International Journal of Innovative Biosciences Research 14(2):1-9, April-June, 2026

 www.seahipublications.org ISSN: 2467-8457

doi:10.5281/zenodo.19444197

Assessment Of Human-Induced Disturbances On Tree Species Diversity And Regenerations In Lungu Forest Shagari Local Government

[1*]Yusuf, S. G., [1]Tambari, U., [1]Adili, I.S., [2]Kasimu, A. S. and [3]Abubakar, Z. L.

[1]Department of Environmental Science Education
Shehu Shagari University of Education Sokoto, Nigeria
***Corresponding author email/phone no.: shafiu.ismaila@ssues.edu.ng/+2347036354432**

[2,3]Department of Biology
Shehu Shagari University of Education Sokoto, Nigeria

ABSTRACT
Natural forests are among the rich habitats on the globe because they host diversified flora and fauna species This study aimed to assess of human-induced disturbances on tree species diversity and regenerations in Lungu forest Shagari local government of Sokoto State Nigeria. Data for the study was obtained from field survey through systematic sampling technique to collect data on tree species, frequency, density, diameter at breast height (DBH), seedlings, and saplings. The result from the study revealed a total of 28 tree species identified across the three Forest sites with Wanke Forest site recording the highest species richness of 10 species. Diversity indices showed that Wanke forest had the highest diversity of 2.10 and richness of 2.41, while Lungu forest exhibited the highest evenness of 0.91. DBH values ranged from 12 cm to 45 cm with Lungu Forest site having the largest tree sizes. Regenerative individuals showed high numbers of seedlings and saplings across all the forest sites. The study concludes that Wanke Forest site is more diverse and ecologically stable, Lungu forest is structurally mature but less diverse, while Sage Forest site is comparatively more disturbed. The study therefore, recommends sustainable forest management practices to enhance regeneration and conserve biodiversity in the study area.
Keywords: Diversity, Lungu forest, Regenerations, Richness and Evenness

INTRODUCTION

Tropical forests are biodiversity hot spot endowed with beautiful vegetation that often display a great diversity of tree species and many other life forms (Burivalova, 2019). Vegetational forests resources supports lives through the provision of various products and services (Beltrán-Rodríguez *et al.*, 2021). Forest products include edible fruits, rope fodder, timber, animals tye and medicinal materials (Ouédraogo *et al.*, 2019), while their regulatory services cover carbon sequestration, soil protection and especially influences water cycles, nutrient cycling, recreation sites, climate regulation, shelter for animals, and nests for birds (Mohammed *et al.*, 2021). These products, services, and their roles are extremely vital for the rural people, forest-based communities, and urban, particularly in Africa and other developing countries (Khamis *et al.,* 2020). On Global scale, 80% of the world's population is believed to rely to some extent on forests resources and as for most people living in Africa, especially in the tropical and sub-tropical regions, natural forests, parklands, and agroforests fulfill more than 85% of the locals' livelihoods and daily food consumptions (Ouédraogo *et al.*, 2019). However, many tree species in Nigeria have declined significantly by more than 20% and others threatened to extinction (FAO, 2019). According to the National Forestry policy of Nigeria, North western region is among the regions that have been greatly affected by loss of tree species resulting from anthropogenic activities (NEMA, 2009).

Assessment of forest community composition and structure is very vital in understanding the status of tree populations, diversity and regeneration for conservation purposes (Mishra *et al.*, 2013). The species richness and diversity of trees are fundamental to total forest biodiversity because trees provide resources and habitat for almost all other forest species (Malik, 2014).

