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Full Length Research Paper

Indigenous knowledge on highland bamboo (*Yushania alpina*) management and utilization practices in Kokosa Woreda, South East Ethiopia

Seyoum Gebrekidan[1], Lemma Tiki[2*] and Yigardu Mulatu[3]

[1]FARM Africa, Bale Eco-Region, Bale, Ethiopia.
[2]College of Agriculture and Veterinary Science, Ambo University, P. O. Box 19, Ambo, Ethiopia.
[3]Ethiopian Environment and Forestry Research Institute, Addis Ababa, Ethiopia.

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Bamboo is one of the world's most important non-timber forest products (NTFPs) which have been advocated for poverty alleviation in many regions. However, in Ethiopia it is utilized below its potential due to lack of scientific knowledge and awareness on its management and utilization. Therefore, the main objective of this study was to investigate the indigenous knowledge of highland bamboo management and utilization practices of local communities in Kokosa woreda. Five kebeles were purposively selected and 196 sample households (HHs) were selected randomly. Primary data was collected through face-to-face interview, direct observation, key informant interview and focus group discussion. The collected qualitative data was analyzed using simple descriptive statistics, mean and percentage values and standard error. The result of the study indicated that, local people have experience of developing bamboo stands using their indigenous knowledge on propagation techniques. Among the propagation techniques, bamboo offsetting (82%) was preferred most, where 89% of the source of bamboo offset was obtained from individual farmers. The local communities have experienced bamboo stand management practices of which fencing the bamboo stands (44%) was most applied followed by compost application (33%). Mean bamboo area coverage is 0.32 ha per household. The average number of bamboo landraces was 4. Bamboo landrace identification criteria used in the area are bamboo diameter (21.31%), length of internodes between nodes (21.20%), bamboo stem color (21.20%) and splitting nature (18.68%). Bamboo is used for a variety of traditional applications including house construction (100%), fencing (100%), fodder (99.48%), household furniture and utensils (92.34%), fuel wood (98.97%) and as cash source (100%). Traditionally, farmers somehow know how to take care for bamboo roots and rhizomes, which is a good habit to sustain bamboo resource utilization. Such habit has to be integrated with modern knowledge as skilled capability of the harvesters for scientific management is required.

Key words: Bamboo, harvesting, landrace, management, offset, propagation, utilization.

INTRODUCTION

Bamboo is the vernacular term for perennial, giant woody evergreen plants in the grass family *Poaceae* (syn. *Gramineae)*; subfamily *Bambusoideae* (Yeasmin et al., 2015). The subfamily *Bambusoideae* has about 75 genera with over 1250 species (Soderstrom and Ellis, 1988). It is estimated that about 21 million hectares of the earth surface is covered by bamboo forests. They are widely distributed in the tropical to temperate zones, from sea level to alpine elevation (Vanita et al*.,* 2015).

Bamboo is one of the world's most important non-

timber forest products (NTFPs) and managed bamboo harvesting and marketing has been advocated for poverty alleviation in many regions (Singh, 2008). Cultivation of bamboo can provide a cost-effective return in the short term (Shanmughavel and Peddappaiah, 2000), and can provide significant proportion of the national income since it is a multipurpose grass useful for day-to-day life of people (Ray and Ali, 2017). Over 1500 distinct uses of bamboo are recorded and this number is growing rapidly with new development initiatives taking place around the world (Ranjan, 2001). The International Network of Bamboo and Rattan (INBAR) estimate that over 2.2 billion people benefit from bamboo (Xuhe, 2003).

Ethiopia has the highest bamboo resource in Africa on area basis (Kelbesa et al., 2000), which accounts for about 67% of the bamboo resource in the continent (Embaye, 2003). According to LUSO consult (1997), the bamboo species found in Ethiopia are the highland bamboo (*Yashinia alpina*) and the lowland bamboo (*Oxytenanthera abyssinica)*. In Ethiopia, bamboos were not considered as a significant NTFP and underutilized (Andargachew, 2008). They have a paramount importance and multifaceted use for the local community in different parts of the country (Kelbesa et al., 2000). According to Ethiopian Ministry of Agriculture Bamboo Cultivation Manual Guideline, reduction of production capacity and yields as well as quality deterioration results from poor utilization system and unmanaged exploitation of the resource (MoA, 2013), which results into many culms/hectare but culms' diameter and height are becoming thin and short (INBAR, 2009). Additionally, some of the small micro-enterprises are suffering from shortage of getting good quality and quantity of bamboo culms in Addis Ababa, Ethiopia; whereas a large numbers of bamboo culms are deteriorating in the bamboo forest (MoA, 2013).

Therefore, the bamboo resource in Ethiopia is utilized far below its potential due to lack of knowledge on its management and utilization (Embaye, 2000) such as lack of technology for its utilization and lack of information on the propagation methods. The resource has also been neglected for many years and even was not included in any forest development endeavors carried out in the country (Andargachew, 2008; Kelbessa et al., 2000).

