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Socio-economic importance of highland bamboo (*Yushania alpina K. Schum*) and challenges for its expansion in Bibugn District, East Gojjam, Ethiopia

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Highland bamboo (*Yushania alpina*) plays an important role in various socio-economic aspects in Ethiopia. However, these socio-economic roles and the associated challenges have not been studied in Bibugn District of East Gojjam, Ethiopia. Therefore, this study was conducted to assess the socio-economic importance of highland bamboo and the associated challenges for its expansion. For this study, four rural sub-districts were selected purposively. Both semi-structured questionnaires and key informant interviews were used for data collection. Statistical Package for Social Science (SPSS version 20) and excel 2016 were employed for the data analysis. The result indicated that there were 82 respondents who have got their own bamboo lots while the remaining 53 respondents did not have their own bamboo lots. The study also revealed that about 149 ha of land was covered by highland bamboo culm under the four sub-districts of the district. Highland bamboo in the study area has been used frequently for house construction, flooring, basket making, source of income and for other household utensils. Among challenges and constrains of highland bamboo expansion in the study area, the most frequent ones were; less market demand followed by land scarcity and eucalyptus expansion competing with bamboo expansion. Statistically, there were no significant difference ($p>0.05$) among sub-districts on the challenges on highland bamboo expansion. For enhancing the socio-economic significance of Bamboo plant in the area, addressing the challenges through awareness creation, proper harvesting, processing, value addition and diversification of products is recommended.

Key words: Yushania alpina, bamboo, challenges, expansion, socio-economic importance.

INTRODUCTION

Bamboo taxonomically belongs to the family of poaceae having about 90 genera and 1,500 species in the world (Desalegn and Tadesse, 2014). Despite being a grass, they still have woody stem or culm that can reach 15-20 m in height, even 40 m in some environments (Assaye et al., 2013; Desalegn and Tadesse, 2014). Highland bamboo (*Yushania alpina*) can appear in the altitudinal range of 2200-3500 m above seas level. It normally grows in warm and humid environment (average annual temperature of 10-20ºC and annual precipitation of 1000-2000 mm) and is commonly found in Africa (7%), Asia (65%) and Central and South America (28%) (Brias and

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Hunde, 2009: Assaye et al., 2013; Desalegn and Tadesse, 2014; Tinsley, 2015). Africa holds 1.5 million ha of bamboo vegetation (Kelbessa et al., 2000).

The natural bamboo forest in Ethiopia is the largest in Africa, around 1 million ha (about 67% of African bamboo resources) covered by bamboo (Assaye et al., 2013). Two indigenous species of bamboo in Ethiopia, highland bamboo (*Yushania alpina*) and lowland bamboo (*Oxytenanthera abyssinica A. Rich* Munro) are scattered in the south, south-west and central parts of Ethiopia which encompasses four regions, namely Benishangul Gumuz, Oromia, Southern Nations and Amhara (Kelbessa et al., 2000; Kassahun et al., 2015). Highland bamboo comprises 130,000 ha (13.3%) while lowland bamboo constitutes 850,000 ha (86.7%) (Embaye, 2000). Lowland bamboo is an indigenous bamboo to Ethiopia and endemic to tropical Africa (Embaye et al., 2003).

Bamboo is one of the world's most important non-timber forest products (NTFPs) since; it is a superior wood substitute, cheap, efficient, fast growing (up to 91cm per day), and it has high potential for environmental protection and wide ecological adaptation (Mekonnen et al., 2014). It has diverse socio-economical (goods), environmental and ecological importance (services) at local, regional, national and global levels. When bamboo is well managed, harvested and if proper market linkage is created, it gives basic household income, which is also a means to reduce poverty and encourage rural development (Tinsley, 2015). There are over 2.2 billion people worldwide benefiting from bamboo through income generation and non-market domestic uses including food and housing (Tinsley, 2015). On the same author, over 1500 distinct uses of bamboo have been recorded around the world, and the number is growing rapidly with new development and innovative initiatives. Traditionally bamboo is used extensively in handicraft, making of chopsticks, blinders, mats, carpets, and furniture but its true market potential is in industrial processed products like flooring and panels (Melorose et al., 2015a). Different modernized bamboo products have been innovated; and are excellent substitutes for timber-produced materials mainly in China, India, and western countries. The properties of bamboo such as resilience, shape and strength makes it an ideal material for construction purposes (Melorose et al. 2015b; Truong and Le, 2014). It is also used for housing, crafts, pulpit, paper, panels, boards, veneer, roofing, fabrics, oil, gas, charcoal (for fuel and as an excellent natural absorbent), and also a healthy vegetable (the bamboo shoot). Bamboo industries are now thriving in Asia and are quickly spreading across the continents of Africa and America (Loboviko et al., 2007).

