ARTÍCULOS DE REVISION

Potentials of bamboo-based agroforestry for sustainable development in Ethiopia

Potenciales de la agrosilvicultura basada en el bambú para el desarrollo sostenible en Etiopía

Biru, Hailu

Biru, Hailu *
kasuhailu128@gmail.com
Ethiopia Forestry Development. Plantation Research. Jimma Centre. Tel: +2159118027898 Jimma, Etiopía

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Abstract: Bamboo based agroforestry frameworks are one of the significant part to improve financial status, yearly pay of partners as well as climate cordial. In Ethiopia, bamboos are established on the waterway bank and territory region to safeguard the streams from various defilement and soil protection. Bamboos reaping can remunerate the financial misfortunes of agrarian yield because of water shortage. Bamboos are great soil fastener because of presence of stringy root foundation and subsequently assume a significant part in soil and water protection. It has the potential for compelling carbon sequestration, subsequently assisting in countering the emanation of ozone harming substances, a worldwide temperature alteration and environment with changing. It additionally brings down the power of light and shields from destructive UV radiations. Planting of bamboo lines in east-west bearing diminishes conceal impact, in this way decline the dirt and air temperature and sun oriented radiation, which straightforwardly impact the dirt water vanishing and moistness. Leaves of bamboo were used as fodder, for animals. So bamboo based agroforestry plantations can be grown extensively in river bank and terrain areas of Ethiopia to boost the socio-economic conditions of farmers and ecological sustainability. Here, we reviewed the potential socioeconomic and environmental benefits of bamboo agroforestry and accentuate implications on sustainable rural development in Ethiopia.

Keywords: Agroforestry, bamboo, Ethiopia, ecosystem services, land use systems, environmental benefit, sustainability.

Resumen: Los marcos agroforestales basados en bambú son una de las partes importantes para mejorar la situación financiera, el salario anual de los socios y el clima cordial. En Etiopía, se establecen bambúes en las orillas de los cursos de agua y en la región del territorio para proteger los arroyos de diversas contaminaciones y proteger el suelo. La cosecha de bambú puede compensar las desgracias financieras del rendimiento agrario debido a la escasez de agua. Los bambúes son excelentes fijadores del suelo debido a la presencia de raíces fibrosas y, por lo tanto, desempeñan un papel importante en la protección del suelo y el agua. Tiene el potencial de obligar al secuestro de carbono, lo que posteriormente ayuda a contrarrestar la emanación de sustancias dañinas para la capa de ozono, una alteración global de la temperatura y el medio ambiente con

cambios. También reduce la potencia de la luz y protege de las radiaciones ultravioleta destructivas. La plantación de líneas de bambú en dirección este-oeste disminuye el impacto oculto, por lo que disminuye la temperatura del suelo y del aire y la radiación solar, que impactan directamente en la desaparición del agua y la humedad. Las hojas de bambú se utilizaban como forraje para los animales. Por lo tanto, las plantaciones agroforestales a base de bambú se pueden cultivar extensivamente en las riberas de los ríos y en las zonas terrestres de Etiopía para mejorar las condiciones socioeconómicas de los agricultores y la sostenibilidad ecológica. Aquí, revisamos los posibles beneficios socioeconómicos y ambientales de la agrosilvicultura de bambú y acentuamos las implicaciones para el desarrollo rural sostenible en Etiopía.

Palabras clave: Agroforestería, bambú, Etiopía, servicios ecosistémicos, sistemas de uso de la tierra, beneficio ambiental, sostenibilidad.

Introduction

Globally there are more than 1250 bamboo species[1] that covering 36 million ha of land, which are distributed in the tropical and sub-tropical belt between 46°cNorth and 47°c south, latitude at elevation as high as 4000 m above sea level. Ethiopia has the greatest bamboo resources in Africa and represents a significant proportion of Africa's total bamboo resources. The country has more than 1 million hectares of bamboo which is 67 % of African bamboo assets and over 7 % of the world's region covered by bamboo. In Ethiopia, there are two bamboo species namely highland bamboo (*Oldeania alpina*) and lowland bamboo (*Oxytenanthera abyssinica*).