However, in Kokosa woreda since studies conducted are not available there is lack of information about indigenous knowledge on the management of bamboo resource and utilization practices. Therefore, this study was conducted with the objectives of generating information about farmers' indigenous knowledge on highland bamboo management and utilization practice in Kokosa woreda, Southeast Ethiopia.

MATERIALS AND METHODS

Description of study area

Location

Kokosa Woreda is one of the Woredas found in West Arsi Zone South East Ethiopia. It is located between 39°10'0"– 39°40'0"E and 6°20' 0" – 6°50' 0" N (Figure 1).

Topography and land use

The area is part of the South East Ethiopia high lands. The agro-ecology of the woreda is 98% Dega (high land) and 2% Woina dega (middle high land) with an altitude range 2300 to 2800 m a.s.l. About 65% of Kokosa woreda is hilly and mountainous landscape whereas the remaining 30% is plain land. Survey reports on land use types of the woreda show that 28% is arable land, 45.3% pasture land, 21.1% forest land, 5.5% wetland (KWARDO, 2016).

Climate

Its minimum and maximum average annual temperature are 12 and 18°C respectively. The average rain fall ranges from 1300 to 2000 mm per annum with a bimodal rainfall season for the area that usually extends from December to May and which extends from June to October (KWARDO, 2016).

Soil and vegetation

The dominant soil types in the woreda are Vertisol and verticambisol. The forest in Kokosa woreda is dry afromontane type with high value commercial tree species like *Juniperus procera, Podocarpus falcatus, Hagenia abyssinica* and highly threatened *prunus Africana, Maytenus* spp. and highland bamboo (KWARDO, 2016).

Demography

According to Central Statistical Agency, the study area has a total population of 180,886 projected for 2016 of which 175,929 live in rural areas and 4,957 in urban area (Central Statistical Agency (CSA), 2016). Population density is 41 person/km^2 with average family size of 6 (CSA, 2007).

Approach

Prior to the research work, preliminary survey and field observations was performed. The prepared questionnaires was pre-tested on 15 households and modified accordingly for validation and to extract the relevant data.

Sampling technique

Based on the preliminary survey, five kebeles (the smallest level of

*Corresponding author. E-mail: kiyalemi@ymail.com.

