

VULNERABILITY ASSESSMENT OF OVERUTILISED FABACEAE MEMBERS OF KATSINA STATE, NORTHERN NIGERIA

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VULNERABILITY ASSESSMENT OF OVERUTILISED FABACEAE MEMBERS OF KATSINA STATE, NORTHERN NIGERIA. Fabaceae, a globally diverse and economically important group of plants, faces increasing susceptibility to both natural and anthropogenic threats, posing significant risks to biodiversity and contributing to the potential extinction of certain species. This study aims to assess the vulnerability of over-utilised members of the Fabaceae in Katsina, utilizing a semi-structured questionnaire to interview 180 respondents about their use of these plants. Vulnerability was evaluated using ethnobotanical indices, including the Relative Frequency of Citation (RFC), Cultural Importance (CI), Relative Importance (RI), and Importance Value (IV). The study identified 32 vulnerable Fabaceae species across 25 genera and 5 subfamilies. Most respondents were male (87%), aged 46-75 (53%), and married (77%), with traditional medicinal practitioners (34%) and farmers (33%) constituting the two largest occupational groups. *Albizia* the most vulnerable genus, with three species. The plant *Parkia biglobosa* had the highest Vulnerability Index (VI) of 3.00. The stem bark (39%) was the most utilised plant part. According to IUCN status, the most vulnerable species were classified as Near Threatened (NT) (13%, 4 species), followed by Least Concern (LC) (78%, 25 species), and Not Evaluated (NE) (9%, 3 species). Key threats identified included deforestation (31%), agricultural expansion (23%), urbanisation (21%), overharvesting (15%), and introduction of the invasive species (10%). Addressing these threats is crucial for the conservation and sustainable use of these important species. The findings could guide conservation efforts, inform sustainable utilization, and inspire further studies on the biodiversity of Fabaceae and ecosystem resilience.

Keywords: Identification, Vulnerable Fabaceae, Plant Overutilization, Plant Conservation, Katsina State.

PENILAIAN KERENTANAN ANGGOTA FABACEAE YANG DIMANFAATKAN SECARA BERLEBIHAN DI NEGARA BAGIAN KATSINA, NIGERIA UTARA. Fabaceae merupakan kelompok tumbuhan yang sangat beragam secara global dan memiliki nilai ekonomi penting, namun semakin rentan terhadap berbagai ancaman alami maupun antropogenik. Kondisi tersebut menimbulkan risiko yang signifikan terhadap keanekaragaman hayati dan dapat berkontribusi terhadap kepunahan beberapa spesies. Penelitian ini bertujuan untuk menilai tingkat kerentanan anggota Fabaceae yang dimanfaatkan secara berlebihan di Katsina dengan menggunakan kuesioner semi-terstruktur untuk mewawancarai 180 responden mengenai pemanfaatan tumbuhan tersebut. Kerentanan dievaluasi menggunakan indeks etnobotani, yaitu Relative Frequency of Citation (RFC), Cultural Importance (CI), Relative Importance (RI), dan Importance Value (IV). Penelitian ini mengidentifikasi 32 spesies Fabaceae yang rentan, yang termasuk ke dalam 25 genus dan 5 subfamili. Sebagian besar responden adalah laki-laki (87%), berusia 46–75 tahun (53%), dan telah menikah (77%), dengan praktisi pengobatan tradisional (34%) dan petani (33%) sebagai dua kelompok pekerjaan terbesar. *Albizia* merupakan genus yang paling rentan, dengan tiga spesies. Tumbuhan *Parkia biglobosa* memiliki nilai Vulnerability Index (VI) tertinggi, yaitu 3,00. Kulit batang (39%) merupakan bagian tumbuhan yang paling banyak dimanfaatkan. Berdasarkan status IUCN, spesies yang rentan diklasifikasikan sebagai Near Threatened (NT) sebesar 13% (4 spesies), Least Concern (LC) sebesar 78% (25 spesies), dan Not Evaluated (NE) sebesar 9% (3 spesies). Ancaman utama yang teridentifikasi meliputi deforestasi (31%), perluasan lahan pertanian (23%), urbanisasi (21%), pemanenan berlebihan (15%), dan introduksi

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spesies invasif (10%). Penanganan terhadap berbagai ancaman tersebut sangat penting untuk mendukung konservasi dan pemanfaatan berkelanjutan spesies-spesies penting tersebut. Hasil penelitian ini dapat menjadi dasar dalam upaya konservasi, mendukung pemanfaatan yang berkelanjutan, serta mendorong penelitian lebih lanjut mengenai keanekaragaman hayati Fabaceae dan ketahanan ekosistem.

Kata kunci: Identifikasi, Fabaceae rentan, Pemanfaatan tumbuhan secara berlebihan, Konservasi tumbuhan, Negara Bagian Katsina

I. INTRODUCTION

Fabaceae, also known as Leguminosae, is considered one of the most economically significant plant families. It ranks as the third-largest plant family globally, comprising approximately 19,500 species across around 735 genera. (Bahuguna, 2024; Putra et al., 2022). The term "legume" originates from this traditional family name. Members of Fabaceae are well recognized for their substantial contributions to agriculture, their adaptability to diverse habitats, and their wide range of life forms (trees, shrubs, herbs, lianas, etc.) (Yahara et al., 2013).

The conservation of Fabaceae is crucial due to its substantial societal and community contributions, particularly as a vital nutritional source in regions with limited access to animal-derived protein. (Henchion et al., 2017). Legumes are rich in essential nutrients and serve multiple purposes, including medicinal, nutritional, fodder, shelter, and ornamental uses. (Joshi et al., 2024; Delgado-Salinas et al., 2021; Sathesh Naik et al., 2020). As such, they play a vital role in ensuring food security. (Joshi et al., 2023).

A vulnerability index is essential for quantitatively assessing the conservation status of plant taxa, thus aiding in their long-term availability. Quantitative ethnobotanical assessments support hypothesis testing, provide statistical evidence, and enable comparative research. These approaches help refine scientific hypotheses by situating them within rigorous research contexts. (Helida et al., 2015; Pacifici et al., 2015). In rural communities, residents depend on plant resources for daily sustenance, drawing on generations of traditional knowledge to utilize and manage

these resources sustainably (Bharadwaj et al., 2021; Mothupi & Shackleton, 2025). However, the overexploitation of plant resources remains a pressing concern. Effective conservation strategies and vulnerability assessments are essential for determining the true status of species in specific study areas to ensure their protection and sustainable management. Species that are most at risk tend to be those that are in high demand, slow-growing, difficult to reproduce, limited in geographic distribution, and native to ecologically fragile environments (Rao & Chellaiah Periyasamy, 2020).

