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Determinants of the Non-Timber Forest Products (NTFPs) Availability and Degradation in the South-Central Sahelian Area of Niger

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Abstract

Non-timber forest products (NTFPs) play a crucial role in food security, household income, and resilience in Sahelian systems. This study aimed to analyze the determinants of NTFP availability and degradation in two agroclimatic zones of the Niger Republic. Data were collected from 379 households using the KoboCollect method and have been analyzed with Stata 16 software through two models, including a linear regression for the availability and a logistic regression for the degradation. The linear regression is globally significant, and results show that the household size and the number of species collected are the main factors driving NTFPs availability. Species analysis reveals that *Maerua crassifolia* predominates in the northern area, while *Diospyros mespiliformis* is more important in the southern one. Other species such as *Lannea microcarpa*, *Sclerocarya birrea*, and *Faidherbia albida* are common across both areas, reflecting their central role in food, forage, and medicinal uses. The logistic model is also significant, with an estimated extinction probability of 71.6%. Households in the northern area are facing a lower species disappearance risk at about 13%, while each additional species harvested increases this risk by 2.4%. Further, education reduces the extinction risk by 11%, highlighting its role in raising awareness of sustainable practices. These findings indicate that both household dynamics and ecological conditions influence NTFPs' sustainability highly, underscoring the need for management strategies such as Assisted Natural Regeneration to ensure biodiversity conservation and secure rural livelihoods.

Keywords

NTFPs, Availability, Degradation, Determinant, Niger

1. Introduction

Non-timber forest products (NTFPs) are an essential resource for rural populations in sub-Saharan Africa, providing food, traditional medicines, and vital income (Faye et al., 2023; Shackleton & Pandey, 2014; Shackleton et al., 2011). Beyond domestic needs, they contribute to ecosystem regulation and community resilience in the face of environmental disturbances (UICN & AGEREF-CL, 2024; Moussa et al., 2023). However, their availability is declining due to overexploitation, population growth, and climate change (FAO, 2019; Fandohan et al., 2020). In Niger, particularly in the Sahelian areas, NTFPs are a strategic component of livelihoods, where agriculture and livestock farming are highly exposed to climate hazards (Boubacar et al., 2022). Despite their vital role, few studies have simultaneously explored the factors determining their availability and those responsible for their degradation using an integrated quantitative approach. Understanding these dynamics is crucial in guiding sustainable management strategies that are tailored to the community's needs and the preservation of ecosystems. This study adopts a dual econometric approach, including a linear regression in order to identify the variables that influence the NTFPs availability and a logit model to analyze their degradation determinants. Therefore, it aims to provide sound scientific information to support the conservation and sustainable use of these vital natural resources in the Sahelian areas. Specifically, it is to characterize the main factors that determine the availability of NTFPs and to identify the variables explaining their degradation. Hypotheses are that availability depends on socio-economic and environmental factors, while degradation is influenced by the intensity of exploitation, demographic pressure, and climate change.

2. Materials and Methods

2.1. Presentation of the Study Area

The study was conducted in two agroclimatic areas following a north-south rainfall gradient in the Maradi region, located in the south-central part of Niger Republic, at approximately 13.5˚ of North latitude and 7.1˚ of East longitude (Haweÿ et al., 2020), namely the northern and the southern Sahelian areas, as illustrated in **Figure 1**, which shows the location of the selected villages within the study area. The southern Sahelian area is characterized by a semi-arid climate, with annual rainfall ranging from 500 to 700 mm (Katkoré et al., 2021). In the southern Sahelian area, vegetation is denser with a tree and shrub layer and predominantly sandy-loamy soils with good water retention capacity (WAEN, 2020). The northern Sahelian area is the driest part of the Maradi region, marking a transition to the Sahara. The climate is semi-arid to arid type, with an annual rainfall ranging from 300 to 400 mm (Soumana, 2021). The northern Sahelian area vegetation is made mainly of shrub and tree steppes, with relatively sparse vegetation cover. Soils are mainly sandy to loamy, with low water retention capacity (WAEN, 2020). The selected villages are presented according to their agroclimatic location, as shown in **Table 1**.

