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Research Article

Impact of Socioeconomic Activities on Biodiversity in Gashaka Local Government Area, Taraba State, Nigeria

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Abstract

Flora biodiversity plays a critical role in sustaining ecosystems, yet anthropogenic activities continue to threaten its existence. This study examines the effects of socioeconomic activities such as logging, farming, and hunting on flora biodiversity in Gashaka Local Government Area of Taraba State. The study employed a combination of descriptive statistics, time-series analysis, and regression modeling to assess biodiversity loss between 2013 and 2023. Findings reveal a significant decline in vegetation cover from 73.50% to 68.40%, accompanied by an increase in bare land. Relative Importance Index (RII) analysis identified poverty, population increase, weak conservation laws, and climate change as primary drivers of biodiversity loss. The study recommends enhanced environmental education, enforcement of conservation laws, and the promotion of alternative livelihoods to mitigate further loss of flora biodiversity.

Introduction

Floral biodiversity is foundational to ecosystem integrity, supporting a wide array of ecological functions such as carbon sequestration, nutrient cycling, water purification, habitat provision, and soil stabilization [1]. As a critical component of terrestrial ecosystems, plant diversity not only enhances ecosystem resilience but also underpins the delivery of ecosystem services upon which human well-being depends [2]. However, this vital resource is increasingly threatened by intensifying anthropogenic pressures. Logging, agriculture, hunting, and urban development are among the leading drivers of floral biodiversity loss. Selective logging, in particular, leads to extensive forest fragmentation, which disrupts forest structure and microclimates, increases vulnerability to wildfires, and alters both plant and animal community compositions [3]. Fragmented forests are less capable of sequestering carbon and supporting diverse flora, compounding global biodiversity loss and accelerating climate change [4].

Agricultural expansion, especially through slash-and-burn and wetland drainage, has caused significant habitat destruction, especially in tropical regions. Wetlands, often cleared for farming, are among the most threatened ecosystems globally, with their loss directly affecting numerous species of plants, insects, amphibians, and mammals [5]. The degradation of these habitats not only diminishes biodiversity but also impairs ecosystem services such as flood control, water filtration, and aquifer recharge [6]. Additionally, socio-economic challenges in rural and developing regions play a major role in biodiversity degradation. For many impoverished communities, natural resources provide essential livelihoods. Dependence on forest ecosystems for fuelwood, construction materials, and subsistence agriculture drives overexploitation and unsustainable use [7]. Wildlife and their habitats often suffer as a result, particularly in areas where regulatory enforcement is weak and alternatives to natural resource dependence are limited.

Climate change further exacerbates these pressures by

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altering precipitation patterns, increasing the frequency of extreme weather events, and shifting vegetation zones—thereby intensifying the vulnerability of already stressed ecosystems [8]. As floral biodiversity declines, so too does the capacity of ecosystems to adapt to these environmental changes, leading to a vicious cycle of degradation and reduced ecosystem functionality. The loss of floral biodiversity also threatens global food security, water availability, and human health. Agroecosystems, forest ecosystems, grasslands, and freshwater systems rely on plant diversity for pollination, pest control, and soil fertility [9]. When these systems are disrupted, the provisioning, regulating, and cultural services they provide are compromised, with long-term consequences for both biodiversity conservation and sustainable development. This study examines the extent of flora biodiversity loss in the Gashaka Local Government Area (LGA) of Taraba State, Nigeria, over a ten-year period (2013–2023), with a focus on the socioeconomic activities driving this decline.

Methodology

The population comprises different socio-ethnic groups with different cultural backgrounds. Some of the major tribes in the area include: Jibawa, Hausa-Fulani, Mambila, Kaka, Kuteb, Kambu, Tiv, Jukun, Ndola etc., Most of these people settle on gentle slopes due to ease of building, transportation, and access to socioeconomic activities. The flat land area, are densely populated with towns and villages featuring various social amenities, such as schools, hospitals, electricity, piped borne water, and worship centres.

