THE CONTRIBUTION OF HIGHLAND BAMBOO (*Yushania alpina*) TO RURAL LIVELIHOODS AND STATUS OF ITS DOMESTICATION AT BULE DISTRICT, GEDEO ZONE, SNNPR

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ABSTRACT

*Yushania alpina*Known as highland bamboo is a perennial, multipurpose and a fast growing plant that supports local livelihoods in many ways. However, for long its uses have been limited to traditional applications. Although bamboo has quit high distribution and widely utilized by large number of local communities in Ethiopia, little baseline information on its livelihood support and domestication status exist for several areas. The objectives of this study were to investigate the role of the highland Bamboo (*Yushania alpina)* in the livelihoods of the rural community and the process of its domestication in Bule district of Gedeo Zone, SNNP Region. The study used combination of methods to achieve the set objectives. The socio-economic survey involved formal and informal interviews and observations. On farm, bamboo stock was assessed using farm level inventory. For socio-economic data collection, formal (questionnaire) survey was administered on 100 respondents after stratification of the respondents into three wealth categories (rich, medium, and poor). The respondents were selected from three peasant associations (PAs); those PAs were purposefully selected from among the 29 villages within the district. This selection was based principally on accessibility and abundance of bamboo resources, use and marketing history. To assess the bamboo stocks at farm-level as indicators of the extent of domestication, six sample households were selected from each wealth class under each PAs and their bamboo stands were assessed. The results showed that the aggregated (i.e. across wealth category and PAs) contribution of bamboo to the gross household income is found to be only 5.6% of the total, which is 14 fold less than the income from agriculture. The income generated from bamboo ranks third in importance as sources of household income. Furthermore, the contribution from bamboo to household income varied significantly ($P<0.05$) across wealth category and among the PAs. Bamboo is used for variety of traditional applications include construction, fencing, fodder, household furniture, fuelwood and as cash source. Almost 93% of households have been started bamboo cultivation on their own land and waste land. Among these, almost above the average respondents (71% of the respondents) had inherited their bamboo stands from parents. The major push factors for cultivation/domestication in their order of importance are: increasing bamboo use for different household purposes, income generation and depletion of bamboo in natural stand. In conclusion, promotion, training and market facilitation for better economic incentive from bamboo may win increased local people participation bamboo cultivation, which may ultimately lead to better conservation and utilization of bamboo.

Keywords: *Yushania alpina, socio economic, household use, income generation, wealth, domestication.*

1 Background and justification

1.1 Introduction

Ethiopia is one of the countries in Africa that is endowed with very wide range of topographic features and climatic conditions that favor the existence of diverse plant and animal species, which offer numerous NTFPs. These NTFPs contribute to the improvement of the livelihoods of rural communities by providing food, medicine, additional income, employment opportunities and foreign exchange earnings for the country (Abebe et al., 2004; Getachew and Wubalem, 2004). The most important NTFPs in Ethiopia include coffee, spice and condiments, honey and wax, bamboo, reeds; natural gum such as gum Arabic, frankincense and myrrh, edible plant products such as leaves and shoots, fruits, simple sugar products, essential oil, tannins and dyes, resins, latex, ornamental plants and giant/ long grass (Getachew and Wubalem, 2004). In general, the contribution of NTFPs to food security is highly significant in Ethiopia.

Bamboo is one of the NTFPs, and is one of the world's greatest renewable natural resources, which yields a multitude of products and services of high economic value to humankind; in addition, its also plays a vital role in conserving ecological stability and biodiversity (Kassahun, 2003; Rawat *et al*., 2003). Bamboos are tall perennial, arborescent grasses, belonging to the sub-family Bambusoideae of the family Poaceae (Surendran *et al*., 2003). Almost 75 genera (Rawat *et al*., 2003; Surendran *et al*., 2003) and more than 1500 species of bamboo and still more with incorrect names, are found in the world (Ohrnberger, 2002). The set of pure bamboo forests in Ethiopia is the largest in Africa; it covers more than one million hectares, and makes up 67% of the total bamboo resources in Africa, and more than 7% of the

world total (Luso Consult, 1997; Kassahun, 2003). The two recorded natural species of bamboo which grow in Ethiopia are *Yushania alpina* Known as Highland bamboo, and *Oxytenanthera abyssinica* (A. Rich) Munro known as Lowland bamboo (Luso Consult, 1997; Kassahun, 2003). Bamboos are the most freely and readily available resources for the communities living within and around the natural bamboo forests of Ethiopia (Kassahun, 2003).

