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RESEARCH ARTICLE

FLORISTIC DIVERSITY AND SPECIES DISTRIBUTION IN DIFFERENT FOREST STANDS IN NORTHERN CHHATTISGARH, INDIA

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Abstract: The understory or vegetation beneath the forest canopy, or undergrowth, flourishes under the stratum of the forest stand and has significant distribution and impact on diversity, regeneration, nutrient cycling, and ecological functions. These are diverse life forms and have a substantial role in forest ecology, silvicultural aspects, and wildlife perspectives. Generally, the occurrence, distribution, and diversity of understory depend upon the canopy closure, light availability, site quality, and environmental conditions that can favor or limit it in a particular region. The present investigation was carried out in five forest land uses (i.e., degraded forest, moderately dense forest, regenerated forest, dense forest, and teak plantation) in the Duldula region of northern Chhattisgarh. Stratified simple random sampling techniques were used for data collection. A total of 89 species (28 tree species, 14 shrub species, 17 climber species, and 30 herb species) were recorded in different forest stands of the Duldula region of Jashpur (C.G.). In the overall floristic richness tree, shrub, climber, and herb contribute 31.46%, 15.73%, 19.10%, and 33.71%, respectively, in total. The frequency class distribution showed mostly species restricted to Classes A and B, reflecting their infrequent or moderate distribution. The origin of species or nativity analysis reflects that most of the species that occurred in different forest stands are native to India and South Asia. These floristic resources need to be preserved, conserved, and protected for future generations and to achieve sustainability.

Keywords: Distribution, Floristic, Flora, Diversity, Regeneration

INTRODUCTION

Forests are the most diverse and biologically rich ecosystems that support human wellbeing and their existence. Floristic representation of forest ecosystems is the key indicator of resilience and health. The forest composition reflects the assemblage of plant species in a given environmental setting, with specific associations among the diverse flora (Poudel and Devkota, 2022; Devi *et al.,* 2023; Tomar *et al.,* 2008 and Tomar, 2024). Species diversity is the variation of the stand represented by its assemblage among the plant community that affects and maintains the forest ecosystem structure and function (Tilman and Dowing, 1994; Jhariya *et al.,* 2024). Forest health is regulated by natural recovery through regeneration in space and time, which determines the status of future stands and their overall sustainability (Jhariya *et al.,* 2023).

Understanding the distribution, pattern, and species presence in different stands is key to assessing the vegetation dynamics, environmental gradient, and disturbance regimes. This information helps to develop management and conservation strategies and plan towards sustainability (Baghel *et al.,* 2025; Rajput *et al.,* 2025). The northern part of Chhattisgarh in India shows the tropical deciduous forest landscape with substantial diversity and richness of biological resources. Despite their socio-economic-ecological role, these resources are degrading day by day due to biotic interferences and mismanagement. However, various scientific explorations have documented the species composition of central Indian forests, but a comprehensive database of northern Chhattisgarh is still a scarce resource and remains limited. Thus, this study highlights the floristic diversity, richness, distribution, and composition in different forest stands in line to facilitate a baseline database towards biodiversity conservation, restoration, and sustainable resource management.

MATERIALS AND METHODS

The study sites placed at Duldula block of Jashpur district. The study was conducted in the Duldula region of Northern Chhattisgarh. The study area lies between 22˚17-23˚15 N and 83˚30-84˚24 E. The forest of the area is tropical dry deciduous type with domination of *Shorea robusta*. The climate is monsoon type with 3-4 months of critical dry periods. Several economically and medicinally important plants occur in the forest area. Highly mountainous and forested, Jashpur is known for its natural beauty and is rich in natural resources; the land is fertile, and forest products are in abundance.