The study employed purposive sampling to select 6 wards out of the 10 wards in the area, which included Garbabi, Gashaka, Gayam, Goje, Jamtari, and Tunga. A two-stage stratified sampling approach was adopted in selecting the respondents. In the first stage, wards were purposively selected for inclusion in the study. In the second stage, households within the selected wards were randomly chosen. The sampling strategy accounted for both professionals (such as staff of the Gashaka Gumti National Park) and non-professionals (including civil and non-civil servants within the Local Government Area). Additionally, satellite imagery analysis was used to track vegetation changes, while the Relative Importance Index (RII) was utilized to rank factors contributing to biodiversity loss.

Aim and objectives

The aim of the study is to assess the effect of socioeconomic activities on flora biodiversity in Gashaka Local Government Area of Taraba State. However, the specific objectives of the study are to:

I. Identify the key socioeconomic activities in the study area.

II. Examine the extent of biodiversity exploitation in the study area.

III. Examine the factors promoting biodiversity exploitation in the study area.

Location and size

Gashaka LGA is located between Latitudes 7° 30' – 08° 00' north of the Equator and Longitudes 11° 00' – 12° 00' east of the Greenwich Meridian. The Local Government is bordered to the north and east by Adamawa State, to the southeast by the Republic of Cameroon, to the south by Sardauna LGA and to the west by Kurmi and Bali LGAs. It has an area of 8,393 Km^2 (Figures 1,2).

Findings and discussion

Figure 3 illustrates the distribution of socio-economic activities within the study area. Fishing (22%) and logging (21%) emerged as the most prominent livelihood activities among respondents, indicating a strong reliance on natural resource-based occupations. In contrast, the least reported activities were civil service and the selling of charcoal, each accounting for only 6% of the responses. Notably, the results reveal that activities such as logging, farming (16%), and charcoal production are significant contributors to floral biodiversity loss, collectively accounting for 43% of all socio-economic engagements in the area. These findings are consistent with studies that emphasize the pressure of extractive and land-use practices on forest ecosystems, particularly in rural and protected areas [10,11]. The predominance of logging and farming underscores the urgent need for sustainable land management practices to mitigate biodiversity degradation and promote conservation.

Figure 4 presents the factors influencing the choice of socio-economic activities among respondents in the study area. The availability of natural resources emerged as the most significant driver, accounting for 34% of responses, followed closely by the market value of those resources at 25%. Cultural values and lack of alternative livelihoods were also notable factors, representing 20% and 21% respectively. These findings suggest that the abundance and economic potential of natural resources are primary motivators for local engagement in activities such as logging, farming, and charcoal production. This aligns with the observations of Gibson, et al. [12], who noted that impoverished communities often depend directly or indirectly on natural resources for survival, leading to overexploitation of wildlife habitats and plant species. As such, the socio-economic reliance on resource availability and market demand continues to pose a significant threat to floral biodiversity, particularly in regions with limited livelihood alternatives.

The study revealed a marked decline in vegetation cover, decreasing from 73.50% in 2013 to 68.40% in 2023. This trend correlates with a significant increase in bare land, which expanded from 20.06% to 24.70% within the same period. The regression analysis indicated that deforestation, induced by logging, farming, bush burning, and overgrazing, was the principal contributor to flora biodiversity depletion. Unregulated logging operations, driven by commercial demand for timber and fuelwood, exacerbated habitat destruction and weakened forest resilience. Agricultural expansion, particularly shifting cultivation and mechanized farming,

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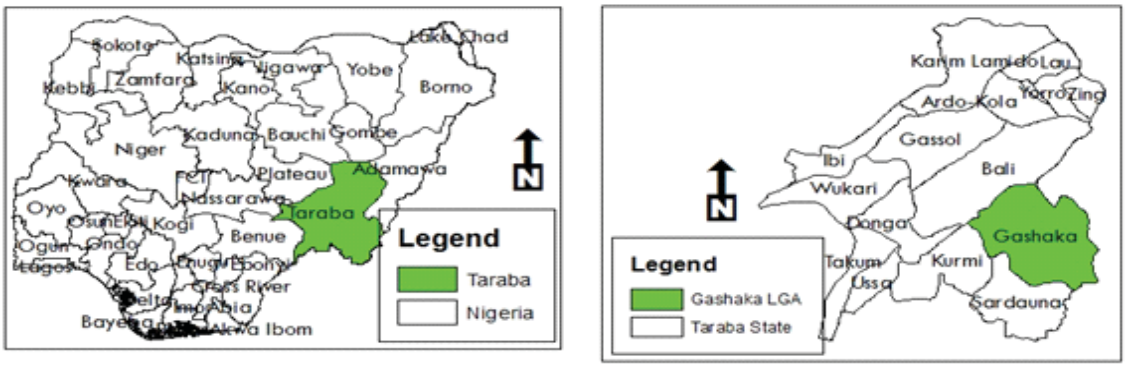