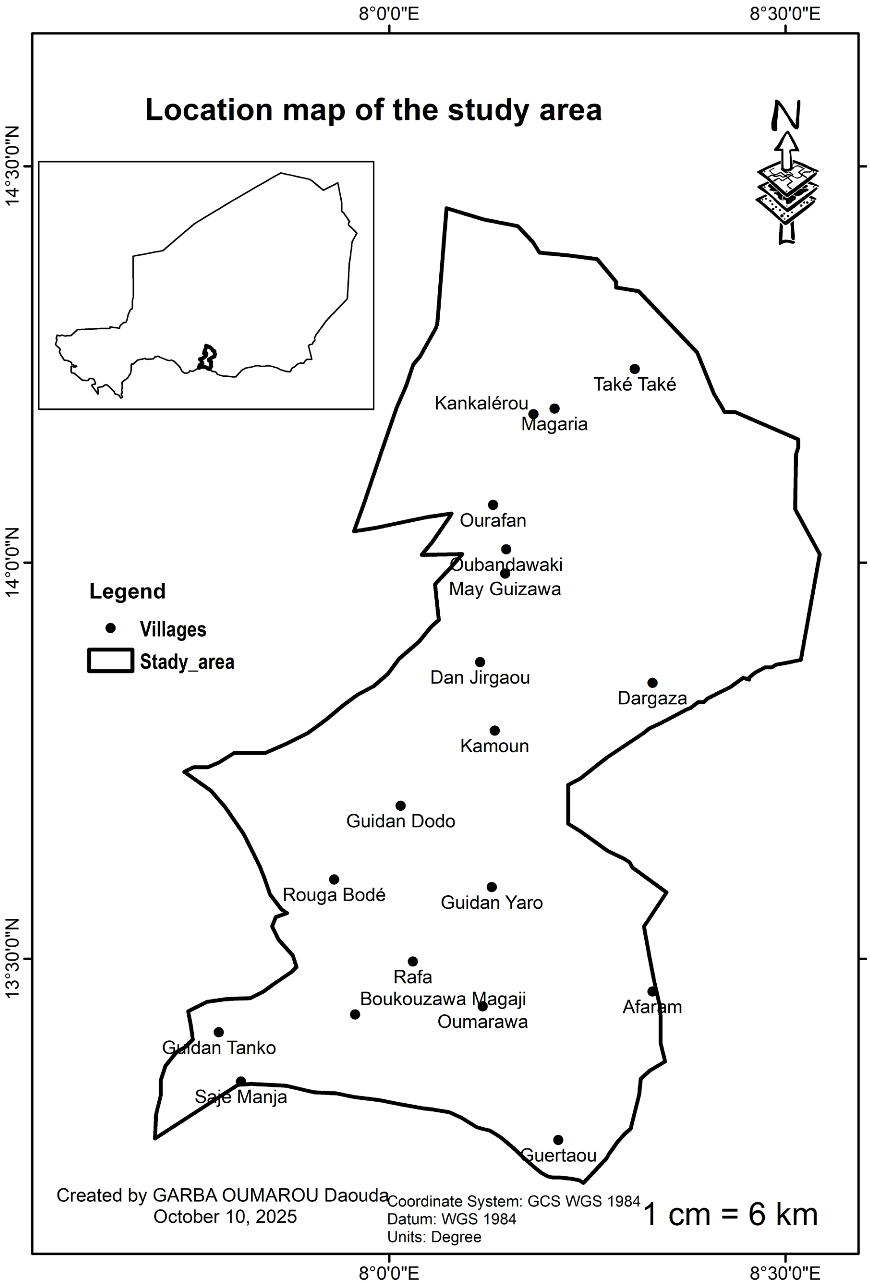

Figure 1. Selected villages' location in the study area.

Table 1. Villages of the study area.

Areas	Northern Sahel	Southern Sahel
Villages	Kamoune, Dargaza, Dan Jirgaou, Maiguizawa, Oubandawaki, Ourafane, Kankalerou, Magaria, and Take-Take	Guidan Dodo, Guidan Yaro, Oumarawa, Afaram, Guertaou, Boukouzawa Magaji, Rafa, Rouga Bodé, Guidan Tanko, and Sajé Manja

These villages were chosen based on their climatic differences, their proximity to the defined land use units, and their accessibility.

2.2. Sampling and Data Collection

A pre-survey was done by contacting local stakeholders in order to get household data by terroir. A sample was then determined using the following formula (Daniel, 2011):

$$n = \frac{t^2 N}{t^2 + (2e)^2 (N-1)}$$

where: n = sample size; t = confidence level; N = parent population; the estimated proportion of farmers using NTFPs as resources; with a margin of error of 5%.

The sample is then of 379 households heads old of at least 18 years. A two-stage stratified sampling was used to ensure adequate household representation. Villages were stratified by ecological proximity (land-use types and agroecological conditions) and sociolinguistic criteria to capture key differences in resource availability and harvesting practices. This approach allows the study to account for relevant population heterogeneity and enables meaningful comparisons between similar villages.Data collected from households heads included socio-economic characteristics, the fields size, and others information on NTFPs, such as the number of species collected, quantities harvested, collection location and distance, perceptions of climate change, pest attacks and excessive logging practices, as well as the degradation or disappearance level of NTFPs, measured by the binary variable "disappeared." All information was collected via a questionnaire integrated into the KoBoCollect application (version 1.29.3) and checked to eliminate inconsistencies and missing values before statistical analysis.

2.3. Data Analysis

Household survey data collected with KoboCollect were processed and analyzed in Stata 16.0 software. Descriptive statistics were first computed, including species citation frequencies to identify the most important woody resources across the study area. To assess the determinants of NTFP availability, a linear regression model was estimated, linking household socio-economic characteristics, farm characteristics, and NTFP-related practices to the total annual quantity of NTFPs harvested per household.

Each variable included in the model was selected based on its theoretical potential to influence NTFP availability and harvesting. Household socio-economic characteristics reflect harvesting capacity, farm characteristics capture access to resources, and NTFP-related practices (number of species collected, collection distance, pest attacks, excessive logging, and climate perceptions) measure harvesting intensity and environmental and contextual factors.

