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continued on the back inside cover

Cover: A Warty Hammer Orchid *Drakaea livida* gets pollinated by a male thynnine wasp through 'sexual deception' — a colour pencil reproduction of photos by ron_n_beths (flickr.com) and Rod Peakall; Water colour reproduction of Flame Lily *Gloriosa superba* -- photo by Passakoran_14; and a bag worm and its architectural genius (source unknown). Art work by Pannagasri G.

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ARTICLE

Ecological status, distribution, and conservation strategies of *Terminalia coronata* in the community forests of southern Haryana, India

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Abstract: *Terminalia coronata* is one of the economically and ecologically important native species of the arid and semi-arid region of south-west Haryana in India. However, the information on the distribution pattern and population structure of this species is very limited. Therefore, a study was aimed to inventorise, characterize, and map the distribution of *T. coronata* in the state of Haryana, India. Population inventory indicated that *T. coronata* is one of the fast-depleting species in the studied region. Consequently, further study was conducted to assess the threat and extinction risk of *T. coronata* in the southern and southwestern Haryana. Some efforts have also been made to design various conservation strategies, such as, development of standard protocols for nurseries, and formulation of government policies for ex situ & in situ conservation of *T. coronata* in Haryana. Results revealed that the distribution of *T. coronata* was limited to only seven districts of Haryana, including Nuh, Rewari, Mahendergarh, Charkhi Dadri, Bhiwani, Jhajjar, and Rohtak. Only 475 individuals of the species were found at 47 sites. The natural regeneration of the species was almost absent. It was suggested that species extinction could be prevented by reducing overexploitation, heavy lopping, land use change, heavy biotic pressure, habitat fragmentation, and climate change. Immediate measures are needed to conserve and develop the species population through appropriate propagation techniques.

Keywords: Biotic pressure, climate change, endemic, habitat fragmentation, Indrok, population structure, threatened.

Hindi: संक्षेप: टर्मिनलिया कोरोनाटा भारत के दक्षिण-पश्चिम हरियाणा प्रदेश के शुष्क और अर्ध-शुष्क क्षेत्रों की आर्थिक और पारिस्थितिक रूप से महत्वपूर्ण देशी वृक्ष प्रजातियों में से एक है। हालाँकि, इस प्रजाति के वितरण, स्वरूप और जनसंख्या संरचना के बारे में जानकारी बहुत सीमित है। अतः हरियाणा राज्य में इस वृक्ष के वितरण को सूचीबद्ध करने, विशेषतावर्णन करने और मानचित्रण करने के उद्देश्य से एक अध्ययन कियागया। जनसंख्या आंकड़ों से संकेत मिलते है कि अध्ययन किए गए क्षेत्र में टर्मिनलिया कोरोनाटा तेजी से कम हो रही प्रजातियों में से एक है। परिणामस्वरूप, दक्षिणी और दक्षिण-पश्चिमी हरियाणा में इस वृक्ष के खतरे और विलुप्त होने के जोखिम का आकलन करने के लिए आगे का अध्ययन किया गया। विभिन्न संरक्षण नीतियों को अभिकल्प करने के लिए कुछ प्रयास भी किए गए हैं, जैसे कि पौधशाला के लिए मानक संलेख का विकास और हरियाणा प्रदेश में टर्मिनलिया कोरोनाटा के अपने प्राकृतिक आवास व प्राकृतिक परिवेश के बाहर के लिए सरकारी नीतियों का निर्धारण शामिल है। परिणामों से पता चलता है कि टर्मिनलिया कोरोनाटा का वितरण हरियाणा राज्य के केवल सात जिलों तक ही सीमित है, जिनमें नूंह, रेवाड़ी, महेन्द्रगढ, चरखीदादरी, भिवानी, झज्जर और रोहतक शामिल है। 47 स्थलों पर इस प्रजाति के केवल 475 वृक्ष पाए गए। इस प्रजाति का प्राकृतिक पुनर्जनन लगभग नगण्य दर्ज किया गया। यह सुझाव दिया गया कि अतिदोहन, अत्यधिक कटाई, भूमि उपयोग परिवर्तन, भारी जैविक दबाव, आवास विखंडन और जलवायु परिवर्तन को कम करके प्रजातियों के विलुप्त होने को रोका जा सकता है। उपयुक्त प्रसारत कनीकों के माध्यम से इस प्रजातियों की आबादी के संरक्षण और विकास के लिए तत्काल उपाय किए जाने की आवश्यकता है।

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Author contributions: KCM and SSY conceptualized and designed the study. KCM, MSB, and SSY surveyed the area, collected data. KCM, MSB, SSY and PB helped in identification of the plant material. KCM and NS wrote the first draft of the manuscript. SSY supervised the whole study. All authors were actively involved in manuscript preparation, reviewing and editing.

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INTRODUCTION

The genus *Terminalia* L. (Combretaceae) comprises approximately 200 species of trees and shrubs distributed across tropical, and subtropical zones, many of which yield high-value non-timber forest products (NTFPs) (Zhang et al. 2019). In India, *Terminalia* species play fundamental ecological and socioeconomic roles, particularly in dry deciduous and thorn forest ecosystems by providing fuelwood, fodder, medicines, and ecosystem stability. *Terminalia coronata* (Stapf) Gere & Boatwr. is among the lesser-studied species in this complex, with its taxonomy recently clarified through molecular revision, wherein *Anogeissus* genus is assimilated into *Terminalia* (Maurin et al. 2017).