Figure 1: Map of Nigeria and showing Taraba state and Gashaka LGA respectively.

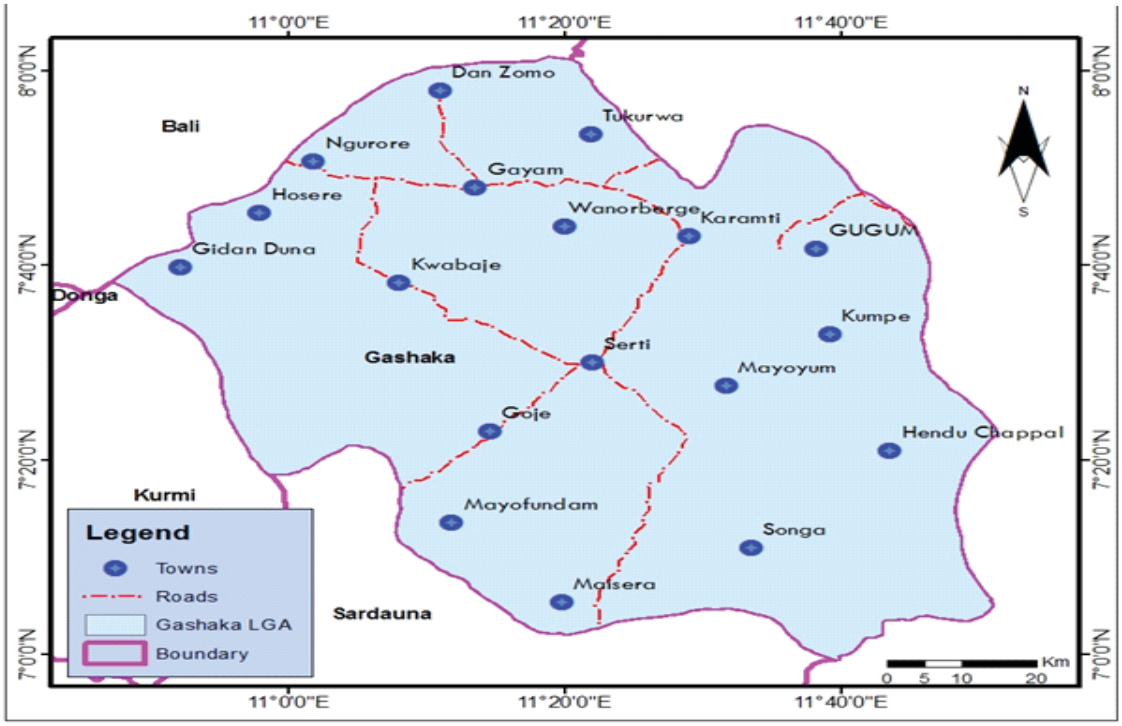

Figure 2: Map of Gashaka LGA showing Wards.

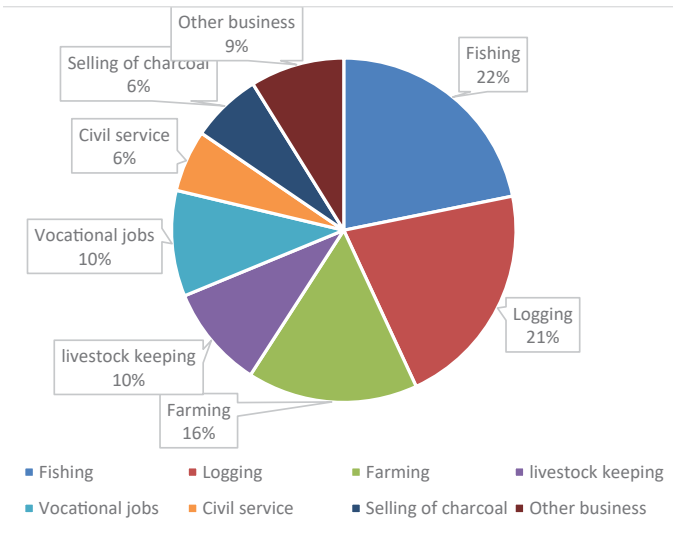

Figure 3: Socio-economic activities.

