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From Boundary Conflict to Defensive Planting: Drivers of Unplanned Eucalyptus Expansion on Croplands in South Wollo zone, Amhara Reginal State of Ethiopia

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Abstract

Eucalyptus, a debatable tree, is expanding over crop fields (98%). However, literature is scant on the cross-boundary farmers conflict due to Eucalyptus externalities on farmland. This study analyzed conflicts of interest among Eucalyptus growers and crop producers, farmers' perception and drivers of planting Eucalyptus on farmland. Data was obtained from 312 households' interview, key informant interview, focus group discussion, case studies and field observation. Data was analyzed using descriptive statistics, regression, and thematic analysis. Consequently, farmers have been shifting from crop production to Eucalyptus woodlot (72%) for cash, wood, countering neighbor Eucalyptus growers, high price of agricultural inputs and labor shortage. Astonishingly, farmers continue planting Eucalyptus on farmland though they have been experiencing plot boundary conflict (69%), perceived not good practice (63.5%), declines crop productivity (78%), and social impact (91%), should be restricted (83%). The logit model results revealed farmers' decision on Eucalyptus plantation on farmland provoked by age (P<1%), gender (P<1%), plot boundary conflict experience (P<1%) and land size (ha) (P<1%). However, it is negatively affected by family size (P<5%), irrigation (P<5%), non-farm income (P<1%), remittance (P<1%) and plot fertility (P<1%). The findings are a clear clarion call for livelihood diversification so farmers can balance their monoculture income and crop production sustainability. It might be working on attitudinal change, land use dispute resolution among Eucalyptus growers and crop producers, site selection, community discussion, regulations and addressing the identified factors. Further studies are needed on the return from Eucalyptus and crops including dietary diversity differences between Eucalyptus and crops growers.

Keywords: Conflict of interest, Ethiopia, Eucalyptus, neighboring landholders, woodlot

1. Background and Justification

Eucalyptus has been planted and expanding in the world, in Africa and Ethiopia for over a century being overplanted species (Birara et al., 2019; Jaleta et al., 2016; Zerga et al., 2021). Ethiopian rural and urban people are dependent on eucalypts for fuel wood and construction materials since its introduction to the country end of 19th century, 1890s (Jaleta et al., 2016; Zerga et al., 2021). Eucalyptus is a multipurpose tree planted as small scall forestry by smallholder farmers in Ethiopia (Lemenih, 2010). Despite the native forest tree species decreasing at an alarming rate, the general forest coverage increases due to Eucalyptus expansion on bare land, grazing land, and cropland (Daba, 2016; Zerga et al., 2021). From 1999 to 2010 Eucalyptus coverage increased steadily by 55% and meaningfully 69% in 2021 in the country (Tesfaw et al., 2023). It covers 41.8%-66.7% farmland in Ethiopia expanding due to free seedlings, wood demand and income (Belachew & Desta, 2025). Astonishingly, Eucalyptus plantation covered 908.87 ha, 3719.05 ha, and 26261.9 ha in 1991, 2006, and 202, respectively at the expense of fertile crop land in Ethiopia (Molla et al., 2023). Moreover, Eucalyptus coverage rose from 1000 hectares in 2000 to 249,260 hectares in 2023 where about 98% of that expansion was made onto croplands (Zeleke et al., 2024). Land use competition between a first priority eucalypt trees and food crops is becoming stronger in Ethiopia (Zerga et al., 2021). Year to year, farmers are shifting their cultivable lands to Eucalyptus plantations irrespective of plot fertility status (Tesfaw et al., 2022); as part of livelihood strategy (Dessie et al., 2019).

However, Eucalyptus plantation is debatable on its advantages and disadvantages. Scholars argue that the advantages of planting Eucalyptus outweigh the benefits for smallholders with proper management and site selection than other land use practices (Molla et al., 2023). Farmers perceived Eucalyptus as a *life savior*, safety *net* and *tree bank* claiming its adaptive and productive benefits though they are aware of its negative externalities (Lemonih, 2010). Accordingly, Eucalyptus product users, growers, environmentalists, researchers, and policy makers baffled on the benefit and impacts of the tree *(Daba, 2016).*

Predominately, the supporter of Eucalyptus plantation argues that Eucalyptus woodlot is an incentive-driven process as it pays off compared to the returns from food crops cultivated with same area of land (Tesfaw et al., 2022); viewed it as livelihood diversification strategy and amplification of income (Belay et al., 2025a). Explicitly, without putting an alternative livelihood support for Eucalyptus growers, it difficult to manage the expansion (Molla et al., 2023). Similarly, plantations of eucalypts provide better income, wood and other products, thereby reducing the pressure on the natural forests (Zerga et al., 2021); provide higher support for natural, physical, financial, and assets formation, firewood, local medicine, prevent soil degradation, fence and construction materials (Belay et al., 2025b; Dessie et al., 2019). Moreover, Eucalyptus plays a significant role in firewood, building poles, biomass provision, lowering natural forests deforestation, and boosting the income of farmers (Lemenih, 2010).

Conversely, though Eucalyptus woodlot is viewed as a major source of income and livelihood supporting strategy, the increasing population may be threatened by a shortage of food as Eucalyptus is expanding at the expense of croplands (Tesfaw et al., 2022); as the woodlots compete for nutrients and moisture with all grown crops around (Belachew & Desta, 2025). Farmers believed that Eucalyptus plantation has negative effect on soil and extravagant use of water, shading and allelopathic effect on other crops, suppress native floras, cross-boundary effect on neighbors' crops, being refuge for crop pests and pathogens and cause social conflict (Dessie et al., 2019; Jaleta et al., 2016). Lastly, there is a view that trees are neither good nor bad if the eucalyptus growers perform it through ecological and social impact analysis before planting with help of experts (Bayle, 2019; Jaleta et al., 2016).

Eucalyptus woodlots compete with all grown crops for nutrients and moisture (Belachew & Desta, 2025); poses a significant challenge to the food system (Kerbo et al., 2024). This situation pushes the rural households to shift from 'food-basket' produced in their own land to monoculture cash income dependent with high price surge (Yirdaw et al., 2026). Majority of African population are smallholder farmers and consume they produce. Particularly in Ethiopia's situation, more than 76% of the population depends on agriculture (ESS, 2024). Farmers are blaming *Eucalyptus* expansion impact on crop production in the adjust farmlands (Daba, 2016). Beyond income and production cost reason, farmers expand Eucalyptus because of the apprehension of the nearby farmland determinantal effect (Molla et al., 2023).