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The forests of the Duldula region of northern Chhattisgarh are divided into different sites based on disturbance and canopy closure, *viz*., degraded forest, regenerated forest, moderately dense forest, dense forest, and teak plantation. Following local inquiry, the field investigation was done, followed by site condition monitoring. The vegetation (trees, saplings, seedlings, shrubs, climbers, and herbs) was identified through local inquiry with people, consulting the literature of the region. The data were collected, recorded, and quantified at the species level. The trees and saplings were analysed by randomly laying quadrats of size 10 m x 10 m, while the seedlings, shrubs, and climbers were assessed within the 5 m x 5 m quadrats in each site. The herb was assessed using a 50 cm x 50 cm quadrat. The seedlings and shrubs were measured at the basal region, while the climbers and herb were enumerated by the count method. The assessment of species rarity or commonness in the sanctuary area was conducted using frequency classes. In this classification, the percentage frequency of the species was classified as A, B, C, D, and E, where A represents rare, B represents low frequency, C represents intermediate frequency, D represents moderately high frequency, and E represents high frequency (common) (Raunkiaer, 1934). Further, the nativity of the species and utilization were recorded using standard literature.

RESULTS AND DISCUSSION

Floristic richness and diversity

A total of 21 tree species in different forest stands were recorded. A total of 5, 3, 7, 15, and 3 species under the tree layer were recorded for degraded forest stand, regenerated forest, moderately dense forest, dense forest, and teak plantation, respectively (Table 1). In the case of the sapling layer, a total of 7, 15, 13, 16, and 3 species were found in the degraded forest stand, regenerated forest, moderately dense forest, dense forest, and teak plantation, respectively. A total of 8, 10, 14, 16, and 5 species were recorded in the degraded forest stand, regenerated forest, moderately dense forest, dense forest, and teak plantation for the seedling layer. A total of 14 shrub species were found in different forest stands, and the highest number of species was reported in regenerated forest. A total of 17 climber species were recorded in different forest stands, and the highest number of species was recorded both for regenerated forest and dense forest. In the herb layer, a total of 30 species were recorded, and the highest number of species (14) was recorded for dense forest.

Table 1: Presence/Occurrence of the tree species in different sites

Species	Degraded Forest	Regenerated Forest	Moderately Dense Forest	Dense Forest	Teak Plantation
Tree Layer					
Anogeissus latifolia Wall.	-	-	+	-	-
Adina cardifolia Hook.f.	-	-	-	+	-
Boswellia serrata, Roxb.	-	-	+	-	-
Buchanania lanzan Spreng.	+	+	+	+	-
Cassia fistula Linn.	-	-	-	-	+
Chloroxylon Swietenia D.C.	-	-	-	+	-
Diospyros melanoxylon Roxb.	+	-	+	+	-
Gardenia latifolia Roxb.	-	-	+	+	-
Lagerstroemia parviflora Roxb.	-	-	+	-	+
Litsea glutinosa (Lour.) C.B.Rob	-	+	-	+	-
Madhuca latifolia, Roxb.	+	-	-	+	-
Phyllanthus emblica L.	-	-	-	+	-
Pterocarpus marsupium, Roxb.	-	-	-	+	-
Saccopetalum tomentosum H.F, & Thoms	-	-	-	+	-
Schleichera oleosa Willd.	-	-	-	+	-
Shorea robusta Gaertn.f.	+	-	+	+	-
Syzygium cumini (L.)	-	-	-	+	-
Tectona grandis Linn. f.	-	-	-	-	+
Terminalia bellerica Roxb	-	-	-	+	-
Terminalia chebula Retz.	-	-	-	+	-
Terminalia tomentosa W&A.	+	+	-	-	-
Sapling Layer					
Anogeissus latifolia Wall.	-	-	+	+	-
Antidesma ghaesembilla, Gaertn.	-	+	-	-	-
Buchanania lanzan Spreng.	+	+	+	+	-