Terminalia coronata is a drought-adapted species native to northwestern and central India, occurring in seasonally dry tropical biomes and presently reported as 'endemic and threatened' in the arid, and semi-arid regions of northwestern India, noting its occurrence in patches—especially in sandy-loam to loamy-sandy soils of depressed landforms (Singh et al. 2021). Within Haryana, especially in the seven districts of Nuh, Rewari, Mahendergarh, Charkhi Dadri, Jhajjar, Rohtak, and Bhiwani, the species is largely confined to the Aravalli hill system, and associated rocky outcrops, configured as a mosaic of community forests, village commons, and degraded scrublands. These landscapes fall under the northern tropical thorn and dry deciduous forest types (Champion & Seth 1968). *Terminalia coronata* tends to appear in small subpopulations along shallow colluvial soils and edges of degraded forest, often co-occurring with species such as *Senegalia senegal*, *Vachellia leucophloea*, *Balanites aegyptiaca,* and *Boswellia serrata*, which are dominant components of biomass in similar landscapes. Its socio-economic uses are consistent with related species, serving as fuelwood and small timber; stems are coppiced for poles, and implements; leaves are occasionally used as fodder; and bark or foliage may serve in traditional remedies as astringents. Similar ethnopharmacological uses are common in *Anogeissus* (now *Terminalia*) species in India and Asia, including treatment of gastric disorders, skin conditions, and wound healing (Zhang et al. 2019). Despite this ecological and socio-economic significance, scientific knowledge of *T. coronata* in Haryana remains fragmentary. Existing literature (regional floras and forest working plans) makes only incidental mentions, lacking quantitative data on distribution patterns, population density, regeneration potential, habitat associations, or responses to disturbance. Also missing are insights into reproductive ecology, genetic diversity, or propagation methods tailored to local restoration efforts.

This knowledge gap presents a pressing conservation challenge, without a clear understanding of the species' spatial occurrence, population health, regeneration dynamics, and threats, it is impossible to properly assess its IUCN Red List status at the state level, design effective management interventions, or include it in Aravalli restoration and enrichment initiatives. Haryana, one of the distributional ranges of *T. coronata*, is a northwestern state in India with a total geographical area of 44,212 km^2. Various theories have proved that the distribution of species is primarily determined by its evolution base, biogeography, and conservation actions taken from time to time (Barik et al. 2018). All these theories have also suggested that biotic, abiotic, and anthropogenic factors played a vital role in the spatial distribution pattern of the species (McKinney 2002). Therefore, the present study provides the first comprehensive species-level assessment of *T. coronata* across community forests in Nuh, Rewari, Mahendergarh, Charkhi Dadri, Jhajjar, Rohtak, and Bhiwani. Outcomes of the study will map its current distribution and habitat associations; quantify population structure based on Diameter at Breast Height (DBH) and regeneration modes; evaluate environmental and anthropogenic influences on its occurrence and formulate community-compatible conservation. These efforts aim to inform species-specific conservation planning, guide propagation and restoration protocols, and strengthen biodiversity resilience in southern Haryana, India.

MATERIALS & METHODS

Study site

Present study was conducted in seven districts of southern part of Haryana State in India. A total of 47 locations were identified in seven districts in Haryana (Nuh, Rewari, Mahendergarh, Charkhi Dadri, Jhajjar, Bhiwani, and Rohtak) (Figure 1, 2). The climatic conditions of the study area vary from arid to semi-arid. Rainfall pattern varies 350–650 mm annually, with majority (75%) of the rainfall during July–September. The area has a distinct topography with flat alluvial plains with local undulations of sand-dunes and Aravalli outcrops with altitude varying 215–275 m. Tropical dry deciduous forests and thorn scrub forests characterized the vegetation. The study area covers about 31% of the total geographical area and about 28% of the state's total population (ISFR 2023).

