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Assessment of Existing Agroforestry Practices in East Hararghe Zone Oromia, Ethiopia

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Abstract
An agroforestry practice produces different benefits, which enhance household incomes and diversification of products. This study was aimed *to* identifying existing agroforestry practices and to identify perception behind of agroforestry practice and to identify the opportunities and major constraints related to agroforestry practices *in* Fedis, Kersa and Jarso Districts of the lowland, midland and highlands agro ecologies, of East Hararghe Zone, oromia, Ethiopia. The study was based on a household survey conducted on 154 farm household heads; focus group discussions, key informant interviews and direct field observations were applied. The data were analyzed using analytical (SPSS 20.0) software packages to calculate descriptive statistics. Chi-squared tests were used to compare the agroforestry practices and agro ecologies. The result indicates that six AFPs exist in the study area namely; scattered trees on croplands (58%), hedge row intercropping (33%), home garden (22%), multipurpose trees on farmland (19%), live fence /boundary planting (18%), and wind breaks (4%) *were dominant.* Significant respondent number (51.96%) of practices is involved in agri-silvicultural system, most of the farmer's (45.12%) have positive attitude towards Agroforestry practices in the study area. Most of the respondents agreed on agro-forestry practices increased the construction input, soil fertility, food, and fodder. On the other hand, sacristy of land, moisture stress, diseases and pests, inadequate seedlings availability, and inadequate extension services are the major constraints. Results of the *socio-economic characteristics* respondents showed that gender, age, family size, and land holding positively and significantly influence the decision of the determined practice of household's and were significantly affected the choice of agroforestry practice by the households. Based on the survey, it is concluded that scattered trees on farmland, hedge row intercropping, and home garden AFP dominant practices across agro ecologies and were the most appropriate agro-forestry practices. This agro-forestry practices increased the construction input, soil fertility, food, and fodder in the area of land sacristy, moisture stress, diseases and pests. *Therefore, further* the tree integration efforts of farmers should be guided by scientific principles, the interaction tree species with annual crops and economic analysis of the individual agroforestry practices, domestication of nitrogen fixing trees, fruit tree species, and promoting sustainable agroforestry should be carried out.
Keywords: Agroforestry practices, indigenous knowledge, scattered trees on crop land, multipurpose tree, small holder farmers, and cash crops
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1. Introduction

Severe land degradation affects the livelihood of many farmers in the lowlands and dry lands of Oromi, eastern Ethiopia. Agro forestry is a kind of land use system that has been practiced since long in many parts of the world. Agroforestry is a dynamic, ecologically based natural resource management system that, through the integration of trees/woody perennials in farm and rangelands, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (ICRAF, 2006). This land use system has good potential for enhancing farm income diversification and rehabilitating degraded lands. In addition, agroforestry has the potential to reduce poverty and can efficiently be used in poverty reduction strategies of the tropical East African countries (Basamba et al., 2016). As a land use system that combines the three main components i.e. food crop, livestock and forest products, preferably on the same piece of land on a sustained yield basis, agroforestry offers potential for enhancing farm production and household farm income. At the same time, it reduces the conflicts between arable farming, livestock keeping, and forestry interests, especially in the high-potential areas that are facing intense population pressure (Dhakal et al., 2012).

A variety of agroforestry technologies is finding enormous application in the East and Central African region (Basamba et al., 2016). Based on agro-ecological diversity, different localities in Ethiopia undertake different agroforestry systems and practices. Some of agroforestry systems in Ethiopia are farm forestry in the south-western highlands, tree based soil and water management in Konso, forest-based resources management in Borena, Ecologically sound land use system in Gedeo and area closures in Tigray, North Shoa and North Wello (Berhane Kidane et. at 2008). Examples of agroforestry practices are: tree homegarden, Woodlot, Windbreaks/shelterbelts, Boundary planting, Live fences, Hedgerow intercropping, improved fallow, Intercropping under scattered or regularly planted trees, Trees on rangelands, Trees on soil conservation and reclamation structures etc. (Atangana et al.,2013).These contribute considerably to the improvements of household economy and food security (Thapa

and Weber, 1994).

Integration trees into farmland, agroforestry helps to diversify income sustaining smallholder production for increased socioeconomic and environmental benefits. Serves as a buffer against increasing human and livestock population pressure, to pursue the scaling up of local efforts of maintaining trees in farm, to overcome the problem resulted from high dependence of the community on natural resource, to reduce the risks and increase the sustainability of both small and large-scale agriculture. They provide fuel wood for the household energy, building materials such as poles (Kebede, T., 2010). Furthermore, there are also fruit tree based agroforestry practices (Badege Bishaw and Abdu Abduilkadir, 2003).

In the management of agroforestry the traditional knowledge of local people is important, and in order to scale up the different agroforestry practices an appreciation of traditional knowledge is needed (ICRAF, 2006) and The existing farming system is the starting point for development (Christiansen et al., 2011). Most development interventions in the past failed due to lack of giving adequate attention to traditional knowledge (Miller et al., 2006). The future of agroforestry lies on the way researchers, workers, and policymakers understand the usefulness of the existing traditional agroforestry practices knowledge about trees in the agroforestry. In Ethiopia, information, on traditional agroforestry practices is generated from limited studies (Abebe, S. 2000., Mehari A. ,2012), Abiyu et al.,2015) and are more specific in terms of site, constraints and socioeconomic benefits (Zebene, A. 2001., Mohammad et al,.2011, Dechasa, Jiru. 1990, Abebaw, Z. 2006., Bishaw, B., and A. Abdelkadir. 2003, Musa, A. et al., 2020).

These studies would not provide adequate information for better understanding of existing agroforestry practices in Eest Hararghe zone. There are several indigenous agroforestry practices in different agro-ecological region of Eest Hararghe zone, but they are not well studied and documented. Besides to this the benefits of traditional Agroforestry practice on local community is not very much organized and identified specifically in the area. Collection of information on the existing agroforestry practices, assessing of farmers perception towards agroforestry practices and identifying its constraints is a prerequisite for agroforestry research and development work in the study areas. Therefore**,** the study was initiated, to identify the agroforestry practices of the farmers; to assess the perception of farmers towards agroforestry practices, and to identify the opportunities and major constraints related to traditional agroforestry practices in the study area of East Harvghe zone, Oromi, Ethiopia

2. Materials and methods

2.1. Descriptions of the study area

Eastern Hararghe is one of the 20 administrative zones of the Oromia regional state. It is located in the Eastern part of the country about 600 km of the capital, Addis Ababa (Figure 1). East Harerghe Zone is geographically located 9^0 42' 41" North latitude and 42^0 0' 9" East longitudes. The zone is bordered on the southwest by Bale, on the west by West Hararghe Zone, on the north by Dire Dawa and on the north and east by the Somali Region. The Administrative center of this zone is Harar. The capital town of the Zone is Harar, which is located at a distance of 526 km East of Addis Ababa. The area coverage of the Zone is 2,260,000 ha (22,600 km^2), comprising of 20 districts with a total population of 2,723,850, an increase of 48.79%. Hararge has a population density of 151.87. While 216,943 or 8.27% are urban inhabitants, a further 30,215 or 1.11% are pastoralists, 17% agro-pastoralists, and the rest are agriculturalists (74%).

