



Conservation Status of Tree Species in Dansoshiya Forest Reserve, Kano State, Nigeria

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Abstract

Protected areas (PAs) serve as vital instruments for biodiversity conservation, playing a crucial role in the In-situ conservation of species. The purpose of this study is to assess the likelihood of extirpation and extinction of tree species in the Dansoshiya Forest Reserve (DFR). The study conducted a detailed fieldwork, 30 stratified random sample plots with a quadrat size of 12.5m x 8m were collected and measured across the area. 8 Scenario-based focus group discussions (SBFGDs) sessions were also conducted. Tree species probability of extirpation and extinction were determined with the species evenness, IUCN indicative thresholds and Threats Model. Floristic survey conducted in the DFR revealed 67 distinct tree species, and these species were categorised as, 89.55% (60 species) as Critically Endangered, 5.97% (4 species) as Endangered, and 4.48% (3 species) as Vulnerable on a local scale. The data obtained from DFR compared with the data obtained from the most recent IUCN Red List of Threatened Trees. Of these, 71.64% (48 species) listed as Least Concern, 20.90% (14 species) as Not Evaluated, 4.48% (3 species) were listed as Vulnerable, and 2.98% (2 species) as Endangered at global scale. Moreover, the result revealed other subcategories of Critically Endangered tree species in the study area. The overall results indicated that critically endangered species at the local level and the category of species of least concern at the global scale are the common tree species in the area. Hence, immediate conservation action is required for a significant portion of the tree species in DFR.

Keywords: biodiversity, conservation status, Dansoshiya, protected areas

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Introduction

Dansoshiya Forest Reserve (DFR) is 1 of the 1,001 protected areas in Nigeria recognised by the International Union for Conservation of Nature (IUCN) (UNEP-WCMC, 2024). Protected areas serve as vital instruments for global biodiversity conservation, playing a crucial role in the in-situ conservation of species diversity (Lovejoy, 2006; Gray et al., 2016; Schulze et al., 2018). According to the International Union for Conservation of Nature (IUCN) and Article 2 of the Convention on Biological Diversity (CBD), protected areas are geographically defined spaces, regulated and managed through legal or effective means to achieve specific conservation goals and ensure long-term protection of nature (United Nations, 1992; IUCN; Dudley, 2008). Nigeria has ratified numerous international agreements and treaties on biodiversity conservation. Currently, protected areas account for 13.86% of the country's total land area. Among these, the DFR spans approximately 65 km² (6,500 ha.) (UNEP-WCMC, 2024).

The predominant socio-economic activities in the area surrounding DFR include farming, livestock rearing, hunting, and the marketing of agricultural products. The area, although sparsely populated, has an estimated population of approximately 119,478, influenced by demographic factors such as birth, death, and migration (Mustapha, 2014). These activities, while sustaining local livelihoods, exert mounting pressure on the reserve and its biodiversity.

Vegetation of the Dansoshiya Forest Reserve (DFR) is characterised by a broad canopy and needle leaved deciduous trees and shrubs species (Cline-Cole et al., 2014; Mustapha, 2014). However, the tree species of the DFR location face increasing threats from various anthropogenic activities, including extreme resource extraction, agricultural expansion, habitat loss due to agricultural expansion and grass planting for animal feed, and spread of invasive species. Moreover, 725 Nigerian tree species are listed on the IUCN Red List of Threatened Species, with 96 categorized as Vulnerable, 34 as Endangered,

and 11 as Critically Endangered, all of which are in urgent need of conservation action (IUCN, 2024). These external pressures pose a serious risk to species diversity and make the DFR a critical case study for assessing the conservation status of tree species in the area. This study aimed to assess the likelihood of extirpation and extinction of tree species in the DFR by assessing their conservation status using tree species-specific data, participant responses from scenario-based focus group discussions (SBFGDs), and threat thresholds adopted from the International Union for Conservation of Nature (IUCN 2012). The findings from this research are expected to provide a data-driven understanding of the current conservation status of tree species diversity in protected areas, particularly in DFR, to inform relevant stakeholders.