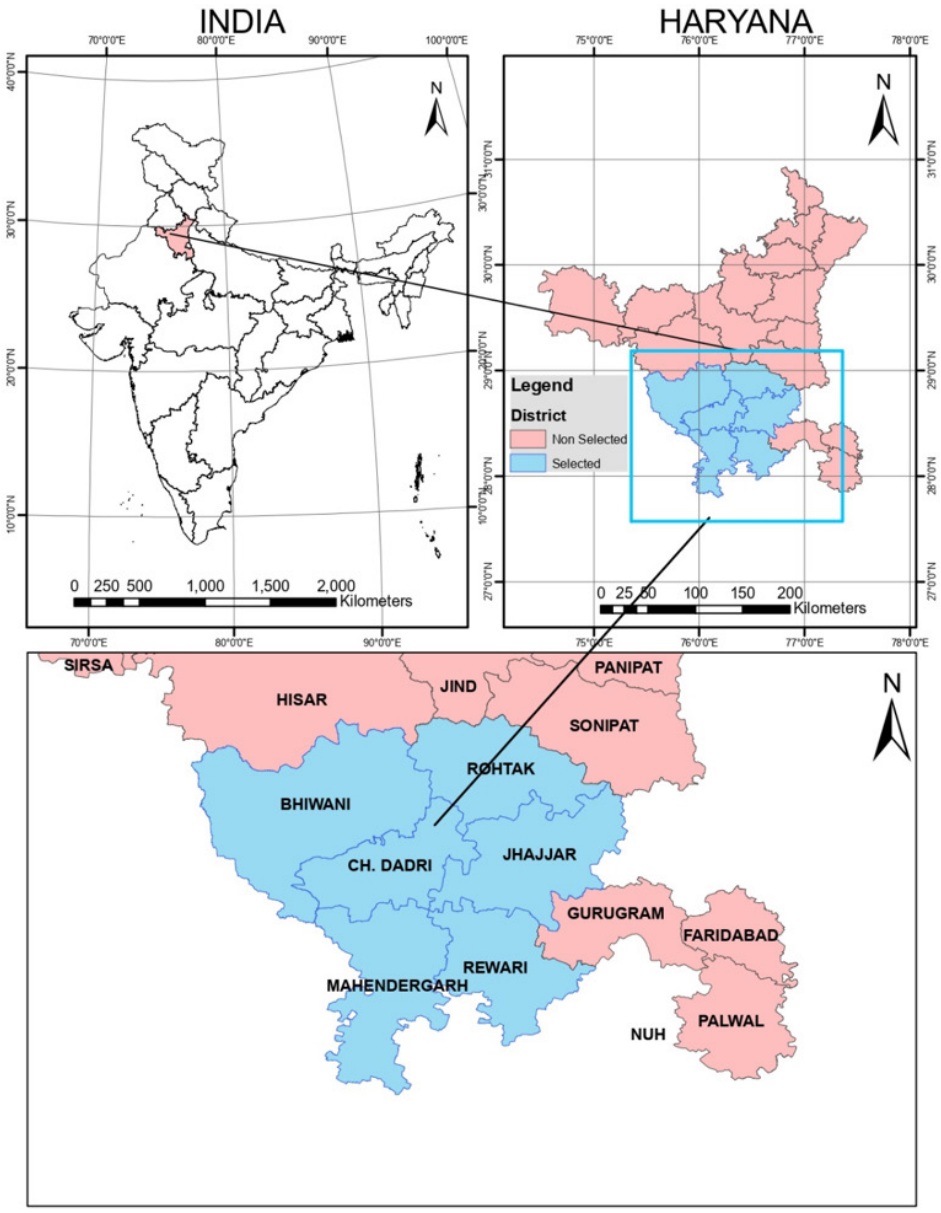

Figure 1. Study area.

Literature survey

An extensive literature survey was conducted to determine historical and contemporary records of *Terminalia coronata* in Haryana following district gazetteers for all districts, forest division working plans, regional floras, tree census records, biodiversity occurrence data, and people's biodiversity registers (PBRs) obtained via district coordinators. Additional location records were gathered through district-wise consultations with forest officials and semi-structured interview with elderly residents of villages possessing community forest patches with open-ended questionnaire. The obtained data were used to corroborate secondary data and identify potential *T. coronata* sites not reflected in official records.

Field investigation

Field investigations were conducted from April 2023 to March 2025 to verify the presence of *T. coronata* across all identified locations. In each site, all individuals—including mature trees, saplings, and seedlings—were enumerated. Botanical identification followed regional floras and taxonomic revisions of *Terminalia*. For each individual, diameter at breast height (DBH), total height, crown diameter, ownership status, and micro-habitat description were recorded.

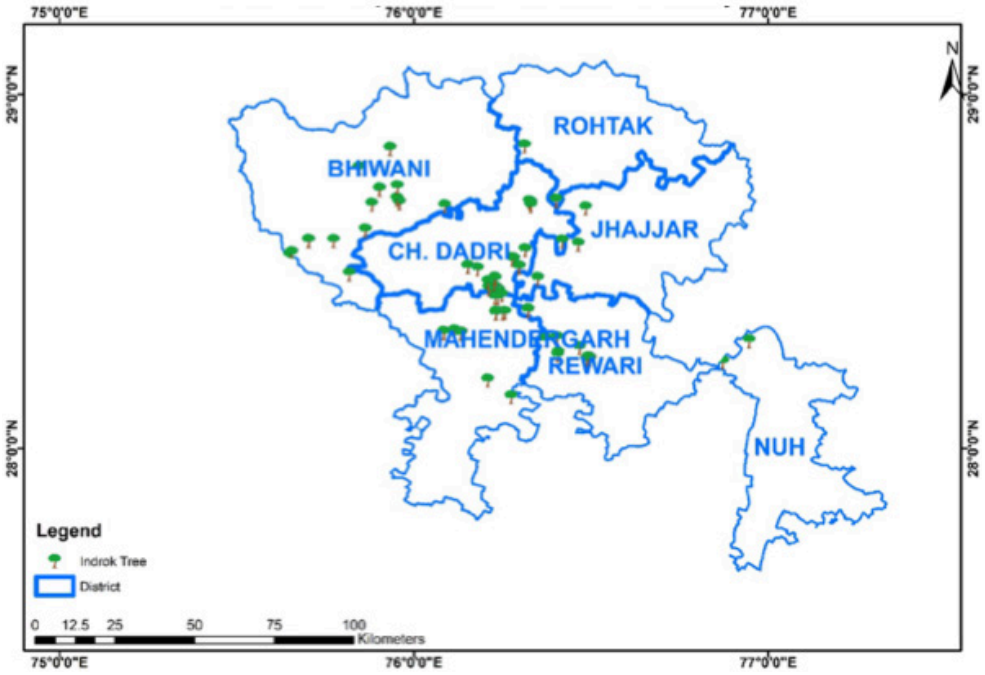

Figure 2. Distribution map of *Terminalia coronata* in Haryana.