Cassia fistula Linn.	-	-	-	+	+
Cleistanthus collinus, Benth.	-	-	+	-	-
Diospyros melanoxylon Roxb.	+	+	+	+	+
Gardenia latifolia Roxb.	-	-	+	-	-
Grewia tillifolia,Vahl.	-	+	-	-	-
Holarrhena pubescens Wall.	+	+	+	+	-
Kydia calycina Roxb.	-	-	+	-	-
Lagerstroemia speciosa (L.) Pers.	-	-	-	+	-
Madhuca latifolia Roxb.	+	+	+	+	-
Mitragyna parviflora Roxb.	-	+	-	+	-
Phyllanthus emblica L.	-	-	-	+	-
Pterocarpus marsupium Roxb.	-	+	-	+	-
Schrebera swietenioides Roxb.	-	+	-	-	-
Semecarpus anacardium, L.f.	-	-	+	-	-
Shorea robusta Gaertn. f.	+	+	+	+	-
Stereospermum chelenoides (L. fil.) DC.	-	+	-	-	-
Strychnos potatorum Linn.	+	+	-	+	-
Syzygium cumini (L.)	-	+	+	+	-
Tectona grandis Linn. f.	-	-	-	-	+
Terminalia bellerica Roxb	-	-	-	+	-
Terminalia chebula Retz.	-	+	+	+	-
Terminalia tomentosa W&A.	+	+	+	+	-
Seedling Layer					
Adina cardifolia Hook.f.	-	-	-	+	-
Anogeissus latifolia Wall.	-	-	+	+	-
Antidesma ghaesembilla Gaertn.	-	+	-	-	-
Buchanania lanzan Spreng.	+	+	+	+	-
Careya arborea Roxb.	+	-	+	-	-
Cassia fistula Linn.	-	-	-	+	+
Diospyros melanoxylon Roxb.	+	+	+	+	+
Grewia tillifolia Vahl.	-	+	+	-	-
Holarrhena pubescens Wall.	+	+	+	+	+
Kydia calycina Roxb.	-	-	-	-	-
Lagerstroemia parviflora Roxb.	-	-	+	+	-
Madhuca latifolia Roxb.	-	+	+	+	-
Ougeinia oojeinensis Benth.	-	-	-	+	-
Phyllanthus emblica L.	-	+	+	+	-
Pterocarpus marsupium Roxb.	-	-	+	+	-
Schleichera oleosa Willd.	-	-	-	+	-
Semecarpus anacardium, L.f.	-	+	+	-	-
Shorea robusta Gaertn.f.	+	+	+	+	+
Strychnos potatorum Linn.	+	-	-	-	-
Syzygium cumini (L.)	+	-	+	+	-
Tectona grandis Linn. f.	-	-	-	-	+
Terminalia chebula Retz.	-	-	-	+	-
Terminalia tomentosa W&A.	+	+	+	+	-
Shrub Layer					
Antidesma diandrum Roth.	+	-	-	-	-
Calotropis gigantea R. Br.	-	-	-	-	+
Carissa spinarum A. DC.	-	+	+	+	-
Casearia graveolens Dalz.	+	+	-	+	-
Caesalpinia crista Linn.	-	+	-	-	-
Capparis aphylla Roth.	-	-	+	-	-
Embelia robusta Roxb	-	-	-	+	-
Indigofera pulchella Roxb.	+	-	+	-	-
Indigofera tinctoria Linn.	-	+	-	-	-
Lantana camara Linn.	+	+	-	-	+

