Journal of Resources Development and Management www.iiste.org
ISSN 2422-8397 An International Peer-reviewed Journal
Vol.30, 2017

Production and Ecological Potentials of Gedeo's Indigenous Agroforestry Practices in Southern Ethiopia

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Abstract
The objectives of this paper were to review the production and ecological potentials of Gedeo's indigenous agroforestry practices. The Gedeo indigenous agroforestry practices are the product of Gedeo indigenous knowledge and integral part of Gedeo culture and belief. The practices has the potential of carrying high population size per unit area without any natural resource and environmental degradation than any other traditional agricultural system throughout the world. Gedeos' indigenous agroforestry practices are self sufficient system and fully packaged with production and ecological services. Based on altitudinal ranges Gedeo agroforestry systems were classified into three categories: enset-tree based agroforestry, enset-coffee-tree based agroforestry and coffee-fruit crops-tree based agroforestry. Research result conducted in enset-coffee based home gardens of the Gedeo, Kochore Woreda revealed that totally, 165 plant species in 135 genera and 65 families were collected and identified as useful plants homegardens and the immediate surroundings. Useful plants recorded from home gardens were 45% herbaceous, 31% trees, 18% shrubs and 6% climbers. Cultivated plants make 92 species (56%) of which 54 (33% of the total) are edibles. Approximately 95% of coffee production in Ethiopia been considered organic. Gedeo's agroforestry practices provided 40% of Ethiopia's premium grade coffee. Average simulated soil organic carbon (SOC) stocks in Gedeo indigenous agroforestry systems (133–179 Mg C^{e} ha^{-1}) were higher than those reported for other tropical agroforestry systems. Hence, Gedeo's indigenous agroforestry practices have rich potentials of production as well as ecological services.
Keywords: Agroforestry Practices; Ecological Potentials; Gedeo; Production Potentials

1. Introduction

The Gedeo, an ethnic group in southern Ethiopia, have been using indigenous knowledge for different purposes, among which traditional agroforestry practices are prominent. Gedeo agroforestry practices are considered to be among the oldest agricultural systems, dating back to Neolithic times (Tadesse, 2002; Edmond *et al.,* 2000; Abiyot *et al*., 2013). According to Mesele and Achalu (2008) Gedeo developed the practices through the domestication of natural forest and intensification of agriculture, so that most of the woody species present in the area are indigenous. Gedeo land use is a modified forest rather than an agricultural system into which trees are re-incorporated and it represents one of well established non conventional systems of land management that incorporate trees that can be coined an agro-forestry system. This system tolerates wildlife in general and weedy herbaceous vegetation (Tadesse, 2009).

Gedeo traditional agroforestry composed of an assemblage of diverse, closely growing trees, shrubs, and annuals that form a seemingly unbroken vegetation cover. These agroforestry practices stand in lush, beautiful contrast to the treeless farmlands of much of the Ethiopian agricultural landscape. The practice is known to be an exemplary land-use system in the region (Tadesse, 2002; SLUF, 2006).Nowadays, all members of the Gedeo community in the zone are practice at least a home-garden type of agroforestry, whereby subsistence crops are grown mixed with trees (Abiyot et al., 2013).

Agroforestry is defined as land use systems which integrate trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability (Nair,1993). Gedeo indigenous agroforestry is a self-reliant and resource-conserving land use system (Tadesse, 2002; SLUF, 2006). The agroforestry practices have a high carrying capacity due to the high productivity of enset and judicious use of accompanying crops. The average land holding size of the agroforestry is about 0.7 hectares, and they support a very dense population of 500–1000 people per km^2, in Wonago woreda population density reaches 1300 persons per km^2. This put the area at first compared to Ethiopians national average of 72 persons /km^2 so is far higher than in the rest of the nation and it is the highest rural population density in the whole of Africa (Tesfaye Abebe *et al*., 2010, Hillbrand, 2011). The objectives were to ascertain out production and ecological potentials of Gedeo agroforestry practices.