In the study area, *Eucalyptus* tree plantations around farmland affect crop production not only for Eucalyptus growers but also for the neighboring farmlands. This leads to socio economic conflict among the adjacent farmers ahead of its environmental effect. The externality from Eucalyptus seeking farmers goes to the neighboring farmers' adjacent crop producers with uncontrolled expansion of Eucalyptus plantations on productive lands (Molla et al., 2023). This study significantly contributes to the body of literature and policy deviating on the externalities of Eucalyptus, particularly its impact on social capital depletion. In agri-food system and development agenda, social capital aspect is overlooked while environmental aspects are sufficiently addressed (Bilali & Strassner, 2021). Moreover, literature is scant in the concerns of social conflict due to Eucalyptus woodlot expansion. So, this research intends to determine how the social relation among farmers is being influenced by Eucalyptus woodlot on farmland; how do farmers perceive Eucalyptus expansion on farmland; and what drives farmers' decision to plant Eucalyptus on farmland.

2. Theoretical background of the study

The Social Ecological System (SES) developed by the Ostrom (2009) is the theoretical foundation of this study. SES is composed of multiple subsystems and variables at multiple levels, including resource systems, resource units, governance systems, and users. SES addresses variables such as size of the resource system, productivity,

predictability, resource unit mobility, number of users, leadership, social capital, and collective-choice rules that frequently affect the likelihood of users' readiness to manage a resource sustainably. This framework guides a complex interactional study between human societies, the natural environment, and their interactional outcomes. In the context of this study, it entails the analysis of the natural resource system which is farmland including nutrients, soil, water, crops, and Eucalyptus woodlot and performed by the system actors including Eucalyptus growers and neighboring farmers (crop production seekers) under specific governance system. This governance system includes local land use patterns, regulations and social norms in the area. This amplifies that the unique characteristics of Eucalyptus such as its high-water consumption, high nutrient uptake capacity, its shading and allelopathic effect interact with the socio-economic drivers such as market demand, low labor access and land use choices resulting in economic gain for Eucalyptus growers, and impacts for the neighboring cropland owners or for both. This interaction leads to conflict of interest among farmers and losses of social capital appeared due to Eucalyptus expansion. In this case the cropland owner might be obliged to establish Eucalyptus woodlot apprehending the externalities from the neighbor's former Eucalyptus woodlot. Collectively leads to production decline thereby affecting the entire food system's sustainability.

Conceptual framework of the study

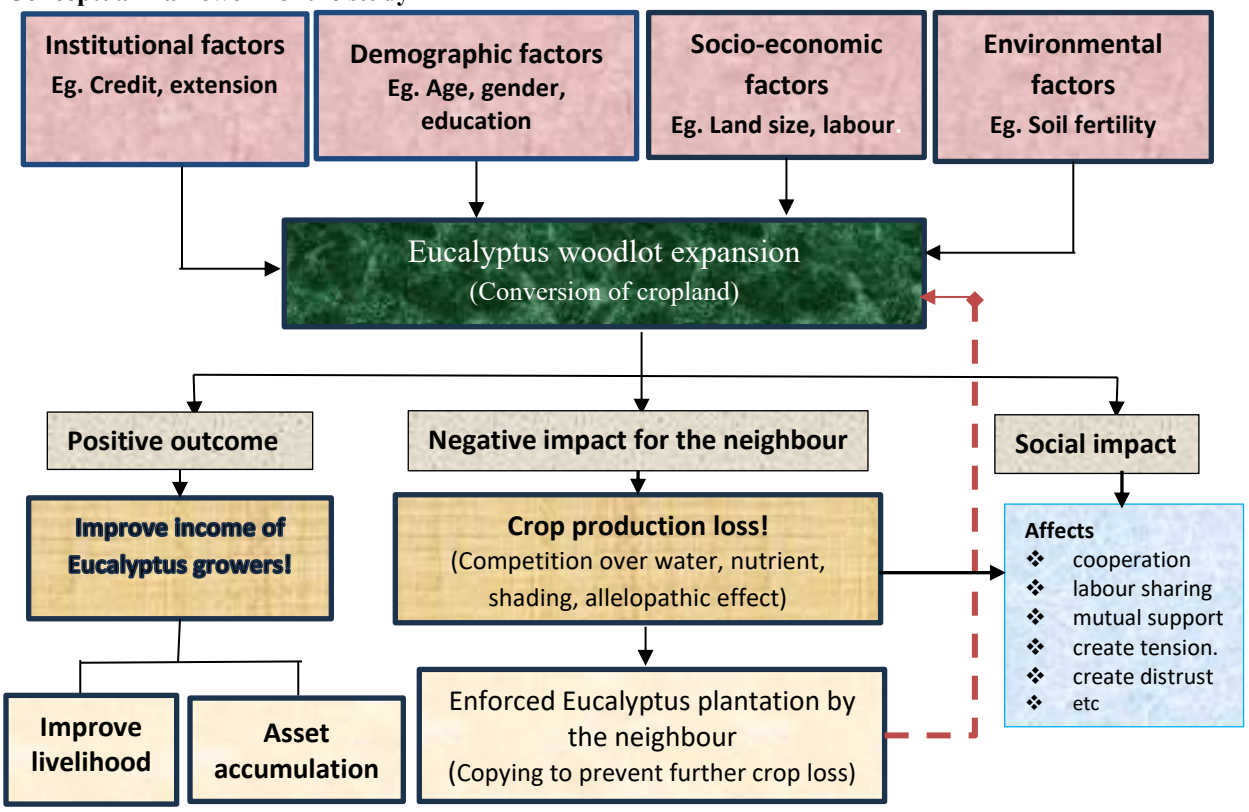


Figure 1: Conceptual framework, Eucalyptus woodlot expansion, drivers and impacts

Source: Own computation

3. Research Methodology

3.1 Description of the Study Area

South Wollo zone is found in the eastern Amhara Region of Ethiopia. The Zone is 404 Km far from Addis Ababa, the capital of Ethiopia, in the north direction. It is located between the Latitude of 10.8997° north and Longitude 38.9877° east with three agro-ecologies: lowland, midland, and highland. The annual rainfall ranges from 750-1400mm with a long-term mean of 1109mm. The major livelihood activities in the zone are crop production, livestock production, Khat production and other non-farm livelihood activities.