Leea asiatica (L.) Ridsdale	-	+	-	-	-
Woodfordia floribunda Salist.	+	-	+	+	-
Ziziphus oenoplia Mill.	+	+	-	-	-
Ziziphus xylopyra Willd.	-	+	+	+	+
Climber Layer					
Acacia caesia W. & A.	+	-	+	+	-
Abrus precatorius Linn.	+	+	+	+	-
Acacia pennata Willd.	+	-	-	-	-
Atylosia scarabaeoides (L.) Benth	-	+	+	-	-
Bauhinia valhii W. & A.	+	-	+	+	-
Butea superba Roxb.	+	-	-	-	+
Cajanus scarabaeoides (L.) Thouars	-	-	-	-	+
Calycopteris floribunda Lamk.	-	+	-	-	-
Cayratia auriculata (Roxb.) Gamble	-	-	-	-	-
Combretum decandrum, Roxb.	-	+	-	-	-
Cryptolepis buchanani R. & S.	-	+	-	-	-
Cuscuta reflexa Roxb.	+	-	-	-	-
Derris scandens Benth.	-	-	-	-	+
Hemidesmus indicus R. Br.	-	-	-	+	-
Smilax ovalifolia Rox	-	-	-	+	-
Olax imbricata Roxb	-	-	-	-	+
Ventilago calyculata Tul.	-	+	+	+	-
Herb Layer					
Ageratum conyzoides (L.)	-	+	-	-	-
Andrographis paniculata Burm.f.	-	-	-	+	-
Apluda mutica L.	-	-	-	+	-
Apluda varia Hack	+	-	+	+	-
Blepharis maderaspatensis (L.) B.Heyne ex Roth	-	+	-	-	-
Cassia absus L.	-	-	-	+	-
Cassia tora L.	-	-	+	+	-
Chrolophytum tuberosum Roxb.	-	-	-	+	-
Chrysopgon montanus Trin.	-	-	-	+	-
Crotalaria retusa Linn.	-	+	-	-	-
Cynodon dactylon Pers.	+	-	+	+	+
Cyprus rotundus L.	+	+	+	+	+
Desmostachya bipinnata Stapf.	-	-	+	-	-
Echinochloa colona Link.	-	-	+	-	-
Evolvulus nummularius (L.)	-	-	-	-	+
Eragrostis diarrhena (Schult. & Schult.f.) Steud.	+	+	+	+	-
Heteropogon contortus Beauv.	+	-	-	-	-
Imperata cylindrica P. Beauv.	+	-	-	-	-
Leucas aspera (Willd.) Link	-	-	-	-	+
Malvastrum coromandelianum L.	-	-	-	-	+
Oplismenus burmannii (Retz.) P.Beauv	-	+	+	+	-
Phyllanthus fraternus Webster	-	-	-	-	+
Psoralea corylifolia Linn.	-	+	-	-	+
Pteris vittata L.	+		+	-	+
Rungia parviflora Nees	-	+	-	-	-
Saccharum spontaneum L.	-	-	-	+	-
Setaria glauca L.	-	-	+	+	-
Themeda quadrivalvis O. Kuntz.	-	+	+	-	-
Trifolium sp	+	+	-	+	+
Urtica dioica Linn.	-	+	-	-	-

Note: (+) = present, (-) = absent

A total of 89 species (28 tree species, 14 shrub species, 17 climber species, and 30 herb species) were recorded in different forest stands of the Duldula region of Jashpur (C.G.). In the overall floristic richness tree, shrub, climber, and herb contribute 31.46%, 15.73%, 19.10%, and 33.71%, respectively, in total. The highest contribution by herbaceous vegetation reflects the suitable microclimate, followed by canopy gaps that permit light to reach the ground and provide a suitable growing environment for the species. Herb species are highly responsive to disturbance and environmental regimes, making them a reliable indicator of ecosystem condition and forest recovery (Gilliam, 2007). After herbaceous vegetation, tree species possess higher flora, reflecting their dominant position in forest structure, maintaining the upper canopy and ecological services (Pretzsch, 2009). Climbers contribute to structural complexity and species interactions in tropical forest stands. They enhance vertical connectivity and biodiversity of the region (Schnitzer and Bongers, 2002). The lower comparative representation of shrubs than others might be a result of competition, canopy architecture, and site conditions (Odum and Barrett, 2005).