A total of 580,735 households were counted in this Zone, which results in an average of 4.69 persons to a household, and 560,223 housing units. East Harerghe zone is subdivided in to three major climatic zones known to be temperate tropical highland, locally known as dega (8%), semi temperate/tropical rainy mid land or woina dega (25%), and semi-arid/tropical dry or kola (67%) with the altitude ranges from 500-3405 masl and the temperature ranges from 130^c to 280^c, characterized with erratic rainfalls .Due to the huge population pressure, the population density of these zones is estimated at 0.025m2 per person with a land holding size of less than quarter of a hectare per household.

The major Agricultural activity in the area is mixed farming system. The dominant food crops grown in the study areas are Sorghum, Maize, Wheat, Barley, Pulses, Potato, Tomato and Groundnuts in their order of importance. *Khat* and Vegetables are the known cash crops. While high value tree crops such as *Mangifera indica*, *Percea Americana*, *Papaya crack*, *Psidium guajava (Guava)* in the lowland and midland and *Malus domestica* (Apple) in the highlands of Jarso woreda's are produced in some quantities. Major livestock reared in the zone are Cattle, goat and sheep are among the livestock species reared by the community.

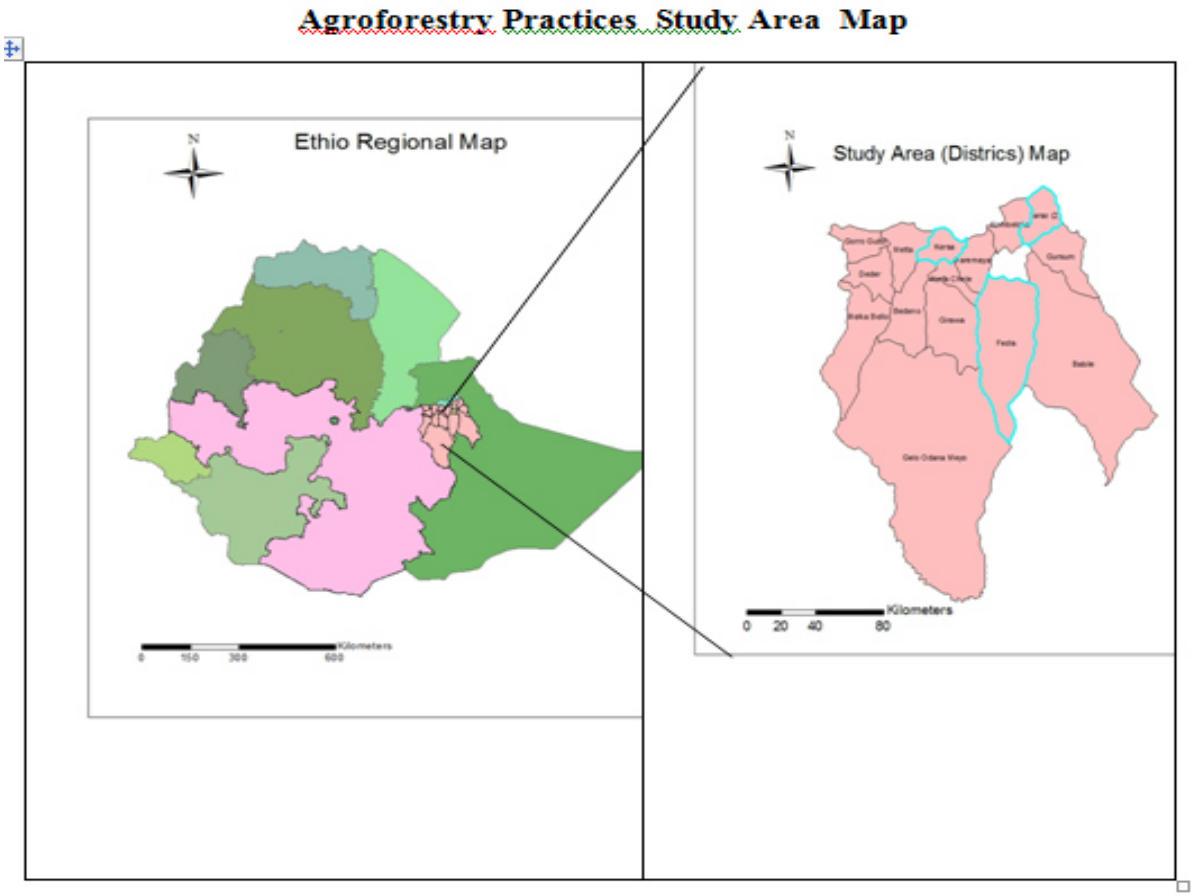

Figure 1: Study area map

2.2. Methodology

2.2.1. Selection of the Study Area

Indigenous agroforestry practices in the low, mid and highlands of East Hararghe Zone were studied according to the following approaches. Secondary information was collected from reports, maps, censuses, thesis and other publications to have an overall picture of the agro ecologies. The specific sites for the study were identified in collaboration with a multidisciplinary research team, local people and administrative bodies. Reconnaissance surveys were undertaken. The study districts, Fedis, Kersa and Jarso were selected purposively based on it's their altitude range that from low land, mid land and highland of agro ecologies zones and their experiences of agroforestry practices. Two districts from each cluster were purposively selected. Then, from each district, two Kebeles were chosen purposively, based on their experiences of agroforestry practices and accessible to road.

A households were selected systematically from the three agro ecologies of the study area. The households were selected randomly from the listed farmers of the three districts of East Hararghe zone. Informal surveys were conducted to gather qualitative information about an agroforestry practices and other related activities. Checklists were developed for the informal survey activities. Major issues that were included in the checklist were site for the practices, perception of farmers, opportunities and constraints. A formal survey was carried out using structured questionnaire to quantify and verify the informal survey findings. The formal survey involved direct field observation of the agroforestry practices, discussions with individual and group interviews, and key informant interviews techniques.

2.2.2. Sampling procedures and sample Size

The cluster sampling methods were employed. Accordingly, districts were clustered based on their altitude range that from low land, mid land and highland of agro ecologies zones and their experiences of agroforestry practices. Two districts from each cluster were purposively selected. Then, from each district, two Kebeles were chosen purposively, based on their experiences of agroforestry practices and accessible to road. Finally, farm households for interview were selected randomly from the sample Kebeles based on proportional to population size using (Yemane, 1967) formula. Two Kebeles were purposively selected among the 35, 19 and 18 rural Kebeles of lowland, midland and highland respectively in consultation with experts and development agents. The two Kebeles, Melka and Nage Umar kulle from lowland were selected; Ifa and Handhura kosum kebeles from midland were selected and Afugug and Amaddhiro kebels were selected based on the presence, success and in agroforestry

practices.