3.2 Sampling Techniques and Sample Size

The study was conducted at household (HH) level using multistage sampling procedures to draw sample respondents. Firstly, from Amhara national regional state of Ethiopia, South Wollo Zone was selected purposively as it is the mandate area of the researcher with high Eucalyptus expansion on farmlands. Secondly, three districts from South Wollo Zone, namely *Jamma, Tewledere* and *Kutaber* districts were drawn purposively based on high Eucalyptus incidence on farmlands or its adjacent. Thirdly, a total of six kebeles (two kebeles from Each district) were selected randomly. Finally, systematic random sampling technique was employed to draw the 322 sample households proportionally from the six *kebeles* following probability proportional to size (PPS) technique. The sample size was determined using (Kothari, 2004) as presented here.

$$\boldsymbol{n = \frac{z^2.p.q.N}{e^2\,(N-1)+ z^2p.q}} \quad =322.45$$

where: n is the desired sample size, N=435,079, is the total number of population in selected districts, z is the value of the standard variant at 95% confidence level and to be worked out from a table showing the area under the normal curve (z = 1.96), e is the level of precision = ± 5%, p is the proportion of sample size (p = 30%), and q = (1−p). For this study, the precision level e=+/-5% was taken at 95% confidence level (z=1.96). From 322 households interviewed, 10 questionnaires were not completed, and 312 samples were used for the analysis. Additionally, focus group discussion (FGD), Key informant interviews (KII) and case studies were sources of data for this study.

Table 1. Survey household distribution and questionnaire response rate

District name	District Population	District Sample	Sample size by Kebele		Rate of response		FGD	KII	Case study
Kutaber	119638	89	Haroye	44	44	100%	1	2	1
			Borkana	45	43	96%	1	2+2 Distr.	
Tehuledere	156926	116	Bededo	57	55	96%	1	2	1
			Mesal	59	57	97%	1	2+2 Distr.	
Jamma	158515	117	Ketari	60	59	98%	1	2	1
			Amayo	57	54	95%	1	2+2 Distr.	
Total	435,079	322		322	312	97%	6	18	3

Note: 2distr.= 2 Key informant interviews (KII) were conducted at the district level while the other two were at the Kebele level.

Source: Own computation from (ESS, 2022).

The sampling procedure and techniques to select sample households are depicted in figure 2.

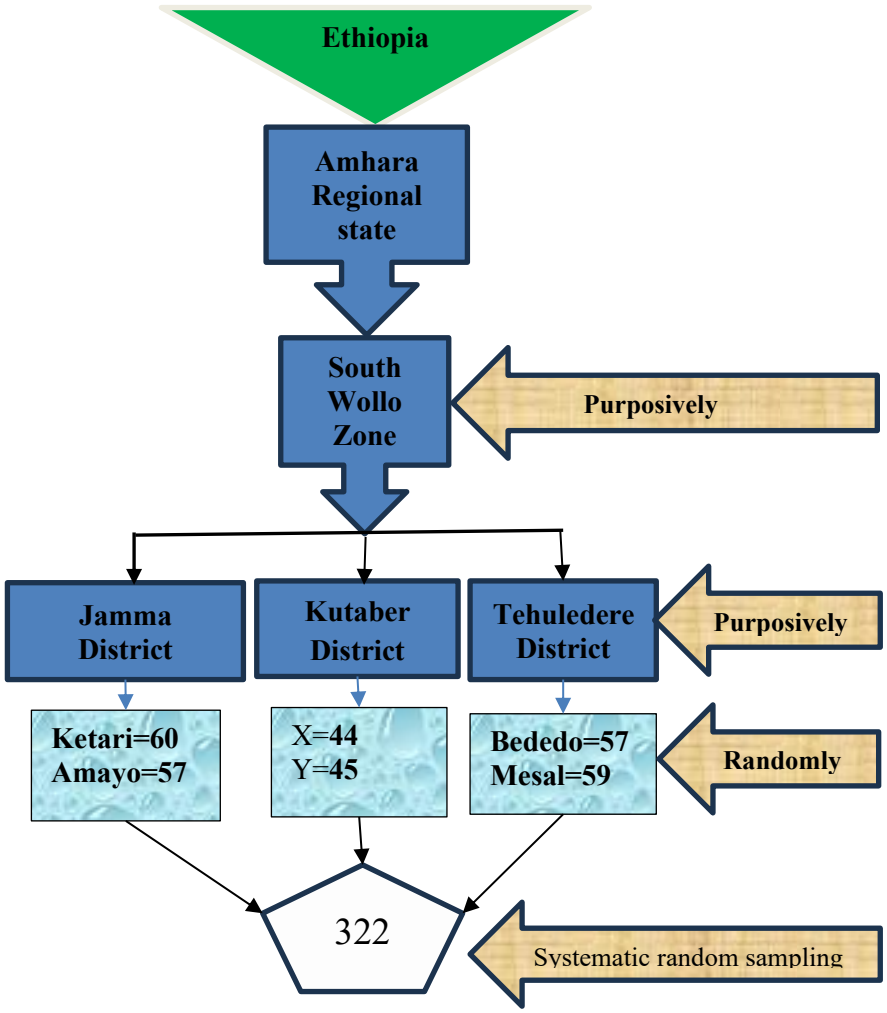


Figure 2: Sampling technique and procedure of the study

3.3 Data types, Sources and Collection Methods of the study

The study employed qualitative and quantitative data obtained from the respondents. Primary data was collected from selected 312 farmers using semi-structured interview schedule with the help of Kobo toolbox. Additionally, 6 FGD, 18 KII, 3 case studies and direct observation were used. FGD with knowledgeable and diversified groups of people were conducted with the guide of checklist to discuss the eucalypts plantation activities and contribution, conflict of interest among neighboring landholders, reasons for expansion of eucalypts plantation on farmland and conversion of cropland to eucalypts woodlot were investigated. The discussions were guided by local facilitators (development agents) in which group members were encouraged to talk freely on the topics. The aim of this group discussion was to elicit different experiences and view of the local community about *Eucalyptus* trees plantation in adjacent farmlands.

KII was conducted with experienced and knowledgeable individuals to draw valuable information about the local history and effect of *Eucalyptus* trees. This provided valuable information on *Eucalyptus* trees trends, drought trends, community resources, natural resources management practice of the study area. The way the local people cope with problems due to *Eucalyptus* historically was investigated through key informant interviews. The major key informants from each Kebele were included; Local elders, land administration experts, kebele level

courts/Shengo. Accordingly, a total of 18 key informants, two for each Kevel and two from each district, were interviewed for this study.

Case studies were also conducted for each study Districts to deeply investigate the expansion and effect of *Eucalyptus* trees woodlot on the social relationship of farmland holders. For this study, one case study was conducted in each District. Effects of eucalypts expansion and conflict cases among adjacent farmland holders due to *Eucalyptus* trees woodlot were investigated. Observing the crop condition at various growth stages and viewing intentional activities going in the study areas was also supplementary data obtaining way.

