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Impact of Land Certification on Sustainable Land Use Practices: Case of Gozamin District, Ethiopia

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Abstract: Agroforestry is attracting considerable attention in Ethiopia because of its potential for sustainable land use practices. As land tenure insecurity is a major limiting factor for sustainable land use practices in Ethiopia and developing countries in general, the Ethiopian government launched a rural land certification program to secure land tenure. There are limited empirical studies about the impacts of land certification on sustainable land use practices. To fill this knowledge gap, this study was outlined for an area in the Ethiopian Gozamen district. It investigates the impact of land certification on sustainable land use practices and is focused on factors affecting tree plantation based on a household survey, key informant interviews, focus group discussions, and field observations. The results of the study showed that the majority of the respondents practiced sustainable land use practices after their land was certified. Therefore, land certification has a great contribution on sustainable land use practices. In addition, age, consultancy, land size, education, and nurseries proved as significant factors for tree plantation. As access to land is a basic socio-economic precondition for sustainable agriculture and forestry in developing countries, tenure security is a key pathway for the development of the poor and it contributes essentially to achieve sustainable development goals.

Keywords: land certification; tenure security; sustainable land-use; agroforestry

1. Introduction

Land is the most fundamental assets in the agricultural sector as it is the gateway through which people gain access to many other assets and opportunities [1] and the key socio-economic asset for the livelihood of the majority of rural people in developing countries like Ethiopia and major contribution to the GDP (Gross Domestic Product) [2,3]. As a result, for instance the Ethiopian economy is mostly based on agriculture, with industry and services slightly increasing recently [4]: Agriculture accounts for 46% of GDP, 80% of export value, and about 73% of employment [5]. About 85% of the country population of close to 79 million lives in rural areas primarily depending on using their labor and land resources to meet their welfare needs [6]. As a result, access to agricultural and forest land is a key factor for the sustainability of agricultural activities and rural livelihoods of Ethiopia.

Agroforestry is one of the dominant agricultural systems in the Sub-Sahara Region including Ethiopia, Malawi, Nigeria, Tanzania, and Uganda as trees on farms contribute to household incomes and welfare by delivering sizeable economic benefits to the rural population and by providing ecosystem services [7].

Even though agroforestry is the oldest traditional practice and common practice in the agriculture system of Ethiopia [8], it is still accounted as a modern land use system today and has attracted considerable attention in recent years because of its potential to provide ecological and economic benefits, enhancing the resilience of smallholder livelihoods through the provision of ecosystem services [9]. Therefore, trees have multiple roles in the rural livelihoods of Ethiopia. Generally, trees outside the forest are key components of Ethiopian agriculture since they contribute essentially to reducing land degradation, to improving soil fertility, to mitigating climate change, to sustaining crop production, to conserving biodiversity, and to improving food security [10–15]. Moreover, tree planting provides rural households with timber products for their own use as well for sale [6,15]. In addition, tree planting contributes to diversify products and minimize risks of production failures. Non-timber forest products in Ethiopia contribute a significant role in the GDP of the country and livelihoods of the people [16–18].

However, in developing countries in general and in Ethiopia in particular, land tenure insecurity is the major limiting factor for tree plantations and other sustainable land use practices. As a result, land degradation and deforestation are the major problems of Ethiopian agriculture. Studies give evidence about an increasing deforestation and an increasing land degradation in Ethiopia due to different factors. Land tenure insecurity is one of the major underlying causes of deforestation and land degradation and with it, unsustainable land use practices [6,15,19–23]. Similarly, [22,24–32] explain that land certification has a positive impact on land investments, such as tree planting, terracing, applying manure, and increasing agricultural productivity. Studies in Ecuador, Malawi, and Southern Burkina Faso come to similar concepts related to tenure security and tree plantations. For example, [33,34] reveal that insecure land rights in Africa are the major reason for households not to plant trees and not to apply other sustainable land use practices. Also in Latin America and Asia, tenure recognition could spur significant average gains to agricultural productivity, to the reduction of deforestation rate, and to strong positive gains to investment [35–37].

In the former times, there was a frequent land redistribution in Ethiopia, which resulted in land fragmentation, underutilization of land and tenure insecurity [2,7,19,24,25,38–42]. Nowadays, the government of Ethiopia is focusing on sustainable land use practices as well as on restoring the degraded landscapes. Thus, the government draws attention to tree plantation and to other sustainable land use practices, such as terracing and composting. Planting trees on the degraded landscape as well as integrating trees with different crop types are proper measures for rehabilitating the degraded landscapes and for improving rural livelihoods.

Cognizant of the adverse effects of tenure insecurity on sustainable and long-term land use practices, the government of Ethiopia launched a modern land registration and certification program in 1998. [43] note that Ethiopia has implemented one of the largest, fastest, and least expensive land registration and certification reforms in Africa. In Gozamin district, which is a part of Ethiopia, the land certification process was launched in 2004. As a result, the first level of the land registration program, which is the provision of land certificates to land owners, is almost completed in Gozamin district. Currently, the second level of the land registration system, which is the delimitation of parcel boundaries, is carried out.

Rural land registration and certification programs have been implemented in different regions of Ethiopia since 1998. The major objectives of the land registration program are the provision of land tenure security and the improvement of land use practices. The "Land possession certificate book" documents the name of the owner/s, the photograph of the owner/s, the size and location of the land, as well as the boundaries of the plot. In addition, statements indicate the rights and responsibilities of the land owner/s. In 1998, the first level of land registration and certification program started in

the Tigray region, followed in 2002 in the Amhara region, and 2004 in the Oromia region as well as in the South Nation and Nationalities of Peoples (SNNP) region. Currently, the second level of the land registration program is launched in all regions of the country. The first level of land registration is less expensive and does not require such an amount of higher professional experts than the second level of land registration. The rural land registration program in Ethiopia is one of the world's largest land programs and the implementation is done properly [6,43].

In general, land reform is a critical issue to maintain sustainable development goals in developing countries. Thus, in recent years governmental and non-governmental organizations give attention to these issues to improve rural livelihoods as well as to reduce poverty. Land reform in developing countries is a prerequisite for the development of the country as well as for the improvement of rural livelihoods. In large parts of the third world land reforms are now more urgent than ever before. Land ownership has become more concentrated during the past decade and this is all the more significant in developing countries such as Africa, Asia, and Latin America as the large majority of the population derives its income from farming [44]. Therefore, land reform provides secure and equitable rights to productive land for the rural poor and contributes to social and ecological sustainability [45]. This allows the poor not only access to land, it also contributes to employment, non-farm activity, GDP growth and distribution, as well as to the improvement of the village status and power of the poor [46]. Generally speaking, inappropriate land policies and programs are important constraints of economic, social, and ecological development.