A simple random sampling technique was employed to select sample households. Using the list of households in the Kebeles as a sampling frame, a total of 154 households were selected for the study. Accordingly, 52 households from lowland, 51 households from midland and 51 households from highland were respectively assessed.

2.3. Method of Data Collection

Both qualitative and quantitative techniques were employed to generate data. Accordingly, determining factors in agroforestry practice, reasons for their participation in agroforestry practices and opportunities and constraints they faced were assessed. The data were collected from two main sources: primary and secondary sources. Primary data was obtained through field observations, key informant interview, a formal survey/questionnaires and focus group discussions. Various information on demographic, household socioeconomic characteristics and institutional factors that may influence and/or support agroforestry practice were gathered.

2.3.1. Data to be collected

The input of all inquiries from each individual and focus group checklists' data/ feedback, including the tree species occurs which are mainly serving in agroforestry system, perception of farmers on agroforestry utilities and constraints, and the types of agroforestry practices in the study area were collected for analysis.

2.4. Method of data Analysis

The primary data collected from household survey were checked, arranged, coded and entered into computer and cleaned and analyzed using Statistical Package for Social Science (SPSS version 20.0). Data collected from field observations, key informant interviews and focus group discussions were also qualitatively assessed using descriptive statistics that include frequency distributions, means and percentages. The socio-economic characteristics of the respondents such as age, gender, household size, land holding, level of education, marital status, role of household, occupation, labor, livestock holding, and crop production of agro forestry were analyzed. The descriptive analysis employed the tools such as mean, standard deviation, percentage, and frequency distribution. In addition, chi-square statistics were employed with respect to some explanatory variables. Hence, the collected data were analyzed using descriptive statistics such as frequency; average and percentage were used for data analysis. Pair wise ranking also were used to analysis the farmers 'constraints in agroforestry practices.

3. Result and Discussion

3.1. Household Characteristics of Sample Households

The results of this study are presented in four sections; the first deals with the household and socio-economic characteristics. The second presented identification of major agroforestry practices within the three different agro ecologies. The third description of perception about agroforestry practices of households is presented. The final section presented reasons for their participation in agroforestry practices and major constraints were assessed.

Age of the household head

The age of the sampled household heads had a range from 18 to 75 years and the average age of the sampled household heads was 34.69 years with standard deviation of 11.58. As indicated in Table 1 the presents the descriptive characteristics of the respondents, an average age of 34.69 years were dominated by working age group. This means that, on average, smallholder farmers in the study areas were relatively middle-aged. Therefore, the study found out that the populations of the surveyed areas were dominated by working age group.

Table 1: Descriptive Statistics of socio-economic characteristics of respondents (n = 154)

Socio-economic Variables	Mean	SD	Min	Max
Age of household	34.69	11.58	18	75
Household size	6.31	2.42	1	17
Land holding	0.44	0.40	0.13	2
Livestock holding	4.11	2.44	1	9
Crop production	2.90	2.51	1	7

Source: Survey Result, 2020

Family Size of the household head: Family size in this study is considered as the number of individuals who resides in the household. The average family size of the sample farm households was 6.31 with minimum of 1 and maximum of 17 persons. Therefore, the study found out that the populations of the surveyed areas were relatively higher household sizes (average of six members per household) than national household average size of 5.1 members per household. The Most of the time, large family size was assumed as an indicator of labor availability in the family to use integrated agroforestry practice and the increasing population number forced the farmers to manage their agroforestry practices at plot level. Household family sizes tend to influence traditional practices of agroforestry due to the fact that it provides more labor to manage agroforestry practices.

With regards to the **Land holding:** Average land holding size of households in the study areas was 0.44 hectare.

According to the sample survey data, the land of the sampled household heads had a range from 0.13 to 2 ha and the average land of the sampled household heads was 0.44 ha with standard deviation of 0.4 and had a small acreage of land to planting trees. Land is the main asset of farmers in the study areas. Land size was thought to be a good proxy indicator of wealth which is important resource for any economic activities in the rural and agricultural sector. Hence, the availability of enough land per household is assumed as a potential for agro forestry using and investment for further economic progress. The average livestock holding of the households was 4.11 TLU. Higher proportions of the respondents have livestock number between 1-9 which is manageable around small land and with family labor. They were used integrated agroforestry practice with livestock and the increase their productivity. Crop production and livestock rearing are the main sources of farm income in the study areas.

Gender of the household heads: Sample households were composed of both male and female household heads. The result of the study indicated that out of the total respondents, 120 (78%) of them were male while the rest 34 (22%) of them were female (Table 2).

Table 2: Gender of house hold and education level of house hold of respondents (n = 154)

Variables	Frequency (f)	Percentage (%)
Gender of house hold		
Male	120	77.92
Female	34	22.08
Total	**154**	**100**
Education level of house hold		
Uneducated	75	48.7
Primary school	60	38.96
Secondary school	15	9.74
Diploma	3	1.95
Degree	1	0.65
Total	**154**	**100**

Source: Survey Result, 2020

Results of this study indicated that the existing agroforestry practices are mostly done by men because of the cultural values and responsibilities of men in east Hararghe families. From the total 154 sample household heads, about 78 % of them were male and the remaining 22 % were female. The result revealed that the percent of male headed households of practicing agroforestry were higher than that of female headed households. Traditional agroforestry practices are mostly done by men because of the cultural values and responsibilities of men in East Hararghe families. Again, generally males are physically stronger than females and can comparatively provide more labor

With regards to the educational status of sample **household heads**: Education is very important for the farmers to understand and interpret the agricultural information coming to them from any direction. Of the total 154 respondents, 48.7 % were uneducated, 38.96 % Primary school, 9.24 % secondary school, and 1.9 % of the respondents were diploma respectively. A better educated farmer can easily understand and interpret the information transferred to them by development agents and any other bodies. **Marital statuses** of the household: Household characteristics of sample households are presented in (Table 3).

Table 3: Marital status of house hold and role of house hold of respondents (n = 154)

Variables	Frequency (f)	Percentage (%)
Marital status of house hold		
Married	151	98.05
widowed	0	0
Diverse	0	0
single	3	1.95
Total	**154**	**100**
Role of house hold		
HH head	144	93.51
First spouse	6	3.9
Second spouse	0	0
Third spouse	0	0
Son or doughtier	4	2.6
Total	**154**	**100**

Source: Survey Result, 2020

With regard to marital status, from the total sample respondents 1.95 % was single while the rest 98.1 % were married households. The proportion of married respondents was much larger than the remaining unmarried categories. Hence, there is real difference in marital status of agroforestry married and single agroforestry

practitioners in the study areas. Role of house hold: With Role of house hold 93.51% were household head and 3.90% were first spouse House hold head and Son or daughter 2.60%. Results of this study indicated that the existing agroforestry practices are mostly done by house hold head because of the responsibilities has given to head of household in east Hararghe families.