There are enormous challenges and constraints for bamboo development, expansion and national utilization. Among such problems, usually observed are; lack of clear bamboo conservation and utilization policies (Lobovikov et al., 2007), agricultural area expansion (due to population growth and increased food demand), insecurity of land tenure right, ecological and environmental impact of bamboo, lack of economic incentive (Brias and Hunde, 2009), low awareness creation to value as useful commodities, less market demand and weak markets linkage on bamboo and its products, and low access to infrastructure (Embaye, 2003). However, the existing challenges and the actual socio-economic contributions of highland Bamboo in Bibugn District of East Gojjam have not been studied. This study was initiated with the objective of contributing to address the knowledge gaps through identifying the socio-economic significance of highland Bamboo and the associated challenges for its expansion.

MATERIALS AND METHODS

Study area description

Location of the area

The study was conducted in Bibugn District, East Gojjam zone, Amhara National Regional State of Ethiopia. It is located at 381 km away from Addis Ababa (capital city of Ethiopia) and 83 km from Debre Markos (capital city of East Gojjam). The district lies between the coordinates of 11º00'N and 12°24'N latitude and 34°70'E and 37º35'E longitude. The district has 308 square kilometer (30879 ha) total land coverage. It also covers 3.8% of East Gojjam zone (Yared, 2014). Bibugn is bordered on the south by Sinan, on the west by the west Gojjam Zone; Degadamot district, on the northwest by Goncha, and on the east by Hulet Eju Enese. Towns in Bibugn include Woyinwuha, Waber and Digotsion (the center of Bibugn district). There are 19 sub-districts (which are the smallest administrative units) in Bibugn District (Berhanu, 2014; Alemu, 2014) (Figure 1).

Bibugn District encompasses parts of Choke Mountain which is the upper source of Blue Nile River. From a total of 12160 ha of Choke Mountain, Bibugn District covers 2855 ha of this highest landscape (Belay, 2013).

Population

The district has a total population of 82,002, of whom 40,190 are males and 41,812, females (Berhanu, 2014). Numbers of inhabitants in urban and rural areas are listed in (Table 1).

With an area of 308 square kilometers, Bibugn has a population density of 205.11 persons per square kilometer, which is greater than the Zone average of 153.8 persons per square kilometer. Regarding their religion, the majority of the inhabitants (99.13%) practiced Ethiopian Orthodox Christianity (CSA, 2007; Berhanu, 2014).

Climate and soil type of the area

As the district covers larger areas, there are also several agro-climatic regions. These are; low-altitude areas (locally called, kola) (4.46%), mid-altitude areas (WoinaDega) (48.06%), high-altitude areas (Dega) (35.5%) and very high-altitude areas (Wurch) (11.95%) (Yared, 2014). Bibugn has a mild climate and its altitude range from 1820-4088 m above sea level. Its average daily temperature is moderate, mean annual precipitation is about 1200