3.4 Methods of Data Analysis

The qualitative data were analyzed through thematic analysis and narration. Likert scale, with five scales (1= strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree) was employed to measure how people feel about *Eucalyptus* trees plantation on adjacent farmlands. SPSS version-26 software was used to process the data. The numerical data were analyzed using descriptive statistics and regression analysis. Binary logit regression was employed to examine the drivers of farmers' decision to establish eucalypts woodlot on their farmland. According to Gujarati (2004), binary logistic regression is used to identify determinants with dichotomous dependent variable. The dependent variable is eucalypts woodlot ownership which takes the value of 1 if the household had eucalypts woodlot on or on the edge of his/her farmland, 0 otherwise. Eucalyptus woodlot ownership in this study is defined as owner when a farmer established Eucalyptus on the farmland or on the near edge/boundary of the farmland which potentially affects the crop production of farmland. Based on the logistic distribution functions, logit model for identification of factors influencing farmers' decision to be woodlot owners and non- owners on their farmland/its adjacent is specified as:

$$Li = \ln\left[\frac{p}{1-p}\right] = \beta_0 + \beta_1 Xi + U_i$$

Where, ln = natural logarithm,

P = Probability of having eucalypts woodlot on farmland

1- p = probability of not having eucalypts woodlot on farmland

β_0 = constant term, β_1 = coefficients of explanatory variables,

X_i = Explanatory variables which are hypothesized in the next subtopic, and

U_i= Error term.

Multicollinearity problem between and among dummy and continuous explanatory variables was detected by contingency coefficient (CC) and the variance inflation factor (VIF), respectively.

The procedure is shown shortly as below.

$$\text{VIF (xi)} = \left[\frac{1}{1-R_i^2}\right]$$

- ✓ Where, R_i^2 = is the squared multiple correlation coefficient between
- ✓ x_i and other explanatory variables and
- ✓ VIF = Variance Inflation Factor.

Contingency coefficient for Categorical variables was also assessed as follows.

$$CC = \sqrt{\frac{X^2}{X^2+n}}$$

Where CC = Contingency coefficient, n = sample size and X^2= Chi-square Value.

3.5. Definition and Hypothesis of Variables

Table 2: Definition and Hypothesis of Variables

No	Determinants	Variable type	Household decision

1.	Age (AGEHHH)	Continuous	+
2.	Education (EDUHHH)	Dummy	_
3.	Family size (HHSIZE)	Continuous	_
4.	Gender (GENDERHHH)	Dummy	+
5.	Remittance income (1=yes, 0 otherwise)	Dummy	_
6.	Land holding size (LANDSIZE)	Continuous	+
7.	Use of credit (CREDIT) (1=yes, 0 otherwise)	Dummy	_
8.	Ox number	Continuous	_
9.	Total annual Income (TOTINCOM)	Continuous	_
10.	Experience in Eucalyptus plantation in year	Continuous	+
11.	Perceived fertility status of p lot (1=yes, 0 otherwise)	Dummy	-
12.	Experience in plot boundary conflict (1=yes, 0 otherwise)	Dummy	+
13.	Participation of household members in nonfarm activities (1=yes, 0 otherwise)	Dummy	-
14.	Use of irrigation (1=yes, 0 otherwise)	Dummy	-

Source: Own construction from literature, 2022

4. Results and Discussion

4.1 Demographic and Socio-economic Characteristics of Respondents

As presented in Table 3, the mean age value of the respondents is 47.37 years, which falls under the active labor force category. This implies that farmers in the study area are expected to actively engage in farming and different income-generating activities. The average family size (5.19) in the study area is above the national average (4.6) which implies the study area has the opportunity for labor force to perform various agricultural activities, however, it is a burden for a household if there is high dependency ratio in the household. About 60% of the respondents attended formal school, dominantly primary education, where it is an opportunity for better farming practices with new technology adoption and other income generating activities. About 72% of the respondents are married. About 56.1% of the respondents use irrigation services and 64.7% of them are not participating in non-farm income activities. About 28% of the respondents receive remittance from abroad as the study area is known for migration to the Arab countries (especially ladies) while 27.6% of the sample respondents use credit services. About 58% of the respondents perceived that their land is not fertile and not suitable for agricultural products. The mean annual income of sample households from all sources was found to be 52202.15 ETB. The average land holding size of the respondents is 0.84 hectare with the standard deviation of 0.44 which is below a hectare with large family size in the study area. On average, the farmers in the study area own 1.16 numbers of oxen with standard deviation of 0.95.

Table 3: Demographic and socioeconomic characteristics of respondents (N=312)

Continues variables	Minimum	Maximum	Mean
Age	20	87	47.37
Family size	1	12	5.19
Land size	0.25	2.50	.8413
Annual Income (ETB)	1800	750000	52202.15
Oxen Number	0	4	1.16
Experience in Eucalyptus plantation (year)	0	20	6.23
Categorical variables	**Category**	**Frequency**	**Percentage**
Gender	Male	225	72
	Female	87	28
Educational Status	Literate	189	60.6
	Illiterate	123	39.4

Marital Status	Single	9	2.9
	Married	225	72.1
	Divorced	41	13.1
	Widowed	37	11.9
Irrigation ownership	User	175	56.1
	No-user	137	43.9
Participating in nonfarm activities	Participate	110	35.3
	Not participate	202	64.7
Access to remittance	Receive	88	28
	Not receive	224	72
Use of credit services	User	86	27.6
	Non-user	226	72.4
Perceived fertility status of plot	Fertile	131	42
	Not fertile	181	58
Eucalyptus woodlot on farmland	Yes	224	71.8
	No	88	28.2

Source: Survey, 2022

4.2. Eucalyptus woodlot expansion and boundary conflict in the study area

As shown in table3 and figure 3, about 72% of the respondents established Eucalyptus woodlot on their farmland or at least in the near peripheries of their cropland. This is confirmed by the finding that about 98% of Eucalyptus expansion in Ethiopia is on crop fields (Zeleke et al., 2024). The maximum years of experience in Eucalyptus woodlot practice is about 20 years with an average value of 6.23 years, and standard deviation of 4.887. This implies that the tree is well adopted and practiced by the households. From the survey, farmers explained the reason for planting Eucalyptus on their farmland or on the adjacent farmland. They insisted on planting Eucalyptus due to its fast growing with good biomass; to satisfy cash demand; to secure fuel wood; prevent boundary conflict, serve as permanent fence especially around farmland which near to home locally called *'Guaro*[1]*';* it is easy to manage with low labor availability and low risk of disease and pest amidst the challenge of climate change. Consistent results were found by Alemayehu & Melka (2022) and Seware et al. (2021) as the expansion of Eucalyptus is associated with fast growing, fuel wood, construction, better price, needs lesser labor, needs lower investment, coppice itself faster than other tree species.

