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Farmers' practice on the management and establishment of bamboo stands in Bore woreda, Guji zone, Oromia region, Ethiopia

Fekadu Dule*, Kedir Aman and Workalama Tsegaye

*Hawassa Environment and Forest Research Center, P.O.Box 1832, Hawassa, Ethiopia; *email: fekadudule2@gmail.com*

Report summary

It is important to study and characterize the existing knowledge on the management of highland bamboo for bamboo stands development and expansion. Farmers have traditional methods of propagating the species. However, these indigenous knowledge and practice are not documented properly. Therefore, this research was designed to characterize the farmers' practices on establishment and management of bamboo stands in Bore district, Guji zone, Oromia region, Ethiopia. Multistage sampling procedure was employed to select sample respondents for data collection. First representative woreda (district) was selected from bamboo growing areas of Guji zone. From selected woreda, two representative Kebeles were selected randomly. Again from each kebele, 5% of bamboo growers were selected randomly for data collection. Primary data was collected through face-to-face interview, key informant interview and focus group discussion. The collected qualitative data was analyzed using descriptive statistics. On average, households had participated on bamboo planting task, for more than twenty years. The mean plant spacing was 2±0.9 meter. The households that got higher income from bamboo plantation were those who applied management activities such as fencing to protect animal encroachment, digging around bamboo culms to loosen the soil and create favorable condition for rhizome regeneration. Management activities such as weeding, thinning, adding livestock manure and /or composting were practiced by 83.7% of the respondents. Training should be given to fill skill gap on propagation, processing, marketing, frost, pest and disease control and management of bamboo plantation as there is still low attention from all stakeholders compared to annual crops.

1. Introduction

It is estimated that about 21 million hectares of the earth surface is covered by bamboo forests (Kalbesa *et al*.,2000). Ethiopia has the highest bamboo resource in Africa on area basis (Kelbesa *et al*., 2000), which accounts for about 67% of the bamboo resource of the continent (Embaye, 2003). Bamboos in Ethiopia are represented by two species, *Oxytenathera abyssinica* (A. Rich) Munro; the lowland bamboo which

accounts 85 % of the total national coverage and the rest 15% is covered by *Yushania alpina* K. Schum.; highland bamboo (Embaye, 2000; Embaye *et al*, 2003).

According to the Ethiopian Ministry of Agriculture's 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 in several thin and short culms (INBAR, 2009).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 was neglected in the past (Andargachew, 2008; Kelbessa *et al.,* 2000), but currently there are different initiatives to manage and develop the resource sustainably.

It is important to study and characterize the existing knowledge (either traditional or introduced) of farmers on the bamboo resource for bamboo stands development and expansion. Local people in Ethiopia have a tradition of growing and managing bamboo stands. The best examples are Sidama and Gamo zone of the SNNP regional state and Guji zone of Oromia national regional state. They also have traditional methods of propagating the species. However, these indigenous knowledge and practice are not documented properly. Therefore, this research was designed to characterize the farmers' innovation on establishment and management of bamboo stands. Different characteristics of their innovation such as planting pattern, decisions making in plantations, spacing, tending operations, cutting age (rotation age), product types, and economic contribution of bamboo to their annual income were the major issues covered in the study.

2. Materials and Methods

2.1 Description of the study area

Bore is one of the 'woredas' (districts) in the Guji Zone of the Oromia Region of Ethiopia. The altitude of the woreda ranges from 1800 to 2900 metres above sea level. A survey of the land in this woreda shows that 29% is arable, 33% pasture, 30% forest, and the remaining 8% is considered swampy, degraded or otherwise unusable. Barley, wheat, corn, teff, and horse bean are important crops. As the 2007 national census reported, a total population of this woreda was 210,179, of whom 105,726 were men and 104,453 women; 10,258 or 4.88% of its population were urban dwellers. With an estimated area of 1,296.88 square kilometers, Bore has an estimated population density of 128.6 people per square kilometer, which is greater than the Zone average of 21.1 (CSA, 2005).