The regenerative individuals of each forest and community level species richness of both seedlings and saplings increases with increase active forest management (Subedi *et al.,* 2018). The forest management activities benefit the forest with improved regeneration (Malik and Bhatt, 2015), greater species diversity and richness (Poudyal *et al.,* 2020), and ultimately leading to sustainability if observed in prescribed way (Pokharel *et al.,* 2015). For sustainable tropical forest management, natural regeneration is crucial for the preservation and maintenance of biodiversity because it contributes substantially to tree species dynamics and composition within several tropical forest ecosystems (De Carvalho, 2017). However, regeneration study not only predicts the current status but also provides insight about the possible changes in forest composition in the future (Malik and Bhatt, 2016). Also, species is one of the major analytical characteristics of the plant community (Malik et a*l.,* 2014). Knowledge of species composition and diversity of tree species is of utmost importance not only to understand the structure of a forest community but also for planning and implementation of conservation strategy of the community (Malik and Bhatt, 2015).

Despite the existence of the policies and legal frameworks such as the National Environmental Policy, National Land Act, National Forest Act, and National Environmental Management Act which are either directly or indirectly related to conservation and management of natural resources, the problem still exists (NFA, 2005). The continued loss and degradation of biodiversity therefore present a serious challenge to livelihoods and economic growth. The Lungu forests are prone to many calamities resulting from anthropogenic activities like logging, fire, grazing, and flood. The most affected plant communities by these calamities are regenerative individuals and young trees. Enough knowledge and study in forest characteristics of different tree species is essential to guarantee forest's natural regeneration (Mousavi *et al.,* 2011).

So, understanding stand composition and structure is useful silviculture knowledge in evaluating species conservation, forest management and forest sustainability (Kacholi, 2014). Unfortunately, most tropical forests are subjects of various environmental and anthropogenic pressures and thus, if not managed properly, they may pose adverse effects on floral biodiversity in the future (Stévart, 2019). Therefore, silviculture and forest management interventions which are beneficial to the maintenance of the overall biodiversity, productivity and sustainability of tropical forests are needful (Kumar *et al.,* 2006) Lungu forest has received very little floral biodiversity research assessment, despite being one of the most livelihood contributor in Shagari Local Government of Sokoto State. Following this challenge, there are needs to assess human-induced disturbances on tree species diversity and regenerations in Lungu forest of Shagari Local government.

MATERIALS AND METHOD

3.1 Study Area

The place describes its origin in his book titled '' Beckoned to serve'' he mentioned that Dan fodiyo reportedly said '' you can remain and Sha (enjoy) your garri (millet flour)'', The area lies within the Sudano–Sahelian ecological zone characterized by sparse woodland and savanna vegetation. The forest is located between latitude 132°4357'5''N and longitude 5°07'070''E. It is located in the south east of Sokoto city. Shagari falls in to the typical tropical climate which has distinct wet and dry season. The annual rainfall was 500–800 mm with average temperature. of 28–40°C. the dominant vegetation consists of savanna tree species such as *Acacia spp.*, *Parkia biglobosa*, *Adansonia digitata* and *Combretum spp* (Bello *et al.*,2020).

Field Survey

Field ecological survey integrated with a socio-ecological assessment was conducted to determine the effects of human activities on tree species diversity and regeneration in Lungu Forest. Before the commencement of data collection, permission was obtained from Department of Forestry, Ministry of Environment Sokoto state branch and later the forest was visited to observed the intensity of human activities within the area. Two research assistants were hired as lead persons to help in language interpretation during data collection. A pilot testing lasted for only one week conducted at the beginning of the study and key informants were also identified with the help of the local assistants and community.

Stratification of the Forest

The Lungu forest were stratified into three forest sites categories based on the intensity of human activities observed within the area. This stratification is important because it enables the study to examine variations in vegetation structure and regeneration patterns across different levels of disturbance.

