Applied Ecology and Environmental Sciences, 2025, Vol. 13, No. 3, 86-93
Available online at http://pubs.sciepub.com/aees/13/3/4
Published by Science and Education Publishing
DOI:10.12691/aees-13-3-4

Wood Use Patterns by Local Population in a Co-managed Forest Reserve

Rodéric Roland Singbénou Sagbo[1,2,*], Sedjro Gilles Armel Nago[1,2,3]

[1]Laboratory of Ecology, Botany and Plant Biology, University of Parakou, Parakou, Benin
[2]Doctoral School of Agricultural and Water Sciences, University of Parakou, Parakou, Benin
[3]Faculty of Agronomy, University of Parakou, Parakou, Benin
*Corresponding author: rodericosagbo22@gmail.com

Received September 28, 2025; Revised October 30, 2025; Accepted November 07, 2025

Abstract In Sub-Saharan Africa, rural communities depend heavily on forests for their livelihoods, yet natural forests are under increasing pressure from socioeconomic factors. While large-scale plantations are proposed as a solution, their impacts are controversial, often creating land disputes and unequal benefit sharing. This highlights the need for an in-depth understanding of how local communities interact with forest resources to ensure sustainable management. This study aimed to analyze how sociodemographic and sociocultural characteristics influence wood use patterns in a co-managed Reserve like Lama Forest Reserve in Benin, where access to forest resources is limited. We hypothesized that these characteristics significantly affect wood use. Using a structured questionnaire with 208 respondents and a Bayesian logistic regression model, we found that gender and village membership are the primary factors influencing wood use. Men were less likely to use firewood but more likely to use construction and craft wood, reflecting distinct gender roles. Village of residence significantly influenced firewood and commercial wood use, suggesting that local contexts like resource accessibility play a crucial role. In contrast, age, education level, and sociocultural group did not have a significant influence on any type of wood use. These results underscore that a one-size-fits-all approach to forest management is ineffective. Future research should use qualitative methods to explore the specific reasons for these local variations and analyze the economic value chains of wood. It should also investigate the effects of formal and informal regulations on wood use and further examine gender-specific roles to propose equitable and effective conservation strategies.

Keywords: *wood use, plantation, forest management, local community, tropical protected area*

Cite This Article: Rodéric Roland Singbénou Sagbo, and Sedjro Gilles Armel Nago, "Wood Use Patterns by Local Population in a Co-managed Forest Reserve." *Applied Ecology and Environmental Sciences*, vol. 13, no. 3 (2025): 86-93. doi: 10.12691/aees-13-3-4.

1. Introduction

Forests play a crucial role in the livelihoods of rural communities, particularly in sub-Saharan Africa, by providing a variety of goods and ecosystem services, such as timber and non-timber forest products [1]. However, these ecosystems are under pressure. The degradation of natural forests, often linked to socioeconomic factors like population growth and poverty [2], endanger these vital resources. This situation makes it urgent to find solutions for the sustainable management of forest resources.

In the face of a growing demand for forest products [3], large-scale tree plantations are often presented as a solution for socioeconomic development in rural areas [4]. They can potentially reduce pressure on natural forests by providing wood for industry [5] and domestic uses.

However, socioeconomic impacts of these plantations are controversial. While they can provide benefits such as job creation, infrastructure development, or income generation [4,6], they also pose major challenges. Studies reveal problems such as community displacement, unequal benefit sharing, and a lack of land compensation [6,7]. Illegal logging is also a serious threat [8], highlighting the complexity of their management.

To maximize benefits and mitigate negative impacts, it is crucial to involve local communities. Participatory approaches and community forest management are increasingly recognized as key drivers for ecosystem sustainability and community empowerment [7,9]. These models allow local populations to be directly involved in resource management, decision-making, and income sharing, thereby contributing to improved livelihoods [7].

Nevertheless, even these approaches face challenges, including unequal participation, a lack of institutional support, and contested land rights for rural and indigenous communities [7,9]. Therefore, it is necessary to conduct an in-depth analysis of how the socioeconomic and cultural characteristics of populations influence their interaction with these resources. The use of wood by local populations is a critical factor in the pressure exerted on forests [2]. While it is known that the characteristics of local populations affect this use [10], there is a lack of

understanding of specific local-level dynamics.

This study aims to fill this gap by analyzing how local populations use wood and what socioeconomic and sociocultural factors influence these practices. The main objective is to better understand wood use patterns to propose more adapted and sustainable management strategies. To do so, we test the following hypothesis: Wood use patterns are significantly influenced by the sociodemographic and sociocultural characteristics of local people.

