production

Market related challenges

Less market demand for bamboo and bamboo products was the main challenges in bamboo sector. In addition to that, Poor processing, low value addition, inadequate technologies on bamboo processing, manufacturing and marketing, are among the major challenges. Very limited local market for bamboo handicrafts processed and few specialized enterprises that produce bamboo furniture and sell with high price. The problem associated with making products from bamboo was lack of the required skills. It was emphasized that lack of handcrafting skill was the major challenge to sell the required quantity of bamboo products for increasing household income. Due to the existing skill gap, there were limited bamboo processors and product sellers in the study area. Majority of Communities cannot benefit since most of them cannot process different products from it. Handicrafts limitation (unable to make different products) was also another challenge of transaction at the market.

Knowledge related challenges

The level of farmers' awareness has less intensive on managing bamboo production system. The household survey result revealed that bamboo management of practice could apply any conservation and protection strategy besides traditional management system. They could not use bamboo and its products beyond some usual products like fence and fuel wood. Selection problem of bamboo culm (mother plant) for plantation and missed planting practices such as space between culms was also stated under low awareness (knowledge based limitation). Usually, users take a bamboo shoot to plant on new area of land without considering the age of the mother plant. The other problems of bamboo raised by respondents occurred due to limited exposure with its importance. However, wrong perception, knowledge gaps and less interest of the people on highland bamboo leads to retard its expansion in the study area. The other misunderstanding of the community was cutting intensity, cycle and regeneration rate. Clear cutting depresses the rate of recovery of bamboo after cutting. The result of the study shows farmers cut bamboo culm on inappropriate age of growth.

3.5 Discussion

The result of the study shows highland bamboo can be used for many purposes. This result was consistent with a study by Daza (2013), which revealed that bamboo culms are utilized in the Amhara Region to build fences, homes, and bee hives. The result of the study revealed that bamboo made up a sizable portion of household income. Similar studies in Ethiopia have found that highland bamboo has become the main source of income for rural households. The percentage income contribution of bamboo was analyzed in different areas of the country, and most of the studies ranked bamboo as the first, second and third major sources of rural household income. The findings by (Mekonnen et al., 2014) and (Abebe et al., 2021) revealed that the revenue from the sale of bamboo products accounted for approximately 18% and 17.2% of the total yearly cash income of poor households, in Hula District, Sidama Region,

and Mandura District, Northwestern Ethiopia, respectively. Similarly, Addis (2021), in Guagusa Shikudad District, Amhara region, found that bamboo revenue ranks in second next to crop, accounting for 35% of the household's income. Likewise, Gebramlak et al (2015), and Obsa et al., (2015) in Tselemti District, Lower Beles River Basin, Northern Ethiopia and Dawuro Zone, South-West Ethiopia, revealed that bamboo contributed 21% and 19.2% of the overall income respectively. Endalamaw et al (2013), found that bamboo contributed 60% and 50% of the total households' income in Awi and Sidama Zones, respectively. Asfaw (2019), in Assosa District, Benishangul Gumuz Regional State found that, 29.44% household income.

The result of multiple linear regression revealed that distance to the market had a significant and negative effect on the income of bamboo as other variables were constant. This finding has conformity with (Asfaw & Etefa, 2017;Bakala et al., 2017;Obsa et al., 2015;Tsegaye et al., 2022). The result also revealed that as educational level of household head increases income from bamboo will decreases as other factor being constant. This is consistent with studies (Tsegaye et al., 2022;Addis, 2021;Mengstu et al., 2023). Mengstu et al (2023), found that household who have more educated have less probability to choose in processor outlet rather they want to produce different value added products. The result of the study also revealed that, price of bamboo culm has a significant effect on the income of bamboo. Bakala et al (2017), found that bamboo product selling has a significant and positive effect on the number of bamboo culms to be sold. The most important challenges that farmers prioritize were lack of technical skill on bamboo production and processing. This showed that bamboo utilization is still limited due to low value addition and weak local market networks. This is in line with the study of Bakala et al., (2017) stated that lack of skilled manpower leads to supply raw bamboo to the market. limited access to markets and lack of road infrastructure were the primary challenges that limits bamboo producers (Guadie et al., 2019;Nigatu et al., 2020).