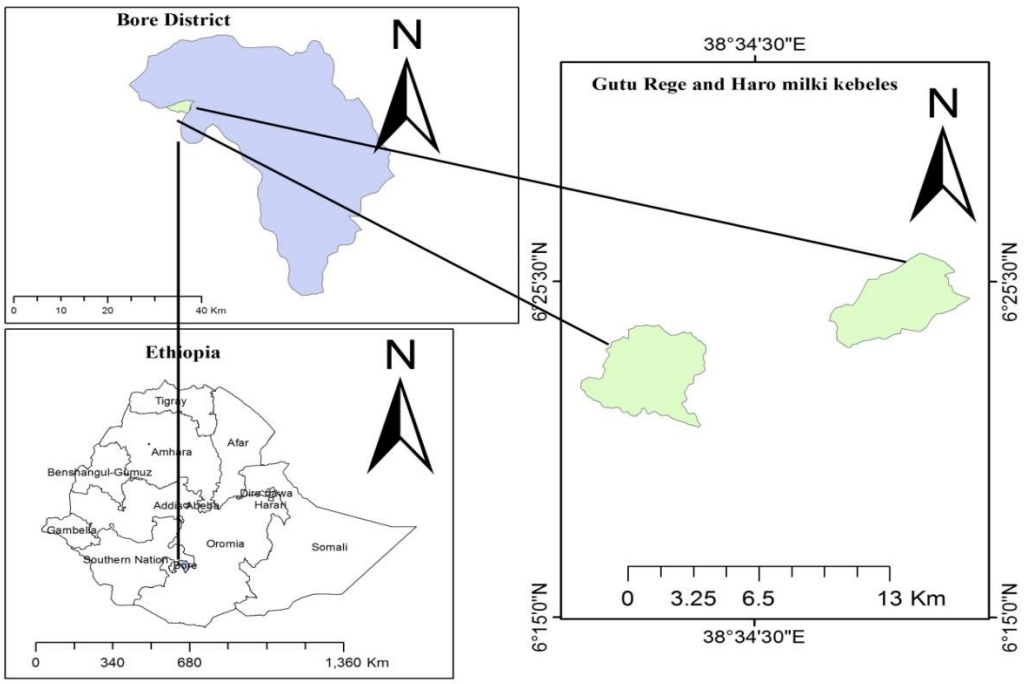

Fig. Location of the study area in Bore woreda, Oromia, Ethiopia

2.2 Sampling procedure and sample size determination

Reconnaissance survey was conducted to identify potential bamboo growing areas. Multistage sampling procedure was employed to select sample bamboo growing kebele. A representative woreda was selected from bamboo growing areas of Guji zone for highland bamboo. Two representative Kebeles were selected randomly from the woreda. Again, from each kebele, 5% of bamboo growers were selected randomly for data collection following the formula byYamane, (1967).

$n=\frac{N}{1+N(e^2)}$ Where n is the sample size, N is the population size, and e is an acceptable sampling error=10% at 90% confidence level.

The total households of Gutu Reji kebele (n_1) was 610 and n_2 (households of Haro Milki) 592.

$N=n_1+_{n2}=610+592=1202$

$n=\frac{N}{1+N(e^2)}=\frac{1202}{1+1202(0.1^2)}=92.31$

2.3 Data collection and analysis

Data were collected using multiple data collection methods that included focus group discussion, key informant interview, observation, and questionnaire. Questionnaire consisting of both closed and open-ended questions were prepared to solicit information on the management of bamboo.

Both descriptive and inferential statistics were employed to analyze the data. Correlation analysis was also conducted to assess the relationship between respondent's characteristics and bamboo management and establishment experience.

3. Results and Discussions

3.1 Demographic characteristics of the households in the study area

About 94.6% of the interviewed respondents were male headed and the rest 5.4% represent the female headed households. Regarding the educational status of respondents, 35.9 % of them never went to school; about 9.8 % were learnt 1-4 class while the others 32.6% followed 5-8 and the rest 21.7 % of respondents were grouped under high school level category. *Figure 1* shows the age class distribution of interviewed household heads.