The variable "perception of climate change" was included because farmers' perceptions influence adaptive behaviors, such as selective harvesting or tree conservation, even in the absence of objective meteorological data (Dembélé et al., 2024).

The dependent variable being continuous, the ordinary least squares (OLS) method was chosen, as it provides unbiased and efficient estimators under classical assumptions (Greene, 2018). Statistical assumptions were tested: residual normality was assessed, and due to observed deviations, the dependent variable was log-transformed; homoscedasticity was examined using the Breusch-Pagan test and corrected via robust standard errors with the White test; model specification was validated (_hatsq p-value > 0.005); finally, no multicollinearity issues were detected (VIF < 10).

Such models are commonly used to explain household-level variation in NTFP collection (Babulo et al., 2009; Heubach et al., 2011). The model was specified as follows:

$$\begin{aligned} \text{Qthousehold/year} = {} & \beta 0 + \beta 1\text{zone} + \beta 2\text{Gender} + \beta 3\text{Education} + \beta 4\text{Ethnicity} \\ & + \beta 5\text{HouseholdSize} + \beta 6\,\text{FieldArea/Hectares} \\ & + \beta 7\,\text{NumberSpecies} + \beta 8\text{CollectionLocation} \\ & + \beta 9\text{Distance} + \beta 10\text{Climate Change} \\ & + \beta 11\text{PestAttack} + \int . \end{aligned}$$

where Qthousehold/year represents the total quantity of NTFPs collected per household per year and ϵ the error term.

In the degradation analysis, a binary logit model was applied to estimate the probability of a species being reported as extinct (1 = extinct, 0 = available), using the same explanatory variables. Marginal effects were calculated to ease interpretation. Similar Logit applications have been used to assess forest resource degradation and household harvesting pressures in West African and Sahelian contexts (Pouliot et al., 2012; Shackleton et al., 2001; Vedeld et al., 2004). These approaches provide robust insights into both the availability and the risk of disappearance of NTFPs in the study area. The Logit equation model was as follows:

$$\begin{aligned} \text{Logit}\left(P\left(\text{Missing} = 1\right)\right) = {} & \alpha 0 + \alpha 1\text{Zone} + \alpha 2\text{Gender} + \alpha 3\text{Education} \\ & + \alpha 4\text{HouseholdSize} + \alpha 5\text{Area} + \alpha 6\text{NumberSpecies} \\ & + \alpha 7\text{CollectionLocation} + \alpha 8\text{Distance} + \alpha 9\text{ClimateChange} \\ & + \alpha 10\text{PestAttack} + \alpha 11\text{Overharvesting} \\ & + \alpha 12\text{FoodInsecurity}. \end{aligned}$$

Indeed, although the pseudo R^2 of the logit model is relatively low (0.0592), which is common in the analysis of complex phenomena, the prediction test shows that the model correctly classified 69.68% of the observations. This confirms that the model retains an acceptable explanatory power and provides relevant insights into NTFP degradation.

2.4. Conceptual Diagram

As shown in **Figure 2**, the conceptual diagram illustrates the relationships between household characteristics (sex, education level, household size, field size), the availability and degradation of non-timber forest products (NTFPs), and the main influencing factors (quantity of NTFPs collected per household per year, species disappearance, number of species exploited, collection distance, agro-climatic area, climate change, pest attacks, overlogging, and food insecurity.

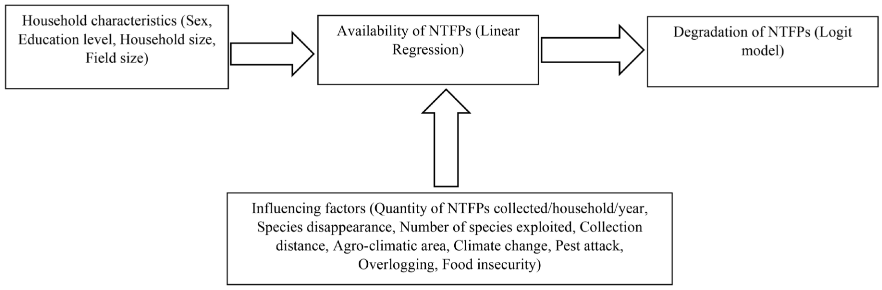

Figure 2. Conceptual diagram.

3. Results and Discussion

3.1. Results

3.1.1. Socio-Demographic and Economic Characteristics of Households

Table 2 lists the socio-economic characteristics of the households surveyed in the northern and southern Sahelian areas of the Maradi region. The majority of household heads are male gender (67.39%). The average age of household heads is approximately 41.8 years, and the mean household size is 9.91 persons, indicating large households with a substantial family labor force.

Table 2. Socio-demographic and economic characteristics of households.

