THE VANISHING BAMBOO FOREST OF GAMO HIGHLAND: A CASE OF BASO-KULANO WATERSHED, SOUTHERN ETHIOPIA

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Abstract

The main objective of the study was to examine challenges and prospects of bamboo forest in Baso-Kulano watershed, Southwestern Ethiopia. Mixed research design was employed. In this case using purposeful sampling technique three kebeles were selected as sample kebeles. From these kebeles, 125 sample household heads were proportionally selected as sample size using systematic random sampling technique. To supplement and bridge data from household survey, focus group discussion, and key informant interview and field observation were utilized. Collected data revealed the complex system of root networks of bamboo forests enabled an excellent mechanism for arresting soil erosion (25%) and buffer against climate change (18.6%). But due to farmland and settlement encroachment, lack of awareness and wasteful utilization practices, obsolete management practices and ineffective policy enforcements at grassroots level bamboo forests are under sever.

Introduction

Bamboo is the name given to a group of perennial evergreen plants that are commonly found in Eastern Asia, the Americas, Australia and sub-Saharan Africa (FAO, 2009). It is a group of large woody grasses classified under family *Poaceae* and sub family *Bambusoideae* (A.A. Ogunjinmi *et al,* 2009). It is directly planted as rhizomes, culm's cuttings or nursery-raised seedlings**.** The same source classified bamboo into two species, namely *Yushania alpina* and *Oxytenanthera abyssinica*. The highland bamboo (*Yushania alpine or Arundinaria alpine*) is afromontane species occurring at the higher altitude ranges between 2200-3500 m a.s.l. (Berhanu and Statz, 2007). This species is situated in important agricultural zones of southwestern highlands of Ethiopia. The highland bamboo species are grown in montane forest, often on fertile, volcanic soils and form extensive pure stands (LUSO Consult, 1997). Hence, Bamboo species of the study area belongs to this group. On the other hand, lowland bamboo (*Oxytenanthera abyssinica*) grows in the lowlands of western Ethiopia bordering the Sudan. It grows in western Ethiopia in altitudes between 700 and 1700 m a.s.l. (Ensermu et al., 2000 as cited in Arsema, 2008).

It was reported that Ethiopia's natural bamboo forest area is estimated to be one million hectares, which is about 67% of Africa's bamboo forest (Kassahun, 2003). But due to farmland encroachment, urbanization, wasteful utilization practices, inadequate management and unsupportive policy enforcements bamboo forest in Ethiopia is under threat of degradation and the most recent national bamboo resource inventory reported a 15% decrease in bamboo forest coverage from 1980 to 1997 (Markos, 2005).

In Southern Nations, Nationalities and Peoples Region (hereafter SNNPR), where the study area is located, majority of highland bamboo forests are grown as agro forestry in homestead yards. In the study area, planting bamboo clumps in the homesteads is a means of fostering self-sufficiency of woody materials as well as fiber. Bamboo is used in the area for the construction of traditional elephant shaped dwellings and the production of domestic materials such as baskets, mats, and beehives etc which are sources of household income. The use of bamboo in agro-forestry

system involves intercropping of cash crops and the planting of hard wood trees.

Apart from its economic importance, bamboo provides many environmental benefits, especially in relation to accumulating organic matter, counteracting erosion and reversing soil erosion in degraded landscapes (Kigomo, 2007). Ecologically, all of bamboo species are important as they stabilize and enrich soils. They are equally important as a habitat for wild life and source of global carbon sequestration. According to Bereket (2008) the Ethiopian highlands are highly threatened by soil erosion, land slide and other environmental evils. The same source further reported the benefit of bamboo forest in recovering environmental damages in addition to its economic and cultural benefits.

Although bamboo played a significant role in economic income of the study households, the indiscriminate clearing, poor management practices, less regard for them as a valuable resources, and policy related gaps has considerably damaged the bamboo forest of the area. Sources documented that bamboo forests are not even in the priority list of resources to be managed and developed by government institutions (Melkamu and Habtemariam, 2012). Effective management involves systematic but selective cutting of matured culms. Selective harvesting of the plant ensures a sustainable supply of valuable and useful raw material. Overgrazing and destruction of young shoots by wild animals like apes and monkeys could be the major challenge of bamboo tree.

Several bamboo forest challenges and benefits to the livelihood of the household and national economy were not investigated & clearly stated. Thus, these problems have initiated the researcher to undertake this piece of work. Hence, the objective of the study is to assess local variety, challenges and cover change detection of bamboo trees in the study area.

