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Drivers of Household Decision-Making on Land-Use Transformation: An Example of Woodlot Establishment in Masindi District, Uganda

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Abstract: Land use transformation at the farm level is attributed to household decision-making, reflected by the behavior and activities of smallholder farmers. Unfortunately, household decision-making in local communities and its determinants are site-specific and hardly understood. This study uses multistage purposive selection of households as a unit for the analysis to investigate the transformation from pure agriculture to farm forest mosaics, especially through woodlot establishment. We use key informants, household surveys, and observations to obtain data on decision-making amongst 84 farm households in Nyantonzi parish, Masindi district, Uganda, as an example. Specifically, the study addresses four research questions. Firstly, what is the current status of gender-based decision-making at the household level? Secondly, is decision making within farm households individualistic or collective? Thirdly, which factors are considered to select annual, perennial and tree-crop farm management regimes? Fourthly, what determinants influence the decision-making process and the likelihood of woodlot establishment? A multilevel analysis comprising parametric statistical models and binary logistic regression is applied to assess difference in household natural, physical, human, and social capital, highlight gender roles, and obtain factors associated to selection of crops and determinants of woodlot establishment at the farm level, respectively. Results reveal that gender based decision-making is clearly disaggregated on the basis of husbands and wives and it is individualistic, mostly dominated by husbands with lower participation by wives and other family members. Households consider various factors before making any decisions, e.g., market prices for both annual and perennial crops, food consumption for annual crops, ease of management, and yields from the previous season for the tree-crop management regimes. The likelihood for woodlot establishment is positively influenced by the willingness and intention of households to establish woodlots and relative age of household head. However, knowledge of land use Policies, Laws, and Regulations (PLRs) in relation to tree planting and harvesting and access to non-farm income reduce the likelihood of woodlot establishment. Here, we recommend that current and future forest land restoration initiatives focus on reducing the gender gap and increase women's participation in decision making, provide market information platforms on wood products, and include woodlot farmers in social organization. Current PLRs on tree tenure should be improved and clearly communicated by using the existing communication assets and social gatherings as channels of change and influence for decision-making.

Keywords: family labor; small-scale tree planting; gender; determinants; forest restoration; binary logit; forest policies laws and regulations; tree tenure

1. Introduction

Forestry land use frequently leads to an increase in the rate of deforestation and degradation, especially in Sub-Saharan Africa [1,2]. The rate of deforestation and degradation is a result of both proximate direct and underlying indirect drivers [3]. Proximate drivers are human actions that occur at the local level. These include agricultural expansion [4,5], permanent conversion for commodity production [6], and infrastructure expansion. Underlying drivers are social processes such as increased population [7], economic, technological, policy, and cultural factors e.g., public beliefs, values, and individual behavior (lack of concern about welfare of others) [3]. Other natural processes such as forest fires also contribute to forest degradation both globally and in the tropics [6]. In Uganda, especially Nyantonzi parish, Masindi district, forest land degradation and deforestation have been accelerated by direct drivers, mainly unsustainable and illegal extraction of forest resources from natural forests, agricultural expansion, and indirect drivers, mainly population increase and unsecure land property rights [8–12]. As a result of degradation and deforestation, Uganda recorded a significant loss in forest area in the period 2000–2010 [13], suggesting that forest resources in Uganda are being depleted at a rate far higher than their production. By 2013, estimates indicated that Uganda required a total of 44 million tons of wood annually, of which the available forest resources could only supply 26 million tons of wood annually [14]. This further highlighted the need to reduce the wood supply deficit in Uganda. To restore the degraded forest resources, there has been an increased interest in regulating and committing to the restoration of degraded forest lands, especially in the tropics. In Africa, over 100 million hectares of land have been pledged to be restored by 2030 under the African Forest Landscape Restoration Initiative (AFR100) as part of the commitment to the Bonn challenge [15]. Uganda has prioritized forest restoration, as observed in current national development plans, and it is one of the signatory countries to AFR100, committing to the restoration of 2.5 million hectares in response to the Bonn challenge, United Nations Conference on Sustainable Development, (Rio+20) land degradation targets, and the Convention on Biological Diversity, (CBD) Aichi target 15 [16]. Uganda follows and aims to implement forest landscape approach through various forest restoration pathways such as large-scale forest plantations, agroforestry, and woodlots and increased protection of forest reserves, hence regulating the extraction of natural forests [16]. Woodlots are small plots of trees with the sole purpose of providing wood for both fuel energy and construction poles [Otsyina et al. 1999 as cited in [17]. They are highly recommended as the most feasible and promising pathway of forest restoration in Uganda [16]. Tree growing by smallholders through on-farm plantation forestry (woodlots) has indirectly received enormous attention and support from governments and other development partners in Uganda, and around the globe e.g., in Latin America [18]. For example, the use of woodlots as a pathway to increase tree cover (forest land restoration) is emphasized by the current forest landscape restoration report for Uganda [16]. Woodlots on agricultural farms are not only used to increase the tree cover but can also be used for climate change mitigation through carbon sequestration. They also help to improve the welfare of village communities through product supply (timber, poles, fuelwood and charcoal), and income from payment of ecosystem service (carbon) schemes [19–22]. However, the success of transforming the current state of forest degradation to forest land restoration through woodlots highly depends on the willingness, beliefs, and decisions of households [23,24]. This is further emphasized by the authors of [25], who state that land use transformation is a result of choices and decisions by interacting individual farm households. Therefore, it is important to understand how household decision-making towards woodlot establishment in small-scale farms is causally linked to factors/determinants. This is done to explore the possibility that some factors may have either a positive or a negative influence on the likelihood of woodlot establishment.