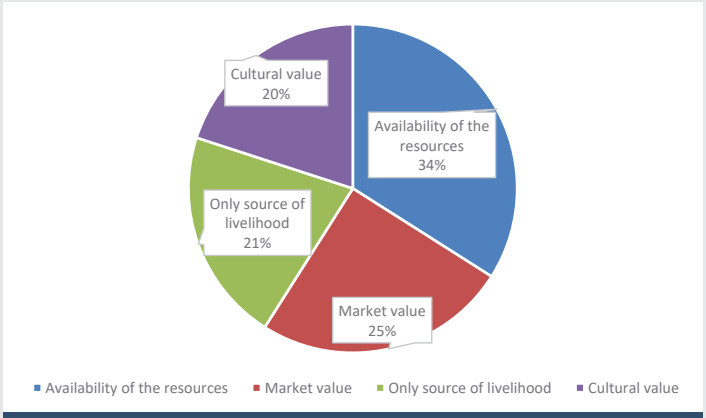

Figure 4: Factors Responsible for the socio-economic activities of Respondents.

further intensified habitat loss, leading to soil degradation and reduced regenerative capacity of plant species.

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Moreover, hunting and indiscriminate bush burning disrupted the ecological balance, contributing to species extinction and declining plant diversity. Agrochemical use, particularly the application of pesticides and fertilizers, resulted in soil toxicity and contamination of groundwater sources, further exacerbating biodiversity loss. The study identified economic deprivation, rapid population growth, weak conservation policies, and climate variability as underlying factors exacerbating environmental degradation. High poverty levels compelled residents to over-exploit natural resources for subsistence, while weak enforcement of environmental laws allowed unsustainable practices to thrive.

Table 1 provides a comparison of Land Use and Land Cover (LULC) data between 2013 and 2023, highlighting the distribution of different land cover types: water, vegetation, built-up areas, and bare surfaces.

Assessing landscape transformation through LULC mapping

Land Use Land Cover (LULC) change analysis was carried out using ArcGIS to understand the spatial distribution and transformation of land features within the study area. This approach is essential for assessing how natural and anthropogenic factors have influenced the landscape over time. ArcGIS offers advanced geospatial tools that allow for the integration and classification of satellite imagery, making it possible to distinguish between various land cover types such as vegetation, built-up areas, bare surfaces, and water bodies.

The 2023 LULC map reveals significant patterns of urban expansion, especially in regions such as Jamtari, Galimjimfa, and Gashaka, where built-up areas are encroaching into previously vegetated zones. Such transformations are critical to monitor, particularly in studies focused on floral biodiversity, as they indicate potential habitat fragmentation and loss of vegetation cover. By visualizing these changes, ArcGIS aids in identifying areas under environmental stress and supports data-driven decision making for land use planning, conservation efforts, and sustainable development. Moreover, LULC analysis enables stakeholders to formulate effective environmental policies, manage natural resources efficiently, and mitigate the adverse impacts of land degradation and climate change (Figure 5).

The bare surface area, representing land without significant vegetation cover, shows a substantial increase over the decade. In 2013, bare surfaces accounted for 52,577.27 km², or 20.06% of the total land area. By 2023, this area had expanded to 64,747.5 km², constituting 24.70% of the total land area. The significant

Table 1: The Extent of Flora Biodiversity Exploitation in Gashaka LGA.