With regards to the **Occupation** of the Respondents**:** From the findings, majority of the respondents 98% indicated they are Farming as their occupation. Others were 0.65 % can easily access information or have knowledge on agroforestry and therefore can influence the agroforestry practices in study area .Farmers are more likely to practiced agroforestry than any other occupation since they practice farming. It was conducted to understand the existing knowledge of farm households on the management of trees under different practices in separated agro ecologies. **Source of labor:** Labor is one of the major resources owned by farm families, with regards to the Source of labor of the respondents, 92.86% of the respondents were family labor, 3.25% of them hired labor, and 3.25% was exchange labor. It can be indicated that farming was the main type of traditional farming system in study site.

Table 4: Occupation and source of labor of respondents (n = 154)

Variables	Frequency (f)	Percentage (%)
Occupation		
Farming	151	98.05
Employment	1	0.65
Trading	1	0.65
Unemployment	1	0.65
Total	**154**	**100**
Source of labor		
Family	143	92.86
Hired	5	3.25
Exchange	5	3.25
communal	1	0.65
Total	**154**	**100**

Source: Survey Result, 2020

With regards to **Districts:** of the total respondents 35.06% were Kersa district found in mid-altitude agro-ecology and 33.12% were Jarso district in highland agro-ecology, 31.82 % were Fedis district found in lowland area.**:** Of the total respondents most were living in mid-altitude agro-ecology. With agro ecologies the respondents, 35.06% of the respondents were midland, 33.12% of them highland and 31.82% was lowland agro ecologies in the study areas.

Table 5: Districts and agro ecological zone of Respondents (n = 154)

Variables	Frequency (f)	Percentage (%)
Districts		
Kersa district	54	35.06
Jarso district	51	33.12
Fadis district	49	31.82
Total	**154**	**100**
Agro ecological zone		
Low land (<1500)	49	31.82
Midland(1500-2300)	54	35.06
Highland(>2300)	51	33.12
Total	**154**	**100**

Source: Survey Result, 2020

Table 5 presents presence of agro forestry practices on farmers' plots in terms of districts with agro ecology**.** agro ecology result showed that in the midland agro ecological zone, household heads grow relatively practices agro forestry more on their farm plots than in the highlands and lowland, but the difference is only weakly significant. Relatively more records of trees on smallholders' farm plots in the midland agro ecological zone than in the highland explains the influence of agro ecology on smallholders' perceptions, attitudes, and management of trees in farmed lands. Agro ecological settings with rich agro biodiversity that include trees growing in farm plots contribute to sustainable livelihood security at the local.

3.2. Description of Major Agroforestry Practices

3.2.1. Major Agro forestry components in the East Harghe Zone, Oromia

In study area the land use systems include annual crop production, horticulture and agroforestry. The agroforestry

practices include scattered trees in cropland agroforestry, alley cropping as hedge row intercropping agroforestry, home garden agroforestry, and multipurpose trees on farmlands, live fence /boundary tree planting agroforestry, and wind breaks. Food crops (sorghum, maize, wheat) and cash crops production (*Catha edulis*, vegetables and root crops) in large quantities are practiced in different types of Cropland agroforestry along with the annual crops. Agroforestry, trees and shrubs were grown in agricultural fields in association with crops, either as single trees, linear formations or woodlots in the study area. *Most of the respondents are practiced agroforestry technology in the study effectively.* The result of the study revealed that, among the different existing traditional of agroforestry practices, scattered trees in croplands were grown cash crops (*Catha edulis*) in the scattered trees as agroforestry practices.

Table 6: Types of crops, trees grown in the study area of Respondents (n = 154)

Land use priority	**Household's response**	
	Frequency	**Percent (%)**
Food crops	66	42.86
Crops(cash crops) with trees	58	37.66
Tree with crops	22	14.29
Tree crops with animals	8	5.19
Total	**154**	**100**

Source: Survey Result, 2020

Table 6 presents that about half of the farmers (42.90%) largely depends on annual crop production. A significant number (51.96%) of practices is involved in agri-silvicultural system (cash crops with trees and tree with crops). The study found that people are more interested in pasture culture (5.20%) with annual crop because of its immediate high cash return. Other farmers showed remarkable interest to grow annual crops in order to provide annual household consumption. Other system is practiced by a limited number of respondents .They also wanted to increase income by incorporating trees.

3.2.2. Types of Agroforestry Practice in the Study Area

Most of the farmers in in the study learn agroforestry from indigenous knowledge systems and have a tradition of practicing Agroforestry practice. Recently their practices have been reinforced by the need for socio-economic and environmental sustainability. Six common Agroforestry types were found in the study area. The household survey result showed that scattered trees in croplands (58%), followed by alley cropping as hedge row intercropping (33%), home garden (22%), multipurpose trees on farmland (19%), live fence /boundary tree planting (18%), and wind breaks (4%) (Table 6)

Table 7: Agro ecology and major agroforestry practices (AFP) in study area

Agro ecology *Agroforestry practices	Agroforestry Practice						Total
	Alley Cropping	Home gardens	MPT on farm land	Scattered trees in croplands	Boundary Planting	Windbreaks	
Highland	9	8	7	18	9	0	**51**
Midland	17	8	10	16	3	0	**54**
Lowland	7	6	2	24	6	4	**49**
Total	**33**	**22**	**19**	**58**	**18**	4	**154**

Agroforestry practices has differ significantly from each other at the 0.05 level.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
χ^2-Value	23.275[a]	10	**0.010**
N of Valid Cases	154		