However, despite the availability of the resource in large quantities and at low cost, its uses have been limited to traditional applications such as hut construction, fencing, and to a lesser extent, the production of handicrafts, furniture, containers for water transport and storage, baskets, walking sticks, agricultural tools, beehives, household utensils and various other artifacts (Kassahun, 2003). Even at regards its low-level traditional applications, there is still little baseline information on the situation of bamboo as a source of livelihood (Ensermu *et al*., 2000). Bamboo, like other NTFPs, receives little attention (Ensermu *et al*., 2000; Kassahun, 2003). However, there is little research and information on the extent of bamboo domestication, on the management of the domestic stocks and on its role in household livelihoods in Ethiopia. Even the very few studies made so far on utilization, seed characteristics and propagation techniques, were mainly on limited sites in the lowlands, (the southwestern) and southeastern highlands of the country (Ensermu *et al*., 2000; Kassahun, 2003; Demelash, 2006). Similar studies and other relevant information is lacking for the larger highland forest area, which needs to be documented. This study is therefore, an attempt to address the need for baseline information on the production and use of bamboo, as well as on the value chain of bamboo in Bule district, Gedeo zone, SNNPR. The aims of this investigation are to assess the livelihood contribution of bamboo *Y.alpine* to the rural

community, and the driving factors that affect the process of bamboo domestication and management systems.

1 Materials and methods

The study was conducted at Bule district of Gedeo zone in SNNPR. The district is situated *ca*. 390 km south of the capital city, Addis Ababa. The area lies between 6°04'16"-6°23'50" N latitude and 38°16'20"-38°26'11" E longitude (Tadesse, 2002), It is one of the areas in Ethiopia with good natural highland bamboo forest cover. The mean annual rainfall of the district is 900mm, with a bimodal rainfall distribution pattern. The rainy seasons are March-May and July-December. The annual temperature ranges from 8-22 °C, with the average of 15 °C. The area lies in the inter- tropical convergence zone, and as a result it benefits from both the equatorial and the monsoons, the two most important trade winds in the region (Tadesse, 2002)

1.2 Research Design and Methods

In this study, a combination of methods was employed to achieve the set objectives. The socio-economic survey involved formal and informal interviews and observations, while domestication assessment on farm, bamboo stock was assessed by means of a farm-level inventory, which is very important to show the strength of the domestication practice and management systems. Three villages (Sika, Suko, and Elalchaloke) were purposefully selected from among the 29 villages within the district. This selection was based principally on accessibility and on abundance of bamboo resources, use and marketing history. Within each village, sample households were randomly picked using distribution proportional to size

among the wealth groups (rich, medium and poor). To assess the bamboo stocks at farm level as an indicator of the extent of domestication, six sample households were selected from each wealth class and their bamboo stands were assessed. Total number of culms per household was assessed.

1.3 Data analysis

Data collected were checked, corrected, coded and entered into micro-soft excel and SPSS version 13.0. Data analyses were made using statistical package for social studies (SPSS). Descriptive statistics and one-way ANOVA were applied as needed. For instance, one-way ANOVA was used to test whether there was a significant difference in income generated from bamboo among the different wealth groups.

2 Results

2 Livelihood activities, household income and the role of bamboo

All (100%) of the respondents had more than one sources of income (Table 5). Households in the study area were engaged in a variety of farm and off-farm activities. However, the major income sources for the households were agriculture (crops, vegetables and livestock), bamboo production and production of other tree products (pole and fuelwood). Other limited sources of income were wage-labor, petty trading and beekeeping (Table 5). The mean annual household gross income (including household consumption) for the entire district was 4674 ETB, with a range from 2294–8140 ETB. Assessment of the income level by household revealed that *ca*. 40% of households had an income of less than 4000 ETB per annum, 33% of the households earn income between 4001–6000 ETB per annum, and the remaining 27% earned more than 6001 ETB per annum

The major source of income in all cases was agricultural, which in aggregate provided 87% of the gross annual household income. The agricultural activity mentioned here includes mixed farming, where crops/vegetables and livestock were managed in combination. Main crops cultivated were barley, beans, peas, onion, collard green, cabbage, and “enset" (Table 5).

The aggregate (*i.e.* across wealth category and PAs) contribution of bamboo to the gross household income was found to be only 5.6% of the total (Fig. 2), which is one-fourteenth of the income from agriculture. Yet the income generated from bamboo ranked third in importance as a source of household income in the study area (Fig. 2). Despite the relatively low contribution of bamboo to household income, the role it plays is appreciated by the majority of the respondents. Accordingly, 93% of the sample households owned bamboo and generated income from it.