Sampling Technique

A systematic random sampling technique was adopted for vegetation sampling across the different Forest sites of the forest and total of 30 plots measuring 20 × 20 m^2 were demarcated using measuring tape and peg where10 plots was established from each disturbance strata for the assessment of mature tree species. In each of these plots smaller subplots measuring 5 m × 5 m^2 was also demarcated in for the assessment of regeneration individual that involves seedlings and saplings. All tree species encountered in each plot were identified and recorded. The unidentified specimens were collected, pressed and taken to Abdullahi Fodiyo University for proper identification where voucher number was deposited at the herbarium, while the verification was done using the database at www.plantlist.org. The tree specimens were collected according to the standard practice, including leaves, flowers and fruits where possible and girths of the trees at 1.3 meters from the ground level (Diameter at Breast Height) were measured by use of a measuring tape and recorded (Adili *et al.*, 2024). Similarly, human disturbance indicators such as tree stumps, charcoal production site grazing intensity, fuelwood collection farming encroachment and footpath will be recorded in each plot.

Data Analysis

The diversity of the tree species community was determined using Shannon Wiener Index which is a most common measure of heterogeneity. The Shannon Wiener index assumes that all species present are represented in a sample and that the sample was obtained (Magurran 2004).

This index is calculated by:

$$H' = -\sum_{i=1}^{s} pi \ln pi$$

Where i, is the proportion of the species relative to the total number of species (pi) multiplied by the natural logarithm of this proportion (lnpi) and the final product multiplied by -1.

The Margalef index "R" was used to determine the species richness for each stand. This index takes the total observed individuals "N" as one factor in the computation. The formula is as follows:

$$\mathbf{R} = \frac{\mathbf{S - 1}}{\mathbf{\ln N}}$$

where R is the Margalef index of species richness, S is the number of taxa or species, and N is the number of individuals. Thus, the higher the R value the richer is the stand in the species.

Species evenness, the proportion of individuals among species in an ecosystem is often assessed by Shannon's equitability index (H'E) which is calculated by:

$$H'E = H' / Hmax$$

Where Hmax is defined as ln S. H'E values range from 0 to 1 and 1 indicates complete evenness.

Structural Analysis.

The structure of the tree species was described based on the analysis of the species density, DBH, frequency, density that are computed on hectare basis. The following formulas were used to calculate tree species stand structural parameters (Kent and Coker, 1992).

Frequency (F). The probability or chance of finding a species in a given sample area or quadrant. It is dependent on the quadrant size, plant size, and patterning in the vegetation (Kent and Coker, 1992). It is calculated as follows

$$\text{Frequency} = \frac{\text{Number of quadrats in which a species occur}}{\text{Total number of quadrats sampled in the study site}} \times 100$$

$$\text{Relative frequency (\%)} = \frac{\text{Frequency of as pecies}}{\text{Frequency of all species}} \times 100$$

Density of a species is the count of the number of individuals of a species within the quadrant (Kent and Coker, 1992). It is closely related to the abundance but more useful in estimating the importance of a species. Counting is usually done in quadrats placed several times in the plant communities under study. Afterward, the sum of individuals per species is calculated in terms of species density per convenient area unit such as a hectare (Mueller-Dombois and Ellenberg, 1974).

$$\text{Density} = \frac{\text{Number of individuals of a species}}{\text{Sum of all plot areas}} \times 100$$

$$\text{Relative Density} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of individuals of all species}} \times 100$$

While the DBH (Diameter at breast height) was calculated using $D = \frac{3.142}{C}$

Regeneration Analysis. The regeneration status of tree species in the Lungu forest was analyzed by comparing the data of seedling with sapling and sapling with matured trees (Gebrehiwot and Hundera, 2014). in the following categories: (1) “good” regeneration, if present in seedling>sapling>mature tree; (2) “fair” re generation, if present in seedling>sapling (Yigrem, and Dessale 2024).

Statistical Analysis

The data generated for the study were computed and summarized using a Microsoft Office Excel (2016) spreadsheet. SPSS version 23.0 software was used for statistical analysis, and the results of the analysis were presented using descriptive statistics

RESULT

A total of 28 tree species were recorded across the three forest sites (Sage, Wanke, and Lungu) in Lungu Forest, Shagari Local Government Area. The Wanke Forest Site (Table 2) has the highest species richness with the recorded number of 10 species, while both Sage (Table 1) and Lungu Forest Sites (Table 3) recorded only 9 tree species each. The distribution of the species varied across the sites with observed dominance of some species. In the Sage Fores site *Acacia nilotica* has the highest frequency of 6 species while in Wanke *Acacia macrostachya* and *Piliostigma reticulatum* has recorded number of 6 species each. However, in Lungu forest Forest site *Anogeissus leiocarpus* and *Parkia biglobosa* depicts the highest number of occurrences which is very important for a study indicating strong ecological dominance in the site (Table 3).