In addition, evidences show that other factors and variables affect tree plantation as well as other sustainable land use practices. Land size [7,31,47–53], tree nursery [50,54], extension services and getting consultancy [28,31,49,52,55], age [52,56,57], and education [47,50,51,53] are major factors for sustainable land use practices including tree plantation.

Even though there has been remarkable progress in land registration and certification in Gozamin district, there are insufficient scientific investigations and empirical evidences about the impact of land certification on sustainable land use practices and other factors for tree plantation. Hence, to fill this knowledge gap, the study focused on analyzing the impact of land certification on sustainable land use practices (SLUP) and on identifying key factors affecting tree planting in Gozamin district.

With this study, the outlined knowledge gap should be filled. The general objective of the study is to assess the impacts of rural land certification on SLUP in Gozamin district. So, the relationship between land certification and land use practices should be examined, key factors affecting household tree planting decisions should be identified, and it should be surveyed, if rules and regulations of tree planting in land registration program are applied. According to these research objectives, the general question of the study is: Do rural land possession certificates have an impact on sustainable land use practices? The research was split into the following sub-questions:

1. What impact does land certification have on the decisions of the households to apply sustainable land use practices?
2. Is there a change in the number of trees before and after land certification?
3. What are the key factors for households' decisions on tree planting?
4. Does the land register proclamation contain any rules and regulations for tree plantation?

2. Materials and Methods

2.1. Study Area

The study was conducted in Gozamin District / Wereda (Figure 1). Gozamin district is located in the East Gojjam Zone of Amhara Regional State of Ethiopia. Gozamin is one of the 18 districts in East Gojjam Zone and it has 25 rural Kebeles (a Kebele is the lowest administrative level in Ethiopia and equivalent to municipalities). The Gozamin district is situated 265 km south from Bahir Dar, the regional capital city, and about 300 km northwest from Addis Ababa, the national capital city [58]. Gozamin is neighbored by Baso Liben in the South, by the Abay River in the Southwest, separating it

from the Oromia Region by Machakel in the West, by Debay Telat in the Northwest, and by Awabel in the East [38].

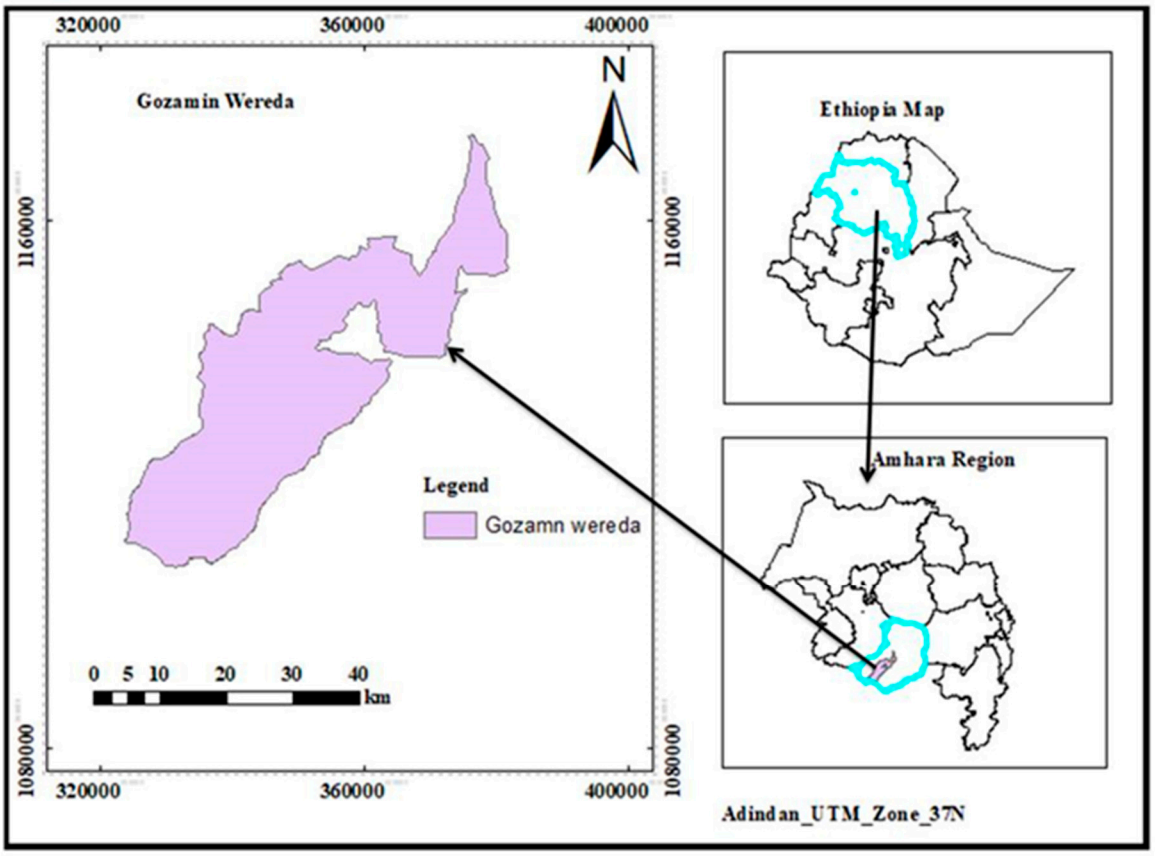


Figure 1. Map of the study area.

The total area of the district is 1218 km^2 with a population density of 119 inhabitants per km^2 [59]. The district has a total population of 153,151, of whom 75,320 are male and 77,831 are female [60]. Of the total population, 4314 are inhibited in urban areas and the remaining 148,837 are rural inhabitants.

2.2. Sampling Techniques

Stratified random sampling was applied to determine the sample size of the study. Two rural Kebeles of the district, Wonka and Fendiqa, were randomly selected. According to the land administration office of the district, landholders were classified into three categories: male-headed (households with land registered and certified to name of the male), female-headed (households with land registered and certified to name of the female) and joint (households with land registered and certified to name of the male and female). All 2705 total landowner households of the two Kebeles were the sample frame (N) of the study (Table 1).

Table 1. Total population of the sample Kebeles and sample size determination.

Kebele	Total Population (N)				Total Sample Size (n)			
	Male	Female	Joint	Total	Male	Female	Joint	Total
Wonqa	289	570	683	1542	37	73	88	198
Fendiqa	296	338	529	1163	38	44	68	150
Total	585	908	1212	2705	75	117	156	348

To determine the sample size (n) of the study, the statistical formula according to Yamane (1997), cited in [61], was used. The calculation of the sample size (n) was based on a 95% confidence level and 5% sampling error. Thus, the sample size (n) of the study was 348 respondents. The sample respondent from each kebele was assigned by the probability proportional to the size principle (Table 1). Finally, a simple random method of sampling was used in selecting the actual sample size in line with the number of respondents assigned to each sample category.

