International Journal of Environmental and Ecology Research
www.environmentaljournal.in
Online ISSN: 2664-7117
Received: 17-04-2026, Accepted: 18-05-2026, Published: 02-06-2026
Volume 8, Issue 2, 2026, Page No. 18-23

Ecological profile of Saraipali and Damdarha villages within Gomarda Wildlife Sanctuary

Toman Singh Mairty[1*], K P Namdeo[2]
[1] Research Scholar, Department of Botany, D.P. Vipra College, Bilaspur, Chhattisgarh, India
[2] Assistant Professor, Department of Botany, Govt. N.K. College, Kota Bilaspur, Chhattisgarh, India
Corresponding Author: Toman Singh Mairty
DOI: https://doi.org/10.66856/ijeer.2026.8.2.8021

Abstract
Chhattisgarh has diverse tropical deciduous forests which occupied approximately 44% of its geographic area. It has incredibly rich in biodiversity but remain underexplored ecologically. Gomarda Wildlife Sanctuary (GWS) lacks systematic data-driven ecological profiling of shrub and tree plant species. Therefore, ecological survey was conducted in the Saraipali and Damdarha villages of GWS using Circular Quadrat Method. Plant identification was conducted as per Bentham & Hooker's taxonomic hierarchy, and was augmented by preliminary digital screening (Google Lens) and rigorous validation by using authentic literature. The study was recorded 59 plant species (61.02% shrubs and 38.98% trees) with the Leguminosae family being most dominant (11 species). Ecologically, trees exhibited greater structural dominance than shrubs. *S. robusta* recorded highest frequency (92.5%) and maximum IVI of 82.15. while shrub *S. occidentalis* recorded as lowest IVI (1.12). The study is geographically restricted to two village boundaries within expansive sanctuary and primarily profiles tree and shrub layers and potentially underrepresenting herbaceous ethnobotanical resources.

Keywords: Gomarda wildlife sanctuary, Saraipali, Damdarha, ecological profile, IVI, *Shorea robusta*, forest ecology

Introduction

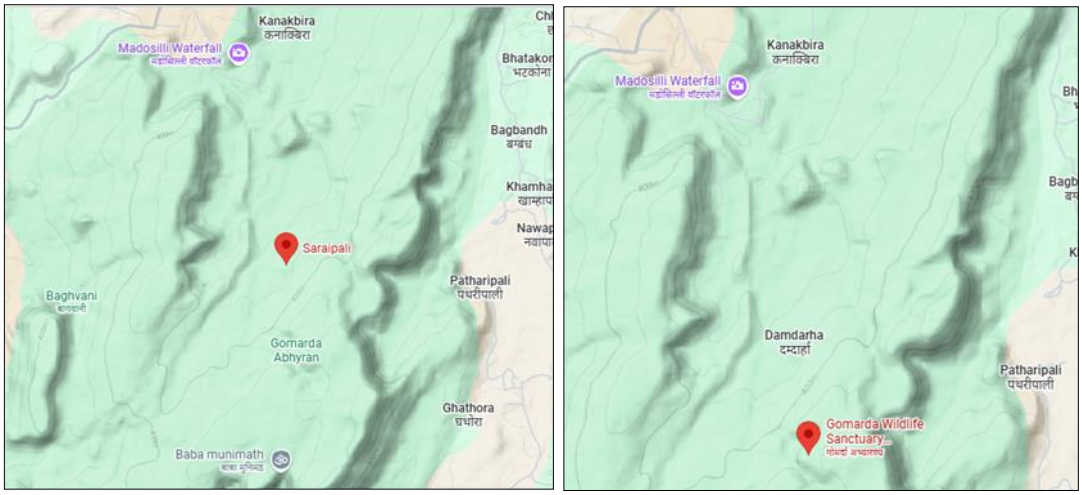
A biome represents specific geographical feature i.e., climate, soil conditions and predominant biota (Mucina, 2019) [16]. Flora and fauna are collectively referred to as biota. Ecology contains interactions among biotic and abiotic components within biomes (Gupta & Saxena, 2026) [7]. It emphasizes flow of energy and nutrients to maintain balance between biotic and abiotic components. Biotic components are living organisms e.g., plants (flora), animals (fauna), fungi, bacteria and etc. Abiotic components comprise non-living, physical and chemical components of the environment, e.g., sunlight, water, temperature and soil. Liu *et al*. (2021) [13] mentioned that biotic and abiotic components of ecosystem define species diversity and productivity. The forests function as primary life-support systems of Earth within these ecological networks (Behboudian *et al*., 2025) [3]. They provide extensive ecological, social and economic benefits in terms of significant carbon sinks (Nzabarinda *et al*., 2025) [20]. It also mitigates climate change, regulates hydrological cycles and prevents soil erosion (Wei *et al*., 2025) [36]. Besides ecological benefits, they support economic backbone of millions of tribals and local population by serving them with timber, fuel and non-timber forest products. These tribals and the local population generally sell these precious products in the local market and earn income to support their livelihoods. P Kumaran *et al*. (2014) [22] revealed that diverse topography and climate of India give rise to various forest ecosystems, e.g., tropical evergreen forests of Western Ghats, tropical deciduous forests, montane forests, tropical thorn forests and coastal mangrove forests.