	2013		2023	
Landuse	Area (Km²)	%	Area (Km²)	%
Water	741.399	0.282801	767.2427	0.292659
Vegetation	192686.4	73.49869	179308.8	68.39592
built-up	16157.97	6.163331	17339.47	6.614004
bare surface	52577.27	20.05518	64747.5	24.69742
Total	2621.63	100	2621.63	100

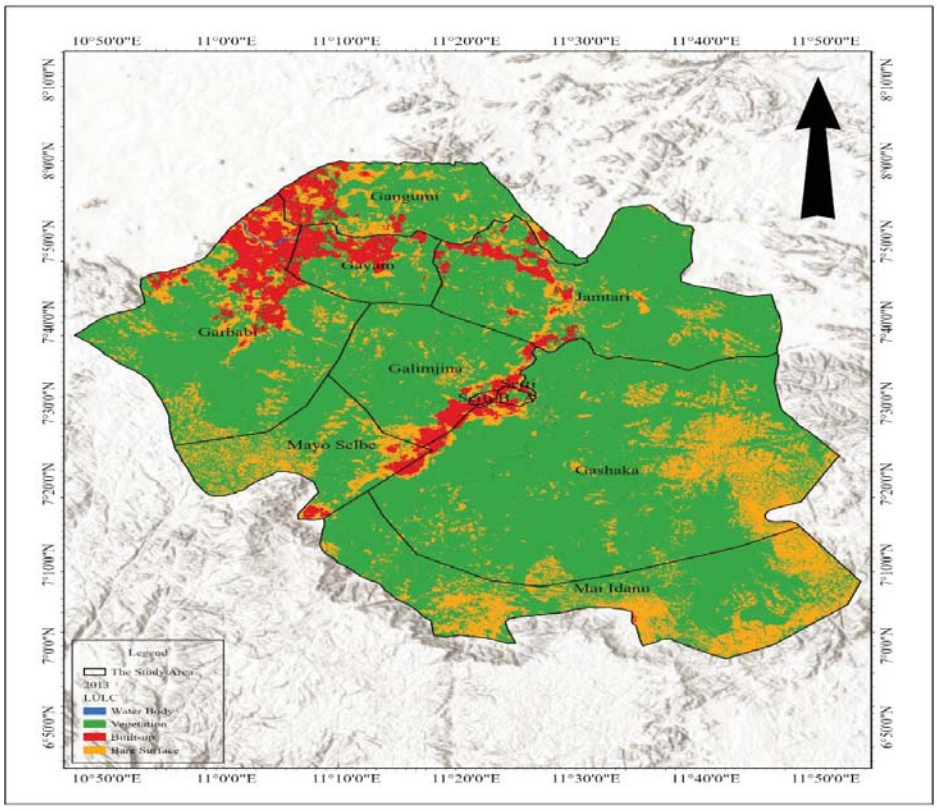

Figure 5: 2013 LULC of the Gashaka Local Government Area, Taraba State.

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increase in bare surface area may be due to land degradation, deforestation, or the conversion of land for other uses such as agriculture or construction, driven by factors like market value, cultural significance, or the necessity of sustaining life.

It is evident from Figure 6 that vegetation occupied the largest portion of the land in both years, but it experienced a decline over time. In 2013, vegetation covered 192,686.4 km², making up 73.50% of the total area. However, by 2023, this had decreased to 179,308.8 km², or 68.40% of the total land area. This represents a loss of 13,377.6 km² of vegetation over the ten-year period.

This finding indicates that vegetation in the study area has declined over the past decade. Unlike the case of Bhaluka in Mymensingh, Bangladesh, where vegetation increased by 54.43 km² in the last ten years [13], the reduction in vegetation in Gashaka Local Government Area, Nigeria, can be largely attributed to agricultural expansion. In rural areas with fertile land, such as Gashaka, both subsistence and commercial farming have intensified. As the population grows and the demand for food and income increases, more land is cleared for agriculture, leading to significant deforestation and loss of natural vegetation [14]. Deforestation is another significant factor contributing to the reduction in vegetation. In Gashaka, logging for timber and the collection of firewood for domestic uses are common practices [15]. Over time, these activities result in the gradual clearing of forests. Additionally, land may be cleared to create pastures for livestock, which is particularly relevant in areas where pastoralism is practiced. The combined effects of logging, fuelwood collection, and pasture creation have led to a notable decrease in the area's vegetation cover.

