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Community-based forest management promotes survival-led livelihood diversification among forest-fringe communities in Uganda

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Livelihood diversification is a prominent feature of rural households in developing countries. It is a strategy commonly pursued by households to enhance their resilience to shocks and/or risks that affect their livelihood. While a common characteristic of Uganda's community-based forest management (CBFM) is the promotion of alternative livelihood activities to reduce household reliance on natural forest resources from gazetted forests, it is unclear how livelihood diversification has been embraced by households engaged in CBFM. We explore livelihood diversification using cross-sectional survey data collected from 423 households in villages adjacent to Collaborative Forest Management (CFM) compartments and non-CFM compartments of Budongo Central Forest Reserve as well as two Community Forests (CF) in mid-western Uganda. We quantified the levels of diversification and fitted a Gini-Simpson Diversity Index as the response variable in two Tobit regression models to examine the determinants of livelihood diversification among forest-fringe communities in CFM and CF sites. Our results reveal high levels of survival-led household livelihood diversification in the area, with an average household engaging in five livelihood activities that were predominantly on-farm or involved the extraction of forest products for subsistence. In the CFM sites, livelihood diversification levels significantly increased with household heads' duration of residence in the village and membership in other social groups in the village. In villages adjacent to the community forests, only the household dependency ratio positively influenced household livelihood diversification. Membership in forest conservation groups did not significantly predict the level of household livelihood diversification. Given the current survival-led diversification that these communities pursue, we recommended that development and conservation agencies in the area and

other similar sites of CBFM deliberately enhance household access to high-return on-farm and non-farm livelihood activities to achieve meaningful transformations in rural livelihoods.

KEYWORDS

livelihood diversification, collaborative forest management, community forestry, livelihood strategies, community-based forest management

1. Introduction

Livelihood diversification is an important concept among scholars and policy makers in developing countries due to its practical connection to rural livelihood resilience (Baffoe and Matsuda, 2017a). Globally, rural livelihoods tend to be centered around three key strategies: agricultural intensification, livelihood diversification, and migration (Barrett et al., 2001). Most rural households in sub-Saharan Africa explore these strategies by pursuing other non-farm and off-farm livelihood activities besides farming (Ellis, 1999, 2000; Block and Webb, 2001; Walelign, 2016; Walelign and Jiao, 2017). This serves as a way of attenuating the negative effects of the predominantly risk-prone farming practices that they pursue for livelihood support (Asfaw et al., 2019; Etea et al., 2019). However, even within the same rural community, there are usually differences in the levels of diversification among households depending on the level of urbanization, access to markets, human and social capital, wealth and other household characteristics (Ellis, 1999, 2000; Baffoe and Matsuda, 2017b; Walelign and Jiao, 2017; Loison and Bignebat, 2018).

Ellis (1999) defined livelihood diversification as a process by which household members construct a diverse portfolio of activities in their struggle for survival. Livelihood diversification enables household members to meet their basic needs, improve their standards of living and cope with risk. Two broad typologies of rural livelihood diversification can be identified: agricultural diversification and non-agricultural diversification. Agricultural diversification involves production of multiple or high-value crops and/or livestock. On the other hand, non-agricultural livelihood diversification is typified by involvement in petty businesses, formal employment, remittances, extraction of forest resources and off-farm labor (Ellis, 2000). While agricultural diversification could result in significant positive livelihood gains for poor households, it may not be beneficial for wealthier households, for whom returns from specialization tend to outweigh the benefits of diversification.

In rural areas, the poorest households often face entry barriers to remunerative livelihood activities (Gautam and Andersen, 2016). Consequently, such households tend to engage in "distress-push" diversification that they pursue involuntarily to cope with shocks and crises. Their wealthier counterparts, in contrast, mostly pursue "demand-pull" diversification to create wealth (Sabyrbekov, 2019). In typical agrarian rural areas, the distress-push diversification pathway is predominant and perpetuated by failure in agricultural output resulting from shocks, unfavorable seasons (Ellis, 1998, 1999), missing or incomplete factor markets and market access limitations (Barrett et al., 2001). Households thus pursue the distress-push pathway with a survival-led focus while the demand-pull diversification pathway is opportunity-driven and largely a means of accumulation (Ellis, 1998; Loison, 2015; Etea et al., 2019). In addition to the household-level socio-economic conditions, the biophysical and institutional context within which farmers operate could also influence the choice of diversification pathway that households pursue (Kassie et al., 2017; Asfaw et al., 2019).

In Sub-Saharan Africa, national governments and development partners have consistently embraced livelihood diversification in their rural development agendas as a means to reduce the persistent rural poverty in the region (Loison, 2015; Loison and Bignebat, 2018). In Uganda, the government has embraced it in its national development planning frameworks, notably, the national development plans (MFPED, 2015, MFPED, 2020) and the country's vision 2040 (NPA, 2013). In Uganda's forestry sector, the main focus has been on achieving both conservation and rural development goals through involvement of forest-fringe households in conservation activities – especially those that provide alternative income sources. Following Uganda's forest sector reforms initiated in the late 1990's, two key CBFM schemes were formulated and promoted: (i) community forestry (CF) and (ii) collaborative forest management (CFM). Under these CBFM schemes, organized and registered community groups sign agreements with the state agency (in the case of CFM) to manage specified areas of a state forest or legally own forests (in the case of CF) on public land or other areas specified in the National Forestry and Tree Planting Act, 2003 (GOU, 2003).