As a definition, household decision-making is a process by which a household (HH) ascertains a choice or judgment to be made, gathers and evaluates information about alternatives, and selects the best choice among alternatives [26]. As examples from the current case study, the decisions are mainly carried out to select crops (perennial and annual) and tree-crop farm management regimes. The farm management regimes of the region mainly include inter-cropping, alley cropping, strip tree planting, and woodlots. Decisions are also made to allocate the limited available resources, especially land and household labor for farm activities such as crop and woodlot establishment, tending, and harvesting.

Farm household decision-making with regards to the aforementioned activities is influenced by a combination of complex factors [27]. Non-consideration of these determinants, is often linked to the poor outcomes of forestry programs and forest land restoration initiatives [28,29]. Based on the decision making concept by French [30], decision making depends on diverse endogenous (internal) and demographic traits, and exogenous (external) socio-economic and biophysical factors [27,31]. Herein, endogenous and demographic traits are categorized into physical, natural, financial, human and social capital as seen in [32]. Physical capital comprises of the number of communication assets, transport facilities and farm equipment. Natural capital includes land tenure and size. Financial capital entails number of livestock and non-farm income. Human capital constitutes household labor, knowledge, and awareness of tree tenure and land use policies, laws, and regulations (PLRs), education status, and household dependents. Social capital embraces social gathering/group memberships, female headed households and household nativity. Exogenous factors comprise of the political environment (policies, laws, and regulations, PLRs), market prices, biophysical attributes including rainfall fluctuations, and support services such as access to credit and extension [30]. As emphasis, farmer resource allocations and decisions are profoundly influenced by the political environment [27,33]. In addition to these factors, one study [30] highlights the significance of gender disaggregated participation (gender roles) in household decision making processes, an aspect neglected by other studies e.g., [34–37] that merely focus on the gender of the household head.

With the complexity involved, the process of decision making in individual households necessitates individual personality and cognitive style [38]. Personality relates to the attitude or beliefs of individuals including culture (see the theory of planned behavior [39]), while cognitive style refers to how individuals receive and process information (see theory of bounded rationality [40,41]). Furthermore, household decision making is culture-specific [42], site-specific, and varies based on farmer preference and landscape. This highlights the importance of locally specific research [43], and homogeneity among households to avoid selection bias. This article thus analyzes the determinants and gender disaggregated roles in decision making towards woodlot establishment by addressing the following research questions:

(1) What is the current status of gender-based decision-making at the household level?
(2) Is decision making within farm households individualistic or collective?
(3) Which factors are considered to select annual, perennial and tree-crop farm management regimes?
(4) What determinants influence the decision-making process and the likelihood of woodlot establishment?

The results provide a better understanding of the household decision-making in homogenous communities, hindering determinants and entry points for polices towards an effective and sustainable forest land restoration. The findings achieved here act as a prior empirical evidence towards agent-based simulation models to better understand land use transformation from the decision-making perspective at the household level.

2. Methodology

2.1. Study Area Selection

The study area was selected with a multistage purposive selection procedure to obtain a specific and homogenous sample of households. This was conducted considering eight criteria, namely:

(1) a region with high rate of deforestation and near a protected forest reserve; (2) a region with high forest land use restoration potential in Uganda [16]; (3) villages with other competing land use such as large scale sugarcane production; (4) villages with limited access to nearby forest resources; (5) villages with tree planting activities, most especially small-scale woodlots; (6) households with land ownership; (7) homogenous households in terms of ethnicity, distance to market and natural forest; and (8) households with a willingness to share their information.

With information from literature, experts and district forestry officials, the Nyantozi parish (Masindi district, Figure 1) was selected and considered as a focal case study. The district is located in western mid-altitude landscape in Uganda, between 31°28′–31°42′ E and 1°36′–1°40′ N. The area experiences a bimodal rainfall scenario at 1397–1524 mm and an average temperature of 23–32 °C [44]. Marketing of products is granted due to good connection to main roads to the nearby cities as well as to Kampala, the capital of Uganda. Additionally, the area is bordered by the Budongo forest reserve and Kinyara sugar factory which influences household decisions and socioeconomic activities by offering alternatives for households' family labor and farm land. One example is the provision of casual jobs as a source of non-farm income and growing sugarcane on farm land. Proximity to the natural forest reserve was also important because the communities surrounding it highly depend on its resources and are well informed on the value of trees. This makes the study area appropriate for assessing the household decision-making on woodlot establishment.