The FGD discussants in Tehuledere District showed that Eucalyptus and 'Khat' expansion is spiking especially for the last eight to ten years. One of the key informants in this District described that he covered one site of his farmland (0.25ha) completely with 'Khat' and part of his land in another site with Eucalyptus. Eucalyptus expansion is extremely high in Tehuledere District which affects crop and horticultural production. It causes boundary conflict in the adjacent farmlands as the FGD discussants raised in each study District especially in Tehuledere and Kutaber Districts (figure 3). This implies that Eucalyptus tree plantation around farmland is highly expanding in Tehuldere and Kutaber districts, respectively as farmers in this area reported low labor shortage. The reason for the labor shortage might be these districts are near to the main city, Dessie, and have opportunities for nonfarm livelihood activities with better infrastructure access. Previous studies affirmed that Eucalyptus woodlot expansion continues unless livelihood option is provided (Zerga Seware, 2017); land use change has occurred as younger generation is migrating to urban areas (Yimam et al., 2025).

Conversely, there is a tendency of reduction in Eucalyptus expansion in Jamma district due to various reasons. Firstly, farmers in the districts awakened that the gain from crop production is more attractive than Eucalyptus

[1] ***Guaro*** *is a farmland surrounded the house or very near to the house of the farmer which is usually allotted for spices, vegetables, fruits and/or other crops. It is usually fertile land as house disposals and animal dung are thrown into.*

woodlot despite Eucalyptus production requires low labor. The reasons are Eucalyptus takes three to four years for sale while crop production takes place annually, even biannually for some crops and vegetables. As a result, farmers do not want to remain idle for three to four years without production with the productive land. Secondly, farmers foresee the market demand of Eucalyptus as house construction in urban, peri-urban areas and even in rural areas is turned into other construction material options such as hallow block and precast concrete (Agri-stone). Finally, in the district, the farmers' association called '*Idir*[2]' decided to ban expansion of Eucalyptus against cropland due to the continuous conflict among farmers in the adjacent farmlands because of crop damage. A previous study proved that people have turned against eucalypts planting though the growers prefer its fast growing and biomass production (Alebachew et al., 2015)**;** smallholder farmers showed decreasing trend from 2001 to 2005 Eucalyptus expansion due to its alleged ecological effect on cropland (Gizachew, 2017).

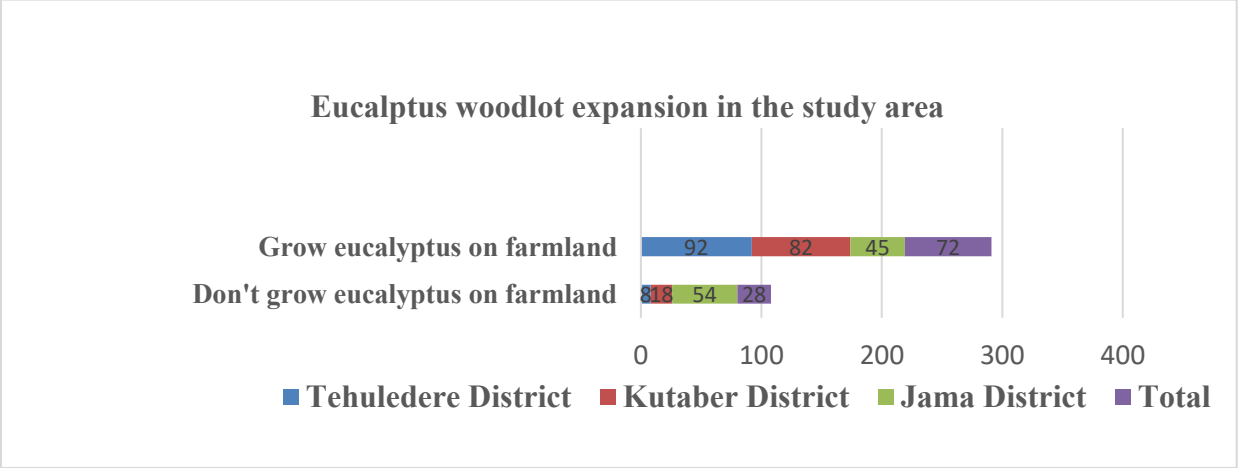


Figure 3: Expansion of Eucalyptus on farmland in the study area
Source: Survey, 2022

About 69% of the study participants experienced boundary conflict (figure 4) due to the cross-boundary effect of Eucalyptus wood lot on farmlands. Farmers who have converted their cropland to eucalypts woodlots are targeting either to earn more income or to increase productivity through Eucalyptus. However, this activity affects the neighboring landholder with low return crops productivity which leads to boundary conflict.

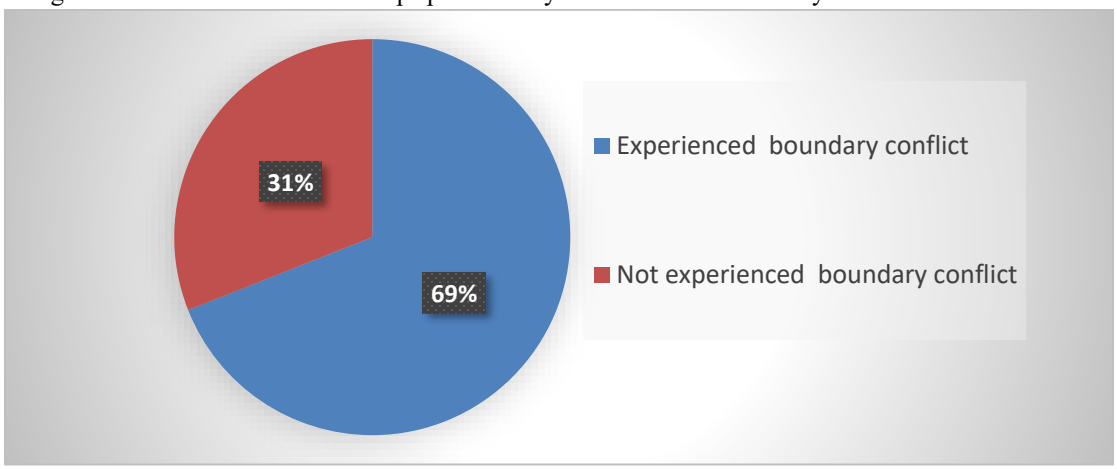


Figure 4: Farmers Experience in Eucalyptus plot boundary conflict in their adjacent farmland
Source: Survey, 2022

[2] **Idir** is a traditional local association of neighbours for mutual support in funeral and other societal activities.

As case study 1 described, there is expansion of *Eucalyptus* woodlot on crop land due to the attractive income gained over agricultural crop production. Khat production is becoming more attractive for farmers in Tehuldere District. Correspondingly, a study confirmed that *Eucalyptus* is being planted at the expense of agricultural crops, forests and grazing lands as a woodlot both in the southern and northern parts of Ethiopia (Alemayehu & Melka, 2022). Similarly, a study in Cheha Districts, Ethiopia, revealed that 27% of the farmers converted their farmland into Eucalyptus wood lot (Gizachew, 2017). This implies that Eucalyptus woodlot is expanding from time to time since it requires less labor and less investment cost.