The community groups participating in CFM are registered as Community-Based Organizations (CBOs) while those seeking to manage CFs are mostly registered as Communal Land Associations (CLAs). Following the implementation of pilot initiatives in the late 1990s, the CFM approach has gained prominence and is now practiced in all forest ranges under the National Forestry Authority (Kazoora et al., 2019). The community forestry approach, on the other hand, has had a slow take-off and is currently being actively implemented in only two forests – Ongo and Alimugonza, both of which are situated in the Budongo Forest landscape. These registered groups (CBOs and CLAs) have benefited from their *de jure* status by appealing to development agencies seeking to promote alternative livelihood schemes (Mawa et al., 2021, 2022). As such, members of these groups have had an advantage over non-members in that they have been more involved in training on alternative livelihood activities and other forms of alternative livelihood support schemes supported by state and non-state development and conservation agencies in the area. Most alternative livelihood schemes in the Budongo forest landscape aim to reduce household reliance on extractive forest resource use through various decoupling interventions such as promotion of apiculture, agroforestry, poultry and other livestock rearing, village

savings and cooperative schemes, vegetable growing and business training (Babweteera et al., 2018).

A common feature in the theory of change of such interventions is the diversification of livelihoods in forest-adjacent households to reduce risks associated with peasant agriculture, and subsequently reduce forest dependence. This thinking is premised on the assumption that participating households find the alternative livelihood interventions more attractive than illegal forest-resource extraction or peasant agriculture. Thus, households with more diverse income sources would face a higher opportunity cost in harvesting forests and subsequently rely less on forestry resources (Wei et al., 2016). The reality around the BFR, however, is that households face complex risks ranging from low agricultural output as a result of human wildlife conflict and weather fluctuations, to entry barriers to high-income opportunities, as well as institutional factors that restrict access to more lucrative forest products. This combination of factors, as well as household attributes, could significantly increase the chances of distress-push diversification. Whereas, the households participating in CBFM schemes have had privileged access to these alternative livelihood schemes, it remains unclear whether interventions supported by CBFM schemes have inhibited or enhanced rural livelihood diversification. Recent studies in other parts of sub-Saharan Africa (e.g., Kassie et al., 2017; Kimengsi et al., 2019) and Asia (e.g., Park and Yeo-Chang, 2021) show positive associations which are largely context-specific.

Community Based Forest Management remains an important tool for managing protected landscapes like Budongo. However, whether the interventions deployed by such schemes are contributing to more equitable management, by diversifying and thus transforming livelihoods of households near protected areas remains gray, which limits opportunities for improving CBFM as a forest management strategy that has been widely implemented but with mixed results for conservation and livelihoods in Uganda.

This study therefore sought to contribute to the existing body of knowledge on outcomes of CBFM initiatives by examining the determinants of livelihood diversification in the Budongo Forest landscape, which harbors the longest successful sites of community forestry and Collaborative Forest Management in Uganda. Specifically, the study was guided by the following research questions: (i) what differences exist in the livelihood activities and pathways pursued by households of conservation group members (CLA and CFM) vis-à-vis non-members? (ii) what socio-demographic characteristics influence the levels of household livelihood diversification in the Budongo forest landscape?

1.1. Analytical approach

Following an extensive review of literature on rural livelihood diversification in sub-Saharan Africa, Loison (2015) reported two dominant approaches that scholars have frequently used to study household livelihood diversification behavior in the region: the "household economic model" (Taylor and Adelman, 2003) and the "livelihoods approach" (Chambers and Conway, 1991; Scoones, 1998; Ellis, 2000). The household economic model views the farming household as a dual-purpose (both producer and consumer) decision-making unit that makes production, labor allocation and consumption decisions that may be interdependent. A key assumption of this model is that such decisions are made to maximize utility. While conceptually sound, the household economic model fails to capture the reality of livelihood activity and strategy choices made by households in stressed environments (Ellis, 2000), and does not account for social relationships between household members that in many cases influence those choices (Ellis, 1998).

Therefore, with its people-centered focus, the livelihoods approach has dominated empirical studies on rural livelihood strategies and diversification in developing countries. The livelihoods approach is premised on the notion that all people have a range of assets (social, physical, financial, human and natural) which determine (i) the options available to them, (ii) the livelihood strategies they adopt, and (iii) their vulnerability to risks and shocks (Ellis, 2000). However, these assets gain their meaning and value through the prevailing social, institutional and organizational environments (DFID, 1999). While many of its components are difficult to measure and have been conceptualized in numerous ways, often using proxies by different authors, the livelihoods approach provides a more realistic picture of rural household-level diversification strategies, constraints faced in their pursuit and the diverse character of livelihoods. This study therefore uses insights from the livelihoods approach to examine household livelihood diversification among forest-fringe rural communities in the Budongo Forest landscape.

2. Materials and methods

2.1. Study area

This study was conducted in rural villages sharing borders with Budongo Central Forest Reserve (BFR) and two community forests (Ongo and Alimugonza) located at the periphery of BFR (**Figure 1**). BFR is a natural tropical forest located in mid-western Uganda, between 1°37′ and 2°03′ N, 31°22′, and 31°46′ E, spanning an area of 82,510 Ha. The Southern, South-Western and Eastern parts of BFR border farms and settlements. Many of the sections of the forest bordering these farms and settlements have been placed under CFM (**Figure 1**). There are six registered CBOs (CFM groups) that have signed agreements to co-manage those sections of BFR with the state agency (National Forestry Authority). These are Budongo Good Neighbours Community Association (BUNCA), Nyantonzi-Kamusenene Environment Conservation and Development Association (NECODA), North Budongo Forest Community Association (NOBUFOCA), Siiba Conservation Environment and Development Association (SEDA), Kapeka Integrated Community Development Association (KICODA), and Karujubu Forest Adjacent Community Association (KAFACA).