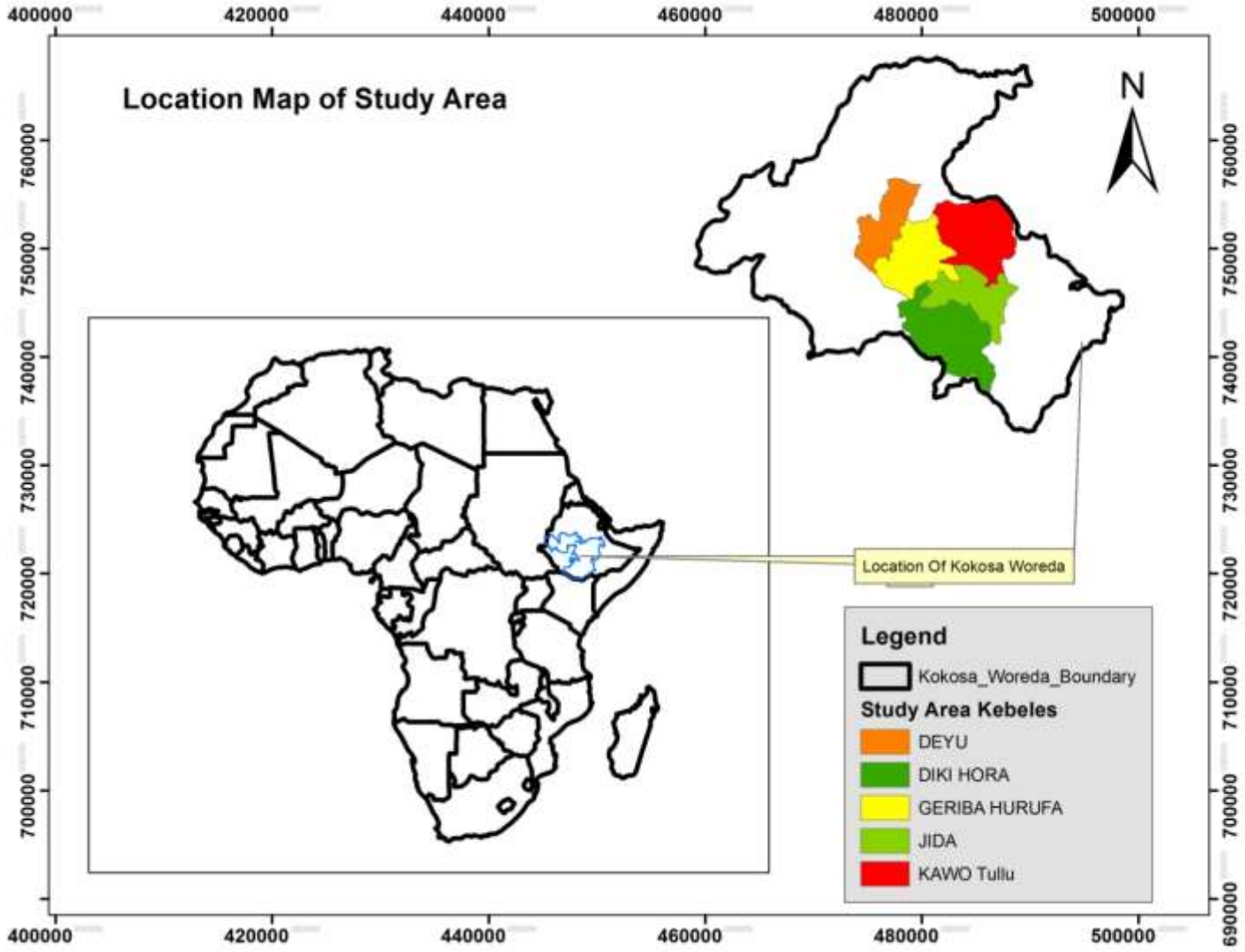

Figure 1. Map of the study area (April, 2017, Ethio-GIS, EMA).

administration boundary) were selected purposively based on the bamboo production potential in the area, that is, the *kebeles* which are highly producing bamboo were selected. Based on the conducted preliminary survey, five kebeles (namely Deyu, Kawo Tulu, Jida, Gerba Hurufa and Diki Hora) which are highly producing bamboo were considered. After selection of each *kebele*, simple random sampling system was employed to select sample households (HHs) to be involved in the study.

According to Dickson and Nyariki (2009), agricultural based socio-economic research usually has 95% confidence level and an error margin of less than 10% statistical significance. Finally, sample size was calculated using a standard formula, thus (Freund and Williams, 1983):

$$N = \frac{(z)^2(pq)}{(d)^2} = \frac{(1.96)^2(0.5\times0.5)}{(0.07)^2} = \frac{0.96}{0.0049} = 195.9 \approx 196$$

Where: N = sample size; z = statistical certainty usually chosen at 95% confidence level, that is, z = 1.96 for an error risk of 5%; p= estimated level/coverage to be investigated, usually p = 0.5 is chosen; q = 1-p; d = precision desired, which need to be less than 10% and then for this research d = 7% = 0.07.
Finally, the sample was proportionally distributed to each kebele.

Data collection

Primary data was collected by using formal and informal survey methods. Secondary sources of information employed in this study included published materials such as reports, plans, official records, research papers and websites. These sources were used carefully by counter checking for their authenticity/accuracy/validity.

Formal survey

Structured questionnaires were developed based on the information required to be gathered on indigenous knowledge towards bamboo

forest management and contribution. This was the most important tool of data collection in this research work. On the bases of information obtained from techniques discussed above and literatures, questionnaires were developed and handled by DAs as enumerators**.** Prior to implementing the survey, training was given to enumerators about administering the questionnaire and at the same time tested for their clarity. Questionnaires that were found not to be clear to the local people and enumerators during training and testing were modified accordingly. Amendment was also incorporated into the questionnaire so as to make the idea easily comprehensible to the interviewees and enumerators.

Informal survey

A check list was developed, only some of the questionnaire was pre-determined and new questions emerged during the interview, in response to answers from those interviewees. The interviewees were key informants and groups discussion participants.

Key informants (people who are supposed to be knowledgeable of their locality and have a good knowledge of the issue) were selected with the help of DAs and Kebele administrators. A total of fifteen key informants which included the *experts from Woreda (3), model farmers (3), elders (3), PA leaders (3), and DAs (3)* were participated.

One focus group discussion which had 8 members each were conducted in each of the five kebele with community *elders, bamboo producers and local bamboo processors* selected by the assistance of DAs and chairman of respective kebeles.

Data analysis

The qualitative data was analyzed by categorizing into different thematic area and narrating each topic separately. The collected quantitative data were organized and fed into SPSS (Statistical Package for Social Science) software version 19 and statistically analyzed by using simple descriptive statistics such as mean, percentage and cross tabulation. In addition, MS-Excel was used to generate tables, pie charts and bar graphs.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

In the study area, out of the total interviewed respondents, 90.8% were male headed households and 9.2% were female headed households. Majority of the respondents' religion is Muslim 89.8%. Regarding age group, the majority of the respondents which were 66.3% fall in the range of the age class of 31-45 and13.8% of them were ≤ 30 years of age. The age group > 30 years old accounts for 86.2% respondents.

In the case of marital status, among the total interviewed households, 96.4% members were married. The implication of having married is that the two couples feel responsibility in establishing and sustainably managing their resources they depend on for their livelihood and to increase their income. The educational levels of the respondents have been known through their replies that 15.3% of them were illiterate of the total respondents. The remaining 84.7% respondents were known to be literate ranging from the level of adult education to the University.

Community interest towards its production and highland bamboo landraces

Out of the total respondents, 100% of them have their own bamboo stand and almost all (95.9%) of them has a willingness to increase the area coverage of their bamboo stand (Table 1). This result indicated that the local community has high interest towards bamboo production and utilization.