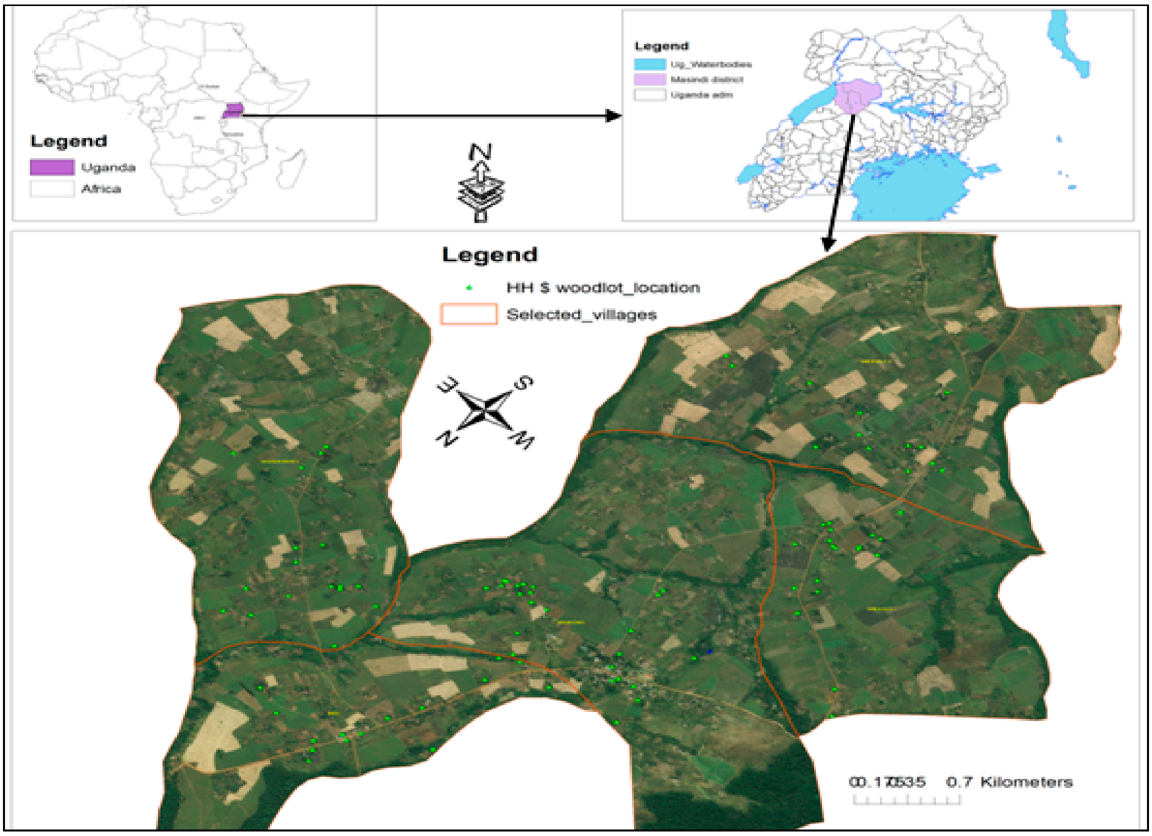


Figure 1. Map showing the location of the study area.

2.2. Sampling

For this study, an individual household was our focal unit of analysis and respective households were randomly selected at the parish level within five small villages from two household categories i.e., households with and without woodlots. Selection of one village was not possible since the number of households with both land and woodlots in a single village was less than that required for statistical inferences. Furthermore, household homogeneity was ensured and distance from each village was minimized to avoid bias and errors due to geographical differences. The minimum sample size to be considered was statistically obtained using Yamane 1967 [45] as summarized below.

$$n = \frac{N}{1 + N \times (e)^2} \tag{1}$$

where n is minimum sample size of households, N is target population of households in the parish (five selected villages), and e is the 10% minimum level of precision accepted for statistical inference [45].

Replacing Equation (1) with actual values,

$$n = \frac{403}{1 + \left(403 \times (0.1)^2\right)} \tag{2}$$

$$n = 80 \text{ Households} \tag{3}$$

Therefore, n = 80 was the minimum sample size of household units that was considered for household sample selection. At the end (as indicated in Table 1), a total of 84 households (44 households and 40 households without woodlots) were sampled, covering 21% sampling intensity of all households in the area (see Table 1).

Table 1. Sampling proportions for household surveys.

	Number of Households Sampled per Village				Sample Percentage Proportion per Village		
Sample Villages	**With Woodlot**	**Without Woodlot**	**Total Sample**	**Total Households**	**With Woodlot**	**Without Woodlot**	**Total Percentage**
Nyantonzi	17	12	29	98	17%	12%	30%
Siiba	7	8	15	86	8%	9%	17%
Ekarakaveni 1	7	8	15	105	7%	8%	14%
Rwentare 1	6	7	13	50	12%	14%	26%
Rwentare 2	7	5	12	64	11%	8%	19%
Total	44	40	84	403	11%	10%	21%

Note: The majority of households do not own land for farming activities.

2.3. Data Collection

Data was collected mainly using key informant interviews, household surveys and field observations.

Key informant interview: Key informants were selected based on snowball sampling mainly focusing on the key role played by an individual within the community. At the end, selected key informants included a district forest officer (Masindi district), forest project field officers from Environmental Conservation Trust of Uganda (ECOTRUST) and Caritas, and local leaders. Information obtained from the key informant interview was used to select both an appropriate study village and access to households with woodlots.

Household survey: During the household survey, 84 households were randomly selected based on the proportion of households from each village. The semi-structured questionnaire was developed and administered to individual household respondents. A semi-structured questionnaire survey was chosen because it provides no strong control over the respondents and it covered a list of different topics as also highlighted by Bernard [46]. The survey was mainly used to collect data on household capital such as physical, natural, social, economic, and human capital [32], factors considered to select between annual, perennial and management regime. Data on gender disaggregated participation in decision making was collected by identifying the proportion of women and men who decide on particular farm activities, and proportion of decisions made by an individual or jointly made by the wife, husband, and other family members. To complement the survey, participatory observation was implemented to gather information on household assets, woodlot and management, and to finally triangulate with the information from household survey.

2.4. Data Analysis

Data analysis and type of statistical model was chosen depending on the type of data collected for example, narrative analysis for qualitative data and parametric models for quantitative data. Quantitative data analysis was mainly done in SPSS version 23 statistical packages respectively [47]. Data analysis combined both descriptive and inferential methods i.e., two independent sample *t*-test and Chi-square for both continuous and categorical variables, respectively. Additionally, Levene's test of homogeneity of variances in groups was used to make an informed decision between subsequent parametric tests of group differences. For example, probability values of the alternative output "equal variance not assumed" were considered for inferences in situations with a significant Levene's test as noted in [48]. The alternative output chosen uses the un-pooled variances to construct the standard errors, and a correction to the degrees of freedom to account for the extra variance estimated [48]. To assess the association of selected categorical variables such as choice of management regimes with woodlot ownership, Pearson's Chi-squared and contingency co-efficiency were used. Additionally, since the response variable was binary and taking values of 1 and 0, binary logistic regression as also seen in [49,50] was the most suitable in obtaining the influential determinants towards woodlot establishment. This is also because the method does not require an independent variable to be on a meaningful scale and it also has less assumptions as compared to linear regression [51]. Conclusively, individual variables not statistically significant in the socio-economic analysis, were excluded and only significant variables were chosen as predictor variables during binary logistic regression process as seen later in the results.

