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Status of Traditional Agro Forestry and Its Future Potential Development for Conservation of Natural Forest in Horo District OromiaWestern Ethiopia

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Abstract: The study was conducted with the main objective of assess and identify best agro forestry system, examining the socioeconomic benefits of agro forestry practices and examining factors influencing agro forestry practices in the study area. The sampling design of this study was involve a multi-stage stratified random sampling technique. The study district was purposively selected. This study identifies as there was some examples of traditional agroforestry practices in study area. The result of the formal household survey revealed that, about 85% of the respondents practice agroforestry in their land whereas only 15% of the respondents have not practice agroforestry. Based on the type of the components involved, 93.75%, 1.5% and 4.68% were characterized as agrosilvopastural, silvopastural and agrisilvicultural systems respectively.About 90% of the respondents owned different types of tree species in their land use systems. Accordingly, 85% and 15% of the respondents owned trees through retention and plantation activities respectively. Land scarcity and shortage of native seedlings were the predominant constraints for the establishment of Agrofrestry system and practice. Lack of awareness was also raised as problem affecting expansion of Agrofrestry system in the area. Although farmers in the study area have been obtaining various types of benefits from these traditional agroforestry practices, they still depend on the surrounding natural forest for different uses and services. These dependencies on the natural forest put the forest resources under serious pressure and have profound effects on the biodiversity of the forest ecosystem, often leading to the change in species composition and vegetation structure of the forest.

Key wards: Agroforestry System and Practice · Alternative Land Use System · Natural Forest Degradation

INTRODUCTION

Agroforestry is an integrated approach of using interactive benefits by combining agriculture and forestry technologies to create more diverse, productive, profitable, healthy and sustainable land use system [1, 2]. It is an integrated system of rural land resource management based on combining shrubs and trees with crops and/or livestock, Baets *et al*. [3] and dynamic, ecologically based, natural resources management system. Some important sustainability concerns on which agroforestry can aid forestry are habitat of biological diversity, wood and non-timber products, ecosystem integrity, soil and water quality, terrestrial carbon storage and socioeconomic benefits [4, 5]. Agroforestry encompasses a large range of land-use practices and is practiced in both modern and traditional forms around the world in which currently, almost 1.2 billion people or 20% of the world's population depends on its products and services for their livelihoods [6, 7].

In Ethiopia, agroforestry is a traditionally practiced. Common agroforestry practices includes; scattered trees in croplands, Home Gardens, Hedgerow Intercropping, Riparian zone vegetation and Enclosures and natural regeneration of species in woodlands and pasture [8]. But the scientific principles of agroforestry have been given due consideration only in recent years [9]. To bring about a shift in thinking on agroforestry practices, first

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national agricultural research organizations need to recognize the contribution of agroforestry to ecosystem services which play crucial role in adoption of agroforestry [10].

In this regard the role of agroforestry on the yields of different crops not yet known and this opportunity shouldn't be failed to notice [11]. So it is necessary to carryout studies on Status of Traditional Agro forestry and Its Future Potential Development for Conservation of Natural Forest [12]. Therefore, this study will attempt to assess status of traditional agro forestry and its future potential development for conservation of natural forest in the study area and will provide information to draw conclusion regarding agroforestry practice disseminations and species diversity used in the system in the study area.

Although agriculture is the main stay of Ethiopian economy, the sector is under continuous threat from various forms of natural resource degradation. Of this forms, deforestation is one of the prominent problems. [13] Reported that agricultural expansion, declining farm land productivity, demand for forest products and investments in the forested areas are some of the major underlying factors exacerbating the problem.

In Horo District of western Ethiopia, shortage of farm land and cash crops, conversion of forest land to agricultural land use system, extensive farming, over dependence on forest resource for energy consumption, construction and timber materials[14]are exaggerating the problem of deforestation due to unsound land management system. These practices of local people for their sustenance over several years have contributed to severe forest degradation. Where forest degradation is high in which indigenous species is endangered and soil erosion is high, the excepted productivity will be low. According to Horo District Office of Agriculture and rural development, there is an effort to aware community regarding forest management, soil and water conservation measures and planting seedling.Despite such effort, there is still a problem of natural resource degradation which resulted in low productive return as a general and particularly to the study area.

To alleviate this problem, huge measures was taken, such as tree planting on individual as well as common land of the farmers, awareness creation by government about natural resource management, short term training for farmers on intensification of farming, development of community forest, soil and water conservation and agroforestery practices dissemination have been taken in the area since 1990.However, there is such anefforts to conserve natural resources, the practicability and adoption of agroforestry practices so far seem to have had limited impact in increasing the sustained use and its spread among the local farmers.