Variables	Modalities	North Sahel (n = 222)	South Sahel (n = 156)	Total (n = 379)
Gender of household head (%)	Female Male	35.91 64.09	31.30 68.70	32.61 67.39
Age of household head (years)	Average	41.65 ±13.15	42.34 ± 13.86	41.8 ± 13.5
Education level (%)	Formal Education	79.73	89.74	84.01
	Non-Formal Education	20.27	10.26	15.99
Ethnicity (%)	Haoussa	80.11	95.22	90.95
	Peulh	12.71	1.30	4.52
	Touareg	7.18	2.17	3.59
	Kanouri	-	1.30	0.94
Average household size (persons)	Average	9.81 ± 5.74	10.04 ± 5.57	9.91 ± 5.65
Cultivated area size (ha^{-1})	Average	3.35 ± 3.78	2.05 ± 1.48	2.81 ± 2.86

Regarding education level, most of the household heads have received formal schooling (84.01%). The dominant ethnic group is Hausa (90.95%), followed by Fulani, Tuareg, and Kanuri. The cultivated area size per household ranges from 2.05 ha in the southern Sahel to 3.35 ha in the north, with an average size of 2.81 ha.

3.1.2. Species Providing NTFPs and Their Importance

A total of 42 woody species were identified, as presented in **Table 3**, where ten species are highlighted for their relatively high citation frequency. For transparency and comparability with other studies, the full list of all species and their importance according to agro-climatic areas is available in **Table A1** (**Appendix 1**).

In the North Sahelian area, *Maerua crassifolia* (15.05%), *Lannea microcarpa* (11.72%), and *Piliostigma reticulatum* (8.37%) emerged as the most prominent species, followed by *Guiera senegalensis* and *Sclerocarya birrea* (7.53% each). In contrast, the South Sahelian area was dominated by *L. microcarpa* (12.20%), *Diospyros mespiliformis* (11.72%), and *S. birrea* (8.35%), alongside *Faidherbia albida* and *Hyphaene thebaica* (7.70% each). These findings suggest that, despite the overall diversity of species recorded, a limited group of species accounts for most of the reported uses and cultural importance, illustrating their pivotal role in household subsistence strategies and local resilience.

Table 3. Woody species providing NTFPs and their importance according to the agro-climatic area.

North Sahelian Area		South Sahelian Area	
Scientific Name	Frequency of Citation (%)	Scientific Name	Frequency of Citation (%)
Maerua crassifolia	15.05	*Lannea microcarpa*	12.20
Lannea microcarpa	11.72	*Diospyros mespiliformis*	11.72
Piliostigma reticulatum	8.37	*Sclerocarya birrea*	8.35
Guiera senegalensis	7.53	*Faidherbia albida*	7.70
Sclerocarya birrea	7.53	*Hyphaene thebaica*	7.70
Vachellia nilotica	5.86	*Piliostigma reticulatum*	6.9
Ziziphus mauritiana	5.44	*Balanites aegyptiaca*	4.33
Moringa oleifera	5.44	*Vachellia nilotica*	4.01
Faidherbia albida	5.02	*Maerua crassifolia*	3.85
Balanites aegyptiaca	4.18	*Ziziphus mauritiana*	3.85

3.1.3. Factors Influencing Availability

As shown in **Table 4**, the linear regression analysis conducted on 379 households shows that the model is overall significant ($p < 0.001$) with a coefficient of determination $R^2 = 0.50$. Two factors appear to be decisive: the number of species collected ($\beta = 0.117$; $p = 0.009$), which is positively and significantly associated with the total quantity collected, and household size ($\beta = -0.017$; $p = 0.015$), whose slightly negative effect suggests that internal resource distribution or activity diversification may limit the quantity collected per member. Other variables (gender, education, ethnicity, land area, collection distance, climate perceptions, parasitic attacks, and collection site) have no significant effects ($p > 0.05$), indicating a relative homogeneity in collection behaviors.

Table 4. Factors affecting NTFP availability.

logTotal Quantity Collected/Household/Year	Coefficient	Std. Error	z-value	p-value
Zone β_1	0.028 727	0.325 898	0.88	0.379
Gender β_2	−0.026 376 2	0.027 710 6	−0.95	0.342
Education β_3	0.042 577 3	0.034 711 5	1.23	0.221
Ethnicity β_4	−0.009 905 7	0.043 096	−0.23	0.818
Household Size β_5	−0.011 111 9	0.011 049 6	−1.01	0.315
Field Area/Hectares β_6	0.008 345 2	0.002 706 7	3.08	0.002
N Species β_7	0.124 187 8	0.008 614 7	14.42	0.000
Collection Distance β_8	−0.036 621 7	0.048 951 8	−0.75	0.455
Climate Change β_9	0.002 463 5	0.003 240 4	0.76	0.448
Parasitic Infestation β_{10}	0.044 710 3	0.026 087 3	1.71	0.087
Collection Location β_{11}	−0.022 404 1	0.056 978 8	−0.39	0.694
Cons	3.548 108	0.086 564 7	40.99	0.000
Wald Chi^2 (11)	21.45			
Prob > Chi^2	0.0000			

3.1.4. Factors Influencing Degradation (Logit Model)

As shown in **Table 5**, the Logit model applied to 379 observations is overall significant (Wald χ^2 (11) = 25.11; $p = 0.0088$) with a pseudo R^2 of 0.0592, indicating that the included variables explain a significant portion of the NTFPs disappearance probability. Among the variables tested, ecological area shows a significant and negative effect ($\beta = -0.63$; $p = 0.025$), indicating that households located in certain areas are less likely to report NTFPs disappearance.