3. Results

3.1. Differences in Household Endogenous and Demographic Traits and Intension to Woodlot Establishment

Endogenous and demographic traits are categorized into physical, natural, financial, human and social capital and are compared between households with and without woodlots. (Table 2) presents the statistical results namely means, Pearson's Chi-squared test of association (χ^2), and *t*-test of difference, respectively. The hypothesis that the socio-economic characteristics differ significantly among the two groups of households could not be confirmed. For example, mean land size of households with woodlots (2.98 ha) does not significantly differ from that of households without woodlots (2.21 ha). Both groups have a similar household "family" labor per day (2.22 and 1.92 man-days per day respectively), and hire relatively the same amount of external labor (3.81 and 4.01 man-days per day respectively). There is also no association between woodlot ownership status and household socio-economic traits such as maximum level of education of household head, land tenure, or household nativity. On the other hand, households with woodlots have slightly higher but significant number of communication assets, and significantly older household heads. Furthermore, a high proportion of households in both categories does not access non-farm income, and have no knowledge on land use PLRs, especially on tree tenure. However, slight differences can be observed between categories. For example, 43% of households with woodlots access non-farm income and 30% have knowledge in on land use PLRs (especially with respect to tree tenure), significantly higher than the values of 5% and 29% of households without woodlots, respectively.

Table 2. Descriptive statistics and comparison of households with and without woodlots. "Standard deviations of means are in parenthesis".

Variables	Households		*t*-Test (*t*-Ratio)	Pearson's Chi-Square (χ^2)	*p*-Values
	With Woodlots	Without Woodlots			
Physical capital					
Mean number of communication assets	1.86 (0.51)	1.6 (0.55)	2.28		0.025 **
Mean number of transport facilities	1.18 (0.39)	1.05 (0.22)	1.93		0.058
Mean number of farm equipment	10.04 (4.68)	8.98 (3.83)	1.14		0.257
Natural capital					
Land tenure					
Customary	77%	87%			
Freehold	2%	3%		1.51	0.417
Leasehold	21%	10%			
Total	100%	100%			
Mean land holding size (ha)	2.98 (2.2)	2.21 (1.73)			0.079
Financial capital					
Mean number of livestock	11.27 (11.25)	9.97 (8.75)	0.59		0.550
Access to non-farm income					
With access	43%	20%			
Without access	57%	80%		5.16	0.023 **
Total	100%	100%			
Human capital					
Knowledge on PLRs					
With knowledge	30%	5%			
Without knowledge	70%	95%		8.61	0.003 **
Total	100%	100%			
plans to change land use					
With plans	64%	93%			
Without plans	36%	7%		9.97	0.001 **
Total	100%	100%			
Mean age of household head (years)	49.50 (12.69)	42.12 (11.03)	2.83		0.006 **
Mean household size	7.43 (2.90)	6.09 (2.64)	2.23		0.028 **
Mean available household labor (man-days)	22.3 (16.38)	18.25 (11.58)	1.29		0.199
Mean available household labor per day (man-days)	3.87 (1.92)	3.46 (1.74)	1.03		0.303
Mean external labor hired labor per season (man-days)	11.45 (13.23)	12.41 (13.19)	0.33		0.742
Mean external labor used per day (man-days)	3.81 (3.21)	4.01 (3.52)	0.27		0.784

Table 2. *Cont.*

Variables	Households		t-Test (t-Ratio)	Pearson's Chi-Square (χ^2)	p-Values
	With Woodlots	**Without Woodlots**			
Mean household labor used	21.36 (15.54)	17.25 (11.06)	1.39		0.170
Mean household labor used per day (man-days)	2.22 (0.95)	1.92 (0.94)	1.46		0.148
Mean number of household dependents	5.47 (2.91)	4.33 (2.46)	1.95		0.055
Social capital					
Proportion of female headed households	0.23 (0.42)	0.1 (0.30)	1.59		0.115
Household nativity					
Native	86.4%	92.5%			
Migrant	11.4%	7.5%		1.33	0.515
Unknown	2.3%	0%			
Total	100%	100%			

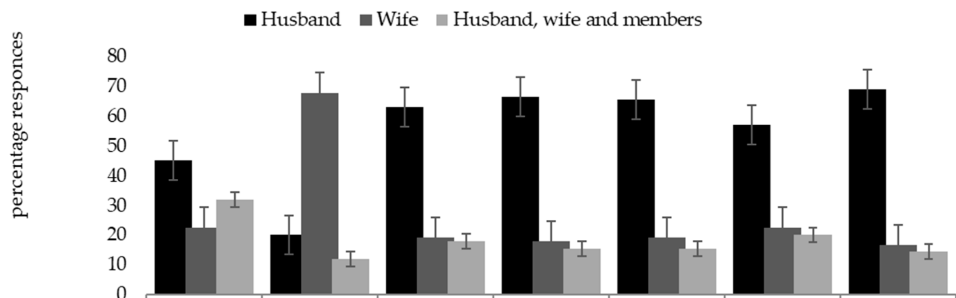
Note: Pearson's Chi-squared test of association (χ^2) for categorical variables and *t*-test of differences in means for continuous variables. Standard deviations in parenthesis are provided only for continuous variables. Asterisks represent level of significances, **: $p < 0.05$. PLR: policies, laws, and regulations.

The biggest proportion of households (93%) without woodlots intend and have future plans to change their land use activities towards woodlot establishment and management. Moreover, only 64% of households with woodlots intend to expand their woodlots.