On average, the family size per households was 10.4±5.5 in number in the study area. An average land holding size of households in the study area was 3.2±3.9 ha and on average households had 0.6± 0.7 ha bamboo plantation.

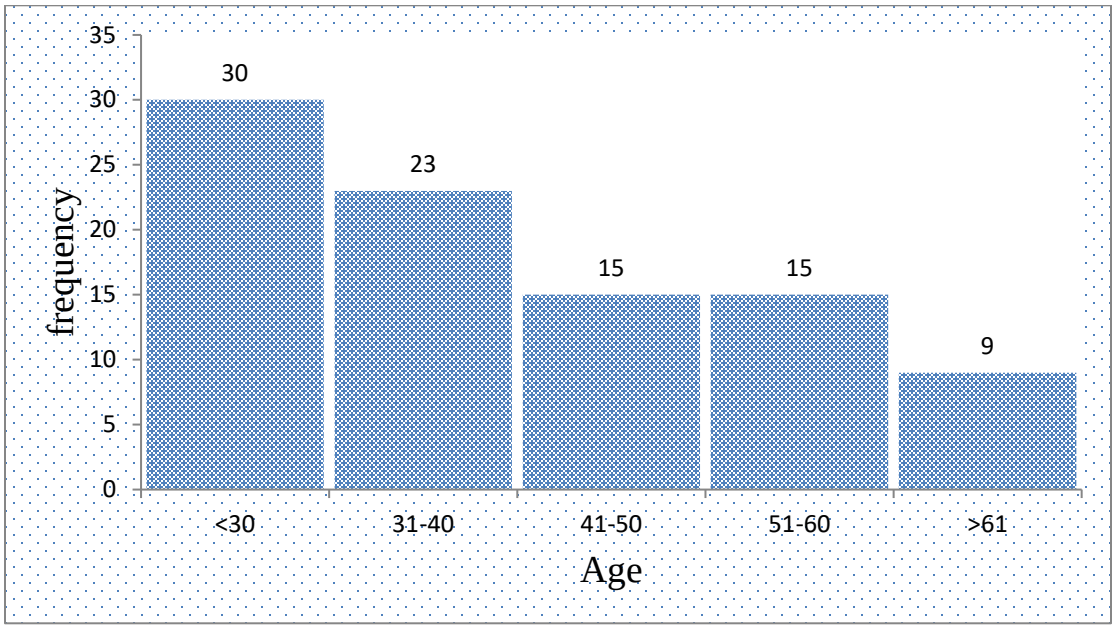

Figure 1: Age class distribution of the households in Bore woreda

As shown in Figure 2, youngsters, women and elders participated on bamboo planting task, most of them had experience on bamboo planting for more than twenty years. About 80.4% of households in the study area got the practice of bamboo planting by their own effort while, 18.5% of them got it from neighbors, and their family. The contribution of other sectors in provision of technical support and training on bamboo was very minimal especially from government institutions. If local people are supported with techniques and inputs like trainings, working tools, planting materials and local administration is involved in resolving such issues and allocate idle areas like river banks and valleys for bamboo, the size of the plantation bamboo forest would significantly increase (Seyoum *et al*.,2018).

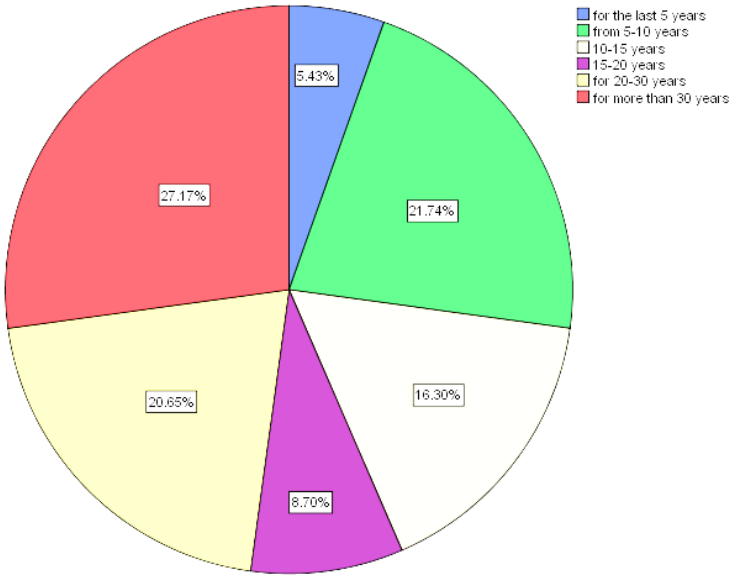

Figure 2: Experience in years on planting bamboo plantation by household in Bore woreda