The individuals of each tree species were segregated based on their DBH (measured at 1.37 m above ground) exceeding 30 cm were classified as mature trees. Those with DBH less than 10 cm were categorised as seedlings, while individuals with DBH values between these two limits were considered saplings (Malik & Bhatt 2015). The geographic coordinates of each tree were recorded using a handheld GPS receiver. These point data were later imported into GIS software (QGIS v3.28) for spatial analysis & mapping of the species' distribution within, and across districts.

Data management and analysis

Data from all field sites were compiled into a relational database. Summary statistics were generated for population structure (seedling, sapling and mature classes), size-class distribution, and health status. District-wise abundance and density were calculated. The spatial dataset was used to prepare thematic maps illustrating current known distribution, overlaid with administrative boundaries, and forest type layers.

RESULTS AND DISCUSSION

Taxonomic treatment

Terminalia coronata (Stapf) Gere & Boatwr. Bot. J. Linn. Soc. 184: 319. 2017. *Anogeissus coronata* Stapf, Kew Bull. 4: 153. 1914; Bhandari Fl. Indian Desert 140. 1990. *Anogeissus sericea* Brandis, Indian Forester 25: 287. 1899. *Anogeissus sericea* var. *nummularia* King ex Duthie, Fl. Upp. Gang. Pl. 1: 340. 1903; Scott in Kew Bull. 33: 559.1979. *Anogeissus rotundifolia* Blatt. & Hallb., Journal Bombay Nat. Hist. Soc., 36: 525.1919.

Botanical Description

Small tree, 4–6 m high; bark rough to fissured, tomentose; branchlets 1–4 mm thick. Leaves 0.6–2 × 0.4–2 cm, orbicular to flabellate or obovate, rounded, obtuse, truncate or subacute at base, rounded, retuse, obcordate or truncate and mucronulate at apex, coriaceous, tomentellous, pale green when dry; lateral nerves 4–6 pairs, faint, arcuate; tertiary nerves inconspicuous; petioles 1–3 mm long. Inflorescence heads 10–20 mm in diam., axillary, and terminal, rarely branched; peduncles 5–25 mm long, tomentellous; bracts on peduncles two pairs, 1–5 mm long, deciduous; bracteoles 1–2 mm long. Flowers tomentellous. Calyx-tube 3–4 mm long; teeth triangular, c. 0.5 mm long. Stamens 2.5–3.5 mm long. Style 1.5–2.5 mm long. Fruits 3.5–5 × 6–8 mm (excluding beak), brown, glabrous; beak 3–4 mm long; wings undulate.

Flowering & Fruiting

September to February.

Table 1. Distribution of *Terminalia coronata* in different districts.

Name of district	Name of locations/ village	No. of trees	No. of sites with a solitary tree	Geo-coordinates of the site
Nuh	Bissar Akberpur	1	1	N28.302579, E76.945815
	Rathiwas	1	1	N28.243575, E76.871532
	Total (2 sites)	**2**	**2**	
Bhiwani	Danger	10	0	N28.3933, E75.5523
	Dhab Dhani	1	1	N28.3846, E75.5250
	Kairu	1	1	N28.4118, E75.5251
	Legha Bhanan	28	0	N28.4132, E75.5731
	Jitanwas	4	0	N28.42 12, E75.7616
	Mansarbas	9	0	N28.4349, E75.5472
	Kalinga	1	1	N28.8535, E76.3132
	Dhani Gurjan	1	1	N28.41227, E76.51098
	Kudal	13	0	N28.61559, E75.86287
	Nangal	5	0	N28.536213, E75.640266
	Jhumpa Kalan	4	0	N28.492037, E75.817452
	Alampur	2	2	N28.792458, E75.845365
	Kharkari Sohan	17	0	N28.846084, E75.932219
	Dhanimahu	3	0	N28.737760, E75.953110
	Chahar Khurd	10	0	N28.586316, E75.702753
	Total (15 sites)	**109**	**6**	
Charkhi Dadri	Changroad	2	0	N28.281121, E76.123303
	Sanwar-Bhageswari Road	2	0	N28.4143316, E76.1931944
	Bhageswari	7	0	N28.684206, E76.330160
	Dudhwa	4	0	N28.28410, E76.13473
	Balali	1	1	N28.506163, E76.180407
	Jhojhu Kalan	3	0	N28.513453, E76.153785
	Jhojhu Kalan-Java Road	2	0	N28.512821, E76.152611
	Mauri	41	0	N28.31602, E76.16551
	Santokhpura	11	0	N28.511648, E76.297968
	Kheri Sawal	10	0	N28.560042, E76.314431
	Nimli	24	0	N28.584679, E76.418903
	Total (11 sites)	**107**	**1**	
Rewari	Nangal	100	0	N28.254975, E76.492723
	Kanwali	7	0	N28.311535, E76.404094
	Dhahina	3	0	N28.306407, E76.373366
	Siha	1	1	N28.26815, E76.406971
	Luhana	1	1	N28.262377, E76.406163
	Bawwa	12	0	N28.388872, E76.323138
	Motla Khurd	2	0	N28.283086, E76.467445
	Total (7 sites)	**126**	**2**	
Mahen-dergarh	Zerpur	4	0	N28.325651 E76.084061
	Sayana	71	0	N28.50271 E76.201376
	Pota	7	0	N28.424729 E76.229263
	Kheri	18	0	N28.38012 E76.231071
	Jharli	3	0	N28.3824 E76.25757
	Pali	5	0	N28.32423 E76.13451
	Baghot	1	1	N28.1449083 E76.274884
	Dongra Ahir	1	1	N28.191936 E76.208685
	Total (8 sites)	**103**	**2**	
Jhajjar	Dubaldhan	3	0	N28.678285 E76.485047
	Khanpur Khurd	11	0	N28.479334 E76.349895
	Matenhail	10	0	N28.589292 E76.41828
	Total (3 sites)	**24**	**0**	
Rohtak	Pilana	4	0	N28.4157 E76.2466
	Total (1 site)	**4**	**0**	
Grand Total	**47**	**475**	**11**	