Chhattisgarh has approximately 44% of its area under forest cover (Sharma, 2019) [31]. It has mostly tropical moist deciduous and tropical dry deciduous forest with canopy predominantly composed of mixed forests, Sal forests and Teak forests (Kumar et al., 2003) [12]. This vegetation structure is exceptionally rich in biodiversity across a wide range of plant species. Sal, Teak, Mahua and Tendu tree form upper canopy and beneath them medium-sized shrubs such as Karonda, Dhatura and Kalmegh make up lush green forest regions. The ground level often comprises soft-stemmed herbs, viz., Tulsi, Aloe Vera and Shatavari that have esteemed medicinal applications. A sanctuary is defined as legal protected area which is designed to conserve wildlife and their natural habitats from human exploitation (Sujithra *et al*., 2021) [34]. Sanctuaries are essential to halt deforestation, protect endangered species and maintain vital ecological balance in forest regions (Sujithra *et al*., 2021; Naik *et al*., 2024) [19, 34]. Sanctuaries act as genetic reservoirs and conserve plant species for long periods (Mishra & Singh, 2023) [15]. The ecological study of shrub and tree plant species in these areas is crucial to assess how indigenous communities rely on native plants for medicine, food and culture in ethnobotanical perspective (Jeyaprakash *et al*., 2017; Naik *et al*., 2024). Bhalla (2003) [5, 9, 19] prepared a biodiversity plant and stated three national park and eleven sanctuaries in Chhattisgarh state. Among them, Gomarda Wildlife Sanctuary (GWS) was established in 1983 and covers 277.82 km^2 in Sarangarh District under Raigarh Region. The Lat-nala and Manai-nala streams are suppling water to Adharpani and Khapan that support indigenous flora and fauna of this region. Further, ecological studies drive greater bio-prospects for the exploration of safer plant-based medicines. Indigenous tribes of Chhattisgarh (e.g., Gonds and Baigas) possess deep knowledge of forest herbs and pass it down orally to their offspring (Ahirwar & Bhoi, 2025) [1]. The scientific conservation of tribal knowledge could create a more effective and sustainable approach to managing these ecosystems. Patel *et al*. (2020) [28] explored 25 plant species of medicinal importance belonging to 16 families within GWS and noted that the family Fabaceae was dominant. Additionally, Patel *et al*. (2025) [25] recorded 54 dye-producing plant species in villages of Gandhrachuan, Lurka, Chhinchpani, Gomarda, Ramtek, Khamharpali, Tamtora, and Damdarha within GWS. Further, Pandey (2019) [23]

identified 45 plant species that serve as food for forest herbivores. Patel *et al*. (2025) [25] assessed the herbal plant species inside GWS and noted 66 herbal plant species. Therefore, limited research has been conducted in GWS for ecological exploration. Henceforth, present research work was conducted on GWS for systematic ecological study of shrub and tree plant species present in Saraipali and Damdarha villages of GWS.