2. Material and Methods

2.1. Study area

The study was carried out in the Lama Forest Reserve (Benin), which is co-managed by Société Nationale du Bois (SONAB) and local population. Located in Southern Benin (Figure 1), the Lama Forest Reserve (LFR), covering 16.250 hectares, is a multi-use protected area. The area is divided into three zones: a strictly protected central natural forest, *Tectona grandis* and *Gmelina arborea* plantations, and resettlement and agricultural zones. It has been legally protected as a Forest Reserve since 1946, which means that entry is prohibited and access to resources is limited for local populations. Villages are located within or near the forest [11,12]. Holli, Fon and Aizo socio-cultural groups mainly inhabit the forest.

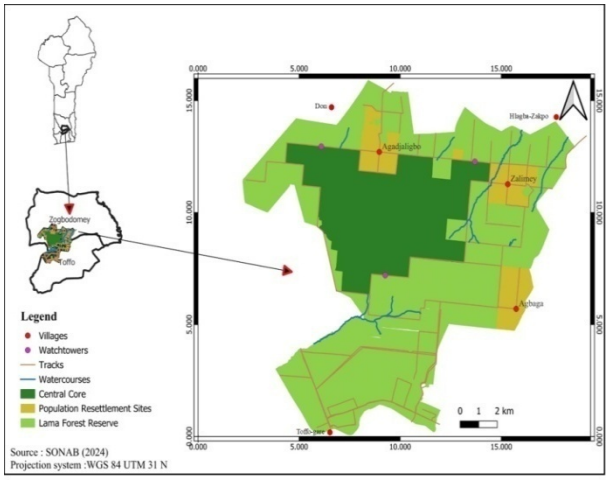

Figure 1. Study area

2.2. Methods

2.2.1. Sampling

A preliminary survey was conducted with 30 randomly selected respondents (over 18 years old) from three villages inside and three representative villages around the LFR [11,13,14]. The objective of this initial phase was to estimate the proportion (p) of respondents able to identify patterns of wood use in the LFR. Based on the estimated proportion of positive responses (p = 0.90), the required sample size (n) was calculated (Eq.1) using the following Dagnelie formula [15].

$$n = (U^2_{1-\alpha/2} xp(1-p))/\ d^2 \qquad (1)$$

Where $U_{1-\alpha/2}$ (α = 0.05) = 1.96, d: the margin error=5 %.

A total of 208 representative people (over 18 years old) [16] were randomly selected in the villages of Agadjaligbo (Agad) [17], Agbaga (Agb) [18], Zalimey (Zal) [17], Don (Don), Hlagba-Zakpo (Hlz), and Toffo-gare (Tg).

2.2.2. Data Collection

Authorization to conduct the survey was obtained from Société Nationale du Bois (SONAB). Verbal consent was obtained from the respondents prior to each survey being carried out [19]. A structured questionnaire was used, and data were collected through a survey using face-to-face interviews in local languages [20]. The survey collected socio-cultural and socio-demographic data on the respondents, such as age, gender, education level, village of residence and socio-cultural group, as well as information on the different uses of wood, such as for firewood, construction, commercial purposes and crafts.

Age was recorded as a continuous variable. Education level was collected as an ordinal variable, categorized as None (0), Primary (1), Secondary (2), and Higher (3). Both village of residence and socio-cultural group were included as nominal variables. Finally, gender (Female=0, Male=1) and wood uses data (No=0, Yes=1) were collected as binary variables.

Table 1. Distribution of respondents by village, gender, sociocultural group and education level

Characteristics	Number	Frequency (%)
Village		
Agadjaligbo	35	16.8
Agbaga	35	16.8
Don	37	17.8
Hlagba-Zakpo	30	14.4
Toffo-gare	35	16.8
Zalimey	36	17.3
Gender		
Male	110	52.9
Female	98	47.1
Socio-cultural group		
Holli	106	51
Fon	95	45.7
Aizo	4	1.9
Adja	2	1
Mina	1	0.5
Education level		
None	1	0.5
Primary	195	93.8
Secondary	8	3.8
Higher	4	1.9

2.2.3. Data Analysis

Statistical analysis was performed using Rstudio (version 2025.05.1+ 513) [21]. Both descriptive and inferential methods were used. Descriptive statistics, such as frequencies, was calculated and graphically visualized using the dplyr, scales and ggplot2 packages [21,22].

Bayesian logistic regression [21,23,24,25,26,27,28] was performed with dplyr and rstanarm packages to analyze whether wood use patterns are significantly influenced by

respondents' sociodemographic and sociocultural characteristics.

The interpretation of Bayesian model summary was straightforward and focused on the 95% credibility intervals, which were the 2.5% and 97.5% columns. An effect was considered significant if its credibility interval did not contain zero. The MCMC diagnostics were very good. The Rhat was close to 1.0 for all parameters, confirming that the model had converged well and the results were reliable. The n_eff was high (greater than 1000 for most parameters), indicating that the Markov chain sample size was adequate and the estimates were precise for firewood use patterns (Table 2), construction wood use patterns (Table 3), craft wood use patterns (Table 4), and commercial wood use patterns (Table 5).