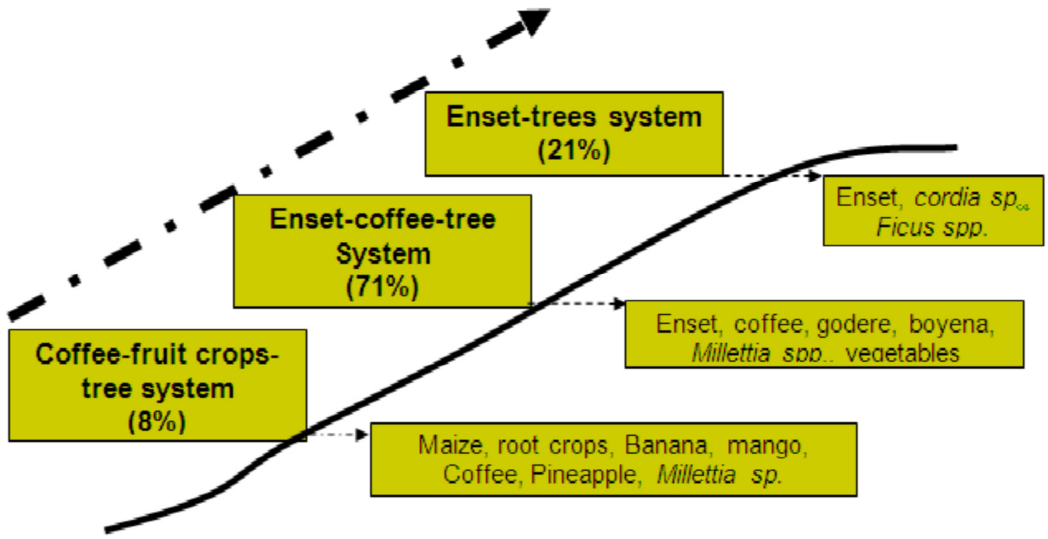
2. Results and Discussion

2.1 Types of Gedeo indigenous agroforestry practices

Based on altitudinal ranges Tadesse's (2002) and Mesele (2012) classified Gedeo agroforestry into three categories: enset-tree based agroforestry, enset-coffee-tree based agroforestry and coffee-fruit crops-tree based agroforestry.

Enset-tree based agroforestry: this agroforestry located at altitude above 2000 masl (higher altitude agroforestry; accounting for 8% of the area), In the Enset-tree system, the upper-story tree species include *Erythrina* spp., *Millettia ferruginea* and *Polyscias ferruginea* (*Polyscias fuluva*) and the understory is dominated by root and herbaceous plants, including *Dioscorea alata* L. and *Capsicum* spp.
Enset-coffee-tree based agroforestry: which is located at altitude ranges of 1600 to 2000 masl (accounts for 71% of area). In the Enset-coffee system, *Erythrina* spp., *Millettia ferruginea* and *Cordia africana* trees shade the coffee and enset. The understory consists of herbaceous crops, including *Disocoria alata*, *Colocasia esculenta* (L.) Schott and *Musa* spp.
Coffee-fruit crops-tree based agroforests: which is located at altitude below 1600 masl accounts for about 21%. In Fruit-coffee system, coffee and fruit trees (e.g. *Persea americana* Mill., *Mangifera indica* L. and *Casimiroa edulis* Lal Llave & Lex.) are shaded by tree species such as *Cordia africana*, *Millettia ferruginea* and *Ficus* spp. The understory consists of herbaceous crops, including *Zea mays* L., *Musa* spp., *Brassica oleracea* L. and *Ipomoea batatas* (L.) Lam.

Fig 1: **Characteristics of Agroforestry Systems of the Zone**



Source : Mesele, 2007

2.1 Production potentials of Gedeo indigenous agroforestry practices

Agroforestry advantages can be described as the provision of multiple products (food, fruit, vegetables, fodder, spices, medicines, oils, nuts, fibers, fuelwood, and timber) which can generate income especially for smallholders (Bishwa, 2003).