Thus, studies on Status of Traditional Agro forestry and Its Future Potential Development for Conservation of Natural Forest have practical significance particularly at the face of growing dependency on natural resource in general and the agricultural sector in particular with objective to assess and identify best agro forestry system, to examine the socioeconomic benefits of agro forestry practices and to examine factors influencing agro forestry practices in the study area.

MATERIALAND METHODS

Description of the Study Area: The study was carried out in Horo district, HoroGuduruwollega zone of Oromia National Regional State, about 313km west of Addis Ababa. Geographically, it is located between 9° 34′ 0.0120" N latitude and 37° 6′ 0.0000" E longitudes. The total population of Horo district as calculated based on 2007 national census report and it was 86, 849. About 83, 375 of them were rural and 3, 474 were urban. Out of the rural population 41, 437and 41, 938 were females and males in respectively.

Site Selection and Sampling Design: The study district was purposively selected because the area represents one of the highest case scenarios on the degree and rate of forest degradation, high remnant natural forest intervention for their different uses, high soil fertility declined, low water and soil conservation measure practiced, high over dependence on forest for forest product and at the same time high practicing of tree planting development program Out of 10 Kebeles found in the district two Kebeles namely Alshaya Dado and LakuIgu were selected through stratified random sampling for this study.

In the third stage before conducting, the selection of sample households sample frame was established. This was done primarily by collecting complete landholders list record from their respective PA administration office. The sample frame were all household head living in the two PA, accordingly, the total numbers of household head living in two peasant associations are estimated as 650. The selected PA were Alishaya Dado and LakuIggu.

Sample Size Determination: Once the total population obtained, the next step were determining total sample size of the survey, based on the established sample frame of the selected PA. Following this, total sample size was determined using probability proportional to sample size-sampling technique [15].

$$no = \frac{Z^2 * (P)(q)}{d^2} \leftrightarrow n_1 = \frac{no}{(1 + no/N)}$$

where;

n_o = desired sample size Cochran's (1977) when population greater than 10000

n_1 = finite population correction factors (Cochran formula, 1977) less than10000

Z = standard normal deviation (1.96 for 95% confidence level)

P = 0.1 (proportion of population to be included in sample i.e. 10%)

q = is 1-P i.e. (0.9)

N = is total number of population

d = is degree of accuracy desired (0.05)

Based on Cochran's population correction factors (1977), a total of 75 sample households' head were selected using simple random sampling techniques for the study. Allocations of the number of sample households in each PA were proportional to the number of household head living in each sampled PA.

Method of Data Collection: Four complementary data collection methods were used to collected data for this study. These includes.

Household Survey: This is a formal survey method where a semi- structured interview scheduled was employed with closed and/or open-ended questions for eliciting information from respondents. On the base results obtained from the pre-test, necessary were made. Two trained technical assistants were administers a structured interview. The interview was conducted within the respondent's territory and in interviewing atmosphere.

Focus Group Discussion (FGD): Is one of the most commonly used qualitative data collection approaches, to complement the household survey, basic descriptive information were collected at the PA and village level in each survey site. This technique was help to acquire useful and detailed information, regarding extension service, problem farmer's face on adoption of the system, etc...This might be difficult to collect through the household survey. Discussions were made with randomly selected 6-8 farmers' respondent under the guidance of a moderator in each PA and a total of 12-16 as the study area. Checklists were prepared to guide topics for open-ended discussion with group of farmer.

Key Informant Interview: To complement the questionnaire and to have a detailed in sight in to agroforestery practices in the areas in-depth interviews and discussion covering different topics like the major causes and extent of forest degradation, perception of farmers towards forest degradation problems and conservation measures, consequences of forest degradation and soil erosion on: environment, social, economic aspects, which types of agroforestry practices accepted, widely disseminated and adopted by farmers? Why? And what are the major factors that affecting farmers' adoption of agroforestry practices in the study area /district were also held with district agricultural experts, DAs, better-informed farmers and opinion leaders to triangulate or verify the responses and to obtain additional information.

Direct Observation: Is one of the other methods used to collect primary data. It was carried out through systematic watching, listening and recording of different data. This informal technique was help to generate ideas and acquire useful and detailed information about biophysical factors, farming system, woody species used in the practices, values of local people especially the "goods" and "bads" of the society and farmers perception of agroforestry practices in the study area.