Table 5. Factors affecting NTFPs degradation.

Disappeared	Coefficient	Std. Error	z-value	p-value
Area α_1	−0.629 770 1	0.280 087	−2.25	0.025
Gender α_2	−0.274 673 4	0.253 764 7	−1.08	0.279
Education α_3	−0.603 692 2	0.369 810 8	−1.63	0.103
Household Size α_4	−0.016 807 3	0.020 874 4	−0.81	0.421
Field Area Size/Ha α_5	−0.008 217 1	0.106 271 6	−0.08	0.938
Nspecies α_6	0.117 246 8	0.069 893 5	1.68	0.093
Collection Distance α_7	−0.045 252 9	0.032 538	−1.39	0.164

Continued

Climate Change α_8	−0.187 207 9	1.298 063	−0.14	0.885
Parasitic Infestation α_9	1.427 658	1.703 534	0.84	0.402
Overlogging α_{10}	0.378 468 1	1.307 855	0.29	0.772
Food Insecurity α_{11}	0.055 745 5	1.293 281	0.04	0.966
Cons	−1.724 231	1.420 925	1.21	0.225
Wald Chi^2 (11)	25.11			
Prob > Chi^2	0.0088			

3.2. Marginal Effects

As shown in Table 6, the Logit model revealed a high average probability of NTFP extinction, estimated at about 71.6%. Marginal effects showed that some variables influence this risk significantly. Belonging to the northern Sahelian area reduces the likelihood of species disappearance by 13% (marginal effect = −0.130; p = 0.027) compared to the southern one. Similarly, higher education levels are associated with an 11% lower probability of extinction (marginal effect = −0.111; p = 0.066). In contrast, the number of species harvested exerts a positive effect (marginal effect = 0.024; p = 0.091), indicating that each additional species collected increases the probability of extinction at about 2.4%. This result highlights the risk of overexploitation when households diversify harvesting practices excessively, thereby intensifying pressure on natural resources. Other factors, including the gender of the household head, household size, and the distance to the collection sites, did not show statistically significant effects. Likewise, insecurity was not found to significantly influence species extinction.

Table 6. Marginal effects.

Variable	dy/dx	Std. Err.	z	$p > z$	[95% C.I.]	X
Area*	−0.130 484 1	0.058 81	−2.22	0.027	−0.245 758 - −0.015 21	0.414 894
Sex*	−0.055 462 4	0.050 87	−1.09	0.276	−0.155 159 - 0.044 234	0.555 851
Education*	−0.111 253 4	0.0606	−1.84	0.066	−0.230 033 - 0.007 526	0.840 426
Size	−0.003 418 8	0.004 23	−0.81	0.419	−0.011 708 - 0.004 87	10.0426
Surface Area	−0.001 671 4	0.021 61	−0.08	0.938	−0.044 03 - 0.040 687	1.726 06
Nspecies	0.023 849	0.014 11	1.69	0.091	−0.003 809 - 0.051 507	4.364 36
Collection Distance	−0.009 204 8	0.006 59	−1.40	0.162	−0.022 115 - 0.003 706	6.287 23
Climate Change*	−0.038 625 9	0.271 51	−0.14	0.887	−0.570 771 - 0.493 519	0.316 489
Parasitic Infestation*	0.201 937 9	0.1442	1.40	0.161	−0.080 683 - 0.484 559	0.026 596
Abusive Cut*	0.072 931 4	0.237 54	0.31	0.759	−0.392 634 - 0.538 497	0.191 489
Food Insecurity*	0.011 327 9	0.262 54	0.04	0.966	−0.503 245 - 0.525 901	0.460 106

Note: (*) dy/dx is for the discrete change of the dummy variable from 0 to 1.

3.3. Discussion

Results show that NTFPs exploitation is closely linked to household characteristics, with most respondents being married farmers and an average household size of around ten persons, representing both a source of labor and an increasing food demand (Faye et al., 2020; FAO, 2011; Shackleton et al., 2019). Beyond these socio-economic attributes, tree species play a central role in household livelihoods. The results confirm that *M. crassifolia* is particularly important in the northern Sahel, where it serves as both a source of food and fodder, in line with the findings of Nazirou et al. (2024). Similarly, *D. mespiliformis* appears more significant in the southern area, where it contributes to household income generation and provides multiple uses in food and traditional medicine, corroborating the observations of Ali et al. (2021). Other species such as *L. microcarpa*, *S. birrea*, and *F. albida* are present in both zones, highlighting their multifunctional value, while *Z. mauritiana* and *B. aegyptiaca* are also distinguished by their contribution to trading and income generation (Shackleton et al., 2015; Mahamane et al., 2021).

The linear regression result indicates that both woody species diversity and household labor determine the availability of Non-Timber Forest Products highly, supporting the evidence that in Sahel and West Africa, plant species richness enhances the access to NTFPs, improves dietary quality, and provides households with food and income opportunities (Osei et al., 2019). The lack of a significant effect of socio-economic variables supports (Ndiaye et al., 2024), indicating that collection remains a community-based activity, largely influenced by household composition and species diversity rather than individual characteristics or land size, as also noted by Mahamadou et al. (2020) and Soumana et al. (2023) in Niger and the Sahel. Furthermore, local governance and community-based management practices play a crucial role in the availability and sustainability of NTFPs, as highlighted by Moussa et al. (2023) in their study on the role of NTFPs in climate action in the West African Sahel.