Distribution

Terminalia coronata is endemic to northwestern India, common in dry habitats at 300–600 m in Rajasthan, Gujarat, Haryana, and Punjab. Earlier studies have reported its distribution in arid and semi-arid parts of Gujarat, Rajasthan, Haryana, and Punjab (Meena et al. 2018). The species occurrence was reported from Banaskantha and Mehsana districts in Gujarat (Kumar & Kalavathy 2010). In Rajasthan, the species was reported from Ajmer, Udaipur, Pratapgarh, Chittorgarh,

Table 2. Diameter at breast height of *Terminalia coronata* in different districts

District	Diameter at breast height (DBH in cm)											Total
	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100	>100	
Nuh	0	0	0	0	0	0	1	1	0	0	0	**2**
Bhiwani	0	2	22	12	22	18	16	5	7	3	2	**109**
Charkhi Dadri	1	2	8	11	20	13	25	12	6	4	5	**107**
Rewari	0	4	11	30	40	22	12	4	1	1	1	**126**
M/Garh	5	34	7	9	13	10	13	6	3	1	2	**103**
Jhajjar	0	2	1	2	3	3	3	2	2	0	6	**24**
Rohtak	1	0	0	3	0	0	0	0	0	0	0	**4**
TOTAL	**7**	**44**	**49**	**67**	**98**	**66**	**70**	**30**	**19**	**9**	**16**	**475**
%	1.47	9.26	10.32	14.11	20.63	13.89	14.74	6.32	4.0	1.89	3.37	**100**

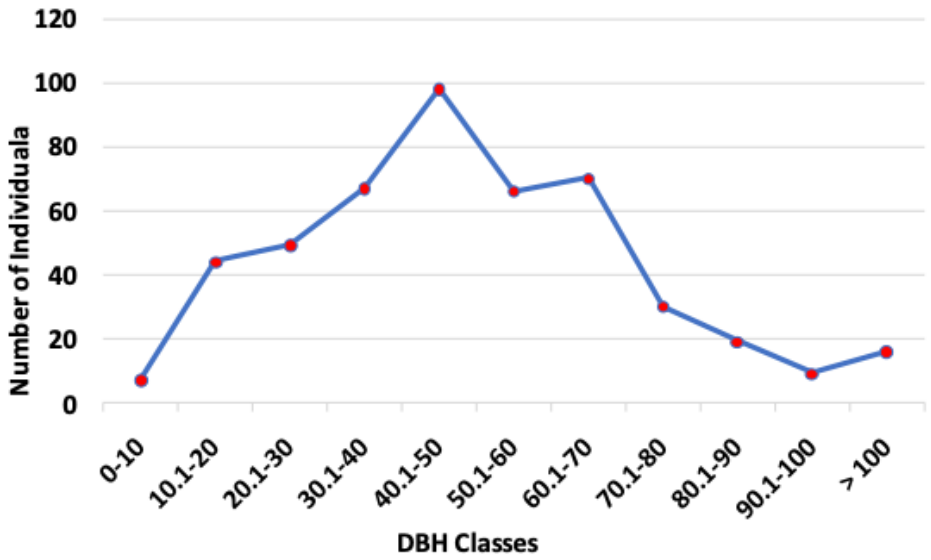

Figure 3. The d-d curve of *Terminalia coronata* in different districts of Haryana.

Pali Rajsamand, Sirohi, Jodhpur, and Alwar (Singh 2016). Additionally, distribution of *T. coronata* was also reported from the Aravalli Hills and Mahendergarh District of Haryana (Singh et al. 2021).