Furthermore, urbanization and infrastructural development, are less extensive in rural areas like Gashaka, have also played a role in reducing vegetation cover as villages and small towns expand, Land areas are converted into built-up spaces. The construction of roads, schools, and health facilities requires land clearing, further diminishing vegetation cover, even in predominantly rural regions , these developments contribute to the overall reduction in natural vegetation cover [16]. Climate change and environmental degradation have exacerbated the loss of vegetation in study area. Changes in climate, such as alteration of rainfall patterns and prolonged dry seasons, can impair vegetation health and regeneration. Droughts, in particular, can lead to the degradation of forests and grasslands. Furthermore, soil degradation resulting from overuse of land for agriculture makes it difficult for natural vegetation to recover, leading to an increase in bare surfaces [17].

The factors promoting flora biodiversity exploitation and loss in the study area

This section explores the factors promoting the exploitation and loss of flora biodiversity in the study area. These range from the factors and methods used in exploitation and the items that have been recovered from some of the poachers especially as it relates to the conserved areas of the Gashaka Gumpti National Park (GGNP).

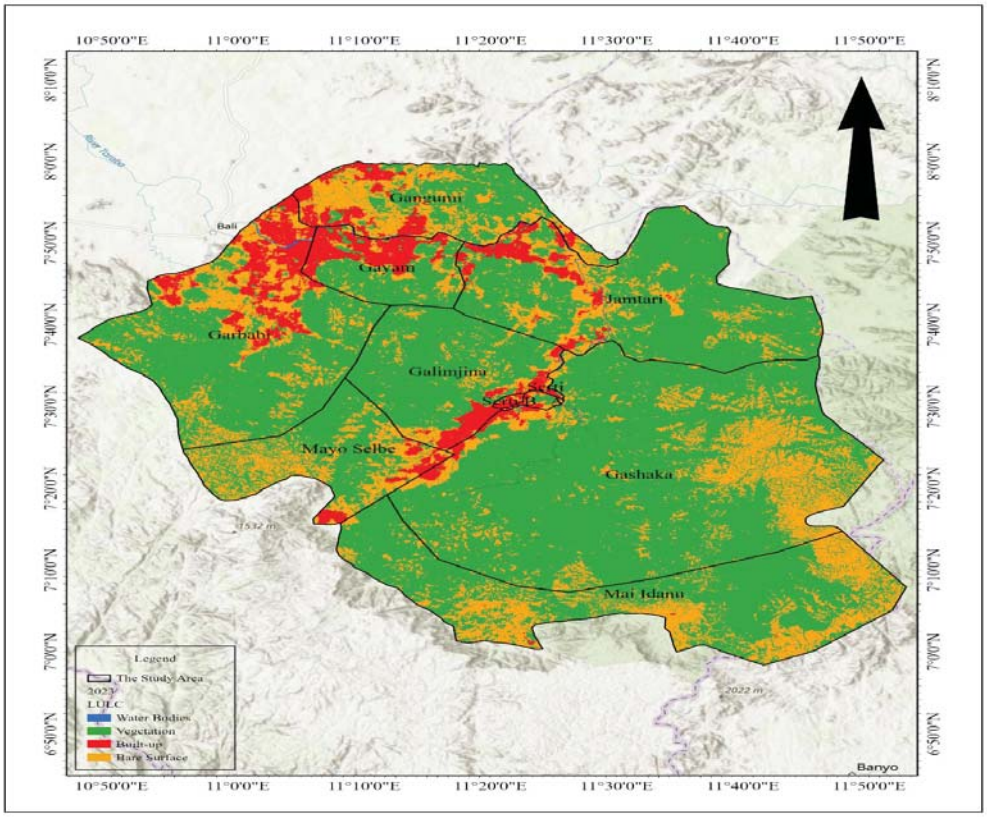

Figure 6: 2023 LULC of the Gashaka Local Government Area, Taraba State.

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Table 2 presents the key socio-ecological and governance-related factors driving the exploitation of floral biodiversity in Gashaka Local Government Area (LGA). The variables, ranked by their Relative Importance Index (RII), highlight poverty (RII = 3.92), population increase (3.89), and obsolete or weak forest conservation laws (3.85) as the top three contributors to unsustainable utilization of plant resources. Additional contributing factors include climate change (3.81), weak implementation of conservation policies (3.36), and the absence of up-to-date legal frameworks (3.29).