2.3. Methods of Data Collection

Primary and secondary data were collected through different data collection methods. The primary data were collected from three key informants, from 348 sample respondents, from two focus group discussions (separated male and female groups, 11 male and 14 female persons), and from the field observations. Structured interviews were held with 348 landholders. Key informant interviews were conducted at zonal, district, and kebele level with two land administration experts and one forest expert. The members of the focus groups as well as the experts participated voluntarily. The primary data were used to identify different factors in order to explain the response variable tree planting, where households either plant trees (1) or not (0) in the light of a set of different factors according to Table 2. The list of factors was derived from a literature survey and from an analysis of government reports and proclamations.

Table 2. Variables of the study: Definition and measurements.

Variables	Definition and Its Measurements
Age	The respondents age (0, 1, . . . , n)
Education	Able to read and write (Yes = 1; No = 2)
EducInst	Education institution attended (Formal = 1; Informal = 2)
Years	Formal years of schooling (0, 1, . . . , n)
Labor	Households labor availability in terms of Man equivalent (0, 1, . . . , n)
Landsize	Total land size in hectare (0, 1, . . . , n)
Certificate	Year of land possession book obtained (0, 1, . . . , n)
After	Total number of trees planted after land certification (0, 1, . . . , n)
Before	Total number of trees planted before land certification (0, 1, . . . , n)
Woodlot	Planting on a separate area (Yes = 1; No = 2)
Boundary	Planting on the boundary of the farm (Yes = 1; No = 2)
Farm	Planting trees integrating with crops (Yes = 1; No = 2)
Homestead	Planting trees around the home (Yes = 1; No = 2)
Compost	Composting after land certification (Yes = 1; No = 2)
Terrace	Terracing after land certification (Yes = 1; No = 2)
Nursery	There are tree nursery sites around the village with proper accessibility for the farmer (Yes = 1; No = 2)
Private	The government encourages private tree nursery sites (Yes = 1; No = 2)
Market	There is a favorable market (Yes = 1; No = 2)
Credit	There is a formal credit institution for tree plantation (Yes = 1; No = 2)
Road	There is comfortable road (Yes = 1; No = 2
Seedlings	Obtained sufficient seeds and seedlings (Yes = 1; No = 2)
Consultancy	Obtained consultancy from experts concerning tree plantation (Yes = 1; No = 2)
Demos	Visited tree plantation demonstration sites (Yes = 1; No = 2)
Training	Are you participated in tree plantation related trainings?
Advantage	Advantages of tree planting (Strongly agree = 5; Agree = 4; Undecided = 3; Disagree = 2; Strongly disagree = 1)
Disadvantage	Disadvantages of tree planting (Strongly agree = 1; Agree = 2; Undecided = 3; Disagree = 4; Strongly disagree = 5)
Perception	Perception about the advantage of tree planting (Disagree = 1; Agree = 2)

2.4. Methods of Data Analysis

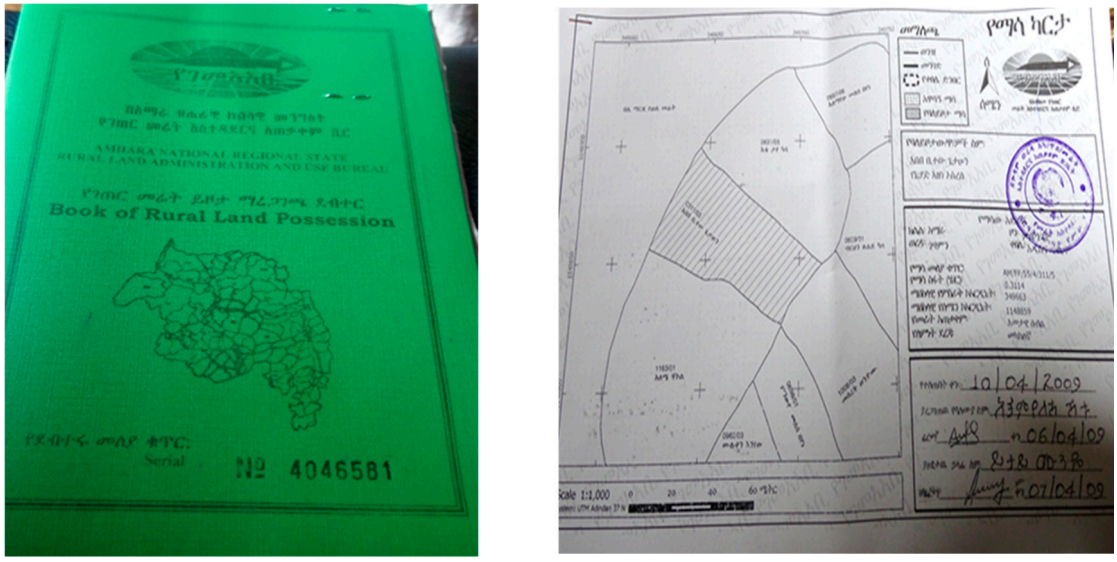
A mix of quantitative data analysis using SPSS version 24, and qualitative data analysis was performed. Both descriptive and inferential statistics were employed. Descriptive statistics, such as frequency, percentage, mean and standard deviation along with the appropriate inferential statistical tests, mainly t-test (both independent and paired sample t-test) and chi-square test, were used. The non-parametric Mann-whitey U-test was used to assess the perception of the household about the advantage and disadvantage of planting trees. Finally, binary logistic regression was applied to analyze the general factors affecting households' decisions on tree planting.

3. Results

In this chapter, the results of single variables and key factors for tree-plantation as an indicator for sustainable land use practices are presented and identified.

3.1. Land Use Practices after Land Certification

The first level of land registration provides land possession certificates to the rural households. This process is almost completed in Gozamin district. A rural land possession certificate book (Figure 2a) is issued either for joint households—by the name of both the husband and wife—or individually by the name of the male or of the female. Totally, 45% of the household have a joint title certificate book, 34% of the households a female, and 21% of the households a male land possession certificate. The second level of land registration determines detailed spatial information of the parcel (Figure 2b).



(**a**) (**b**)

Figure 2. Rural land registration and certification: (**a**) Land possession certificate book; (**b**) Parcel map in the second level of land registration.