Taxonomic note

Various molecular studies have supported that *Terminalia* (Combretaceae: Terminaliinae) is paraphyletic, with the genera *Pteleopsis, Buchenavia*, and *Anogeissus* incorporated (Maurin et al. 2010). The molecular results confirmed that *Anogeissus*, *Buchenavia,* and *Pteleopsis* are embedded in *Terminalia*. These three genera were formally transferred to *Terminalia* (Maurin et al. 2017). Accordingly, all eight species of the earlier genus *Anogeissus* were put under *Terminalia*.

Ecology & Population Structure

Terminalia coronata grows luxuriantly in areas with lime-rich sandy loam to loamy sand with good water-holding capacity, and prefers low-lying areas near village ponds, earthen bunds, moist valleys, seasonal waterways, and foothills. It is generally found in gregarious form in pure patches near water bodies or low-lying areas. Similar growth pattern was also reported from Gujarat, Madhya Pradesh, and Bundelkhand region of Uttar Pradesh (Kumar & Kalavathy 2010; Meena et al. 2018).

After an extensive survey of the study area, *T. coronata* population was found at 47 sites only (Figure 2). Majority of the populations were situated in Bhiwani District (15 sites), followed by 11 sites in Charkhi Dadri,

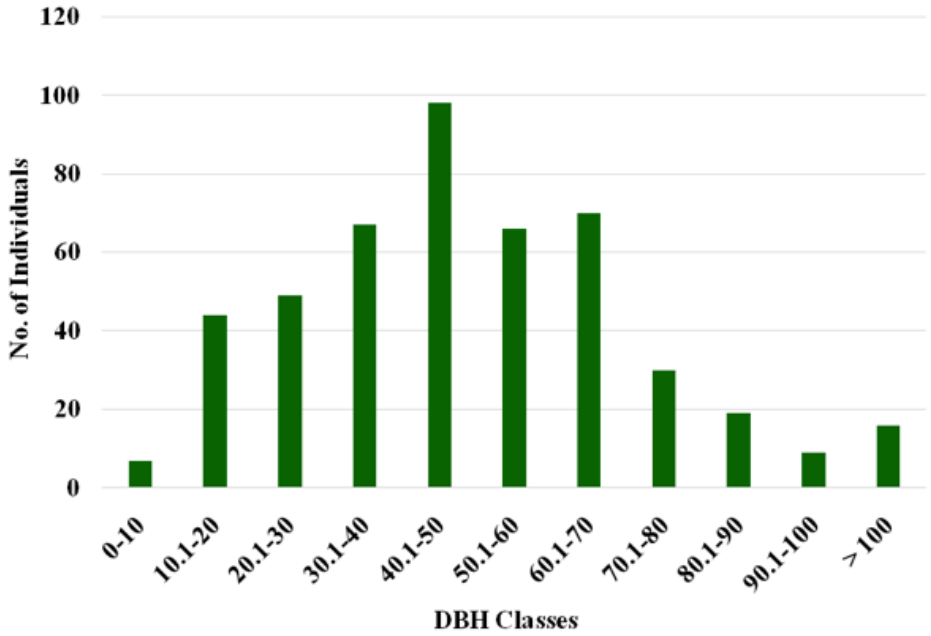

Figure 4. Distribution of diameter class of *Terminalia coronata* in Haryana.

eight sites in Mahendergarh, seven sites in Rewari, two sites in Nuh, and three sites in Jhajjar districts. In Rohtak, only one location of *T. coronata* population was found. Cumulatively, 428 trees were found in the seven districts. Habitat distribution of the species indicates its highly fragmented pattern concentrated in small patches, which were basically remnants of community forests. At 11 locations, only a single mature individual was present. Such solitary populations of *T. coronata* always remain vulnerable to disappearance by anthropogenic disturbances.

The tree with a maximum girth of 540 cm (172 cm DBH) was found in the Kharkhari Sohan Village of Bhiwani District. The maximum group population of 100 individual trees was found in village Nangal in Rewari District, followed by 41 trees in Mauri Village of Charkhi Dadri District, and 28 trees in village Legha Bhanan in Bhiwani District. The highest number of trees in a population was found in Rewari District, followed by Bhiwani, Charkhi Dadri, Mahendergarh, Jhajjar, Rohtak, and Nuh Districts (Tables 1,2). Results of the study also revealed that total stem density (trees with a diameter ≥10 cm) increases with diameter up to a certain threshold, specifically within the intermediate diameter class (30–34.9 cm). As a result, the diameter-density curve takes on a bell-shaped pattern (Figure 3). Diameter-wise distribution is a key indicator of forest dynamics, structural diversity, and the functioning of various forest ecosystems (Lutz et al. 2013), reflecting the mature status of the population

Table 3. The ownership pattern of *Terminalia coronata* in different districts of Haryana.

District	Ownership pattern			
	Panchayats	Forest	Temple	Private
Nuh	1	0	0	1
Bhiwani	76	0	32	1
Jhajjar	24	0	0	0
Rohtak	4	0	0	0
Mahendergarh	93	0	10	0
Charkhi Dadri	104	2	0	1
Rewari	121	1	4	0
Total	**423**	**3**	**46**	**3**
Percentage	89.05	0.63	9.68	0.63

of a species (Dar et al. 2017). This pattern may be attributed to past disturbances that potentially reduced the species' regeneration and the removal of large trees (Nizami 2012).