Data was analyzed using SPSS version 16.0 computer software. Descriptive statistical analysis including frequency, percentage and ranking were used. The analytical technique was being applied including independent t-test to detect differences in the mean of variable between two groups of respondents. The Chi square-test was applied to detect any systematic association between the dependent variable of interest and specific household characteristics.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents: Although the majority of the respondents (89.3% of the total) were male headed household, about 10.7% of female household heads were also included in the formal survey.

Table 1: The socio-economic profile of sampled house hold (n=75)

Socio economic characteristics		Value
Sex	Male	67
	Female	8
Agricultural land holding size(ha)		
	Average land holding(ha)	0.77
	Less than 0.5 ha (%)	22.7
	Greater than 1 ha (%)	13.3
	Average family size	7
	Average age	40
Means of livelihood (%)		
	Mixed farming	86.6
	Crop production only	2.66
	Coffee production only	2.66
	Livestock rearing only	2.66
	Off farm activities	5.33

The results of this study showed that mixed farming is the major source of livelihood and income for local community in the study area. However, the average land holding size per individual farmers is 0.77 hectare and average family size per individual farmers is seven (7). This small size of land holding and increasing population number forced the farmer to manage their agroforestry practices at plot level, at the same time they are also forced to encroach natural forest for agricultural expansion. On the other hand, the respondents mentioned as they have been benefited from this increasing family size for labor availability. Table 1 shows the detailed socio-economic characteristics of the sampled households.

The evolution of vegetation cover changes over time.

During the key informant interview and formal household survey people confirmed that vegetation cover changes have happened through time. In the previous time the vegetation cover of the area was dense and had large land coverage. These large and dense vegetation covers had been declining with time and were gradually reduced to only scattered trees on the farm land and disturbed natural forest. The observation was in agreement with the findings of [16] who states that The status of forest resources is decreasing from time to time in Ethiopia in general and the study areas in particular.One of the key informants had to say this about the vegetation cover change of the area as in the following context:

"I was borne during the end of Hilesilase regime and I have been living here for more than 42 years. It is not only of the information that I have heard about the dense vegetation cover of the area from my parents, but during the Derg regime I myself used to collect fuel wood from and make beehives from native tree species at the nearby site of our residence. This time, however, it is not easy to get remnants of those species at the nearby site of my residence I should travel 3 hours to get those species to use for different purpose".

Another key informant discussed the vegetation cover changes of the area by comparing the past and the recent years as in the following: "I have lived over the past two government regimes and am living in the third one. During these times I have observed vegetation cover changing from ample and dense coverage to only scattered trees on the farm land and a few patches of remnant natural forest. During the period of Hayilesilase land was under the control of land lords. Because of this reason cutting a single tree for any purpose and forest encroachment for agricultural expansion as well as use of forest products was strictly forbidden. As a result of this, there was no serious deforestation and vegetation cover was better than recent times. During the Derg regime land was taken from the land lords and distributed to the farming community following the proclamation of land for the tillage. Consequently, the land distribution opened the loophole and a way for forest encroachment and agricultural expansion. The event guaranteed the start of the destruction of vegetation. During the period of the downfall of the Derg government, people used the opportunity of the weak law enforcement as to fasten the clearance of vegetation for different purpose. Similar trend has been continued on the remnant natural forest until now".

Similar to the evidence about the evolution of reduction in vegetation cover over time was given from the key informants, the result from the formal household survey indicated that reduction in vegetation cover has been increased through time and about 93.3% of the respondents verified as the vegetation cover of the area was highly reduced for the past 10 years as compared to the previous time (Table 2). The major cause of reduction in vegetation cover through these periods was agricultural expansion due to population growth followed by fire and seasonal grazing in the natural forest (Table 3).

Traditional Agro Forestry Practices: This study identifies as there was some examples of traditional agroforestry practices in Alshaya Dado and LakuIgu Peasant Association (PA) of HoroDistrict. These examples have emerged through the experience of people living in these areas. Individuals living in the areas developed their own version of traditional agroforestry practices.

Table 2: Responses of sampled House hold (N=75) on vegetation cover changes of the study area during the last 50 years

Year classes	IDK (%)	HLI (%)	SLI (%)	NCH (%)	SLR (%)	HLR (%)
50-41 years	46.6	-	6.6	-	33.3	13.3
40-31 years	53.5	-	-	-	33.3	13.3
30-21 years	20	6.6	6.6	-	13.3	53.3
20-11 years	-	-	13.3	-	53.3	33.3
10-1 years	-	26.6	40	-	13.3	6.6

IDK= I do not know, HLI= highly increased, SLI=slightly increased, NCH= No change, SLR= slightly reduced, HLR= highly reduced

Table 3: Percent of respondents (n=75) who responded on the reasons for vegetation cover changes during the last 50 years.