Logit model results reveal a high probability of species extinction (71.6%), with significant marginal effects including that households in the northern area is facing lower risk of about 13% compared to those in the south, education reduces extinction probability by 11%, while harvesting a greater number of species increases this risk fot about 2.4% (Goussanou et al., 2019). These findings suggest that simultaneous exploitation of multiple species may exacerbate the risk of overharvesting, consistent with observations that increasing reliance on NTFPs for income can exceed the regeneration capacity of the harvested species (Twine et al., 2025; Ondo-Azi et al., 2025). Similar concerns have been raised in Central Africa, where unsustainable harvesting of *Baillonella toxisperma* wrecked both ecological resilience and local livelihoods (Reij & Garrity, 2016). Overall, these results highlight a transition from socio-economic factors to ecological pressures, showing that NTFPs' sustainability in Sahelian systems is mainly conditioned by species availability, household dynamics, and local management practices. This underlines the importance of promoting biodiversity and implementing community-based strategies, such as Assisted Natural Regeneration, to sustain natural resources and strengthen resilience (IPCC, 2022; Reij et al., 2024).

4. Conclusion

This study highlights the importance of NTFPs in the livelihoods of Sahelian households and reveals the threats to their sustainability. Results confirm that the availability of NTFPs is primarily determined by demographic structure and the species diversity exploited, while their degradation depends on ecological conditions and the level of usage pressures. They also underscore the importance of integrating biodiversity and Assisted Natural Regeneration practices into management policies, strengthening community natural resource governance, diversifying income sources to reduce dependence on NTFPs, and implementing participatory monitoring of their dynamics. Such an approach would contribute to reconciling food security, household resilience, and ecological sustainability in Sahelian regions.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Ali, A., Oumarou, M., Mounkaila, S., Mahamane, A., & Saadou, M. (2021). Perception paysanne de l'utilisation de Diospyros mespiliformis Hochst. ex A. Rich Au Niger. *Journal of Applied Biosciences, 160,* 16460-16474. https://doi.org/10.35759/jabs.160.3

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J. et al. (2009). The Economic Contribution of Forest Resource Use to Rural Livelihoods in Tigray, Northern Ethiopia. *Forest Policy and Economics, 11,* 109-117. https://doi.org/10.1016/j.forpol.2008.10.007

Boubacar, I., Adam, T., & Rabiou, H. (2022). Contribution des produits forestiers non ligneux à la sécurité alimentaire au Niger. *Revue des Sciences de l'Environnement, 18,* 45-61.

Daniel, J. (2011). *Sampling Essentials: Practical Guidelines for Making Sampling Choices.* SAGE Publications, Inc. https://doi.org/10.4135/9781452272047

Dembélé, B., Yameogo, J. T., Gomgnimbou, A. P. K., Ouédraogo, O. W., Caroll II, D. A., & Sanon, A. S. (2024). Perception du changement climatique et pratiques d'adaptation des exploitants agricoles dans le bassin versant du Kou au Burkina Faso. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), 18,* 23-31.

Fandohan, B., Assogbadjo, A. E., & Glèlè Kakaï, R. (2020). Exploitation et durabilité des ressources ligneuses en Afrique de l'Ouest. *Bois et Forêts des Tropiques, 343,* 5-15.

FAO (2011). *State of the World's Forests 2011.* Food and Agriculture Organization of the United Nations.

FAO (2019). *The State of Food and Agriculture 2019: Moving Forward on Food Loss and Waste Reduction.* Food and Agriculture Organization of the United Nations.

Faye, M. D., Weber, J. C., Abasse, T. A., Boureima, M., Larwanou, M., & Bationo, A. B. (2023). Contribution of Non-Timber Forest Products to Household Food Security in the Sahel. *Agroforestry Systems, 97,* 521-536.

Faye, M. D., Weber, J. C., Abasse, T. A., Boureima, M., Larwanou, M., & Bationo, A. B. (2020). Farmers' Preferences for Tree Functions and Species in the Sahel: Implications for Agroforestry Development. *Agroforestry Systems, 94,* 123-136.

Goussanou, C., Tente, B., Djego, J., Agbani, P., & Sinsin, B. (2019). Inventory and Sustainable Use of Non-Timber Forest Products in West African Drylands. *Forest Ecology and Management, 437,* 50-62.

Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson.

Hawey, T., Sitou, L., Manssour, A. M., Soumana, I., Massaoudou, M., & Zoubeirou, A. M. (2020). Risques pluviométriques, source d'insécurité alimentaire et nutritionnelle au Niger. *International Journal of Biological and Chemical Sciences, 14,* 452-464. https://doi.org/10.4314/ijbcs.v14i2.12

Heubach, K., Wittig, R., Nuppenau, E., & Hahn, K. (2011). The Economic Importance of Non-Timber Forest Products (NTFPs) for Livelihood Maintenance of Rural West African Communities: A Case Study from Northern Benin. *Ecological Economics, 70,* 1991-2001. https://doi.org/10.1016/j.ecolecon.2011.05.015

IPCC (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press. https://doi.org/10.1017/9781009325844

Katkoré, B., Mahamane, A., Saley, K., Morou, B., Idrissa, S., Manzo, O. L. et al. (2021). Caractérisation de la végétation de trois parcours naturels du Centre-Sud nigérien. *IOSR Journal of Environmental Science, Toxicology and Food Technology, 15,* 23-29.