Table 2. Fit and MCMC diagnostics of Bayesian logistic regression of firewood use patterns

Fit Diagnostics					
	mean	sd	2.5%	50%	97.5%
mean_PPD	0.682	0.033	0.615	0.683	0.745
MCMC diagnostics					
	mcse		Rhat		n_eff
(Intercept)	0.045		1.000		3080
Age	0.000		0.999		5058
Gender1	0.007		1.000		4676
VillageAgb	0.014		1.000		3818
VillageDon	0.018		1.001		2786
VillageHlz	0.020		1.002		2606
VillageTg	0.030		1.001		2802
VillageZal	0.010		1.000		4760
SCGAizo	0.038		0.999		4366
SCGFon	0.028		1.001		3020
SCGHolli	0.031		1.002		2700
SCGMina	0.039		1.001		4029
Educ_level1	0.031		1.001		3162
Educ_level2	0.028		1.000		3430
Educ_level3	0.030		1.000		3418
mean_PPD	0.001		1.000		4154
log-posterior	0.006		1.003		1773

Table 3. Fit and MCMC diagnostics of Bayesian logistic regression of construction wood use patterns

Fit Diagnostics					
	mean	sd	2.5%	50%	97.5%
mean_PPD	0.313	0.033	0.250	0.312	0.380
MCMC diagnostics					
	mcse		Rhat		n_eff
(Intercept)	0.050		1.003		2273
Age	0.000		1.000		5110
Gender1	0.008		1.000		3421
VillageAgb	0.011		1.000		3364
VillageDon	0.022		1.001		2133
VillageHlz	0.025		1.002		2203
VillageTg	0.024		1.002		2303
VillageZal	0.010		0.999		3939
SCGAizo	0.033		1.001		2960
SCGFon	0.033		1.003		2188
SCGHolli	0.035		1.004		2201
SCGMina	0.040		1.000		4265
Educ_level1	0.028		1.000		2651
Educ_level2	0.029		1.001		2639
Educ_level3	0.030		1.000		2885
mean_PPD	0.000		1.000		4834
log-posterior	0.072		1.002		1448

Table 4. Fit and MCMC diagnostics of Bayesian logistic regression of craft wood use patterns

Fit Diagnostics					
	mean	sd	2.5%	50%	97.5%
mean_PPD	0.046	0.019	0.014	0.043	0.087
MCMC diagnostics					
	mcse	Rhat	n_eff		
(Intercept)	0.061	1.000	2659		
Age	0.001	1.000	3857		
Gender1	0.016	1.000	3153		
VillageAgb	0.026	1.001	2669		
VillageDon	0.027	1.000	2762		
VillageHlz	0.028	1.003	2426		
VillageTg	0.030	1.001	2808		
VillageZal	0.024	1.003	2632		
SCGAizo	0.039	1.000	3810		
SCGFon	0.030	1.001	2602		
SCGHolli	0.033	1.002	2616		
SCGMina	0.045	1.000	3478		
Educ_level1	0.041	1.000	3212		
Educ_level2	0.041	1.000	3550		
Educ_level3	0.045	1.000	3307		
mean_PPD	0.000	1.000	4190		
log-posterior	0.071	1.000	1566		

Table 5. Fit and MCMC diagnostics of Bayesian logistic regression of commercial wood use patterns

Fit Diagnostics					
	mean	sd	2.5%	50%	97.5%
mean_PPD	0.270	0.034	0.207	0.269	0.337
MCMC diagnostics					
	mcse	Rhat	n_eff		
(Intercept)	0.043	1.000	2547		
Age	0.000	1.000	4724		
Gender1	0.007	0.999	4144		
VillageAgb	0.039	1.001	2246		
VillageDon	0.027	1.000	2490		
VillageHlz	0.028	1.000	2243		
VillageTg	0.028	1.000	2246		
VillageZal	0.009	0.999	4501		
SCGAizo	0.028	1.000	3330		
SCGFon	0.024	1.000	3110		
SCGHolli	0.034	1.000	2329		
SCGMina	0.037	0.999	4400		
Educ_level1	0.025	1.002	3033		
Educ_level2	0.026	1.001	3074		
Educ_level3	0.029	1.001	3131		
mean_PPD	0.001	1.000	4014		
log-posterior	0.068	1.000	1660		