	Year classes				
Reasons	50-41	40-31	30-21	20-11	10-1
Agricultural expansion	50	55.8	66.6	73.3	80
Grazing in the forest	20	11.76	13.3	13.3	6.6
Fire	5	5.88	6.6	0	2.66
Poor law enforcement	12.5	14.7	6.6	6.6	6.6

Different types of woody perennials have deliberately been grown together with agricultural crops and /or livestock components on the same land management unite. Eragrostisteff, wheat, barely, Zea mays, bicolor, Coffeaarabica, Saccharumofficinarum (Sugarcane) are the major type of crops integrated with the other agroforestry components (Woody perennials) and livestock (Cattle, sheep, goat, hen and apiculture).

The result of the formal household survey revealed that, about 85% of the respondents practice agroforestry in their land whereas only 15% of the respondents have not practice agroforestry. In the study area multipurpose trees on the farm land (With multistrata layer), homestead and farm boundary (In spatial structural arrangements) agroforestry practices were observed. Based on the type of the components involved, 93.75%, 1.5% and 4.68% were characterized as agrosilvopastural (Homesteads involving animals and apiculture with trees), silvopastural (Trees on pasture land) and agrisilvicultural (Multipurpose trees and shrubs on farm land) systems respectively. The result of the study also revealed that, among the different niches of agroforestry practices, trees on farm lands is the best preferred one followed by homestead and farm boundary respectively (Table 4).

The Tradition of Tree Inclusion in Farmlands: Framers in the study area have a promising tradition of keeping trees on their land. About 90% of the respondents owned different types of tree species in their land use systems. They owned these tree species through retention of remnant or naturally regenerated indigenous tree species and undertaking plantation activities.Accordingly, 85% and 15% of the respondents owned trees through retention and plantation activities respectively. Olea Africana is the most dominant tree species that was maintained followed by Crotone macrostachyus, *Acacia bussei*, Podocarpusfalcauts, Ekebergiacapensis, Ficussur, Maytenusarbutifolia (Kombolcha), Vernonia and Eucalyptus respectively in Alshaya Dado PA whereas Nuxiacongesta (Anfare), Dombeya torrid (Danisa), Ekebergiacapensis, Ficussur, Vernonia and Eucalyptus respectively in LakuIgu PA.

Even though there are some trends in planting exotic tree species such as Eucalyptus species and Grevillearobusta, people in the study area have maintained indigenous tree species for both retention and plantation purpose. Consequently, Cordiaafricanais were also the preferred tree species for plantation in both PAs (Table 5). This result is disagree with result of [17] who identifies exotic species are more pre dominant than indegiounus species in practicing agrofrorestry system in kenya.

Farmers in the study area have been retaining trees in different niches. Homestead, farm boundary, farm land, grazing land and live fence are the niche where tree retention has been undertaken. Among the above mentioned niches, homestead is the most preferred niche by the majority of the respondents followed by farm boundary and farm land. Similarly, home stead is the most preferred niche for tree plantation, this finding is similar with finding of [16] who identifies as Farmers of the some agro ecological study site plant tree/shrub species in home gardens i.e. 85 % of the respondents at Jeldu and 80 % at Guder have trees on their homesteads. The result was agree with result of [18] who gets as Home garden were the land use types that household are getting benefits directly from while practicing Agroforestry system and practice (Table 6).

Table 4: Percent of respondents (n=75) practicing different Agro forestry niches.

Niches	No of Respondent	
	Frequency	Percent (%)
Farm land	55	73.3
Homestead	13	17.3
life fence	1	1.3
Farm boundary	22	29.3
Grazing land	1	1.3

Table 5: Lists of tree species and percent of respondents (n=75) who have been engaged in retention and plantation of different tree species

Tree species	Percent of respondents owning MPTS through	
	Retention	Plantation
Podocarpusfalkatus	93.3	6.7
Cordiaafricana	13.3	86.7
Croton macrostachyus	94	6
Ficus Sur	94	6
Olea Africana	86.6	13.4
Grevillearobusta	-	100
Eucalyptus camaldulensis	-	100
Acacia bussei ,	86.6	13.4
Ekebergiacapensis,	93.3	6.7
Vernonia	14.6	85.4
Maytenusarbutifolia (kombolcha)	100	-

Table 6: Percent of respondents (n=75) and list of tree species in niches of retained trees

Tree species	Niche				
	FL	HS	LF	FB	GL
Podocarpusfalkatus	73	-	-	-	2.66
Cordiaafricana	85.3	10.66	1.33	1.33	1.33
Croton macrostachyus	80	4	8	2.66	5.33
Ficus Sur	40	6.66	-	20	33.3
Olea Africana	66.6	2.66	13.33	8	9.33
Acacia bussei	80	1.33	2.66	6.6	9.33
Ekebergiacapensis,	86.6	1.33	4	4	5.33
Vernonia	20	53.3	20	-	6.6
Maytenusarbutifolia (kombolcha)	80	-	6.6	6.6	6.6

FL=farm land, HS=homestead, LF=life fence, FB=farm boundary, GL=grazing land.