It additionally has extraordinary potential for commercialization and can drive country improvement[2]. It very well may be used at all degrees of modern movement from little specialties-based businesses to present-day exceptionally coordinated plants (mash, paper and dress, furnishings, flooring) as a substitute for conventional hardwoods). Two native bamboo in particular high country bamboo and lowland bamboo species are dispersed in the south, south-west, and central parts of Ethiopia. These assets are to a great extent tracked down in four districts, in particular Benishangul-Gumaz, Oromia, Southern Countries, and Amhara. There has been a general instinct that Ethiopia has 1 million hectares of bamboo assets, yet the volume and spot of asset circulation insights aren't very much investigated.

Accordingly, research shows that agroforestry (a land use system that combines trees/shrubs and other perennials with crops and/or animals) can contribute substantially in this direction through its multiple benefits and ecosystem services. Agroforestry provides a set of innovative practices that are designed to enhance productivity in a way that often contributes to climate change mitigation through enhanced carbon sequestration[3], and also strengthens the system's ability to cope with adverse impacts of changing climate conditions[4]. In addition, agroforestry options may provide a means for diversifying production systems and increasing the 'sustainability' (allowing farmer's ability to continue) of smallholder farming systems[5].

Author notes

* **Contact address:** Ethiopia Forestry Development. Plantation Research. Jimma Centre. Jimma, Ethiopia. Tel: +215911802789 **Kasu Hailu Biru** E-mail address: kasuhailu128@gmail.com

In Ethiopia, bamboo resources constitute one of the largest non-timber forests products identified to be a suitable complement to timber usages such as building and construction, pulpwood, flooring, panel products and furniture[6,7]. In comparison with forest timber species, bamboo has a short gestation period of five years and has huge range of socio-economic and environmental benefits[8]. In many parts of SSA, bamboo is currently being promoted for forest plantation developments to reduce the natural forests for timber and wood fuels[9-11]. Notwithstanding, researchers will concur that sole bamboo manor advancements might influence adversely on food security with the exception of they are apparently settled on corrupted lands. This makes the integration of bamboo into indigenous cropping systems (via agroforestry) ergonomically interesting and necessary to meet both socioeconomic and environmental needs. While experiences from Asia and other countries demonstrate that the integration of bamboo within agricultural systems is a suitable approach for increased productivity of food crops and non-food biomass[12,13], there is limited available data to verify the suitability of the technology in Ethiopia (and Africa in general) and elucidate the ecological principles by which the system works. In addition, the current state of knowledge on bamboo agroforestry offers very little guidance as to how investments into the land use system may contribute to sustainable rural development in Ethiopia. Here, we reviewed the potential socioeconomic and environmental benefits of bamboo agroforestry and accentuate implications on sustainable development in Ethiopia.

Development

Overview of bamboo production and distribution in Ethiopia. Ethiopia is the country in the African Landmass with the biggest area of natural bamboo stands. It has been assessed that around 67 % of African bamboos are settled down in Ethiopia. Moreover, it has also been estimated that about 7 % of all bamboo resources in the world are found in this country. There are only two local types of bamboo in Ethiopia, highland (*O. alpina*) and lowland bamboo, *O. abyssinica* (sympodial bamboo). *O. abyssinica* are tracked down and dissipated in the south, southwest, and central parts of Ethiopia[5].

Highland bamboo. Accordingly, the highland bamboo (*O. alpina*) grows naturally and plantation in the south, south-west, central, and north-west highlands of Ethiopia with an altitude ranging between 2200 m to 4000 m a.s.l. and yearly precipitation is over 600 mm during the stormy season isn't under 90 days. The average diameters of the height of highland bamboo are 8 cm and 17 m, consequently[14]. High-country bamboo (*O. alpina*) is found in the Awi zone of the Amhara Provincial State and is utilized as construction material for houses, walls, furniture, and bee colonies in the towns.

TABLE 1
Major highland bamboo areas in Ethiopia

No	Bamboo area	Region	Natural stand (ha)	Plantation (ha)	Area (ha)
1	Ijibara	Amhara	30	2350	2380
2	Agaro	Oromia	-	1500	1500
3	Bale mountains	Oromia	56851	-	56851
4	Shenen/ Jibat	Oromia	1774	2561	4335
5	Gera	Oromia	36000	12503	7250
6	Bole/Hegereselam	South/Oromia	-	2460	2460
7	Chencha/Arbaminch	South	2460	3250	5710
8	Indibiri/Jembero	South	-	1850	1850
9	Jima/Ameya	South/Oromia	-	900	900
10	Mizan Teferi/Kulish	South west	-	1850	1850
11	Debresina/Wofwasha	Amhara	35	-	35
12	Wushwush/Bonga	South west	-	1120	1120
13	Bonga/Ameya	South west	7979	-	7979
14	Masha	South west	18652	-	18652
15	Munessa/Shashemene	South Oromia	4183	-	4183
Total			127982	19091	147073