Methodology

Study area

The study was conducted at the Dansoshiya forest reserve that lies roughly between latitude $11^{\circ}30'30''\text{N}$ to $11^{\circ}37'00''\text{N}$ and longitude $8^{\circ}3'37''\text{E}$ to $8^{\circ}8'70''\text{E}$ of the Greenwich meridian (see Figure 1), and located in the Sudan Savanna region of Nigeria, approximately 57 km southwest of Kano. Its climate is similar to the Kano region, with a tropical wet and dry type. The elevation of the area ranges from 500-750 meters above sea level and is characterised by a broad canopy and needle leaf deciduous trees and shrubs (Mustapha, 2014). The natural vegetation of the area includes a variety of trees species such as *Acacia nilotica*, *Tamarindus indica*, *Butyrospermum parkii*, *Bombax buonopozense*, *Terminalia* spp. and shrubs, adapted to drought conditions through long tap roots, leathery leaves, and needle leaves. Most trees and shrubs shed their leaves during the dry season, except for *Acacia Albida*, which retains green leaves throughout the year. Shrub species are densely distributed, with variation in density and composition from place to place. Notable species include *Jatropha curcas*, *Annona senegalensis*, *Guiera senega-*

lensis, *Lannea acida*, *Conniphora africana*, *Ximenia americana*, *Maytenus senegalensis*, *Dioscoria bulbifera*, *Cassia gorantensis*, and *Piliostigma thonningii* (Cline-Cole et al., 2014).

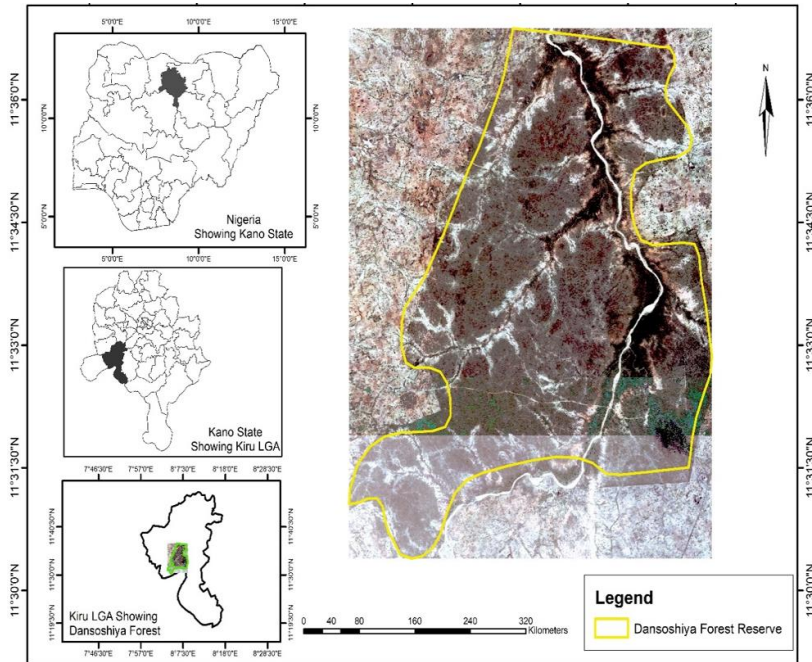


Fig. 1: *Dansoshiya Forest Reserve. Source: Resource Room, Dept. of Environmental Management, Bayero University Kano.*

Data Collection

Detailed fieldwork was conducted for the collection of tree species diversity information. 30 sample plots with a quadrat size of 12.5m x 8m (equivalent to 10m x 10m) (Kindt & Coe 2005 and Krebs 2014) were stratified randomly (Brunbjerg et al., 2019; Dengler et al., 2016) selected and measured across the study area.