Of the total sample, 64% of the respondents plant trees after they receive the land possession certificate. In addition, 73% of the respondents apply compost and 69% of them construct terraces. These practices indicate a shift towards the sustainability of rural livelihoods and agricultural systems in Ethiopia. The study indicates that the mean number of trees planted after land certification is greater than before land certification (Table 3).

Table 3. Total number of trees planted before and after land certification.

Total Number of Trees Planted	Mean	N (Total Respondents)	Std. Deviation	*p*-Value
Before land certification	634	348	993	
After land certification	788	348	867	0.000
The change (After-before)	153	348	134	

A paired sampled t-test indicates a positive and significant mean difference ($P < 0.001$) of the number of trees planted before and after the household received the land possession certificate (Table 3).

Figure 3 documents that trees are planted as a woodlot, by mixing them with different types of crops (on-farm), on the boundaries of the farm, and around the home. The majority of the respondents plant trees around their home (homestead) and on the boundaries of the farm.

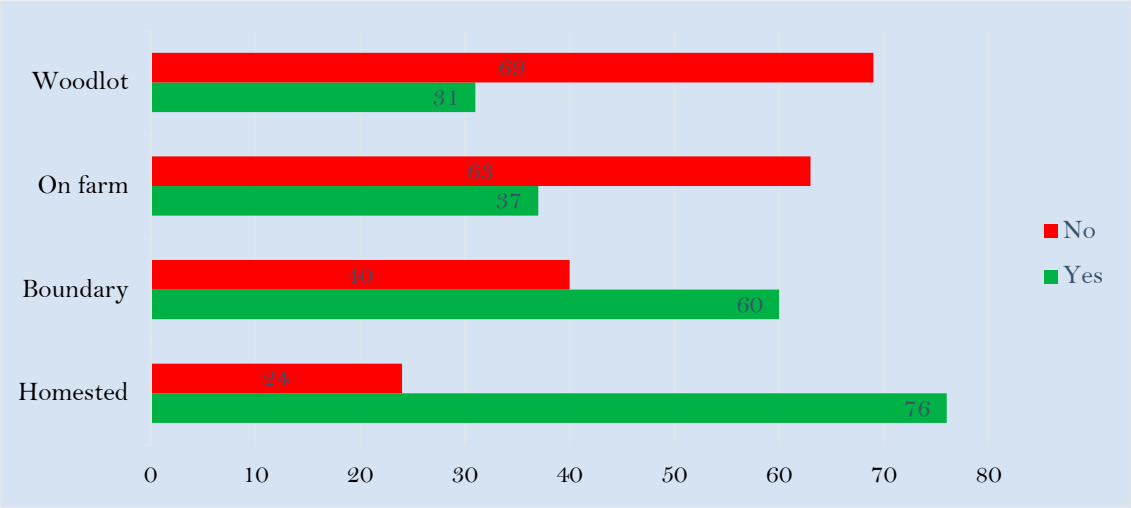


Figure 3. Tree planting techniques in percentage according to respondents' response.

3.2. Land Size

In the study area, the average land size of the sample household is 1.3 ha. The maximum and minimum land size ranges between 3.00 ha and 0.25 ha, respectively. The result of the study indicates that respondents hold small parcels of land. This corresponds to observations that the average farm sizes in Ethiopia are small with more than 85% of farming households operating less than two hectares [62]. According to Figure 4, households planting trees have a larger average land size (1.3 ha) than those who do not plant trees (1 ha). The t-test revealed a significant mean difference ($p < 0.00$) of land size between those households who planted and did not plant trees.

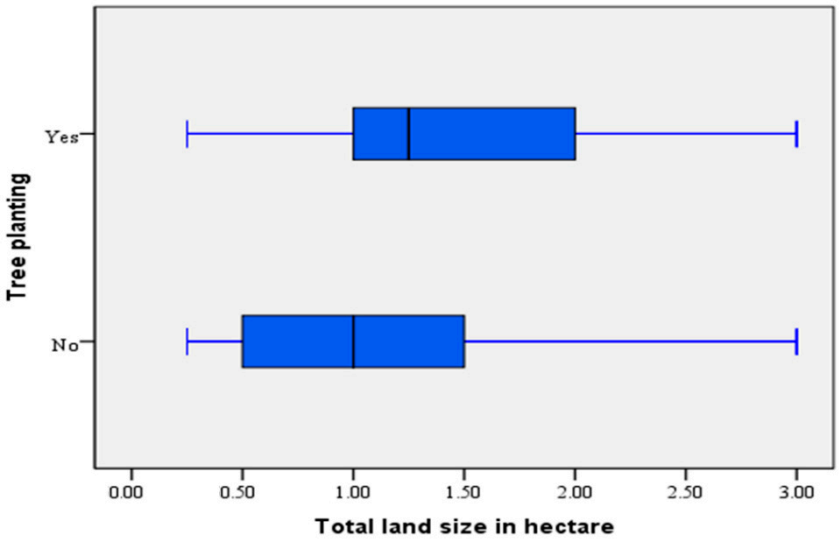


Figure 4. Households land size distribution.

3.3. Age of the Respondents and Labor Availability

The mean age of the total sample respondents is 48 years with a standard deviation of 11 years. Table 4 shows that the mean age of sample respondents who plant trees is less than the mean age of respondents who do not plant trees. The statistical analysis of an independent sample t-test reveals that the mean age differences between the two groups is significant at $P < 0.05$ (Table 4).

Table 4. Sample respondents mean age and labor availability distribution and its relation with tree planting decision.

Variable	Plant Trees	N	Mean	Std. Deviation	*p*-Value
Age	Yes	224	48.00	11.00	0.028
	No	124	50.00	11.00	
	Total	348	48.00	11.00	
Labor	Yes	224	2.92	1.09	0.004
	No	124	2.56	1.12	
	Total	348	2.79	1.11	

Labor is an important household resource to undertake different agricultural practices. The amount of household labor availability is measured by a man-equivalent conversation factor (Appendix A (Table A1). As documented in Table 4, the overall mean labor availability of sample households in terms of man equivalent is 2.79 with a standard deviation of 1.11. The average number of the available labor force in terms of man equivalent for those households planting trees and not planting trees is 2.92 and 2.56 respectively. The outlined *t*-test verifies labor mean differences between the two groups at 1% significance level. This indicates that labor has a positive and significant relation with tree planting.