The present study revealed the highest population (58.45%) in the middle-class diameter having 30–60 cm DBH. About 13.84% of the population has DBH of more than 100 cm, while 27.71% has less than 30 cm DHB (Figure 4). Most of the over-mature trees having more than 100 cm DBH are half-dried or diseased. Maximum over-mature trees were found in the district of Mahendergarh whereas the highest population of young trees was found in the district of Bhiwani, followed by

Image 1. Sapling and young *Terminalia coronata* plants at community forests in Sayana Mahendergarh. © Authors.

Mahendergarh District and Rewari District. A population with a higher number of seedlings and saplings (new recruits) in comparison to a mature population indicates a stable population. A smaller proportion of juveniles present a declining population, considered an unstable population (Lutz et al. 2013). The DBH size distribution curve comes out almost bell-shaped (Figure 3), if the population of over-mature trees are deducted from the total population. This indicates the dominance of middle-size classes (Dar et al. 2017). This pattern may be due to anthropogenic disturbance in the past, the removal of healthy big-size trees and the effect of climate change, which resulted in episodic recruitment.

Natural regeneration was almost absent in the sites except for the village of Sayana in Mahendergarh District (Image 1). Only few seedlings and samplings in Sayana Village in Mahendergarh District, and almost no natural regeneration in other sites indicated negligible regeneration of the species. At other sites, the lower-size class of young plants was more than 20 years old. They have shown no regeneration in the recent past. The species prefer moist and deeper soils, and grow along the natural drainage lines. The natural drainage system was highly disturbed or disappeared due to anthropogenic activities in the region, which might also be responsible for its negligible natural regeneration.

Threat status of *Terminalia coronata* population

Terminalia coronata is endemic to northwestern India and currently faces severe conservation concerns. It has been listed as indeterminate globally, included in CITES Appendix I, categorized as 'Rare' nationally, and more recently assessed as 'Endangered' under the IUCN Red List (Kaushal et al. 2021) reflecting its restricted distribution, overexploitation, habitat loss, and extremely poor regeneration.

A semi-structured interview with villagers, particularly elderly residents, across the study sites in southern and southwestern Haryana revealed multiple interlinked factors contributing to the decline of *T. coronata*. Most large mature trees have become hollow, half-dried, and diseased due to regular heavy lopping, and have become susceptible to fungal attacks, whereas roots were exposed due to soil. Historically, indiscriminate and unsustainable harvesting for its high-quality, durable timber—used in making carts, agricultural implements, furniture, and for construction—along with frequent lopping of branches for fodder and fuelwood, led to severe overexploitation of mature trees Land-use change posed another significant threat. Recent researches (Rajendrakumar & Kalavathy 2010; Meena 2013) also reported that agricultural expansion, driven by population growth and canal irrigation development,

resulted in the clearance of large tracts of wasteland—once important habitats for *T. coronata*—with the species now nearly absent from cultivated lands; groundwater depletion and changing rainfall patterns have exacerbated this decline. Natural regeneration remains critically poor, with extremely low seed viability (0.1–0.2%) and high proportions of empty seeds, further aggravated by insect damage, overgrazing, climate change, and biotic pressures (Saxena & Dhawan 2001; Kanther 2019; Dadhich et al. 2022). Invasion by alien plants including *Parthenium hysterophorus*, *Lantana camara*, and *Xanthium strumarium* further degrade the habitat. Lastly, climate change, particularly declining precipitation, and rising temperatures in the fragile arid, and semi-arid ecosystems, has altered phenological patterns with reduced seed production leading to gradual decline in existing *T. coronata* populations.

Conservation strategies

The conservation of *T. coronata* in Haryana requires a multifaceted, community-inclusive approach that integrates protection, propagation, and policy measures. Immediate steps should focus on safeguarding existing populations through legal protection of key habitats, prevention of land-use change in biodiversity-rich community forests, and incentivising communities, and landowners for conservation efforts. Interaction with the locals revealed that *T. coronata* is well conserved in the village community forests (Bani) and sacred groves protected by the local communities primarily due to religious faiths, and beliefs. Parallelly, ex situ strategies must be strengthened by developing and standardising nursery, vegetative propagation, and tissue culture techniques to overcome poor seed viability, and limited natural regeneration. Lastly, large-scale reintroduction programs should be integrated into state plantation schemes, reviving traditional planting practices near ponds, temples, and grazing areas, thereby combining cultural heritage with ecological restoration.

CONCLUSION

The distribution of *Terminalia coronata* in the state of Haryana was confined to only seven districts falling in the southern and southwestern regions where its occurrence exists in small patches of community forests, and sacred groves. Over the years, its population has experienced a steep decline due to excessive exploitation for timber, which has historically been prized for its strength, and durability. The overexploitation, narrow extent of distributional presence, minimal natural stands, biotic pressure, habitat loss, poor generation, slow growing habit, susceptibility to grazing, and lack of awareness among the local residents are the main driving factors for the decreasing population of this species of economic significance. Many existing mature trees show signs of decay, hollowness, and disease, while regeneration in natural habitats remain extremely poor. The species suffers from very low seed viability and high seed predation, which, combined with heavy lopping, prevents successful recruitment of seedlings. and saplings. The species faces serious threats and extinction risks in the study area. There is an urgent need for both ex situ and in situ conservation of the species to ensure their protection, conservation, and propagation as well as to bring it out of the threatened status.