Materials and Methods

Description of the Study Area

Covering an area of 373.5 square kilometer, Basso Kulano watershed is located in the eastern margin of Gamo highlands at about 515 km south west of Addis Ababa, the capital city of Ethiopia. Geographically, the watershed extended between 6° 10'N to 6° 23'N latitude and 37° 27'E to 37° 39' 30"E longitude (Figure 1). The topography is characterized by undulating and rugged terrain, dominated by plateau landscape. The minimum and maximum altitude of the area is 1680 m and 3400 m a.s.l. (Mayilo Mountain's peak). The plateau terrain is stretched from Chencha woreda in the east to Dita woreda in the west for about 30 km. At Chencha weather station mean annual rainfall and temperature is 1317.5 mm and 14.6^{o}c respectively.

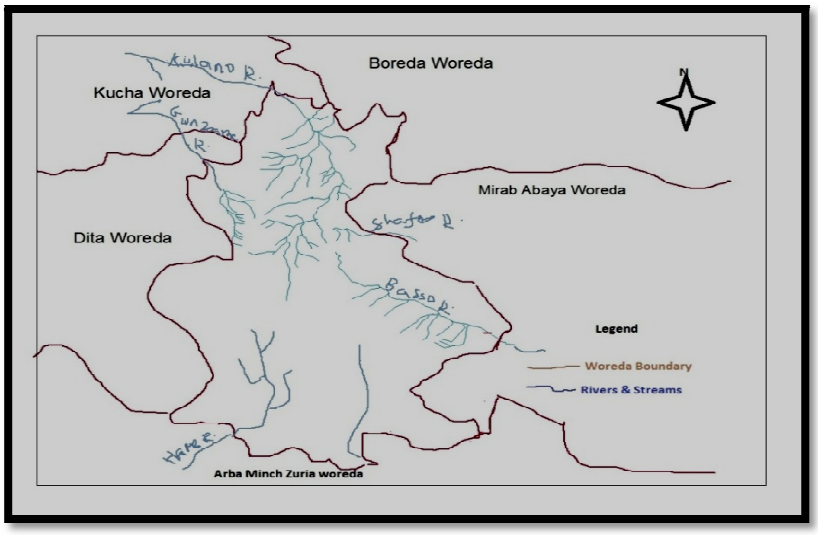

Figure 1. Location Map the study area

Based on the broad categorization of Zerihun (1999), the vegetation cover of the study area is mainly full in evergreen forest category. It includes

tree species such as *Dodonaea angustifolia, Acokanthra schimperi, Ximenia americana, Clutia abyssinica, Maytenus arbutifolia Rhus natalensis, Arundinaria Alpina, Eucalyptus Globulus, Juniperus Procera, Hagenia Abyssinica,* and *Syzygium Guineense*. These species are confined to mid altitude to higher altitudes and remote localities of the study area. However, with increasing altitude it is possible to view dispersed trees of *Combretum-terminalia* woodland, while the moist highlands are covered by *Arundinaria alpina* bamboo species (Desalegn, 2002). But small pockets of sacred forests are found in varying remote localities like *Wuytso* (in Kogo kebele), *Nagassa* (Ezo Tulla kebele), *Doshkie* (Dorze Doshkie area) and *Tsudo* (Doko Shaye kebele). The main reason for the presence of sacred forests at pocket areas is owing to a belief of the community that if trees or its branches are fetched or cut down from these areas, bad fortunes will occur and damage the households, land and cattle. But currently due to historic settlement, obsolete farming practices and harmful resource uses vegetation cover in Baso-kulano watershed is badly threatened.

The study area is characterized by high population density (465 people per square kilometer) with mean per capita farm holding of less than 0.25 hectare for an average family size of seven. Generally, the study area is the most degraded landscape in Ethiopian mountain system in terms of change in land use/cover and associated disruption in household livelihoods, mainly characterized by out migration of working population.

Methodology

In the study mixed research approaches (qualitative and quantitative) were utilized. The study area was selected purposefully owing to the enormous decline of bamboo forest cover compared to its previous potential. The study area has forty five rural administrative kebeles. For the purpose of this study, only three kebeles were selected using purposeful sampling technique. To secure research data, 125 sample size was proportionally selected from 1245 total household heads of the study area. Selection of sample size was made possible using systematic random sampling technique. In this case, selected sample size was proportional to the size of household heads in each sample kebeles. In addition, female household heads were also considered as a sample size to address female

contribution to the resource use and balance the gender gap in the study. To support the quantitative data focus group discussion and key informant interview was undertaken with 21 informants selected from the sample kebeles. Research data were analyzed using descriptive and narrative approaches. In addition, Pearson correlation coefficient was used to evaluate the relationship between dependent and independent variables used in the study. Finally, tables, figures and photoes were utilized to support the study with pictorial evidence.