Mahamadou, A., Abdourahmane, M., & Issa, H. (2020). Socio-Economic Drivers of Forest Resource Use in Niger. *Sustainable Agriculture Research, 9,* 77-90.

Mahamane, A., Saadou, M., & Boubacar, A. (2021). Woody Species Diversity and Their Contribution to Household Resilience in Nigerien Sahel. *African Journal of Ecology, 59,* 325-336. https://doi.org/10.1111/aje.12831

Moussa, S. A. R., Iddi, H. S., & Moussa, S. (2023). Non-Timber Forest Products (NTFPs) as Climate Actions in West African Sahel: A Review. *Journal of Business and Environmental Management, 2,* 1-23.

Nazirou, H. S. M., Aissetou, D. Y., Ousmane, Z. M., Amadou, H. A., Idriss, H. L., & Laminou, S. A. (2024). Ligneux fourrager du Sahel, Maerua crassifolia et ses insectes ravageurs. *African Scientific Journal, 3,* 826-851.

Ndiaye, S., Djighaly, P. I., Ndiaye, S., & Dramé, F. A. (2024). Dynamique de l'Exploitation des Produits Forestiers non Ligneux Commercialisés dans le Département de Goudomp, Sénégal. *European Scientific Journal, ESJ, 20,* 147-161. https://doi.org/10.19044/esj.2024.v20n9p147

Ondo-Azi, A. S., Moussavou, J. L. B., Athomo, A. B. B., Robles, E., Mehats, J., Mbadinga, S. D. B. et al. (2025). Assessing the Physicochemical Properties, Thermal Stability, Anti-Inflammatory and Antioxidant Activities of *baillonella Toxisperma* Seed Butters. *Journal of Agricultural Chemistry and Environment, 14,* 318-334. https://doi.org/10.4236/jacen.2025.143022

Osei, C., Wongnaa, C. A., & Gockowski, J. (2019). Contribution of Nontimber Forest Products to Rural Household Income in the Kassena-Nankana West District of Ghana. *Forest*

Products Journal, 69, 217-227. https://doi.org/10.13073/fpj-d-18-00049

Pouliot, M., Treue, T., Obiri, B. D., & Ouedraogo, B. (2012). Deforestation and the Limited Contribution of Forests to Rural Livelihoods in West Africa: Evidence from Burkina Faso and Ghana. *AMBIO, 41,* 738-750. https://doi.org/10.1007/s13280-012-0292-3

Reij, C., & Garrity, D. (2016). Scaling up Farmer-Managed Natural Regeneration in Africa to Restore Degraded Landscapes. *Biotropica, 48,* 834-843. https://doi.org/10.1111/btp.12390

Reij, C., Garrity, D., & Botoni, E. (2024). Farmer-Managed Natural Regeneration in Niger: Advances and Lessons for Dryland Restoration. *Land Degradation & Development, 35,* 1452-1467. https://doi.org/10.1002/ldr.482

Shackleton, C. M., & Pandey, A. K. (2014). Positioning Non-Timber Forest Products on the Development Agenda. *Forest Policy and Economics, 38,* 1-7. https://doi.org/10.1016/j.forpol.2013.07.004

Shackleton, C. M., Pandey, A. K., & Ticktin, T. (2015). *Ecological Sustainability for Non-Timber Forest Products: Dynamics and Case Studies of Harvesting.* Routledge.

Shackleton, C. M., Shackleton, S. E., & Cousins, B. (2001). The Role of Land-Based Strategies in Rural Livelihoods: The Contribution of Arable Production, Animal Husbandry and Natural Resource Harvesting in Communal Areas in South Africa. *Development Southern Africa, 18,* 581-604. https://doi.org/10.1080/03768350120097441

Shackleton, C. M., Shackleton, S. E., & Shanley, P. (2019). *Non-Timber Forest Products and Poverty Alleviation: Evidence, Impacts and Opportunities.* Springer.

Shackleton, S., Delang, C. O., & Angelsen, A. (2011). *Non-Timber Forest Products in the Global Context.* Springer.

Soumana, B., Abdourahmane, M., & Issa, H. (2023). Facteurs socio-économiques influençant la collecte des produits forestiers non ligneux au Niger. *Journal of Agroforestry Research, 9,* 67-78.

Soumana, I. (2021). Productivité, valeur pastorale et capacité de charge des parcours naturels de la région de Maradi, Niger. *International Journal of Biological and Chemical Sciences, 12,* 1705-1716.

Twine, W., Shackleton, C., & Thondhlana, G. (2025). Livelihood Dependence on Non-Timber Forest Products and Implications for Sustainability in the Limpopo Basin. *Environmental Research Letters, 20,* Article ID: 024012.