3.2. Decision-Making at the Household Level

3.2.1. Gender Disaggregate Decision-Making Behavior of Household

There were different household farm activities considered for decision-making including choice of crops or tree species to grow, collection of fuelwood, buying land, disposal of land, forest product use, and labor allocation (Figure 2). Decisions on crops grown (45%), buying land (63%), disposal of land (67%), forest product use (66%), and labor allocation (57%) are mostly made by husbands. Decisions on fuelwood collection (68%) are mostly made by wives. None of the decisions are mainly made jointly (19%). This suggests that decision-making for most activities within the household with the exception of fuelwood collection is mostly performed by single member of the household (81%), in this case husbands.



	crops to grow	collect fuel wood	buying new land	disposal of land	forest product use	labor allocation	trees to grow
■ Husband	45	20	63	67	66	57	69
■ Wife	23	68	19	18	19	23	17
■ Husband, wife and members	32	12	18	16	16	20	14

Household activities

Figure 2. Decision-making at the household level in homogenous communities. Non-overlapping error bars indicate statistically significant differences between the groups of decision makers.

3.2.2. Household Decision to Select Perennial and Annual Crops and Management Regimes

A seen in Figure 3a, market price is the most common factor considered by households for selection of an annual crop. This is followed by food for consumption, previous yields, easy management, seed availability, growth rate, availability of credit, and lastly rainfall forecast. Information on market price is equally considered by both household categories. However, food consumption and easy management are more considered by households without woodlots. In contrast, crop yields in the previous seasons, seed availability of the crop, and growth period are more greatly considered by households with woodlots than without woodlots. Regarding perennial crop (Figure 3b), the market price is the only noteworthy selection criteria, but it does not differ between households' categories. Other factors such as neighbors' use, easy management, previous yields, seed availability, and credits are less considered in deciding on which perennial crop to grow.

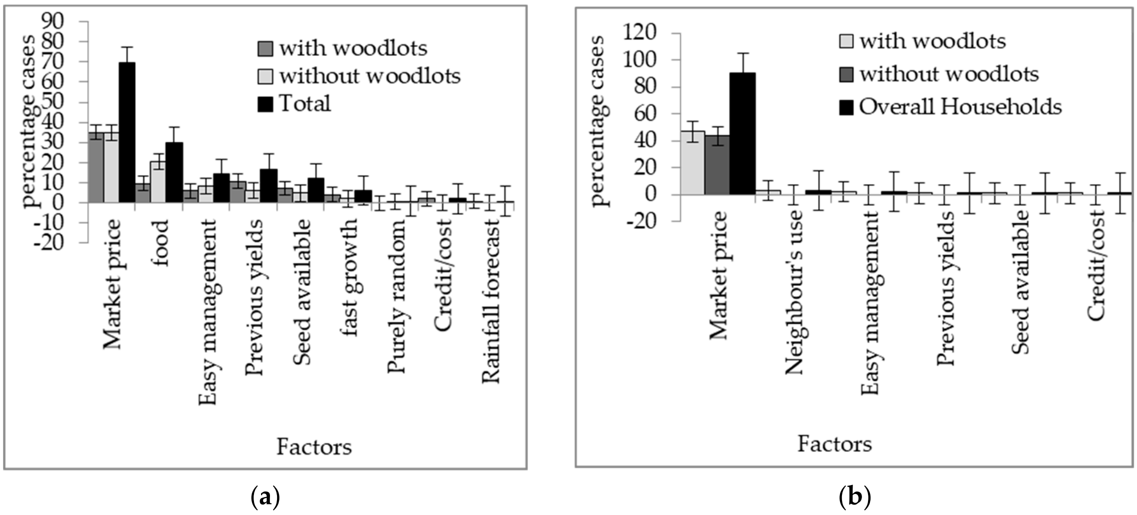


Figure 3. Factors considered to select an annual crops (**a**) and perennial crops (**b**), respectively. Since the variable was a multiple choice question, results are based on the number of cases each parameter was mentioned. Error bars with no overlaps indicate a statistically significant difference within individual factors.

Overall, choice of tree-crop farm management regimes, i.e., woodlot establishment, depends on the simplicity of the particular regime, the previous yields, and the availability of credits, extension service, neighbors' use, and the market prices, but also on non-specified random selection (Figure 4). Easy management and neighbors' use is more greatly considered by households without woodlots as compared to those with woodlots. In contrast, previous yield, credit/cost, extension advice, and lastly market price is more considered by those with woodlots. Additionally, selection of the management regime is highly associated and strongly related to the woodlot ownership status (Chi-squared values 13.875, df = 6, p-value = 0.031; contingency coefficient = 0.384, p-value = 0.031).

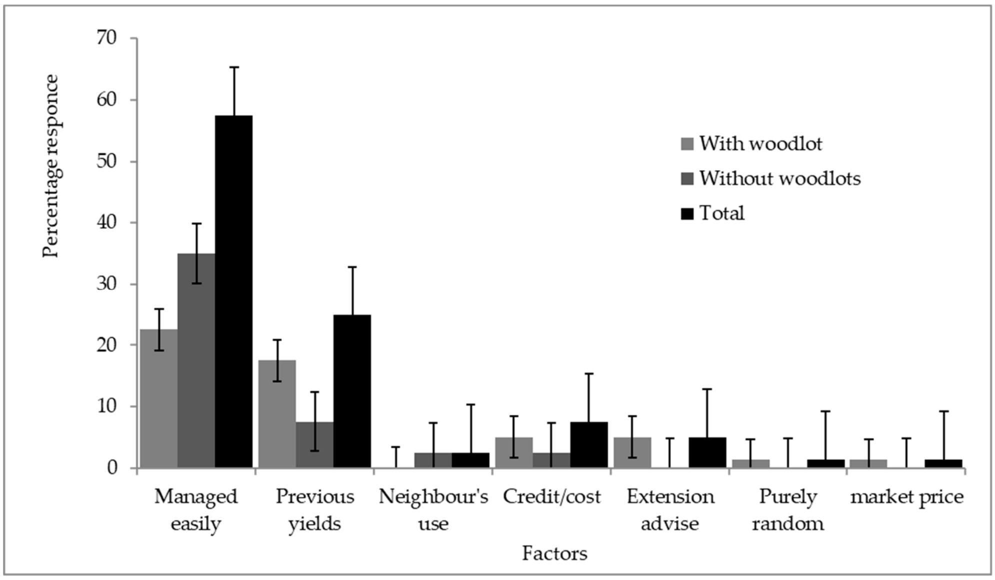


Figure 4. Percentage responses of determinants considered to select a tree-crop land use management regime.

