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Market supply determinants of lowland bamboo culms: The case of Homosha district, Northwestern Ethiopia

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Bamboo market in Ethiopia is not well developed and bamboo marketing as a viable alternative for farmers has become a very challenging issue. In the Homosha district, despite the abundant and valuable lowland bamboo resources, the income contribution of bamboo is very low and livelihood of smallholder farmers in the area is desperate due marketing challenges. Thus, the study was initiated to identify and analyze factors influencing bamboo culm market supply as well as its opportunities and challenges. Both primary and secondary data were used in this study. The primary data were collected from 141 household heads in three villages via household survey, key informant interviews, field observation, market assessment and stakeholder consultation workshop. The data were analyzed using STATA13. It was found that family size (in working age) and experience of culm selling were positively and significantly related to quantity of bamboo bundles supplied for sale at 5% significance level, whereas, education level, access to market information, marketing linkages and prices were positively and significantly related to quantity of bamboo bundles supplied for sale at 1% significance level. But, age of harvesters is significantly and negatively related to quantity of bamboo bundles supplied for sale at 5%. In spite of high bamboo resource in Homosha district, it is declining due natural and anthropogenic related activities. Reverse to this government and non-governmental organizations are working on rehabilitation activities in some areas of the district. Bamboo utilization is confined to household level and products are manufactured traditionally and there was a low local demand for these bamboo products. Market actor lack training and is few researches conducted on bamboo production, processing and utilization. Therefore, in addition to toughening interaction among harvesters and buyers, spreading of relevant information and establishing bamboo product market center and cooperatives, and engagement of relevant institutions to assist bamboo marketing, it is encouraged to train market actors on bamboo economic benefits and marketing as well as conduct research on production, processing, management and utilization.

Key words: Bamboo bundles, determinants, harvesters, marketing linkages.

INTRODUCTION

Non-timber forest products have long contributed to subsistence needs offering energy, food, other materials and cultural objects (Ingram, 2010). Bamboo is one of the non-timber forest products (NTFPs) and it is the fastest

growing and highest yielding renewable resource (INBAR, 2006). The highest diversity and area coverage of bamboos is recorded from the Asian continent, followed by the America and Africa continent (Inga and Camille, 2011). Ethiopia has only two native bamboo species, viz., lowland bamboo (*Oxythenanthera abyssinica* [A. Richard] Munro) and highland bamboo (*Yushania alpine* [K. Schumann] Lin) which was formerly named as *Arundinaria alpine* (strake, 2014). Bamboo meets a rising and diverse consumer demands and generates income and contribute to reforestation and climate change mitigation due to its fast growth and environmentally friendly character (Pabuayon, 2009; Lobovikov et al., 2011). However, there is no accurate data on area coverage of Ethiopian bamboo resources (Strake, 2014). According to INBAR (2011), Ethiopia has over one million hectares bamboo resources in Africa.

From this lowland bamboo covers 850,000 hectares, while highland bamboo covers 350,000 hectares (INBAR, 2011). It is noted that Benishangul Gumuz region comprises about 48% of the total lowland bamboo resources of the country. The region is identified as an area with the largest natural stands of lowland bamboo.

The very difference of the two native Ethiopian bamboos is as shown in Figure 1. The lowland bamboo has a completely solid culm, with high bulk density and greater stability, while the highland bamboo has a hollow culm, which is easier to process (Stake, 2014).

In Ethiopia, bamboo utilization is limited to house construction, fences and some rudimentary furniture and household utensils as well as bamboo resources and products are currently not properly managed and utilized (INBAR, 2007). Development of bamboo resources and marketing system requires a good understanding of factors affecting decisions to engage, develop, and benefit from the bamboo resources across the major bamboo-growing regions (Adnew and Statz, 2007; Andargachew, 2008). Such understanding could facilitate sustainable utilization and management of the ever-declining bamboo forests which enhance the penetration of smallholder producers into the markets through increased market information and access, value adding, forging of partnerships, and proportional share of prices for bamboo products and eventually improves bamboo product marketing system. However, there is no adequate information on factors influencing market supply of bamboo culms in region in general and specifically in Homosha district.

This study, therefore, was initiated to analyze determinants of market supply for lowland bamboo culms in Homosha district. Specifically, the study aims: (i) to identify socioeconomic determinants for lowland bamboo culm market supply and (ii) to assess prospects and challenges in bamboo culm marketing and management in the study area. In coming up with these objectives,

Figure 1. Transversal section of highland bamboo *Yushania alpina* (left) and lowland bamboo *Oxythenanthera abyssinica* (Starke, 2014: 3).

detailed explanations of bamboo culm market supply determinants, management activities as well as opportunities and challenges in bamboo culm marketing were provided. Addressing these research objectives will offer knowledge concerning the determinants of bamboo culm market supply as well as the constraints and opportunities in bamboo culm marketing that will support to meliorate bamboo culm marketing system. Thus, this paper contributes to the understanding of wider issues regarding socioeconomic determinants of bamboo culm market supply, management activities as well as destinies and restraints in marketing of lowland bamboo culm in Ethiopia and further.