Identification of tree species:

PictureThis android-based application were used for identification, classifica-

tion and placement of the tree species into an appropriate taxonomic hierarchy (i.e. Name of Species and local name) (Balakrishnan, 2005 & Boho et al., 2020). Furthermore, the accuracy of species identification and classification was validated by cross-referencing with Plants of the World Online (Royal Botanic Gardens, Kew, 2023) and Tropicos (Missouri Botanical Garden, 2023), following initial identifications made using PictureThis during the detailed fieldwork.

Determination of the current conservation status

The conservation status of each tree species at the local level was assessed using tree species evenness (i.e. species evenness that entails how many individuals of each species are present in the study area) (Kindt & Coe, 2005) and the IUCN indicative thresholds for a threatened category adopted from the International Union for Conservation of Nature (IUCN 2012), as outlined in the IUCN Red List Categories and Criteria Version 3.1. (<https://www.iucn.org/resources/publication/iucn-red-list-categories-and-criteria-version-31-second-edition>).

Assigning tree species to EXT or CR(PEW/PE):

Eight Scenario-based focus group discussions (SBFGD) sessions was conducted within and surroundings settlements with participants. With 6-8 participants in each SBFGDs session. Argument map was constructed outlining the participants line of reasoning of the estimated threat parameters, from which the species extirpation, or P(E), was calculated. As a result, the Threats Model formula (Keith et al., 2017) was utilised to determine the species' probability of extirpation:

$$P(E) = P(\text{local}) \times P(\text{spatial}) \dots\dots\dots(1)$$

Where—P(local) = Local Extinction Probability, P(spatial) = Spatial Extinction Probability.

Global conservation status of DFR's tree species:

Regarding the conservation status of individual tree species of the study area based on their probability of extinction at the global scale, the tree species identified in the DFR were compared with the most current World List of Threatened Trees at <https://www.iucnredlist.org/>.

Results and Discussion

Conservation Status of Tree Species Diversity

The results of the survey and analysis showed that there were many different species of trees in the study area, with species counts ranging from 0 to 212 across the whole sample plots. This variation in range of tree species diversity reflected th

e conservation status, ecological richness and potential habitat variability within the forest reserve. Tables 1 and 2 provide detailed breakdowns of the species abundance and conservation status, highlighting the differences in species condition across the reserve. These tables offered insights into the biodiversity levels, which include both vulnerable (VU) and critically endangered (CR) species, as provided by these tables.

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—Yusuf, Mohammed Sunusi. <https://doi.org/10.5281/zenodo.17846208>