A vulnerability assessment of farmlands in northern Katsina State, Nigeria, has revealed significant ecological degradation due to desertification, which threatens horticultural productivity and biodiversity. Desertification refers to land degradation in arid, semi-arid, and dry sub-humid regions, primarily caused by climatic changes and unsustainable human activities. This results in the loss of vegetation and soil fertility. The findings highlight the urgent need for effective land management strategies, including vegetation restoration, soil rehabilitation, and the expansion of irrigation practices (Yahaya, 2021). Further analysis of vulnerable species in Katsina State has emphasized the severe threat biodiversity faces in the region. Over 100 species have been identified as threatened, with *Xeroderris stuhlmannii* reported to be locally extinct (Bello et al., 2019). Globally, approximately 15,000 medicinal plant species are currently at risk of extinction (Aftab & Hakeem, 2021). The preservation of these species, especially native and indigenous ones, is critical for biodiversity conservation. Achieving this goal requires changes in local living standards and attitudes

toward plant use and conservation. This study aims to evaluate the vulnerability index of species within the *Fabaceae* family in Katsina State to support informed conservation and sustainable management efforts.

II. MATERIAL AND METHOD

A. Study Area

This research was conducted between March and August 2024 in Katsina State, one of the northwestern states of Nigeria (Fig.1). Katsina State has a land area of 23,938 km² and is located between latitudes 11°08'N and 13°22'N and longitudes 6°52'E and 9°20'E (Saulawa et al., 2018). The state is bordered to the north by the Niger Republic, to the east by Jigawa and Kano States, to the south by Kaduna State, and to the west by Zamfara State. Nine (9) local governments were randomly selected as representatives of the total of thirty-four (34) local government areas. The study LGAs were the areas we visited and sampled, selected to serve as representatives of the entire state.

B. Data Collection Methods

Information on *Fabaceae* (Leguminosae) was obtained through semi-structured questionnaires, and purposive sampling was used to select 180 respondents for interviews across nine local government areas in Katsina State, Nigeria. The selected Local Governments included Funtua, Bakori, Kankara, Batagarawa, Katsina, Kaita, Sandamu, Mai'adua, and Zango, which were drawn through stratified sampling. In this process, the local governments were divided into subgroups based on three zones: Katsina, Daura, and Funtua. A sample was then randomly selected from each group to ensure that each zone is equally represented in the final sample. The people interviewed included farmers, traditional medicine herbal practitioners, and others (petty traders, craftsmen, animal husbandry, etc). The interviews were conducted in the respondents' native language, Hausa, allowing them to explain the various natural and artificial factors affecting *Fabaceae* in their communities. The questionnaires comprised two sections:

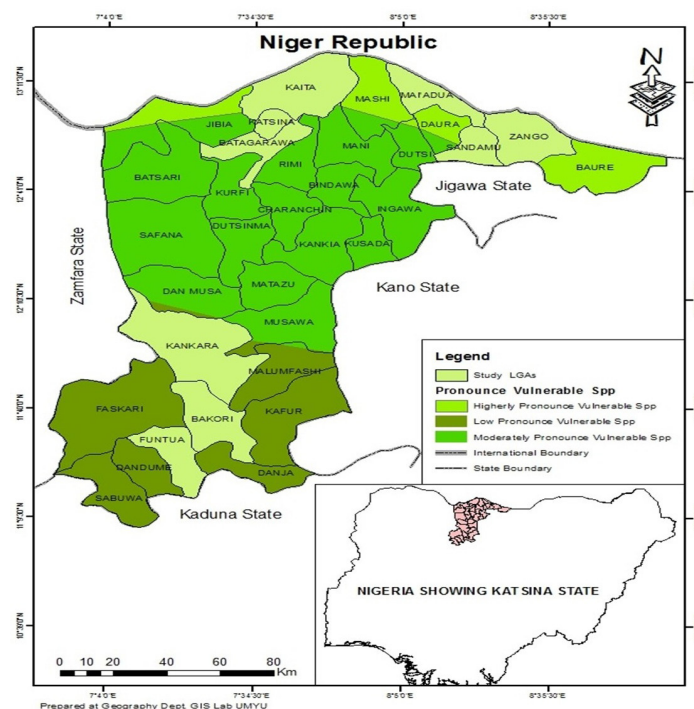


Figure 1. Map of Katsina State showing the study area

Section A focused on the demographics of the respondents (age combined with sex, occupation, and marital status), while Section B gathered information related to the major factors causing the plant's vulnerable, parts of Fabaceae that are utilized (species' local names, organs/parts used, categories of ailments managed by each organ/part, and products made from each species).

C. Collection and Identification of Plant Samples

Numerous trips have been undertaken to document plants in various locations across the state, including home gardens, protected areas, and farmlands. The identification and verification of the collected samples were conducted using the Plants of the World online resource. Furthermore, the samples were deposited at the Umaru Musa Yar'adua University Herbarium in Katsina, Nigeria, for identification and voucher specimen number.

D. Data Analysis

The data gathered here were tabulated in the Microsoft Excel spreadsheets, and descriptive statistics analysis was employed. Demographic characteristics of the respondents are analyzed using percentages.

1. Frequency of Citation (FC)

The total number of respondents mentioned a given species during the surveys. If many respondents mention a certain species, there is a tendency towards overutilization. Where FC is the total number of citations (Shah et al., 2023).

2. Relative Frequency of Citation (RFC)

$$RFC = FC/N \dots\dots\dots(1)$$

Where FC = Frequency of Citation. N = Total number of respondents who participated in the study. This signifies how important species are in a community (Ralte et al., 2024).

3. Number of Use (NU)

This is the expert categories' number of uses for each species.

$$NU = \sum UR_u \dots\dots\dots(2)$$

Where NU = Number of Uses, UR = Category of uses for a taxon, and u = all the categories of uses mentioned in the study (Alemayehu et al., 2023).

4. Use Report (UR)

This is the use report per organ/parts reported by the respondents.

$$UR = \sum UR_{ui} \dots\dots\dots(3)$$

Where UR = Total use reports, UR_{ui} = Report for each category (Tamene et al., 2023).

5. Relative Importance (RI)

This is the summation of the relative frequency of citations and the number used, divided by two.

$$RI = \sum RFC + NU/2 \dots\dots\dots(4)$$

Where RI = Relative Importance, $\sum RFC$ = Total number of mentioned reports, NU = Number of uses (Leonti 2022).

6. Vulnerability Index (VI)

This is the summation of the percentage results obtained from frequency of citation (FC%), number of uses (NU Scalling), and number of organs/parts used (NOU Scalling) (Todou et al., 2023).

$$VI = FC + NU + NOU \dots\dots\dots(5)$$

Where FC indicates the percentage category within frequency of citations (FC) of a species, which is measured in 3 scale scores, NU= represents the number of uses of each species, and NOU= the number of organs used (NOU) (Badjaré et al., 2018; Kankara et al., 2022; Kankara et al., 2024). These were the main concern parameters in identifying the vulnerability index of the species.

E. Frequency of Citation (FC)

In 2022, the International Union for Conservation of Nature (IUCN) published

the Red List of Threatened Species, which classifies the conservation status of plant species into nine categories: Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW), Extinct (EX), and Not Evaluated (NE) (IUCN, 2022). In this study, the assessment was done based on the above criteria and status.