Table 1 Mean annual incomes generated from each of the livelihoods activities of the sample households by wealth category (n=100)

	Sika				Suko				Elalchaloke			
Source of income	**Poor**	**Medium**	**Rich**	**Total**	**Poor**	**medium**	**rich**	**Total**	**poor**	**medium**	**rich**	**Total**
crops and vegetable	1952.4	3444.3	4367.1	3056.8	2058.6	3693.1	3471.4	2861.2	1949.95	3064.7	3701.1	2859.8
livestock	585	1916.4	2326.5	1463.9	494.71	1659.3	1569.7	1078.3	684.091	1454.2	2313.8	1408.6
bamboo product	166.92	394.75	543.75	337.66	159.04	244.38	302.5	212.89	111.364	277.5	467.5	268.71
honey	11.538	32.9	30.5	23.323	0	0	0	0	0	0	5	1.1429
petty trading	130.77	50	150	109.68	70.588	0	216.67	71.429	90.9091	37.5	112.5	71.429
wage labor	303.85	0	0	127.42	282.35	0	0	137.14	222.727	0	0	70
other (tree product)	182.69	199.75	370	236.53	70.294	165.21	380.83	156.07	57.2727	40.625	216.56	86.071
Mean	**476.167**	**862.59**	**1112.55**	**765.045**	**447.94**	**823.14**	**848.73**	**645.29**	**445.1877**	**696.361**	**973.78**	**680.8218**
Total	**3333.168**	**6038.1**	**7787.85**	**5355.313**	**3135.582**	**5761.99**	**5941.1**	**4517.029**	**3116.3138**	**4874.525**	**6816.46**	**4765.7529**

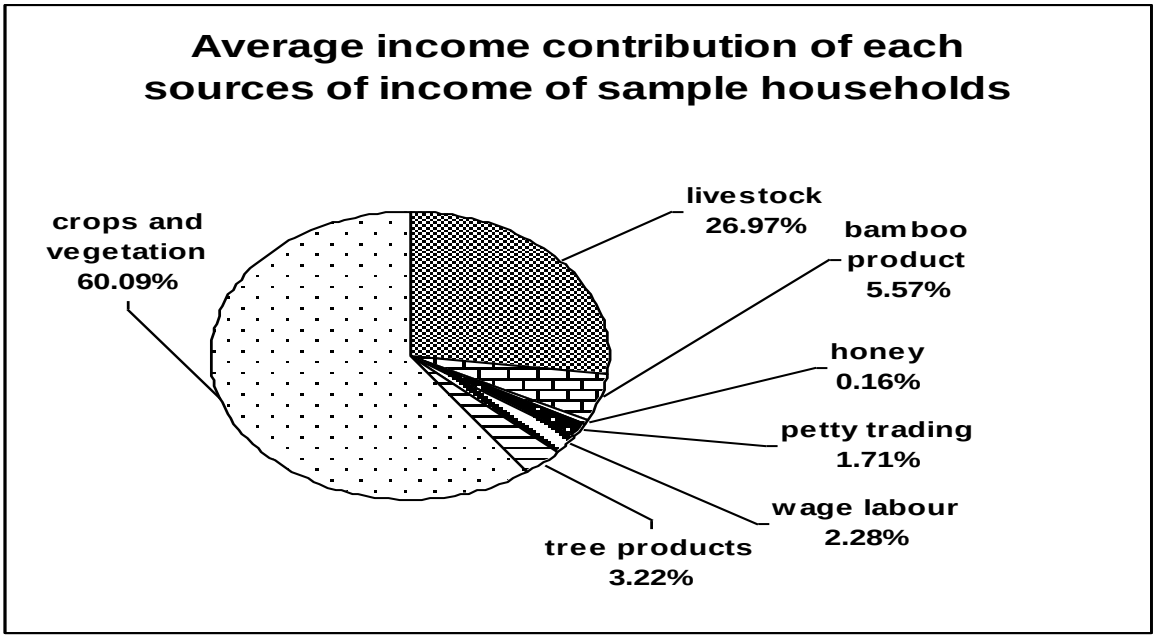


Figure 1 Relative share of the different income sources in the annual income of households in the study district.

In fact, the contribution from bamboo to household income varied significantly ($P < 0.05$) across wealth category and among the PAs. The contribution of bamboo was higher for households in Sika and Elalchaloke PAs relative to Suko. This probably has to do with the distances of the PAs from town and road. Both Sika and Elalchaloke PAs are relatively closer to the district town and also closer to an all-weather road, which may have increased market access for these two PAs.