Species Rarity and Commonness

The frequency class distribution entails the species rarity and commonness over the site (Table 2). The Raunkiaer class varied among different forest stands and vegetation layers, which showcases the variation in species admixture and regeneration prospects. In the degraded forest, tree layers reflect the absence of intermediate-sized classes; 40% of species showed rarity over the site, while low, moderately high, and common classes showed equal distribution (each 20%). In contrast, regenerated, moderately dense, and dense forests reflect higher concentrations of saplings, seedlings, and herb distribution in Class B, showing more stable vegetation. Under teak plantation, it reflects simpler distribution from lower to higher classes. The most common frequency class distribution is restricted to Classes A and B, reflecting its infrequent or moderate distribution, which is a common characteristic of tropical forests (Condit *et al.*, 2002).

Table 2: Frequency class distribution of species under different strata and sites

Site	Layer	Frequency class				
		A	**B**	**C**	**D**	**E**
Degraded Forest	Tree	2	1	0	1	1
	Sapling	4	1	1	1	0
	Seedling	3	2	0	2	1
	Shrub	0	3	3	0	0
	Climber	0	2	3	0	0
	Herb	0	4	3	1	0
Regenerated Forest	Tree	2	1	0	0	1
	Sapling	6	6	1	1	1
	Seedling	3	4	2	1	0
	Shrub	1	6	1	0	0
	Climber	2	2	1	0	1
	Herb	0	3	6	2	0
Moderately Dense Forest	Tree	2	6	1	0	1
	Sapling	3	3	4	2	1
	Seedling	2	6	4	1	1
	Shrub	0	3	2	0	0
	Climber	1	1	1	1	1
	Herb	1	8	2	1	0
Dense Forest	Tree	10	4	1	0	1
	Sapling	5	6	3	1	1
	Seedling	1	10	0	4	1

	Shrub	1	3	1	0	0
	Climber	0	4	1	0	1
	Herb	1	9	4	0	1
Teak Plantation	Tree	2	0	0	0	1
	Sapling	2	0	0	0	1
	Seedling	1	1	1	2	0
	Shrub	1	1	0	0	1
	Climber	3	2	0	0	0
	Herb	3	3	1	1	0

Note: A (0-20)= rare, B (20-40)= low, C (40-60)= intermediate, D (60-80)= moderately high, E (80-100)= high/common

Nativity analysis

The origin of species or nativity analysis reflects that most of the species that occurred in different forest stands are native to India and South Asia, reflecting strong indigenous characters of the floristic diversity (Table 3). Further, a few exotic taxa were found in different layers, showcasing natural floristic integrity retained by the study forests besides a limited introduced species distribution. The dominance of indigenous taxa in northern Chhattisgarh imitates natural phytogeographical affinity, ecosystem stability and resilience (Pavoine and Ricotta, 2023).