Lowland Bamboo. The plant name of lowland bamboo is *O. abyssinica* in Ethiopia. It is intrinsic in Ethiopia and endemic in tropical Africa[15]. This species is cultivated solitary in the Western piece of Ethiopia along the significant stream valleys and in the lowland boundary of Sudan. This species is cultivated solitary in the Western piece of Ethiopia along the significant waterway valleys and in the lowland line of Sudan. Lowland bamboo is found between 1100 m to 1700 m.a.s.l. and covers over 1 million hectares of land and 85 % of this area is covered by *O. abyssinica*. The typical width and level of a solitary bamboo is 5 cm and 7 m, consequently[14]. The species has huge significance for the country's society and fills the defile of cast material in pastoral areas. It is additionally usually utilized as an option for lumber in house cast, hedge, and furthermore as feed for livestock, human food, and as energy supply during the dry season[16].

Environmental benefit from bamboo agroforestry. Agroforestry isn't generally completely perceived as it incorporates both spatial and time scales and numerous ideas simultaneously. In any case, this is fundamental for strategy producers to advance agroforestry. strategy bodies like[17] characterize agroforestry as an aggregate name for land use frameworks and innovations where woody perennials (trees, bushes, palms, bamboo, and so on) are purposely used on the same land management units as agricultural crops and/or animals", the definition also supported by[18]. Agroforestry is the deliberate integration of woody vegetation in at least two vertical layers on land, with the bottom layer providing an agricultural product such as crops or forage/ pasture which is consumed by animals[19].

TABLE 2
Major lowland bamboo areas in Ethiopia

No	Bamboo area	Region	Natural sand (ha)	Plantation (ha)	Area (ha)
1	Hinde/North Nekemte	Oromia	8670	-	8670
2	Asossa	Benishangul Gumuz	77947	-	77947
3	Bambasi	Benishangul Gumuz	64245	-	64245
4	Begi	Oromia	21509	-	21509
5	Nejo	Oromia	27612	-	27612
6	Dibate	Benishangul Gumuz	14200	-	14200
7	Guba	Benishangul Gumuz	7757	-	7757
8	Kemashi	Benishangul Gumuz	33723	-	33723
9	Pawe	Benishangul Gumuz	53830	-	53830
10	Gimbi	Oromia	29125	-	29125
11	Guten	Oromia	6044	-	6044
12	Metema/Desha/Humera	Tigray/Amhara	425000	-	425000
13	Dedessa valley	Oromia	135000	-	135000
14	Dangu	Benishangul Gumuz	27350	-	27350
15	Bulen	Benishangul Gumuz	16780	-	16780
16	Galesa	Benishangul Gumuz	10870	-	10870

Accordingly, the definition of agroforestry[20] demonstrates a key feature of agroforestry as a land use system that is designed to meet both environmental and socioeconomic needs for land users at all levels. In any case, the accomplishment of such financial and natural advantages is regularly subject to the woody part which is the most vital of agroforestry frameworks. Below, reviewed certain socioeconomic and ecological needs in Ethiopia which could be met through bamboo agroforestry.

Land restoration and soil conservation. Accordingly, land degradation is a major biophysical problem in Ethiopia normally contributed by the removal of vegetation through unstainable agricultural practices and illegal mining operations[21,22]. Like most trees, bamboo has the tendency to improve soils as it grows on marginal soils with low fertility. The significant elements of bamboo for controlling soil disintegration are its broad sinewy underground root growth, associated rhizome framework, the verdant mulch it might create on the dirt surface, its comparatively dense foliage which protects against beating rains, and its habit of producing new culms from underground rhizomes which allows harvesting without disturbing the soil[23].