III. RESULT AND DISCUSSION

A. Demographic Characteristics of The Respondents

1. Respondents' Age and Gender Reports

In this study, participants were randomly selected and grouped into three age categories: 15–45 years, 46–75 years, and above 75 years to capture generational differences in plant knowledge. This is because younger, middle-aged, and elderly people often hold and transmit ethnobotanical knowledge in distinct ways. The results revealed that individuals in the 46–75 age range made the most significant contributions in this study to documenting the various medicinal and cultural importance of the plants, especially members of the family *Fabaceae* (Table 1). This finding is consistent with previous studies by Abdallah et al. (2020); Mechaala et al. (2022) and Elhasnaoui et al. (2024), which similarly identified this same age group as the key holders of the most extensive ethnobotanical

knowledge. The older age contributions, especially on ethnobotanical studies, suggest a gradual erosion of traditional ecological knowledge among the younger generation, raising concerns over the sustainability of this cultural heritage. Therefore, urgent measures are needed to foster intergenerational knowledge transfer, such as incorporating ethnobotanical knowledge into community-based educational initiatives and engaging youth in conservation practices.

The study also revealed a higher proportion of male participants, reflecting traditional gender roles, in which men (157) were the majority interviewed, compared with females (23), who have limited access to and engagement with natural resources. This could be due to cultural limitations, social and religious constraints, etc. This pattern aligns with the findings of Ngamsou Abdel et al. (2024), who also observed male dominance in ethnobotanical knowledge systems. However, this gender disparity highlights the need for gender-sensitive conservation strategies that actively involve women in biodiversity management and plant resource governance. Recognising and integrating women's knowledge, often transmitted through informal networks and domestic use, can contribute to more inclusive and effective conservation outcomes, ensuring that both ecological and cultural dimensions are preserved.

Table 1. Potential of ecoregional identity for ecotourism development in Aceh Tengah District.

Age	Respondents number	Gender	Number of respondents per gender	Percentage (%)
15-45 years	57	Males	56	31
		Female	01	0.5
46-75 years	95	Males	83	46
		Females	12	6.7
>75 years	28	Males	18	10
		Females	10	5.6

2. Respondents' Marital Status

Table 2 outlines the marital composition of participants. In this study, married men comprised the largest group at 77%, followed by others at 17%, while singles represented the smallest group at 6%. The highest number of married men identified in this study reflects their exploration of various life forms, driven by poverty and limited resources, which is essential for providing for their families. This finding aligns with the work of Kankara et al. (2020) who studied medicinal plants used for complementary and alternative cancer therapy in Katsina State, Northwestern Nigeria, as well as the research by Asigbaase et al. (2024) in their ethnobotanical survey of medicinal tree species used by forest-fringe communities in Southwestern Ghana. Both studies highlighted the dominance of married men among their participants.

3. Respondents' Occupation

Figure 2 displays the representation of the respondents' occupations, revealing that the majority of participants were traditional

medical practitioners (62, 34.4%), slightly higher than farmers (59, 32.8%), and those in other categories (59, 32.8%). The other category included respondents with various occupations, which were merged for this study. The prevalence of traditional herbal practitioners and farmers suggests a consensus among locals and lower-income earners on the use of plants for healing. However, this trend raises significant concerns for biodiversity and increases the vulnerability of species to extinction. Many people cut plants without ensuring proper replacements, which threatens sustainability. Some plants take a long time to grow, are difficult to cultivate and harvest, or are collected from the wild without being replanted. Even small amounts of repeated harvesting can gradually deplete wild populations, particularly for rare or locally endemic species, leading to ecological disruption and potential extinction. Most respondents inherited their knowledge from closely associated persons, a finding that is inconsistent with that of Obakiro et al. (2023) and Owor et al. (2024).

Table 2. Potential of ecoregional identity for ecotourism development in Aceh Tengah District.

Marital status	Number of each category	Percentage (%)
Single	11	6.11
Married	138	76.66
Others	31	17.22

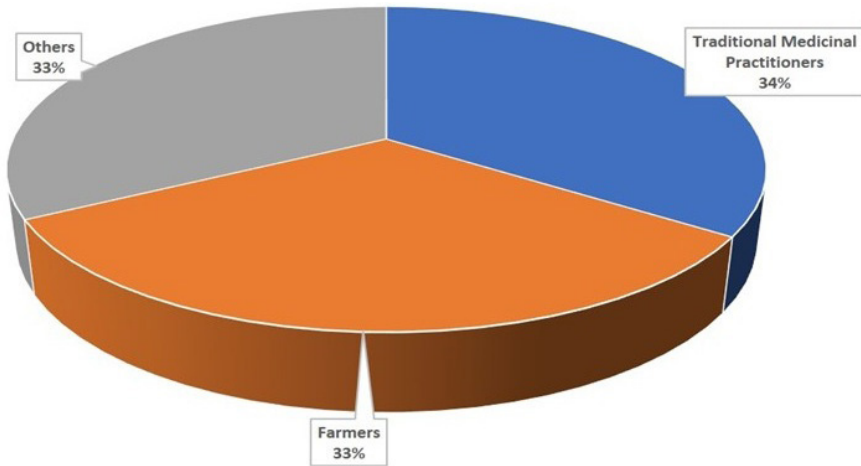


Figure 2. Respondent's Occupation

4. Identification of the vulnerable *Fabaceae* species of Katsina State

Table 3 presents 32 vulnerable species belonging to the *Fabaceae* family in Katsina State. These species span 25 genera and five subfamilies. The genera with the highest number of representatives were *Albizia* (3 species), followed by *Acacia*, *Bauhinia*, *Cassia*, *Detarium*, and *Erythrophleum*, each represented by two species. The remaining genera, such as *Daniellia*, *Dialium*, *Dalbergia*, etc., each contributed only one species.

These species were distributed among five subfamilies: *Caesalpinioideae* (47%), *Mimosoideae* (22%), *Papilionoideae* (19%), *Detarioideae* (9%), and *Cercidoideae*, which had the least representation with (3%) (Figure 3). The documented species are extensively used in the treatment of a wide range of ailments, including gastrointestinal

disorders, diabetes, cancer, asthma, anemia, hemorrhoids, wound healing, and spiritual afflictions (Yaradua, 2015; Bello et al., 2019; Yirgu et al., 2019; Kankara et al., 2022).

However, the overutilisation of *Fabaceae* species for medicinal purposes, along with other uses such as fodder, timber, furniture, wood handles, fuelwood, charcoal, mortar and pestle production, handicrafts, and dyes, raises significant conservation concerns. These pressures are compounded by environmental and anthropogenic factors such as unsustainable agricultural practices, deforestation, desertification, the introduction of invasive species, and rapid urbanisation. Collectively, these dynamics have exacerbated the vulnerability of *Fabaceae* species across the region, particularly in light of Katsina's rapidly changing ecological landscape (Bello et al., 2019; Lawal et al., 2022).