METHODOLOGY

Study area description

The study was conducted in Homosha district in Asosa zone, Benishangul Gumuz Regional State (BGRS). The district is located at a distance of 711 km from Addis Ababa to Northwestern. The total land area of the district is 48,325 hectares which comprised 15 rural villages. Data collection for the study was carried out in three rural village, viz., Tumet, Ashura and Jima (Figure 2).

Data collection methods

A multi-stage sampling technique was employed. First the study area was selected purposively based on the availability of bamboo resources. Second, three villages, namely, Tumet, Ashura and Jima were selected for the study based on the intensity of harvesting and level of bamboo marketing activities. Thirdly, households were selected randomly as all households in the study area harvest bamboo for domestic use and/or for sale (Fayera et al., 2016). In addition to secondary sources, primary data were gathered through household survey, key informant interviews, field observation, market assessment and stakeholder consultation workshop.

Different socioeconomic variables were determining the quantity of bamboo culm bundles[1] supplied for sale. Taking the number of

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[1]Bundle refers to bamboo culms tied together, one bundle contains ten single bamboo culms and it is locally known.
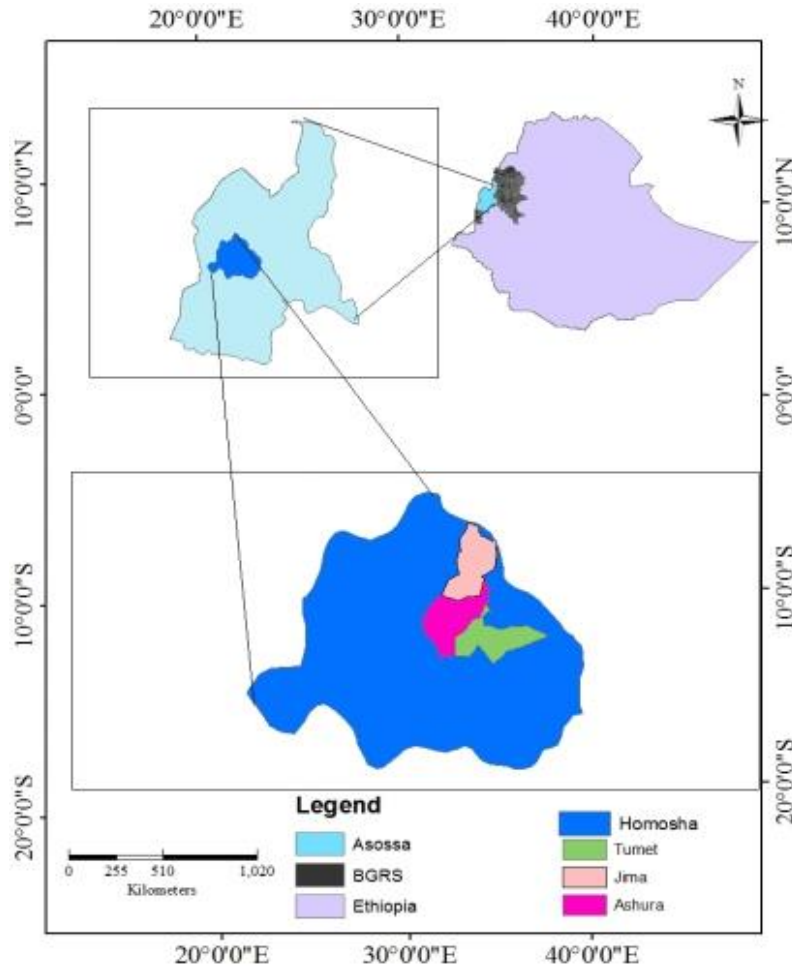
Figure 2. Map of study area.

expected explanatory variables into consideration, the sample size was determined by rule of thumb suggested by Greene (2003);

$$N \geq 50 + 8m$$

where N is the sample size and 'm' is the number of explanatory variables.

Eleven variables are hypothesized to determine bamboo culm supply for sale. Accordingly, using the household list, 141 respondents (household heads) were selected for interview (Table 1). Analysis was conducted using a combination econometric methods and descriptive statistics.

Market supply determinants

Market supply determinants refer to factors that hinder the ability of

producers to supply their products to the market. The most important market supply determinant factors are divided into economic and political factors. Economic factors include product price, provision of consumer goods, production cost and market supply costs and political factors include the level of government intervention. In agriculture, supply is the function major factor affecting farmers' willingness and ability to supply agricultural products. These factors include (a) price of the commodity to be supplied, (b) cost of all the inputs necessary to produce the commodity, (c) net income or profit that could be had from alternative crops, (d) state of technology that affects potential yields, (e) total acreage available, (f) expectations about future price changes, and (g) risks to production (weather, insects). In this study of bamboo culm market supply was determined by econometric method.

In Ethiopia, bamboo harvesting is legal, but the market is weak due to low quality products, and poor coordination among agents

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Table 1. Sample size distribution of bamboo harvester households in the selected villages (Survey Result, 2014).

Name of village	Number of households	Number of sample households
Tumet	223	70
Ashura	108	34
Jima	119	37
Total	450	141

Table 2. Socioeconomic characteristics of respondents (categorical variables).