Table 3: Nativity of species found in the study sites of northern Chhattisgarh

Tree Species		
Species	**Family**	**Origin**
Adina cordifolia Hook.f.	Rubiaceae	Southern Asia
Anogeissus latifolia Wall.	Combretaceae	India
Antidesma ghaesembilla Gaertn.	Euphorbiaceae	Australia
Boswellia serrata Roxb.	Burseraceae	India
Buchanania lanzan Spreng.	Anacardiaceae	South east Asia
Careya arborea Roxb.	Lecythidaceae	Indochina
Cassia fistula Linn.	Legumuinosae	India
Cleistanthus collinus Benth.	Phyllanthaceae	Australia
Chloroxylon Swietenia D.C.	Meliacese	Southern India
Diospyros melanoxylon Roxb.	Ebenaceae	India
Gardenia latifolia Ait.	Rubiaceae	India
Grewia tillifolia Vahl.	Tiliaceae	Sri Lanka
Holarrhena pubescens Wall.	Apocynaceae	Southern Africa
Kydia calycina Roxb.	Juncaceae	South east Asia
Lagerstroemia speciosa (L.) Pers.	Lytharaceae	Southern Asia tropical
Litsea glutinosa (Lour.) C.B.Rob	Lauranceae	India
Madhuca latifolia Roxb.	Sapotaceae	India
Mitragyna parviflora Roxb.	Rubiaceae	India
Ougeinia oojeinensis Benth.	Leguminosae	India
Phyllanthus emblica L.	Euphorbiaceae	India
Pterocarpus marsupium Roxb.	Legumuinosae	West indies
Saccopetalum tomentosum H.F,&Thoms	Anonaceae	India, Sri Lanka
Schleichera oleosa Willd.	Sapindaceae	Indo China
Schrebera swietenioides Roxb.	Dipterocarpaceae	India
Semecarpus anacardium L.f.	Anacardiaceae	India
Shorea robusta Gaertn. f.	Dipterocarpaceae	India
Stereospermum chelenoides (L. fil.) DC.	Bignoniaceae	South Asia
Strychnos potatorum, Linn.	Loganiaceae	Burma
Syzygium cumini (L.)	Sapindaceae	India
Tectona grandis Linn. f.	Lamiaceae	South East Asia
Terminalia bellerica Roxb	Combretaceae	South East Asia
Terminalia chebula Retz.	Combretaceae	South Asia

Terminalia tomentosa W&A.	Combretaceae	Southern & Southeast Asia
Shrub Species		
Antidesma diandrum, Roth.	Phyllanthuceae	China, Pakistan
Calotropis gigantea R. Br.	Apocynaceae	Shri Lanka, India
Carissa spinarum A. DC.	Apocynaceae	Africa
Casearia graveolens Dalz.	Salicaceae	Asia, China
Caesalpinia crista Linn.	Fabaceae	India, Africa
Capparis aphylla Roth.	Capparaceae	India, Africa
Embelia robusta Roxb	Leguminoseae	India
Indigofera pulchella, Roxb.	Fabaceae	India
Indigofera tinctoria Linn.	Fabaceae	India
Lantana camara Linn.	Verbenaceae	American tropics
Leea asiatica (L.) Ridsdale	Vitaceae	West Asia
Woodfordia floribunda Salist.	Lythraceae	Shri Lanka, India
Ziziphus oenoplia Mill.	Rhamnaceae	Bangladesh
Ziziphus xylopyra Willd.	Rhamnaceae	Southeast Asia
Climber Species		
Acacia caesia W. & A.	Leguminosae	Bangladesh
Abrus precatorius Linn.	Fabaceae	India
Acacia pennata Willd.	Fabaceae	South-east Asia
Atylosia scarabaeoides (L.) Benth	Fabaceae	Australia
Bauhinia valhii W. & A.	Fabaceae	India
Butea superba Roxb.	Fabaceae	India
Cajanus scarabaeoides (L.) Thouars	Fabaceae	Africa
Calycopteris floribunda Lamk.	Combertaceae	Bangladesh, India
Cayratia auriculata (Roxb.) Gamble	Vitaceae	Africa, Asia
Combretum decandrum Roxb.	Combertaceae	India
Cryptolepis buchanani R. & S.	Apocynaceae	India
Cuscuta reflexa Roxb.	Convolvulaceae	India
Derris scandens Benth.	Fabaceae	India, Asia, Australia
Hemidesmus indicus R. Br.	Apocynaceae	India
Smilax ovalifolia Rox	Smilacaceae	China tropical
Olax imbricata Roxb	Olacaceae	India
Ventilago calyculata Tul.	Rhamnaceae	South-east Asia, Australia
Herb Species		
Ageratum conyzoides (L.)	Asteraceae	Tropical America
Andrographis paniculata Burm.f.	Acanthaceae	India, Shri Lanka
Apluda mutica L.	Poaceae	Central Asia, China, Japan
Apluda varia Hack	Poaceae	Asia, India
Blepharis maderaspatensis (L.) B.Heyne ex Roth	Acanthaceae	Africa, Southeast Asia
Cassia absus L.	Fabaceae	India, Southeast Asia
Cassia tora L.	Fabaceae	Central America
Chrolophytum tuberosum Roxb.	Asparagaceae	Africa, India
Chrysopogon montanus Trin.	Poaceae	India, Southeast Asia
Crotalaria retusa Linn.	Asparagaceae	Tropical Asia, Africa, Australia
Cynodon dactylon Pers.	Poaceae	Africa
Cyprus rotundus L.	Cyperaceae	Africa, Central Europe, Southern Asia
Desmostachya bipinnata, Stapf.	Poaceae	Northern Africa, China, India
Echinochloa colona, Link.	Poaceae	Tropical Asia
Evolvulus nummularius (L.)	Convolvulaceae	Mexico, South America
Eragrostis diarrhena (Schult. & Schult.f.) Steud.	Poaceae	Tropical Africa, Subtropical Asia
Heteropogon contortus Beauv.	Poaceae	Southern Asia, Africa, Northern Australia
Imperata cylindrica P. Beauv.	Poaceae	Southern Asia, India, Australia
Leucas aspera (Willd.) Link	Lamiaceae	India
Malvastrum coromandelianum L.	Malvaceae	North and South America
Oplismenus burmannii (Retz.) P.Beauv	Poaceae	Zimbabwe