Soil and water conservation. Bamboo woodlands have a broad rhizome framework, a thick litter layer, exceptionally versatile culms, and a thick covering. These qualities give bamboo woodlands a high limit with respect to disintegration control, soil and water preservation, avalanche counteraction, and security of riverbanks[24]. Reports, the broad rhizome arrangement of bamboos lies principally in the top layers of soil, subsequently, it frequently assumes a significant part in settling soils on steep slopes and river banks[25]. Most of the time bamboo is described by a complicated organization of rhizome underground root growth which causes them to succeed other backwoods types to really keep soil particles intact, consequently, thereby preventing soil erosion and promoting water percolation. Because of the inescapable underground root growth, extraordinarily molded leaves, and thick litter floor, the amount of stem stream rate and overhang capture of bamboo is 25 %, which significantly diminishes runoff, forestalling huge disintegration and keeping up two times as much water in the watershed[26], especially in the space of inclined to high measures of overflow and debased lands. On one hand, this species are evergreen plants, and thick shade and soil cover given by dead leaves reduces sprinkle separating and further creates assault limit[27]. Thus, it is significant in getting the hydrological capability of the catchments and waterways. A greater part of bamboo species is trademarked in high-height biological systems on steep slants in zones of high seismic action, consequently, their job in soil adjustment might be basic. The over-the-ground piece of bamboo wood diminishes disintegration by precipitation capture and by protecting the dirt from wind disintegration and sun drying[2,25].

Bamboo for carbon sequestration. Accordingly, besides being a tool for poverty alleviation in rural areas, bamboo plantations are also a significant carbon sink and a key option to mitigate land degradation[28]. While most wood species need many years or hundreds of years to arrive at development, bamboo typically matures in less than 10 years. This suggests high biomass mature rates and, subsequently high carbon sequestration limit[29], with its quick produce rate and high yearly regrowth in the wake of gathering, the bamboo woodland has a high carbon stockpiling potential, particularly when the reaped culms are changed into tough items. The expanded life expectancy of sturdy bamboo items created conceivable by present-day innovation can guarantee that the sequestered carbon won't return rapidly to the environment, in this way dragging out the carbon stockpiling by bamboo[30]. Not just preferred soil security over arable land, bamboo might possibly sequester a significant measure of carbon in its over-the-ground biomass and subterranean soil natural carbon[31]. For this, it has been examined that the promotion of putting away carbon under a bamboo trimming framework would also build ranchers' pay.

Biodiversity functioning. The stand of species is essentially important for biodiversity conservation. In various pieces of the country, the species give living space, food, sanctuary, and destinations for proliferation to different imperiled species[16].

Socio-economic contributions of bamboo in Ethiopia. In Ethiopia, rural communities have a strong bond with forests and use them for many purposes, and they make use of timber and non-timber forest products to support their livelihoods. Nowadays using forest and its products is mandatory and studies show that there will be a huge demand for wood and wood products. Bamboo can be used to share pressure and substitute other hardwood[32]. In general, bamboo is used for fences, houses, baskets, beehives, hats, mats, furniture, traditional sticks, and house utensils, for animal feed and agricultural tools. It is likewise utilized for medication[27].

However, the volume of income was miniature as it is expected since the area is endowed with natural bamboo forests and suitable conditions for establishing bamboo plantations. In addition, poor harvesting and processing are the leading factors for low benefits derived from bamboo. Hence, a lot should be done to improve the grower's income. Bamboo plants have many traditional and cultural uses in many parts of Ethiopia and the entire world. From this, we can deduce, that bamboo has a contribution to a household's

livelihood though it is very little in amount. Another review uncovered that bamboo estate has both positive and negative monetary impacts on cultivators and conditions[33,34].

The contributions of bamboo to the household income in Ethiopia. The degree of different uses of bamboo for income generation by three different wealth categories (Rich, medium, and poor) indicated that all farmers use bamboo for house cast, fencing, kindling, grain compartments, and fodder for livestock[34]. In southern regional states and Benishangul-Gumaz National Regional States in Ethiopia reported that bamboo accounted for 2-3 % at the national level and more than 50 % in rural areas[35]. Likewise, bamboo pay contributed up to 11 % of the yearly money pay of the families, the least (3.4 %) at Masha and the biggest (38 %) at Banja and Bahir Dar Zuria Districts. In the present study, 19.22 % of the household income is more or less similar to these studies[10].