About 59.8% of households plant bamboo as block plantation and a few of them planted around their home as homestead plantation. Households planted highland bamboo for its enormous benefits such as selling culm for income generation, for hut and fence construction, for making traditional beehives and temporary cereal crop store, for feeding cattle with bamboo shoots and rhizome, and for fuel. All the interviewed households witnessed that bamboo is profitable over annual crops due to its coppicing/sprouting behavior once established appropriately on the field and minimum input cost requirement throughout its life span in contrast to annual crops that require huge labor and high input each year. Growth to full height and diameter is completed in one growing season of 3-6 months' time (Getachew and Wubalem, 2014). It has maturity age of about 3-7 years for construction and furniture purposes and short rotation life that can be harvested in 3-5 years versus 10-50 years rotations for most softwood and hardwood tree species (Getachew and wubalem, 2014). Farmers saw bamboo culm as a bank account as they can cut and sell the culms at any time when needed.

About 54.3% of household perceived that they could face many challenges in absence of bamboo resources as there was no access to bamboo products and services, and the remaining 45.7% had the opinion that even sustenance of life was difficult in absence of bamboo plantation. Even though the supply of bamboo planting material is plenty among smallholder bamboo growers, there was a large gap on processing and value addition to bamboo in the study area. Study conducted by Tirusew *et al*. (2017), in Hula woreda, Sidama zone showed that about 58% of bamboo poles produced by the households were directly sold as raw poles to traders while about 40% were used for fences, and house construction.

On average, households in the study area planted bamboo with the spacing of 2±0.9 m(Figure 3). The households that planted bamboo on wider spacing in the study area reasoned out that they selected wider spacing to get quality culm through minimizing competition for soil nutrients, allowing good shoot growth

and ease of management and primarily for sprouting habit of bamboo while, those planted bamboo on narrower spacing planted it with intention of improving quantity of bamboo planting material for propagation and for intermediate income generation.