The tree species density and relative density (RD) varied among the study sites. The Lungu Forest Site recorded the highest density values with *Anogeissus leiocarpus* showing a density of 66.66% and Relative Density of 9.6 indicating a high concentration of individuals within fewer species. In comparison with Sage and Wanke forests site that shows more moderate density values distributed among several species.

The regenerative individuals based on the number of seedlings and saplings unravels that all forest sites exhibited active regeneration. Wanke forest showed the highest regeneration capability with several species recording up to 5 seedlings and 4 saplings while Sage and Lungu forests sites also demonstrated considerable regeneration although its slightly lower. However, the relatively high number of seedlings and saplings compared to mature trees suggests limited transition into the adult stage which result from anthropogenic disturbances affecting growth of the species.

There was a variation in DBH across the study sites. The Lungu Forest Site recorded the highest DBH values of 20–45 cm with *Ceiba pentandra* having the largest diameter of 45 cm while the Wanke Forest Site recorded moderate DBH with the values of 18–28 cm. However, Sage Forest Site recorded relatively lower DBH values of 12–25 cm.

Table 1. Sage Forest Site of Lungu Forest Shagari Local Government

S/N	Botanical names	F	RF	Density	R D	D/H	Seedling	Saplings	DBH (cm)
1	*Azadirachta indica*	5	13.15	32.89	4	12.5	3	2	18
2	*Mangifera indica*	3	7.89	19.73	2.4	7.5	1	1	22
3	*Psidium guajava*	3	7.89	19.73	2.4	7.5	2	1	12
4	*Delonix regia*	2	5.26	13.15	1.6	5	1	0	20
5	*Eucalyptus obliqua*	2	5.26	13.15	1.6	5	1	1	25
6	*Faidherbia albida*	4	10.52	26.31	3.2	10	2	2	20
7	*Acacia nilotica*	6	15.78	39.47	4.8	15	3	2	16
8	*Balanites aegyptiaca*	5	13.15	32.89	4	12.5	3	2	15
9	*Ziziphus abyssinica*	3	7.89	19.73	2.4	7.5	2	1	14

Key: F= Frequency, RF= Relative frequency, RD= Relative density and D/H = Density per hectare