Table 7: Percent of respondents (n=75) and lists of tree species with varying uses of trees

Trees/Shrubs	Uses of trees								
	FW	CN	FR	TM	FI	SH	BK	SF	LF
Podocarpusfalkatus	100	100	-	-	50	20	-	-	-
Cordiaafricana	20	100	-	-	20	50	100	40	-
Croton macrostachyus	100	40	-	-	50	20	100	100	-
Ficussur	93.3	94.6	100	-	86.6	53	66.6	92	
Oleaafricana	100	50	6.6	66.6	66.6	53	40	50	20
Grevillearobusta	100	6.66	4	80	20	-	-	-	-
Eucalyptus camaldulensis	100	100	-	6.6	26.6	-	6.6	-	-
Acacia bussei ,	100	46.6	-	-	6.6	40	20	100	20
Ekebergiacapensis	50	20	-	-	6.6	66.6	20	20	-
Vernonia	100	20	-	6.6	50	4	100	100	100
Maytenusarbutifolia (Kombolcha)	100	40	-	-	20	-	40	40	50

FW=fuel wood, CN=construction material, FR=fruit, TM=traditional medicine FI=farm implement SH=shade BK=bee keeping SF= soil fertility, LF=livestock feed

The uses and benefits obtained from trees were mentioned as the motive for tree retention and plantation in the study area. Because of this people in the study area have been accruing diversified uses and services from the trees that were retained and planted in their lands. Among the uses and services are: fuel wood, construction materials, fruit, traditional medicine, farm implement, shade, bee keeping, soil fertility and timber (Table 7). Based on the diversity of uses and product provision, Cordia africana ranked first followed by Podocarpusfalcatus, Ficus Sur, Croton macrostachus and Olea Africana in the order of importance respectively in both PAs (Table 7).

Major Factors Influencing Agro Forestry Practices in the Study Area: Various factors have been identified that could affect the growing of woody plants in farmers' land holdings. Of oll respondent about 90% raised as farm size and feragmented extension serevice affects the expansion of agroforestry practice in area.this result was agre with finding of [17] who identifies farm size and poor extension as the main problem of agroforestry practice in Kenya sepecifically Kapsaret local area.The nature of the constraints depends on the land uses in which the woody plants are to be grown. For example, land scarcity and shortage of native seedlings were the predominant constraints for the establishment of Agrofrestry system and practice. For boundary planting the major problem cited is the shortage of tree indigenous seedlings. And, in homesteads, the absence and shortage of appropriate tree species that can be complementarily grown in such niches is a major constraint. In general, in most of the niches, seedling shortage has been identified as the predominant constraint. The nearby state nursery has been the major source of tree seedlings observed in the holdings of the farmers but this nursery was give focus on exotic species. Lack of awareness was also raised as problem affecting expansion of Agrofrestry system in the area.

CONCLUSION

The results of this study have shown that multilayer homestead involving crops and animals, multipurpose trees and shrubs on farm land and as shelter belt and wind breaks (At farm boundary) are the common traditional agroforestry practices in the study area. From these agroforestry practices, farmers have been acquiring diversified types of benefits for their means of livelihood.Although farmers in the study area have been obtaining various types of benefits from these traditional agroforestry practices, they still depend on the surrounding natural forest for different uses and services. These dependencies on the natural forest put the forest resources under serious pressure and have profound effects on the biodiversity of the forest ecosystem, often leading to the change in species composition and vegetation structure of the forest.In line with these problems, farmers in the study area perceived positively towards the future potential role of agroforestry in natural forest conservation. It was also recognized that future development of agroforestry would help to provide different uses and services, which were being obtained from the natural forest by the local community and thus bring down the dependency on the natural forest. Various factors have been identified that could affect the growing of woody plants in farmers' land holdings like land scarcity and shortage of native seedlings were the predominant constraints for the establishment of Agrofrestry system and practice. Lack of awareness was also raised as problem affecting expansion of Agrofrestry system in the area. Therefore, the introduction and development of agroforestry practices around the remaining natural forest area could help to attain both the intended development and conservation objectives.

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