Significantly from each other at the 0.05 level

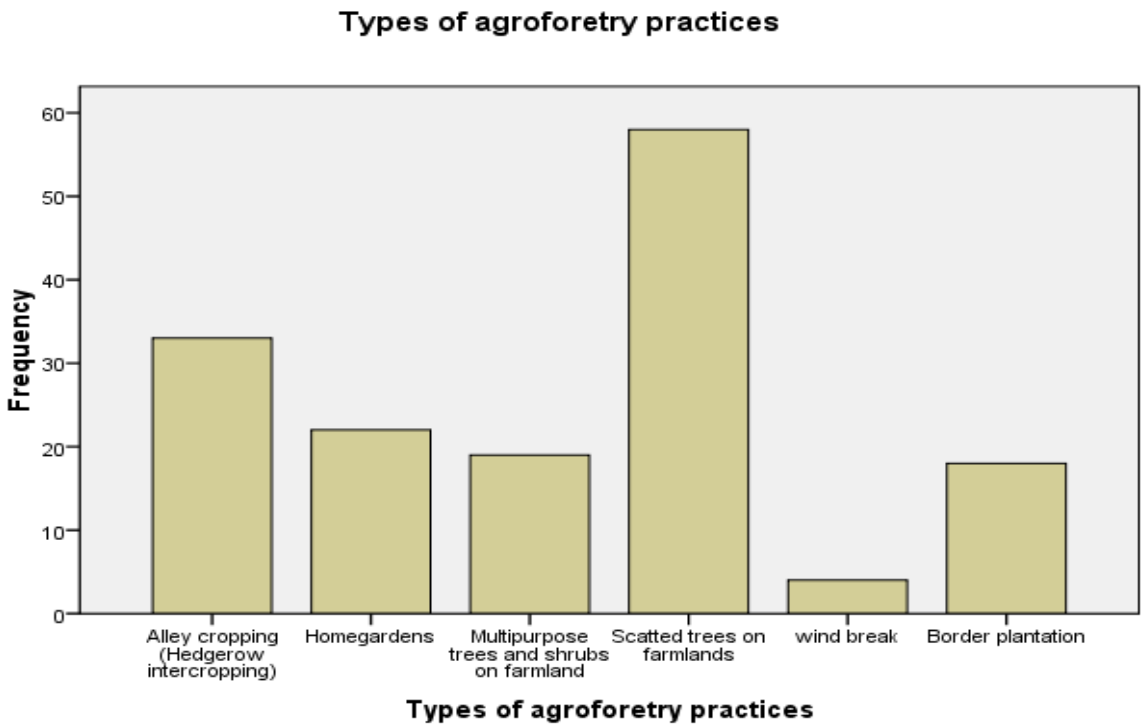

Figure 2: Agroforestry practices by frequency in study area

The major agro forestry practices involved in the study area were scattered trees on the farm land followed by hedge row intercropping agro forestry practices (Figure 3 and Table 7).Scattered trees on the farm land agro forestry practices had higher value with significant difference ($p< 0.05$) between highland and lowland agro ecology than that of the midland in the study area. This indicates that scattered trees on the farm land agro forestry practices is preferred to that of the other agro forestry practices on study area by the respondent farmers. Hedge row intercropping Agro forestry practices also had higher value with significant difference ($p< 0.05$) between highland and midland agro ecology than that of the lowland in the study area. This indicates that hedge row intercropping agro forestry practices is preferred to that of the other agro forestry practices on study area by the respondent farmers.

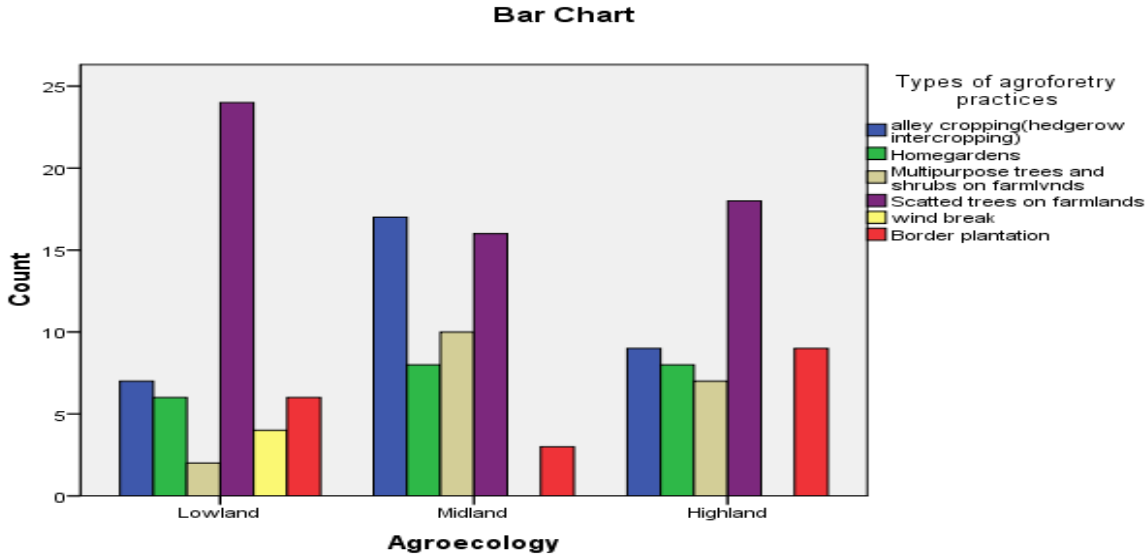

Figure 3: Types of agroforestry practices within agroecology in East Harargh Zone

Scattered trees and shrubs on the farm:

Scattered trees on the farm has been a long tradition in the study area, within farm lands scattered trees are found and cover large areas. 58% dispersed trees grown in farmlands characterize a large part of the study areas .In this agroforestry practice, trees are managed to produce timber, firewood, fodder, fruit and shade. Common tree species are *Cordia africana, Olea africana, Acacia albida, Croton macrostachyus, Casuarina equisitifolia, podocapus*

falucatus, cupressus lusitenica, Eucalyptus camadulesiss, Eucalyptus globulas and *Gravillea robusta* were wide spread on their farm. The crops grown in association with scattered agroforestry practice are, sorghum, maize, wheat, barley and pulses such as beans. The fruits tree species: *Psidium guajava*, *Mangifera indica*, *Annona seneglensis,* and *Zizipus* are common. Particularly the decision to take new agroforestry technology may vary depending on their farm land size, as when their farm land size large and labor availability is low, then the farmers can be more ready to adopt agroforestry practice such as tree on crop land.

Alley Cropping (hedge row intercropping):

Out of 154 agroforestry practice 33% respondents are practice alley cropping in their farm land. Alley cropping is an agroforestry practice contains growing of food crop in the middle of hedge rows of planted trees and shrubs. The sorghum/maize and chat (*Catha edulis*) hedgerow intercropping in the eastern parts of Ethiopia the growing of food crops between hedgerows of planted shrubs and trees, preferably leguminous species. The main objectives this practices to improve soil fertility and water conservation.

Boundary planting: The planting of trees along the perimeters of farmers‟ properties for land delimitation, timber, fuel wood, soil conservation and wind protection. 18% Respondents planted or retained trees/shrubs along the boundary of their farms to protect their crops and as a source of different wood products. *Eucalyptus camaldulensis, Allophilus abssyinicus, Olea africana,* and *Doviyales abysinicus* were the familiar trees planted on farm boundaries.

Homegarden: A home garden is one of the agroforestry system practiced in the study area (22%). The main objectives of this practice are to produce food, fodder, construction materials and to gain income from the product. Crops such as chat, coffee, and numerous kinds of vegetables are dominant components of the study area homegerdens. The common fruit trees in the homegardens were *Psidium guajava*, *Mangifera indica*, *Annona reticulate*, and *Casimiroa edulis* are also practiced in homegardern agroforestry. Feed trees, *Leucenea*, *susbania*, *Catha edulis* and *Cordia africana* were planted in the home garden. Trees such as *Cordia africana*, *Grevillea robusta*, and *Acacia* species are among the species that form the upper story of home garden. Home gardens integrated mostly fruit trees combined with fodder crops, vegetable, beans and even maize on small gardens near to homested. The result is also similar with the findings (Berhane Kidane *et. al*, 2008).