Case Study 1:

The farmer from Tehuledere District, Amimo kebele, said that I am married and have six children. I have 13 years of experience in Eucalyptus production. I am producing Eucalyptus because it is less labor intensive with good biomass and market value since my children are attending education. For the last 9 years, I was planting Eucalyptus on the grazing land and on less-fertile land. But, in the last four years, I am obliged to allot my part of crop land for Eucalyptus and Khat because of labor shortage, agricultural inputs price increment and the decline of crop productivity of the land. Additionally, eucalyptus and Khat have low risk of disease and pest which are affecting our crop due to climate change. For the future, I want to expand Khat production.

4.3. The perception of farmers on Eucalyptus trees plantation on farmlands

Different perception domains were provided for respondents to capture their view on Eucalyptus trees plantation on farmlands or the adjacent farmlands and its impact (table 5).

Domain 1: Eucalyptus woodlot on farmland and conflict: the result of the survey revealed a strong census regarding Eucalyptus woodlot expansion on farmland causes bounder conflict among neighboring farmers. The large percentage, 44.9% agree and 33.7% strongly agree reflecting farmers boundary conflict experience due to the externality of Eucalyptus woodlot crossing boundaries. The finding triangulates the survey result where 69% of the respondents experienced boundary conflict (figure 4). This is because Eucalyptus' root absorbs the nutrient and water of the adjacent farmers' (crop production seekers) and shading effect as explained by the FGD discussants in each district. A study reported farmers' compliance with the negative externalities of Eucalyptus expansion on agricultural production system as it affects neighbors adjacent crop production and suppress pastures, fodder, and other native trees which finally leads to boundary conflict among farmers (Desta et al., 2023). On the other hand, the 10% neutral response on this issue might imply further clear discussion on Eucalyptus' impact on crop production and boundary concern based on farmers' experience.

Domain 2: Eucalyptus woodlot and neighboring farmers crop productivity: Similarly, about 51% of the respondents agreed and 27.2% strongly agreed that planting Eucalyptus on farmland affects the productivity of adjacent farmers and about 15% of the respondents were neutral on this view. Apparently, the Eucalyptus shade affects adjacent crop productivity, animal fodders, native trees which are eco-friendly, hosting crop pests and pathogens, reduces the flow of rivers for irrigation use or reduces the moisture of the farmland (Desta et al., 2023).

Domain 3: Restriction of Eucalyptus expansion on farmland: Astonishingly, a remarkable majority of the respondents (83%), where 52.9% agreed and 30.4% strongly agreed, affirm Eucalyptus planting on farmland should be legally restricted for long-term land productivity to assure food supply while 10% of the respondents were neutral on this view. This implies farmers are growing Eucalyptus for short-term benefits due to various reasons may be due to low labor availability and low other opportunities for cash gain. But farmers are conscious of the long-term effect of Eucalyptus on crop land productivity as proved by similar studies (Desta et al., 2023; Yimam et al., 2025).

Domain 4 Legal perception of Eucalyptus expansion on farmland: regarding the moral legitimacy of "Eucalyptus planting practices on farmland" with respect to cropland use sustainability and from the neighbor farmers' impact point of view, about 63.5% of the respondent believed this is not right practice where 28.2% disagree and 35.3% strongly disagree and disagree in this group. The finding amplifies Eucalyptus externalities is widely shared in the community as similar finding affirms (Yimam et al., 2025). On the other hand, about 20% of the respondents become neutral in the notion of 'wait and see' to this practice may imply further awareness of the impact among farming community is needed. Though it is difficult to attach it with legal issues of planting it on farmland, Eucalyptus planters demonstrate slightly greater environmental awareness on Eucalyptus expansion (Yimam et al., 2025).

Domain 5: Social relation impact of Eucalyptus expansion on farmland: A significant majority of the respondents (91%), with 42% agree and 49% strongly agree, attested that Eucalyptus plantation on farmlands or in the near farmland adjacent area affects crop productivity for both the eucalypt growers and crop producers in the area. It causes social tension and in turn affects crop production activity and other social support efforts in the community as the Eucalyptus woodlot creates adverse effect on adjacent croplands in line with the finding of Mulu et al. (2022). Again, it is the cause of Eucalyptus expansion as counter defense mechanism implemented by the affected cropland owner and goes to vicious circle of social capital depletion among farmers.

Table 4: Perception of farmers on Eucalyptus trees plantation on farmlands

Perception Domains	Scale/score(N=312)					mean	SD
	1	2	3	4	5		
Planting Eucalyptus on farm boundaries causes conflict	7(2.2)	28(9)	32(10.3)	140(44.9)	105(33.7)	3.99	1.002
Planting Eucalyptus on farms affects the productivity of adjacent farm	1(0.3)	19(6.1)	48(15.4)	159(51)	85(27.2)	3.99	0.837
Eucalyptus planting on farmland should be legally restricted	6(1.9)	15(4.8)	31(9.9)	165(52.9)	95(30.4)	4.05	0.877
Eucalyptus planting on farms is right practices	88(28.2)	110(35.3)	61(19.6)	31(9.9)	22(7.1)	2.32	1.187
Eucalyptus plantation on farm boundary affects farmers' social relation	7(2.2)	38(12.2)	65(20.8)	86(27.6)	116(37.2)	3.85	1.119
Eucalyptus plantation on farms affects crop productivity (owner's)	0	12(3.8)	16(5.1)	131(42)	153(49)	4.36	0.752

Note: *mean values are based on 5-point scale (1= strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree)*

Source: Own survey (2022)

4.4 The Effect of *Eucalyptus* woodlot on the social relationship of adjacent farmland holders

The result of the household survey, (table 5), indicates that about 65% of the respondents perceived that Eucalyptus tree plantation on farm boundary affects farmers' social relationship whereas about 21% of the respondents were neutral on this issue. On the other hand, about 69% (figure 4) of the respondents experienced boundary conflict because of Eucalyptus woodlot on the farmland surroundings. Similarly, the result of key informants' interview proved that local farmers went into conflict as Eucalyptus trees exhausted the cropland because of shading effects, water and soil nutrition competition, hosting pests and birds. The FGD discussants in all districts affirmed cropland productivity invasion by Eucalyptus and Khat (in Tehuledere district) causes social friction being a major concern for the coming generation.