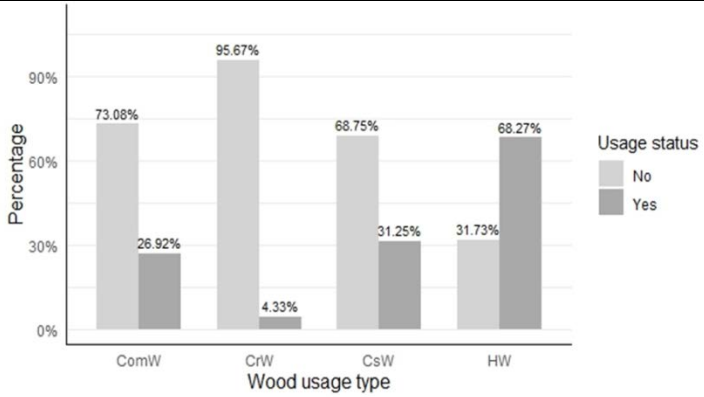

Figure 2. Different types of wood' use in the Lama Forest Reserve

3. Results

The findings show that respondents used wood in several forms: 68.27% for firewood (HW), 31.25% for construction wood (CsW), 26.92% for commercial wood (ComW), and 4.33% for craft wood (CrW) (Figure 2).

The coefficient for Men (Gender 1) was -2.485, and its credibility interval was [-3.494, -1.553]. Therefore, the effect was highly significant. The negative coefficient indicated that men were less likely to use firewood compared to women (Table 6).

Village membership had a significant influence, but it varied between villages. For Agbaga (Agb), the coefficient was 2.429, with an interval of [0.963, 4.267]. The coefficient was 3.724, with an interval of [0.987, 7.313] for Toffo-gare (Tg). This had a very significant and positive effect. The coefficient was 1.318, with an interval of [0.077, 2.688] for Zalimey (Zal). Thus, residents of Agbaga, Toffo-gare, and Zalimey were more likely to use firewood (Table 6).

The credibility interval for age was [-0.037, 0.052] and indicated that age did not have a significant influence on firewood use. Similarly, education levels did not have significant influence. All intervals for the various sociocultural groups also indicated they did not have a significant influence on firewood use (Table 6).

Table 6. Bayesian logistic regression analysis of the influence of respondents' sociodemographic and sociocultural characteristics on firewood use patterns

HW					
Estimates					
	mean	sd	2.5%	50%	97.5%
(Intercept)	1.751	2.480	-3.167	1.730	6.745
Age	0.007	0.022	-0.037	0.007	0.052
Gender1	-2.495	0.486	-3.494	-2.485	-1.553
VillageAgb	2.472	0.845	0.963	2.429	4.267
VillageDon	-0.990	0.950	-2.911	-0.964	0.800
VillageHlz	-0.419	1.030	-2.424	-0.397	1.592
VillageTg	3.824	1.614	0.987	3.724	7.313
VillageZal	1.334	0.666	0.077	1.318	2.688
SCGAizo	0.851	2.482	-3.520	0.620	6.375
SCGFon	-2.056	1.540	-5.389	-1.968	0.602
SCGHolli	-0.892	1.621	-4.254	-0.840	2.026
SCGMina	0.874	2.464	-3.494	0.654	6.093
Educ_level1	1.306	1.737	-2.032	1.263	4.881
Educ_level2	-1.370	1.664	-4.732	-1.328	1.843
Educ_level3	-0.222	1.736	-3.720	-0.212	3.092

The coefficient for Men (Gender 1) was 3.366, and its credibility interval was [2.474, 4.393]. Since this interval was entirely positive, the effect was highly significant. The positive coefficient indicated that men were significantly more likely to use construction wood compared to women (Table 7).

Village membership had a significant influence, but only for one village. The coefficient was -2.023, and the interval was [-4.092, -0.193] for Don. This indicated a significant and negative effect: residents of Don were less likely to use construction wood. (Table 7).

The credibility interval for age was [-0.022, 0.056]. Therefore, age did not have a significant influence on construction wood use. None of the credibility intervals for the different education levels were significant, indicating that education level did not have a significant influence. Similarly, none of the intervals for the sociocultural groups were significant (Table 7).

The coefficient for Men (Gender1) was 1.558, and its credibility interval was [0.019, 3.479]. Given that this interval was entirely positive, the effect was significant, indicating that men were more likely to use craft wood compared to women (Table 8).