3.2.3. Determinants That Influence Household Decision-Making with Respect to Woodlot Establishment

As highlighted in the analysis, binary logit regression model was run to identify significant determinants that influence household's decision making to woodlots establishment. The binary logit was instrumental to examining the influence of the independent variables on the dependent variable. This is because the response variable is binary and takes values of 1 (availability of woodlots) and 0 (absence of woodlots) on agricultural farms. The binary logit is extremely flexible and easily used from the mathematical point of view and can provide a meaningful interpretation (Amemiya 1981 in [49]. Analytically, a household has two choices: either to establish a woodlot (denoted as one), or not to establish a woodlot (denoted as zero). Logistic regression is carried out by obtaining the predictor variables X that best associate with the dependent variable y.

$$\text{Given by}:\ y = \begin{cases} 1 & \beta_0 + \beta_1 x + \varepsilon > 0 \\ 0 & \text{else} \end{cases} \tag{4}$$

where ε is the distribution error by the standard logistic distribution, and logistic function takes the real input value t, whereas the output always takes values between 1 and 0, making it a probability/likelihood function. Therefore, the logistic function σ (t) is defined as

$$\sigma(t) = \frac{1}{1 + \exp^{-t}} \tag{5}$$

Expressing t as a linear function of a single predictor x

$$t = \beta_0 + \beta_1 x \tag{6}$$

Hence, the logistic function becomes

$$y_{1=}\frac{1}{1+\exp^{-(\beta_0+\beta_1 x)}} \tag{7}$$

This can be linked to the linear predictor function

$$\text{logit}(p_i) = \text{In}\left(\frac{p_i}{1 - p_i}\right) = y_1 = \beta_0 + \beta_1 x_{1,i} + \ldots + \beta_n x_{n,i} + \varepsilon \tag{8}$$

where P_i is the probability of a household establishing a woodlot or not establishing a woodlot and it ranges from 0 to 1. y_1 is the dependent variable explained by predictor variables, $x_1, \beta_1, i \ldots \ldots \ldots \ldots ..n$ are independent variables used to explain the response variable, β_0 is the intercept of the regression model, $\beta_1, i \ldots \ldots \ldots \ldots ..n$ are constant parameters associated with predictor variables, and ε is distribution error term of the equation as seen in [45,49,52]. During the analysis, only statistically significant variables identified previously in Table 2 are entered as predictors. These are knowledge on land use policy, laws, and regulations (*K_PLRs*), willingness and future plans (*WandFP*) to transform from current land use to woodlot establishment or expansion, access to extra source of non-farm income (*EI*), age of household head (*AH*), total number of household communication assets (*TN_asset*), and household size (*H_size*) as elaborated in Table 3. Inserting these variables, Equation (8) becomes,

$$\text{logit}(p_i) = \text{In}\left(\frac{p_i}{1-p_i}\right) = y_1 = \beta_0 + \beta_1 K_{PLRs} + \beta_2 WandFP + \beta_3 EI + \beta_4 AH + \beta_5 TN_{asset} + \beta_6 H_{size} + \varepsilon \tag{9}$$

Table 3. Summary of the determinants used in the binary logit model.

Variable Names	Definition of Variables	Unit of Variables
K_PLRs	Knowledge on land use policy law and regulations most especially those concerned with tree planting and harvesting; 1 = yes, 0 = otherwise	Binary
WandFP	Household members or household heads willingness and plan to transform their current land use towards woodlot establishment or expansion; 1 = yes, 0 = otherwise	Binary
EI	Household members or household heads that access to extra source of income (non-farm income) most especially remittances, private business and formal jobs; 1 = yes, 0 = otherwise	Binary
AH	Age of the household head	Continuous
TN_asset	Total number of household assets such as, Television used for communication and information sharing	Continuous
H_size	Household size defined by the sum of individual members within the household	Integer

Only four of them, namely; *K_PLRs*, *WandFP*, *EI*, and *AH,* were retained in the final logit regression model, and their combined significant impact on the dependent variable (woodlot owner or not) was confirmed (Chi-squared $X^2 = 35.11$, p-value ≤ 0.001). Model evaluation showed that 77.3% of the total number of households with woodlots were correctly assigned to this category (Table 4). The age of the household head, access to extra source of non-farm income, plans to change farm activities and the knowledge on land use PLRs significantly influenced household decisions and likelihood of establishing a woodlot (p-value = 0.003; 0.037; 0.004; 0.003 respectively). Using the log odds, the extent of influence decreases from knowledge on land use PLRs (−2.771), future willingness and future plan to change land use activities towards woodlot establishment (2.279), extra source of non-farm income (−1.312), and to the age of household head (0.079). The resultant equation to assess the likelihood probability of the farmer to establish or not to establish a woodlot is given by

$$\log\left(\frac{p}{1-p}\right) = -0.302 - 2.771K\_PLRs + 2.279WandFP - 1.312EI + 0.072AH \quad (10)$$

where *WandFP* is willingness and future plans to change land activities to woodlot establishment, *K_PLRs* is the knowledge on land use PLRs towards tree planting and harvesting, *EI* is access to extra source of non-farm income, and *AH* is the age of household head.

Table 4. Determinants that influence household decision on woodlot establishment.