The social conflict among adjacent farmers affects the labor sharing culture of the farming community such as Jige (Jige refers to informal organization of farmers for working together by sharing the labor during ploughing, weeding, sowing, harvesting, trashing and other agricultural activities and house construction), mutual support including food sharing, and other forms of social interaction. A study confirmed the negative effect of Eucalyptus woodlot such as acidity (on soil and water), shading, allelopathic effect on crop production crosses the growers' land boundary and affects the neighbors' crop production (Dessie et al., 2019). But another study argued that trees are neither good nor bad. However, this study did not hide ecological and social impact of Eucalyptus if not undertaken careful planning before planting (Bayle, 2019). Moreover, Eucalyptus woodlot expansion also affects the employment opportunity of the rural economy since it is less labor intensive compared to crop production which affects the community (Bayle, 2019); the issue of job displacement and crop production effect is more pressing for small-scale farmers in the cereal-based subsistence farming systems of north-western Ethiopia where the study area is located (Nigussie et al., 2017). As case study 2 elaborates, farmers are obliged to expand Eucalyptus on their farmland due to boundary conflict as defense mechanism which worsens boundary conflict distorting farmers' social relationship.

Case Study 2:
The farmer from Jamma District, Ketary kebele, reported that I am 56 years old and married having seven children. I have 9 years of experience in Eucalyptus production in this area though I have it for 16 years on my wife's family land on another far place. I am producing Eucalyptus to satisfy my financial needs and simultaneously to protect my land from illegal push of the adjacent farmer. I had three times conflict with neighboring farmers due to this illegal push of my farmland and planted Eucalyptus countering as permanent fence for my land on the boundary before 5 years. Frankly speaking, my land was very productive, but the crop yield reduces from time to time after the Eucalyptus plantation. On the other hand, I confronted with the other farmers because his farmland productivity is declined from time to time due to my Eucalyptus woodlot on the other side adjacent area. We are trying to fix the problem with local elders (*Idir*) for future adjacent farm management and to reduce boundary conflict.

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Case Study 3:
A relatively young respondent in Kutaber District, he was not willing to talk about himself and his family, said that I have small land which is gifted from my father in one site and another small farmland which is gifted from my wife's family. I was producing Tef, and wheat for few years. But I planted Eucalyptus tree on the edge of my farmland where my wife's family offered. The basic reason is that one of the adjacent farmers in the east direction planted Eucalyptus on his farmland and affected my crop productivity. My reaction was planting Eucalyptus in the boundary of this place. Now, I am working sometimes on non-farm income generating activates even travelling to Dessie and Kobolcha town**.**

4.5 Determinants of Eucalyptus woodlot establishment on adjacent farmland

Table 5 presents binary logit result of the determinants of farmers' decision on Eucalyptus woodlot plantation on farmland. As a result, age of the household, gender of the household, land size (ha), and plot boundary conflict experience were found significantly provoked households' decision to plant Eucalyptus on/adjacent farmland.

However, family size, use of irrigation, non-farm income activities, remittance and fertility status of plot have a negative association.

Table 5: Determinants of Eucalyptus woodlot establishment on adjacent farmland

Variables	B	S.E.	Sig.	Odds Ratio
Age	.096	.031	.002***	1.101
Gender of respondents	7.893	1.226	.000***	2679.715
Total family Size	-.404	.181	.026**	.668
Educational status	-.213	.633	.737	.808
Landholding Size (ha)	1.408	.764	.065*	4.088
Use of Irrigation	-1.448	.646	.025**	.235
Total income	.000	.000	.905	1.000
Participating in non-farm activities	-1.888	.630	.003***	.151
Oxen Number	-.252	.349	.470	.777
Access to remittance	-2.020	.679	.003***	.133
Credit Utilization	.331	.714	.643	1.392
Eucalyptus plantation Experience (year)	-.063	.060	.292	.939
Perceived fertility status of plot	-1.790	.644	.005***	.167
Experience in plot boundary conflict	1.945	.689	.005***	6.990
Constant	-4.796	1.865	.010**	.008
Chi-square	273.548			
R-square	0.837			
-2Log	99.115[a]			
Observation	312			

Note: ***, **, *significant at 1%, 5% and 10% level of significance.

Source: Survey, 2022

Age: Age of the household head significantly and positively associated with household's decision on Eucalyptus woodlot establishment at less than 1% level as per the hypothesis. An increase in the age of the household head increases the likelihood for the household to decide to plant Eucalyptus on the farmland/adjacent area by a factor of 0.096. Keeping other factors unchanged, the odds ratio implies in favor of households' decision to plant Eucalyptus on their farmland increases by a factor of 1.101 as the age of the household head increases by one year. It might be due to farmers' aging issues and low labor availability for agricultural production. The KII and FGD discussants triangulated the tendency of farmers to perennial trees (Eucalyptus and Khat) due to labor shortage; youths are not attracted to the existing agricultural practices and are in schooling. Previous findings affirmed that older aged household heads engage in Eucalyptus woodlot production due to the less labor-intensive nature of the business (Dessie et al., 2019); aged farmers have less ability to harvest crops, fruit, and vegetables, instead, grow Eucalyptus tree (Mulatu & Setiye, 2016).

Gender: As per the hypothesis, there is significant positive association between gender of household heads and household's decision on Eucalyptus woodlot establishment at less than 1% level. It implies being male-headed household, the probability of establishing Eucalyptus woodlot on farmland will increase by a factor of 7.893. The Odds ratio in favor of households' decision to plant Eucalyptus on their farmland, cetris paribus, increases by a factor of 2679.715 as the household head is being male. The possible reasons might be that female headed households in the study area has limited land access and offer their limited farmland for share or rent out for other farmers in the form of contract for crop production. The finding coincides with other study indicated that female-headed household are less likely to be engaged in woodlot management due to the difficulty in obtaining resources such as land as well as technical small-scale forest management (Mulu et al., 2022).

Family Size: The logit model result revealed a significant negative relationship with households' decision on Eucalyptus woodlot establishment and family size at less than 5% probability level. The negative relationship indicates that the odds ratio in favor of the probability of Households' decision on Eucalyptus woodlot establishment decreases with an increase in the family size. The odds ratio in favor of Households' decision on Eucalyptus woodlot establishment, cetris paribus, decreases by a factor of 0.668 as the family size increases by one household member. The finding implies that, in the study area where households depend on agricultural land production, increasing household size results in restricting the households' decision to plant Eucalyptus on farmland for sake of providing food for the family and there is adequate labor for agricultural activity. The finding contradicts with Mulatu & Setiye (2016) with their explanation of large family size for Eucalyptus planters needed labor force to plant and manage the tree. But the labor demand for crop production is more than Eucalyptus production; so, households prefer crop production to eucalypts so that they can feed their large family and availablity of adquate labour enables engaging in better crop production activities as proved by Gizachew (2017).