Multipurpose trees on crop land: trees are grown for fodder, cash income and soil fertility improvementTree species found in this area; *Cordia africana, Olea africana, Croton macrostachus*, and *Capparis tomentosa* species were commonly grown trees to provide fuel, building, fodder and improve soil fertility, conserve soil moisture and improve the microclimate of the area. Wind breaks**:** Windbreaks are narrow plantings of trees and shrubs protect their land from heavy wind and animal damage. *Doviyales abysinicus,* and *Entada abyssinica* were planted for windbreak

3.3. Socio-economic factors affecting agroforestry practices

Major Agroforestry practices within the three different agro ecologies *with the suggested* socio-economic *factors*. There are different socioeconomic factors such as, gender, age, family size, land holding, education, marital status and occupation in agroforestry practices have been assessed. From among those, only gender of house hold, Age of the household, and family size were important factors significantly and positively related to agroforestry practices and influencing practices

Table 8: Correlation results of agroforestry practices with factors affecting the stud area

Socio-economic factors affecting agroforestry practices	AF Practices with P value
Gender	**0.054***
Age	**0.03***
Family size	**0.004***
Farm land size	0.069*
Education level	0.55^{ns}
Marital status	0.99^{ns}
Occupation	0.77^{ns}

* Correlation significant at less than 5% probability level, ns=not significant

The analysis showed that male households relatively more agroforestry practice *on their farm plots than female-headed household do, but no significant mean differences (P<0.05) (Table 8) were observed. The gender distinction in* agroforestry practice *on farm plots was ascribed to many different reasons, including that it was too difficult a job for females, it was a job unfamiliar to females, there is a perception of it being the duty of men, it was a work burden, social classification dictates that females' engagement be in indoor activities,* and *female income is low.* The relation of age and agroforestry practice results of differences in agroforestry practice among average age groups of smallholder farmers. The results of the study showed that middle age (35 age) informants integrate more trees, along with possessing relatively more knowledge than younger people, with a significant difference (P<0.05). This agrees with the general fact regarding age-wise distribution of indigenous botanical and ecological knowledge among rural farming communities. This needs to be focused on in future selection and

expansion of tree plants on farmed landscapes; participation of knowledgeable becomes critical.

An increase in the household size by one member, increases the likelihood of choosing agroforestry technologies by 5.57% (Ayuya *et al.,* 2012). Larger households with sufficient labor source tend to embrace agroforestry practices compared with those of small households. However agroforestry adoption may as well increase in small household sizes, perhaps for the reason that agroforestry is less labor demanding. Another study by Bzugu *et al.,* (2012) agrees that, much labor used in small scale farms emanates from the household, and therefore the larger the household the more labor available to carry out agricultural practices like agroforestry. Madalcho *et al.,* (2016) argues that larger households would have enough labor to practice agroforestry and are able to provide adequate management for the agroforestry practices, than smaller households. This is in agreement with Tefera (2016) who indicated that farmer's socio-economic characteristics namely household size, had a significant positive influence on the adoption of agroforestry.

3.4. Farmers Reason for Planting and managing trees in Study area

Agroforestry practiced households are knowledgeable on the use of different trees they have grown on the farmland and have developed their own set of criteria for choosing what tree species to plant. During key informant interview, it was mentioned that tree species to be incorporated in to farmland must have a role in increasing farm income and soil fertility. Tree species with evergreen leave characteristics were kept around the residence, farm boundary and grazing land to provide shade and livestock fodder. The survey results indicated that increase farm income and provision of construction materials are the best criteria followed by tree species that are conducive for ability to increase soil fertility. Ability to increase shade service for human and livestock (Table 9). Accordingly, *Gravillia robusta, Cordia africana, Acacia* and *Sesbania* tree species were grown deliberately together with other crop components, while trees like *Eucalyptus cammaldulensis* and *Cuppressus lustanica* were grown around homes and as wood lots for construction and income generations purpose. Farmer's important reasons for planting and managing trees involved in the study area were identified. Small holder farmers in the study area have great awareness about the benefits of agroforestry practices. Most of the respondents believe that agroforestry practice is enhancing the overall productivity. The major reasons and benefits for planting trees species in agroforestry practices in the study area are in the order of its use includes: as Provide construction materials, Increase farm income, Improvement in soil fertility, Potable leaves by animals, Provision of shade by trees (Table 9).

Table 9: Farmer important reasons for planting and managing trees

Reasons for planting trees	**Household's response**	
	Frequency	**Percent (%)**
Provide construction materials	112	72.73
Increase farm income	22	14.29
Ability to increase soil fertility	9	5.84
Potable leaves by animals	9	1.30
Used for shade purpose	2	5.84
Total	**154**	**100**

Source: Survey Result, 2020.

This supports the findings of Biruk (2006), who concluded that farmers in south east langano, Ethiopia maintained trees/shrubs on their farms for different socio-economic purpose including medicinal products, provision of shade shelter, fodder, fuel wood and the like.

3.5. Perception of Farmers towards Agroforestry Practices

The farmer's interest for practices of new agroforestry technology depends on their perception about agroforestry in table 10 below shows most of the respondents were aware of both environmental and economic benefits of agroforestry. More specifically most of the respondent's perception towards agroforestry practices is that it increased farm income, soil fertility, decreased complete crop failure and a potential of solving their fuel wood needs. The farmers also believed that agroforestry practices is more profitable and less risky than other agricultural alternatives. However, the main problems of the farmer's attitude towards agroforestry are their negative thinking that this activity takes long time to generate income as a result they tried to practice activities that generate income in short period such as to fulfill their basic needs. The combination of different varieties of products which are both subsistence and income generating, support farmers to fulfill basic needs and decreased the risk of complete crop failure. The results in table 10 shows that most of the respondents agreed that agroforestry practice increase soil fertility 48.7% of the respondents, 37.01% of the respondents are strongly agree and 12.34% neutral only the rest are disagree perception. The farmer's perceptions about agroforestry practice increase farm income are positive about 43.51% are agree and 35.71% are strongly agree and 20.13% neutral and the rest of the respondent are disagree about agroforestry practice increase farm income. Their perception towards agroforestry practice reduce complete crop failure 44.8% are agree, 26.6% strongly agree, 25.7% neutral and the rest of the respondents are dis agree response. The fourth statement are about agroforestry practice saved time on collecting fuel wood

from forests 43.5% are agree, 30.5% strongly agree, 24.7% neutral and the rest of the respondents are dis agree response. The others sustain natural conditions 44.8% are agree, 29.9% strongly agree, 23.5% neutral and the rest of the respondents are dis agree response.