Table 7. Bayesian logistic regression analysis of the influence of respondents' sociodemographic and sociocultural characteristics on construction wood use patterns

CsW					
Estimates					
	mean	sd	2.5%	50%	97.5%
(Intercept)	-2.535	2.369	-7.271	-2.516	1.865
Age	0.016	0.020	-0.022	0.016	0.056
Gender1	3.382	0.494	2.474	3.366	4.393
VillageAgb	0.695	0.626	-0.522	0.695	1.925
VillageDon	-2.050	1.020	-4.092	-2.023	-0.193
VillageHlz	-1.684	1.173	-4.116	-1.664	0.506
VillageTg	1.027	1.128	-1.217	1.030	3.319
VillageZal	0.257	0.645	-0.981	0.258	1.517
SCGAizo	-0.205	1.789	-3.747	-0.194	3.288
SCGFon	-0.189	1.551	-3.001	-0.253	3.040
SCGHolli	0.945	1.637	-2.114	0.878	4.242
SCGMina	-0.376	2.589	-6.099	-0.243	4.379
Educ_level1	-1.464	1.439	-4.331	-1.453	1.386
Educ_level2	-1.844	1.498	-4.924	-1.815	0.999
Educ_level3	-1.270	1.603	-4.427	-1.259	1.891

Table 8. Bayesian logistic regression analysis of the influence of respondents' sociodemographic and sociocultural characteristics on craft wood use patterns

CrW					
Estimates					
	mean	sd	2.5%	50%	97.5%
(Intercept)	-7.630	3.149	-14.124	-7.494	-1.840
Age	0.028	0.034	-0.039	0.028	0.094
Gender1	1.614	0.891	0.019	1.558	3.479
VillageAgb	0.105	1.322	-2.587	0.109	2.617
VillageDon	-0.143	1.438	-3.024	-0.141	2.577
VillageHlz	1.327	1.395	-1.397	1.330	4.027
VillageTg	0.255	1.571	-2.866	0.291	3.287
VillageZal	1.553	1.229	-0.685	1.493	4.171
SCGAizo	-1.075	2.423	-6.363	-0.867	3.147
SCGFon	-0.363	1.519	-3.329	-0.389	2.763
SCGHolli	-0.786	1.700	-4.174	-0.791	2.575
SCGMina	4.038	2.631	-0.219	3.742	10.001
Educ_level1	1.775	2.331	-2.235	1.598	6.949
Educ_level2	-1.018	2.416	-6.394	-0.794	3.156
Educ_level3	-0.739	2.563	-6.404	-0.620	3.843

Age, village membership, sociocultural group, and education level did not have a significant influence on craft wood use (Table 8).

The coefficient for Men (Gender1) was -1.721, and its credibility interval was [-2.717, -0.850]. Therefore, men were less likely to use commercial wood than women (Table 9).

Village membership had a strong influence, but it varied between villages. The coefficient was -4.484, with an interval of [-9.282, -2.194]. This effect was significant and negative, meaning that residents of Agbaga (Agb) were less likely to use commercial wood. The coefficient was 1.677, with an interval of [0.567, 2.874], for Zalimey. Therefore, the inhabitants are more likely to use commercial wood (Table 9).

Age, education level, and sociocultural group did not have a significant influence on commercial wood use (Table 9).

Table 9. Bayesian logistic regression analysis of the influence of respondents' sociodemographic and sociocultural characteristics on commercial wood use patterns

ComW					
Estimates					
	mean	sd	2.5%	50%	97.5%
(Intercept)	-2.216	2.161	-6.643	-2.172	2.003
Age	0.016	0.019	-0.021	0.016	0.054
Gender1	-1.732	0.470	-2.717	-1.721	-0.850
VillageAgb	-4.803	1.826	-9.282	-4.484	-2.194
VillageDon	-2.311	1.351	-5.220	-2.233	0.117
VillageHlz	-1.126	1.332	-3.775	-1.110	1.423
VillageTg	0.003	1.313	-2.598	0.007	2.467
VillageZal	1.682	0.588	0.567	1.677	2.874
SCGAizo	-0.206	1.632	-3.367	-0.210	3.063
SCGFon	0.760	1.351	-1.785	0.693	3.583
SCGHolli	1.719	1.624	-1.289	1.690	5.098
SCGMina	-1.003	2.436	-6.450	-0.787	3.213
Educ_level1	0.248	1.377	-2.396	0.245	3.058
Educ_level2	1.246	1.451	-1.582	1.225	4.222
Educ_level3	0.668	1.623	-2.556	0.670	3.773

4. Discussion

Our study aimed to test whether wood use patterns in the LFR were influenced by the sociodemographic and sociocultural characteristics of residents, in accordance with our initial hypothesis. Our results, derived from a robust Bayesian model, confirm this hypothesis as [29], but with nuances, by highlighting specific variables and important distinctions depending on the type of wood use.

4.1. Factors Influencing the Use of Firewood, Construction, Craft, and Commercial Wood in the Lama Forest Reserve

The results reveal that gender and village membership are crucial factors in firewood use. Men are significantly less likely to use firewood than women. This finding is particularly relevant because it contrasts with some studies that minimize the influence of gender in contexts of resource scarcity [30]. The higher probability of firewood use among women can be explained by their traditional role in domestic and culinary activities, where wood is often the main energy source [31]. This observation highlights the need to integrate gender perspectives into forest management plans.