Likewise, the rich households generated more income from bamboo than did the poor and medium households (Fig 3). In absolute terms, the annual income generated from the sale of bamboo ranged from 60 Birr for the poor to 525 for rich per annum and in relative terms it contributed to 5% for the poor and 8% for the rich. In all of the PAs, the rich generated a significantly higher income from bamboo than the other categories (table 5). Income from

bamboo ranked third for the rich and medium categories (Fig 3 a & b), but fourth for the poor (Fig. 3c). For the poor, the third largest source of income proved in most cases to be wage labor rather than bamboo (Fig. 3c). Not only have the relative importance, but also in terms of absolute income from bamboo, had the rich and medium categories generated far more than the poor (Table 5). The gross annual household income and the part generated from bamboo differed significantly between the rich, medium and poor ($P < 0.001$).

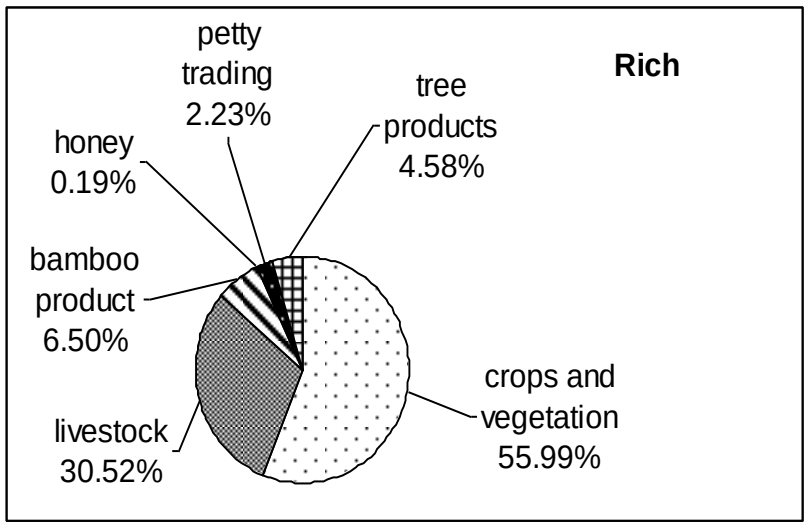
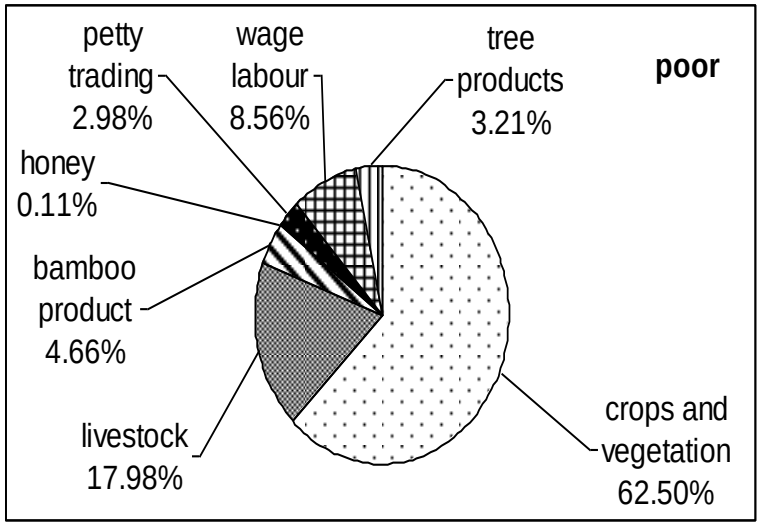


Fig a



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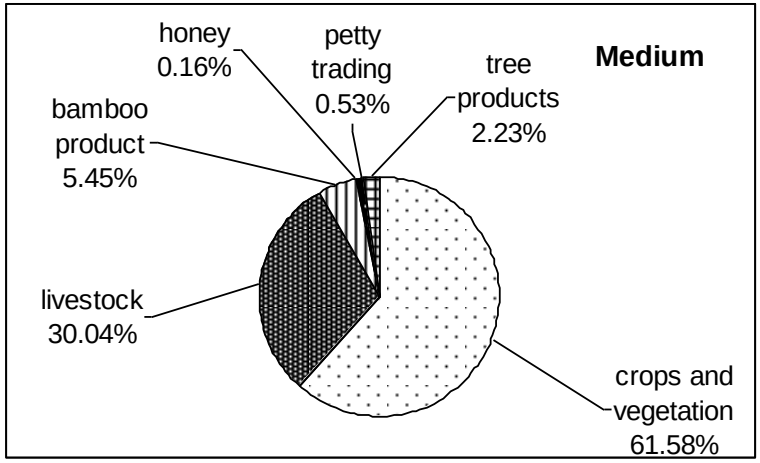

Fig b

Figure 2. The proportional contribution of the various income sources by wealth category in the study area.