2.1.1 Food production

Enset (*Ensete ventricosum)*and coffee (Coffea arabica L.) play a central role in Gedeo indigenous agroforestry practice. Enset is one of the potential indigenous crops for food production in the area (Tadesse, 2002; Brandt *et al*., 1997). It is a high yielding crop whereby only 42 mature plants per year, grown in a small plot of land could support the food demand of a household of seven. Due to the long period of time it takes from planting to harvesting, the enset plants need to be spread out over time so as to ensure that there is enset available for harvest every other season(Tadesse, 2002).

The major foods obtained from enset are kocho, bulla and amicho. Kocho is the bulk of the fermented starch obtained from the mixture of the decorticated (scarped) leaf sheaths and the grated corm (underground stem base). Bulla is the small amount of water-insoluble starchy product that may be separated from kocho during processing by squeezing and decanting the liquid. The main feature of enset foods is their high energy value. Kocho contain 6.5 MJ per kg and bulla contain 8.5 MJ per kg. (Wolde-Gebriel *et al.,* 2006)

Fruit is another component of the Gedeo agroforestry system. The fruits are grown predominantly in the lower altitude (Abiyot, 2013; Mesele, 2007). Farmers in mid and high altitude grow it but not as dominant as in the lower altitude. Banana *(Musa x paradisiacal L.),* Mango *(Mangifera indica L.),* Avocado *(Persea americana Mill),* Pineapple *(Ananas comsus (L.) Merr),* Gishita *(Annona squamosa L.),* Koki *(Prunus persica L. (L.) Batsch)* and Zeitun *(Psidium guajava L.)* are some of the major fruits grown in the area.The production of fruits and vegetables among the Gedeo community held the third position next to coffee and enset crop. However, unlike coffee, fruits and vegetables are produced for consumption and local market.

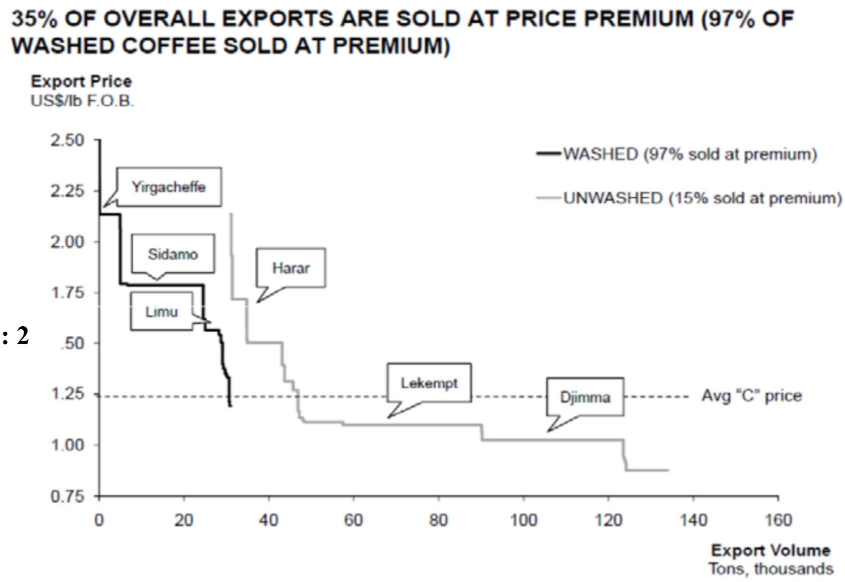
2.1.2 Organic coffee production

Coffee (*Coffea arabica L.*) accounts for over 35% of agricultural foreign exchange earnings in Ethiopia and about 4% of agricultural GDP, provides income to over 15 million people in the country through provision of jobs for farmers, local traders, processors, transporters, exporters and bankers (FAOSTA, 2011). Approximately 95% of coffee production in Ethiopia been considered organic. Coffee production in the country is categorized into four (4) systems namely forest coffee, semi-forest coffee, garden coffee and plantation coffee (Taye *et al.,* 2004).

Gedeo Zone is the major organic coffee producing areas in the Southern region and coffee is grown as garden (cottage or smallholder) crop, intercropped with Enset (*Enset ventricosum*) or under the evergreen shade trees of *Erythrina* Spp., *Milletia ferruginea* and *Albezzia* species. (Tefestewold, 1995). Yirgacheffe and Sidama coffee types produced in this Zone possess unique quality, are largely preferred by arabica coffee consumers and fetch premium prices in the world market (Ashenafi et al., 2014). Gedeo coffee provided 40% of Ethiopia's premium grade coffee.