Furthermore, the significantly greater use of firewood observed in Agbaga, Toffo-Gare, and Zalimey compared to the other three villages indicates the critical influence of geographic proximity. [32]. Local variations in resource accessibility or cultural cooking habits could explain these differences. This result supports the idea that a generic approach is insufficient and that it's crucial to acknowledge the diversity of local contexts [33].

In contrast to village membership and gender, our results indicate that age and education level do not have a significant influence on firewood use. This finding partly contradicts some literature suggesting that older individuals are more likely to use firewood [34,35] or that education can reduce wood dependency [36]. However, our result may be explained by the predominance of local geographical and behavioral factors [32], which may outweigh the influence of traditionally studied sociodemographic variables.

An analysis of wood use for construction, crafts, and commercial purposes reveals distinct dynamics. For construction and craft wood, men are significantly more likely to use it than women. These uses are often associated with construction, production, and income-generating activities, areas where men are typically more involved [36].

Conversely, the use of commercial wood, including charcoal, is less common among men, suggesting that women may play a more significant role in the informal or local value chains for this type of product. This observation once again highlights the complexity and nuances of forest exploitation based on product type.

Village membership plays a crucial role, but in varying ways. Construction wood is more likely to be used in some villages than in others. These local variations can be attributed to factors such as proximity, resource availability and accessibility, or the specifics of local economies.

Consistent with firewood results, age and education level have no significant influence on other forms of wood use. Furthermore, sociocultural groups do not appear to have an impact on any of the analyzed uses. While some studies suggest that age and education influence the perceived value of forest products [36], our data indicate that these variables are not significant predictors of wood use.

In the Lama Forest Reserve (LFR) plantations, the main exploited species (teak and gmelina), mainly provide timber and leaves. This contrasts with indigenous fruit species used for a wide array of purposes, including food, medicine, crafts, spiritual practices, as well as fuelwood, fodder, and rural construction material [37]. Nevertheless, a few fruit species are cultivated in resettlement and agricultural areas. Furthermore, the LFR's management system promotes sustainable exploitation by prioritizing the controlled harvesting of fast-growing exotic species while conserving slow-growing native species. This model stands in contrast to other protected areas in Benin, such as certain community forests, where local populations may exploit woody resources without ecological restoration measures, often leading to unsustainable exploitation [38].

4.2. Implications of Findings and Future Research Perspectives

To expand upon the results of this study, future research

should focus on the specific factors that explain the variations in wood use. This would involve conducting qualitative studies, particularly through interviews and focus groups on villages like Agbaga, Toffo-gare, and Zalimey. Such research would assess the impact of forest resource accessibility, the presence of local markets, as well as the influence of cultural habits and culinary practices on wood consumption.

It's crucial to better understand the economic value of wood for households. Future studies could quantify the monetary value of timber forest products to better assess the communities' economic dependency. It would also be relevant to analyze the wood value chains, from harvesting to sale. By distinguishing between self-consumption and commercial uses, we could identify commercial circuits and opportunities to develop sustainable value chains.

For more effective management, it's important to evaluate the impact of existing policies. Research should investigate the effects of formal and informal regulations on wood use practices. This would help determine whether access restrictions lead to illegal exploitation or, conversely, promote sustainable management. Furthermore, an in-depth analysis of gender roles is necessary. This would involve studying how men and women share in the exploitation and processing of different types of wood to identify decision-making points and the benefits for each gender.

5. Conclusion

In conclusion, wood use patterns are indeed influenced by certain sociodemographic characteristics, particularly gender and location. However, the influence of these variables is specific to the type of wood used. These findings underscore the need to develop forest management policies that are not uniform, but that consider local dynamics and the differentiated roles of gender within communities. Sustainable management can only be effective if it adapts to the complex and diverse realities that shape a community's relationship with the forest. It is imperative to move beyond generalizations and consider local specifics and gender roles to develop effective and equitable conservation policies. To be relevant, participatory management must therefore recognize and integrate these complex dynamics to ensure the sustainability of forest resources and the well-being of communities.

ACKNOWLEDGEMENTS

The authors thank the ITTO Fellowship Program (ITTO Ref. Number: 055/24A) for financial support for this research, the SONAB managers for authorizations to collect data, the local populations, the local field assistant and the students who provided technical support for the work.

Declaration of Authors

The authors declare no competing interests.

References

[1] Abdeta, D., Ayana, A.N. and Bekele, Y, “Willingness to pay for forest conservation: Evidence from a contingent valuation, survey analysis in Southwest Ethiopia”, *Global Ecology and Conservation*, 46. e02551. October 2023.

[2] Kefa, C.A., Lung, M., Espira, A. and Gregory, A.J, “Quantifying the rate of subsistence wood harvesting from a tropical rainforest in Kenya”, *Oryx*, 52 (2). 369-373. April 2018.