Phyllanthus fraternus Webster	Phyllanthus	Pakistan
Psoralea corylifolia Linn.	Fabaceae	India, Shri Lanka
Pteris vittata L.	Pteridaceae	Asia, Tropical Africa, Australia
Rungia parviflora Nees	Acanthaceae	India
Saccharum spontaneum L.	Poaceae	India
Setaria glauca L.	Poaceae	India
Themeda quadrivalivis O. Kuntz.	Poaceae	India, Nepal, Malaysia
Trifolium sp.	Fabaceae	Central Asia
Urtica dioica Linn.	Urticaceae	Europe, Asia, North Africa

Ethnobotanical Scenarios

The ethnobotanical inventory reflects that the recorded tree species are associated with diverse taxonomic groups, with varied parts used for economic and medicinal purposes. The plant part used reflects that bark was the most used than the other parts, showing a strong reliance on this for traditional healthcare. The medicinal utilization is predominantly associated with the cure of gastrointestinal disorders and peptic ulcers using the species *A. cordifolia*, *A. latifolia*, *H. pubescens*, *T. bellirica*, *T. tomentosa*, *S. cumini*, and *P. emblica* (Table 4). Besides, several other medicinal uses (skin care, wound healing, pain, diabetes, various disorders, etc.) were also mentioned with the suitable species. The higher use of bark and leaves in traditional cure reflects their higher preference due to the availability of secondary metabolites in these parts (Yadav *et al*., 2015; Painkra *et al.*, 2015; Tomar and Singh, 2006; Tomar, 2007; Tomar, 2009; Tomar, 2022 & Tomar, 2023).