On the other hand the study result showed that the mean bamboo area coverage in hectare was 0.32 ± 0.02. It implies that land covered with bamboo is so little as compared to the land allocated for other land use types. If local people are supported with techniques and inputs like trainings, working tools, planting materials and local administration involved in resolving such issues and allocate idle areas like river banks and valleys rather than reserving for extra grazing area, the size of the plantation bamboo forest would significantly increase.

The reason why majority of the respondents were willing to expand their bamboo plantation (Table 1) was due to their interest towards obtaining high benefit from bamboo plantation (43.49%) and 33.73% respondents have reflected due to additional income they obtained from bamboo development (Figure 2). This result implies that the local communities have great concern for bamboo such that they have many interests on bamboo resource towards getting more income than what they generate from various sources and keeping environmental condition suitable in the study area. Similar finding was reported by Adnew and Statz (2007) which indicated that, a great number of people in Ethiopia are engaged in bamboo management to support their livelihoods.

Bamboo landraces

Regarding availability of different bamboo landraces, 98.5% of the total sample households responded that bamboo landraces are available in the local area (Table 1). The mean number of bamboo landraces the study result showed was 4±0.11. Though, the local communities do not have experience of naming different bamboo landraces, Mulatu (2012) found naming of bamboo landraces as Tifro, Wonde, Welele and Enkotekot in the study conducted at Choke Mountain, northern Ethiopia. However, bamboo is classified by the community as different bamboo landraces based on different criteria of bamboo characteristics. The participants of the group discussions explained that the criteria the local people used to classify bamboo landraces were splitting nature, stem color, between node length, diameter and rooting

Table 1. Local community interest towards bamboo plantation.

Parameter	Yes		No	
	Frequency	%	Frequency	%
Have their own Bamboo stand	196	100	0	0
Willingness to increase area coverage of bamboo	188	95.9	8	4.1
Undertaking management practices for bamboo stand	196	100	0	0
Availability of different bamboo landraces	193	98.5	3	1.5

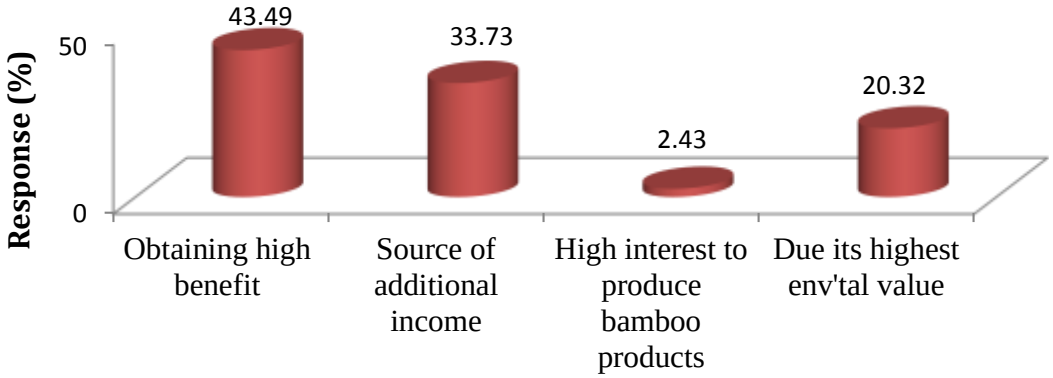

Figure 2. Reasons for interest towards bamboo plantation development.

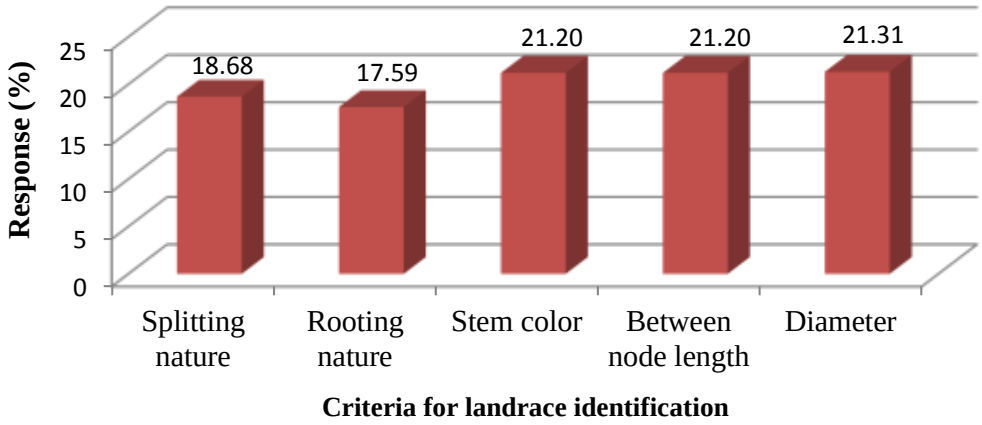

Figure 3. Bamboo landrace identification criteria by the local community.

nature. The indigenous knowledge of the local community used to classify bamboo landraces is partially similar to that of criteria used in the research result of Mulatu (2012).