3 Utilization of bamboo other than for income

The local people indicated that bamboo is used for a variety of local or traditional applications in the study area. The applications include construction, fencing, fodder, household furniture, and as a cash source. In order of importance, application for construction ranked first in across all wealth categories (poor (81%), medium (82%) and rich (62%)). The relatively low importance of construction among the rich, compared to the other category, is due to the fact that the rich can afford to construct better houses, covered by corrugated iron, and utilized more of eucalyptus than bamboo. Instead, the rich households utilized bamboo mainly for fencing, fodder and as a source of income. In fact, the rich households also owned relatively large bamboo resources compared to the other categories.

Of the households, 80% expressed that the view that the usefulness of bamboo has no parallel, compared with any other species found in the locality. The uniqueness of bamboo, as expressed by the locals, includes flexibility, strength, and fast growth, which makes bamboo more preferable than other tree species. Furthermore, 100% of the respondents valued most the local uses over income generation. This implies that marketing of bamboo in the study area is relatively undeveloped. In the construction of the traditional house roof, bamboo serves the dual purpose of both nail and corrugated iron, two independent component materials that would otherwise be required for building a typical house roof. Generally, in the process of house construction, at the beginning the wall is of mud, reinforced with the wooden poles and bamboo culms. The underlying layer of roof—the prospective ceiling—is constructed by interweaving bamboo splits against the already fixed solid culms. The bamboo sheaths are stretched horizontally over this layer, and tied by interweaving bamboo that makes the roof (outer layer) of

the house. The layer of sheath, mantled in the middle of the two layers, provides waterproofing by blocking leakage through the roof. The floors inside the house are also built by splitting the culms and interweaving them against each other at ground level. The types of house traditionally constructed of bamboo, are called *"SHAKO*"

Figure 3 Traditional house constructed from bamboo and other material

Bamboo is also used for constructing fences of various appearances that result from different orientations of splits while interweaving. The common procedures in fencing building are the erection of short cut bamboo culms on the ground following the fencing line, followed by closely interlocking bamboo split against the erected beams, until no holes are left.

Figure 4 The type of fence constructed from bamboo

Bamboo sheaths and calms are also used for making umbrellas and mats of various sizes and shapes. Young leaves and new sprouts of bamboo are usually browsed by domestic and wild animals as fodder, hence bamboo plantations are fenced to protect young sprouts: traditionally this is called "*Amecho*." In addition to this, the evergreen nature of bamboo enhances the beauty of the region.

4 Domestication, its trend and niches for cultivation

The data summarized in Table 6 below suggest that the inhabitants of the survey area have a long-standing tradition of bamboo cultivation. As the survey result indicated, 75.3% had inherited their bamboo stands from parents, 20.4 % of the sample respondents had begun cultivation ten years earlier, and the remaining 4.3% of the respondents slightly more than five years earlier. The major driving factors for cultivation/domestication, in order of importance are: increasing bamboo use for different household purposes, income generation, and the depletion of bamboo in natural stands.

Table 2 Number of household engage in bamboo cultivation and time start

		Sika	**Suko**	**Elalchaloke**	**Total**
Bamboo domestication		Freq	Freq	Freq	Freq
households engage in bamboo cultivation		28	33	32	93
Time start bamboo cultivation	inherited from parent	17	29	24	70
	ten years before	9	3	7	19
	five years before	2	1	1	4

Furthermore, 71% of the respondents (82%, 39% and 94% from Sika, Suko and Elalchaloke respectively), indicated an increase in their bamboo plot over time, while 29 % of the respondents indicated a decrease in their bamboo plot. For the former category the increase was due to increased income from bamboo and increasing application of bamboo, including its services. For the latter category, the constraints on bamboo cultivation, hence the decrease the area, were shortage of land, decreased fertility of croplands, poor market condition (lack of demand, lack of enough local traders, and low price), lack of infrastructure(all-weather road, communication, *etc*), low utilization and lack of enough support from the Government. Compared to the other two PAs, 61% of the respondents in Suko PA indicated a decline in their bamboo area. This implies that distance from the market center, communication with intermediate and infrastructure such as roads, influenced the farmers' decision to engage in bamboo cultivation.

All (100%) respondents had bamboo stands on farmland, 23% of the respondents also had bamboo stands around home or in backyard/homestead and 19% also cultivated bamboo on wasteland. Personal observation also shows that some farmers allocated portions of the land crop fields for establishing bamboo plantations. This shows a shift in emphasis towards bamboo cultivation, for its supplementary role as a competitive land-use option.

5 Bamboo resource owned and its management

The size of the bamboo resource owned by individual farmers is summarized in Table 7 below. The number of culms owned per household ranged from 217–15000, the average being 3512 culms per household. In terms of area, the average land allocated for bamboo cultivation was 0.09 ha per household.