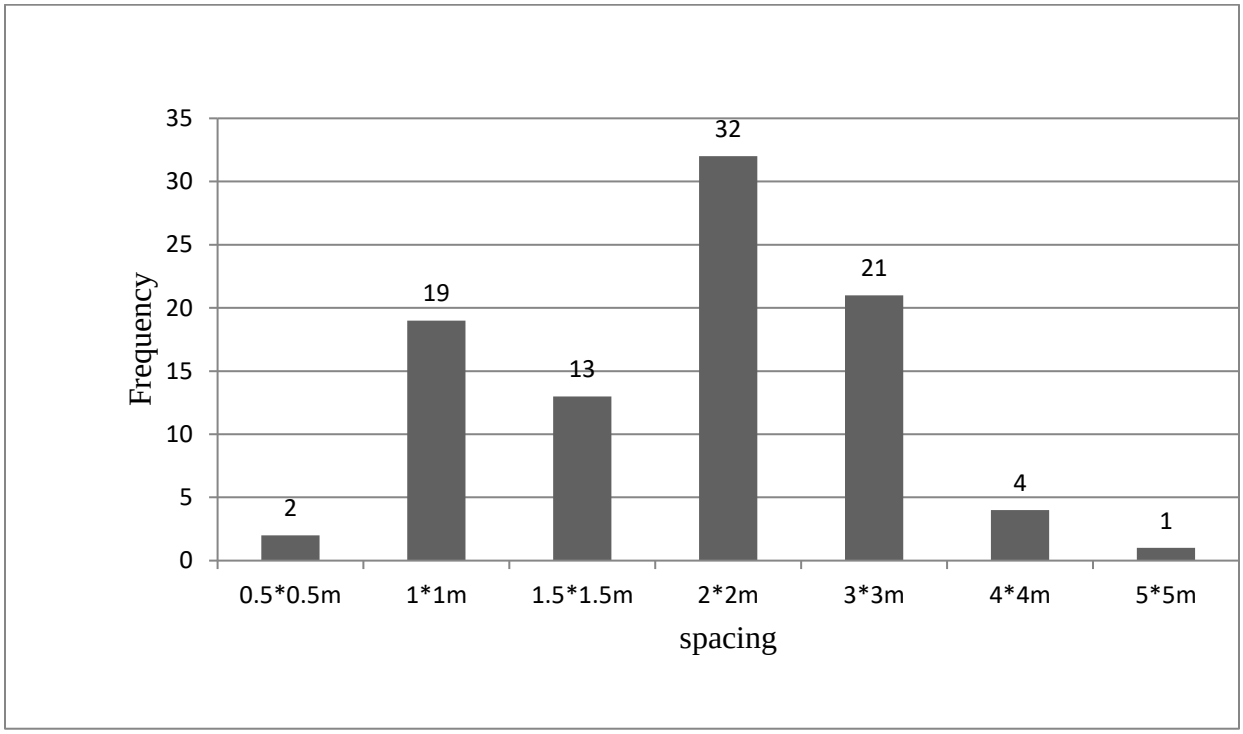

Figure 3: Spacing used by households for planting highland bamboo in Bore woreda

The majority of the respondents revealed that the survival and growth performance of bamboo plantation was very good (Figure 4).

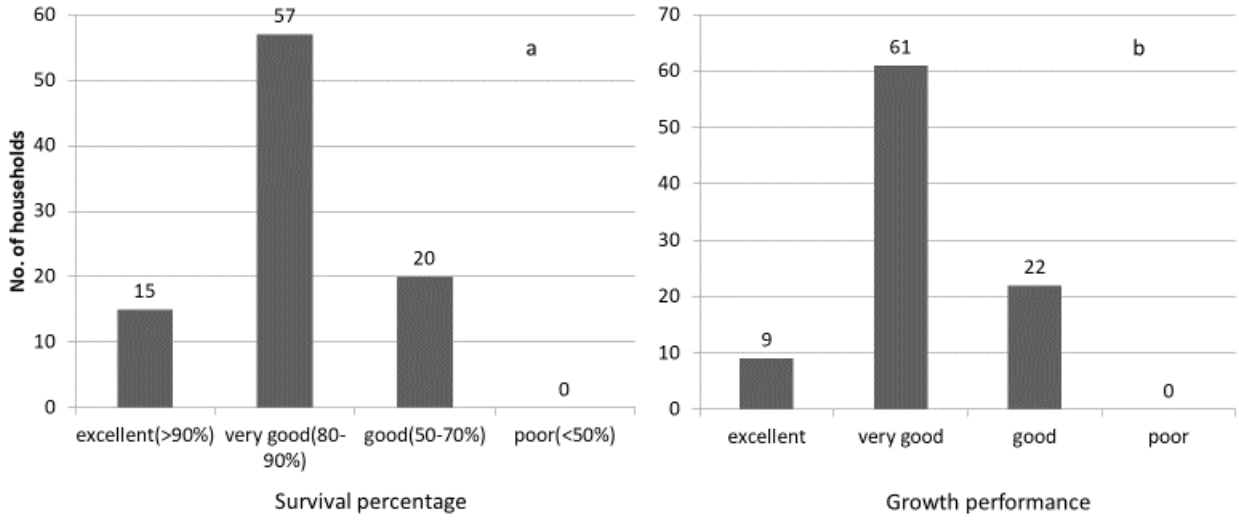

Figure 4: Survival (a)and growth performance (b) of bamboo in plantation in Bore woreda

About 34.8% of the bamboo plantation were between 1-3 years old, and such age high proportion of young population category might be due to selective cutting of matured bamboo culms all months except when bamboo is sprouting in rainy season (Figure 5).