The survey result has illustrated that the landrace identification criteria utilized by the community were almost equally ranked as a range of 17.6 - 21.3% (Figure 3). Almost these equivalent results have shown that all bamboo growers have more or less similar knowledge and experiences of setting criteria to differentiate bamboo landraces.

Bamboo stands development

Bamboo growing micro-sites and ownership

According to the result obtained from key informant

Figure 4. Bamboo offset propagation.

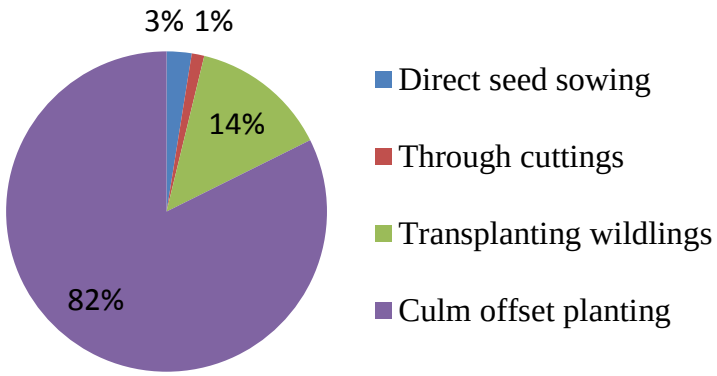

Figure 5. Bamboo propagation strategies practiced in the study area.

interview and focus group discussion, the existing bamboo forest is classified into three based on ownership holding; private bamboo holding, that is, holding by individual farmers; communal holding by the peasant association; and government ownership. Individual household and collective members of the peasant association have their own plantation at plain land, backyard, farm boundary and homestead. This finding agrees with reports from North West Ethiopia (Mulatu, 2012), where bamboo plantations are developed in different micro-sites such as homesteads, valley areas, riversides, ridges, stream heads and farmlands under the ownership of farmers. Government owned natural bamboo forest covers mostly ridges and mountains in the study sites. This is because the natural bamboo forest resources which were not captured by individual farmers were owned by the State.

Propagation and regeneration of highland bamboo

Private bamboo forests in the study area originated from the seeds dispersed after the whole community and government owned bamboo stands had flowered (Sentata (local language)) at once and disappeared from the area some forty to fifty years back. Wild seedlings that emerged from the dispersed seeds were taken by the local people and have been transplanted on their land holdings. Some individuals were collecting seeds from the ground and have raised only few seedlings in their backyards. However, the people have suggested that the result obtained from sowing bamboo seeds was very low and that this might be due to the short viability of the seeds. In line with this, Anonymous (1997) has stated that Ethiopian highland bamboo seeds are difficult to find, as they do not flower regularly. When fruits are found, most of them are usually empty of seeds. When seeds are found, the highland bamboo is not viable which is in line with Ray and Ali (2017).

Among the different strategies used, bamboo offset planting (Figure 4) was the major and accounted for 82%, while transplanting wildlings of bamboo from the wild bamboo forest strategy was known as the next better practice used which has accounted for 14% (Figure 5). Even this result has not agreed with the study result of Kigomo (1995) and Ray and Ali (2017), who stated that

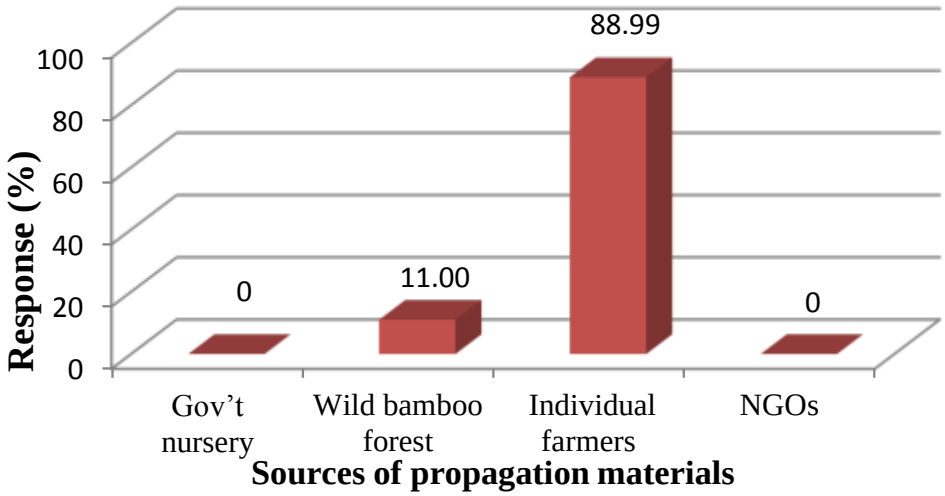

Figure 6. Sources of bamboo planting or propagation materials. *NGO = None Governmental Organizations.

use of bamboo cutting is a viable alternative in most bamboo species but the indigenous bamboo species of Ethiopia have proved difficult to raise planting materials through cuttings.