Most of the farms in the area are of subsistence nature, dominated by annual crops such as beans, sweet potatoes, cassava, and groundnuts. Over the past two decades, sugarcane plantations belonging to out-growers that supply Kinyara sugar factory have also expanded in the area, especially on the southern edge of the forest (Babweteera et al., 2018; Jeary et al., 2018). The factory is located about 5 km away from the forest edge. Resources accessed from BFR support the daily subsistence, and occasionally, cash

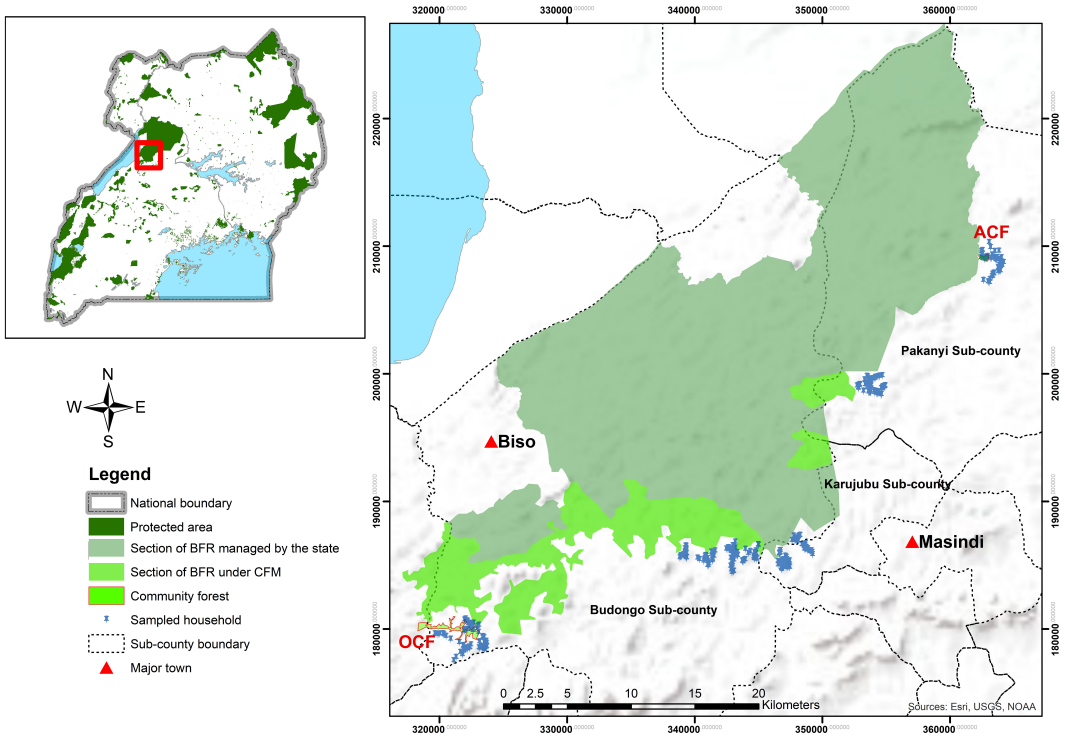

FIGURE 1
Location map of sampled households in villages adjacent Bugongo Forest Reserve (BFR), Ongo Community Forest (OCF), and Alimugonza Community Forest (ACF) in mid-western Uganda.

needs of the forest-fringe households (Tumusiime et al., 2010; Mawa et al., 2020b).

The two community forests (Ongo and Alimugonza) are natural tropical forests located in the Budongo Forest Landscape. Ongo community forest covers 172.32 Ha and is located on the South-Western side of BFR while Alimugonza community forest is 28 Ha and is located on the Eastern side. Both community forests provide resources that are important for the daily subsistence needs of households in the surrounding villages (Mawa et al., 2020a, 2021). Each of the community forests is managed by a Communal Land Association (CLA). The CLAs are formed by community members drawn from villages that have historically accessed resources from the respective forests. Most households in these villages are sedentary subsistence farmers.

The Budongo forest landscape is ethnically diverse with over 50 ethnic groups. The Banyoro who speak the Runyoro dialect are the indigenous inhabitants. The others comprise of immigrants from other parts of the country, Democratic Republic of Congo and South Sudan. The widely spoken languages in the area are Runyoro, Kiswahili, Lugbara, and Alur.

2.2. Data collection

We conducted a cross-sectional survey in 17 villages located in the Budongo forest landscape. Ten of the villages were in Kapeeka, Kibwona, Kyaguzi, and Nyabyeya parishes that border Budongo Central Forest Reserve. The remaining seven shared boundaries with the two community forests. The survey was conducted between September and December 2018. We sought clearance and permission to conduct the study from the Uganda National Council of Science and Technology, Masindi District Forest Service and National Forestry Authority. A multistage sampling strategy was used to select households for interviews. First, a list of households was obtained from the respective village Local Council Chairpersons. These lists were stratified based on membership to CBFM schemes as CFM or CLA member households and non-members. Following Krejcie and Morgan (1970), a total of 423 households were selected for the two strata using systematic random sampling technique. This sample comprised of 96 CFM member households, 196 non-CFM members, 40 CLA member-households, and 91 non-CLA members. We adapted the Poverty Environment Network (PEN) household questionnaires (CIFOR, 2008) to collect data on household livelihood assets, activities, strategies, income sources and household socio-demographics. Interviews were held with household heads or any other adult member of the household who was knowledgeable about the household livelihood assets and activities. The interviews were held in the local languages by trained research assistants.