Bamboo poles are harvested seasonally with harvesting concentrated from November to January. Harvesting is avoided from April to June as it is the reproduction season. Depending on the intended markets or end uses, the harvesting age varies. Bamboo poles used for construction often need to be more mature and harvesting starts from the age of three years and above.

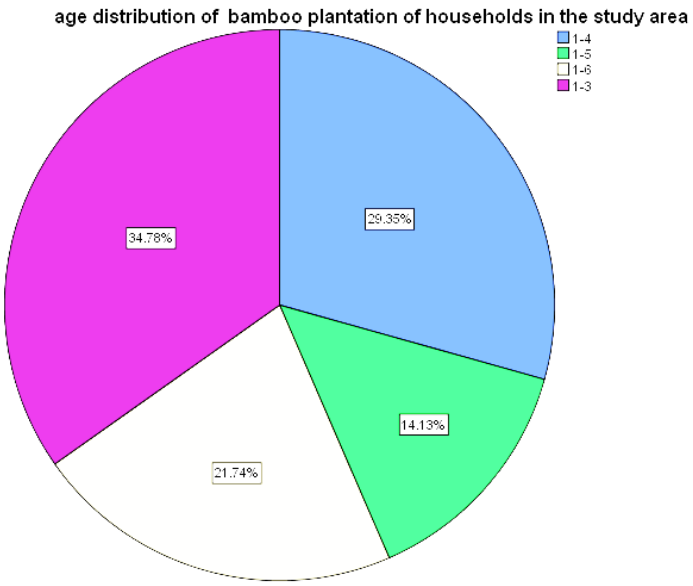

Figure 5: Age distribution of bamboo plantations in Bore woreda

Majority of the households used rhizome cutting as a bamboo planting material, while seed is rarely used by few households in the study area due to seed unavailability owing to the rare flowering nature of bamboo species. Seeds of *Yushania alpina* are not available on regular basis, besides their low viability (Azene Bekele, 2007) and hence not reliable source of planting material (Yigardu Mulatu and Masresha Fetene, 2014).
Respondents indicated that on average planted bamboo close to each other (compete for spacing/close the space between the individual bamboo plant by sprouting and branching) within 3.5±0.85 years of establishment on the field. On average households planted about 28 bamboo planting material with the range of 4-175 annually.

On average households cut bamboo culms when it is about four years old, with the range of 2-6 years. The entire interviewed household used selective cutting of matured bamboo for domestic use and/ or selling.

The result obtained from household interview indicated that farmers cut bamboo culms all the time except when it is sprouting to minimize damage that might be happened on rhizome/root suckers and to increase the rate of growth and ensure that next year could be safe for sprouting. Furthermore, the other purposes are for the planting material to reach to planting stage at dry season and to decrease the probability of disease occurrence on the culms. Once successfully planted, the bamboo keep on rhizoming, shooting and maturing every year. The annual selective cutting and sustainable utilisation can be implemented without damaging ecological environment (Yigardu Mulatu and Mengistie Kindu, 2010).

As the respondents indicated, the average price of one bamboo culm was 12.68±3.09 Birr which highly depends on individual bargaining power and market condition at the time of selling culms. On average

they travel 3.8±1.7km to sell bamboo culms. About 42% of the respondents sold greater than 200 bamboo culms annually (Figure 6).

Majority of them (65.2 %) sold their bamboo culms directly in the local market while the remaining 34.8% sold their culms through brokers. On average household gets annual income of 2384.73±1018.23 ET birr annually from bamboo plantation with the range of 420-5000 birr.