Bamboo offset planting is the process through which they carefully uproot bamboo Culms and transporting it together with the soil held by the roots and then plant in holes dug wider and deeper prepared two or three months before planting (Figure 4). According to the farmers, this type of propagation has many difficulties, as it is laborious, tiresome, time consuming and impossible to transport more culms at a time. Similar opinion which is stated as the traditional production method using offsets, that is, root-rhizome plus part of aerial culm, is cumbersome and too inefficient for practical use (Embaye, 2001; Mudoi et al., 2013; Singh et al., 2013).

Additionally, the local communities using their indigenous knowledge have trend of establishing bamboo stand on a piece of land where it was used for livestock barn in which cow dung was accumulated and decayed. Bamboo offset uprooted was then planted in holes dug on these old barns, abandoned serving as livestock shelters based on the reality that the places were already treated with compost or manure. A new barn or shelter for livestock then is constructed to continue the experience in the same way.

Sources and adequacy of bamboo propagation materials

Majority of the respondents (89%) replied that the sources of bamboo planting materials were individual farmers (Figure 6). This implies that cooperation among the community members was so strong. The remaining 11% of all sample respondents have replied that wild bamboo forest was the source of bamboo planting material for the local bamboo stand growers. From the local government and non-government organizations, bamboo propagation materials had not been provided to the community.

Management of mature bamboo stands

The study result obtained has also revealed that major bamboo forest management practices in the study area have been identified as fencing was highly important. 44% of the total 196 sample respondents have replied that fencing the bamboo stand to protect from some damaging agents was primary issue. 33% of the respondents valued compost application was the next major practice whereas 23% of the total respondents replied that bamboo clump cultivation in the bamboo stand and slashing away of unnecessary vegetation was equally important practices in the bamboo stand management (Figure 7). The above results imply that local people use their indigenous knowledge to manage their bamboo stands so as to make use of the resource for their livelihood and economic development.

Regarding bamboo forest stand protection, every bamboo producers protect their bamboo plantation from encroachers, wrongdoers, livestock, and wildlife like monkeys, baboons and browsers. Fire is also a concern of the community to attentively watch their bamboo forest from damage by fire. In the bamboo management process, women and all family members of every household play a great role. In the case of insects like weevil and borers there is no any traditional or chemical known treatments been applied for bamboo protection since the past long time.

Good protection and adequate care was given to

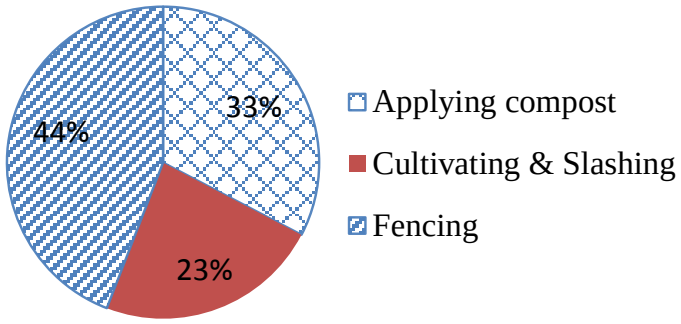

Figure 7. Major bamboo stand management practices in the study area.

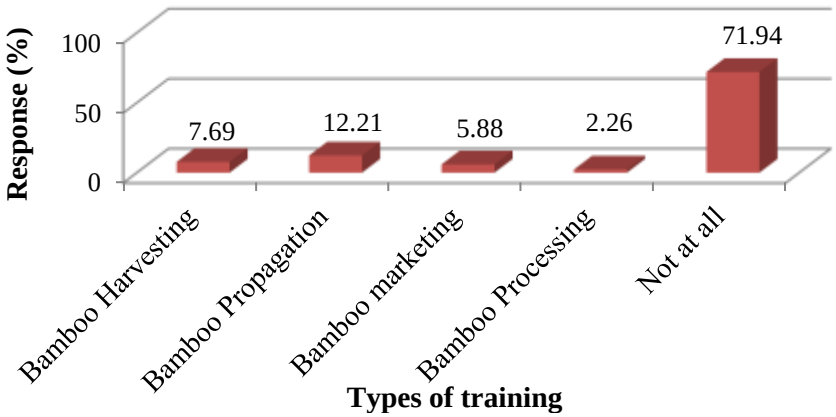

Figure 8. Training support provided to the local bamboo growers.

private bamboo forest and somehow for communal bamboo forest. According to the information obtained from woreda technical staffs on the discussion held with community representatives and key informants, even though, people give irregular protection for the highly smuggled natural bamboo forest at day time, some illegal individuals affect the resource in the evening and night time coming from kebeles established inside the forest and from the nearby kebeles, bordering the natural bamboo forest existing at different sights. This result agrees with the study result of Embaye (2003) which was stated as 'They are now fast disappearing due to improvements in road networks and establishment of villages within them and their vicinities'.

Training support on bamboo management and propagation

About 71.94% of the respondents confirmed that they did not get any sort of training at all on bamboo management techniques (Figure 8). 12.21% of the respondents have replied they have been given bamboo propagation training, 7.69% replied that they have been trained on bamboo harvesting techniques and 5.88% of the sample respondents have replied that they have been offered a training on bamboo product marketing; lastly, the remaining 2.26% respondents have replied that they have been trained on bamboo processing techniques.