Results and Discussion

Though there are conflicting views on the origin of bamboo, it grows everywhere except those places with extremely harsh climatic condition. But FAO (2009) has documented that it is thought to have originated in China, where the first use of bamboo to make every day items was recorded. Contrary to literature, the study showed that over 90 % of the respondents have the opinion that bamboo is indigenous to their locality, but only a quite insignificant size of the studied households (1.6%) replied that it was exotic. This view of the indigenous nature of bamboo was confirmed by informal discussion which was conducted with village elders who have the opinion that bamboo trees are aboriginal to their locality.

Table 1: *Views about the origin of bamboo tree*

Views	Amarana Bodo (%)	Otte (%)	Shale (%)	Total (%)
Indigenous to their locality	100	83.3	89	90.4
Imported from abroad	0	4.7	0	1.6
Unable to decide	0	12	11	8
Total	**100**	**100**	**100**	**100**

Source: Survey data, August 2016

Though bamboo varieties are differentiated by botanists, it seems more appropriate to present locally known bamboo types in the study area. Hence, during field survey, respondents were asked to differentiate varying species of bamboo of their locality. Accordingly, majority of the

respondents (43.2%) have chosen three bamboo varieties. Moreover, the remaining 16%, 12.8% and 4% have chosen two, five and more than five local bamboo varieties, respectively (Table 2). As revealed in the study, over 67% of the respondents replied that there are more than four local bamboo species. Moreover, they differentiate them based on their color and morphological characteristics. These varieties are named locally as *'laala', 'gishare', 'tsarzo', 'solko', 'dido'*, *'hombe'* and *'zokolla'* (Figure 2, 3, 4,5, & 6). From these seven varieties, *'laala', 'gishare', 'tsarzo', 'solko'* and *'dido'* are economically most preferred varieties according to survey result. This is due to size, strength and fast growing nature of the species. In addition, *hombe species is* larger in size and mostly grown in cool highland areas, whereas *zokolla* is thinner in type and grown in warm mid-land areas of the study area.

Table 2: *Locally identified bamboo species*

Type of local varieties	Amara Ena Bodo (%)	Otte (%)	Shale (%)	Total (%)
Two	26.3	12	11	16
Three	57.9	23.8	49	43.2
Four	13.2	35.7	22	24
Five	2.6	23.8	11	12.8
More than five	0	4.7	7	4
Total	**100**	**100**	**100**	**100**

Source: Survey data, 2016

Most bamboo varieties identified in the study area have grayish, yellowish and green color. According to the informants, color of bamboo bark enables the user to easily distinguish matured culms from the young one. Accordingly, young culms have grey color, while matured culms have yellowish or orange color. The bamboo species mentioned below are dominantly grown in the study area.

1. *Laala* variety: Matured Culm of this variety has yellowish color while newly emerging shoots have gray color. In addition, the culms are thin in size and have short length between internodes. And its leaves are very short.

Figure 2. Laala Variety (left) and Gishare Variety (right)

2. *Gishare* variety**:** It is large in size, grey color and easily brittle in nature (Fig. 2). Gishare variety is best grown in soils with moderate to high fertility, usually in the homestead farms immediately after enset (ensete ventricosum) yard. As compared to other bamboo varieties, Gishare variety is less affected by pests and borers.

3. *Tsarzo* variety: it has thin culms with long body appearance. Matured Tsarzo is green in color. It is luxuriantly grown in optimum rainfall (more than 1800 mm) environment and less tolerant to moisture stress. According to informants view, this type is more preferred by consumers than the other varieties due to its strength to make household utensils.

Figure 3. Tsarzo variety (left) and Solko variety (right)

4. *Solko* variety: it is green in color and has large sized culms with easily brittle surface. As a result, Solko variety has low preference by local community as compared to other varieties to make household utensils.

5**.** *Dido* variety: it has large culms but is easily brittle and has low resistance to pest damage. Dido variety has teeth-like structures along its nodes,

which makes them to be less preferable to make household utensils. Like *Solko*, it does not need much rainfall and generally shares similar character to solko type.