2.3. Data analysis

2.3.1. Propensity score matching

We used the Propensity Score Matching (PSM) technique to obtain suitable counterfactuals for comparison of livelihood diversification among conservation group member-households

(participants) and non-members (non-participants). We fitted a binary logistic regression model for each site (CFM and non-CFM) to generate a propensity score for each respondent based on relevant socio-demographic and biophysical characteristics (number of years of education of Household Head, number of years since the household was formed, age of Household Head, Household size (Adult Equivalent Units), distance of the household to the nearest forest, market and motorable road). The response variable (participation in CBFM) was a dummy i.e., 1 if at least one household member belonged to a community-based forest conservation group and 0 otherwise. We then used the nearest-neighbor algorithm in the *matchIt* Package (Ho et al., 2011) in R Programming language (R Core Team, 2020) to create groups of CFM/CLA members and non-members that were as closely matched as possible. Following Rosenbaum (2010), we used a caliper distance of 0.2 of the standard deviation of the estimated propensity scores. We ran sensitivity analyses to check for possible bias due to confounders using the *rbounds* package (Keele, 2014), in the R Programming language. The unmatched dataset from the CF sites was well-balanced on the selected covariates, rendering PSM unnecessary. However, for the CFM sites, 85 CFM-participating households were matched to the same number of non-participating households and used for the subsequent analyses.

2.3.2. Livelihood activities

Guided by insights from similar recent studies in Africa (Tumusiime et al., 2011; Loison, 2015; Gebru et al., 2018; Loison and Bignebat, 2018; Kimengsi et al., 2019, 2020) and Asia (Khatun and Roy, 2012; Gautam and Andersen, 2016; Dai et al., 2020), household income sources were disaggregated into 11 categories: (i) Commercial crop farming (ii) Food crop farming (iii) Subsistence forest product extraction (iv) Commercial forest product extraction (v) Poultry farming (vi) Small livestock farming (vii) Large livestock farming (viii) Off-farm agricultural wage (ix) Petty business (x) Non-farm self-employment and (xi) Non-farm salaries and wages. These income sources were compared among CFM/CLA member households and non-members using the non-parametric Wilcoxon Rank Sum Test.

Various indices have been used in the livelihood diversification literature to compute levels of diversification. Common indices include: Shannon-Weiner Diversity Index, the Gini-Simpson Index, Share of non-farm income, number of livelihood activities (or income sources), Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index (Shiyani and Pandya, 1998; Khatun and Roy, 2012; Loison and Bignebat, 2018; Asfaw et al., 2019). In this study, four measures of livelihood diversification were computed: (i) the number of livelihood activities pursued, (ii) the share of non-farm income (iii) Shannon-Weiner Diversity Index and, (iv) Gini-Simpson Index. The Shannon-Weiner Diversity Index (H') is a widely accepted diversity measurement index, commonly used in community ecology. Several previous authors of livelihood diversification (Wan et al., 2016; Etea et al., 2019; Sabyrbekov, 2019) have also used it as a measure of household livelihood diversification. Its key strength is that it accounts for equity and richness of livelihood strategies and activities. Shannon-Weiner Diversity Index (H') was computed as:

$$H' = -\sum_{i=0}^{N} p_i \ln p_i \quad (1)$$

Where p_i = proportion of household income generated by activity i to the total income. N = total number of different income sources. An increase in the value of H' implies an increasing diversity of household income sources.

The Gini-Simpson Index is particularly popular due to its computational simplicity, robustness and ease of interpretation. Thus, it was computed and used as a dependent variable in the Tobit regression models. The index takes into account both the number of activities and the evenness of the income shares across the activities. The Gini-Simpson index has also been severally used by previous authors (Debela et al., 2012; Khatun and Roy, 2012; Chilongo, 2014; Etea et al., 2019). The index computes unbiased estimates of diversification, especially when the samples are randomly drawn from populations (Caso and Gil, 1988). The Gini-Simpson Index (D_1) was computed as:

$$D_1 = 1 - \sum_{i=0}^{N} p_i^2 \quad (2)$$

Where a D_1 value of 0 indicates a single source of income, while a value of 1 indicates an infinite number of income sources of equal size. Thus, as D_1 approaches 1, it reveals an increasingly diversified household income portfolio. We also compared and visualized the levels of diversification among conservation group members and non-members by constructing five categories of the levels of diversification based on values of the Gini-Simpson index as shown in **Table 1**.

2.3.3. Determinants of livelihood diversification

Since the Gini-Simpson Index value is limited between zero and one, ordinary least square regression is not suitable to explain the determinants of livelihood diversification. Therefore, we ran two Tobit regression models (Tobin, 1958) to assesses and explain the determinants of livelihood diversification among forest-fringe rural households in the Budongo forest landscape: one model for CF and the other for CFM sites. Recent studies on livelihood diversification (Awotide et al., 2010; Torres et al., 2018) have also used the Tobit model due to its ability to provide consistent estimates for censored response variables (Hill et al., 2018; Wooldridge, 2019) as it is in our case.

TABLE 1 Categories of livelihood diversification.

Category	Gini-Simpson Index
No diversification	≤0.01
Low level diversification	0.01–0.25
Medium level diversification	0.26–0.50
High level diversification	0.51–0.75
Very high-level diversification	>0.75

TABLE 2 Predictor variables used in the Tobit regression models.