Table 3 Distribution of Households by Size of Bamboo Plantation

No of culms	Number of respondents	%
≤1000	11	20.4
1001-3000	17	31.5
3001-5000	8	14.8
5001-7000	10	18.5
7001-9000	6	11.1
≥9001	2	3.7
Total	**54**	**100**

The number of culms owned per household differed significantly ($P < 0.01$) between wealth categories; rich (5951 culms) > medium (2543 culms)> poor (1039 culms). Similarly, the average land area allocated for bamboo plantation showed a highly significant ($P<0.001$) difference between wealth categories. On average, the poor households owned 0.06 ha of bamboo, equivalent to 11% of their total landholding. For the medium wealth category, the area allocated for bamboo amounted 0.16 ha; 12% of their total landholding. The rich category allocated 0.26 ha for bamboo cultivation, 10% of their total landholding. Comparison of bamboo landholdings between the wealth classes showed that the bamboo area of rich farmers was nearly 4.3-fold higher than that the poor farmers, and 1.6 fold higher than the area allocated for bamboo by medium farmers.

As regards management, farmers in general did little. In most cases, once the stand was established, there was little follow-up management activity, except fencing and harvesting.

During community discussion, it was learnt that their ancestors used to obtain rhizomes from wild stands, but after the natural stands become depleted, communities obtain planting material from peers whenever needed. For instance, 44.1% of respondents obtained planting materials from their friends as well as from natural/wild bamboo forest, while 52.7% established their stands with materials from natural stands. The remaining 3% obtained planting material from peers.

Establishment: - During interviews, several informants responded that the practice of artificial establishment of bamboo stands was uncommon. However, there were rare cases of artificial restocking or filling of gaps due to harvesting, by planting culms. As most of the respondents related, during the inventory and field visit, the process of establishment starts from site preparation, *i.e.* the making pits, which are relatively deeper and wider than normal tree pits, prepared planting material, which is free from disease and 2-3 years old, with root systems, and planting in the previously prepared pits. They said that most of planting is carried out during the beginning of the rainy seasons.

Tending and Maintenance: -during the interviews, the respondents replied that they did little with regard to the tending and cultivation of bamboo stands, and thus relying mostly upon natural regeneration. However, some instances of weeding around new shoots, fencing, refining and thinning were noticed. As they mentioned, thinning was not common a tending operation commonly exercised. However, they did thin out especially to those stands affected by borers and disease, and the dry and overmature.

Harvesting: - generally, the interviews showed that the harvesting method was selective *i.e*., culms of the right sizes were selected, depending on the intended utilization, and on their maturity. Culms that have reached harvesting age they are identified by color; they become yellowish and begin to be attacked by fungus. However, they also harvested immature culms for mats and some furniture making.

Management problems: - during interviews and field visit, almost all respondents indicated that there were management problems, which affected product quality and quantity. They also responded that the buyers provided no advice concerning product quality; only one farmer said that a buyer assisted him in identifying the stage at which a product should be harvested, and how it should be harvested. The major problems, as indicated by most of respondents, were trampling and browsing by domestic animals and wild animals, borers and diseases that affecting the bamboo stems, decay of new shoot, and sometimes drying before they have reached maturity. All of these problems could be attributed to lack of knowledge, and inadequate support from experts. The major responsibility for managing a bamboo plantation is said to lie on the head of the household; he or she is responsible for protecting and maintaining the plantation, and for taking decisions on harvesting and selling. The other family members were also responsible for the protection and maintenance of the plantation.

3 Discussion

3.1 Roles of Bamboo in the household economy

This study indicates that households in Bule district domesticate and cultivate bamboo both for household applications and for generating cash income. This study agrees well with the wealth of literature (Marshall *et al*., 2006, Shaanker *et al*., 2004, Mirjam *et al*., 2003, and Perez *et al*.,

2000) that indicates the tremendous socio-economic role of NTFPs, as crucial elements of livelihood strategies across a variety of settings. The importance of NTFPs including bamboo for rural households, especially at times when alternative incomes, food, or animal fodders are scarce, is well-documented (Perez *et al*., 2000). The present study also indicated that agriculture alone could not sustain the overwhelming proportion of the households in the studied district, and that support from other activities should complement household livelihoods. To this end, the role and importance of bamboo was found to be crucial in filling income gaps and supplying the needs of households for additional income.