Variable	Variable description	Frequency (N=141)	%
Sex	Male	107	75.9
	Female	43	24.1
Access to extension services	No	60	42.6
	Yes	81	57.4
Marketing linkage	No	124	87.9
	Yes	17	12.1
Access to market information	No	86	61
	Yes	55	39
Education level	Not attended formal education	60	42.6
	Attended primary education (1-8 grade)	59	41.8
	Attended secondary education (9-12 grade)	22	15.6
Marital status	Married	127	90.1
	Single	14	9.9

N is sample size.

involved in the marketing chain (Andargatchew, 2008). In addition, few incentives exist for sustainable management of native bamboo forests; degradation and land conversion have resulted in a significant loss of bamboo forests and resources throughout Ethiopia (Andargatchew, 2008). In Ethiopia, bamboo product marketing and demand is growing, but the market potential is restricted because local entrepreneurs and rural households have not been successfully incorporated into this emerging market.

Model specification

Multiple linear regression model is applied to determine two or more factors affecting dependent variable. Thus, multiple linear regression is used to identify the relationship between quantity of bamboo culm bundles supplied for sale (dependent variable) and independent variables (Table 2). General form of multiple linear regression is:

$Y= \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_4 X_k + \varepsilon i$

where Y represents dependent variable and $X_1, X_2, X_3, X4\ldots X_k$ represent independent or explanatory variables and εi represents

disturbance factor.

Variable descriptions and hypothesis

Different socioeconomic factors are considered in this study that is supposed to affect willingness and ability to supply and sell bamboo poles. Each of the hypothesized explanatory variables are described subsequently and summarized in Table 2 at the end of this subsection.

Number of bamboo pole bundles supplied for sale (NBPBS): This is a dependent variable. It indicates the number of bamboo pole bundles supplied for sale in the year 2014 by harvesters.

Sex of household head (SEX): This is dummy variable which is 1 household head who supply bamboo pole for sale and is male and zero otherwise. Both male and female headed households involve in bamboo supply for sale, but male headed households might have better tendency than female headed households. Thus, it is hypothesized that male harvesters supply more bamboo poles than female headed households. NTFPs marketing are dominated by

women. However, the sale of some wild food products grass-cutters and other plant products (rattans, bamboo, hides and skins) and other wild animal products are dominated by men (Albert and Emmanuel, 2011).

Age of household head (AGE): It is a discrete variable and measured in years. It is hypothesized that older households supply less bamboo pole bundles for sale and it is expected to have a negative relationship with number of bamboo pole bundles supplied for sale.

Family size household (FASI): This is a discrete variable that refers to number of family members of greater than 15 years old in the household and expected to have a positive relationship with the supply of bamboo pole bundles for sale. Therefore, as the working labor of family increases the quantity of bamboo pole bundles supplied to the market will increase. Family with large working labour has sufficient labor to transport bamboo poles from distant forests, required in excess for household consumption, and such families may be motivated to sell what is left from their own consumption (Tefera et al., 2013).

Education level (EDULEV): It is a discrete variable measured by years of schooling. It is hypothesized that educated household heads supplies more bamboo pole bundles for sale. The educated household tries to diversify income sources. Therefore, it has positive influence on the bamboo poles supplied for sale. In Masha (Sheka zone of SNNPR) farmers who engaged in bamboo trading and harvesting were better educated and had access to market information (Tefera et al., 2013). Their knowledge and information positioning may help them to benefit from market opportunities available in the in the area.

Experience of household head (EXPER): This refers to the number of years the harvester participated in supplying bamboo poles for sale. It is expected to be related positively to the number of bamboo pole bundles supplied for sale. As farmers got more experience in bamboo selling, the probability of increasing supply would be higher. The more years of experience for a given seller increases supply and seller has the more he would learn about how the market works (Bauch and Sills, 2007).

Access to extension services (AEXSER): This dummy variable taking value of 1 if bamboo pole supplier has contacted with a development agent and 0 otherwise. Extension service is expected to have positive relationship with number of bamboo pole bundles supplied for sale. Expansion of extension education among producers may enhance the commercial engagement of producers and improve the accessibility of bamboo resources for commercial production (Tefera et al., 2013). It is expected that extension services widens the household's knowledge with regard to better bamboo quality supply and positively impact bamboo market supply.

Access to market information (AMI): This is a dummy variable taking value of 1 if the harvester has access to market information and zero otherwise. It is assumed to have positive impact on the supply of bamboo pole bundles. If farmers gain the proper information about what the market needs and what buyers are willing to pay, they are more likely to make wise decisions in forest management and work in a more efficient way (Wang, 2006). Therefore, lack of market information obstacle that prevents farmers from gaining more benefits from forest management.

Market Linkages (MLINK): This is a dummy variable that takes value of 1 if the harvester has linkage/relationship with buyers of bamboo poles and zero otherwise. It is assumed to have positively related to the number of bamboo pole bundles supplied for sale. Setting up a local bamboo marketing center in or around the bamboo growing area or processing area would significantly help to build a strong connection/linkage between the bamboo growers, processing industries and traders (Wang, 2006). Hence, increase market supply of bamboo products.