Table 3. Medicinal and Other Uses of Vulnerable Species of *Fabaceae* in Katsina State.

S/N	Species	Subfamily	Voucher's number	Uses
1	<i>Albizia chevalieri</i> Harms	Caesalpinioideae	UMYUH06	Used to treat piles and gastrointestinal disorders in addition to being used as fuel wood, wood handles, and roofing making, also serves as fodder.
2	<i>Albizia lebbeck</i> (L.) Benth	Caesalpinioideae	UMYUH0780	Serves to manage hemorrhoids, diabetes, and aphrodisiacs, and other uses such as seed uses for music entertainments, stems used as fuel wood, mortar and pestle making, handicraft, and charcoal making.
3	<i>Albizia coriaria</i> Welw. ex Oliver	Mimosoideae	UMYUH1992	Used to manage hemorrhoids and for charcoal making and demarcation of a piece of land, fuelwood, handles, and fodder
4	<i>Acacia polyacantha</i> Willd.	Mimosoideae	UMYUH33	Used to treat all cold-related diseases and general body problems, and serves as fodder, fuel wood, and wood handles.
5	<i>Acacia pycnantha</i>	Mimosoideae	UMYUH2373	Used to treat gastrointestinal disorders and for roofing, serves as fodder and fuel wood.
6	<i>Bauhinia reticulatum</i> (Schum.) Milne Redhead	Caesalpinioideae	UMYUH1011	For cancer and anemia treatments, seeds and seed pods are used to enhance the building strength, and the leaves serve as fodder for animals. The stem bark is also used in furniture, handicrafts, and charcoal making.
7	<i>Bauhinia rufescens</i> Lam.	Cercidoiceae	UMYUH1984	Ease labor and spiritual treatments, Fodder for animals, firewood, and used in the making of mortar and pestle.

S/N	Species	Subfamily	Voucher's number	Uses
8	<i>Cassia arereh</i> Delile	Ceasalpinioideae	UMYUH611	For gonorrhea and stomachache treatments, in addition, they have been used to increase lactation in mothers. Other uses were for roofing houses, serving as fodder for animals, furniture, fuel wood, handicrafts, and wood handles.
9	<i>Cassia fistula</i> L.	Ceasalpinioideae	UMYUH1294	Addresses infertility in women and sickling problems. Other uses include fuel wood and fodder for animals.
10	<i>Daniellia oliveri</i> Hutch. & Dalziel	Detarioideae	UMYUH2390	For fever and cancer treatments, also used for Fuel wood and wooden handles.
11	<i>Detarium microcapum</i> Guill. & Perr.	Detarioideae	UMYUH698	Used to treat wounds and toothache, gonorrhea, and cholera also serves as fuel wood, roofing for houses, and furniture.
12	<i>Detarium senegalense</i> J.F. Gmel.	Ceasalpinioideae	UMYUH335	Used to treat fever, asthma, and gastrointestinal disorders, also serves as fuel wood and fodder for animals.
13	<i>Dialium guineense</i> Willd.	Ceasalpinioideae	UMYUH2398	Used to treat stomachache and asthma, also serves as fuel wood, charcoal making, and building of houses.
14	<i>Dalbergia sissoo</i> Roxb.	Papilionioideae	UMYUH2093	Used against spirituals and for roofing houses
15	<i>Delonix regia</i> (Hook.) Raf.	Ceasalpinioideae	UMYUH100	For diabetes and inflammation treatments, the seeds are used for musical entertainment, and the stem bark for fuel wood, mortar, and pestle.
16	<i>Dichrostachys cinerea</i> (L.) Wight & Arn,	Ceasalpinioideae	UMYUH614	For back pain and gastrointestinal disorders, and used for fuel wood, and in building houses
17	<i>Entada Africana</i> Guill. & Perr.	Mimosoideae	UMYUH2117	For stomachache and hemorrhoid treatments and fodder for animals, and fuel wood.
18	<i>Erythrophleum saueolens</i> (Guill. & Perr.) Brenan	Ceasalpinioideae	UMYUH356	For pulmonary disease treatments, and used as fuel wood and charcoal making
19	<i>Erythrophleum africana</i> (Benth.) Harms.	Ceasalpinioideae	UMYUH1670	Used for convulsion treatments in babies, axe and hoe handles, firewood, and fodder
20	<i>Erythrina senegalensis</i> DC.	Papilionioideae	UMYUH356	For the treatment of fever and hemorrhoids, and is also used for fuel wood and furniture.
21	<i>Faidherbia albida</i> (Delile) A. Chev,	Ceasalpinioideae	UMYUH599	Used to treat measles and pneumonia, break spiritual ailments, for animal fodder, used in furniture and mortar and pestle making, axe and hoe handles.
22	<i>Indigofera polyphylla</i> DC.	Papilionioideae	UMYUH210	Serves to break spiritual ailments and for dyeing.
23	<i>Isobertinia doka</i> Craib & Stapf	Detarioideae	UMYUH2389	Used for gastrointestinal disorders treatments and furniture making, fuel wood, and hoe handles.

S/N	Species	Subfamily	Voucher's number	Uses
24	<i>Lonchocarpus sericeus</i> (Poir.) Dc.	Papilionoideae	UMYUH2113	For spiritual treatments, fuel wood, and charcoal.
25	<i>Leucaena leucocephala</i> (Lam.) de Wit	Cesalpinioidae	UMYUH2393	For the treatment of stomachache-related problems in animals and sources for timber, fuelwood, and forage for animals
26	<i>Milletia thonningii</i> (Schumach. & Thorn.) Baker	Papilionoideae	UMYUH345	Used for abdominal pain and helminth treatments and in making fish apparatus, fuelwood, furniture, wood handles, handicrafts, and tables, etc
27	<i>Parkia biglobosa</i> (Jacq.) G.Don	Mimosoideae	UMYUH1274	For the treatment of hemorrhoids, fever, and coccidiosis, its seed is used in soup making, serves as fodder, is used to strengthen the building, and is also used in furniture making and fuelwood.
28	<i>Prosopis africana</i> (Guill. & Perr.) Taub.	Mimosoideae	UMYUH639	Used for pile treatments and in the making of mortar and pestle, roofing of houses, leaves used as fodder, charcoal making, wood handles, furniture, and timber
29	<i>Pterocarpus santalinoides</i> Dc.	Papilionoideae	UMYUH2106	For treatment of hypertension and furniture making, fuel wood, wood handles, and fodder for animals.
30	<i>Senna siamea</i> (Lam.) H.S. Irwin & Barneby	Cesalpinioidae	UMYUH220	For cancer treatments, and use as fodder for animals and fuel wood.
31	<i>Tamarindus indica</i> L.	Cesalpinioidae	UMYUH2219	For gastrointestinal disorders and cancer treatments, it also serves as a blood tonic and is used for fodder, fuel wood, mortar and pestle making, and timber.
32	<i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb.	Mimosoideae	UMYUH600	Used for piles, conjunctivitis, ear, and wound treatment, also for soup making, fodder for animals, and as fuel wood.