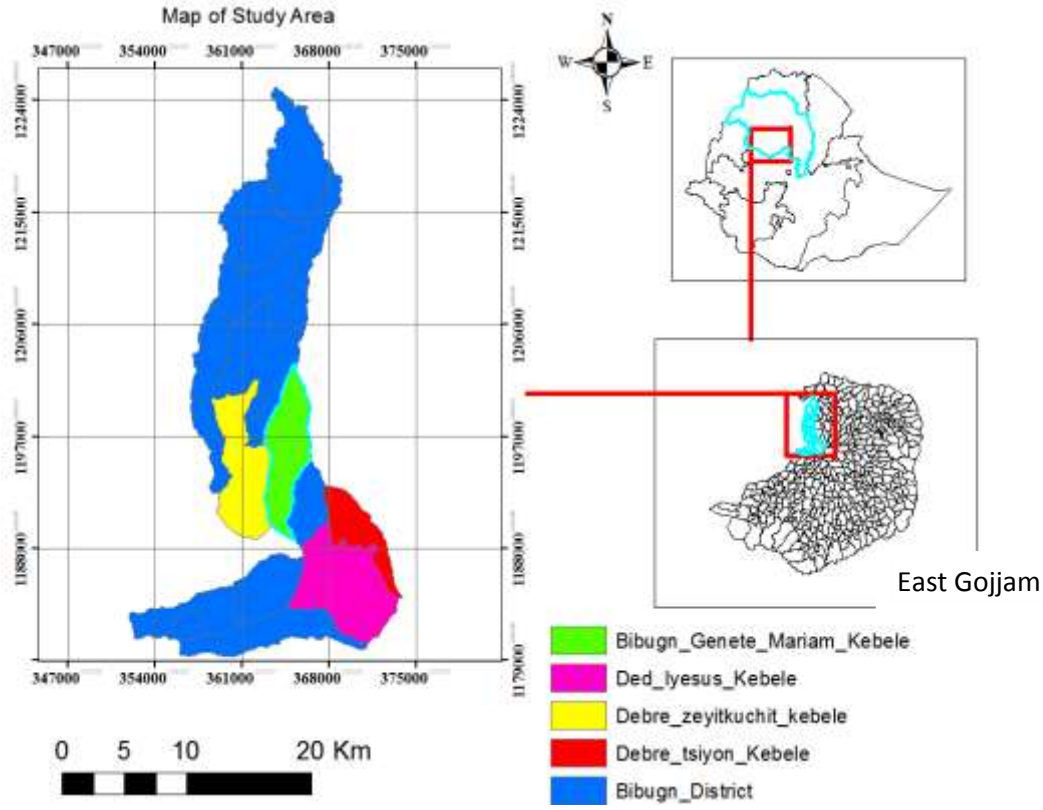

Figure 1. Map of the study area.

Table 1. Number of inhabitants in Bibugn district.

Location	Male	Female	Total	Household's
Urban	3100	3141	6241	2125
Rural	37,090	38,671	75761	16327
Total	40,190	41,812	82,002	18,452

mm and has uni-modal rainfall regime starting from June to September. About 18,935 ha of land is covered with annual crops and 3058 ha is covered with forest. The soil type in the area is classified as; 44.55% red in color, 14.9% black color, 35.11 % brown color and 5.44% gray color (Berhanu, 2014).

Distribution of bamboo in Bibugn District

Based on the information obtained from district agricultural development office, Bibugn encompass around fifteen rural sub-districts and four urban sub-districts (two of them are sub-urban districts). From fifteen rural sub-districts of Bibugn district, five sub-districts are below 2300 masl, and the remaining ten sub-districts are above 2300 masl. Highland bamboo *(Yushania alpina*) is cultivated only on ten sub-districts and from these; five sub-districts (namely; Ded Iyesus Abo, Debretsion, Bibugn Genetemaryam, Debrezeit Kuchit and Gedeb Giorgis) have the potential for bamboo coverage as compared to other sub-districts of the district. But, the other sub-districts or sub-districts (the remaining five sub-districts from highland sub-districts) have rare bamboo cultivation and production potential, and hence cannot adequately satisfy the people's need for bamboo utilization. Five sub-districts from the district namely; Amba, Moseba, Digo Kanta, Debresina, and Genamemicha do not practice highland bamboo cultivation. Highland bamboo covers 451 ha in the district. Lowland bamboo (*Oxytenanthera abyssinica*) has been grown rarely in this lowland (five sub-districts) of the district. But its area coverage in ha has not been well known (BWAO, 2016).

Debrezeit Kuchit sub-district is more prominent by highland bamboo cultivation and utilization as well commercialization on market level. It covers 74.96 (50.4%) ha in the sub-district against other three sub-districts (Table 2).

METHODOLOGY

Study site selection

The study area; Bibugn district, East Gojjam zone, Amhara national regional state of Ethiopia was selected purposively based on the potential of the community towards bamboo cultivation and utilization. Bibugn is endowed with highland bamboo forest. The researcher also has background knowledge since familiar with the study site. Thus, data were collected from respondents without language and cultural difficulties.

Sampling technique and sample size

To conduct this study, population of the district was divided into Sub-district administrative areas. From 15 rural sub-districts (and a total of 19 sub-districts/sub-districts in the district), four rural sub-

Table 2. Area coverage of Highland bamboo.