Table 1: Conservation status of the identified tree species in the study area

Name of species	Local name	Abundance	% in DFR population	Conservation status at DFR	Criterion applied	Conservation status at global scale	Year of global assessment
Combretum mole	Wuyan damo	212	13.6	VU	A1cd	LC	2018
Terminalia leocarpa	Marke	188	12.1	VU	A1cd	LC	2018
Diospyros mespiliformis	Kanya	176	11.3	VU	A1cd	LC	2021
Detarium microcarpum	Taura	118	7.6	EN	A2cd	LC	2009
Jatropha curcas	Bini da zugu	106	6.8	EN	A2cd	LC	2018
Combretum glutinosum	Calauniya	89	5.7	EN	A2cd	LC	2018
Landolphia owariensis	Cewu	83	5.3	EN	A2cd	NE	
Vitellaria paradoxa	Kadanya	44	2.8	CR	B2ab(i,ii,iv,v)/D	VU	1998
Isobertinia doka	Doka	27	1.7	CR	B2ab(i,ii,iv,v)/D	LC	2009
Pseudocedrela kotschyi	Tonna	21	1.4	CR	B2ab(i,ii,iv,v)/D	LC	2018
Ziziphus spina-christi	Kurna	20	1.3	CR	B2ab(i,ii,iv,v)/D	LC	2020
Acacia macrothyrsa	Gwano	19	1.2	CR	B2ab(i,ii,iv,v)/D	NE	
Ziziphus mauritiana	Magarya	18	1.2	CR	B2ab(i,ii,iv,v)/D	LC	2018
Faidherbia albida	Gawo	18	1.2	CR	B2ab(i,ii,iv,v)/D	LC	2018
Bretonadia salicina	Kadanyan rafi	18	1.2	CR	B2ab(i,ii,iv,v)/D	LC	2018
Commiphora africana	Dashi	17	1.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Terminalia macroptera	Kwandari	17	1.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Acacia sieberiana	Farar kaya	16	1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Entada africana	Tawatsa	16	1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Vitex doniana	Dinya	15	1	CR	B2ab(i,ii,iv,v)/D	LC	2017
Balanites aegyptiaca	Aduwa	15	1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Ficus ingens	Kawuri	14	0.9	CR	B2ab(i,ii,iv,v)/D	LC	2018
Dioscorea bulbifera	Tuwon buri	13	0.8	CR	B2ab(i,ii,iv,v)/D	NE	
Gardenia aqualla	Gaude	13	0.8	CR	B2ab(i,ii,iv,v)/D	NE	
Sterculia setigera	Kukkuki	13	0.8	CR	B2ab(i,ii,iv,v)/D	LC	2018
Pericopsis laxiflora	Rafkau/makarho	12	0.8	CR	B2ab(i,ii,iv,v)/D	LC	2018
Azadirachta indica	Darbejiya	12	0.8	CR	B2ab(i,ii,iv,v)/D	LC	2018
Dichrostachys cinerea	Dundu	12	0.8	CR	B2ab(i,ii,iv,v)/D	LC	2009
Ficus iteophylla	Shirinya	12	0.8	CR	B2ab(i,ii,iv,v)/D	NE	
Anonychium africana	Kiryia	11	0.7	CR	B2ab(i,ii,iv,v)/D	NE	
Hyphaene thebaica	Goriba	11	0.7	CR	B2ab(i,ii,iv,v)/D	LC	2017
Tamarindus indica	Tsamiya	9	0.6	CR	B2ab(i,ii,iv,v)/D	LC	2017
Terminalia ivorensis	Baushe	9	0.6	CR	B2ab(i,ii,iv,v)/D	VU	1998
Acacia nilotica	Bagaruwa	9	0.6	CR	B2ab(i,ii,iv,v)/D	LC	2017
Erythrina senegalensis	Minjiyya	9	0.6	CR	B2ab(i,ii,iv,v)/D	LC	2009
Sclerocarya birrea	Danya	9	0.6	CR	B2ab(i,ii,iv,v)/D	NE	
Grewia mollis	Kyalli	7	0.5	CR	B2ab(i,ii,iv,v)/D	LC	2018
Adansonia digitate	Kuka	7	0.5	CR	B2ab(i,ii,iv,v)/D	NE	
Bombax costatum	Gujjiya	7	0.5	CR	B2ab(i,ii,iv,v)/D	LC	2018
Carissa edulis	Gizaki	7	0.5	CR	B2ab(i,ii,iv,v)/D	EN	1998
Eucalyptus globulus	Dogon yaro	7	0.5	CR	B2ab(i,ii,iv,v)/D	LC	2019
Ficus thonningii	Cediya	7	0.5	CR	B2ab(i,ii,iv,v)/D	LC	2918
Hymenocardia acida	Janyaro	7	0.5	CR	B2ab(i,ii,iv,v)/D	LC	2018
Khaya senegalensis	Madaci	7	0.5	CR	B2ab(i,ii,iv,v)/D	VU	1998
Strychnos usambarensis	Kokiya	7	0.5	CR	B2ab(i,ii,iv,v)/D	NE	

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Yusuf, Mohammed Sunusi. <https://doi.org/10.31838/lasujes.17846208>