3.4. Educational Status and Farmers' Perception

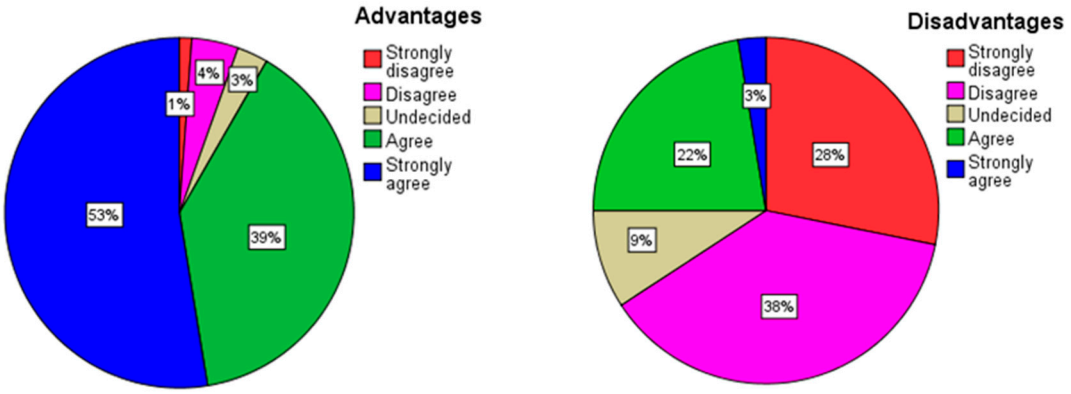
Of the total sample respondents, 60% are illiterate (could not read and write) and the remaining 40% literate (Table 5). In addition, 19% of the respondents attended formal schools and 21% were educated in informal institutions (Table 5), for example, in orthodox churches. Of those who attended formal education, the average year of schooling was 5 years (grade 5) while the maximum and minimum years of attended formal education was 2 (grade 2) and 10 (grade 10) years respectively.

Table 5. Educational status of the head of the households.

Educational Status	N	Percent
Attended formal education	67	19
Attended informal education	72	20
Illiterate/cannot read and write	209	60
Total	348	100

The study investigates the association between tree planting and educational status of the head of the households. A chi-square test used to examine the differences between the groups shows that the relation between tree planting decisions and the educational level of the head of the households is significant ($p < 0.001$). The survey includes farmers' perception about the advantages and disadvantages of tree planting by Likert scale type questions. Respondents rate the statements related to different advantages as well as disadvantages of tree planting. Statements related to the advantages of tree planting include an increase in soil fertility, a prevention of soil erosion, an increased household income, provision of fodder for livestock, as well as a reduced drought and erratic rainfall. Disadvantages of tree planting are related to the need of high skill, to labor intensiveness, to the occupation of space for growing crops, to long-term yield, and to reduced crop yield.

To understand the respondents' perception, the medians of the advantages and disadvantages of all statements are calculated separately. As documented in Figure 5, the majority of the respondents perceives the advantages of tree planting positively and strongly. Fifty-three percent strongly agree and 39% agree with the advantages of tree planting. Only a few respondents perceive the advantages negatively.



(**a**) (**b**)

Figure 5. Farmers' perception about tree planation: (**a**) Percentages of the advantage; (**b**) Percentages of the disadvantage.

The perception of the disadvantages of tree planting also are surveyed: 28% strongly disagree, 38% disagree, 22% agree, 3% strongly agree with the outlined disadvantages, and the remaining 9% could not decide.

The majority of the respondents does not agree with the disadvantages of tree planting. This implies a positive perception of the respondents about tree plantation. As a result, the vast majority of the respondents perceived tree plantation positively. In addition, during the focus group discussions, the participants realized well which tree species can improve soil fertility.

With a non-parametric test (Mann-Whitney U-test) the association between the perceptions of farmers and their decisions on tree planting is assessed. The perceptions about the advantage of tree plantation and about decisions of the households are statistically significant ($P < 0.001$).

3.5. Institutional Related Variables

Another aim of the study is to assess the relevance of institutional factors for tree plantation practices. Such factors are extension and infrastructural services.

The extension system in Ethiopia has a great potential to support farmers by facilitating the adoption process of new and improved technologies and practices. According to [63], the major goals of the extension system in Ethiopia are to contribute significantly to the attainment of food and nutrition security, to poverty reduction and to wealth creation. All of them can be achieved by adapting technologies, as well as by delivering market-oriented, demand-driven, and pluralistic extension services. Agricultural extension services are important factors to improve farmers' livelihood and the adoption of agroforestry practices. As the provision of technical as well as non-technical skills and experiences are very important for rural households to improve their livelihood, the study also investigates whether institutional and extension services are in line with tree plantation.

As documented in Table 6, 145 (42%) respondents reply that there is a favorable market for seedlings and for tree products. One-hundred and forty (40%) respondents say that there is a comfortable road to the market and to nursery sites. Fifty-five of all respondents (16%) participated in tree planting related trainings, and one-hundred and ten (32%) got tree plantation consultancy from experts. Thirty-five (10%) of the respondents visited forest demonstration sites. Of the listed variables in Table 6, the availability of roads, trainings, and consultancies are significantly associated with tree planting decisions of the respondents.

Table 6. Institutional related variables.

			Planting Trees		Total	
			No	**Yes**		***p*-Value**
Is there is a favorable market for seedlings and tree products?	**Yes**	**N**	44	101	145	0.82
		%	30	70	100	
	No	N	80	123	203	
		%	39	61	100	
Is there a comfortable road to the market and nursery sites?	Yes	N	36	104	140	0.002 **
		%	26	74	100	
	No	N	88	120	208	
		%	42	58	100	
Are you participated in tree planting related trainings?	Yes	N	13	42	55	0.043 **
		%	24	76	100	
	No	N	111	182	293	
		%	38	62	100	
Did you get consultancy from experts concerning tree plantation?	Yes	N	24	86	110	0.000 ***
		%	22	78	100	
	No	N	100	138	238	
		%	42	58	100	
Have you visited tree plantation demonstration sites?	Yes	N	8	27	35	0.096
		%	23	77	100	
	No	N	116	197	313	
		%	37	63	100	

, * indicates significant at P < 0.05 and P < 0.001 respectively.

The figures give evidence about the weak coverage of institutional services concerning tree plantations. There are 2068 private and six governmental tree nursery sites in Gozamin district. The private nurseries produce 20,000,000 seedlings per year, while the governmental tree nurseries produce 3,000,000 seedlings per year. However, the majority of the respondents, which is 70%, perceives a lack of nursery sites at local level. Out of the respondents with a nursery site around their village, 76% plant trees. Thirty-one percent of the respondents state that the government encourages private tree

nursery sites. Eleven percent of the total respondents obtained sufficient tree seeds and seedlings from governmental nursery sites, whereas the majority of the respondents (89%) did not get sufficient tree seeds and seedlings. The chi-square test confirms a significant association ($p < 0.01$) of the likelihood of tree planting and the availability of tree nursery sites.