Bamboo harvesting

Using their indigenous knowledge, most of them harvest according to their experiences without serious damage on the bamboo stand. Almost all 98% of the respondents perceive that as the age of bamboo exceed 5 years the quality of bamboo product will decrease (Figure 9).

Bamboo producers of the study area have good experience of harvesting their bamboo products at a stump height of not more than 20-25 cm and at an age of three years and above old bamboo Culms. This statement agrees with a statement stated by Brias and Hunde (2009), that Culm cutting should be done between the 1st and 2nd nodes, below the first branch of leaves.

But other members who are almost poor harvest their

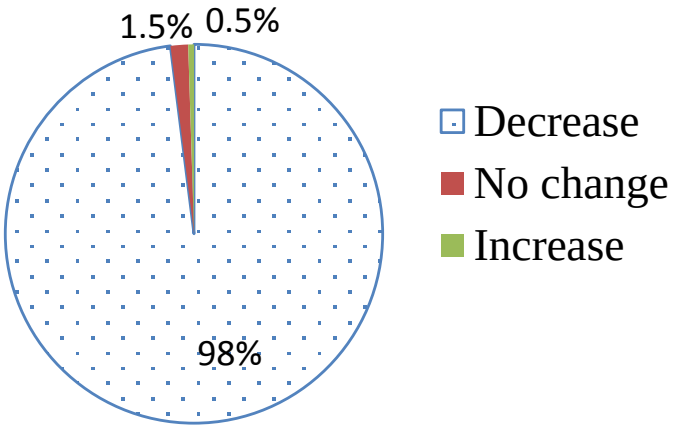

Figure 9. Expected quality of bamboo products after 5 years.

Figure 10. Bamboo harvesting systems in the area.

bamboo product at an age of greater or equal to one year old bamboo Culms for sale where its consequence leads to shortage of bamboo supply from plantation or natural bamboo forests. Accordingly, Chihongo et al. (2000) have stated that the importance of bamboos and their products in local economies has led to overexploitation and a decline in the supply of bamboo from natural stands in some parts of Ethiopia and Tanzania. A tool used for harvesting bamboo culms was mainly slashing knife (*Konchera/Gejera*). Cutting styles were almost two types, all round cut making smaller angles and a one side slash cut with bigger angle at the bottom end or stump of the bamboo culms (Figure 10). Most of the time, the latter is the most experienced method of harvesting in the area.

Bamboo harvesting period can be throughout the year in view of the availability of the required quality and quantity obtained, whereas harvesting frequency was determined by the grower as to his need. If he is in shortage of money he can harvest even immature or a one year old bamboo Culms and sell it in the nearby small towns. Otherwise, many of the local people cut bamboo for any utilization type at the age of two and above years.

Bamboo utilization

The study result has shown that bamboo has been utilized 100% for house and fence constructions by all interviewees and next higher percentage of respondents of bamboo utilization aspects being utilized for other purposes were fodder, fuel wood and household utensils at 99.48, 98.97 and 92.34%, respectively (Figure 11). Food, paper production and charcoal making were other bamboo utilization purposes replied by 5.10, 4.59 and 3.06% of the sample respondents.

House construction: Bamboo houses are mostly cheaper as compared to wood plus mud, bricks and other concrete buildings. They are also light and strong in which any bamboo grower can build from bamboo materials found in his locality. Bamboo housing have also been reported by Bitew (2014), that they are usually cheaper than wooden houses, light, strong and

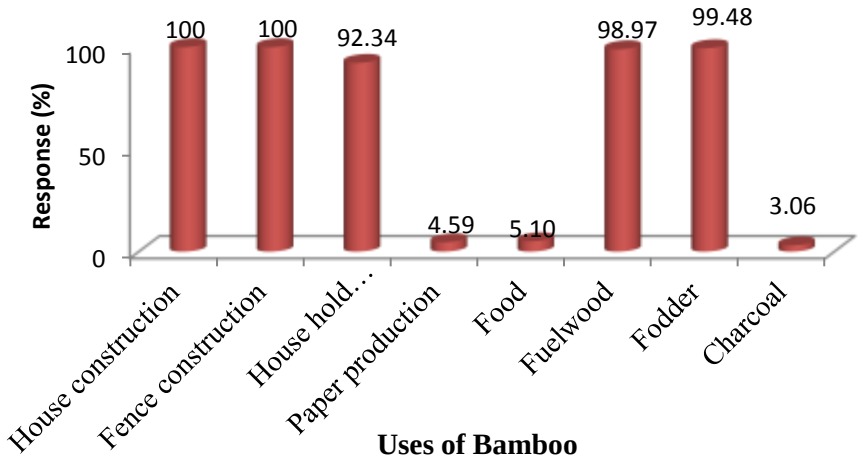

Figure 11. Purpose of bamboo utilizations in the study area.

Figure 12. Traditional residential houses constructed from bamboo.

earthquake resistant, unlike brick or cement constructions. Xiao et al. (2009) and Xiao et al. (2010) have also demonstrated that laminated bamboo can be used in structural applications, presenting new opportunities to standardize bamboo-based construction and produce modern modular housing designs that are potentially suitable for East African markets.