Name of species	Local name	Abundance	P(E)	Conservation status at DFR	Criterion applied	Conservation status at global scale	Year of global assessment
Borassus aethiopicum	Giginya	6	0.4	CR	B2ab(i,ii,iv,v)/D	LC	2016
Euphorbia poissonii	Tinya	6	0.4	CR	B2ab(i,ii,iv,v)/D	NE	
Pterocarpus erinaceus	Madobiya	6	0.4	CR	B2ab(i,ii,iv,v)/D	EN	2017
Stereospermum kunthianum	Sansami	5	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Daniellia oliveri	Maje	5	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Ziziphus mucronate	Magaryar kura	5	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Ximenea Americana	Tsada	4	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Acacia polyacantha	Karo	4	0.3	CR	B2ab(i,ii,iv,v)/D	NE	
Albizia chevalieri	Katsari	4	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Cassia sieberiana	Marga	4	0.3	CR	B2ab(i,ii,iv,v)/D	LC	2018
Parkia biglobosa	Dorawa	3	0.2	CR	B2ab(i,ii,iv,v)/D	LC	2018
Annona senegalensis	Gwandar daji	3	0.2	CR	B2ab(i,ii,iv,v)/D	LC	2018
Catunaregam nilotica	Kwanarya	3	0.2	CR	B2ab(i,ii,iv,v)/D	NE	
Acacia seyal Delle	Dushi	2	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2019
Bauhinia rufescens	Tsattsagi	2	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Securidaca longipedunculata	Sanya	2	0.1	CR	B2ab(i,ii,iv,v)/D	NE	
Ficus polita	Durumi	1	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Cassia singueana	Runhu	1	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Ceiba pentandra	Rimi	1	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2017
Ficus platyphylla	Gamji	1	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2018
Piliostigma thonningii	Kalgo	1	0.1	CR	B2ab(i,ii,iv,v)/D	LC	2021
Securinea virosa	Tsa	1	0.1	CR	B2ab(i,ii,iv,v)/D	NE	
Total		1554	100				

Source: Authors fieldwork, 2023

Table 2: Participants estimated threats to extirpated species in study area.

Name of species	Local name	Abundance	P(E)	Conservation status at DFR	Criterion applied	Conservation status at global scale	Year of global assessment
Boswellia dalzielii	Ararabi	0	0.97	EXT	Threats model	NE	
Mitragyna inermis	Giyayya	0	0.81	PEXT	Threats model	LC	2019
Combretum micranthum	Geza	0	0.62	PEW	Threats model	LC	2018
Moringa oleifera	Zogale	0	0.64	PEW	Threats model	LC	2019

Source: Author's fieldwork 2023

Note—EX = Extinct – No known individuals remaining (Keith et al., 2017). EXT = Extirpated – Locally extinct; no longer present in the study area, though found elsewhere (Keith et al., 2017). PEW = Possibly Extinct in the Wild – Beileid extinct in the wild but not yet confirmed (Keith et al., 2017). PEX = Possibly Extinct – Likely extinct globally, pending formal confirmation (Keith et al., 2017). CR = Critically Endangered – facing an extremely high risk of extinction in the wild. EN = Endangered – Facing a very high risk of extinction in the wild. VU = Vulnerable – Facing a high risk of extinction in the medium term. LC = least Concern – Widespread and abundant species, at low risk of extinction. NE = Not Evaluated – Species has not yet been assessed by the IUCN. A1cd = Past population decline from habitat loss and overexploitation, with causes that are known, reversible, and have ceased. B2ab(i,ii,iv,v) = Species has a small range, few locations, and is declining in area, range, subpopulations, and mature individuals. D = A very small or restricted population to a very small area at high risk of extirpation. Note: Conservation status is based on the IUCN Red List classification (IUCN, 2012; Keith et al., 2017). Local abundance and threat levels were derived from field survey conducted from the end of September to the second week of October 2023 by the author, combined with community-based data obtained during scenario-based focus group discussion (Author's fieldwork, 2023).