Premium prices for quality coffees are critical issues for the sustainable development of the coffee sector and human well-being in developed and developing countries (Belachew and Sacko 2009) (figure 2). Taye *et al*., (2004) also described the traditional organic coffee production system as the only viable option to remain competitive in the world market and the only hope for smallholder coffee producers in Ethiopia. However, it requires accreditation and certification to enhance coffee quality and premium prices, and thus improve the living standards of rural coffee producers. According to Fair trade Labeling Organization (FLO) standard (2011) certified organic coffee an extra minimum differential of USD 30 cents per pound and a fair trade premium of USD 20 cents per pound (with USD 5 cents per pound earmarked for productivity and quality improvements) are added to the purchase price.

Figure: 2



Average coffee price

Source: Bekele, 2011

There are two main certifications. The first one is organic coffee certificate, which corresponds to coffee that was produced so that the biological value of coffee harvested is equal to the value returned to the soil. The second most used certification is Fair trade. Fair trade implies granting producers a decent price for their product, allowing them to fulfill basic needs such as access to water or education (Boot, 2011). Applicants for organic certification must meet several criteria. Either individuals or organizations can apply for the certificate because the certification applies to agronomic conditions rather than social conditions, in contrast to fair trade certification.

According to Yirigacheffe Coffee Farmer Cooperatives Union (YCFCU) report (2015), 23 primary cooperatives of YCFCU members are certified in both organic and fair tread certificate from international labeling organizations. However, the amount of coffee sold in organic market rout is only 18 % out of produced by member farmers. Kodama (2007) find that YCFCU has received 21.8%, 23.9% and 15% higher organic, organic & fair trade and fair trade coffee premium respectively over conventional coffee in year 2004/5 (Table 1). Organic coffee can be sold through both conventional marketing routes and fair trade routes.

Table 1. Purchased Coffee by the Yirgacheffe Coffee Farmers Cooperative Union 2004/05

Types of coffee	Tone	% of total	Price ($/lb, average	New York City ($/lb, average)	Addis Ababa auction price ($/lb, average)	Difference of price with NY average (in %)
Organic	142	14	1.388			21.8
Organic & fair trade	581	57	1.412			23.9
Fair trade	238	23	1.318			15.6
Conventional	62	6	1.168	1.14	1.089	
Total	1023	100	1.396			

Source: Kodama, 2007

2.1.3 Production of spices

Demographic pressure on Gedeo indigenous agroforestry is high. The population has steadily increasing in the zone. Thus, spice crop could be one option for more intensive and sustainable land-use in the system.

Though, Gedeo zone has suitable environmental and edaphic condition for spice production, the production of spices is declining. According to Gedeo Zone Agriculture and Natural Resource Department report (2015) its production decline from 295.4ton in 2010 to 64.4ton in 2015. The decline is due to lack of emphases to these crops and their incompatibility to intercrop with coffee. However, the second reason is contrary to investigation of coffee intercropped with turmeric and ginger which was conducted at similar agroecology (Tepi, southwest Ethiopia), with the objectives to evaluate the agronomic and economic benefits of the practice. The research findings reveal that coffee intercropping with turmeric and ginger was found to be agronomically and economically beneficial (Anteneh and Taye, 2015).

2.1.4 Honey production

Beekeeping is the keeping and management of honey bees for various products: honey, beeswax, royal jelly, propolis, bee pollen and brood, as well as for pollinating flowering agronomic or tree crops. It requires low investments and so can be taken up by small, marginal and landless farmers, educated unemployed youth and women. Bee products provide health, high-nutrient food, safe medicines and raw material for pharmaceutics and cosmetics industries (Lietaer, 2009).