Parameter	B	S.E.	Wald	df	Sig.	EXP(B)	95% Confidence Interval for EXP(B)	
							Lower	Upper
Age of household head	0.072	0.024	9.097	1	0.003 **	1.075	1.026	1.126
Access to extra nonfarm income	−1.312	0.63	4.34	1	0.037 *	0.269	0.078	0.925
Intention to change land use	2.279	0.795	8.208	1	0.004 **	9.765	2.054	46.418
Knowledge on land use PLR	−2.771	0.947	8.555	1	0.003 **	0.063	0.01	0.401
Constant	−0.302	1.275	0.056	1	0.813	0.739		

Note: B—the coefficient, S.E—standard error, df—degrees of freedom, sig.—significance, EXP(B)—exponentiation of the B coefficient. Asterisks represent level of significances, *: $p < 0.01$; **: $p < 0.05$. PLR: policies, laws, and regulations.

4. Discussion

4.1. Differences in Household Endogenous and Demographic Traits and Intension to Woodlot Establishment

The non-significance in most of the selected variables between households with and without woodlots further implies the homogeneity of the interviewed households in the parish. Households with and without woodlots hire similar external labor to carry out given farm activities. In total, 84 man days of potential labor within the household are untapped. This provides the potential to utilize the untapped labor for woodlot establishment and management, if it is available in the right season. The results concede with other findings in that households tend to minimize labor inputs, leading to low quantities and qualities of tree farm outputs [53]. As observed by similar studies from the tropics, farmers with more land resources are able to carry out tree planting [54], implying that the similarity in land size ownership indicates the potential of households without woodlots to establish woodlots. This raises the question, however, as to why households with similar land size do not engage into woodlot establishment irrespective of the high intension to establish woodlots. The results imply that behavior and decision to allocate the untapped input resource towards tree planting within the study area is influenced by other determinants such availability of non-farm income, age of household head, and willingness for tree planting [33]. As explained by the theory of bounded rationality [41], household decision towards woodlot establishment would be improved with time if the existing communication assets and social gatherings were well utilized as channels of change.

4.2. Gender Disaggregate Decision-Making Behavior of Household

Generally, decision-making on buying and selling land, commercializing forest products like timber and poles, and allocation of labor and tree planting rest with the household head (husband), apart from fuelwood collection that is more decided by wives. Women's power is left to less and non-commercial activities, irrespective of the large efforts to increase gender equality and women's participation in decision-making and natural resource management [17]. This confirms the social dominance of male individuals in natural resource management and lower land tenure security among women in Africa [17,55,56]. With the increased migration of men to urban areas, however, there is also an increase in female headed households and female saving groups in the rural areas as observed in our case study. In these cases, responsibilities such as establishment and management of woodlots at the farm level are left for the women [17]. Involvement of women in forest restoration projects may then positively impact on forest land use transformation towards woodlot establishment. Inclusion of women has to be accompanied by capacity building on the management practices, and access to market information. Additionally, as focused support of women provides a sense of ownership towards woodlots, their acceptance in household decision-making will be strengthened and will lead to a collective decision-making in the households. So far, decision-making at the household level in homogenous communities—as in our case study—is individualistic and dominated by husbands, with less collective bargaining of female and other household members.

4.3. Household Decision-Making for Selection of Crops and Management Regimes

Generally, a household's decision to select an annual crop is based on market prices. The possibility to provide food for consumption is also highlighted as a factor, but more considered by households without woodlots. For the selection of perennial crops, only the factor of market prices plays a significant role, indicating that farm households in our cases are more market-oriented. This suggests that availability of information on market prices is a significant factor in making decisions on which annual and perennial crop to grow within the agricultural farms. In other words, a household member's decision is based on his/her cognitive capacity [38], bounded by only the available information as explained by the theory of bounded rationality in Schlüter et al. [57]. In addition, choice of a given management regime (tree-crop arrangement) is attracted by the ease of management and yield from the previous seasons of a given applied managed regime. Focus on ease of management is due to inadequate household's knowledge, management skills and information on advanced tree-crop technologies. Looking at previous yields, high yields from the previous seasons provide confidence in the management practices used, increasing the likelihood for their selection in the next season. The fact that a households' decision is affected by the outcomes of its previous decisions suggests that households habitually learn from their experiences in the past. In summary, the results suggest that household decision-making to select a given crop and management regime is fully based on market prices, ease of management, and yields from the previous seasons, since higher prices lead to higher economic output.

4.4. Determinants That Influence the Likelihood for Households' Decision-Making to Woodlot Establishment

4.4.1. Age of Household Head

Household head is the major decision entity with a high influence on decision-making at a household level. From the study, a unit increase in age of the head increases the chances of a household establishing a woodlot by 0.072. This is backed up by the fact that mean age of households with a woodlot is significantly higher (p-value = 0.006) than the mean age of households without a woodlot. A similar trend in results was observed by other studies, e.g., [49,58]. In contrast, some studies [36,59] obtained an opposite trend in proportion of age of household head and the rate of tree planting. They found out that an increase in age of household head favors and is linked to higher chances of tree establishment. The direct proportionality of age and tree planting in this study could be attributed to the fact that older household heads have larger land sizes [60] and farm experience [59], they have less family responsibilities, a greater need for recreation, greater knowledge about the functionality of trees, and have better access to external support, e.g., remittances. This enables them to establish woodlots unlike younger heads who focus on short-term farm returns to satisfy the high demands of their households.