Tables 1 and 2 presented a comprehensive overview of the conservation status of the recorded tree species. The local conservation status assessment focused on the current extinction risk of each species within the DFR, applying IUCN categories and criteria. This system categorises species into different levels of conservation concern. Given the numerous anthropogenic pressures in the Dansoshiya Forest Reserve (DFR), such as habitat degradation, deforestation, and illegal logging. Floristic survey conducted in the DFR revealed 67 distinct tree species. According to IUCN Red List criteria (Version 2012-3.1-second-edition), these species were categorised as follows: 60 species (89.55%) as Critically Endangered, 4 species (5.97%) as Endangered, and 3 species (4.48%) as Vulnerable. However, as seen in several cases, local extinction risks can diverge significantly from global trends. Species that are extirpated (locally extinct) within the DFR, such as those no longer found or critically endangered in the DFR but still present elsewhere in the world, may not be classified as globally threatened. For example, *Daniellia oliveri* (commonly known as Maje) is listed as Least Concern on the IUCN Red List at global level, due to its wider distribution and relatively stable populations across West and Central Africa (IUCN, 2024). However, within Dansoshiya Forest Reserve, it is classified as Endangered (see Table 1), primarily due to overexploitation, habitat degradation and ongoing deforestation.

Based on a floristic survey conducted in the DFR, and comparative data obtained from the most recent IUCN Red List of Threatened Trees (<https://www.iucnredlist.org/>), a total of 67 distinct tree species were identified. Of these, 48 species (71.64%) listed as Least Concern, 14 species (20.90%) as Not Evaluated, 3 species (4.48%) were listed as Vulnerable, and 2 species (2.98%) as Endangered. However, despite their global status suggesting minimal threat, several species like *Boswellia dalzielii* and *Combretum micranthum* (IUCN, 2024) (see Table 2) are either extirpated or at risk of extirpation

in the DFR. This local decline is largely driven by pressures such as unsustainable resource extraction, habitat loss from agricultural expansion and grass planting for animal feed, and spread of invasive species. The disparity between local and global conservation status highlights the importance of addressing area-specific threats and conditions to conserve biodiversity on a local scale.

Species Level of Endangerment in the Study Area

The data in Tables 1 and 2 enable further categorisation of the recorded tree species by their levels of endangerment. These levels of endangerment are shown graphically in Figure 2, which distinguished between species that are more secure, those that require urgent conservation effort and possibly extirpated species (including Possibly Extinct in the Wild and Possibly Extinct species not previously discussed).

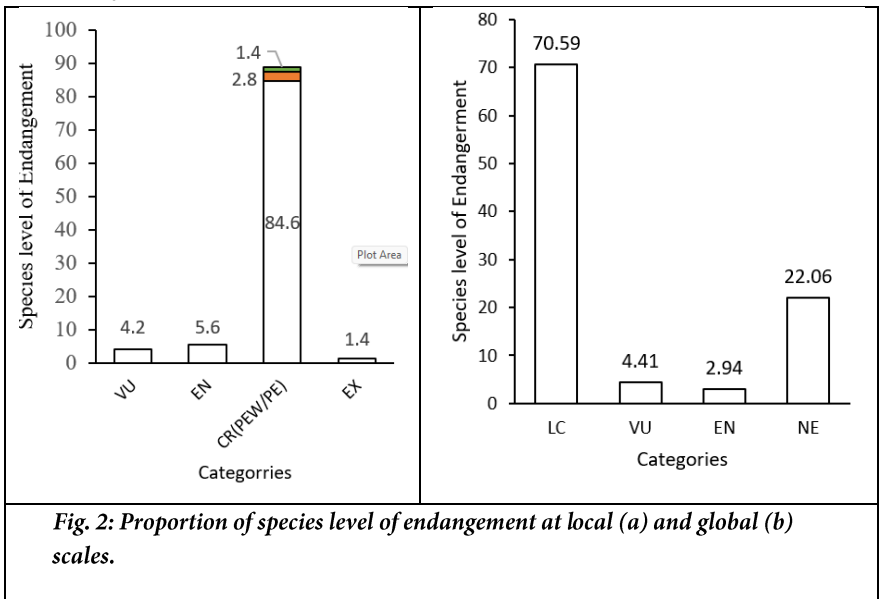


Fig. 2: Proportion of species level of endangerment at local (a) and global (b) scales.