Variable	Variable description	Description of variable coding	Expected effect on D_1
X2	Sex of household head	Dummy, takes the value of 1 if household is male-headed and 0 otherwise	+
X3	Duration of residence in the village	Continuous (number of years)	+
X4	Number of parcels of land	Continuous	+
X5	Dependency ratio	Continuous (computed as the number of household members aged 15 or below or above 64, divided by the number of household members aged between 15 and 64)	+
X6	Total value of durable fixed assets	Continuous	+
X7	Membership in CFM or CLA	Dummy, takes the value of 1 if yes and 0 otherwise	+
X8	Access to finance	Dummy, takes the value of 1 if yes and 0 otherwise	+
X9	Membership in other social groups	Dummy, takes the value of 1 if yes and 0 otherwise	+
X10	Leadership position in the village	Dummy, takes the value of 1 if yes and 0 otherwise	+

The set of predictor variables (**Table 2**) used in the models were selected following an extensive review of literature on rural livelihood diversification (Ellis, 1999; Block and Webb, 2001; Awotide et al., 2010; Debela et al., 2012; Loison, 2015; Gautam and Andersen, 2016; Wan et al., 2016; Baffoe and Matsuda, 2017a; Kassie et al., 2017; Gebru et al., 2018; Asfaw et al., 2019; Kimengsi et al., 2019, 2020; Sabyrbekov, 2019; Žakevièiûtë, 2019; Dai et al., 2020; Dedehouanou and McPeak, 2020; Senganimalunje et al., 2020).

All statistical analyses were conducted using R version 4.0.3 (R Core Team, 2020). **Table 2** presents a list of variables used in the model with *a priori* sign expectations. The Marginal effects were computed and reported to ease interpretation.

3. Results

3.1. Livelihood activities of forest-fringe households in the budongo forest landscape

Both conservation group member and non-member households undertook similar livelihood activities. These were dominated by on-farm activities such as food and commercial crop farming, poultry and small livestock farming. Over 40% of the households in the sample (**Figure 2**) were engaged in each of these activities. Rearing of large livestock (cattle) was not popular in the study area. Forest environmental income was dominated by subsistence forest product extraction that over 70% of the households in our sample engaged in. Commercial forest product (timber and charcoal) extraction was practiced by 13% of the households in the villages adjacent to BFR while only 2% of those located in villages adjacent to the community forests were engaged in it. Non-farm income was dominated by petty businesses (20 and 10% in the CFM and community forestry sites, respectively). Salaries and wages, just like large livestock farming were not major sources of income for the average household in our sample. About 40% of the households in both CFM and community forestry sites obtained part of their household income from off-farm wage labor (offered on other farms in the area) as shown in **Figure 2**.

For households in the CFM sites, subsistence forest resource extraction was the most important income source for both CFM-member households (Median = UGX 92,000) and non-member households (Median = UGX 89,846). This was followed by small livestock farming (Median = UGX 68,210 for CFM-member households and Median = UGX 35,571 for non-CFM member households), poultry farming (Median = UGX 22,000 for CFM member households and Median = UGX 19,090 for non-CFM member households), commercial and subsistence crops were the least important household income sources (**Table 3**).

For households in villages bordering the community forests, food crop farming was the main income source among CLA member households (Median = UGX 106,363). While the livelihood activities that non-CLA member households engaged in were similar to those observed in the CFM sites, CLA member households obtained significantly higher median incomes from subsistence forest product extraction (Wilcoxon rank sum test, W = 1,307.5; p = 0.001) and petty businesses (Wilcoxon rank sum test, W = 1,554, p = 0.020) as shown in **Table 3**.

3.2. Levels of household livelihood diversification

The average CFM member household in our sample was engaged in significantly higher number of livelihood activities (Mean = 5.25; SE = 0.13) compared to non-CFM member households (Mean = 4.61; SE = 0.10) ($p < 0.05$). However, their average Shannon's and Gini-Simpson indices were not significantly different from those of non-CFM member households ($p > 0.05$). In the CF sites, there were no significant differences in the average number of livelihood activities that CLA member households and non-members engaged in ($p > 0.05$). Non-farm livelihood activities contributed marginally to the total household income, especially among communities surrounding the community forests, where its average contribution was less than 10% (**Table 4**).

Over 55% of the households around both BFR and the two community forests practiced high to very high levels of livelihood

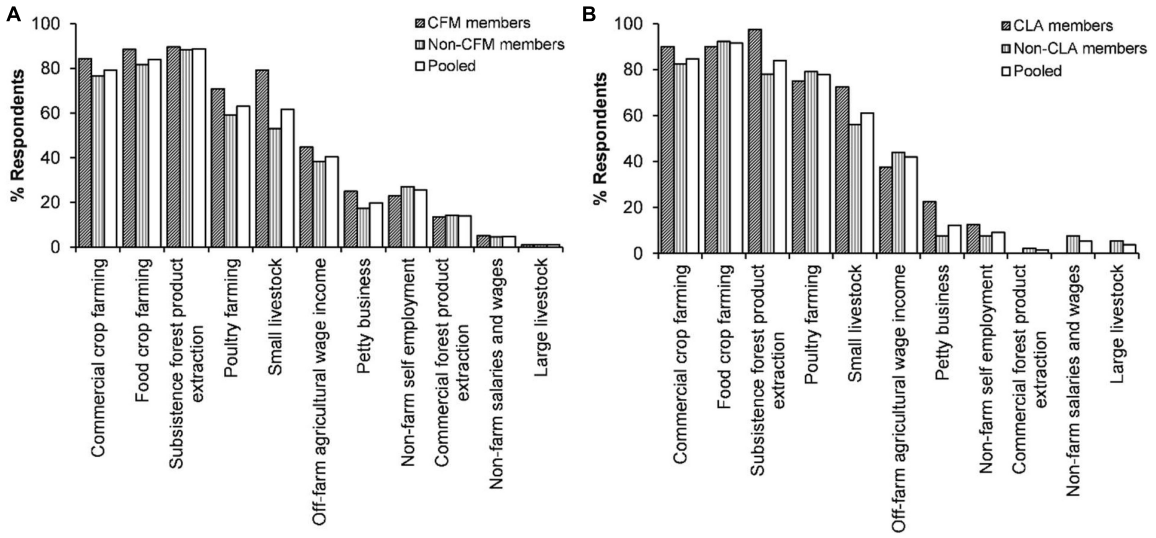

FIGURE 2
Livelihood activities of forest-fringe rural communities around Bugongo Forest Reserve (BFR) **(A)** and community forests **(B)** in mid-western Uganda.