Gedeo indigenous agroforestry are covered by forest trees, herbaceous flora of weeds cultivated crops and shrubs (Teklu, 2016). The trees, herbs and shrubs play major role for honey production with tree species dominate by bearing bee flora yearly and therefore beekeeping should be integrated with the vegetation conservation for livelihood improvement and food security. Preferred pollen trees and shrubs in Gedeo indigenous agroforestry practices included: *Coffea arabica L.*, *Cordia africana*, *Croton macrostachys, Millettia ferruginea*, *Albizia gummifera, Fagaropsis angolensis., Syzygium guineense*, and *Vernonia amygdalina*. Coffee is one of potential pollen shrub in the area. Honey from coffee pollen is said to be of the best quality (Mesele, 2007;Teklu, 2016).

Even if there are some basic constraints that have to be taken a due considerations such as lack of improved honey bee flora and improved apiculture equipments, prevalence of honey bee enemies, limitation of introduced technologies to the sites; the existing potential could make the area one of the model apiary site in not only in the region but also in the country level (Teklu, 2016).

2.1.5 Livestock production

Apart from enset and coffee, livestock is also very vital component of Gedeo indigenous agroforestry practices. However, the contribution of livestock in the existing agroforestry systems is less significant. The average holding of cattle, sheep, goat and chicken are d 2.42 (2.8), 5.33(0.32), 3.46(0.35) and 2.9(0.24) respectively. This is mainly attributed to shortage of grazing land (Selamawit et al., 2015). To cope up the challenge, farmers practice cut and carries system of fodder production. Species that are used as fodder include *Millettia sp., Vernonia sp.* and *Erythrina spp*. *Trichilia sp*, besides its medicinal uses also plays an important role in increasing milk productivity. Moreover, the *enset* leaves and corms are chopped and fed animals, particularly in the dry season, even though this may reduce supplies for human consumption. (Mesele, 2007).

2.1.6 Fuel wood and small timber production

The rural Ethiopian households entirely depend on biomass fuel to meet their energy requirements for cooking, heating and lighting. Biomass based fuel accounts for 85% and 95% of the total energy and household consumptions respectively (EARO, 2000). Agroforestry practices are sources of fuel wood and potentially reduces deforestation. The woody species grown in Gedeo indigenous agroforestry practices are potentially used as market and to cover their own fuelwood and construction wood consumption rank higher in priority than other agroforestry peactices.

The research result on 50 plant species grown by the smallholders in Gedeo indigenous agroforestry practices revealed that 28 % of the plant species are grown for firewood, 26 % for timber/poles. *Millettia sp.* is the most commont species and is used for fuelwood (Mesel, 2007). Tadesse's (2002) in the area also recorded that *Prunus africana (Hook. f.) Kalkm* as a popular species for fuelwood. The branches and twigs of most other woody species are used for fuelwood. Old coffee stems are also used either for fencing or for fuelwood, allowing farmers to use the household's refusal and cow dung as fertilizers of the homegarden (Mesele and Achalu, 2008).

Agroforestry can contribute to energy substitution and becomes an important carbon offset option. Production of fuel wood and timber that otherwise would be harvested from the forest; and fuelwood is also used as a substitute for fossil fuel (Unruh *et al*., 1993).

2.2 Ecological potentials of Gedeo indigenous agroforestry practices

2.2.1 Soil and water conservation

Agroforestry system has the potential to enhance soil fertility, reduce erosion and improve water quality (Jose, 2009). Furthermore, the presence of deep-rooted trees in the system can contribute to improved soil physical conditions and higher soil microbiological activities under agroforestry (Nair et al., 2008). Moreover, the hydrology of the system is well maintained and enhanced by reduced evapo-transpiration due to its canopy structure and pumping effect of trees (Bogale, 2007).

Study on Gedeo indigenous agroforestry practices demonstrated the ability of trees and shrubs, apart from optimizing the yields of diverse crop/tree species, regularly replenish soil fertility and productivity through continuous supply of organic matter and through protection from erosion and leaching (Tadesse, 2002). The annual litter-fall productions per unit area in Gedeo indigenous agroforestry systems (446–1014 g m^{-2} y^{-1}), were considerably higher than reported for woody species in other agroforestry systems. The high litter fall production of the traditional Gedeo agroforestry systems found account for the high productivity of these systems (Mesele, 2013).