Number of bamboo pole bundles harvested (NBPBH): It is an independent continuous variable and measured in number of bamboo pole bundles harvested in 2014. The variable is assumed to have positive relationship with the number of bamboo pole bundles supplied for sale. Household who harvest more bamboo products supply more to the market than those who harvest less.

Annual non-bamboo income (ANBIN): This is one of the determinants of lowland bamboo poles market supply. It is a continuous variable and represents the amount of income earned in 2014 E.C from other sources, excluding income generated from bamboo products. It is measured in Birr[2]. It is noted that poorer households are widely involved and gather more NTFP. This variable is expected to influence marketable supply negatively.

Price of bamboo pole (PRICE): This is continuous variable measured in birr per bamboo pole. This variable is expected to influence marketable supply positively. When the price of the product is promising, farmers are motivated to take their produced to the market. Bamboo marketing system and pricing affects household engagement in and benefits from the bamboo development and production system (Mokennen et al., 2014).

Various challenges and opportunities were identified in bamboo marketing and management aspects by workshop discussion held with market actors, then after from the raised challenges were prioritized using pair-wise ranking matrix.

RESULTS

Socio-demographic characteristics of respondents

Respondents are farmer households who harvest bamboo culms from forest either for domestic use or sale. About ¾ of the interviewed respondents were male- and the remaining were female-headed households. About 57.4 and 39% of total interviewed harvesters had an access to extension services and market information about bamboo. Of the total respondents, 90.1% were married, whereas the remaining 9.9% harvesters were single. Concerning educational level, about 42.6% respondents did not attend formal education, whereas 41.8 and 15.6% of the sampled respondents attended primary and secondary education level, respectively (Table 2).

The result of study indicated that maximum and minimum age of sampled respondents was 18 and 66, respectively with average age of 40.25. This implies that majority of the harvesters are in working age. Harvester

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[2]The basic unit of money in Ethiopia; equal to 100 cents

Table 3. Socioeconomic characteristics of respondents (continuous variables).

Variable	Observations	Minimum	Maximum	Mean	Std. Deviation
Age [years]	141	18	66	40.25	11.055
Experience [years]	141	3	6	4.53	1.112
Supplied culms [No. of bundles]	141	5	120	41.87	26.971
Family size [No.]	141	2	20	8.37	4.308

Table 4. Relationship between mean of bamboo culm bundles and socioeconomic characteristics.

Variable	Category	Mean culm supplied for sale[in bundles]	Std. Deviation	t-test
Marketing linkage	No	36.33	21.796	-7.905***
	Yes	82.29	27.186	
Sex	Female	32.47	14.91	-1.392
	Male	48.36	26.751	
Access to extension services	No	21.27	7.865	-11.736***
	Yes	57.14	25.944	
Access to market information	No	36.21	21.639	-2.966**
	Yes	50.73	31.906	
Experience	3-4 years	28.96	15.261	-7.089***
	5-6 years	58.32	29.679	

*** and ** indicates statistically significant at 1 and 5% significance level, respectively.

households had an average of 4.52 years of experience in supplying bamboo for sale with minimum and maximum of 3 and 6 years, respectively. On average, 41.87 bamboo culm bundles were supplied annually for sale by sampled households with maximum and minimum of 120 and 5 bundles, respectively (Table 3).

Even though there was no significant difference between the mean values of bamboo culm bundles supplied by male- and female-headed households, the activity were dominated by male-headed households. This is due to the fact that the task is very challenging for females to harvest and transport culms from inaccessible and remote areas to selling place. As indicated in Table 4, the mean value of bamboo culm bundles supplied by harvesters who had access to extension services about bamboo is significantly different from harvesters who had no access to extension services at 1% significance level. As well, the mean of bamboo culm bundles supplied by harvesters who had an access to market information and marketing linkage concerning bamboo are statistically significantly different from those harvesters who had no access to market information and marketing linkage at 5

and 1%, respectively. Harvesters who had 5 years and above experience in raw bamboo selling were supplied more bamboo bundles than those harvesters with less than 5 years of experience. This difference is statistically significant at 1% significance level.

Education level and family size

As shown in Table 5, about 42.6% bamboo harvesters did not attend formal education, but the remaining 41.8 and 15.6% of the bamboo harvesters had primary and secondary education level, respectively (Table 6). The mean of bamboo culms supplied by harvesters who attended secondary education level was 68.91 bundles, nonetheless on average 22.65 bamboo bundles were supplied by harvesters with no formal education. There was a significance difference among the mean of bamboo culm bundles supplied by harvesters with secondary education level, primary education level and with no formal education at 1% significance level. The reason behind this is that educated harvesters

Table 5. Education level, family size of respondents and supplied bamboo culms.