Table 2. Wanke Forest Site of Lungu Forest Shagari Local Government

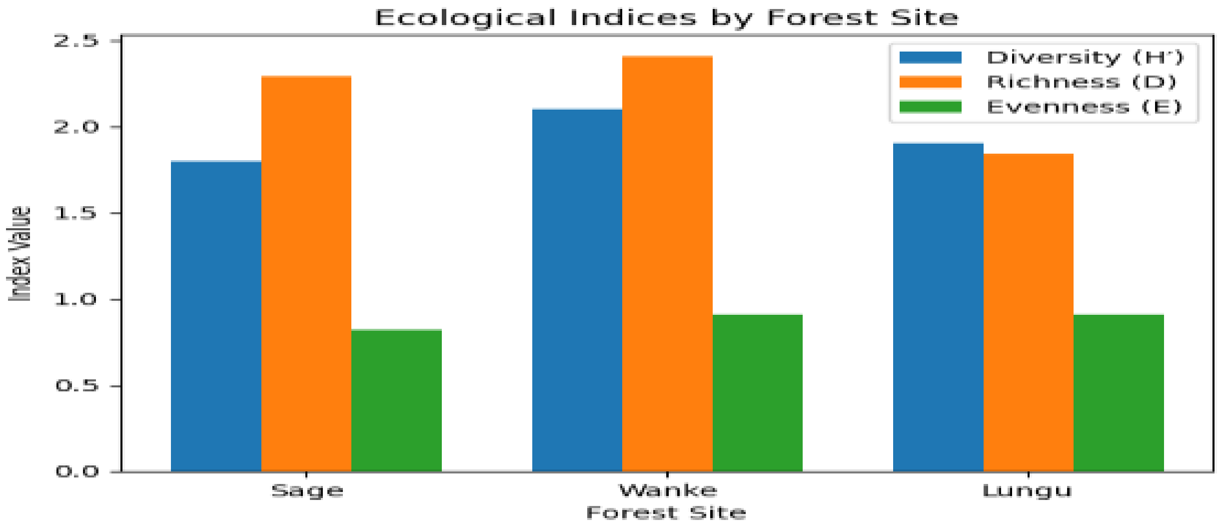
S/N	Botanical names	F	R F	Density	R D	D/H	Seedling	Saplings	DBH (cm)
1	*Acacia macrostachya*	6	14.28	35.71	4.8	15	5	4	20
2	*Acacia sieberiana*	5	11.9	29.76	4	12.5	4	3	22
3	*Detarium microcarpum*	4	9.52	23.8	3.2	10	3	3	24
4	*Diospyros mespiliformis*	3	7.14	17.85	2.4	7.5	2	2	26
5	*Lannea macrocarpa*	5	11.90	29.76	4	12.5	4	3	23
6	*Piliostigma reticulatum*	6	14.28	35.71	4.8	15	5	4	18
7	*Prosopis africana*	4	9.52	23.8	3.2	10	3	3	25
8	*Vitex doniana*	4	9.52	23.8	3.2	10	3	3	24
9	*Tamarindus indica*	3	7.14	17.85	2.4	7.5	2	2	28
10	*Ficus vallis-choudae*	2	4.76	11.90	1.6	5	2	1	27

Key: F= Frequency, RF= Relative frequency, RD= Relative density and D/H = Density per hectare

Table 3. Lungu Forest Site of Lungu Forest Shagari Local Government

S/N	Botanical names	F	RF	Density	R D	D/H	Seedling	Saplings	DBH (cm)
1	*Anogeissus leiocarpus*	12	26.66	66.66	9.6	30	10	8	30
2	*Parkia biglobosa*	11	24.44	61.11	8.8	27.5	9	7	35
3	*Khaya senegalensis*	4	8.88	22.22	3.2	10	3	3	40
4	*Cordia africana*	4	8.88	22.22	3.2	10	3	3	32
5	*Ceiba pentandra*	2	4.44	11.11	1.6	5	2	1	45
6	*Ximenia americana*	4	8.88	22.22	3.2	10	3	3	20
7	*Acacia nilotica*	4	8.88	22.22	3.2	10	3	2	22
8	*Balanites aegyptiaca*	4	8.88	22.22	3.2	10	3	3	24
9	*Anogeissus leiocarpus*	12	26.66	66.66	9.6	30	10	8	30

Key: F= Frequency, RF= Relative frequency, RD= Relative density and D/H = Density per hectare



The above bar chart from figure 1 revealed that Wanke forest exhibited the highest values of diversity with 2.10 and the highest species richness of 2.41, while lowest richness of 1.84 was observed in Lungu suggesting possible competitive exclusion. both Wanke and Lungu showed similar levels of evenness with the value 0.91. However, Sage Forest site recorded lowest evenness of 0.82 depicting dominance by only few species.

DISCUSSIONS

The observed variation in species composition, diversity, regeneration, and structural characteristics across the three forest sites reflects differences in ecological processes and anthropogenic disturbances in study area. The relatively higher species richness and Shannon diversity index recorded in Wanke forest suggest a more favorable ecological condition that supports species coexistence. Forest diversity is largely controlled by interactions among regeneration, competition, and mortality processes, which shape species composition over time (Luu *et al.*, 2024).