The majority of the respondents are not satisfied with the road and market situation and argue that there is a weak market situation for wood and other tree products. For instance, the farmers state a lack of fixed places to sell wood and other tree products, as every time the government authority forces them to change the place. In addition, there is no organization in the district, which gives credit service for tree plantation. Moreover, participants of the focus group discussed the problems of the absence of a comfortable road to the market and nursery sites. One participant state the problem (Box 1) as follows:

Box 1. Cases of the absence of comfortable road to the nursery site.

"Tree seedlings should be planted during the winter/rainy season but we could not go to the nursery site during this time due to the bad condition of the road: it is so difficult to walk on the road in the rainy season because of the stickiness of the mud and bad quality of the road. Moreover, there is no bridge to cross the river. Extension agents also suffer from this situation. Last time the government has started to build the bridge in our village, but I do not know why it did not accomplish yet so that our community is in trouble to cross the river and to go to the nursery site during the wintertime"(Participant from the focus group discussion).

3.6. Key Factors Affecting Tree Planting

As trees have diverse benefits, it is very important to identify the key factors for tree plantation to improve the spreading of SLUP. Binary logistic regression is employed to assess the key factors that affect household's decisions of tree planting in the study area. The following ten expected explanatory variables are entered into the logit model: age, labor, education, land size, land certification, nursery, road, training, consultancy, and perception. The analysis is carried out by using the forward stepwise likelihood ratio (Forward: LR) method [64].

Table 7 depicts that the variables age, education, land size, nursery, consultancy, and land certification are significantly associated with household's decision of tree planting. The omnibus test of the model shows that the model is significantly fit (chi-square = 55.250, P = 0.000). Another indicator of the goodness of the model is the Hosmer and Lemeshow test [64]. The value of the applied Hosmer and Lemeshow test is greater than 0.05 (p = 0.109), which proves the goodness of the model. In addition, the model correctly classifies 72% of the overall cases.

Table 7. Logit model of key factors affecting tree planting in the study area.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Age	−0.034	0.012	8.658	1	0.003 **	0.966
Education	0.662	0.259	6.541	1	0.011 *	1.939
Land Size	0.519	0.172	9.145	1	0.002 **	1.680
Nursery	0.622	0.286	4.728	1	0.030 *	1.863
Consultancy	0.741	0.285	6.744	1	0.009 **	2.098
Certificate	0.928	0.306	9.213	1	0.002 **	2.528
Constant	0.267	0.594	0.201	1	0.654	1.305

B (coefficients); S.E (standard errors); Wald (Wald chi square); df (degree of freedom); Sig. (*p*-value); Exp(B) (odds ratio). **, * significant at P < 0.01 and P < 0.05 respectively.

4. Discussion

In Ethiopia, unsustainable land use practices cause land degradation and threaten agricultural production. Therefore, SLUP are important to improve rural livelihoods and agricultural productions. Agroforestry trees are important indicators of sustainable land use practices since they have a great

role in economic and ecological sustainability through provisioning of both timber and non-timber forest products [65].

The land registration and land certification program is a recent initiative in Ethiopia to improve land use practices by providing tenure security of rural households. As shown in this study, the greater number of the households has joint and female-headed land possession certificate books. Amhara Regional State in general and Gozamin district in particular are concerned to promote joint land certification to ensure gender equality in land rights. As a result, Gozamin district is pushing to ensure joint and female land possession certificates. This is a great change in Ethiopia to improve gender equality in terms of land rights. Past Ethiopian regimes denied land rights for women.

The major objective of the study is to assess sustainable land use practices after land certification. The study identifies that the majority of the farmers practice more sustainable land use after they received their respective land possession certificate book. As outlined above, the planting of trees is a very important practice for sustainable land use. Therefore, another predominant objective of the current study is the identification of key factors influencing households to plant trees. Certification, land size, age, consultancy, education, and tree nurseries are identified as the most significant factors (Table 7), which discussed in the following paragraphs.

4.1. Certification

Land certification contributes to tree planting significantly ($P < 0.01$) and positively. The current land registry program is reducing frequent land redistribution, is improving land tenure security of rural households, and is encouraging landowners to initiate long-term investments, i.e., planting trees. As land certificates secure land tenure rights of the households, the households with certificates are more interested in planting trees on their plots of land. The logit model indicates that by keeping other explanatory variables constant, the odds in favor of planting trees are increased by a factor of 2.528 for those households, whose land is certified longer than eight years ago. Similarly, the majority of the participants stated during focus group discussions that land certification increases their tenure security and it creates a sense of ownership of the land. They perceived that land certification increases their opportunity for planting trees and triggers them to practice more sustainable land use because the land belongs to themselves. There is no fear that someone could take the land at any time. They are satisfied that they can transfer ownership of the land to their families and/or to another person. Therefore, it is evident that land tenure security encourages farmers for long-term investments. For example, [6] stated that "land tenure insecurity caused by frequent land redistribution had forced farmers in Ethiopia to favor short-term exploitation of land resources over long-term conservation, contributing to land degradation and low farm productivity".

The study gives evidence by the household questionnaire as well as by the key informant interviews that the number of trees planted after land certification increased. All participants agreed that tree planting is increasing in recent years. *Eucalyptus* tree was the dominant species growing in the study area. Key informants indicate that in some districts of East Gojjam Zone, e.g., in Sinan district, farmers shifted from crop cultivators to *Eucalyptus* growers after land certification. *Eucalyptus* is introduced all over Ethiopia, covering large areas of land previously used for food production [66] and making Ethiopia the largest *Eucalyptus* producer in East Africa [67].

According to the participants of the focus group discussion, the major reasons for growing *Eucalyptus* trees are as follows:

- The fast growing of the trees;
- The potential of *Eucalyptus* trees to grow also in degraded land and wetlands;
- The trees do not require large space compared to indigenous trees like *Cordia African;* and
- The trees are highly demanded for fuel and construction purposes

Eucalyptus tree can protect soil erosion and rehabilitate the degraded landscape. [66] find that *Eucalyptus* potentially benefits soil fertility of previously degraded land by extensive cultivation.

Participants of the focus group discussion also underline that they plant *Eucalyptus* trees mainly on the gully erosions and swampy areas, which are not favorable to grow crops. They indicate that compared with other tree species *Eucalyptus* trees can grow in the degraded and marginal land without any treatment.

However, planting *Eucalyptus* will cause sustainability problems in the future due to negative ecological impacts. Due to this reason, the nursery sites of the district, specifically Wonqa Kebele, are focusing on producing indigenous tree species rather than *Eucalyptus* tree. This finding is in line with a study by [68] in the West Gojjam Zone of Ethiopia, which points out that farmers prefer to shift their farmlands from producing food crops to tree plantation. Farmers find tree plantation to be more weather shock resilient than seasonal food crop productions, which more often could face seasonal crop failures. The study outlines that substantial parts of the area were converted from cereal crop production to agroforestry land use.