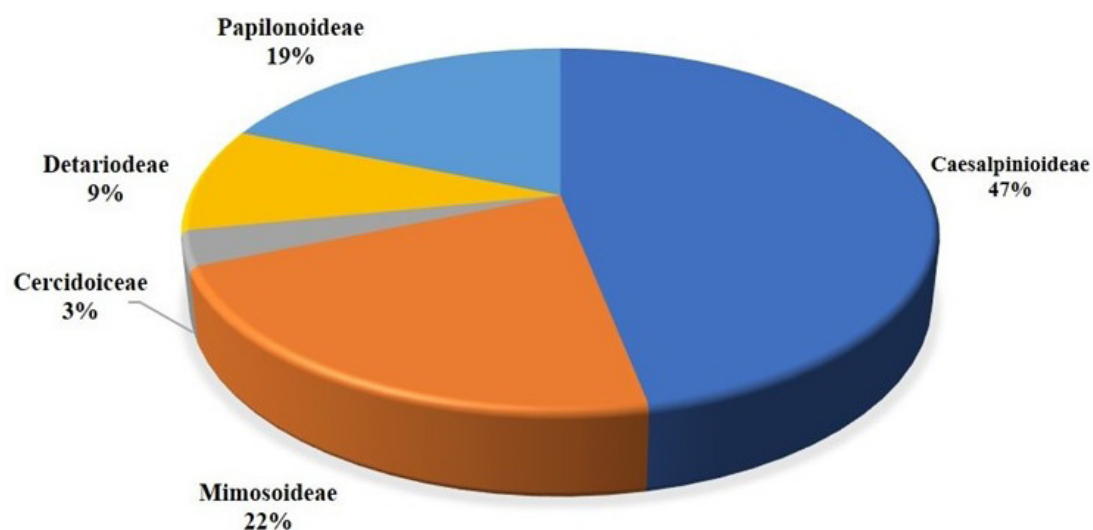


Figure 3. Category of each subfamily representative

5. Vulnerability Index of Fabaceae Species

Table 4 presents the vulnerability status of each documented *Fabaceae* species, alongside the contributing factors responsible for their decline. These factors include the frequency and diversity of uses, specific plant parts exploited, methods of collection, and the growth stage at which the plant parts are harvested (Kankara et al., 2024). Among these, anthropogenic influences were found to be the most critical, particularly in communities facing high poverty rates and limited access to formal healthcare systems, where dependence on plant-based resources is intensified.

In this study, species vulnerability was assessed using a set of ethnobotanical indices: frequency of citation (FC), relative frequency of citation (RFC), number of uses (NU), relative number of uses (RNU), and organ/part used (OU). These were complemented by vulnerability parameters, including the number of organs used (NOU), relative importance (RI), and values derived from core index analyses (FC, NU, and NOU). The resulting composite

measure, the Vulnerability Index (VI), was used to classify species on a scale from 1 to 3, where values approaching 3 indicate higher vulnerability.

Based on this metric, the four most vulnerable species identified were *Parkia biglobosa* (VI = 3.00), followed by *Bauhinia reticulatum*, *Tamarindus indica*, and *Vachellia nilotica* (each with a VI of 2.67). While *Parkia biglobosa* emerged as the most frequently cited species, it is important to note that citation frequency alone does not fully account for vulnerability (Breshears et al., 2021). Notably, the three remaining species identified as highly vulnerable did not rank as the next most cited, highlighting that vulnerability is shaped by multiple interacting factors beyond mere popularity or frequency of use.

Ultimately, it is the cumulative pressure from diverse utilitarian activities ranging from medicinal and domestic applications to timber and fodder extraction that determines a species' vulnerability status. This underscores the importance of integrating multidimensional indices in assessing the conservation priorities of ethnobotanically significant taxa.

Table 4. Basic Indices Used to Identify the Vulnerable Species of Fabaceae in Katsina State.

No.	Species	Basic Indices					VI Parameters					
		FC	RFC	NU	RNU	OU	NOU	RI	FC%	NU Sca	NOU Sca	VI
1	<i>Parkia biglobosa</i> (Jacq.) G.Don	121	0.67	9.00	1.00	RSLD	4	0.84	3.00	3.00	3.00	3.00
2	<i>Bauhinia reticulatum</i> (Schum.) Milne Redhead	78	0.43	6.00	0.67	RSLD	3	0.55	2.00	3.00	3.00	2.67
3	<i>Tamarindus indica</i> L.	67	0.37	8.00	0.89	RSLD	4	0.63	2.00	3.00	3.00	2.67
4	<i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb.	92	0.51	7.00	0.78	RSLD	4	0.65	2.00	3.00	3.00	2.67
5	<i>Albizia chevalieri</i> Harms	88	0.49	6.00	0.67	RS	2	0.58	2.00	3.00	2.00	2.33
6	<i>Albizia lebbeck</i> (L.) Benth.	37	0.20	7.00	0.78	RSL	3	0.49	2.00	3.00	2.00	2.33
7	<i>Albizia coriaria</i> Welw. ex Oliv.	37	0.20	5.00	0.56	RSL	3	0.38	2.00	3.00	2.00	2.33
8	<i>Bauhinia rufescens</i> Lam.	74	0.41	6.00	0.67	RSL	4	0.54	2.00	3.00	2.00	2.33
9	<i>Cassia arereb</i> Delile	97	0.54	7.00	0.78	RSL	3	0.66	2.00	3.00	2.00	2.33
10	<i>Detarium microcarpum</i> Guill. & Perr.	92	0.51	6.00	0.67	RSL	3	0.59	2.00	3.00	2.00	2.33
11	<i>Detarium senegalense</i> J.F.Gmel	96	0.53	5.00	0.56	RSL	3	0.55	2.00	3.00	2.00	2.33
12	<i>Dialium guineense</i> Willd.	67	0.37	5.00	0.56	RSL	3	0.47	2.00	3.00	2.00	2.33
13	<i>Delonix regia</i> (Hook.) Raf.	31	0.17	5.00	0.56	RSLD	4	0.37	1.00	3.00	3.00	2.33