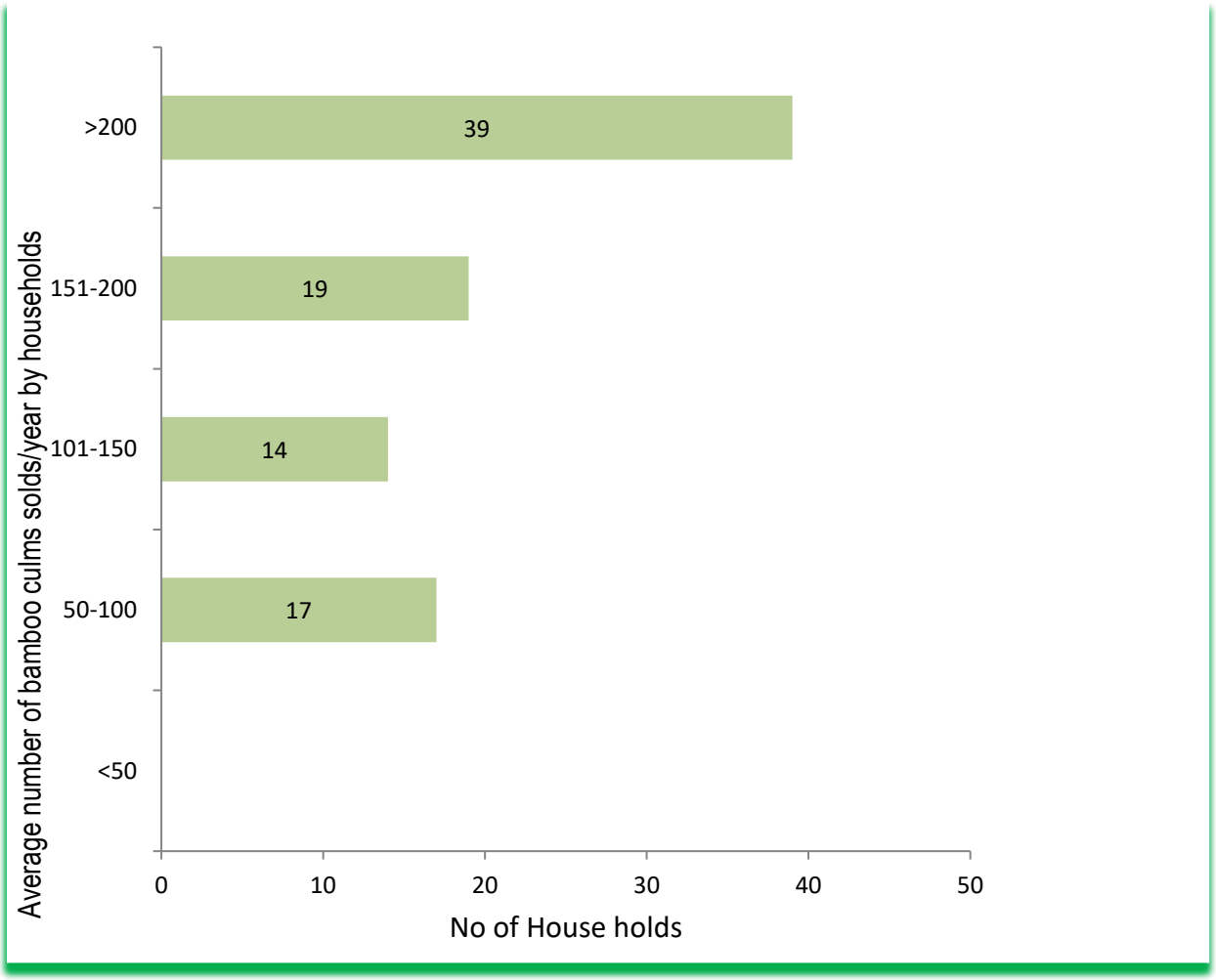

Figure 6: Average number of culms sold by households in Bore woreda

Households with higher income from bamboo plantation applied management activities such as fencing to protect animal encroachment, digging around culms to loosen the soil and create favorable condition for rhizome regeneration. About 83.7% of the respondents manage their bamboo plants by mulching, adding green manure, weeding and thinning, while 9.8% of them apply management activities such as fencing, thinning and transplanting and the rest 6.5% of the respondents apply only fencing as a management activity.