Variable	Category	N	Mean of culms supplied for sale	Std. deviation	F-test
Education level	Not attended formal education	60	29.65	15.69	
	Primary level	59	44.22	24.59	22.891
	Secondary level	22	68.91	35.78	
Family size 15 ≤age≤64	0-2	42	30	22.21	
	3 -5	63	32.22	14.65	48.07
	6-8	22	61.95	26.18	
	9-11	14	89.36	11.37	

Number of observations (N) =141, 15≤age≤64 represents family members in working age.

Table 6. Determinants of number of bamboo culm bundles supplied for sale.

Variable	Coefficients	Std. Error	t-value	p-value
Constant	-16.524	5.375	-3.074	0.003
SEX	1.727	1.872	0.922	0.358
AGE	-0.091*	0.087	-1.045	0.098**
FASI	0.451*	0.218	2.069	0.041**
EDULEV	0.694**	0.223	3.112	0.002***
EXPER	1.575*	0.771	2.042	0.043**
AEXSER	1.852	2.382	0.777	0.438
AMI	4.366**	1.480	2.949	0.004***
M LINK	8.280**	2.293	3.611	0.000***
NBPH	0.628**	0.044	14.210	0.000***
ANBIN	-0.001	0.000	-1.199	0.233
PRICE	5.160**	1.122	4.600	0.000***

N=141; R^2 =93.4; adjusted R^2=92.9; ** and *** indicates significant at 5 and 1% significance level.

understood bamboo selling as income source. This is inducement for harvesters to pay due attention for bamboo resource management. About 44.7% sampled households had 3 to 5 individuals in working age in family members. The remaining 29.8, 15.6 and 9.9% of total respondents had 1-2, 6-8 and 9-11 individuals in working age in family members, respectively. Mean of bamboo culm bundles supplied by these groups showed significant difference at 1% significance level. This is attributed to the fact that households who had more family members in working age provide high number of labor for bamboo harvest; this puts the quantity of bamboo culm bundles to a larger.

Econometric output of the regression model

Before running the OLS regression analysis, all hypothesized variables were checked for existence of heteroscedasticity and multicollinearity. The result of Breusch-Pagan showed that there was no heteroscedasticity problem (p=0.15) at 1% significance level. Variance inflation factor (VIF) and contingency coefficients (CC) were used to test the existence of multicolliniarity problem among continuous explanatory variables and dummy variables, respectively. The results indicated that there was no serious problem among the independent variables.

Age of the household head (AGE)

The age of the household was associated with the quantity bamboo culm bundles supplied for sale negatively and statistically significant at 5% significance level. This implies that older individuals supply less quantity than younger. As age of the household head increases by one year, the amount of bamboo culm

supplied for sale decreases by 0.091 bundles as bamboo resources are located in remote areas and challenging to transport to selling places for aged households.

Family size (FASI)

The result shows that family size has positive relationship with the quantity of bamboo culm bundles supplied for sale at 5% significance level. An increase in family size by one individual in working age increases the quantity of bamboo culm bundles supplied for sale by 0.451, keeping the other variables constant.

Education level (EDUCLEV)

Education has showed direct association with the quantity of bamboo culm bundles supplied for sale at significance level of 1%. On average, if the harvesters get educated, the number of bamboo culm bundles supplied for sale increased by 0.694 bundles. This is due to the fact that education improves ability of the households to earn income from different sources.

Experience (EXPER)

Experience in supplying bamboo for sale is significantly and positively related to the quantity of bamboo culm bundles supplied for sale at 5% significance level. One year increase in experience of bamboo culm supplying and selling increases the number of bamboo culm supplied for sale by 1.575 bundles.

Access to market information (AMI)

This variable is positively related to quantity of bamboo culm supplied for sale at 1% significance level. Households who had access to market information supplied 4.366 more bamboo culm bundles than those who had no market information. Access to market information helps to acquire new idea and information related to bamboo market and increases bamboo culms supplied for sale.

Marketing linkages (MLINK)

The variable is positively related to the quantity of bamboo culm supplied for sale and statistically significant at 1%. Harvesters who have a relationship with bamboo buyers supplied 8.280 bundles than those who do not have marketing linkage.

Number of bamboo culm bundles harvested (NBPBH)

The variable is positively related to number of bamboo culm supplied for sale at 1%. This show as number of harvested bamboo increases by one bundle, the number bundles supplied for sell increases by 0.628 bundles, that means if harvested culms exceeds the domestic demand for consumption, extra bamboo culm (surplus) would be supplied for sale to meet the income demand households.

Price of bamboo culm (PRICE)

Price of bamboo is positively related to the number of bamboo culms supplied for sale and statistically significant at 1% significance level. In this case as the price of bamboo culm increases by one unit, the amount of honey supplied to the market will increase by 5.160, other things remain constant.