Although bamboo is a versatile multipurpose perennial species with wide industrial and local uses, the community in Bule district utilizes it mainly for traditional/domestic purposes and for sale to generate income. Yet, despite the overall low absolute income generated from bamboo cultivation, its contribution stands in the third place in importance. This is similar to the results reported by Ensermu *et al*., (2000), who indicated that four-fifths (79%) of his respondents ranked it second, while the remaining one-fifth valued it as of primary importance to their livelihood. In fact, the role of bamboo reported from the study is lower compared to that in reports from other countries such as Mvera, Malawi, where there is considerable activity with bamboo. For instance, the result reported by Sosola and Johnsen (2005) in a study in which they compared the average cash incomes from the sale of bamboo and other household activities, indicated that bamboo played a considerable subsistence role in the livelihoods of artisans and bamboo vendors. Moreover, Perez. *et al*. (1999) in Anji country, China, reported that bamboo is the second most important source of income after off-farm work, representing 25% of the total family income. Morris (2002) in Leo PDR in south Asia, also reported that the participants

ranked bamboo as their most important source of cash income, accounting for 40% of the households' cash income. This implies that the contribution of bamboo to rural livelihoods is considerable across various settings. Nonetheless, compared to the role that bamboo plays in other countries, its role in Bule district in particular and Ethiopia in general is very low or underdeveloped. This also shows that a concerted effort is needed to boost the role and importance of this sub-sector, to obtain increased rural and national benefits. Similarly, the relative contribution of bamboo to household income from the present study, which amounts to 6%, is much lower compared to studies made on other NTFPs in other parts of Ethiopia. For instance, a study in the southern lowlands of Ethiopia indicated that one-third of the annual subsistence income of a pastoral household was derived from sale of NTFPs (Mulugeta *et al*., 2003). Similarly, Ambrose (2003) reported a 15% contribution of NTFPs to household income in Southwest Cameroon, where there is considerable activity with NTFPs are practiced.

Interestingly, the role that bamboo plays varied from village to village, depending on their relative location with respect to road and town (market centers), as well as on household wealth status. The rich have greater advantage than the poor from bamboo cultivation, and households close to market centers have greater advantage than those distant from road and market centers. The rich households derive more income from bamboo than do poor households, contrasts with the finding of several studies, that poor households derive more benefit from the use of NTFPs than do wealthy or intermediate households (Neumann & Hirsch, 2000; Shackleton and Shackleton, 2005). In fact, several studies indicate that rich households generate a greater absolute income from NTFPs than poorer households, while still other studies have shown that the use of NTFPs is not strictly wealth-dependent, but depends on other factors, such as product

specialization, proximity to the resource base and household dependency on NTFPs (Godoy *et al*., 1995; Marshal *et al*., 2006). The present study also confirmed that differences in the utilization of NTFPs varied significantly with proximity to the market and the road network as reported by Godoy *et al*., (1995). This finding is also supported by Jalan and Ravallion (2002), cited in Javier (2005), who highlighted the importance of the existence of rural infrastructure facilities, as well as of the complementarities among them, as an essential requirement for rural income growth and poverty reduction.

From socio-economic study, it was observed that bamboo has an age-old connection with the daily life of the Gedeo Zone people, in the highland agroclimatic zone, where ecological conditions favor the growth of bamboo. More than 80% of respondents stated that the usefulness of bamboo is unparallel by other equivalent trees species. According to the respondents, the main reasons for this are its workability, strength, accessibility and other characteristics (easy to propagate and high biomass). This implies that, because of its characteristics, the community perception of the utilization of this species relatively higher than that for other tree species. The remaining 20% of the respondents indicated that it is as useful as other tree species. Kassa (1997) also supported this idea that, owing its workability, durability, strength, and accessibility, it is given first preference for construction and other activities. Nair (1988) cited in Kassa (1997) also listed these characteristics of bamboo as very important attributes to its versatility.

The social survey indicated that bamboo resources are used for limited purposes when compared with their potential use. They are mainly used for the constructions of house roofs and walls, in fencing, as fodder, and for making furniture. In the study area, bamboo is primarily consumed for

domestic use or used for income generation, through the production and sale of raw material. Almost 78% of the respondents used it primarily for house construction, and the remaining 22% used it for fencing. Similar results were also reported by Ensermu *et al*., (2000) and Kassa (1996), that most rural household mainly use bamboo as raw material for construction, fencing, making house utensils and as a source of domestic energy.

Apart from domestic consumption for constructing traditional houses, fencing, fodder, and making furniture; bamboo was used to generating income through sale of raw bamboo raw material. The results show that the average annual income obtained from the sale of raw bamboo was 235 ETB per household (60 ETB for poor to 525 ETB for rich per annum). There was a significant difference between wealth categories in income generation from bamboo; rich farmers obtained greater benefit than the medium and poor farmers do. Luso Consult (1997) also reported that the income from bamboo sales by poor households can reach 70% of total cash income in Enjibara, Amhara Regional state. A similar result was also reported by Ensermu *et al.*, (2000) that the annual income per household from bamboo cultivation was in the range 90-540ETB. This implies that bamboo cultivation undoubtedly provides a source of employment and supplementary income to farm households in the survey areas.