The dominance of a few species such as *Anogeissus leiocarpus* in Lungu forest, despite its high density and large DBH values indicates a structurally mature species availability in the site with less diverse ecosystem. This agrees with findings that forest ecosystems with strong dominance often exhibit reduced species diversity due to competitive exclusion among species (Kinnoumè *et al.*, 2024).

The regeneration pattern observed across all sites, characterized by high numbers of seedlings and saplings, indicates active recruitment and potential for forest recovery. Natural regeneration plays a critical role in shaping future forest composition and ecosystem resilience, especially in disturbed or secondary forests (Williams, *et al.*, 2024). However, the irregularities between regeneration stages and mature indicates suggests that many individuals fail to reach adulthood. This pattern is mainly associated with anthropogenic disturbances such as logging, grazing, charcoal production and fuelwood extraction which limit the survival of mature trees. The diameter at breast heigh (DBH) distribution further supports this interpretation. The presence of larger diameter trees in Lungu forest indicates a more mature stand structure whereas the predominance of smaller diameter classes in Sage and Wanke suggests regenerative species. Studies have shown that forests dominated by smaller DBH classes often exhibit an inverted J-shaped distribution which is typical of regenerating forests but may also indicate selective removal of larger trees due to the anthropogenic activities (Awoke *et al.*, 2025).

CONCLUSION

The assessment of vegetation structure and diversity across Sage, Wanke, and Lungu Forest sites unravel significant variations in species composition and regeneration development. Wanke Forest site exhibited the highest species diversity and richness showing a relatively stable and productive ecosystem. Lungu Forest site on the other hand depicted higher tree density and larger DBH values, reflecting a more mature forest stand although with lower species diversity due to dominance by a few species. Sage forest recorded lower diversity and smaller tree sizes suggesting greater exposure to disturbance. The high presence of seedlings and saplings across all sites indicates strong regeneration ability but the low number of mature trees indicates that many species are affected anthropogenic pressures such as deforestation, grazing, and fuelwood extraction. This imbalance may threaten long-term forest sustainability if not properly regulated.

REFERENCES

Adili, I. S., Tambari, U., Yusuf, S. G., Singh, D., Keta, J. B., Mustapha, S. W. and Sadiya, A. W. (2024). Community Structures of On-Farm Tree Species in Budaka Sub-County, Budaka District, Eastern Uganda. Journal of *Ecology and Evolutionary Biology* Vol. 9, No. 3, pp. 83-90 https://doi.org/10.11648/j.eeb.20240903.12

Awoke, A., Asnakew, M., Chagito, G., Andualem, A., Zewdie K. and Moa, M. (2025). Woody Plant Species Diversity, Vegetation Structure, And Regeneration Status of Modi-Geyi Forest in Andracha District, Southwest Ethiopia. *BMC Ecology Evolution* 25, 133 (2025). https://doi.org/10.1186/s12862-025-02473-w

Bello, A. S., Al-Hassan, R. M. and Amikuzuno, J. (2020). Seasonal Rainfall Variability and Its Implications for Agricultural Production in The Sudano-Sahelian Zone of Nigeria. *Weather and Climate Extremes, 27*, 100182. https://doi.org/10.1016/j.wace.2019.100182

Beltrán-Rodríguez, L., Valdez-Hernández, J. I., Saynes-Vásquez, A., Blancas, J., Sierra-Huelsz, J. A., Cristians, S., Martínez-Ballesté, A., Romero-Manzanares, A., Luna-Cavazos, M., Borja de la Rosa, M. A., Pineda-Herrera, E., Maldonado-Almanza, B., Ángeles-Pérez, G., Ticktin, T. and Bye, R. (2021). Sustaining Medicinal Barks: Survival and Bark Regeneration of *Amphipterygium adstringens (Anacardiaceae)*, A Tropical Tree Under Experimental Debarking. *Sustainability*, 13(5), 2860. https://doi.org/10.3390/su13052860