Figure 4. Dido variety

Challenges of bamboo plantation

Despite having a significant ecological and economic importance, bamboo forest has encountered numerous challenges in the study area. It is revealed that farmland encroachment and infestation by pests & wild animals are the top two major challenges of bamboo forest as rated by 36.3 % and 25.3 % of the sample population respectively. Furthermore, over-harvesting and cutting immature bamboo trees resulted from poverty driven constraints and the growing demand of bamboo logs in the proximate urban centers. This was considered as the third most rated constraint, reported by 12 % of the respondents. This finding was complimentary to Engidawork's (2012) report. Engidawork noted the rapid areal decline of bamboo forest related to its early harvesting. Therefore, in condition of bamboo forest degradation, wasteful utilization of young trees will further worsen sustainability of this precious resource in Gamo highlands. Due to unproductive & marginal farmlands, working age groups tend to migrate to urban areas in search for off-farm activities during the off farm seasons and sometimes even throughout the year.

Table 3: *Locally observed threats of bamboo forest*

Challenge	**Sample kebele**			
	Amara-Bodo (%)	Otte (%)	Shale (%)	Mean (%)
1. Farmland encroachment	38	35	36	36.3
2. Absence of bamboo farming enterprise	0.6	1.2	3.2	1.7
3. Policy related gaps	1.3	7	3.4	3.9
4. over-harvesting/ cutting immature bamboo tree	12.8	12.2	11	12
5. Uncontrolled grazing	10.6	10.4	10	10.3
6. Infestation by shots damaging pests & wild beasts	23.6	29.2	23.2	25.3
7. Gender biased in bamboo management	9.1	4	12.2	8.4
8. Awareness related constraints	4	1	1	2

Source: Survey data

As stated in Table 5, uncontrolled grazing (10.3 %) and exclusion of women from resource control (8.4 %) are the other considerable challenges as practiced elsewhere in traditional and patriarchal societies, wherein social, economic and managerial role of females are highly threatened by their male counterpart. Moreover, in a discussion with the widowed woman from Ezo otte kebele, she elaborated her concern in the following manner:

> *"I lost my husband a decade ago. When my husband was alive, we have large size of bamboo plantation besides our dwelling. It served us to construct our dwelling, to make household utensils and as source of income. But, after the death of my husband, no one plants or takes care of our*

> *bamboo plantation. Rather, I sold all the bamboo trees including un-matured trees. My children are too young to plant & properly manage the yards. According to Gamo culture (ethnic tribe in the study area) females do not engage in activities that demand physical labor like planting trees. Instead, they carry out household duties. Because of these constraints, our bamboo plot is diminishing in size and has reached the point of complete elimination."*

From the aforementioned findings, it is evident that bamboo forest in the study area is under threat of exhaustion and its sustainability is at risk. Despite the existing institutional & policy related commitments, land use legislation implementation constraints (such as tenure insecurity, restriction of property rights transfer, and lack of transparent and accountable land administration institutions) also hampered further expansion of bamboo plantation in the highlands. Thus, as revealed in the study 3.9 % of the sample population has the opinion that policy related issues are a constraint to bamboo forest. This finding was comparable to Melkamu and Shewakena's (2010) report that revealed land use & administration related constraints as a drawback for farmers to invest on large scale perennial tree farms.

Key informant report suggested the fear on the side of small holder farmers on current land use policy, owing to the fact that their plots might be taken away by local government officials when need arises. Discussion with *Amara ena* Bodo and *Ezo Otte* kebele elders confirms similar concern. According to their views, though land use certificate were currently issued guarantying land possession right, discussants suspect its sustainability since land is a public/state property in Ethiopia.

Factors Affecting the Status of Bamboo Forest

Several demographic and socio-economic factors affect the extent of bamboo forest in the study area. The statistical result showing the level of relationship between socio-economic variables such as sex, age, family size of household, educational status of household head, household income and land holding size and area of bamboo forest was described here under. The study showed that there is a strong statistical relationship

(0.73) between sex of the household head and area cover of bamboo forest as 0.5 significance level (Table 4). Strong positive relationship could be ascribed by the fact that in a patriarchal society like that of the study area, traditionally the man is considered to be the head of household asset including bamboo yards with an active engagement in planting and management of bamboo yard which demand physical labor and that female household heads are less likely to involve in. In traditional communities like those of the study area, females are more engaged in household activities.

Table 4: *Socio-economic factors affect bamboo forest*

Variables used	Correlation coefficient(r)
Sex	0.73
Age	0.84
Family size	-0.40*
Educational status	0.19
Income	0.68
Size of land holding	0.72

*Correlation is significant at 0.05 level.