No.	Species	Basic Indices					VI Parameters					
		FC	RFC	NU	RNU	OU	NOU	RI	FC%	NU Sca	NOU Sca	VI
14	<i>Entada africana</i> Guill. & Perr.	85	0.47	4.00	0.44	RSLD	4	0.46	2.00	2.00	3.00	2.33
15	<i>Faidherbia albida</i> (Delile) A. Chev.	98	0.54	8.00	0.89	RSL	3	0.72	2.00	3.00	2.00	2.33
16	<i>Milletia thonningii</i> (Schumach. & Thorn.) Baker	37	0.20	6.00	0.67	RSL	3	0.44	2.00	3.00	2.00	2.33
17	<i>Prosopis africana</i> (Guill. & Perr.) Taub.	83	0.46	7.00	0.78	RSL	3	0.62	2.00	3.00	2.00	2.33
18	<i>Acacia polyacantha</i> Willd.	31	0.17	5.00	0.56	RSL	3	0.37	1.00	3.00	2.00	2.00
19	<i>Acacia pycnantha</i> Benth	48	0.26	4.00	0.44	RSL	3	0.35	2.00	2.00	2.00	2.00
20	<i>Cassia fistula</i> L.	45	0.25	4.00	0.44	RSL	3	0.35	2.00	2.00	2.00	2.00
21	<i>Daniellia oliveri</i> Hutch. & Dalziel	62	0.34	4.00	0.44	RSL	3	0.39	2.00	2.00	2.00	2.00
22	<i>Dichrostachys cinerea</i> (L.) Wight & Arn,	60	0.33	4.00	0.44	RSL	3	0.39	2.00	2.00	2.00	2.00
23	<i>Eythrira senegalensis</i> DC.	58	0.32	4.00	0.44	RSL	3	0.38	2.00	2.00	2.00	2.00
24	<i>Pterocarpus santalinoides</i> Dc.	29	0.16	5.00	0.56	RSL	3	0.36	1.00	3.00	2.00	2.00
25	<i>Senna siamea</i> (Lam.) H.S. Irwin & Barneby	81	0.45	3.00	0.33	RSL	3	0.39	2.00	2.00	2.00	2.00
26	<i>Dalbergia sissoo</i> Roxb.	31	0.17	2.00	0.22	SL	2	0.20	1.00	2.00	2.00	1.66
27	<i>Erythrophloeum sauveolens</i> (Guill. & Perr.) Brenan.	27	0.15	3.00	0.33	RSL	3	0.24	1.00	2.00	2.00	1.66
28	<i>Erythrophloeum africana</i> (Benth.) Harms	33	0.18	4.00	0.44	RSL	3	0.31	1.00	2.00	2.00	1.66
29	<i>Indigofera polyphylla</i> DC.	19	0.10	2.00	0.22	SL	2	0.20	1.00	2.00	2.00	1.66
30	<i>Isobornia doka</i> Craib & Stapf	24	0.13	3.00	0.33	RSL	3	0.23	1.00	2.00	2.00	1.66
31	<i>Lonchocarpus sericeus</i> (Poir.) Dc.	31	0.17	3.00	0.33	RSL	3	0.25	1.00	2.00	2.00	1.66
32	<i>Leucaena leucocephala</i> (Lam.) de Wit	31	0.17	4.00	0.44	RSL	3	0.31	1.00	2.00	2.00	1.66

Remarks: FC= frequency of citations; RFC = relative frequency of citations; NU = number of uses; RNU = relative number of uses; OU = organs used; NOU = number of organs used; RI = relative importance; VI = vulnerability index; L = Leaves; S = Stem; R = Root; D= Seeds, Sca= Scale.

Scoring: FC%: scored 1 if FC = 20%; scored 2 if FC > 20% to 60%; scored 3 if FC > 60%

NUSca: scored 1 if NU < 2; scored 2 if 2 ≤ NU ≤ 4, scored 3 if NU ≥ 5

NOUSca: scored 1 if NOU < 2; scored 2 if 2 ≤ NOU ≤ 3; scored 3 if NOU ≥ 4

6. The Most Utilised Plant Parts of the Vulnerable Species and IUCN Status

Table 5 presents data on the plant parts used from vulnerable species and their corresponding International Union for Conservation of Nature (IUCN) status. The most commonly utilised plant part in this study was stem bark (39%, 32 species), followed by leaves (33%, 27 species)

. Roots were the third most used (22%, 18 species), while seeds were the least utilised (6%, 5 species) (Figure 4). The high reliance on stem bark highlights the socio-economic challenges faced by local communities, as it is frequently used not only for traditional medicinal purposes such as treating gastrointestinal disorders, cancer, hemorrhoids, asthma, fever, gonorrhea,

and diabetes but also as a source of fuelwood. This pattern aligns with findings by Ngamsou Abdel et al. (2024), who also identified the stem bark as the most commonly used plant part in treatments related to COVID-19.

In terms of IUCN conservation status, the majority of species fell under the Least Concern (LC) category (78%, 25 species), followed by Near Threatened (NT) (13%, 4 species), and Not Evaluated (NE) (9%, 3 species) (Figure 5).

Table 5. The Most Utilized Vulnerable Species, Plant Parts Used, and IUCN Status

No.	Species	Part Used	IUCN Status
1	<i>Parkia biglobosa</i> (Jacq.) G.Don	Stem bark, Leaves, Seeds & Roots	LC
2	<i>Bauhinia reticulatum</i> (Schum.) Milne Redhead	Stem bark, Seeds, Leaves & Roots	NE
3	<i>Tamarindus indica</i> L.	Stem bark, Leaves, Seeds & Roots	LC
4	<i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb.	Stem bark, Leaves, Seeds & Roots	LC
5	<i>Albizia chevalieri</i> Harms	Stem bark, Root	LC
6	<i>Albizia lebbbeck</i> (L.) Benth,	Stem bark, Leaves & Roots	LC
7	<i>Albizia coriaria</i> Welw. ex Oliv.	Stem bark, Leaves & Roots	NT
8	<i>Bauhinia rufescens</i> Lam.	Stem bark, Leaves & Roots	LC
9	<i>Cassia arereb</i> Delile	Stem bark, Leaves & Roots	NT
10	<i>Detarium microcarpum</i> Guill. & Perr.	Stem bark, Roots & Leaves	LC
11	<i>Detarium senegalense</i> J.F.Gmel	Stem bark, Leaves & Roots	LC
12	<i>Dialium guineense</i> Willd.	Stem bark, Roots & Leaves	LC
13	<i>Delonix regia</i> (Hook.) Raf.	Stem bark, Leaves, Roots & Seeds	LC
14	<i>Entada africana</i> Guill. & Perr.	Stem bark, Leaves, Seeds & Roots	LC
15	<i>Faidherbia albida</i> (Delile) A. Chev.	Stem bark, Leaves & Roots	LC
16	<i>Milletia thonningii</i> (Schumach. &Thorn.) Baker	Stem bark, Leaves & Roots	LC
17	<i>Prosopis africana</i> (Guill. & Perr.) Taub.	Stem bark, Leaves & Roots	LC
18	<i>Acacia polyacantha</i> Willd.	Stem bark, Leaves & Roots	LC
19	<i>Acacia pycnantha</i> Benth	Stem bark, Leaves & Roots	LC
20	<i>Cassia fistula</i> L.	Stem bark, Leaves & Roots	LC
21	<i>Daniellia oliveri</i> Hutch. & Dalziel	Stem bark, Leaves & Roots	LC
22	<i>Dichrostachys cinerea</i> (L.) Wight & Arn,	Stem bark, Leaves & Roots	LC
23	<i>Erythrina senegalensis</i> D.C.	Stem bark, Roots & Leaves	LC
24	<i>Pterocarpus santalinoides</i> D.C.	Stem bark, Leaves & Roots	NE
25	<i>Senna siamea</i> (Lam.) H.S. Irwin & Barneby	Stem bark, Leaves & Roots	LC
26	<i>Dalbergia sissoo</i> Roxb.	Stem bark & Leaves	NT
27	<i>Erythrophloeum saueolens</i> (Guill. & Perr.) Brenan.	Stem bark, Leaves & Roots	NE