Burivalova, Z., Allnutt, T. F., Rademacher, D., Schlemm, A., Wilcove, D. S. and Butler, R. A. (2019). What Works in Tropical Forest Conservation, and What Does Not: Effectiveness of Four Strategies in Terms of Environmental, Social, and Economic Outcomes. *Conservation Science and Practice*, 1(2), e28. https://doi.org/10.1111/csp2.28

De Carvalho, R. M. (2017). *Tropical Forest Regeneration.* In R. L. Chazdon (Ed.), *Encyclopedia of Tropical Forests* (pp. 2053–2067). Elsevier. https://doi.org/10.1016/B978-0-12-809633-8.02053-7

Food and Agriculture Organization (2019). Global Forest Resources Assessment: Nigeria Report. Rome: FAO.

Gebrehiwot, K. and Hundera, K. (2014.). “Species Composition, Plant Community Structure and Natural Regeneration Status of Belete Moist Evergreen Montane Forest, Oromia Regional State, Southwestern Ethiopia,” *Momona Ethiopian Journal of Science*, Vol. 6, no. 1, pp. 97–101, Kacholi, D. S. (2014). Edge-Interior Disparities in Tree Species and Structural Composition of the Kilengwe Forest in Morogoro Region, Tanzania. *International Scholarly Research Notices*, 2014, Article ID 873174. https://doi.org/10.1155/2014/873174

Kent, M. and Coker, P. (1992.). Vegetation Description and Analysis: A Practical Approach, John Wiley and Sons, New York, NY, USA,

Khamis, H. A., Akambi, H. S. K., Houndonougbo, J. S. H., Noulèkoun, F., Agoyi, E. E., Assogbadjo, A. E. and Sinsina, B. (2020). Three Decades of The Practice of Decentralised Forest Management in Africa: A Systematic Review of Current Knowledge and Prospects. ResearchGate.

Kinnoumè S. M. D., Gouwakinnou, G. N., Noulèkoun, F., Balagueman, R. O., Houehanou, T. D. and Natta, A. K. (2024) Trees Diversity Explains Variations in Biodiversity-Ecosystem Function Relationships Across Environmental Gradients and Conservation Status in Riparian Corridors. *Frontiers For Globlobal Change* 7:1291252. doi: 10.3389/ffgc.2024.1291252

Kumar, P., Rai, N., Parveen, S., Tiwari, A., Kumar, V. and Lakra, T. S. (2006). *Silviculture: Principles and practices for sustainable forest management.* CRC Press.

Luu, H., Ris Lambers, J. H., Lutz, J. A., Metz, M. and Snell, R. S. (2024). The Importance of Regeneration Processes on Forest Biodiversity in Old-Growth Forests in the Pacific Northwest. *Biological Science*. 379(1902):20230016. doi: 10.1098/rstb.2023.0016. Epub 2024 Apr 8. PMID: 38583471; PMCID: PMC10999264.

Magurran, A. (2004). Measuring Biological Diversity. Blackwell Science Ltd, A Blackwell Publishing Company.

Malik, Z. A. and Bhatt, A. B. (2015). Regeneration Status of Tree Species and Survival of their Seedlings in Kedarnath Wildlife Sanctuary and Its Adjoining Areas in Western Himalaya, India. *Tropical Ecology*, 56(3), 327–338.

Malik, Z. A. and Bhatt, A. B. (2016). Regeneration Status of Tree Species and Survival of Their Seedlings in Kedarnath Wildlife Sanctuary and Its Adjoining Areas in Western Himalaya, India. *Tropical Ecology*, 57(4), 677–690.