Name of sub-district	Number of bamboo Culms	Area of bamboo coverage (ha)	Percent (%)
Ded Iyesus Abo	84,941	5.66	3.8
Debretsion	643,722	42.91	28.9
Bibugn Genetemaryam	377,793	25.18	16.9
Debrezeit Kuchit	1,124,432	74.96	50.4
Total	2,230,888	148.71	100

Source; Bibugn district agricultural development office (2016); (Note, 1 ha = 15000 bamboo culm according to BWAO, 2016 report).

districts (Debretsion, Bibugn Genete Mariam, Dede Iyesus Abo and Debrezeit Kuchit) were selected purposively because of their potential for bamboo production as compared with the remaining sub-districts. From those sub-districts, proportional sample households were selected randomly. The sample size was quantified based on sample size determination formula (Cochran, 1977).

$no= (z^2 *p (q))/d^2$ $n1= no/(1+no/N)$

Where; no = desired sample size when population greater than 10000, n1= finite population correction factors less than10000, Z = standard normal deviation (1.96 for 95% confidence level), P = 0.1 (proportion of population to be included in sample i.e. 10%), q =is 1-P i.e. (0.9), d = margin of error (0.05)
N= is total number of population.

Based on this formula, there were 135 total sample sizes from four sub-districts.

Data types and methods of data collection

The study used both quantitative and qualitative data from both primary and secondary sources. Quantitative data include; total area coverage of bamboo in ha on individual respondent's land, cash income users get annually, and qualitative data collected include the cause of bamboo coverage reduction, which challenges or problems mainly influence expansion of bamboo, and for what purposes they use bamboo resources. Primary data were collected by using observation, semi-structured questionnaire and key informants interviews. Secondary data such as total area of highland bamboo coverage in a district and sub-district level, distance of each sub-districts from the market, and description of the study area were collected from different books, documentary sources, annual reports, internet and district administration office.

Data analysis

All data obtained from the semi-structured interview, key informants and observation were organized and analyzed by using descriptive and inferential statistics. Analysis of descriptive statistics was displayed in chart or tabulation expression and those expressed in frequency and percentage. Inferential statistics were also used to reach conclusions, and to infer from the sample data about what the population looks. SPSS version 20 and excel 2016 were used to put data in percentage and frequency using tables and figures. Pearson correlation was applied to test whether there is a relation or not between area of bamboo and landholding size of the respondents, transaction of bamboo and distance from the market. Chi-square test was also used to test relation among categorical data such as demographic characteristics and bamboo cultivation, and challenges identified by respondents.

RESULTS AND DISCUSSION

Highland bamboo cultivators in the study area

There were 82 (60.7%) cultivators and 53 (39.3%) non cultivators of highland bamboo from total sample respondents. Statstically, there was no significan relation ($P > 0.05$) between highland bamboo cultivation and demographic characterstics. It shows that cultivation of this vegetation is not determined by demographic characteristics because dwellers in the study area receive or confiscate bamboo forest resources from their former parents or ancestors.

Socio-economic importance of bamboo in the study area

Highland bamboo in the study area ranked as the second advantageous plant (17% of the respondents) next to *Eucalyptus globulus* (55%) based on frequency table of sampled respondents (Figure 2).

The study indicated that people in Bibugn District use highland bamboo for different socio-economic purposes (including domestic use and commercial purposes). Therefore, importance of bamboo can be categorized in to two; domestic uses (direct uses) and commercial uses. The continuous decline of forest resources requires the use of non-timber materials such as bamboo in many structural and non-structural applications previously dominated by wood. Bamboo products can be safely used in the application of furniture, interior paneling, flooring and parquet.