UICN & AGEREF-CL (2024). *Valorisation des produits forestiers non ligneux pour la diversification économique et la préservation des écosystèmes dans la région des Cascades, Burkina Faso.* Programme de Petites Initiatives (PPI). https://www.programmeppi.org

Vedeld, P., Angelsen, A., Sjaastad, E., & Berg, G. K. (2004). *Counting on the Environment: Forest Incomes and the Rural Poor. World Bank Environment Department Paper No. 98.* World Bank.

WAEN (2020). *Niger.* https://www.westafricaecotourism.network/niger/

Appendix

Table A1. Complete list of 42 species and their importance according to the agro-climatic area.

APG Family	Scientific Name	Names Locals (Hausa)	Proportion of Respondents (%)		
			North-Sahelian Zone	South-Sahelian Zone	Total
Anacardiaceae	*Lannea microcarpa* (Hochst. Ex A. Rich.) Engl.	Farou	11.72	12.20	12.06
	Sclerocarya birrea	*Dania ou Loula*	7.53	8.35	8.12
Apocynaceae	*Leptadenia hastata* (*Pers.*) *Decne.*	*Yadia*	-	0.16	0.12
Arecaceae	*Hyphaene thebaica* (L.) Mart	*Gorouba*	0.42	7.70	5.68
Bignoniaceae	*Stereospermum kunthianum* Cham.	*Sansami*	-	0.32	0.23
Burseraceae	*Boswellia dalzielii* Hutch.	*Hano*	-	0.16	0.12
	Commiphora qfricana (Lour.) Dandy	*Dashi*	0.42	0.16	0.23
Capparaceae	*Boscia angustifolia*	*Dilo*	0.42		0.12
	Boscia salicifolia Oliv.	Zuré	0.84	0.64	0.70
	Boscia senegalensis (Pers.) Lam. ex Poir.	*Anza*	0.84	0.16	0.35
	Maerua angolensis DC.	Cicciwa	-	0.16	0.12
	Maerua crassifolia Forsk.	*Jiga*	15.06	3.85	6.96
Combretaceae	*Anogeissus leiocarpus* (DC) Guill. Et Perr.	Marké	0.42	0.96	0.81
	Combretum ghasalense	*Tsiri*	-	0.32	0.23
	Guiera senegalensis J.F. Gmel.	*Sabara*	7.53	0.64	2.55
Ebenaceae	*Diospyros mespiliformis* Hochst. Ex A.DC.	*Kania*	2.09	11.72	9.05
Euphorbiaceae	*Euphorbia balsamifera* Ait.	*Aguwa*	0.84	0.32	0.46
Fabaceae	*Acacia raddiana*	*Kandili*	0.84	0.96	0.93
	Acacia seyal Del.	Fara-‘k’aya	0.84	0.32	0.46
	Acacia sieberiana DC.	Fara bagaruwa	-	0.64	0.46
	Albizia chevalieri Harms	*Kassari*	-	0.80	0.58
	Bauhinia rufescens Lam.	*Dirga*	1.26	0.96	1.04
	Dichrostachys cinerea (L.) Wight et Arn.	Dundu	-	0.32	0.23
	Faidherbia albida Del	*Gao*	5.02	7.70	6.96
	Parkia biglobosa (Jacq.) R. Br. Ex G. Don	*Dorowa*	-	0.16	0.12
	Piliostigma reticulatum (DC.) Hochst	*Kalgo*	8.37	6.90	7.31

Continued

	Prosopis africana (Guill. et Perr.) Taub.	*Kiria*	-	1.44	1.04
	Senegalia senegal	Dakwara	0.84	0.48	0.58
	Tamarindus indica L.	Tsamia	3.77	3.05	3.25
	Vachellia nilotica	*Bagaroua*	5.86	4.01	4.52
Lamiaceae	*Vitex doniana* sweet.	Dumnia	-	3.05	2.20
Malvaceae	*Adansonia digitata* L.	*Kouka*	7.11	2.09	3.48
Meliaceae	*Azadirachta indica* A. Juss.	*Bedi*	2.51	2.09	2.20
	Khaya senegalensis (Desr.) Juss.	*Madaci*	-	0.16	0.12
Moraceae	*Ficus platyphylla* Del.	*Gamji*	-	0.64	0.46
Moringaceae	*Moringa oleifera* Lam.	*Zogala ou* El makka	5.44	3.21	3.83
Rhamnaceae	*Ziziphus mauritiana* Lam.	*Magaria*	5.44	3.85	4.29
	Ziziphus spina-christi (L.) Desf.	*Kourna*	-	3.69	2.67
Rosaceae	*Neocarya macrophylla (Sabine) Prance*	*Gawassa*	-	0.32	0.23
Rubiaceae	*Mitragyna inermis* (Willd.) Kuntze.	*Guiyeya*	0.42	0.64	0.58
Sapotaceae	*Vitellaria paradoxa* gaertn. Syn.	Kadé	-	0.32	0.23
Zygophyllaceae	*Balanites aegyptiaca* (L.) Delille.	*Adoua*	4.18	4.33	4.29
Total			100.00	100.00	100.00