Malik, Z. A., Singh, S. and Sharma, C. M. (2014). Tree Species Richness, Diversity, and Regeneration Status in Different Oak *(Quercus spp.)* dominated forests of Garhwal Himalaya, India. *Journal of Asia-Pacific Biodiversity*, 7(3), 293–300. https://doi.org/10.1016/j.japb.2014.06.002

Mishra, A. K., Behera, S. K., Singh, K., Sahu, N., Bajpai, O., Kumar, A., Mishra, R. M., Chaudhary, L. B. and Singh, B. (2013). Relation of Forest Structure and Soil Properties in Natural, Rehabilitated and Degraded Forest. *Journal of Biodiversity Management & Forestry*, 2(4), 1–7. https://doi.org/10.4172/2327-4417.1000117

Mohammed, O., Onyekuru, N. A., Marchant, R. and Ihemezie, E. J. (2021). Forest Resource Use and Management in Nigeria: Implications for Implementation of *REDD+* For Climate Change Mitigation in West Africa. In Handbook of Climate Change Management (pp. 1–23). *Springer*. https://doi.org/10.1007/978-3-030-22759-3_132-1 (doi.org in Bing)

Mousavi, K. S. A., Roshani, G. A., Jalali, S. G. and Shahrdami, A. (2011). The Effects of Cover Crown Percentage and Slope Aspect on The Quantitative Distribution of Alder's Saplings in Forests of North Iran. *African Journal of Agricultural Research*, 6(16), 3817–3821. https://doi.org/10.5897/AJAR10.692

Mueller-Dombois, D. and Ellenberg, H. (1974). Aims and Methods of Vegetation Ecology, John Wiley and Sons, New York, NY, USA.

National Emergency Management Agency (NEMA). (2009). *National Forest Policy of Nigeria*. Federal Ministry of Environment, Abuja.

NFA (2005). *National Forest and Tree Assessment and Inventory*. Ministry of Agriculture, Lebanon. Technical Cooperation Program (TCP/LEB/2903).

Ouédraogo, R. A. (2019). Impact Des Pratiques De Gestion De La Fertilité Sur La Qualité des Sols Sous Cultures Maraîchères À Bobo-Dioulasso (Burkina Faso). Doctoral Dissertation, Université Catholique de Louvain, Belgique.

Pokharel, R. K., Neupane, P. R., Tiwari, K. R. and Köhl, M. (2015). Assessing the Sustainability in Community-Based Forestry: A Case from Nepal. *Forest Policy and Economics*, 58, 75–84. https://doi.org/10.1016/j.forpol.2014.11.006

Poudyal, B. H., Maraseni, T., & Cockfield, G. (2020). *Scientific forest management practice in Nepal: Critical reflections from stakeholders' perspectives. Forest Ecology and Management,* 458, 117740. https://doi.org/10.1016/j.foreco.2019.117740

Stévart, T., Dauby, G., Lowry II, P. P., Blach-Overgaard, A., Droissart, V., Harris, D. J., Mackinder, B. A., Schatz, G. E., Sonké, B., Sosef, M. S. M., Svenning, J.-C., Wieringa, J. J. and Couvreur, T. L. P. (2019). A Third of the Tropical African Flora is Potentially Threatened with Extinction. *Science Advances*, 5(11), eaax9444. https://doi.org/10.1126/sciadv.aax9444

Subedi, M. R. and Oli, B. N. (2015). Effects of Management Activities on Vegetation Diversity, Dispersion Pattern and Stand Structure of Community-Managed Forest *(Shorea robusta)* in Nepal. *International Journal of Biodiversity Science, Ecosystem Services and Management,* 11(2), 96–105. https://doi.org/10.1080/21513732.2014.984334

Williams, B. A., Beyer, H. L. and Fagan, M. E. (2024). Global Potential for Natural Regeneration in Deforested Tropical Regions. *Nature* 636, 131–137. https://doi.org/10.1038/s41586-024-08106-4

Yigrem, W. and Dessale, W. (2024). Effects of Selective Harvesting on Diversity, Structure, and Regeneration of Woody Plants in Mixed Plantation of Menagesha Suba Forest, Central Ethiopia. *International Journal of Forestry Research.* Volume 2024, Article ID 3355857, 20 pages https://doi.org/10.1155/2024/3355857