Bamboo for domestic uses

Respondents during the study stated that the various domestic or direct uses of highland bamboo include use for house construction (usually hut), indoor utensils, fence, rattan, flooring, rope, basket, kitchen, scaffold, weaving, firewood, leaves for mud fixer, mulching for

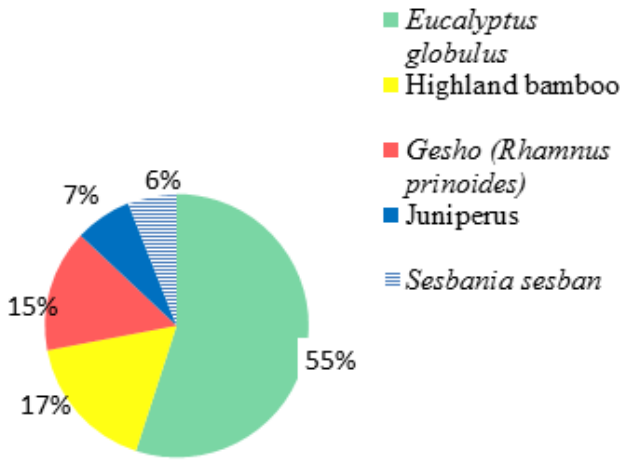

Figure 2. Rank of highland bamboo from other vegetation based on respondent's interest.

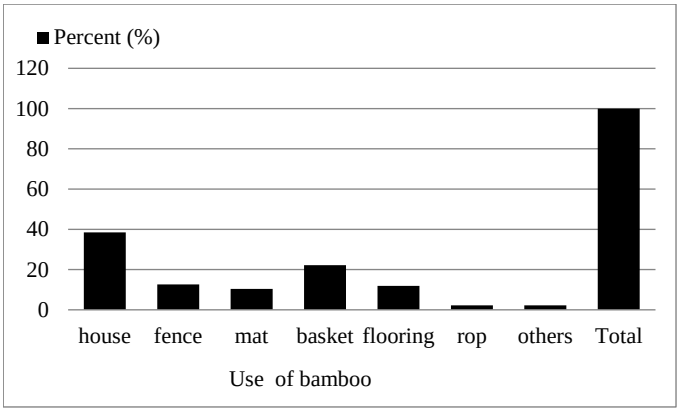

Figure 3. Major domestic uses of highland bamboo.

nursery bed, lash, leaves for animal feed, tube for water translation (gutter), flute, mast, broom, and walking sticks. This result was in line with the study conducted by Kelbessa et al. (2000) and Daza (2013) which showed that bamboo culms in Amhara Region are used as construction material for housing, fences, and beehives in the sub-districts. Many of the landless men buy bamboo from farmers and engage in producing mats, and baskets (Figure 3).

Based on key informants and household survey results;- highland bamboo used mainly for house construction (39%) followed by basket (22% of respondents). According to Mekonnen et al. (2014) findings, up to 2014, over one billion people throughout the world were estimated to be living in traditional bamboo houses and Ethiopia is a good example. Because of poverty, most rural dwellers are enforced to use bamboo for traditional hut construction.

One of the uses of bamboo which is called house flooring has become preferable in Bibugn District. Bamboo flooring is a relative new application to our community. It is strong, moisture resistant, comfortable, easy to clean, beauty, resilient and an excellent choice for bathrooms and kitchens. Bowyer et al. (2014) also reported as bamboo has been used for flooring coverage and become significantly increase internationally since this product is undeniably attractive, with a hardness rating comparable to most hardwoods that makes it a green choice. Besides using for house and flooring, bamboo is also beneficial as firewood and wood replacement. Nowadays, the torture of women for firewood searching is decreasing since bamboo has been planted on individual resident's land. This makes bamboo to be utilized as major substitute of wood for rural and urban dwellers in Ethiopia. Indirectly, it is also important for minimizing deforestation of timber forests. The major characteristics of bamboo which makes it preferable are;- cheap and fast growing. Other domestic products or goods made from bamboo which are significantly important includes;- cereal and crop collector, mat, bed, bee hive, basket (the most use of bamboo in the study area next to house construction) and rope.

Bamboo as source of income /commercial use

Highland bamboo and its products also have great contribution as source of households' income. It has been sold in the form of raw bamboo, basket, mat, *woch* (local names) and other house-hold goods. The annual cash income obtained from highland bamboo products transaction is presented in Table 3.

From Table 3, the maximum income obtained from bamboo sale was 18,750 ETB in Debrezeit Kuchit sub-district and the minimum was recorded in Debretsion sub-district (5,000 ETB). The total sum of income from bamboo under sampled households was 51,050 ETB.