Bamboo management systems and marketing

Farmers frequently cut immature/young culm growing at peripheral of clumps, as the harvesting is easy and quick. In addition to this, culms harvested in rainy season at the clump have high starch content for new growing shoots[3]. This practice ultimately destroys the clumps by gradually decreasing the rhizome vitality (Figure 3). Consequently, deteriorate the resource and adversely affect the regenerative capacity of the clumps as well as future bamboo availability. Culm harvesting should be only during the dry season. The starch content of bamboo is lower during the periods of dryness. Lower starch content in the culms will make them less susceptible to attack by borers. Unharvested aged culms at the center of clump die and start rotting in the rainy season. This attracts insects and fungi initiating diseases in the clumps and leads to fall in clump health and decreases the volume of bamboo culms for local users. Agricultural office of the district manages bamboo resources to a little extent. As per bamboo utilization regulation devised by regional government individuals who harvest dozens of culms shall get permission from agricultural office of the district. Once permission is provided, the office does not control the rafts whether the exactly requested amount or not. It is informally known that harvesters take out more bamboo culms than the exactly formally requested; this negatively impact sustainability of bamboo resource in the Homosha district.

Farmers harvest culms for sale and/or home use. There were a very limited local market and demand for

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[3]Bamboo shoots are the new culms that just emerge from existing clump.

Figure 3. Peripheral young bamboo culms harvested due to quick and easy access.

raw bamboo culms and manually manufactured bamboo products. The marketing activities of rudimentary products in the study area were confined to the area and were not broadcasted in the region. The bamboo marketing system is not further developed or organized in a systematic way to create and improve market linkage between suppliers and consumers in the study area. Even though the bamboo handicrafts supplied to a lesser extent, consumers were not willing to buy these products due to poor quality and design, hence low demand and price for bamboo manufactured products in the study area. Regarding bamboo culms, more the culms are supplied to the market, so that the price per culm was low. As well bamboo forest a free access and community harvest bamboo with no payment from the forest and reluctant to purchase culms. This resulted in less market demand for bamboo culm.

Prospects and challenges in bamboo marketing in the study area

Homosha has high natural bamboo resources. The main road from Ethiopia to South Sudan passes through this district. This creates an opportunity to export both raw bamboo and processed bamboo products to South Sudan. Bamboo Star Agro forestry Plc. was installed in the Asosa town, about 36 km from Homosha district. The factory started bamboo processing at small scale; in future if the factory started bamboo processing on the large scale, the harvesters might supply bamboo culms for the factory and will be benefited. This is a great opening for bamboo marketing, since it creates demand for bamboo culm as well as produces considerably designed and quality products. Thus, supply of good quality and durable bamboo products that changes attitudes of the people for poor quality and low durability bamboo products. This expands market for bamboo products. Non-governmental organization (NGO), Natural Resource Development and Environmental Protection (NRDEP) started bamboo seedlings production to rehabilitate depleted bamboo resources by South Sudan refugees who settled in the study area. This is great opportunity for sustainability of bamboo resource and whenever the activity continued and expanded, future market supply will be sustained.

The uses of bamboos are restricted to the household level, and the primary use of raw bamboo material is for housing, fencing and household utensils in Homosha district. Thus, bamboo marketing confined to local area. There is no strong linkage among bamboo marketing actors. The stakeholder consultation workshop discussion on bamboo value chain at held at Hawassa University, Wondo Genet College of Forestry and Natural Resources on March 23-25, 2015 also identified poor marketing system in Benishangul Gumuz Regional State and Sidama zone of South Nations and Nationalities and Peoples region.

There is lack of training for market actors and lack of research on bamboo production, processing, management and utilization in the study area. Natural stands are declining due to human related activities and gregarious flowering and currently, nearby bamboo resources are exhausted. Anthropogenic (poor management) and natural (gregarious flowering) causes diminish the future bamboo availability to meet demand of users. Refugees from Southern Sudan living in Homosha district are exerting pressure on bamboo resources. Even though refugees are disallowed to sell bamboo culms to the market, high numbers of bamboo culms were harvested for home use. Renewable resources are exhaustible if harvested for too long at a rate exceeding their regeneration capacities. The identified challenges in the lowland bamboo marketing were prioritized using pair-wise ranking matrix as follows:

(1) Lack of marketing chains/linkages,
(2) Low market demand for bamboo products,
(3) Lack of infrastructure (road s and transporting facility),
(4) Lack of market information accessibility concerning bamboo marketing,

(5) Lack of market center for bamboo products,
(6) Lack of government support for bamboo product market expansion,
(7) Lack of training and working tools for craftspersons,
(8) Lack awareness (about bamboo economic value the resource).

DISCUSSION

Determinants of bamboo culm market supply

Aged household could not go far to harvest bamboo culm and they are not capable to extract bamboo culms from inaccessible areas. Adult members significantly influence the decision to participate in non-timber forest products extraction and marketing (Prakash et al., 2006). According to these authors, the probability of households participating in forest product commercialization was negatively correlated with age of household heads participating in non-timber forest products activities. As household head is becoming aged, the amount of bamboo culm supplied for sale is declining. As the number of family members with working age increases, bamboo supplied to the market will rises. The study of Arun (2006) shows that family size is positively related and has significant effect on non-timber forest products extraction and market supply. In the study area, mostly students harvest and sell bamboo culms during their free time to cover educational expenses. Household heads who attended formal education supplied more bamboo culms to the market. This is similar with Marshall et al. (2006), who found that in the case of soyate palm (non-timber forest products), the more educated the producers, the larger the share of their income contributed by non-timber forest products commercialization and education improves awareness to market and help the actors to acquire new idea in relation to market information and thereby increase bamboo culms supplied for sale.