Although much of the landscape of Gedeo is very steeply sloped, incidences of runoff and erosion are minimal because of the intact vegetation cover (Bishaw et al., 2013). Enset, which is lion share (in terms of coverage) of agroforestry, besides serving as a food plant, it provides mulching and maintenance of soil fertility and moisture (Tadesse, 2002, Brandt et al., 1997). Enset has exceptional ability to suck up a lot water in rainy seasons and store it in the stem and in drier season the enset plant will distribute the water to coffee plant and other nearby crops. Moreover, enset system significantly increased soil available total nitrogen (TN), available phosphorus (P) and organic carbon (OC) than annual cropping system (table 2).

Gedeo people have also good indigenous knowledge of soil fertility management. The methods of soil fertility maintenance in Gedeo are slashing of weeds in the farm field (Shafa), Traditional compost preparation, and minimum tillage (locally known as *Hofa*), deliberate left over residual of enset, trees and other crops as a source of organic matter (Bogale, 2007). Hence, the soils of Gedeo are generally good in soil nutrients except their deficiency in phosphorus content. Organic matter ranges between 4-5 per cent, CEC from 21-25 (meg/100g soil), nitrogen between 0.3-0.5 per cent, pH between 5-6, and phosphorous 1-4 ppm (Tadesse, 2002).

Table 2. Mean values ± SEM of soil chemical properties under the enset and annual crops.

No	Soil parameters	Mean value and rank			
		Enset field		Annual crop field	
		Mean value	Rating	Mean value	Rating
1	pH H2O (1: 2)	6.94±0.153	Neutral	6.17±0.130	Neutral
2	OC %	3.60±0.280	High	2.58±0.256	High
3	Av. P (ppm)	66.76±12.092	Very high	15.16±3.653	Medium

Source: Chakoro and Mekuria, 2015

2.2.2 Carbon sequestration

Global climate change caused by rising levels of carbon dioxide (CO_2) and other greenhouse gases is recognized as a serious environmental issue of the twenty-first century (Kumar et al. 2011). Agroforestry systems are increasingly recognized for the provision of both climate change mitigation and adaptation services. The systems are often very productive, taking up large amounts of CO_2 from the atmosphere and storing the C in standing vegetation (biomass), soil organic matter, and harvested biomass products (Losi *et al.,* 2003 and Montagnini and Nair, 2004).

Carbon stocks of Gedeo indigenous agroforestry practices were found to be amongst the highest reported for tropical forests and agroforestry systems (Mesele and Starr, 2013). Average simulated soil organic carbon (SOC) stocks in Gedeo indigenous agroforestry systems (133–179 Mg C^e ha^{-1}) were higher than those reported for other tropical agroforestry systems. The higher soil C stocks in the systems can be attributed to the higher proportion trees and associated coarse litter and humus inputs. Tree-coffee system recorded higher SOC stocks than the other two agroforestry systems. This was possibly due to the high litter input from biomass compartment. Moreover, Tree-coffee system is dominated by fruit trees such as *Persea americana* and *Mangifera indica* with high litter fall inputs, being valued 5264 and 1683 kg ha^{-1} yr^{-1}, respectively, and accounting for 54% of the total litter fall of the six dominant tree species found in the system (Mesele and Starr, 2013).

Long-term simulated total biomass C stocks (rotation age of 50 years) for the Gedeo indigenous agroforestry systems (76–122 Mg C ha^{-1}) are within the range of reported for agroforestry systems worldwide (12–228 Mg C ha^{-1}). The tree cohort substantially contributed to the simulated total biomass C stocks while the shares of enset and coffee were insignificant, showing that trees play important role in C sequestration in the indigenous agroforestry systems (Mesele, et al., 2015). This is due to following reasons: first most tree species in the overstory of the Gedeo home gardens are slow growing and long lived. They can also form a large canopy volume with a high total carbon accumulation. An example is *Ficus*, one of the most prominent canopy species, which is a slow-growing tree that can attain a large size, has a higher carbon density, and can be credited with sequestering a maximum total carbon (**Bishaw et al., 2013). Second t**ree management in the Gedeo agroforestry system primarily consists of lopping and pollarding. The wood is used for fuel, construction, and/or farm implements. Whole tree harvest is uncommon in the management of this type of system; thus, the carbon sequestered stays there over a long period of time. In a system, then the use of such large-sized and long-lived canopy species within a Gedeo-type agroforestry system can play a critical role in climate change mitigation.