Generally, land tenure security is a crucial factor for the sustainable land use system as well as tree plantation in developing countries. This, in turn, supports rural livelihood sustainability by diversifying their livelihood strategies and initiating for long term investments.

4.2. Land Size

As the size of the land could influence household's preferences of agricultural activities, the study examined the relationship between the household's preferences of tree growing and the household's land size. The investigation identifies the household land size as an important factor in tree plantation. Households with a larger area of land had a higher willingness to plant trees. It is positively and significantly ($P < 0.01$) associated with the households' decisions of tree planting. By keeping other explanatory variables constant, the analysis gave evidence that, when land size is increased by one hectare, the probability of the households to plant trees increases by a factor of 1.680 (Table 7).

Similarly, participants of the focus group reported that the small size of land is a major reason for not planting trees. They say that they would like to plant more trees, but they have not enough land to plant trees. For example, two female participants from the focus group discussion shared their experience as follows (Box 2):

Box 2. Case study about land shortage problem.

Case 1: "I am a married woman and have six children. We have one timad (timad is the traditional land size measurement, which is equals to 0.25 hectare) of farmland, which is not enough to produce sufficient crops for my families. We would like to grow trees but how can we grow on this small size of land; we have no other plots to grow trees. Moreover, I have worried about my families for the future time as what I will inherit to them" (Female participant from focus group discussion).
Case 2: "I am married, have 8 children, and 2 timad (0.5 hectare) of farmland. My children are young enough to make any investments on the land, but they could not do anything due to the shortage of land. The land is not enough for them and I could not inherit the land for them. Due to this reason, they went to the town to search a job and now they are labor workers as there are no other alternatives to lead their lives. Land is a critical problem; the majority of youth in my village have no land, but old people owned large size of land. The government should consider this situation and should distribute the land to the rural youths since they are active labor of the country" (Female participant from focus group discussion).

There are different techniques of tree planting in the study area (Figures 3 and 6). The majority of the respondents plant trees around their home and on the boundaries of the farm. This is because the landholding size of the farmers is very small and farmers are mostly interested in growing short-term crops on their plots of land to lead their livelihood. As a proper alternative, households with a small amount of land are planting trees around their home and/or on the boundaries of their farmland.

Figure 6. Example of tree planting techniques: (**a**) & (**b**) Trees dispersed on the farmland; (**c**) & (**d**) Trees on the boundary of the farm; (**e**) Woodlots; (**f**) Trees around the home/homestead trees.

According to the key informant interviews, the district has identified different agroforestry tree types/species, which are suggested to be plant in different landscapes. Table 8 documents the categories of agroforestry trees and the predominant tree types for the specific category. Farmers are recommended by experts to plant trees in different sites accordingly to maintain SLUP.

Table 8. Agroforestry tree types for different landscapes/sites.

Site	Tree Types/Species
Wood lot	*Eucalyptus spp, Vernonia amygdalina, Acacia decurrens*
Homestead	*Cordina africana, Eucalyptus spp, Rhamnus prinoides, Croton macrostachyus, Acacia decurrens, Suspania susban, Lucera tree, Carissa spinarum, Cupressus lusitanica, Cauarina equsetifolia, Cauarina equsetifolia, Olea Africana.*
Dispersed on the farm	*Corton macrostachyus, Acacia albida, Albezia gumufera*
Boundary of the farm	*Gravillea robusta, Acacia decurrens, Eucalyptus spp* *
Multistory	*Cordina Africana, Papaya spp, Mangufera indica, Coffea arabica, Rhamnus prinoides, Citers spp, Guava spp, Banana spp and etc.*
Soil bund	*Suspania susban, Lucera, Vetiver ** and Desho **
Gully erosion	*Acacia decurrens, Acacia saligna, elephant grass **

* should be planted at least 17 to 20 meter away from the crop farm; ** grass species.

Despite the fact that the households have small land size (0.25 ha to 3 ha), they do not apply improved technologies and practices. Key informant interviews document that backward and inappropriate technologies raise also problems for SLUP. One key informant stated *" . . . .we are still using backward traditional farming systems and inappropriate land management practices. Farmers are still farming by oxen and so they get small output per plot".*

Land shortage is a general problem of the Ethiopian population. However, misuse of land due to inappropriate policies is also a limiting factor for SLUP. For example, there is still abundant land, which is not covered by forests and trees until now. This can be seen as an indicator for inappropriate policies and technologies exacerbating unsustainable land use practices.

Moreover, the current rural land administration and land use proclamation focuses only on the legal frameworks of land administration. The proclamation is not addressing legal frameworks for land use practices. Until now, the main objective of land administration officials is to enable land tenure security by providing a land-holding certificate book. A legal framework about how to use the land is still missing. Only article 13 of the Proclamation No. 456/2005 covers some land use issues including tree planting on sloppy land, e.g., "Land use planning and proper use of sloppy gully and wetlands": "Rural lands, the slope of which is more than 60 percent, shall not be used for farming and free grazing; they shall be used for development of trees, perennial plants and forage production".

4.3. Tree Nursery

The establishment of tree nursery sites around the community is essential to develop forestry and agroforestry, as it supports the restoration of degraded land by afforestation and reforestation [14]. In Wonqa Kebele, there is only one governmental tree nursery site—"Wonqa Kebele Forest and Agroforestry Nursery Site" (Figure 7). It is one of the six governmental nursery sites in the district. According to an expert working in the nursery, the governmental nursery sites produce different tree seedlings, such as Coffee, Avocado, Mango, Acacia, Croton macrostachyus, Casuarina cunninghamiana, but no *Eucalyptus*.

(**a**) (**b**) (**c**)

Figure 7. Wonqa Kebele Forest and Agroforestry Nursery Site: (**a**) Matured coffee seedlings ready to be distributed to farmers; (**b**) Small size coffee seedlings; (**c**) Grass seedlings.

The study identifies the availability of tree nursery sites as another prominent factor of tree planting in the study area. Tree nursery sites have a significant ($p < 0.05$) and positive impact on households´ decisions on tree planting, but they have to be accessible on roads. The probability of planting trees increased by a factor of 1.863 for those households, who had access to tree nursery sites (Table 7). Therefore, tree nursery availability with a proper accessibility for the farmer is a prerequisite for sustainable land use practices and for the maintenance of ecological sustainability.