TABLE 3
Success stories of bamboobased agroforestry systems

Some bamboo-based agroforestry success stories
Intercropping bamboo with maize, cowpea cassava in Ghana - This example revealed a greater advantage of integrating bamboo with food crops over mono-cropping systems. Changes in soil properties, crop productivity and economic potential of a bamboo-based intercropping system was evaluated in the Sekyere Central District in the Ashanti region of Ghana over three years. This involved *Bambusa balcooa* with maize, cowpea and cassava. Results showed significant higher soil moisture, pH and crop productivity levels for the bamboo-based agroforestry over monocropping systems. Additionally, minimal productivity of the bamboo-based frameworks was assessed over the monocropping frameworks[39].
The bamboo cum cereal farming system in Ethiopia - Here bamboos are planted as farm boundaries, or fence rows between croplands and grazing lands and along farm plots. The bamboos are planted as a narrow strip of linear bamboo plantation and interspersed with barley, wheat, millet, tef, potato or thatching grass. The bamboo boundary plantations are established and maintained with minimum inputs (land, traditional digging tools, axe and sickle) by farm households. The significant administration input is insurance against touching and stomping on harm. Bamboos are harvested all year round and used to make mats, carpets, broom, cover for baking plates, walking sticks, chairs, tables, fuelwood, etc. The bamboo leaves and twigs are also fed to animals as fodder. Normally family members help manufacture the products. Farmers are able to accrue uninterrupted cash income throughout the year without major financial and labour investments[40].
The "talun-kebun" system in Indonesia - In the "talun-kebun" system (a modified shifting cultivation system practiced in West Java, Indonesia) a 6-7-year management cycle of a 4-5-year fallow period enduring clustering bamboos is exchanged with 2 years of food crop creation. The success of the system is based on the ability of bamboo to reverse much of soil nutrients leached deeper into the soil profile during the 2 years of food crop production. The pumped-up nutrients are deposited at or near the soil surface as aboveground bamboo litter and dead bamboo fine roots for use by the food crops during the 2 years crop production period[41].
Bamboo as limit plants around rural fields and for water and soil protection in India. In Jharkhand (India) bamboos are planted around agricultural fields as boundary plants to protect food crops from high wind speed. The bamboos are also used for water and soil conservation during water stressed periods. When the bamboos are harvested, they are sold to compensate the monetary losses of the agricultural crops. The bamboo leaves are also served to livestock as fodder. Therefore, the bamboo-based agroforestry practiced in the area is able to enhance the socio-economic conditions of farmers and also ensure ecological sustainability of their farming systems[42].
Bamboo-based agroforestry in wasteland conditions. Bamboo-based agroforestry was found to raise the overall production and productivity of farming systems in wasteland conditions in central India. The investigation included 2 bamboo species (*Dendrocalamus strictus* and *Bambusa arundinacea*) with 4 kharif crops (moong, soybean, paddy and until). Financial examination brought about higher money related returns of the bamboo-based agroforestry framework over the sole trimming frameworks[43].

Human consumption and Animal feed. Bamboo leaves are likely to contain much higher concentrations of nutritionally important components such as nonstructural carbohydrates and protein, as well as minerals such as phosphorus and potassium, compared to other plant parts[36]. The leaves of bamboo can likewise have esteem as a forage supplement, especially in the colder time of year time. Around the world, local stands of bamboo are natural surroundings and scrounge for a scope of wild and homegrown livestock.

Ecological processes and component interaction within bamboo agroforestry. Interactions may occur aboveground or belowground. Competitive and complementary interaction within a bamboo agroforestry system may be dependent on the arrangement of the components, planting density, and the level of technical management[37]. The survey of cooperation in bamboo agroforestry may require the assessment of mind-

boggling natural cycles. Experimental designs with different planting spacing and densities of bamboo and crops may be crucial in defining the best cultural practices applicable to specific bamboo species and agricultural crop.

Potential Bamboo based Agroforestry systems. Bamboo-based agroforestry systems can play important roles in enhancing productivity, sustainability and resource conservation in agricultural systems[38]. Care should however be taken to include factors needed for their successful implementation and sustainability of effects during their design stage. For instance; the general objective of the frameworks, explicit should be met, monetary and specialized capacities, market accessibility for produce and secure residency should be thought of. The triumphs of coordinating bamboo into cultivating frameworks have been accounted for by a few creators, model[39-43] (Table 3). These fast-growing plants can therefore be taken advantage of to improve the productivity of agricultural systems which are mostly considered as low in tropical Africa.

The possibility of integrating bamboo into food crop production as live stakes can also be considered. Live staking is where living trees or woody perennials are used as support for growing crops such as yam, potatoes and beans. Currently at the Crops Research Institute of the Council for Scientific and Industrial Research in Ghana, a trial where bamboo is being explored as live stakes for yam production is underway. Comparing bamboo-based systems to tree based systems, the former has the advantage of fast growth and early maturity. Within 3 to 4 years, bamboo comes into production, reaching maximum productivity in 7 to 8 years[44]. In comparison to similar agroforestry systems with a tree - *Acacia mangium* and a shrub - *Tephrosia candida*, intercropping with bamboo resulted in reduced run-off and lower erosion[45]. In Northern Vietnam, bamboo accounted for higher percentage of household income (7-14 %) than *A. mangium* and *T. candida* (1-10 %) in an agroforestry system[45]. In Jharkhand, India, bamboo culms from agroforestry systems are good alternatives for depleting and expensive timber resources, and these culms are also available at lower prices[42].