4. Conclusion

This study assessed the challenges and contribution of bamboo production and marketing in two potential Woredas of Gurage zone, across central Ethiopia. From the findings of the study, it is possible to conclude that households, who have short distance to the market and who get more price of bamboo culm tend to generate more income from bamboo production. In contrast, households who have better education generated low income from bamboo. From the study, it is possible to understand that farmer's engagement in bamboo production/collection can increase the income of the households. Similarly, the findings suggest that bamboo play an important role by contributing for income share of the household's. Therefore, households who engage in bamboo production improve their income share of the households. Overall, bamboo contributes a remarkable income share for households in the study area. Therefore bamboo makes significant economic contributions for rural households. This implies that creating conducive production environment for the bamboo sector plays a vital role to improve the income and livelihood of farmers. Finally, there is a need, from the national level to the local community, to pay due attention to the bamboo sector and improve its productivity to change and improve the lives of the society. For sustainable bamboo production and development, the Ethiopian government is also expected to establish suitable institutions, invest in human capital, create a suitable market environment and encourage the development of the bamboo sector. Maximizing the social and economic benefits of bamboo resources will help improve the livelihoods of rural households.

Acknowledgments

We would like to forward our special thanks to all respondents in the study area for their unreserved openness and honest responses during the field data collection.

References

Abebe, S., Minale, A. S., & Teketay, D. (2021). Socio-economic importance of the bamboo resources in the Lower Beles River Basin, north-western Ethiopia. Environment, Development and Sustainability, 1–20.

Addis, a. (2021). determinants of bamboo production, the case of guagusa shikudad wereda, amhara regional state, ethiopia. st. mary's university.

Asfaw, A., & Etefa, L. (2017). The contribution of non-timber forest products to the rural livelihood: The case of yayo district, illu ababora zone, oromia regional state, western Ethiopia. International Journal of Applied Agricultural Research, 12(2), 157–169.

Asfaw, e. (2019). assessing the contribution of bamboo products on the smallholder farmers income generation: a case of assosa woreda, benishangul gumuz regional state, ethiopia. st. mary's university.

Bahru, T., & Ding, Y. (2021). A Review on Bamboo Resource in the African Region: A Call for Special Focus and Action. International Journal of Forestry Research, 2021, 10–12. https://doi.org/10.1155/2021/8835673

Bakala, F., Bekele, T., & Woldeamanuel, T. (2017). Market supply determinants of lowland bamboo culms: The case of Homosha district, Northwestern Ethiopia. African Journal of Marketing Management, 9(4), 46–58.

Boissière, M., Beyessa, M., & Atmadja, S. (2019). Guiding principles for sustainable bamboo forest management planning Benishangul-Gumuz Regional State (BGRS).

Chen, D., Yu, X., Song, C., Pang, X., Huang, J., & Li, Y. (2016). Effect of pyrolysis temperature on the chemical oxidation stability of bamboo biochar. Bioresource Technology, 218, 1303–1306.

Desalegn, G., & Tadesse, W. (2014). Resource potential of bamboo, challenges and future directions towards sustainable management and utilization in Ethiopia. Forest Systems, 23(2), 294–299.

Du, H., Mao, F., Li, X., Zhou, G., Xu, X., Han, N., Sun, S., Gao, G., Cui, L., & Li, Y. (2018). Mapping global bamboo forest distribution using multisource remote sensing data. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 11(5), 1458–1471.

Dule, F., Aman, K., & Tsegaye, W. (2020). Farmers practice the management and establishment of bamboo stands in Bore Woreda, Guji zone, Oromia region. Ethiopia. Working Paper Series 02/2020, Addis Ababa.< https://www. efd. gov ….