Household engaged in bamboo marketing for longer time supplied more culms than new harvesters recently started bamboo marketing. Marketing skills and experiences are essential for buyer and sellers of non-timber forest products and experience is an important asset for traders who remained surprisingly faithful to particular products (Marshall et al., 2006). The study of Alejandro (2005) shows that a family experience of participation in gathering and harvesting has a positive impact on participation in non-timber forest products harvest. Access to market information facilitates bamboo marketing activities, hence, increases bamboo market supply. According to IFAD (2008) without access to market information, forest dwellers have little knowledge of how much a consumer in the city or in developed countries will pay for the final product, and they have little

or no means of bargaining for an increased stake in growing profits. Similarly, harvesters who have better access to market information, have the probability of getting better price, which would in turn increase the market supply. Non-timber forest products markets are usually characterized by asymmetric information (Simone and Erin, 2007). Interactions market actors seen as a source of knowledge and learning for innovation (Flint et al., 2008; Morrison et al., 2008; Bakhshi and McVittie, 2009; Fu et al., 2011). Besides market information, marketing linkages also plays positive role in bamboo marketing. According to Marshall et al. (2006), good organization and linkage of non-timber forest product producers and processors contributes to improved product quality and quantity, more cost-effective transportation and increased negotiating ability. Development of infrastructure for linking resource, consumer centers and expansion of extension education among producers may enhance the commercial engagement of producers and improve the accessibility of bamboo resources for commercial production (Tefera et al., 2013). The same study indicated that in most bamboo growing areas of Ethiopia market linkages are weak with a small number of intermediaries and trade is largely restricted to local markets.

In Ethiopia, there only exists a very limited local market for bamboo handicrafts which are not further developed or organized (Wang, 2006). Particularly, in the study area, there only exists a very limited demand for bamboo culms and bamboo related products and its marketing system which is not developed and organized. Raw bamboos were processed locally by using rudimentary tools and traditional techniques, hence, limits the raw bamboo culm markets. The types and number of bamboo products produced by craftspersons in the study area were very few. These products have low local market demand. Asian experiences (Pabuayon, 2009) indicate that new products and designs, appropriate materials and processing designs increase return and durability of bamboo products which leads to expansion bamboo marketing system. Ethiopia does not have a modern bamboo based processing industry, and the handicraft sector is poorly developed and affects the marketing activity (Wang, 2006). In Africa, some progresses have been registered for manufactured products (Bell, 2007; Juma, 2011). Nowadays, in Ethiopia also few bamboo processing factories are installed in Ethiopia. Lowland bamboo is declining at an alarming rate as a result of forest clearing to establish new agricultural land, forest fires, for human resettlement programs, unregulated harvest and flowering.

Bamboo management systems and marketing

Little is known about the harvesting and utilization of

bamboo in Africa, specifically in Ethiopia. Lack of modern management scheme or extremely traditional management system (UNIDO, 2006) and lack of research and development (R&D) and extension packages (Adnew and Statz, 2007) caused deterioration in productivity of bamboo stands in Ethiopia. Additionally, Berta Ethnic group, the dominant ethnic group in the district, uses bamboo shoot for food in growing seasons. As a result, overharvest of bamboo shoot shrinks availability of bamboo stand in the Homosha district. Presently bamboo resources are available in remote and inaccessible areas where the human and encroachments are less. In Ethiopia, bamboo stands are either depleted because of overharvesting of young culms or poor management (Motuma and Yigardu, 2015). Government owned bamboo forests are actually nobody's forests that have been suffering from the "tragedy of the commons" (UNIDO, 2006). No protection what so ever from illegal harvesting, wildfire, pests and disease; no protection from encroachment and clear felling; no practical arrangements exist to manage, protect and utilize the especially in lowland bamboo forests (Motuma and Yigardu, 2015). The government of the Ethiopia lacked economic incentives to value and prioritize bamboo resource as useful commodities that require attention and planned action, as a result did not budget adequate finance to protect, manage and use them the resource properly (UNIDO, 2006). The uncontrolled exploitation of this resource has resulted in reduced productivity and yields as well as resource deterioration in different areas the country including the study district. Bamboo promotion to various bodies increases. However, if bamboo is promoted and demand and cultivation and sustainable, long-term supply and management harvesting and management need to occur in parallel (Verina and Julius, 2012).