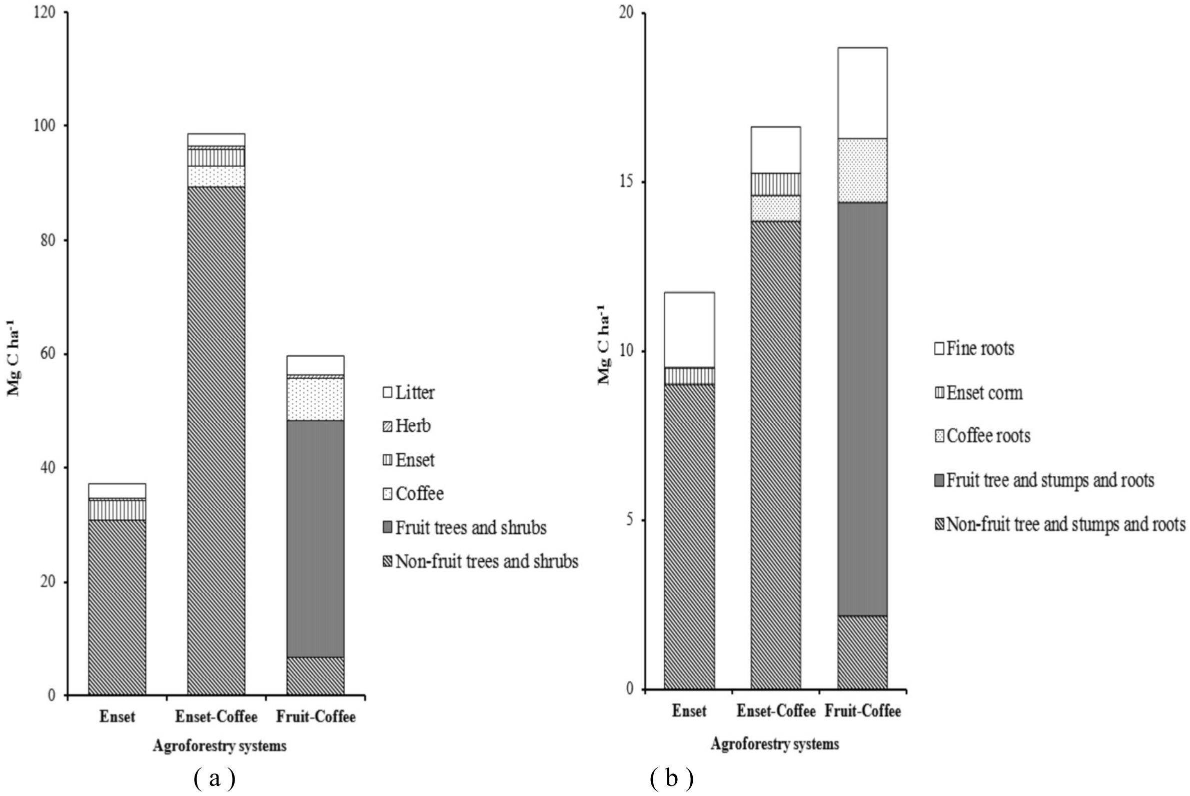


Fig 3. (a) Aboveground biomass carbon stocks of the three agroforestry systems and (b) Belowground biomass carbon stocks of the three agroforestry systems

2.2.3 Biodiversity conservation

The agroforestry system is a well-known land-use system and supporting a wide range of plant species. These floristically and structurally diverse agroforestry systems can provide habitat and resources for partially forest-dependent native plant and animal species that would not be able to survive in a purely agricultural landscape. The enset-coffee system based on perennial cropping is believed to be a bio-diversity hotspot to the extent that some people consider it a museum for genetic resources. Biodiversity regarded as an inherent property of the complexity of the Gedeo agroforestry practices. The Gedeo indigenous agroforestry practice comprises diverse species of annual and perennial crops, which have ecological, social, and economic benefits. This system tolerates wildlife in general and weedy herbaceous vegetation.