3.2 Bamboo domestication and management

It can be seen from this study that domestication though various means by different households is well established. It can also be learned that the land-tenure reform in 1974, after the fall of the feudal regime, was the first incentive for the individual farmers to begin domestication. Furthermore, domestication expanded for two principal reasons: (1) depletion of the natural bamboo forest and (2) the versatility use of the bamboo resource both as a source of income and

for use at household level. This understanding fits well with the agronomic development theory of NTFPs, described by Hamma (1995). According to this theory, when there is wider use of, and increased market demand for, a given NTFP, the natural source is at first overexploited, causing natural stands to dwindle. Then, as commercial or household demand for the product continues to grow, increased domestication of the source follows. According to this theory, the production of such NTFPs will therefore move from being an extraction activity from natural stands, to domestication and cultivation of agricultural or forestry crops. Hamma (1995) has described very well the various phases in the transition of important NTFPs, from wild to domesticated resources. According to that author, when NTFPs find consistent and significant importance in the livelihood of local people, they will often be domesticated. The case of bamboo domestication shown in the present study and other similar studies in Ethiopia, is one case of such transformations from a wild to a domesticated plant. Other studies in Ethiopia (e.g. Ensermu *et al.,* 2000; Berhanu & Jochen (2007)) also demonstrated extended domestication of bamboo, due to its wider use at household level. For instance the report by Ensermu *et al.,* (2000) showed that 91% of the respondents interviewed had cultivated bamboo for over ten years. Studies in Ethiopia, including the present study, by comparison with studies of bamboo domestication in countries such as Bangladesh and Malawi, revealed greater participation in domestication by local people. For instance, Islam *et al*., (2001) reported from Bangladesh that only 42% of households had a bamboo plantation, and that the numbers of bamboo stems per hectare were estimated to be 15,331, or 69 culms per clump. Sosola and Johnsen, (2005) also reported from Malawi that only ten individual households had homestead bamboo. However, the extent of cultivation varied with wealth status. The commercial importance of the bamboo resources means

that rich households, which can afford to allocate more land to bamboo plantations because of their large landholding, have the advantage.

4 Conclusions and Recommendations

4.1 Conclusion

Households in the study area are engaged in a variety of farm and off-farm activities using their asset endowment. Bamboo is one of the livelihood strategies of the households and has a pivotal function as a coping strategy to fill income and subsistence gaps of different categories of people in the area. Bamboo is appreciated in the area, above all because of its domestic/traditional uses. The increasing importance of bamboo, both for household applications and as an income source, is extending its domestication. However, the role it plays depends on socio-economic status and market and road availability. Unlike other categories of NTFPs, the advantage of bamboo are utilized more by the rich than by the poor, and by those closer to the market or along roadsides.

Bamboo is versatile in use. The survey results showed that the utilization priorities for bamboo in the region were for house construction, fencing, income generation, furniture-making and as source of fodder, in the order of importance. Utilization systems were merely bound to traditional ways and depended on obsolete technology.

Despite its increasing use and the expansion of its cultivation, there is no profound bamboo management practices have traditionally been developed in the survey area. In most cases, once it is established, there are scarcely any additional tending operations.

4.2 Recommendations

The following recommendations are given to promote the bamboo sector and to ensure equitable benefit-sharing by the communities that grow bamboo, the processing and marketing enterprises and the national economy at large.

- Government and international funding agencies should support short-term training and research for overall development of the bamboo sector
- There is a need to organize bamboo traders and craftsmen into associations, to enable them to participate in the bamboo trade from a position of strength;
- Good marketing infrastructure and a reliable information system should be developed, mainly to address the lack of awareness by consumers about the price and competitiveness of bamboo products;
- Need for improved marketing practices
- Acquisition and dissemination of appropriate bamboo technology for bamboo cultivation, processing and utilization.
- Creation of public awareness concerning bamboo uses, at all levels and by all possible means
- Strengthen development support to bamboo growing and through extension activities use communities to sustain the production and utilization of bamboo.
- Provide skilled training in the design and manufacture of good quality bamboo products.
- Conducted on detailed analysis on value chain, management and utilization to enhance productivity and consumption.

- Farmers use traditional propagation methods. Hence, their way of propagation may not cop with large consumption of bamboo if large-scale processing starts. Research works on propagation methods should be strengthened and knowledge transferred to producers

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