TABLE 4
Some qualities of the bamboo plant that qualify it as a good agroforestry component

Agroforestry strengths of the bamboo plant
Bamboos are the quickest developing plants with a development rate going from 30 to 100 cm every day inside a developing season, arriving at a most extreme level of more than 36cm and a breadth of 1-30 cm. Inside 2 to 90 days, the bamboo culm can arrive at its full level[44].
Bamboo has the ability to regenerate vegetatively, be harvested repeatedly and be grown on marginal lands unsuitable for forestry or agriculture[46,47].
Bamboo can reestablish debased lands[48]Bamboo is utilized for various purposes because of its solidarity, straightness, softness, hardness, overflow, scope of size and short maturation period[44,46].
Bamboo can substitute for timber. Bamboo can be utilized for development, furniture, crafted works, clothing, and so on. Bamboo can help slow down depleting timber resources and deforestation[48,49].
Bamboo is easily adaptable to different soil and climatic conditions[50] Bamboos can maintain soil health[44].
Bamboo has the ability to sequester carbon[51,52].Bamboo can provide alternative livelihood support for farmers during off-farming season Example, bamboo can be used for charcoal production to raise extra income[53] Bamboo can be used for erosion control and slope stabilization[54].

Aside the fast growth and early maturity, other qualities qualify bamboo as a good agroforestry component (Table 4). It must however be noted that bamboo can show promising results in agroforestry systems when each plant receives individual care[44]. Like other mixed species planting systems, there is bound to be competition among the components of bamboo-based agroforestry systems. Bamboos may out-compete the agricultural or food crop components because of their higher root densities. To overcome interspecific competition in bamboo-based agroforestry systems, agricultural crops can be planted 8-9 m away from the bamboo clumps[44]. In situations where shorter distances are desired[44] further recommend that bamboo roots can be spatially isolated from the crops through trenching (30-40 cm wide and 50-60 cm deep) at 5-6 m away from the bamboo clumps. To manage aboveground interactions, pruning of the bamboo canopy may be considered[14].

As per[55] fitting dividing for bamboo is critical to improve creation of bamboo and related crops. Hence, a potential tradeoff is expected for bamboo-based agroforestry frameworks to streamline creation of intercrops without compromising bamboo yields. The yields of intercrops in bamboo-based agroforestry systems are

higher in wider spacings as compared to closer spacings[42]. This is because the intercrops are able to utilize resources such as sunlight, soil moisture, space and nutrients better at wider spacings. Since agricultural systems cannot effectively function on impoverished soils, the focus of all agricultural systems is to improve soil fertility whilst increasing or maintaining crop yields[56]. As[41] put it, the nutrient pumping action of bamboo, the slow decomposition of the silicarich bamboo litter and the extremely high biomass of fine bamboo roots improve soil fertility and soil health to make bamboobased agroforestry systems successful.

Conclusion

From the above reviews, it can be concluded that the bamboo-based agroforestry systems are essential as regards socio-economic and environmental status in Ethiopia. Because of its shorter harvesting time and excellent growth and survival on any soil strata, bamboo can be included in profitable agroforestry systems, besides this, bamboo can play an important role in soil and water conservation as well as have a significant impact on various features of physical and chemical properties of soil. Besides this, the bamboo plantation also helps in better carbon sequestration and adding various types of nutrients through its litter falling into the soil. The socioeconomic and ecological importance of bamboo are not farfetched particularly with the provision of huge biomass source for renewable energy, potential for restoring degraded forestlands and also as a sustainable carbon sink. By incorporating bamboo into mixed-use agroforestry complexes, we can maximize its functionality while integrating it with other production crops. As a relatively new innovation, it is imperative that research on the socioeconomic and biophysical aspects of it is intensified, so that future developments and scaling-up can be rooted in robust scientific findings rather than the intuitions of governments and development actors.

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Research limitations: Ethiopia is country with large potential Bamboo source. However, there is a knowledge gap to use large potential Bamboos resource, to overcome this gap conducting such kinds of review is mandatory.

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