In a study conducted by Mesele (2007) a total of 50 plant species with 35 plant families were recorded in a home garden plot of about 100 m^2. In addition that, Research result conducted in enset-coffee based home gardens of the Gedeo, Kochore Woreda revealed that totally, 165 plant species in 135 genera and 65 families were collected and identified as useful plants homegardens and the immediate surroundings. Useful plants recorded from home gardens were 45% herbaceous, 31% trees, 18% shrubs and 6% climbers. Cultivated plants make 92 species (56%) of which 54 (33% of the total) are edibles. The rest 73 species (44%) of the total are wild or semi-wild useful plants managed in and around home gardens that are tolerated, encouraged or deliberately planted. Among the total, 68 species (41%) were grouped as edibles, while 32 (19%) were medicinal plants. In addition, 34 (21%) species were ornamental and 40 (24%) species were used in the material culture of the Gedeo people (Tamrat, 2011).

Furthermore, Plant Species Diversity and Composition of the Home garden in Dilla Zuriya Woreda, Gedeo Zone, showed high species richness in the system. In mean size of 665.42m^2 area 75 plant species with ten major use categories have been recorded. Out of which 44% were trees, 14.7% were shrubs, 38.6% were herbs and 2.7% were climbers representing 48 families. The average plant diversity per home garden was 21 plant species, ranging from 11 to 37 throughout the home gardens (Melese and Daniel, 2016). The intimate mix of diversified agricultural crops and multipurpose trees help to improve biodiversity and plays a significant role in income generation (Fekadu, 2009). The species diversity in Gedeo's agroforestry practices contribute to farmer's food security and less vulnerability towards fluctuation of the market prices.

2.2.4 Ecotourism service

Ecotourism is environmentally responsible travel to natural areas, in order to enjoy and appreciate nature that promote conservation, have a low visitor impact and provide for beneficially active socioeconomic involvement of local people (Ngece, 2002). It is an alternative form of tourism that is consistently gaining grounds on a global scale during the past few years and one of the newest opportunities for income generation from natural resources without destroying the environment (UNWTO, 2006).

Gedeo agroforestry practice is one of known potential tourist attractions in Southern Ethiopia. It is one of pre registered world heritage in United Nation Educational, Science and Cultural Organization (UNESCO). The Gedeo mixed cultural and natural landscape is the combination and the presence of a harmony between nature and cultural civilization(UNESCO, 2016). It is endowed with unique attractive natural resources and cultural heritages that attract tourists and it is the best and, most accessible. The indigenous agroforestry practices, megalithic stones, rock engrave and caves are some of cultural resources of Gedeo community. There are also high diversity of plants and animals in Gedeo indigenous agroforestry practices. In addition to these, there are impressive features of Gedeo landscape with evergreen mountains, rivers, and impressive waterfall. The most outstanding features of Gedeo land is its concentrations and diversity of great and magnificent ancient megalithic stones. According to Joussaume (2001) out of 10000 stelae in east Africa more than 6000 stelae found in Gedeo zone. Hence, ecotourism has the potential to become a driver of sustainable tourism development and also provide opportunities for the development of the disadvantaged, marginalized and rural areas leading to poverty alleviation.

3. Conclusion

Gedeo's indigenous agroforestry practices are fully packaged with production potentials and ecological services. The practices need not any energy intensive agricultural technologies such as fertilizer, pesticide, and other inorganic agricultural inputs. Hence, all agricultural products of the system are premium deserved high quality organic product, as a result high economic returns and safe to environment and human health. The practices are capable of sequestrate high amount of carbon and exemplary model solution for global environmental challenges. The landscape also has high potential of eco-tourism with unbroken lush and evergreen arena. However, nowadays the practices are under pressure. High population pressure together with incompatible agricultural technology and practices threaten the practice highly. In addition to that unwillingness of youth generation to recognize the practice put the system under question. Hence, all stakeholders especially young generation have to make all possible endeavors to maintain the indigenous practices.

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