Note—EX = Extinct – No known individuals remaining. EXT = Extirpated – Locally extinct; no longer present in the study area, though found elsewhere. PEW = Possibly Extinct in the Wild – Beleided extinct in the wild but not yet confirmed. PEX = Possibly Extinct – Likely extinct globally, pending formal confirmation. CR = Critically Endangered – facing an extremely high risk of extinction in the wild. EN = Endangered – Facing a very high risk of extinction in the wild. VU = Vulnerable – Facing a high risk of extinction in the medium term. LC = least Concern – Widespread and abundant species, at low risk of extinction. NE = Not Evaluated – Species has not yet been assessed by the IUCN.

The tree species diversity in the Dansoshiya Forest Reserve exhibits varying levels of endangerment across the top four IUCN Red List categories: Vulnerable, Endangered, Critically Endangered (which includes subsets such as Possibly Extinct in the Wild and Possibly Extinct), and Extinct. At the local level, a total of 71 were assessed in the study area, including four subcategories within the Critically Endangered species. Of these, 88.8% (63 species) were classified as Critically Endangered, including 2.8% (2 species) considered Possibly Extinct in the Wild and 1.4% (1 species) as possibly extinct. Additionally, 5.6% (4 species) were categorised as Endangered, 4.2% (3 species) as Vulnerable, 1.4% (1 species) as Extinct, as illustrated in figure 2a. These findings reflected the critical need for immediate conservation action to prevent further tree species loss at the local level.

At the global level, tree species diversity in DFR was assessed using four IUCN Red List categories: endangered, vulnerable, least concern, and not evaluated as shown in figure 2b. The percentages are based on a total of 68 tree species identified in the Dansoshiya Forest Reserve with global conservation status. Among them, 70.59% (48 species) were classified as Least Concern, indicating relatively low extinction risk. In contrast, 22.06% (15 species) had not yet been evaluated by the IUCN, reflecting significant data gaps. Additionally, 4.41% (3 species) were listed as Vulnerable, and 2.29% (2 species)

as Endangered, the smallest proportion among the globally assessed categories for the reserve. This disparity between local and global assessments emphasizes the importance of addressing localized threats while considering the broader, global context of species conservation.

Conclusion

The conservation status of tree species within the Dansoshiya Forest Reserve revealed the presence of various threats in the area. The results of the assessment suggested that certain species, including *Boswellia dalzielii*, *Combretum micranthum*, *Moringa oleifera*, and *Mitragyna inermis* may have already been extirpated (locally extinct) or critically endangered in the area. This raises significant concerns about the loss of tree species diversity and the potential disruption of the local ecosystem. Therefore, it is evident that urgent conservation action is required for a significant portion of the tree species in DFR. Moreover, a considerable number of tree species, such as *Ficus platyphylla*, *Cassia sieberiana*, *Piliostigma thonningii*, and *Securinega virosa*, were classified as least concern or not evaluated at the global level. However, these same species were classified as highly endangered at the local level, indicating a disconnect between their global status and the specific threats they face within the DFR. Local drivers of tree species diversity loss such as habitat degradation, deforestation, and illegal logging, unsustainable resource extraction, agricultural expansion, including grass cultivation for livestock feed as the peculiar drivers of biodiversity loss in the reserve. Based on the findings of this research, it is recommended that conservation efforts and resources be strategically redirection to prioritise the conservation of critically endangered and endangered tree species (Croteau & Mott, 2011).

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