The other statements are agroforestry practice takes long time to generate incomes and more respondents are 44.3% are agree, 31.2% are strongly agree, and the other are disagree and neutral response. Improve the surrounding conditions and for this more respondents are 46.7 % agree, 33.1% strongly agree, 18.0% neutral, and the rest of the respondents are dis agree response. The farmer's positive perception is shown as necessary steps in practices of agroforestry practice (Franzel *et. al*, 2002). the main problems of the farmer's attitude towards agroforestry are their negative thinking that this activity takes long time to generate income as a result they tried to practice activities that generate income in short period such as to fulfill their basic needs. The combination of different varieties of products which are both subsistence and income generating, support farmers to fulfill basic needs and decreased the risk of complete crop failure

Table 10: Perception of respondents about Agroforestry in the study area

Attributes of agroforestry practices	Response					
	1	2	3	4	5	Total
Increased soil fertility	1(0.7%)	2(1.3%)	19(12.34%)	75(48.7%)	57(37.01%)	154(100%)
Increased farm income	0	1(0.7%)	31(20.13%)	67(43.51%)	55(35.71%)	154(100%)
reduce complete crop failure	1(0.7%)	3(1.9%)	40(25.9%)	69(44.8%)	41(26.6%)	154(100%)
saved time on collecting fuel wood	0	2(1.3%)	38(24.7%)	67(43.5%)	47(30.5%)	154(100%)
Sustain natural conditions	1(0.7%)	2(1.3%)	36(23.5%)	69(44.8%)	46(29.9%)	154(100%)
Took a long time to get income	0	3(1.9%)	35(22.7%)	68(44.2%)	48(31.2%)	154(100%)
Improve the surrounding conditions	0	2(1.3%)	29(18.0%)	72(46.7%)	51(33.1%)	154(100%)

Source: Survey Result, 2020. 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

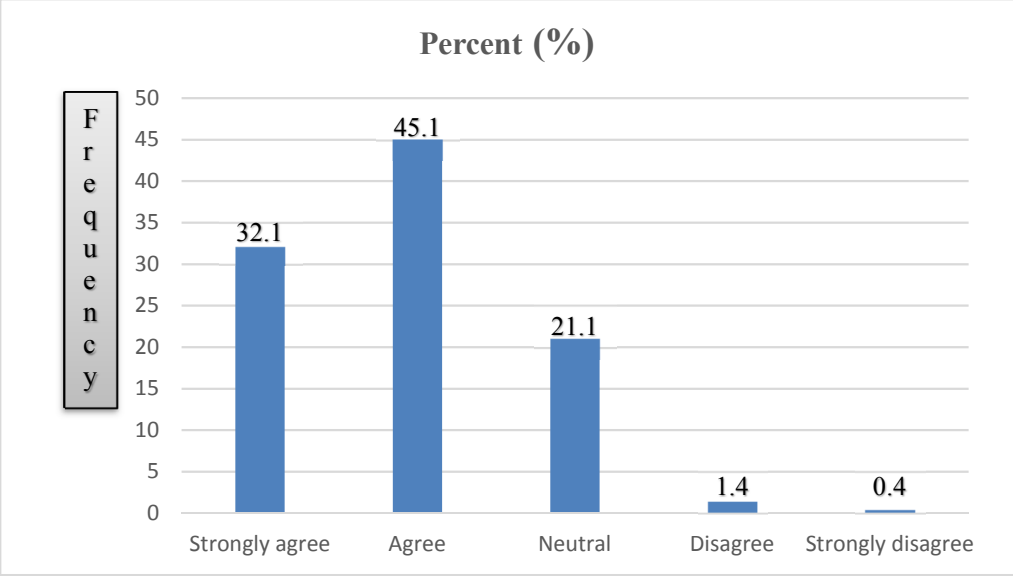

Figure 4: Farmer's perceptions about agroforestry practices in study area

Farmer's perceptions about agroforestry in the study area were found to be diverse figure 4. The farmer's practices agroforestry traditionally within their agricultural cropland as well as their homestead. In the study area a remarkable proportion of the farmers think positively about agroforestry systems. They believed that Agroforestry has a great role to increase productivity (36.4%) of land, 17.5% agreed on improved soil, 11% believed increase production in managing, and space utilization to meet their demands of wood, firewood and other forest products. 24.0% respondents agreed with this point of view (Kittur, 2013).

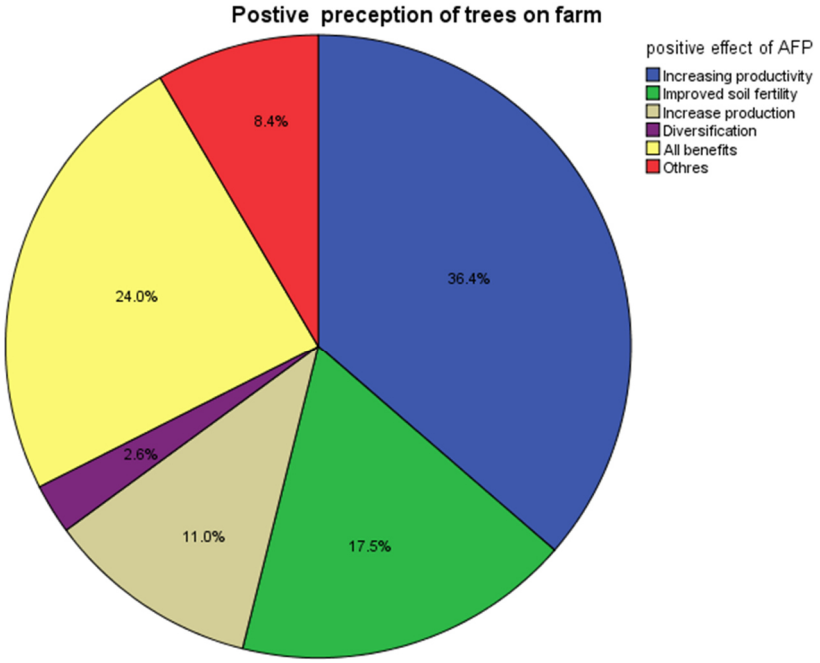

Figure 5: Positive farmer's perceptions about agroforestry practices in the study area

The farmers also perceived that Agroforestry is more profitable and less risky than other agricultural options (8.4%). From agroforestry practice the farmers reported that they can get agricultural crops in the short term as well as earn a large amount of cash from the sale of the trees in the long term. The table 10 below shows the farmer perception on the tree planting with crops have in maximizing competition of resource 40.01%, shading effects 32.6%, Attract pests and diseases 10.44%, lower water tables 8.92 and attract birds 8.10% out of the total respondents. Similarly negative attitude among the farmers may be the main reasons for less practices of agroforestry technology (Chauhan. *et, al*.2009).