On the other hand, age of the household head is the other demographic variable that has perfect positive relationship (0.84) with area of bamboo forest. As can be seen practically on the ground, with increasing age households usually develop long planning and thinking horizon compared to their younger counterparts. Thus, elderly farmers are less likely to over harvest bamboo yards, since they consider it as a means of security in their older age. Contrary to this finding, in the study area, researchers' personal observation showed that young household heads are engaged in off-farm activities such as small business and weaving, but their personal bamboo lot was small. Contrary to the expectation, there is an inverse relationship between family size (-0.4) and areal cover of bamboo lots. Under normal case, forest lots are expected to increase with the increase of farm labor force, because of ample labor for planting and management measures.

The correlation is also statistically significant at 0.5 confidence level freedom (Table 4). This can be explained when youth members of the households are married and become head of new household and the former household head divides his holdings to the newly married household. This condition may strengthen the probability to dwindle both farmlands and bamboo lots in the study area. The statistical result showed that the relation between educational status of the household head and bamboo forest was weak (0.19). This situation is beyond our expectation that the horizon of educated household to

use modern improved forest management techniques is higher than the uneducated counterpart.

Household income and size of land holdings are the major economic variables that showed strong positive relationship with area of bamboo cover (0.68 and 0.72 respectively). Accordingly, a household head with better income is less likely to over-exploit immature trees, because he/she has better means of income to cover household expenses compared to economically weak households. Similarly, the strong positive relationship with size of holdings is usually the expected event; when a farmer has large land under his possession he/she has the possibility to diversify his/her household income through planting and managing extensive bamboo plantation, cultivating various crops and even leaving some parts for meadow.

Opportunity of bamboo forest

Bamboo forests have several environmental and economic benefits. The survey result revealed that bamboo forests have the ability to arrest soil erosion and landslide, which was reported by 25.3% of the total respondents (Table 5). Our finding was comparable to Muller and Rebelo (2011) who noted the significance of bamboo forest in controlling soil erosion, especially through the network of rhizomes (Figure 5). A similar study conducted by Henley and Yiping (2009) has revealed that planting bamboo on severely degraded lands can possibly raise the water table by seven meters in five years period, suggesting the potentials of bamboo forest in regulating moisture availability of soil. Therefore, planting bamboo trees has such a golden opportunity for sustainable management of the natural resource in the study area which is characterized by high to severe erosion and steep terrain with permanent land slide events.

Figure 5. Network of Bamboo rhizomes

Table 5: *Environmental benefits of bamboo*

Variable	Amarana Bodo (%)	Otte (%)	Shale (%)	Total (%)
1. Wild life game and home	36	37	33.06	35.5
2. Protect soil erosion and land slide	22	21.8	34.64	25.3
3. Shade for environment	21	20.6	19.68	20.6
4. Buffer against Climate Change	21	20.6	12.59	18.6

Source: Survey data

Over 35% of the respondents reported that bamboo forest was used as a shelter for wild life and game reserve; whereas 20% of the total respondents replied that bamboo forest is highly important source of cover for the environment. During dry season, it enabled the environment to be wet. Large portion of the respondents argued that bamboo trees are predominantly used as buffer against climate change, shelter for wild life, and adornments of natural scenery (35 %). Nearly 19% of the respondents reported that bamboo forest could buffer against climate change. This is probably due to rate of growth, size and rapid bio-mass production of bamboo tree. Similarly, a study by Legesse (2012) also outlined the significance of bamboo as net sink for global carbon dioxide.

Therefore, sustainable utilization & management of bamboo from homestead forest is an excellent input for Ethiopia's resilient climate and green economy strategy. As can be understood from the statistical evidences above, bamboo provides significant environmental and economic benefits to the households of the Baso-Kulano watershed.

Figure 6. Partial view of a traditional house made from bamboo in the study area

Conclusion

Bamboo is one of the fastest growing plants which grow in incredible speed and with great density per area. Bamboo forest is a perennial ever green plant that belongs to the grass family, commonly found almost in every climatic zone except in Frigid Zone. In the study area, bamboo forests were dominantly homestead plantations and mainly owned by individual farmers. Farmland encroachment, wasteful utilization, inadequate management practices & above all low level policy enforcements at grassroots level put bamboo forests under threat of degradation. If the rate of degradation is not reversed and continues in the same level, it aggravates soil erosion, endangers sustainability of existing bamboo cover, and finally badly harm the livelihood of the community in the study area's watershed. Thus, in order to minimize the level of degradation of bamboo plantation and sustainably utilize its potential due attention should be given to it from the respective government institutions and policy enforcing agents.

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