4.4.2. Access to Extra Source of Income "Non-Farm Income"

Access to extra source of income can limit or favor adoption [61], such as venturing into woodlot establishment, but our results show a tendency towards a negative effect. Two-thirds of the total respondents have no access to off- or non-farm income, such as teaching, private businesses, or remittance. Additionally, the majority of the households obtaining off- or non-farm income re-invest a high percentage of the money into both agricultural and education for their children, rather than investing it into woodlots. This proves the hypothesis that household heads involved in non-farm income are less likely to take a decision to plant trees on their farms [50]. The reason behind is that most households with access to non-farm income lack time and labor for woodlot establishment, supervision, and management. With the high echelon of responsibilities and poverty, it is impossible to venture into woodlot establishment unless households have a surplus in income and external support such as provision of credit or of tree planting stock. This explains the negative likelihood observed from the logistic regression analysis. The results obtained provide different insights from those of Gebreegziabher et al. [62] and Deressa et al. [34] who argued that the more exogenous income a farmer has, the more likely he would plant trees. Determinants of household decisions, however, are site-specific and depend on the type of households and current pressing needs of the farmer. Based on this fact, increase of extension services such as provision of high quality seedlings and capacity building would aid household's decision towards woodlot establishment.

4.4.3. Knowledge on Land Use PLRs Towards Woodlot Establishment

Farmer's awareness on land use PLRs plays an important role with regards to woodlot establishment, because it influences household's tree planting behavior [63]. In our study, it is observed that knowledge on PLRs negatively influences the likelihood of household's decision to establish woodlots. From the narratives, households attribute this failure to the denial and absence of flexible tree harvesting rights and freedom (tree tenure). They add that the process of woodlot registration and development of forest management plan is complex. Negative experiences from woodlot farmers in neighboring villages also play a part in this regard. This creates insecurity with regard to land ownership and product use, and hence the view that woodlot establishment is an unsecure venture by the households [54]. Moreover, knowledge on land use PLRs is not well disseminated by the extension agents hence households obtain partial and outdated information. As a consequence, households may misinterpret the obtained information resulting into negative decisions towards woodlot establishment.

4.4.4. Willingness and Future Plans to Change Land Use Activities Towards Woodlot Establishment

Farmer's aspirations, future plans and willingness to change their land use activities plays a big role in woodlot establishment and expansion. As evidence, 92% of the total farm households plan to diverse from pure agriculture to woodlot establishment. This is confirmed by the strong association between current land use and planned land use activities, most especially woodlot establishment ($\chi^2 = 15.5$, df = 2, p-value ≤ 0.001). The desire to establish a woodlot in future is attributed to anticipated increase in future demand of tree products and their respective market prices. Additionally, a reduction in the local natural resource availability, including denial to access the surrounding forests like the Budongo forest reserve, enhances the motivation towards tree growing, as also noticed in Kenya, Bangladesh, and Sri Lanka [64,65]. Additionally, the proximity of households to markets and main roads (4.32 ± 1.27 km and 0.81 ± 1.08 km, respectively) facilitates the desire for future woodlot establishment. Nevertheless, there is a mismatch between the stated intention of woodlot establishment by 90% of the households and the actual decisions, with only 50% of households having woodlots. This indicates the validity of the theory of planned behavior, which states that implementation of households' intentions depends on the given constraints [39], and implies that other factors not captured here, like pests and disease, drought, and lack of planting stock also have an important effect.

5. Conclusions and Policy Implications

The study analyzed the decision-making of homogenous small-scale households focusing on land use transformation, mainly diversification of agricultural lands with forest woodlots. Homogeneity of households was ensured to eliminate a number of similar predictor variables among households and avoid selection bias. Using a mixture of methodologies, it was observed that households allocate a limited number of available assets for woodlot establishment. It was also found that small-scale households lacked the cognitive economic capacity and skills for tree management to ensure quality and tree productivity which would lead to the maximization of the untapped labor and land resources. Irrespective of that, farm households have the potential to establish woodlots on their agricultural farms. Decision-making roles is clearly disaggregated on the basis of husbands and wives, with less participation and bargaining on the part of wives. The process is mainly dominated by husbands who focus on highly profitable activities. This indicates prevailing gender inequality like in many other places in the tropics. Furthermore, decision-making within the household is individualistic, mostly dominated by men and with less involvement of other family members. In light of that, policy interventions and forest restoration initiatives should focus on reducing the gender gap and increase women's participation in decision making. This can be done through increased access by wives to information coupled with capacity building services.

As observed earlier, households in the study area are market oriented with regards to selection of both annual and perennial crops. However, crops that provide food for consumption are as well looked at while making decisions, but are more greatly considered by households without woodlots. Additionally, selection of a given management regime (tree-crop arrangement) is attracted by the ease of management and yield of a given applied managed regime from the previous seasons. The likelihood for woodlot establishment is positively influenced by the willingness and intention of individual households to diversify and transform their land use from pure agriculture to woodlots, and the age of household head. However, knowledge on land use policies, laws, and regulations in relation to tree planting and harvesting and more access to non-farm income reduce the likelihood for woodlot establishment. Here we recommend that current and future forest land restoration projects consider smallholder capacity and potential for woodlot establishment and their freewill in converting their land use activities. Also essential is availability of favorable land use policies that are clearly communicated by tapping the existing communication assets and social gatherings as channels of change, and provision of flexible tree harvesting rights and contracts, especially in cases of payment for ecosystem services (PES) schemes. Consideration of age, gender, and cognitive capacity to establish and manage woodlots is an added advantage. Provision of wood product prices and markets, e.g., with an information platform, and inclusion of smallholder tree planters in social organizations such as tree grower's associations and cooperatives would boost woodlot establishment, production, and value addition. This could contribute to current initiatives such as the African Forest Landscape Restoration Initiative (AFR100) and the Bonn challenge, which aim to restore degraded forest landscapes, minimize pressure on natural forests, and reduce wood deficit at the local, national, and international levels.

Methodologically however, further analysis is required to quantify and simulate various scenarios to understand the extent at which PLRs and other factors influence woodlot establishment through agent-based simulations. Additionally, testing the applicability of household decision-making and behavior theories such as utility maximization theory, theory of habitual learning etc. would be of great importance in this era of forest landscape restoration.

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