REFERENCES

Barik, S.K., O.N. Tiwari, D. Adhikari, P.P. Singh, R. Tiwary & S. Barua (2018). Geographic distribution pattern of threatened plants of India and steps taken for their conservation. *Current Science* 114(3): 470–503.

Champion, H.G. & S.K. Seth (1968). *A Revised Survey of the Forest Types of India*. Manager of Publications, Delhi, 404 pp.

Dadhich, A., L. Sharma, M. Dhiman, P. Dhawan, A. Singh & M.M. Sharma (2022). Anogeissus Species in Rajasthan (India): A Comprehensive Review on an Unexplored Plant. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences* 92(4): 723–729. https://doi.org/10.1007/s40011-022-01359-x

Dar, J.A., M.Y. Rather, K. Subashree, S. Sundarapandian & M.L. Khan (2017). Distribution patterns of tree, understorey, and detritus biomass in coniferous and broad-leaved forests of Western. Himalaya, India. *Journal of Sustainable Forestry* 36: 787–805.

ISFR (2023). India State of Forest Report. https://fsi.nic.in/forest-report-2023 Accessed on 13.i.2025.

Kanther, R.P. (2019). Dominant Flora of Todgarh- Raoli Wildlife Sanctuary Rajasthan, India. *The Journal of Indian Botanical Society* 98(1&2): 59–70.

Kaushal, S., R.L.S. Sikarwar & D. Mishra (2021). Status, Distribution and Conservation of *Terminalia coronata* (Stapf) Gere & Boatwr. in India. *Indian Forester* 147(12): 1204–1207.

Kumar, S.R. & S. Kalavathy (2010). Status and distribution of the 'rare' (r) tree species, *Anogeissus sericea* Brandis var. *nummularia* King ex Duthie. in the forest of North Gujarat Region (NGR), Gujarat, India. *Life Sciences Leaflets* 6: 178–181.

Lutz, J.A., A.J. Larson, J.A. Freund, M.E. Swanson & K.J. Bible (2013). The importance of large diameter trees to forest structural heterogeneity. *PLoS One* 8: e82784. https://doi.org/10.1371/journal.pone.0082784

Malik, Z.A. & A.B. Bhatt (2015). Phytosociologicalanalysis of woody species in KedarnathWildlife Sanctuary and its adjoining areasin western Himalaya, India. *Journal of Environmental Sciences* 31(3): 149–163. https://doi.org/10.7747/JFES.2015.31.3.149

Maurin, O., M.W. Chase, M. Jordaan & M. van der Bank (2010). Phylogenetic relationships of Combretaceae inferred from nuclear and plastid DNA sequence data: implications for generic classification. *Botanical Journal of the Linnean Society* 162: 453–476. https://doi.org/10.1111/j.1095-8339.2010.01027.x

Maurin, O., J. Gere, M. van der Bank & J.S. Boatwright (2017). The

inclusion of *Anogeissus, Buchenavia* and *Pteleopsis* in *Terminalia* (Combretaceae: Terminaliinae). *Botanical Journal of the Linnean Society* 184(3): 312–325. https://doi.org/10.1093/botlinnean/box029

McKinney, M.L. (2002). Effects of national conservation spending and amount of protected area on species threat rates. *Conservation Biology* 16(2): 539–543.

Meena, D., S. Bhatnagar & A. Singh (2018). A critical review of *Anogeissus pendula*: an important species of arid zone. *International Journal of Conservation Science* 9(1): 165–172.

Meena, K.L. (2013). Conservation priorities for endemic and threatened species Anogeissus sericea var. nummularia King ex Duthie-from Rajasthan, India. *Journal of Economic and Taxonomic Botany* 37(4): 636–643.

Nizami, S.M. (2012). The inventory of the carbon stocks in sub-tropical forests of Pakistan for reporting under Kyoto Protocol. *Journal of Forestry Research* 23: 377–384.

Rajendrakumar, S. & S. Kalavathy (2010). Status of Mature Trees, Seedlings and Saplings in Tropical Thorn Forest (TTF) of North Gujarat Region (NGR), Gujarat, India. *Life Sciences Leaflets* 6: 188–193.

Saxena, S. & V. Dhawan (2001). Large-scale production of Anogeissus pendula and A latifolia by micropropagation. *In Vitro Cellular & Developmental Biology-Plant* 37(5): 586–591. https://doi.org/10.1007/s11627-001-0103-1

Singh, K. (2016). Effect of Land use types on floral diversity and carbon sequestration in Jodhpur district of Rajasthan. Ph.D. Thesis. Forest Research Institute (Deemed) University, Dehradun, 182 pp.

Singh, K., R.L.S. Sikarwar & D. Mishra (2021). Status, Distribution and Conservation of *Terminalia coronata* (Stapf) Gere & Boatwr. in India. *Indian Forester* 147(12): 1204–1207. https://doi.org/10.36808/if/2021/v147i12/158802

Zhang, X.R., J.S. Kaunda, H.T. Zhu, D. Wang, C.R. Yang & Y.J. Zhang (2019). The genus Terminalia (Combretaceae): An ethnopharmacological, phytochemical and pharmacological review. *Natural Products and Bioprospecting* 9(6): 357–392.

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