No.	Species	Part Used	IUCN Status
28	<i>Erythrophleum africana</i> (Benth.) Harms	Stem bark, Leaves & Roots	LC
29	<i>Indigofera polyphylla</i> DC.	Stem bark & Leaves	NT
30	<i>Isoberlinia doka</i> Craib & Stapf	Stem bark, Leaves & Roots	LC
31	<i>Lonchocarpus sericeus</i> (Poir.) Dc.	Stem bark, Leaves & Roots	LC
32	<i>Leucaena leucocephala</i> (Lam.) de Wit	Stem bark, Leaves & Roots	LC

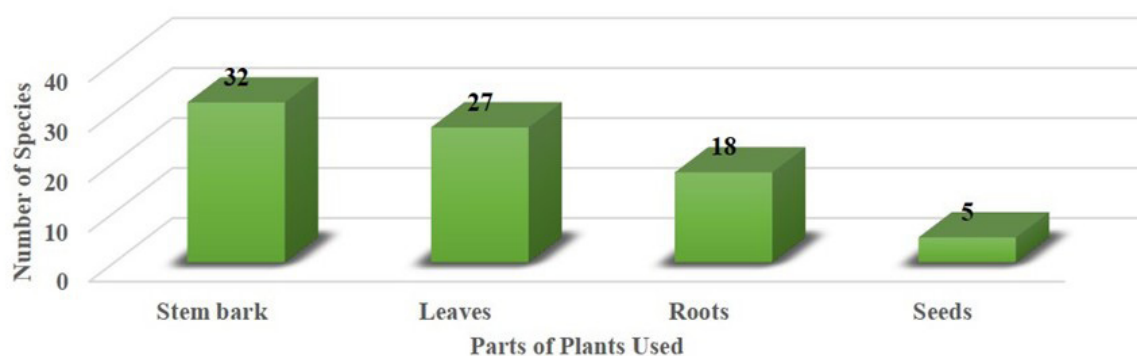


Figure 4. Plant Parts Used

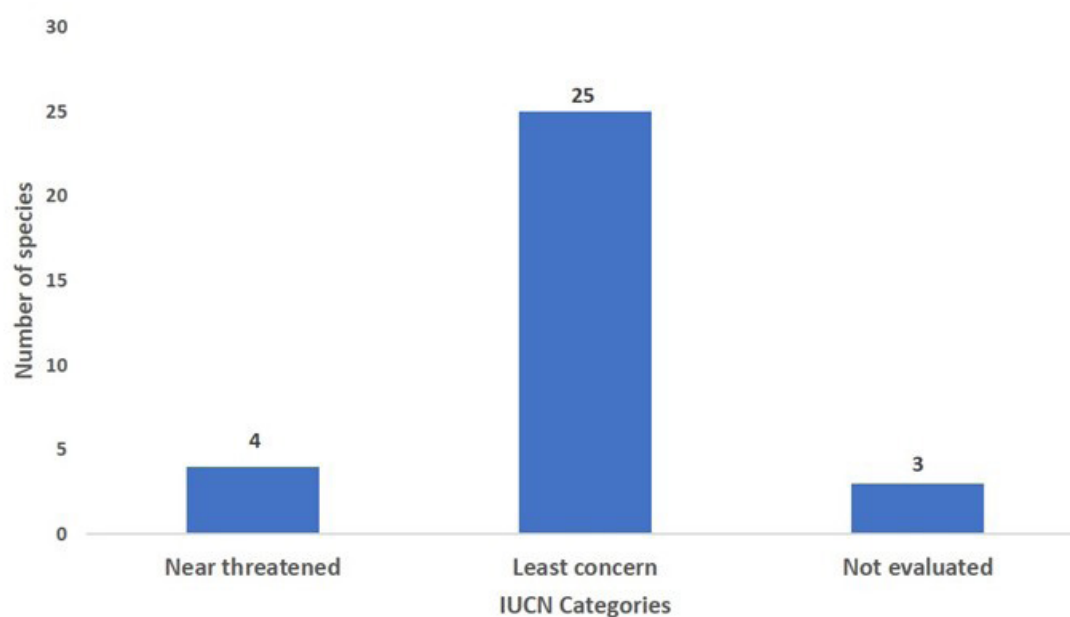


Figure 5. Global IUCN Status of the Overutilized Species Identified Factors Responsible for The Plant's Vulnerability

The overutilisation of plant resources in Katsina State has been attributed to a variety of anthropogenic activities. The major factors identified in this study include the deforestation (57 respondents, 31%) agricultural expansion and related challenges (41 respondents, 23%), urbanisation (38 respondents, 21%), overharvesting (27 respondents, 15%), introduction of invasive species (17 respondents, 10%), (Figure 6). These human-induced pressures have significantly altered natural ecosystems and disrupted biodiversity, thereby threatening ecological stability (Prakash & Verma, 2022).

Among the threats, deforestation was reported by respondents as the most pressing concern. If left unmitigated, it poses the risk of widespread ecosystem degradation. These findings are consistent with those of Bello et al., 2019 and Dueñas et al., 2018, who similarly reported that a majority of threatened plant species in their studies were adversely affected by anthropogenic drivers such as overutilisation, deforestation, unsustainable harvesting practices, and agricultural encroachment.

Anthropogenic activities have significantly altered ecosystems and continue to pose substantial threats to species' survival within the study area. In this study, thirty-two (32) highly vulnerable plant species were identified. Of these, 26(81%) were reported to be

exploited for fuelwood, 15(47%) for fodder, 11(34%) for timber, 9(28%) for the production of wooden items such as handles, doors, and windows, 5(16%) for charcoal, 4(13%) each for mortar, pestle, and handicrafts, and 1(3%) for dyes (Figure 7). These findings illustrate the extent of human reliance on plant resources for a variety of utilitarian purposes, despite the potential ecological consequences.

This pattern of overutilisation is consistent with previous studies by Gasperini & Artuso (2022); Poudyal et al. (2023); Charmakar et al. (2024), who emphasized that unsustainable exploitation of natural resources, particularly for fuelwood, timber, and related uses, plays a critical role in accelerating biodiversity loss. These findings reinforce the pressing need for sustainable resource management and conservation strategies targeting vulnerable species.