Income from sale of raw bamboo represents the maximum amount of income rather than from its products such as basket and mat sold on market in the study area. Not all persons who have bamboo sell raw bamboo and its products because of many limitations. As the respondents stated, community members who have only long and large circumference bamboo (about > 16 cm circumference and > 9 m tall), can sell with better price, which ranges from eight up to ten ETB in Debretsion and Ded Iyesus Abo sub-districts. In case of Debrezeit Kuchit sub-district the price increased up to twenty ETB for the same size of bamboo. Most of the raw bamboo sellers could not make bamboo products such as basket, mat and other domestic utensils efficiently. Thus, they sell for local merchants who can make those goods listed above and then supply to market. According to the survey results from respondents, only 44 persons of the total samples of bamboo cultivators have sold bamboo and its products, and 38 respondents did not sell due to lack of sufficient bamboo plant, skill gap (handicraft) problem,

Table 3. Annual income obtained from highland bamboo per household in each sub-districts.

Name of sub-districts	Mean of income (ETB)	Sum of income (ETB)	Max. of income (ETB)
Ded Iyesus Abo	377	16,600	2,500
Debretsion	238	5,000	2,300
Bibugn Genetemariam	356	10,700	2,500
Debrezeit Kuchit	468	18,750	3,200
Total	1,439	51,050	10,500

Table 4. Challenges of highland bamboo expansion.

Challenges of bamboo expansion	Frequency	(%)
Less market demand	34	25.2
Land scarcity	27	20.0
Competition by Eucalyptus plantation	30	22.2
Negative Environmental effect	15	11.1
Shading effect on crops	12	8.9
Unsuitability of the land	17	12.6
Total	135	100.0

less market demand and infrastructure problems.

The problems associated with making baskets and other different goods from bamboo as stated by respondents were;- time consuming, and lack of the required skills. It was emphasized that lack of handicrafting skill was the major challenge to sell the required quantity of bamboo products for earning household income. Due to the existing skill gap, there were limited bamboo processors and product sellers in the study area. From the total handicrafts men of bamboo in the study area, out of the 38 men, only 16 men were capable of selling their products in local markets.

Challenges for highland bamboo expansion in Bibugn District

Highland bamboo plantation and expansion in Bibugn district have been diminished and gradually going to total destruction of this forest as stated by respondents. Based on key informants' interview, lack of awareness was identified as one of the top ranking challenges for bamboo expansion and utilization in the area. Regarding challenges on highland bamboo expansion, statistically, there was no significant difference ($p>0.05$) among sub-districts. This showed that those challenges for highland bamboo production raised under each sub-districts have not significant difference, since all respondent interested on the same issue which was price or market demand of bamboo.

Household survey showed that, there were some challenges which retard the expansion and cultivation of highland bamboo in the study area. These challenges are listed based on the respondents' preference (Table 4).

Market demand of highland bamboo

In Bibugn District highland bamboo was relatively better demanded by Debretsion sub-district relatively because of the fact that the sub-district inhabitants can sell raw bamboo for local merchants who come from Hulet Eju Ense for transaction towards Mota market. On the other hand, most other sub-district dwellers were not in the position to sell raw bamboo, but can sell by adding values, or sell for local merchants who can make various products from the raw bamboo. However, this cannot benefit majority of the communities since most of them cannot process different products. This is in agreement with the study of Endalamaw et al. (2013) and Tinsley (2015). This showed that Ethiopian bamboo utilization is still limited primarily due to low value addition and weak local market networks. The study of Kelbessa et al. (2000) also stated these problems as bamboo based handicrafts or manufacturing enterprises producing for the market are not widespread in the rural communities. Bakala et al. (2017) also reported that lack of skilled processors in Ethiopia leads dwellers to supply raw bamboo to market.

According to the information obtained from key informants' interview, there was only one person who was engaged in making chairs, tables and stools from bamboo for short period of time, but after some time, he went to other district that is called Degadamot district to get better profit. This showed that there was no sufficient external linkage and network on markets in Bibugn

Table 5. Eucalyptus vs highland bamboo cultivators.

Parameter	Bamboo		Eucalyptus	
	Cultivators	Non-cultivators	Cultivator	Non-cultivators
Number of households	82	53	131	3
Percent	60	40	97	3

Table 6. Area of Eucalyptus relative to bamboo in ha.