In the study area, resource wastage during harvesting, transporting and processing were observed. Bamboos were cut at above 1 m from the ground and chopped off the upper narrow part to take out only the middle portion. According to Fayera et al. (2016) lack of efficient culm utilization and only about 1/3 (middle part) of the whole bamboo culm were used, whereas the remaining 2/3 of the whole culm were discarded. Unprocessed bamboo culms are dominantly traded due the lack of skilled processors and capital. Most developing countries, especially those in Africa, are still trading primarily unprocessed products and are locked in low-skill activities (World Bank, 2006; Juma, 2011; Bell, 2007). Bamboo marketing in Africa is circumscribed to bamboo growing sites and consequently, bamboo is less commercialized compared with other regions or products, for instance 93% for bamboo from Guanxi, China (Hogarth and Belcher, 2013) is commercialized. In Ethiopia, bamboo processing is manual and produces less durable products (Tefera and Pretzsch, 2012). Similarly, markets for bamboo are not well developed (Andargachew, 2008; Tefera et al., 2013; Mekonnen et al., 2014). This situation contributed to low local market demand for raw bamboo culms in the country. Harvester households had long experience in bamboo harvesting for domestic utilization (Fayera et al., 2016). Nevertheless, they had short experience (3-6 years) in supplying bamboo for sale. This determined the market extent of bamboo market of the region. Most of the harvesters involved in the bamboo culm marketing were got formal education. Educated household heads tend to diversify income and, hence, participate more in cash-generating activities, such as bamboo production and marketing (Mekonnen et al., 2014).

Presently, there is shortage of forest products specifically with an expected increase of demand for lumber and wood-based products in the future (Gebremariam et al., 2009). Since the past few years, such a gap has triggered bamboo utilization and is becoming the major substitute of wood for house construction in Ethiopia (Alito, 2005; Bewketu, 2009; Gebremariam et al., 2009; INBAR, 2010; Kibwage and Misreave, 2011). This facilitated bamboo marketing activities in different parts of the country. Additionally, domesticated production system is often preferred to afford a sustainable and adequate source of raw material with desired quality (Tefera et al., 2013). Successful commercialization of tree products depends on the domestication of product sources and the production activity (Schreckenberg et al., 2006). In Ethiopian where bamboo is originating from domesticated systems such as in Sidama and Awi is more commercialized than the resources obtained open-access bamboo forests of Sheka and Benishangul Gumuz region. Bamboo is harvested from natural forest in Benishangul Gumuz region (Fayera et al., 2016). In Sheka and Benishangul Gumuz region bamboo market was intermittent and prices are low enough and producers are discouraged from investing in management and trade. However, in Sidama and Awi zones, it is harvested from privately possessed land (Tefera et al., 2013) and producers earn high income due to sufficient buyers as compared to farmers in Homosha district. This shows that producers engage in private cultivation whenever there is an economic advantage relative to wild harvesting. Domestication of wild species mostly linked to the economic importance obtained from it (Schippmann et al., 2006). Recently, there are some progresses in bamboo marketing in Ethiopia including the study area.

Conclusion

The study was conducted to analyze determinants of

bamboo culm market supply and to look into its management aspects. Farmers in the study area harvest bamboo domestic use and also sell bamboo culms in order to meet their income demand. Raw bamboo is a primary bamboo product traded in the local market of study area. Quantity of bamboo bundles supplied for sale is function of socio-demographic factors. Lack of raw bamboo processing center and knowledge diminished local market demand of raw bamboo culms. Bamboo has got less attention and its management is very loose, because of the sustainability of the resource is doubtable unless intervened. The results showed that education level, access to market information, marketing linkage, family size, bamboo culm selling experience harvested and price of bamboo culms were significantly and positively related to quantity of bamboo culms supplied for sale, while the age was significantly and negatively related to number of bamboo culms extracted and supplied for sale. Households with more experiences in bamboo culm selling with good interaction (marketing linkage) supplied larger number of bamboo culm bundles. There is significantly positive relationship between price and quantity of supplied culm. Therefore, improvements in market information regarding bamboo, price and marketing interaction among harvesters and buyers increases the number of bamboo culms supplied for sale, hence, boost income for harvesters which is incentive to engage in resource management. Homosha district has huge coverage of natural lowland bamboo standing; however, the resource is worsening due to natural and human related activities. The main road from Ethiopia to South Sudan passes through Homosha district, created a chance to export bamboo products. Bamboo processing factory installed in Asosa town, this pave a way for harvester to supply bamboo culms to the factory. Contrary to these opportunities, there were challenges in bamboo marketing such as lack of skill oriented training for market actors and lack of research on bamboo production, processing and utilization.

RECOMMENDATIONS

Marketing linkages and access to market information are critical determinants and significantly and positively related to the supply of bamboo culms positively. Therefore, strengthening relationship between buyers and harvesters, and disseminating relevant information help to improve supply of bamboo for sale.

Education level of households and price of bamboo culms are positively and significantly related to the number of bamboo culms supplied for sale. In order motivate for the management and supply of culms for market, it is better to aware community about economic value of this resource and to discover new buyers.

More experienced households in selling bamboo are supplied larger number of bamboo bundles than households with fewer experiences therefore, increasing awareness and providing training for younger households (older harvester supplied less as compared younger) concerning bamboo supply for sale will encourage them supply bamboo culm.

Family size with high number of members within working age supplied more bamboo culms for sale. Therefore, it is well again if these individuals get training concerning on bamboo management and marketing.

It is better to install small basic bamboo processing centers; this may boost the culm demand locally.

Bamboo resources must be advocated for its economic benefits and ecological stability.

Further research needs to be conducted on bamboo and shoot production, processing, management and utilization.

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CONFLICT OF INTEREST

The authors have not declared any conflict of interest.

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