7. The influence of human activities on the species vulnerability

Anthropogenic activities have significantly altered ecosystems and continue to pose substantial threats to plant species' survival within the study area. In this study, 32 highly vulnerable plant species were identified. Of these, 26 (81%) species were reported to be exploited for fuelwood, 15 (47%) for fodder, 11(34%) for timber, 9 (28%) for the production

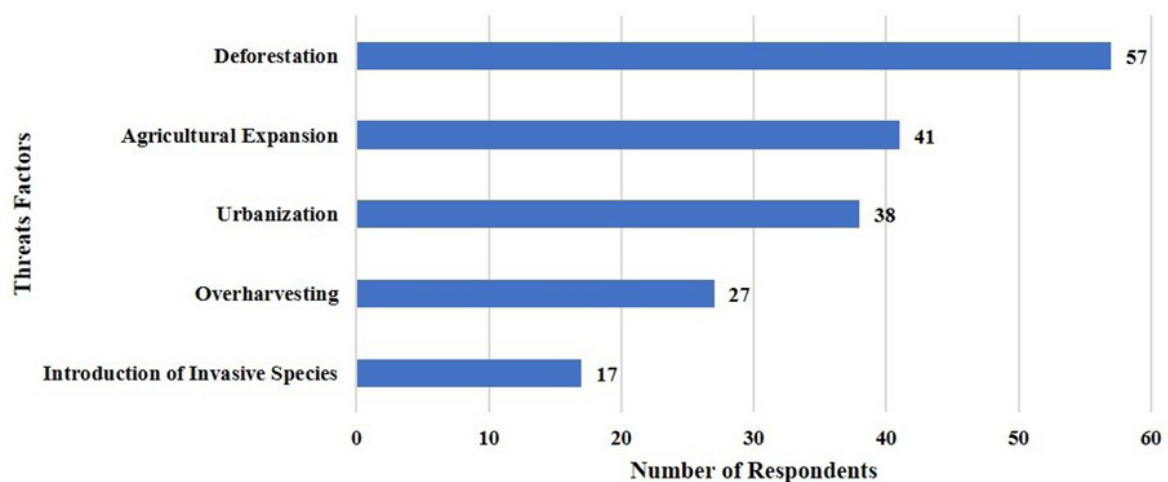


Figure 6. Threat factor causing plant species vulnerability in the study area

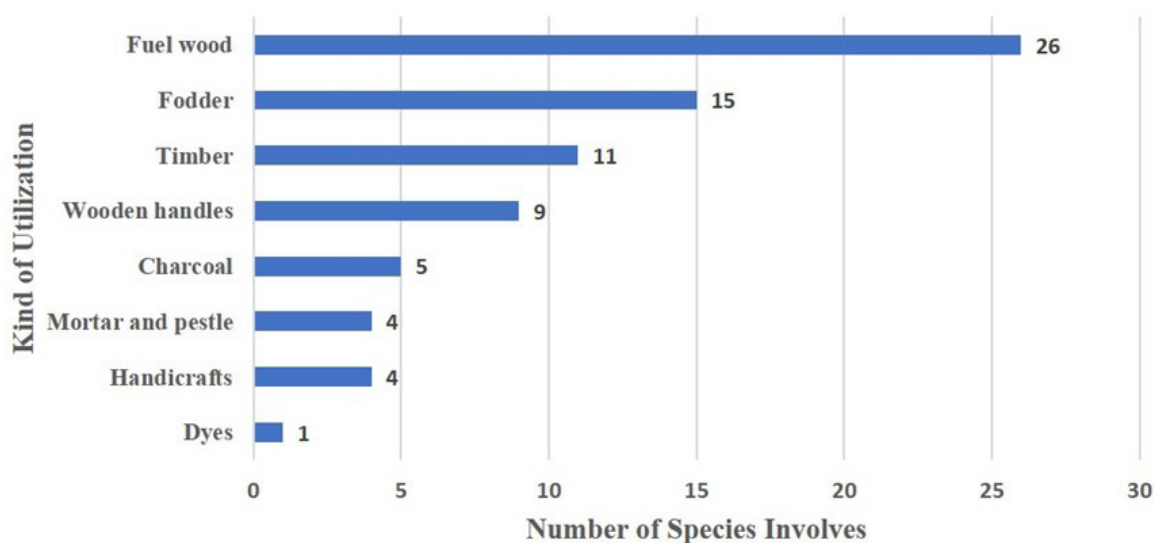


Figure 7. The utilization of the threatened Species

of wooden items such as handles, doors, and windows, 5(16%) for charcoal, 4 (13%) each for mortar, pestle, and handicrafts, and 1(3%) for dyes (Figure 7). These findings illustrate the extent of human reliance on plant resources for a variety of utilitarian purposes, despite the potential ecological consequences.

This pattern of overutilisation is consistent with previous studies by Gasperini & Artuso (2022); Poudyal et al. (2023; Charmakar et al. (2024), who emphasized that unsustainable exploitation of natural resources, particularly for fuelwood, timber, and related uses, plays a critical role in accelerating biodiversity loss. These findings reinforce the pressing need for sustainable resource management and conservation strategies targeting vulnerable species.

IV. CONCLUSION

This study highlights the alarming vulnerability of plant species in Katsina State, particularly in Sandamu, Zango, and Maiadua, Local Government Areas. The threat factors identified include deforestation (31%), agricultural expansion (23%), urbanisation (21%), overharvesting (15%), and the introduction of invasive species (10%). The

findings reveal a high dependence on plant resources for fuelwood, timber, fodder, and traditional medicine practice, while vital to local livelihoods, are contributing to the rapid decline of several ecologically and culturally significant species.

The study identified 32 vulnerable *Fabaceae* species across 25 genera and 5 subfamilies. *Albizia* emerged as the most vulnerable genus, with three species, while *Acacia*, *Bauhinia*, *Cassia*, *Detarium*, and *Erythrophleum* each contained two vulnerable species. Most respondents were male (87%), aged 46-75 (53%), and married (77%), with traditional medical practitioners (34%) being the dominant occupations. Among the 32 vulnerable species identified, four species, *Parkia biglobosa* (Vulnerability Index/VI of 3.00), *Tamarindus indica*, *Bauhinia reticulatum*, and *Vachellia nilotica*, each with a VI of 2.67 were found to be the most at risk due to intensive human use. The stem bark (39%) was the most utilised plant part.

Although only four species, namely *Albizia coriaria*, *Cassia arereh*, *Dalbergia sissoo* and *Indigofera polyphylla* are currently listed as Near Threatened under IUCN criteria, region-specific pressures suggest that the global conservation status may underestimate local threats. Therefore,

establishing a regional plant assessment framework is critical for providing timely data and supporting effective conservation planning. Immediate, context-sensitive conservation strategies, including community engagement, sustainable harvesting practices, reforestation efforts, and policy implementation, are essential to mitigate the ongoing loss of biodiversity. Without such intervention, the degradation of plant resources will not only threaten ecological balance but also compromise the socio-economic resilience of the communities that depend on them.

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