Table 4: Species utilization and ethnobotanical uses of species

Tree Species	**Plant Part Use**	**Utilization**
Adina cardifolia Hook.f.	Bark	Bark for dysentery, bruises and wounds
Anogeissus latifolia Wall.	Bark, Heart Wood, Gum	Diarrhea, dysentery, skin diseases, jaundice
Antidesma ghaesembilla Gaertn.	Leaf, Branch, Fruit	Fevers, pain, gastrointestinal, timber and dye
Boswellia serrata Roxb.	Gum	Relieves joint pain, asthma & respiratory care, perfumery & cosmetics, paints, varnishes & inks
Buchanania lanzan Spreng.	Root, Leaves	Skin diseases, heal open wounds, cosmetics & soaps, food
Cassia fistula Linn.	Bark, Fruit pulp and Pods, Root, Leaves	Natural laxative, anti-inflammatory agent, constipation, joint pain, and timber source
Chloroxylon swietenia D.C.	Leaf, Stem, Bark	Skin infection treatments, insect-repellent essential oils, fungal skin infections, rheumatism, and painful joints
Diospyros melanoxylon Roxb.	Leaves, Bark, Root, Fruit	Digestive issues, skin eruptions, joint pain, and snakebites. Provides valuable leaves for the rural beedi industry, edible fruits
Gardenia latifolia Roxb.	Bark, Fruit, Timber	Anti-inflammatory, wound-healing, and natural coloring properties, natural dye, perfume, wood crafting
Grewia tillifolia Vahl.	Stem, Bark, Leaves	Healing wounds and treating ulcers
Holarrhena pubescens Wall.	Seed, Bark, Root	Treating severe diarrhea, amoebic dysentery, and skin conditions
Kydia calycina Roxb.	Leaf, Bark, Stem	Treating body pains, skin diseases, and joint aches
Lagerstroemia parviflora Roxb.	Bark, Wood, Leaf	Treat skin sores, carbuncles, and syphilis, coughs, asthma, and bronchitis**,** silk farming, dyes and tannins, fuel and gum
Litsea glutinosa (Lour.) C.B.Rob	Seed, Bark, Leaf, Flowers	Bone fractures and bruises, gastrointestinal relief, incense, agarbatti binding, soap and candle production
Madhuca latifolia Roxb.	Seed Oil, Leaves, Flowers, Bark	Soaps, traditional liquors and industrial alcohol, joint pain, rheumatism, and swelling

Mitragyna parviflora Roxb.	Leaf, Bark	Pain relief**,** wound healing**,** and timber production
Phyllanthus emblica L.	Fruit, Bark	Treats hyperacidity, peptic ulcers, and helps regulate blood sugar levels in diabetic care; immune support, high vitamin C and tannin content
Pterocarpus marsupium Roxb.	Bark, Leaves, Gum, Wood	Timber, dyes, tannins, cosmetics, diarrhea, dysentery, and oral ulcers
Saccopetalum tomentosum H.F,&Thoms	Seed, bark, leaves	Essential oils, carbohydrates, proteins, and essential vitamins
Schleichera oleosa Willd.	Seed, Bark, Leaves	Treat acne, skin itches, burns, and ringworm, relieve rheumatic and joint pains, biodiesel and fuel, lac production
Shorea robusta Gaertn.f.	Seed, Bark, Leaves, Resin	Diarrhea, dysentery, and weak digestion, oil and resin, cooking, making soaps
Stereospermum chelenoides (L. fil.) DC.	Root, Bark, Leaves	Anti-inflammatory, antimicrobial, and timber properties
Strychnos potatorum Linn.	Seed, Fruit	Eye to treat conjunctivitis, corneal ulcers, and watering eyes, paper and textiles
Syzygium cumini (L.)	Seed, Bark, Leaves, Fruit, Wood	Helps lower blood glucose, diarrhea, dysentery, and stomach cramps
Tectona grandis Linn. f.	Bark, Leaves, Fruit	Treating wounds, skin diseases, easing inflammation, blood purifier
Terminalia bellerica Roxb	Fruit /Pulp	For digestive trouble
Terminalia chebula Retz.	Fruit	Seeds for leucorrhea
Terminalia tomentosa W&A.	Bark, Wood	Diarrhea, dysentery, ulcers, fractures, and bleeding disorders, timber, sericulture, tannin and gum

CONCLUSION

The studied forest has high species presence and distribution reflecting a good regional biodiversity. Overall, the floristic diversity recorded in the Duldula region reflects its ecological significance and its utilization in traditional health care, economic and other uses. Considering the dominance of indigenous species and the limited distribution of many taxa, effective protection, conservation, and sustainable management are essential to preserve this valuable floristic diversity for future generations and to ensure long-term ecological resilience and sustainability.

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