Endalamaw, T. B., Lindner, A., & Pretzsch, J. (2013). Indicators and determinants of small-scale bamboo commercialization in Ethiopia. Forests, 4(3), 710–729.

Feleke, S. (2013). Site factor on nutritional content of Arundinaria alpina and Oxytenanthera abyssinica bamboo shoots in Ethiopia. Journal of Horticulture and Forestry, 5(8), 115–121.

Gebramlak, G. D., Abadi, N., & Hizikias, E. B. (2015). Socioeconomic contribution of Oxytenanthera abyssinica (a. Rich) Munro and determinants of growing in homestead agroforestry system in northern Ethiopia. Ethnobotany Research and Applications, 14, 479–490.

Gebrekidan, S., Tiki, L., & Mulatu, Y. (2018). Indigenous knowledge on highland bamboo (Yushania alpina) management and utilization practices in Kokosa Woreda, South East Ethiopia. Scientific Research and Essays, 13(11), 111–122.

Guadie, Y. W., Feyssa, D. H., & Jiru, D. B. (2019). Socio-economic importance of highland bamboo (Yushania alpina K. Schum) and challenges for its expansion in Bibugn District, East Gojjam, Ethiopia. Journal of Horticulture and Forestry, 11(2), 32–41.

Kassahun, T., Emana, B., Mitiku, A., & Jimma, E. (2015). Determinants of highland bamboo (Yushania alpina) culm supply: the case of Loma and Tocha districts, Dawuro Zone of Southern Ethiopia. Journal of Biology, Agriculture and Healthcare, 5(21), 49–60.

Kebede, G. F. (2018). Social capital and entrepreneurial outcomes: Evidence from informal sector entrepreneurs in Ethiopia. The Journal of Entrepreneurship, 27(2), 209–242.

Mekonnen, Z., Worku, A., Yohannes, T., Alebachew, M., & Kassa, H. (2014). Bamboo Resources in Ethiopia: Their value chain and contribution to livelihoods. Ethnobotany Research and Applications, 12, 511–524.

Mengstu, M., Alemu, A., Dagnew, A., & Worku, C. (2023). Determinants of the Market Outlet Choice of Bamboo Culms (Yushania alpine) Producers in Banja District, Western Ethiopia. International Journal of Forestry Research, 2023(1), 5578146.

Mera, F. A. T., & Xu, C. (2014). Plantation management and bamboo resource economics in China. Ciencia y Tecnología, 7(1), 1–12.

Mulatu, Y., & Fetene, M. (2014). Propagation techniques for highland bamboo (Arundinaria alpina) in the Choke Mountain, Northwestern Ethiopia. Ethiopian Journal of Agricultural Sciences, 24(2), 23–36.

Nigatu, A., Wondie, M., Alemu, A., Gebeyehu, D., & Workagegnehu, H. (2020). Productivity of highland bamboo (Yushania alpina) across different plantation niches in West Amhara, Ethiopia. Forest Science and Technology, 16(3), 116–122.

Obsa, O., Kassa, M., & Tajebu, L. (2015). Income contribution of bamboo (Arundinaria alpina) based agroforestry practice in Dawuro Zone, South West Ethiopia. Journal of Economics and Sustainable Development, 6(9), 155–161.

Solomon, T., Moon, H., Abebe, S., Minale, A. S., & Teketay, D. (2020). Promoting bamboo-based agroforestry for enhancing ecosystem services from degraded lands. Agroforestry for Degraded Landscapes: Recent Advances and Emerging Challenges-Vol. 2, 423–444.

Tsegaye, M., Adicha, A., & Belay, T. (2022). Determinants of highland bamboo (Yushania alpine) culm market supply in semen ari district, South omo zone of southern Ethiopia. International Journal of Forestry Research, 2022.

Yamane, T. (1967). Statistics; an introductory analysis. Harper and Row.