Bamboo shoots has been developed in the months of March and May each year and then bamboo sheath has been collected in May and June to use for roofing to be woven in between two layers of bamboo splits to avoid rain leakage, cold and excess heat into the house. The house floors paved with bamboo splits woven against each other on the ground. The types of houses traditionally constructed from raw bamboo, are called *"Sheekka"* in the local language (Figure 12).

The majority of the rural communities live in bamboo made traditional houses in the study area. In line with this, ITTO (2002) estimated that globally, one billion people live in bamboo houses, and bamboo housing in Costa Rica, other Latin American countries, and Ethiopia is a good example. Similar results were also reported by Ensermu et al. (2000) and Kassa (1996) that most rural households mainly use bamboo as raw material for construction, fencing, making house utensils and as a source of domestic energy.

Fences: Community use bamboo for different fences like house compound fence, circular bamboo fence (barn) to shelter their livestock, crop field fence and boundary fence to secure their resources and/or assets from various damages and losses (Figure 13).

Household utensils: Hollow huge bamboo cylindrical water fetching container, seats, tables, shelves, umbrella made from bamboo sheath and Culm splits, cups, and beds mostly for own consumption. The above stated bamboo utilization in the study area almost agrees with

Figure 13. Traditional bamboo made fences and livestock barn for different uses.

the statement 'Communities in Ethiopia have history of customary utilization of A. *alpina*. It is used for diverse functions including construction of houses, mats, fencing, tool handles, umbrella, broom, wine storage barrels, musical instruments, crafts making and in animal and human bone setting in the traditional medicinal practice' (Wassihun et al*.,* 2003).

Fodder: Livestock are fed with bamboo fresh and soft leaves at a time of grazing feed scarcity.

Handle: Community use bamboo sticks and poles for axe, spade, digging hoe, reek and brooms handles, for walking sticks, spear handle and thin bamboo sticks for driving livestock to the grazing field and back to home in the evening.

Beehive construction: Some local **c**ommunity members traditionally construct beehives from different local materials but most of the people prefer bamboo based on its advantage that one can construct the hive as the size he wants small, medium or bigger very easily which is convenient for honey harvest because bamboo split is flexible in any construction and makes the work easy.

Conclusions

Even though there is increase in use and the expansion of bamboo plantation, there is no such intense bamboo management practices have been developed in the area. The existing management system, especially traditional harvesting system of bamboo clump is unscientific. Fostering better productivity of the bamboo stand in the local area is necessary. Traditionally, farmers somehow know how to take care for bamboo roots and rhizomes while selectively harvesting not to cause damage, which is a good habit to sustain bamboo resource utilization. Such habit has to be integrated with modern knowledge of selective harvesting with maximum care based on the right harvesting season and age structure of the bamboo stand with skilled capability of the harvesters for scientific management.

The survey results showed that the utilization priorities for bamboo in the study area were for house construction, fencing, fodder, fuel wood, household items production and other smaller uses, in the order of its importance. Utilization systems were merely connected to traditional methods and depended on backward technologies.

So for that matter, overall, bamboo management skill training should be given to development agents and woreda natural resource experts working closely with the rural communities. Poor policy support to the bamboo growing sector, in terms of sufficient road infrastructure, intense training and bamboo market promotion could not improve its usefulness for the local people. In fact, the support currently available, with respect to little training through development agents (DAs) of Woreda Agriculture and Rural Development Office (ARDO), is less appreciable.

Every household properly manages his agricultural land registered by his name but, if bamboo forest areas managed by community, which is regularly not protected from illegal and other problems, are divided into pieces available for lease, it would be simpler to frequently monitor and conduct inventory of the bamboo forest.

Even if, bamboo trading is a routine activity conducted in the area, the marketing strategy is not well designed and coordinated among the business actors by concerned sectors of the woreda administration in a way that all business actors could benefit fairly and equitably to sustain the resource availability and trading in its broadened manner.

RECOMMENDATIONS

1) Government and other stakeholders including national and international NGOs should involve in supporting bamboo related training for overall bamboo development to bamboo section in the agriculture sector.
2) Without ignoring good traditional experiences of the community, intensive research works on propagation methods, harvesting, handling, drying, management practices, preservation, shoot for food should be strengthened and knowledge transferred to bamboo producers.
3) Appropriate and essential bamboo technologies for bamboo forest management (silvicultural management, development, protection, processing and utilization) activities and technology transfer of local communities are vital to the actors.
4) Encourage bamboo management support to bamboo producers and through rural development programmes, make use of local communities to sustainably intensify the development and utilization of bamboo resource.
5) Government owned natural bamboo forest has to be properly demarcated and managed by the concerned government sectors, to support local government economy in particular and national economy in general. The other key issue to think about is that illegal settlement in and around the natural bamboo forest should be resettled in villages where they come from and be legally restricted to secure sustainable utilization of the forest in collaboration with the local community.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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