[3] Phimmavong, S., Maraseni, T.N., Keenan, R.J. and Cockfield, G, “Financial returns from collaborative investment models of Eucalyptus agroforestry plantations in Lao PDR”, *Land Use Policy*, 87. 104060. September 2019.

[4] Kainyande, A., Hintz, K.S., Kyamagero, S., Auch, E. and Giessen, L, “Reviewing the ambiguity in the socio-economic outcomes of large-scale tree plantation investments: reconciling decades of contrasting evidence from sub-Saharan Africa”, *International Forestry Review*, 26 (4). 470-489. December 2024.

[5] Pirard, R., Dal Secco, L. and Warman, R, “Do timber plantations contribute to forest conservation?”, *Environmental Science & Policy*, 57. 122-130. March 2016.

[6] Barney, K, “Commercial timber plantations and community livelihoods: Insights from comparative case studies in southern Laos”, *Forest Policy and Economics*, 158. 103099. January 2024.

[7] Muluneh, A. and Sime, G, “Participatory Forest management for sustainable rural livelihoods and forest ecosystem services: The case of Deneba Forest Managing Cooperative in Ethiopia”, *Journal for Nature Conservation*, 78. 126580. March 2024.

[8] Lee, J.H., Kubo, Y., Fujiwara, T., Septiana, R.M., Riyanto, S. and Iwasa, Y, “Profit Sharing as a Management Strategy for a State-owned Teak Plantation at High Risk for Illegal Logging”, *Ecological Economics*, 149. 140-148. July 2018.

[9] Gabay, M. and Alam, M, “Community forestry and its mitigation potential in the Anthropocene: The importance of land tenure governance and the threat of privatization”, *Forest Policy and Economics*, 79. 26-35. June 2017.

[10] Al-Subaiee, F.S, “Socio-economic factors affecting the conservation of natural woodlands in Central Riyadh Area-Saudi Arabia”, *Saudi Journal of Biological Sciences*, 23 (3). 319-326.

[11] ONAB, *Plan Directeur d’Aménagement et de Gestion du Noyau Central de la Forêt Classée de la Lama*, 2011, 1-97.

[12] Agbahoungba, S., Assogbadjo, A.E., Chadare, F.J., Idohou, R., Salako, V.K., Agoyi, E.E. and Glèlè Kakaï, R.L, “Ecological diversity and conservation of wild edible fruit trees species in the Lama Forest Reserve in Benin”, *Bois et Forêts des Tropiques*, 329 (3). 53-65. July 2017.

[13] INSAE, *Cahier des villages et quartiers de ville du département du Zou (RGPH-4, 2013)*, 2016a, 1-37.

[14] INSAE, *Cahier des villages et quartiers de ville du département de l’Atlantique (RGPH-4, 2013)*, 2016b, 1-40.

[15] Dagnelie, P, *Statistiques théoriques et appliquées*, Tome 1, Bruxelles : De Boeck et Larcier, 1998, 1-508.

[16] Masud, M.M., Shahabudin, S.M., Baskaran, A. and Akhtar, R, “Co-management approach to sustainable management of marine protected areas: The case of Malaysia”, *Marine Policy*, 138. 105010. April 2022.

[17] Folahan, S.O.N., Dissou, E.F., Akouehou, G.S., Tente, B.A.H. and Boko, M, “Ecologie et structure des groupements végétaux des écosystèmes de la Lama au Sud-Bénin”, *International Journal of Biological and Chemical Sciences*, 12 (1). 322-340. February 2018.

[18] Nitiema, B., Hien, S., Traore, L., Boussim, I.J. and Guissou, K.M.L, “Caractérisation des services écosystémiques du Chantier d’Aménagement Forestier de Tiogo au Burkina Faso”, *International Journal of Biological and Chemical Sciences*, 18 (3). 904-916. June 2024.

[19] Gouwakinnou, G.N., Biaou, S., Vodouhe, F.G., Tovihessi, M.S., Awessou, B.K. and Biaou, H.S.S, “Local perceptions and factors determining ecosystem services identification around two forest reserves in Northern Benin”, *Journal of Ethnobiology and Ethnomedicine*, 15 (61). December 2019.

[20] Yetein, M.H., Houessou, L.G., Lougbégnon, T.O., Gbodja, G.T., Sèmèvo, D.F. and Oumorou, Madjidou, “Perceptions of ecosystem services provided by the landscapes of the coastal lagoon at the 1017 Ramsar site in Benin (West Africa)”, *Environmental Challenges*, 19. 101122. June 2025.

[21] Posit team, *RStudio: Integrated Development Environment for R*. Posit Software, PBC, Boston, MA, 2025.