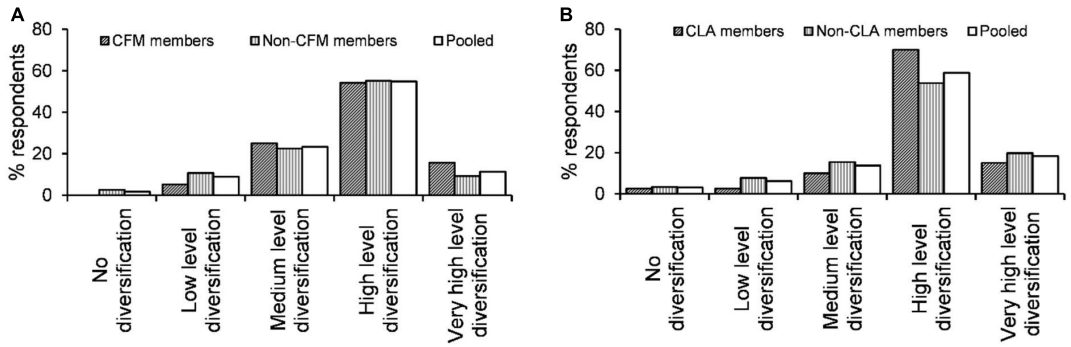

FIGURE 3
Levels of livelihood diversification among forest-fringe rural households around Bugongo Forest Reserve (BFR) **(A)** and community forests **(B)** in mid-western Uganda.

diversification (Figure 3). This pattern was consistent for all households regardless of membership in conservation groups.

3.3. Determinants of household livelihood diversification

The number of years of residence of a household head and membership in other social groups in the village significantly influenced a household's level of livelihood diversification in the villages bordering BFR. For households in villages surrounding the two community forests, a household's dependency ratio had a statistically significant influence ($p < 0.05$) (Table 5). For households in the CFM sites, each additional year of residence of the household head in the village increased their Gini-Simpson index of diversification by 0.0023 ($p = 0.025$). Similarly, having a household member belonging to other social groups in the village increased the household's Gini-Simpson index of diversification by 0.081 ($p = 0.025$). For households in villages bordering the CFs, an additional increase in a household's dependency ratio increased their Gini-Simpson index of diversification by 0.0001 ($p = 0.037$). The rest of the predictors did not significantly influence a household's level of livelihood diversification ($p \geq 0.05$).

3.4. Relationship between total household per capita income and livelihood diversification

Total household per capita income was negatively correlated with Gini-Simpson index in villages bordering BFR (Kendall's tau-b = −0.133; $p = 0.010$) among both CFM-member households (Kendall's tau-b = −0.148; $p = 0.042$) and non-member households (Kendall's tau-b = −0.133; $p = 0.049$). However, there was no clear association between total household per capita income and Gini-Simpson index of diversification among households in villages bordering the community forests (Kendall's tau-b = −0.031; $p = 0.601$). This was observed among both CLA member

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TABLE 3 Household income from the different livelihood activities among forest-fringe communities in mid-western Uganda.

	Commercial crop farming	Food crop farming	Subsistence forest product extraction	Poultry farming	Small livestock farming	Off-farm agricultural wage	Petty business	Non-farm self-employment	Commercial forest product extraction	Non-farm salaries and wages	Large livestock farming
CFM members (n = 85)											
Mean	67,373	507,196	241,099	55,441	89,322	194,922	56,952	78,713	29,222	28,956	4,364
Standard deviation	137,129	1,591,960	550,478	115,125	95,982	390,695	159,157	272,326	136,583	126,309	40,234
Median	17,500	13,750	92,000	22,000	68,210	0	0	0	0	0	0
Interquartile range	50,556	62,294	114,165	64,311	121,572	210,526	0	0	0	0	0
Non-CFM members (n = 85)											
Mean	31,517	107,165	186,346	106,337	73,887	126,119	50,047	99,676	49,501	56,491	6,745
Standard deviation	66,784	372,578	364,412	549,779	118,292	312,117	155,213	351,036	148,818	305,290	62,187
Median	9,429	12,500	89,846	19,090	35,571	0	0	0	0	0	0
Interquartile range	24,647	37,643	125,867	59,529	100,000	60,000	0	0	0	0	0
V	1,098	1,352	1,708.5	1,296.5	1,201	609.5	266	283.5	150	26	2
P-value	0.012**	0.107	0.877	0.626	0.176	0.125	0.803	0.722	0.237	0.722	0.997
CLA members (n = 40)											
Mean	89,648	106,363	443,003	65,921	124,914	108,357	30,036	304,013	0	0	0
Standard deviation	285,649	221,360	2,012,381	123,567	342,537	332,156	87,807	1,816,481	0	0	0
Median	22,455	106,363	91,125	30,821	49,135	0	15,182	0	0	0	0
Interquartile range	80,871	83,119	141,771	68,083	93,443	85,417	103,556	0	0	0	0
Non-CLA members (n = 91)											
Mean	33,921	55,712	83,952	74,836	62,318	97,297	36,996	59,268	8,106	46,119	91,477
Standard deviation	51,246	74,976	104,053	145,612	92,509	231,483	289,414	474,086	75,997	183,662	428,502
Median	20,000	28,500	44,308	40,615	32,364	0	0	0	0	0	0
Interquartile range	35,311	58,000	116,873	70,286	88,000	83,750	0	0	0	0	0
W	1,578	1,643.5	1,307.5	1,992.5	1,590	1,914.5	1,554	1,725	1,860	1,960	1,920
P-value	0.227	0.379	0.001***	0.387	0.237	0.601	0.020**	0.345	0.353	0.074*	0.134