Table 11: Negative perceptions of respondent's bout agroforestry practices

Negative perceptions of trees	**Household's response**	
	Frequency	**Percent (%)**
Competition of resource	60	40.01
Shading	49	32.60
Attract pests and diseases	18	10.44
attract birds	14	8.92
lower water tables	13	8.10
Total	**154**	**100**

Source: Survey Result, 2020

3.6. Opportunities and constraints of the farmer's preference of tree /shrubs species in agroforestry practice

Respondents indicated that there were opportunities for agroforestry expansion in the study area. This includes the increasing demand for wood products, the declined of soil fertilities, shortage of land increasing of climate changes, and effective seedling distribution. The result shows that as the resource become scarce farmers change their survival strategy either by migrating to productive areas or by diversifying their current practices. The agrosilvo-livestock keeping system practiced in the study area helped farmers to produce a wide variety of products such as fodder, fuel wood, livestock and crops. The districts have favorable climate for growing of trees the farmers have a habit of protecting and using trees such as *Acacia albida*, *Eucalyptus camaldulensis*, *Cordia africana* and *Croton macrosthays* in lowland areas and *Juniperus procera*, *Podocarpus fluctus*, *Acacia abyssinica, Eucalyptus cammaldulensis* and *Cuppressus Lusitanica* in highland area grow naturally on farms. In the midland agro ecologies there is a better potential and experience for improving agroforestry than others agro ecologies because of strong tradition of growing trees and intercropping of trees with fruit trees and vegetables. Therefore, excellent opportunities for improved agroforestry practices. The farmers' plant/protect trees on farmland and appreciate their role in improving soil fertility.

Major constraints to adopt agroforestry practice are shortage of land for tree planting 58.44%, shortage of Rainfall 29.87%,and Disease and pastes 5.19% more barrier to adopted agroforestry practice. Therefore; farmers

need to be provided with appropriate seedlings and encouraged to plant on farms. Appropriate planting and management techniques need to be developed and extended to farmers. Besides, screening should be carried out to select suitable varieties or provenances for distribution to farmers. Hence it is necessary to carryout agroforestry trials in relation to intercropping designs, spacing, planting techniques, and management of shaded trees.

Table 12: Constraints that influences farmer's not participating agroforestry practice

Major constraints	Frequency (f)	Percentage (%)	Rank
shortage of land for tree planting	90	58.44	1st
Shortage of Rainfall	46	29.87	2nd
Disease and pastes	8	5.19	3rd
Lack of seedlings availability	7	4.55	4th
Inadequate extension agents	3	1.95	5th
Total	**154**	**100**	

Source: Survey Result, 2020

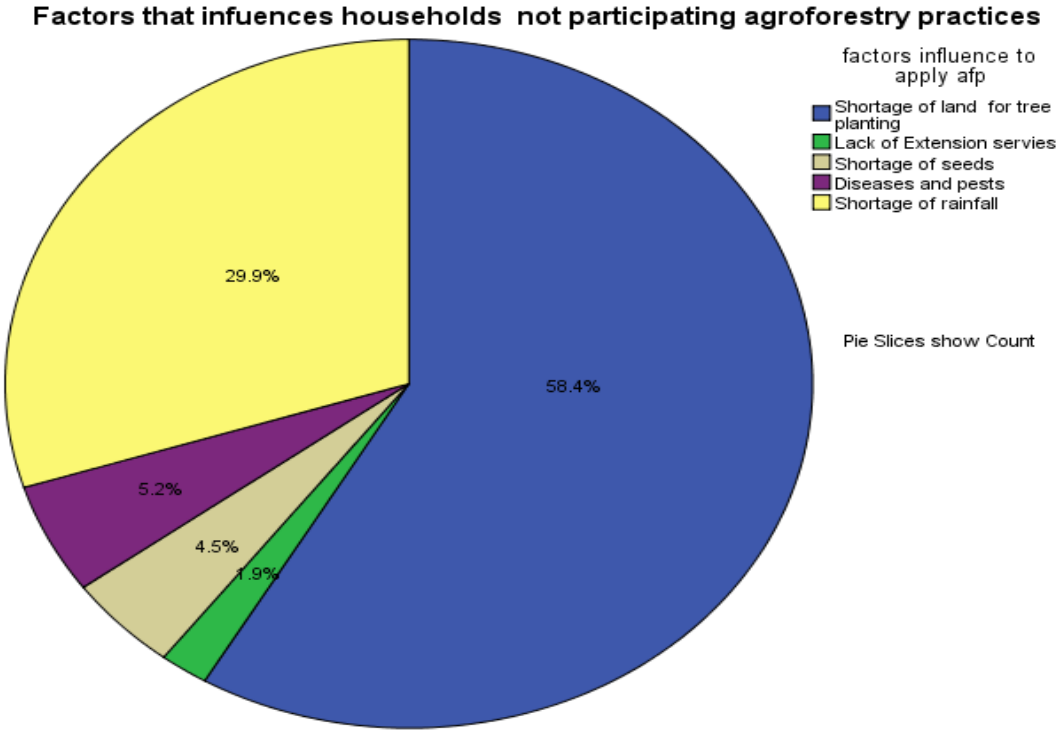

Figure 6: Major constraints to adopt Agroforestry practices in the study area

4. Conclusion and Recommendations

This study addressed assessments of agroforestry practice, perception of farmers towards agroforestry practice and opportunities and major constraints related to traditional agroforestry practices *in* the three *a*gro ecologies of East Hararghe zone. Respondents' demographic variables : age, gender, household size, land size, level of education, marital status, role of household, occupation, and labor were discussed as influenced the implementation of agroforestry practices. There was also significant correlation between the respondents' characteristic variables of age, gender, family size, and land size with their perception of agroforestry. Some of the major Agroforestry practice that has commonly practiced in the study areas *a*re scattered trees on farm lands, hedge row intercropping (*alley cropping)*, home garden, multipurpose trees in crop land, farm boundary tree planting/live fence and windbreak planting types of agroforestry practices used in the area. From this study we conclude that agroforestry technologies that are practice in the study area are six types.

The perceptions of farmers towards agroforestry practice are positive and they are aware that agroforestry practices increase farmers' income, soil fertility, decreased complete crop failure and a potential for solving fuel wood shortages. The main challenges associated with adoption of agroforestry practices are shortage of land for tree planting, shortage of rainfall, and disease and pastes, the long time it takes to give benefit and the demands for labor and capital to practice agroforestry technology as a result they tried to practice activities that generate income in short period and with limited capital to fulfill their basic needs. Most of the farmer's (45.12%) have positive attitude towards Agroforestry practices in the districts Therefore, agroforestry practice could be one option to improve small farmer's life in study site.

Based on the main finding for the study the following recommendations are made.
1) Agroforestry practices that are practice in the study area are only six it should be diversified through providing the necessary material for adoption of more agroforestry practice for farmers. So, further researches should need diversified.
2) Even if farmer's perceptions towards agroforestry practice are positive most of the farmers still not adopted agroforestry practice in the study area. So adoption of agroforestry practice should be improved in the different agro ecological zone.
3) Further researches should be done on assessment of adoption of agroforestry practice in the future in the study area.
4) Further researches should be done on propagation and interaction tree species with annual crops and economic analysis of the individual agroforesty practices in the future in the study area

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