[22] Ying, T.H., Kibria, A., SMG. and Nath, T.K., "Modeling city dwellers' perceptions on the ecosystem services supplied by urban green spaces in Malaysia: A logistic regression analysis". *Environmental Development*, 55. 101198. July 2025.

[23] Stroud, T.W.F, "Bayesian analysis of binary survey data", *The Canadian Journal of Statistics*, 22 (1). 33-45. March 1994.

[24] Gelman, A., Jakulin, A., Pittau, M.G. and Su, Y.-S, "A weakly informative default prior distribution for logistic and other regression models", *Annals of Applied Statistics*, 2 (4). 1360-1383. December 2008.

[25] Greco, T., Landoni, G., Biondi-Zoccai, G., D'Ascenzo, F. and Zangrillo, A, "A Bayesian network meta-analysis for binary outcome: how to do it", *Statistical Methods in Medical Research*, 25 (5). 1757-1773. August 2013.

[26] Rainey, C, "Dealing with Separation in Logistic Regression Models", *Political Analysis*, 24 (3). 339-355. August 2016.

[27] Negrín-Hernández, M.-A., Martel-Escobar, M. and Vázquez-Polo, F.-J, "Bayesian Meta-Analysis for Binary Data and Prior Distribution on Models", *International Journal of Environmental Research and Public Health*, 18 (2). 1-18. January 2021.

[28] Clark, R.G., Blanchard, W., Hui, F.K.C., Tian, R. and Woods, H, "Dealing with complete separation and quasi-complete separation in logistic regression for linguistic data", *Research Methods in Applied Linguistics*, 2. 100044. January 2023.

[29] Akpovo, A.H., et Fandohan, A.B, "Usages, distribution des connaissances traditionnelles et valeur économique de *Ricinodendron heudelotii* au Bénin", *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, 9(2). 274-285. Juin 2021.

[30] da Silva, M.M.S., Feitosa, I.S., Cruz, R.S., de Sá, V.A., de Medeiros, P.M. and da Silva, R.R.V, "Use of firewood for artisanal ceramic production in a context of forest scarcity in Northeastern Brazil", *Ethnobiology and Conservation*, 12 (23). 1-14. November 2023.

[31] Semenya, K. and Machete, F, "Factors that influence firewood use among electrified Bapedi households of Senwabarwana Villages, South Africa", *African Journal of Science, Technology, Innovation and Development*, 11 (6). 719-729. April 2019.

[32] Romanach, L. and Frederiks, E, "Understanding the Key Determinants of Residential Firewood Consumption in Australia: A Nationwide Household Survey", *Energies*, 14 (20). 6777. October 2021.

[33] Dawson, N., Carvalho, W.D., Bezerra, J.S., Todeschini, F., Tabarelli, M. and Mustin, K, "Protected areas and the neglected contribution of Indigenous Peoples and local communities: Struggles for environmental justice in the Caatinga dry forest", *People and Nature*, 5 (6). 1739-1755. November 2021.

[34] Nzabona, A., Tuyiragize, R., Assiimwe, J.B., Kakuba, C. and Kisaakye, P, "Urban Household Energy Use: Analyzing Correlates of Charcoal and Firewood Consumption in Kampala City, Uganda", *Journal of Environmental and Public Health*, 2021 (1). 1-8. April 2021.

[35] Florkowski, W.J. and Neupane, S, "Cooking fuel frequency use in urban Uganda: addressing household air pollution", *Environmental Science and Pollution Research*, 30. 120722-120734. November 2023.

[36] Kariuki, D.W, "Socio-Economic Determinants of Household Continued Use of Solid Biofuels (Fuelwood and Charcoal) for Cooking Purposes in Sub-Saharan Africa- Kenya's Situation", *East African Journal of Environment and Natural Resources*, 3 (1). 49-68. March 2021.

[37] Agbo, I.R., Missihoun, A.A., Vihotogbe, R., Assogbadjo, E.A., Ahanhanzo, C., et Agbangla, C, "Impacts des usages traditionnels sur la vulnérabilité de *Detarium microcarpum*, Guill. & Perr. (Caesalpiniaceae) dans le district phytogéographique Zou au Bénin (en Afrique de l'Ouest)", *International Journal of Biological and Chemical Sciences*, 11 (2). 730–742. July 2017.

[38] Hadonou-Yovo, A.G., Houessou, L.G., Lougbegnon, T.O., Adebi, Y., Sinasson, G.K.S., Semevo, D.F., Lange, U., et Boko, M, " Diversité et formes d'utilisation des espèces ligneuses de la Réserve de biosphère du Mono (Bénin)", *VertigO - la revue électronique en sciences de l'environnement*, 19(2), Octobre 2019, mis en ligne le 05 octobre 2019, consulté le 23 octobre 2025.