Poverty remains the most significant driver of floral biodiversity exploitation in Gashaka LGA. Rural communities with limited economic alternatives often depend on forests for fuelwood, herbal medicine, construction materials, and subsistence agriculture. This dependence intensifies under economic stress, leading to unsustainable harvesting practices that degrade forest structure and species diversity [18,19]. Households lacking secure income streams typically prioritize immediate survival over long-term ecological sustainability, exacerbating deforestation and the loss of native plant species [20].

Population increase correlates strongly with land conversion, forest clearing, and increased demand for forest products. As population density rises, especially in fringe communities near protected areas like Gashaka-Gumti National Park, the pressure on floral resources also intensifies. Agricultural expansion and settlement growth frequently lead to forest fragmentation, reducing habitat connectivity and exposing fragile ecosystems to degradation [21].

The ranking of obsolete or weak forest conservation laws and poor implementation of biodiversity policies suggests that the current legal and institutional framework is insufficient for protecting floral biodiversity. Existing laws may not reflect present-day realities, including the rapid pace of habitat loss and the changing socio-economic context. Where laws exist, enforcement is often hampered by underfunding, lack of political will, and limited institutional capacity [22]. The situation is worsened by inadequate community participation in policy formulation, resulting in rules that are poorly understood or misaligned with local livelihood strategies.

Climate change serves as a compounding factor, altering rainfall patterns, increasing temperatures, and intensifying the frequency of droughts and wildfires. These changes disrupt natural regeneration processes and may render certain plant species more vulnerable to extinction [1]. In areas like Gashaka, where subsistence agriculture and traditional medicine rely heavily on native plant species, climate-induced stress can drive communities to overexploit floral biodiversity in response to dwindling yields and reduced ecosystem productivity.

The relatively lower ranking of weak implementation and lack of conservation laws highlights systemic issues in governance. Even where laws exist, enforcement remains inconsistent due to inadequate surveillance, corruption, and the absence of inter-agency collaboration. Additionally, the lack of clear land tenure and user rights often fuels open-access exploitation, where individuals overharvest common resources without accountability [23].

The findings underscore a critical need for integrated policy responses that address both ecological and socio-economic drivers of floral biodiversity loss. Sustainable livelihood alternatives—such as agroforestry, non-timber forest products (NTFPs), and eco-tourism—should be promoted alongside strengthened conservation governance. Furthermore, legal reform is essential to update outdated forest laws and align them with contemporary conservation science and participatory forest management approaches [24]. Strengthening institutional capacity for law enforcement and enhancing community engagement will be crucial in reversing the trends of floral biodiversity exploitation in Gashaka LGA and similar regions.

The statistical significance of these variables (p - values < 0.05) confirms that their effects on biodiversity loss are not due to chance (Table 3). Therefore, analysis reveals that all variables have a positive effect on biodiversity loss, as indicated by their positive coefficients. Among these variables, the use of agrochemicals and bush burning have the most significant impact, with coefficients of 1.10 and 0.90 respectively. This suggests that increases in agrochemical use and bush burning are strongly associated with greater biodiversity loss. The use of agrochemicals had a significantly negative impact with flora biodiversity. Pesticides and fertilizers can contaminate soil and water resources, leading to detrimental effects on plant health and diversity [25]. Regular burning can lead to the destruction of vegetation and alter soil properties, which negatively impacts plant species diversity and abundance [26]. The frequency and intensity of burning are critical factors influencing biodiversity outcomes.

Furthermore, logging, farming, and herding, also contribute to biodiversity loss but to a lesser extent compared

Table 2: Factors Promoting Biodiversity exploitation in Gashaka LGA.

Variables	RII	Rank
Poverty	3.92	1st
Population increases	3.89	2nd
Obsolete/weak forest conservation law	3.85	3rd
Climate change	3.81	4th
Weak implementation of biodiversity/conservation laws	3.36	5th
Lack of conservation laws	3.29	6th

Table 3: The Effects of Socioeconomic Activities on Flora Biodiversity in Gashaka LGA.