Name of sub-district	Area of highland bamboo coverage (ha)	Area of Eucalyptus coverage (ha)	Difference (ha), Eucalyptus or bamboo dominated
Ded Iyesus Abo	5.66	252.2	246.54 (Eucalyptus)
Debretsion	42.91	19.75	23.16 (bamboo)
Bibugn Genetemaryam	25.18	45	19.82 (Eucalyptus)
Debrezeit Kuchit	74.96	38.75	36.21 (bamboo)
Total	148.71	355.7	207 (Eucalyptus)

Source: Bibugn district agricultural office (2016).

district, and there was also limited demand of the people to utilize bamboo products.

Competition for Eucalyptus plantation due to economic preference

Eucalyptus thrives and expands in the study area as it is economical preferable and expensive in relation to bamboo. Cultivators and users of Eucalyptus are more than highland bamboo cultivators (97% and 60% respectively) in the study area (Table 5). Von Roder (2015) reported that Eucalyptus is the most widely cultivated of all plants, covers wide geographic and environmental gradients throughout the world even if it has negative influences on soil, water and biodiversity. According to Chin (2007), eucalyptus destroys soil nutrients and uses more water than the ecology can provide since its roots can go deeper up to eight meters under the ground. However, inhabitants in the study area did not consider environmental impacts of eucalyptus.

There were also a great difference in area coverage of these forests (bamboo and *Eucalyptus globulus*) in the study area, which takes 149 ha and 356 ha respectively (Table 6).

Land scarcity

Due to shortage of land in the study area, inhabitants not only restrict their bamboo resource on the parcel of land, but also deforest and eliminate bamboo it for the sake of wide farmland searching so as to feed the family. This result was in line with the study by Tinsley (2015) that states land conversion for agricultural or grazing use is the leading cause of deforestation of bamboo in Ethiopia. In addition to deforesting bamboo to expand crop land, there was also substitution of bamboo resource on other market demanded vegetation such as eucalyptus and hop or *Rhamnus prinoides*. There were few respondents that had high bamboo coverage (>= 0.25 ha) on their farmland with a land size of above 1.25 ha. Most farmers have very scarce land holding of about 0.75 ha. Due to these reasons, peasants in Bibiugn district tried to use agroforestry system on piece of land to overcome shortage of land. Based on the respondents' view, however, bamboo cannot be used in agroforestry system since it has shading effect in addition to shoot expansion influence on farmland, crops, grass and water.

Pearson correlation coefficient proved that there was positive relation between land size and size of bamboo in the study areas. There is statistically high significant ($p < 0.01$) correlation between land size and size of bamboo.

Infrastructure problem

Based on key informants, it was also one cause of bamboo forest reduction in the study area. It did not directly affect the bamboo cultivation and plantation rather on other side such as from transport aspect. Gojjam Province especially Bibugn District has undulating and rough topography which is unsuitable for market transaction of bamboo and its products. There is not rural vehicle road due to the difficulty slope and topography of the area. Because of such transport and topographical difficulty, from four sub-districts of the study sites, Debrezeit Kucht sub-district has better market performance in addition to other opportunities on bamboo and its product transaction since it is the nearest sub-

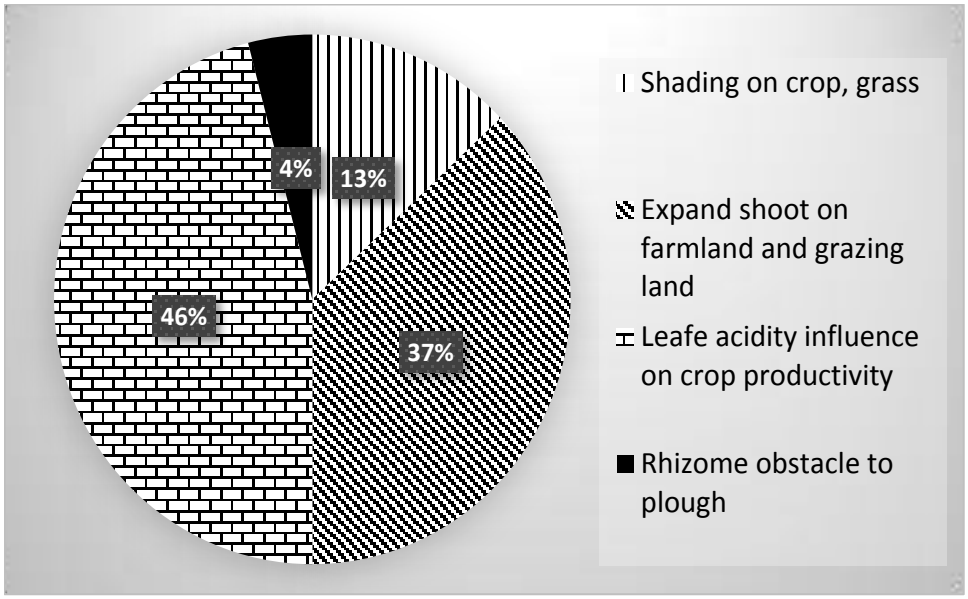

Figure 4. Response of household interviewee on negative effects of highland bamboo.

district to town of the district.