The per capita incomes are presented in Uganda Shilling (UGX), a local currency. The asterisks *, **, and *** denote statistically significant difference in Median incomes at 10, 5, and 1% levels, respectively, following Wilcoxon rank sum test with continuity correction [for the community forestry (CF) dataset] and Wilcoxon signed rank test with continuity correction [for the Collaborative Forest Management (CFM) dataset]. Weighted Average Inter-Bank Foreign Exchange Market Mid-rate for the year 2018 was UGX 3727.79≈USD 1.0.

households (Kendall's tau-b = −0.082; p = 0.456) and non-CLA members (Kendall's tau-b = −0.089; p = 0.212).

4. Discussion

4.1. Livelihood activities pursued by forest-fringe households

Our findings reveal a precarious set of livelihood activities that dominate the Budongo forest landscape, an area that has been a hub for field experimentation of community-based forest management approaches in the country. A typical household in the area, regardless of membership in conservation groups, tends to engage in several agricultural enterprises. These enterprises are largely subsistence in nature and typify the rural agrarian landscape in Uganda. The only notable difference between conservation group member households and non-members was the increased value of income from commercial crop farming accruing to the households participating in CFM (Table 3). This is attributed to the increased efforts of actors, especially Non-Governmental Organizations (NGOs), toward supporting alternative livelihood activities through various schemes in the

TABLE 4 Descriptive summary of levels of household livelihood diversification among forest-fringe communities in mid-western Uganda.

Measures of diversification	Collaborative forest management			Community forestry		
	CFM members (n = 85)	Non-CFM members (n = 85)	P-value	CLA members (n = 40)	Non-CLA members (n = 91)	P-value
Number of livelihood activities	5.21 ± 0.13	4.66 ± 0.16	0.009***	4.98 ± 0.19	4.63 ± 0.14	0.138
Share of non-farm income	0.14 ± 0.02	0.19 ± 0.02	0.127	0.08 ± 0.02	0.09 ± 0.02	0.680
Shannon's diversity index	1.10 ± 0.04	1.01 ± 0.05	0.166	1.22 ± 0.06	1.12 ± 0.05	0.193
Gini-Simpson diversity index	0.57 ± 0.02	0.54 ± 0.02	0.222	0.62 ± 0.03	0.59 ± 0.02	0.339

The mean ± SE are reported together with p-values following independent samples t-test [for the community forestry (CF) dataset] and dependent samples t-test [for the Collaborative Forest Management (CFM) dataset]. The asterisk (***) denotes statistical significance at 5% level.

TABLE 5 Tobit estimates of determinants of livelihood diversification among forest-fringe rural households in mid-western Uganda.

Predictor	Collaborative forest management				Community forestry			
	dy/dx	Standard error	z	P-value	dy/dx	Standard error	z	P-value
Household is male-headed	0.0622	0.0456	1.36	0.173	−0.0189	0.0611	−0.31	0.757
Duration of residence in the village	0.0029	0.0011	2.61	0.009***	0.0006	0.0012	0.50	0.614
Number of parcels of land	−0.0038	0.0175	−0.22	0.829	−0.0302	0.0333	−0.91	0.365
Dependency ratio	−0.0002	0.0001	−1.59	0.113	0.0003	0.0001	2.08	0.037**
Total value of durable fixed assets	-6.05×10^{-09}	0.0000	−0.71	0.476	-4.36×10^{-09}	0.0000	−0.46	0.647
Membership in CFM or CLA	0.0204	0.0305	0.67	0.503	0.0282	0.0418	0.67	0.500
Household accesses finance	0.0163	0.0326	0.50	0.617	0.0023	0.0378	0.06	0.952
Membership in other social groups	0.0812	0.0362	2.25	0.025**	−0.0012	0.0481	−0.03	0.980
Leadership position in the village	0.0416	0.0370	1.12	0.261	0.0108	0.0484	0.22	0.823
N	170	–	–	–	131	–	–	–
Log likelihood	38.919	–	–	–	27.95	–	–	–
Prob > chi2	0.0003	–	–	–	0.0010	–	–	–
AIC	−83.838	–	–	–	2.44	–	–	–

The asterisks *** and ** denote statistical significance at at 1 and 5% levels, respectively.

communities adjacent to BFR. Provision of alternative livelihood schemes dominate decoupling interventions in the area. These interventions aim to increase options available to their beneficiaries and reduce household dependence on the forest for subsistence. For example, Budongo Conservation Field Station (BCFS) through its alternative livelihoods projects has promoted small livestock rearing and supported production of high-value non-traditional crops such as rice, cabbage and soybean for commercial farming (Babweteera et al., 2018). Other NGOs such as Village Enterprise and the Jane Goodall Institute have also actively implemented related alternative livelihoods schemes in the area.