Variable	Coefficient (βi)	Standard Error	t-Value	p-Value
Intercept	1.50	0.45	3.33	0.001
Logging	0.75	0.20	3.75	0.0005
Farming	0.60	0.18	3.33	0.001
Herding	0.45	0.22	2.05	0.045
Bush Burning	0.90	0.25	3.60	0.0006
Agrochemicals	1.10	0.30	3.67	0.0004

p - Values < 0.05 are considered statistically significant.

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to bush burning and agrochemicals. This suggests that increased logging activities are associated with a decrease in species richness and abundance. Logging can lead to habitat destruction and fragmentation, which adversely affects plant species [27]. Farming activities also exhibited a negative impact on flora biodiversity. Intensive agricultural practices, including the conversion of forested areas into farmland, contribute to habitat loss and reduced plant diversity [28,29]. However, the effect size was smaller compared to logging, indicating that the impact of farming may vary depending on the type and intensity of agricultural practices. Also, the impact of herding on flora biodiversity was less pronounced. While herding which had the least impact, possibly due to its localized effects or varying management practices can lead to overgrazing and soil degradation; however, its effects on plant diversity were not statistically significant in this analysis. This indicates that herding's impact may vary by herd size and grazing intensity [12].

Conservation and sustainable management strategies

To mitigate biodiversity loss and promote ecological sustainability, the study underscores the necessity for stringent conservation policies and enhanced enforcement mechanisms. Strengthening environmental legislation, coupled with community-based conservation programs, can promote sustainable resource use and enhance habitat conservation. Sustainable livelihood programs, including agroforestry and ecotourism, should be promoted as alternative income sources to reduce dependence on destructive activities. Public awareness campaigns on the dangers of deforestation and the benefits of conservation can also play a vital role in shaping environmentally conscious behaviors.

Reforestation initiatives and afforestation projects must be prioritized to restore degraded ecosystems and enhance carbon sequestration. Integrated land management approaches that combine sustainable agriculture, controlled grazing, and ecosystem restoration can support biodiversity conservation while ensuring food security. Climate-resilient practices, including advanced irrigation systems and stress-tolerant crop varieties, should be encouraged to minimize forest encroachment due to agricultural expansion.

Conclusion

The study provides empirical evidence of the adverse effects of socioeconomic activities on flora biodiversity in Gashaka LGA. The accelerating rate of deforestation and habitat degradation underscores the urgent need for coordinated conservation interventions. Strengthening legal frameworks, promoting sustainable economic alternatives, and fostering community participation in biodiversity management are essential in reversing ongoing biodiversity degradation. A coordinated effort involving policymakers, environmental agencies, and local stakeholders is essential to safeguard Gashaka LGA's ecological heritage.

Recommendations

1. Establish an Institutional Framework for Flora Conservation Establish a Floral Biodiversity Desk within the Gashaka LGA Secretariat to coordinate, monitor, and implement all flora-related conservation initiatives. This office should be responsible for integrating floral biodiversity into local development plans, overseeing compliance with environmental regulations, and liaising with stakeholders including NGOs, academic institutions, and government agencies.

2. Promote Community-Based Forest Management and Capacity Building Empower local communities through Community Forest Management (CFM) schemes by:

   - Training community members in sustainable forestry, reforestation, and biodiversity monitoring.
   - Allocating forest zones under communal stewardship, with clearly defined usage rights and responsibilities.

3. Enhance Afforestation and Agroforestry Initiatives Reinforce the LGA's commitment to landscape restoration by:

   - Prioritize afforestation in degraded areas.
   - Supporting smallholder agroforestry under local agricultural extension programs to improve ecosystem services and livelihood resilience. These initiatives should focus on integrating biodiversity-friendly practices with sustainable agriculture.

4. Leverage NGO partnerships and enhance youth engagement for Conservation Awareness Collaborate with environmental NGOs and civil society organizations to:

   - Facilitate youth-focused conservation programs aimed at building awareness and practical skills in biodiversity protection.
   - Facilitate micro-grants and technical capacity-building for youth-led green enterprises, such as beekeeping, nursery development, and eco-crafts. This approach fosters a culture of stewardship and creates sustainable livelihood alternatives.

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