Less awareness level of the people

Farmers have less intensive managed bamboo production system, which was an entirely natural forest-based system in the study area. In addition to key informants, the household survey revealed that most farmers in the domesticated system obtained their bamboo products from privately owned sources. This result is in line with the study conducted by Endalamaw et al. (2013). They stated there was poor management of bamboo in Ethiopia; people could not apply any conservation and protection strategy besides traditional management system. Handicrafts limitation (unable to make different products) was also another challenge of transaction at the market. They could not use bamboo and its products beyond some usual products like mat, baskets, fence and ropes. 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 mother plant. Brias and Hunde (2009) stated culms that will be used in cultivation purpose from bamboo clump should be selected between 1 and 2 years old.

Respondents in the study area frequently raised that bamboo leaves had negative influence on environment such as soil, water and grass. Usually they plant bamboo around the river and slide land or steeply lands too far apart from crop land, water and grass. They also raised that bamboo rhizome wan an obstacle to plough, expand shoot on farmland, grazing land; and shading effect on crops and grass (Figure 4).

On the other hand agricultural experts (key informants) and written documents explained that bamboo leaves are used as fertilizer rather than acidification of the soil. Reddy and Narsihma (2011) realized that, even though the decomposition was a complex and prolonged process; humus content, bicarbonates, chlorides, nitrogen content and phosphorus increased relatively in soil-bamboo litter system, and this contributed to increase soil fertility. Yiping et al. (2010) also reported that bamboo litter has been used as effective fertilizer when incorporated with sludge composing thereby effectively reducing nitrogen loses in the soil. 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 lead to retard its expansion in the study area. This study was also in line with the findings of Desalegn and Tadesse (2014) that stated lack of awareness of stakeholders about the socio-economic importance of bamboo resource and its environmental friendship is the major problem among enormous challenges of highland bamboo expansion. The other misunderstanding of the community was cutting intensity, cycle and regeneration rate. Clear cutting depresses the rate of recovery of bamboo after cutting. According to the information obtained from sub-district agricultural experts (key informants), local people cut bamboo culm on inappropriate age of growth. Kelbessa et al. (2000) reported as rate of recruitment of culms and rate of recovery of a clump to full size should be able to provide

useful guidelines for cutting intervals and cutting cycles should be governed by the recovery period.

Conclusions

In Bibugn District (four selected sub-districts), there were 82 cultivators and 53 non cultivators of high land bamboo that covers about 1489 ha of land. From those sub-districts, Debrezeit Kuchit has better coverage of highland bamboo which was 74.96 ha and the least was recorded on Ded Iyesu Abo which was 5.66 ha. In the study area highland bamboo was used mainly for house construction, flooring, baskets, house utensils, fence, rope and shading (bed) for nursery site. It was also important for maximizing household income. The total annual income obtained from selling of highland bamboo and its products in the study area was 51,050 ETB and the mean income of the sampled sub-districts per individual was 378 birr which is very low level of highland bamboo transaction performance relatively. On the other hand, there were major challenges and constraints for its expansion, such as low awareness of the community, less market demand, insufficient land and higher market demand for eucalyptus. People in the study area prefer cultivation of eucalyptus to bamboo plant.

Recommendations

Based on the findings; the following recommendations are forwarded:

1) Coordination of government and people is essential for bamboo plant expansion, rational utilization, and adoption of new technologies regarding bamboo processes.
2) Agricultural and other experts should provide awareness on multiple benefits of bamboo and should give training on how bamboo can be rocessed to value addition beyond usual utensils, household goods and furniture.
3) Market chain and linkage should be established and strengthened.
4) Further research is recommended on bamboo leaf influence on soil fertility reduction.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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