Bamboo planting was done right at the onset of rainy season as stated by 83.7 % of the respondents while a few of them (7.6%). said timing of management for bamboo was conditional and flexible. Results

indicated that about 85.9% respondents face labor shortage on bamboo plantation management at planting and harvesting season while 14.1% said that they did not face any critical labor problem in bamboo plantation management. The major problems encountered in the establishment and management of bamboo stands were absence of technical support and training on bamboo plantation propagation and management as stated by 67% of the respondents. Land use change and resulting shortage of land size, frost and labor shortage, and high animal encroachment during dry season were the core problems identified in establishment and management of bamboo plantation in the study area.

Table 1: Pearson correlation matrix for factors affecting bamboo plantation establishment and management in Bore woreda

Pearson correlation coefficient showed that family size was significantly and positively correlated with age and land holding size of the respondents. The results indicated that households with large family size/elders did not face significant challenges in a season where labor become a critical challenge (Table 1). Elders had higher bamboo plantation as well as better experience on bamboo establishment and management than youngsters (Table1).

	age	LHS(ha)	FS(number)	BPO(ha)	EBP(years)	BPS(meter)	DBPCEO (years)	PMBP(per year)	ADBP	ANCS (per year)	APBC(ET birr)	AIFB in ET birr	DTSB IN KM)	ACBC in year
age	1													
LHS(ha)	.287**	1												
FS(number)	.549**	.545**	1											
BPO(ha)	.323**	.661**	.495**	1										
EBP(years)	.560**	.092	.424**	.165	1									
BPS(meter)	-.093	-.110	.134	.072	.031	1								
DBPCEO (years)	.111	-.132	.090	.135	.127	.225*	1							
PMBP(per year)	-.130	.226*	-.001	.086	.076	.298**	-.021	1						
ADBP	-.043	.037	-.023	-.009	-.170	-.028	.037	.095	1					
ANCS (per year)	.179	.128	.126	.123	.268**	-.055	-.083	.113	-.231*	1				
APBC(ET birr)	.047	.004	.039	-.014	-.034	.029	.246*	.227*	.096	-.128	1			
AIFB in ET birr	.174	.182	.199	.157	.197	-.029	.059	.223*	-.123	.721**	.515**	1		
DTSB IN KM	.028	.115	-.014	-.075	.198	-.263*	-.173	.063	-.146	.180	-.199	.046	1	
ACBC in year	.083	-.034	.050	.068	.107	.214*	.296**	.108	-.134	.157	.100	.156	.020	1

**correlation is significant at the 0.01 level (2-tailed),* correlation is significant at the 0.05 level (2-tailed). Where ,LHS(ha)=land holding size (ha),FS= family size(number), BPO=Bamboo plantation owned(ha), EBP=Experience on bamboo planting(years), BPS=Bamboo planting space(meter), DBPCEO=Duration planted bamboo for closing each other(years), PMBP=planting materials of bamboo planted per year, ADBP= age distribution of bamboo plantation ,ANCS=Average number of bamboo culms sold/year, APBC= average price of one bamboo culm, AIFB=annual income from bamboo in ET birr, DTSB=Distance traveled to sale bamboo culms in (km), ACBC=age of cutting bamboo culms for use or sale.

4. Conclusions and Recommendations

The result of the study indicated that, local people had sound experience of developing bamboo stands. Households that applied management activities such as fencing to protect animal encroachment, digging around culms to loosen the soil and create favorable condition for rhizome regeneration, mulching and adding green manure around bamboo culms, weeding, thinning, adding livestock manure and /or composting got higher income from bamboo plantation, compared to those who carried out only fencing and thinning. The timing of bamboo plantation management was during the onset of rainy season/beginning of 'Belg' (short rains) as stated by majority of surveyed households in the study area. Land use change and resulting shortage of land size, frost attacks and labor shortage, and high animal encroachment during dry season were the core problems identified in establishment and management of bamboo plantation in the study area.

Training should be given to fill skill gap on propagation, processing, marketing, frost, pest and disease control and management of bamboo plantation as there is still low attention from all stakeholders compared to annual crops. Government and non- governmental organizations should encourage farmers growing highland bamboo by giving incentives, providing access to the road and market through creating market chain so as to sustainably establish and utilize the reosources to minimize pressure that arise from expansion of agricultural land to bamboo plantation and grazing of regenerating rhizome by cattle.

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