Landholding Size (hectare): The results of the logit model indicated households who have larger farm size decide to establish Eucalyptus woodlot on farmland at less than 10% probability level. The odds ratio, cetris paribus, in favor of households' decision on Eucalyptus plantation on farmland increases by a factor of 4.088 when household's landholding size increases by one hectare. The possible justification is farmers who have large farm sizes have better chances to produce more and can allot portion of land for Eucalyptus woodlot to diversify their income and share the agricultural input cost. The FGD discussant reported they plant Eucalyptus on farmland due to the decline of land productivity from time to time, and the rise of input price especially for seed and fertilizer. The result coincides with finding of Gizachew (2017); Mulatu & Setiye (2016). But contradicted with finding of Mulu et al. (2022) where the area of land allocated for small-scale forest including Eucalyptus was inversely proportional to land holding size.

Use of Irrigation: A significant negative relationship with household' decision was found to establish Eucalyptus woodlot on farmland at less than 5% probability level. The odds ratio, cetris paribus, in favor of households' decision on Eucalyptus plantation on farmland decreases by a factor of 0.235 when the household uses irrigation services. The study area, Wollo, is moisture stressed area and getting water through irrigation would improve boosting agricultural output. The farm won't be free throughout the production seasons using irrigation services and thereby farmers may not intend to establish Eucalyptus woodlot on their farmland for income. However, the finding is in contrast with Ashraf et al. (2015) where their finding revealed that area of irrigated land and tree plantation correlates significantly and positively.

Participation in non-farm activities: A 1% probability level significant negative association was found between non-farm income activities participation and household's decision to establish Eucalyptus woodlot on their farmland. The odds ratio, cetris paribus, in favor of households' decision on Eucalyptus plantation decreases by a factor of 0.151 when one household member participates in non-farm income generating activities. Because when the household participates in non-farm income generating activities. The household's cash demand will be satisfied, and the farmland will be allotted for crop production. The FGD and KII participants assured that one of the Eucalyptus wood lot establishments aims is to earn cash income from the sale of various parts of the tree. The finding supported by previous study that farmers plant Eucalyptus for its income generation potential (Dessie et al., 2019).

Access to Remittance: Household's decision to establish Eucalyptus woodlot associates with remittance income negatively and significantly at less than 1% probability level. The odd ratio, cetris paribus, in favor of the households' decision on Eucalyptus plantation on farmland decreases by a factor of 0.133 when the household member receives one unit of remittance. In the study area, most of the households sent their children (especially girls) to Arabian countries; and the household receives remittance from abroad. Moreover, it is a sort of competition to send family members to Arabian countries as it was mentioned by the respondents. Households who have access to remittance may either use it to improve their income-generating activities thereby earning more income to

improve their households and it buffers the immediate income need. A previous study confirms that the survival is challenging without remittances from sending daughters to Arab countries or through the plantations of Eucalyptus trees in the study area, South Wollo (Belay et al., 2025b).

Perceived fertility status of plot: Household's decision to establish Eucalyptus woodlot on their farmland was found to be affected significantly and negatively by fertility status of land at less than 1% probability level. The odd ratio, cetris paribus, in favor of households' decision on Eucalyptus plantation on farmland decreases by a factor of 0.167 as the households perceive their farmland is fertile. When households perceive the farmland as infertile, they intended to establish Eucalyptus woodlot for greater profitability. Researchers confirmed that farmers shift in inadequate quality of land for planting Eucalyptus tree (Mulatu & Setiye, 2016); farmers are more intended to Eucalyptus woodlot establishment on less fertile land (Belachew & Desta, 2025; Gizachew, 2017; Tesfanesh, 2021).

Experience in plot boundary conflict: Experience of the household in plot boundary conflict has a significant positive association with household's decision to establish Eucalyptus woodlot on their farmland at less than 1% probability level. The odd ratio, cetris paribus, in favor of households' decision on Eucalyptus plantation on farmland increases by a factor of 6.990 as the household is experienced boundary conflict with adjacent farmers. From the reality in the study area, farmers establish Eucalyptus woodlot (in most cases) and other perennial trees to prevent adjacent farmland conflicts due to illegal expansion from neighbors. As presented in the case study and FGD discussants, farmers also forced to establish Eucalyptus woodlot, even though the farmer does not prefer it, due to the Eucalyptus woodlot from adjacent farmland. Consistently, studies proved that farmers are still in argument regarding the plantation of Eucalyptus woodlot on the adjacent areas of farmland (Dessie et al., 2019); converting croplands to Eucalyptus plantation is linked to loss of land holding and use rights caused household and community level conflicts even ended up with migration and landlessness (Zeleke et al., 2024).

5. Conclusion and Recommendation

From the Social Ecological System (SES) theoretical framework point of view, resource systems and collective-choice rules affect the likelihood of users' readiness to manage a resource sustainably. Accordingly, Eucalyptus woodlot as a component of livelihood improvement is expanding as significant majority of the respondents (72%) are practicing it on their land for cash, fuel wood, and construction material demand. Beyond economic gain, farmers perceived and experienced (69%) Eucalyptus woodlot-based conflicts as eucalypt grower's and neighboring land holders' productivity declines causing conflict and affecting social capital (such as Jige, debo, sharing food, sharing life experiences, migration, displacement etc.) spanning from household to community level. The severity of conflict varies among the study Districts and farmers (as implied in Jemma District) make rational choices and land use decisions based on socio-economic imperatives instead of sticking to Eucalyptus-based income. However, farmers continue planting Eucalyptus though they perceived the disadvantages of Eucalyptus woodlot on farmland. The decision of farmers to establish Eucalyptus woodlot on their farmland is significantly provoked by age of the household head, gender of the household head, experience in plot boundary conflict and land size (ha). However, it is significantly and negatively affected by total family size, use of irrigation, participating in non-farm income activities, access to remittance and perceived fertility status of plot. The study found a clear call for livelihood diversification support for farmers so that they can balance their income from monoculture (Eucalyptus) production and diversified crop production sustainability. Therefore, attention should be given to managing the identified factors and changing smallholder farmer's attitude towards Eucalyptus plantation for the sustainability of crop land productivity and land use dispute resolution. It may be with appropriate site selection and discussion with local community leaders like what the community in Jammi district did.

6. Limitation of the study

This study is based on cross sectional data on limited geographic areas and it's difficult to generalize about the larger farming conditions. On the other hand, the study is limited to the perceptions of farmers, the unveiling conflict among Eucalyptus growers and crop production seekers and the drivers of Eucalyptus planting on farmland.

Therefore, further study is needed to compare the return from Eucalyptus with other crops in terms of dietary diversity and long-term socio-economic fate of farmers addressing a wider community.

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