4.4. Consultancy

Getting any support from extension agents and/or forest experts is another relevant factor for tree plantation in the study area. Consultancy from experts is very important to change the attitude of people and to share knowledge, skills and experiences. Extension agents in Ethiopia have a great potential to support the acceptance and improvement of land use practices and technologies. As discussed before, the majority of respondents cannot read and write nor do they have extensive access to mass media. Any innovative information from experts contributes to change the perception and attitude of the people. Therefore, getting consultancy from the extension agents related to agroforestry practices is a significant factor to plant trees as well as to apply improved land use practices on their plots of land. Consultancy from experts related to tree plantation was found to have a positive and

significant ($P < 0.01$) impact on tree growing. By keeping other variables constant, the odds in favor of planting trees are increased by a factor of 2.098 for those households, who get a consultancy concerning tree plantation (Table 7). This study gives evidence that getting consultancy from experts is a prominent factor for agroforestry development since the rural people have no direct access to other forms of information like mass media.

The key informant interview identifies advisory services including training concerning forest and agroforestry practices as very important for both the experts and the farmers. There is a shortage of forest experts in the district and in Ethiopia in general. Forest experts are mainly working in higher professional institutions, such as in universities and research centers, but they are hardly involved in consultations for local people. Nevertheless, the district experts give training for the local experts once a year, giving advice for nursery management, tree plantation, agroforestry, tree seed management, etc.

The study identified institutional weaknesses of forest and agroforestry sector in the district. Currently, at Ministry level, the forest administration is separated from the agriculture sector. The responsible agency at the regional and zonal level is called "Environment, Forest and Wildlife Protection and Development Authority". As at district level, the forest sector is not separated from the agriculture sector. Forest experts are mainly doing tasks beyond their profession, such as providing fertilizer and improving crop seeds for farmers. Therefore, the forest sector also should be established at the district level and should work cooperatively with the agriculture sector to guarantee SLUP. Forest experts should get the opportunity to focus their services on forest and tree development practices.

4.5. Age

The age of the respondents is another factor that affects the decision of households to plant trees. Age is negatively and significantly associated ($P < 0.01$) with the decision to grow trees. The likelihood of planting trees decreases with increasing age of the head of the household. According to Table 7, if the age of households' heads increased by five years, the odds ratio in favor of planting trees decreases by a factor of 4.83. Farmers become more reluctant to plant trees when they get older. As a result, to improve sustainable land use practices, any development organizations should consider the age of the landowners.

4.6. Education

The education level has a positive and significant ($P < 0.05$) impact on the decision of the household to plant trees. By holding other variables constant, respondents who can read and write are more likely (1.939 times higher) to plant trees than respondents who cannot read and write (Table 7). Literate persons are more likely to plant trees and to apply SLUP than their illiterate counterparts are. This is because literate person can more easily understand improved and sustainable land use practices, and because they are more flexible than illiterate ones.

5. Conclusions and Recommendations

The most important objective of the current study was to examine the role of land certification on sustainable land use practices. The study confirmed that land certification has a significant and positive impact on household's decision to practice sustainable land use practices, such as planting trees, constructing terraces, and applying compost on their plots of land. Moreover, land tenure security due to land certification stimulates farmers for long-term investments, especially tree planting. As a result, there was a change in the number of trees planted after land certification, i.e., the number of trees increased after a land possession certificate was obtained. Therefore, land tenure security through land certification is a prerequisite for sustainable land use practices. Land tenure security is a key pathway for the development of the poor and contributes to achieving sustainable development goals (SDGs) since land is a basic socio-economic asset of agricultural based economics in developing countries.

As land tenure insecurity is generally a challenge in many developing countries, attention should be given to activities supplying land rights to the people in general and to marginalized groups in

particular. Appropriate land tenure rights should be considered as an entry point for the empowerment of the poor. In Ethiopia, currently land registration and land certification are applied for providing land tenure security. This contributes to the improvement of sustainable land use practices. Thus, other countries, specifically developing countries can learn from this success and emphasize on land tenure rights for the development of their country and for the sustainability of rural livelihoods.

Although land registration and certification has a remarkable impact on SLUP, in Ethiopia a proper and comprehensive land use policy is still missing. The current rural land administration system is not emphasizing on land use regulation. Rural land administration and land use proclamations draw less attention to land use rights. The legal framework is mainly focused on land administration issues. Of course, land ownership and tenure security are basic factors for sustainable land management practices, and they are a good start. Nevertheless, a land use policy for proper land use practices should be established to enforce SLUP. Otherwise, the problem of land degradation and deforestation cannot be solved. This, in turn, might be a threat for the agricultural production and worsen the poverty situation of the country.

Eucalyptus tree is widely planted in the study area. Despite *eucalyptus* having multiple positive impacts on the livelihood of rural households, many studies identified its significant negative effects. The authors of this study suggest focusing on other multipurpose indigenous tree species. Forest experts and other concerned bodies in the study area should promote multipurpose tree species to guarantee ecological sustainability as well as livelihood improvements.

Good organizational and institutional structures are needed to implement tasks and activities efficiently and effectively. There is potential to improve the institutional structure in Ethiopia, as currently forest experts are employed by the agriculture sector and they are responsible for other agricultural activities rather than tree plantation. It is recommended that governmental bodies distinguish between tasks and expertise, and allow for a close collaboration of forest and agricultural experts to enable SLUP.

In addition, there is a weak linkage between the experts and the local people concerning tree plantation. Most of the time, practices and technologies are developed top-down without the involvement of the local people. This situation does not lead to SLUP and sustainable development in general. Indigenous knowledge of the local people should be integrated with the scientific knowledge of the experts to improve SLUP as well as to increase agricultural production.

The development of tree nursery around the community contributes to agroforestry development and ecological sustainability. The government should enable sufficient tree nursery sites for the communities in the district. In addition, they should provide adequate tree seedlings, like *Apple*, *Rhamnus prinoides*, *Mangufera indica*, *Acacia albida*, *Cordia Africana*, *Rhamnus prinoides*, *Croton macrostachyus*, *Acacia saligna*, *Olea Africana*. The government should be supported in this field by non-government organizations, who are focusing on agroforestry development and sustainable land use practices at the local level to enable an accessibility for all community members.

As a final conclusion, a land certification system is an important starting point for sustainable rural development in developing countries. In order to exhaust its full potential, further measures as pointed out in this study have to be taken into consideration to promote sustainable land use practices. Therefore, it is recommended to focus future research activities on sustainable rural livelihood in line with the issue of tenure security and sustainable land use practices.

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Appendix A

Table A1. Conversion factors used to compute man equivalent.

Age Group	Male	Female
<10 years	0.0	0.0
10–13	0.2	0.2
14–16	0.5	0.4
17–50	1.0	0.8
>50	0.7	0.5

(Source: Strok et al., 1991 as cited in [69]).

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