Previous studies on the effects of the alternative livelihood schemes in the Budongo forest landscape have reported mixed results. On one hand, success stories have been documented e.g., for project that supported ex-hunters (Hsiao et al., 2013; Tumusiime et al., 2010) while failures and negative externalities in an earlier intervention meant to curb human-wildlife conflict in the area have also been reported (Webber et al., 2007). Lessons from these interventions could be used to achieve better livelihood outcomes. However, given their fragmented, time-bound, small and short-term nature of the predominantly donor-funded grants that such projects often rely on Wicander and Coad (2018), Kazoora et al. (2019), best practices may be too costly to implement within their personnel, time and budget constraints. Therefore, dedicated state support in terms of adequately funding community-based conservation and development activities and ensuring a minimum level of coordination for projects promoting alternative livelihoods schemes in these areas is required.

In the community forest sites, CLA member households obtained higher income from subsistence forest products sourced from the community forests and petty businesses. Subsistence forest resource extraction is therefore an important livelihood activity in the BFR landscape, which equally offers other lucrative livelihood activities mostly pursued by wealthier and 'more-connected' households in covert ways (Mawa et al., 2020b). Because it is largely extractive in nature, the high dependence on subsistence forest resources in the adjacent communities could jeopardize forest conservation goals in the long run, leading to forest degradation (Mawa et al., 2020a) or forest conversion to other land uses.

In such rural landscapes, that are characterized by significant entry barriers for the poorest segments to meaningfully benefit from high return non-farm or farm-based activities, diversification interventions targeting specific socio-economic segments of the rural population should be promoted with a view of enhancing access to sustainable economic activities, credit and markets

(Asfaw et al., 2019). This would enable the households to secure better living standards by engaging in activities that generate cash, expand their asset portfolios and enhance their ability to diversify across both farm and non-farm sectors (Ellis and Freeman, 2004). Consequently, such households would be more resilient in the face of the risky farming decisions that characterize the rural space (Barrett et al., 2001; Ellis and Bahiigwa, 2003).

4.2. Determinants of household livelihood diversification in budongo forest landscape

4.2.1. Years of residence of household head in the village

Household heads in the villages bordering BFR, who had spent more years in the village, were in better position to diversify. This is because such households tend to have more knowledge about the village — a key attribute that new projects and related development initiatives tend to consider for inclusion as key informants during situational analyses and later, as beneficiaries. This inevitably predisposes them to new development opportunities, compared to those that are relatively new in the village. Similar findings were reported by Park and Yeo-Chang (2021) in their study in South Korea where new settlers around Southern Seoul National University forest faced restricted access to forest resources under the country's Collaborative Forest Management arrangement.

4.2.2. Membership in other social groups

Membership in other social groups positively influenced household livelihood diversification in the CFM sites. The common social groups in the area are those related to religious activities, credit and savings, and gender-specific groups such as women's groups and youth groups that benefit from initiatives that require such levels of organization to promote alternative livelihood activities. Involvement in these social group activities exposes the household members to new opportunities since social gatherings (e.g., in group meetings) are commonly utilized for disseminating information and exchanging ideas (Johnson, 2007).

4.2.3. Dependency ratio

The effect of the dependency ratio on the level of livelihood diversification was only significant among households in villages bordering the community forests. In the literature on rural livelihoods, higher dependency ratio is a common indicator of poor household wellbeing (Dutta and Kumar, 2016) and low human capital (Angelsen et al., 2014). These households are often unintentionally driven to pursue survival-led livelihood diversification pathways. In the study area, their reliance on the forest is for subsistence. These households are mostly headed by uneducated women, children or sickly persons with limited access to land for farming. Their members often engage in provision of low-paying off-farm labor, for survival. These characteristics present significant entry barriers to lucrative livelihood activities, rendering them locked up in survival-led diversification pathway. In a recent study in Ethiopia, households with high dependency ratios were reported to have lower probabilities of participating in high-return off-farm and non-farm income-generating livelihood activities (Gebru et al., 2018) that are commonly pursued for accumulation (Barrett et al., 2001).

5. Conclusion and policy implications

This study sought to determine the levels of household livelihood diversification among forest conservation group members and non-members in Budongo Forest landscape and document its determinants. Households in the study area pursued high to very high levels of diversification. While membership in a CFM group or CLA was hypothesized to be associated with high levels of livelihood diversification, this was only witnessed in the CFM sites, where CFM member households engaged in more livelihood activities compared to their non-CFM member counterparts.

Households where the household head had resided in the village for extended periods and those that had members who belonged to other social groups in the village tended to diversify more. However, the livelihood activities that they pursued were mostly farm-based and practiced for survival, not wealth creation or accumulation. Therefore, state and non-state actors need to design deliberate development interventions targeting these poor households to generate cash, build assets and diversify across both farm and non-farm activities. Such initiatives could be incorporated into the management plans of the existing conservation groups. In addition, market linkages and non-extractive forest uses such as ecotourism need to be developed to achieve meaningful livelihood transformations in the Budongo Forest landscape.

The current alternative livelihood schemes that are promoted by state and non-state actors are disjointed. The Collaborative Forest Management and Community Forestry coordination desks of the state agencies should be strengthened to streamline alternative livelihood schemes being promoted to achieve conservation and development goals. Additionally, the existing governance platforms such as Uganda Network of Community Forest Associations should be strengthened to coordinate CFM/CLA activities at regional and national levels. For future research, we recommend that a more detailed sociological assessment be undertaken to better understand how the rural households in our study area negotiate contextual factors to shape the observed livelihood diversification pathways.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by National Council of Science and Technology, Uganda.

The participants provided their written informed consent to participate in this study.

Author contributions

CM and EO collected the field data. CM led the analysis and write-up of the manuscript. All authors contributed to the design and implementation of the research, writing of the manuscript, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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