Materials and Methods

The present ecological study was systematically done in Saraipali (21.42N and 83.19E) and Damdarha (21.46N, 83.18E) villages located inside GWS (21°22'-21°38' N and 83°26'- 83°15' E). These villages were selected for their relatively undisturbed forests and rich biodiversity. Therefore, these study sites (selected villages) could provide an ideal and representative ecological profile of indigenous plant species of GWS. An extensive preliminary field survey was undertaken to define precise study zones. The shrub and tree vegetation were quantitatively analyzed using Circular Quadrat Method (CQM) to accurately assess frequency and abundance of plant species across selected study sites. The initial quadrat's circumference was expanded by a factor of 3. This iterative expansion continued radially outward until no additional previously undocumented plant species were observed within subsequent defined boundary inside study site (Odum, 1971; Muller-Dombois and Ellenberg, 1974) [17, 21]. Representative plant species were carefully selected and collected for detailed taxonomic identification after documentation. The initial field observations were correlated to digital tools, i.e., Google Lens.High-resolution photographs taken on-site were analyzed using Google Lens to obtain rapid preliminary morphological matches. The formal classification and systematic arrangement of collected plant specimens were executed strictly in accordance with established traditional taxonomic hierarchy proposed by Bentham & Hooker (1876). However, all digital identifications were rigorously cross-referenced and validated with existing taxonomic monographs and relevant botanical literature.



Map Source: Google Map Terrain

Fig 1: Study sites (Saraipali and Damdarha) in GWS

The vegetation sampling protocol was replicated three times across sub-zones in Ramtek and Damdarha to improve the accuracy of ecological data and account for spatial heterogeneity. These data were pooled and analyzed to calculate the Mean Importance Value Index (IVI) and Standard Deviation (±SD) for each species (Jain & Rao, 1977) [8]. Parameters viz., Relative Density, Relative Frequency and Relative Dominance from basal cover, were systematically calculated. These parameters were summed to derive IVI as per Patel *et al*. (2025b) [25]:

$$RF = \frac{\text{Frequency of a species}}{\text{Total frequency of all the species}} \times 100$$

$$RD = \frac{\text{Density of a species}}{\text{Total density of all the species}} \times 100$$

$$RA = \frac{\text{Abundance of a species}}{\text{Total abundance of all the species}} \times 100$$

$$IVI = RF+RD+RA$$

Results and Discussion

Present research investigation was conducted to examine ecological profile of Saraipali and Damdarha villages within GW. Present assessment recorded 59 distinct plant species across these two sampled sites. The observation revealed 36 shrub species (61.02%) and 23 tree (38.98%). The taxonomic distribution showed that Leguminosae family was dominant with contribution of 11 plant species to overall plant species count. This was followed by Combretaceae and Rubiaceae families with contributions of 5 plant species each and Verbenaceae family with 4 plant species. The average frequency of plant species occurrence in study sites was 39.72%. The tree species *Shorea robusta* was noted as maximum frequency (92.5%) followed by shrub species *Lantana camara* (85.0%) and tree species *Terminalia alata* (82.0%). Conversely, lowest frequency was observed with shrub species *Ricinus communis* (12.0%).

The mean frequency was recorded higher with trees (44.84%) as compared to shrubs (36.45%). The average IVA was 15.04 across entire plant species studied in study sites. *S. robusta* was exhibited highest ecological dominance with maximum IVI of 82.15 ± 8.6 followed by *T. alata* (IVI 48.12 ±7.1) and *T. grandis* (IVI 45.55 ± 6.2). The lowest

IVI was observed with shrub *S occidentalis* (1.12 ± 1.9). Tree species have average IVI of 22.97 and collectively represent dominant structural role in GWS ecosystem compared to shrub species (average IVI of 9.97).

S.No.	Botanical Name	Family	Local Name	Habit	Frequency (%)	IVI ± SD
1.	*Barleria prionitis*	Acanthaceae	Katsaraiya	Shrub	30.5	8.42 ±1.2
2.	*Justicia adhatoda*	Acanthaceae	Adusa	Shrub	32.4	8.75 ±1.2
3.	*Leea macrophylla*	Ampelideae	Hathipaila	Shrub	28.6	7.92 ±1.4
4.	*Buchanania lanzan*	Anacardiaceae	Chironji	Tree	58.4	26.55 ±3.9
5.	*Lannea coromandelica*	Anacardiaceae	Moyan	Tree	38.0	16.45 ±2.6
6.	*Carissa carandas*	Apocynaceae	Karonda	Shrub	45.6	12.35 ±2.1
7.	*Carissa spinarum*	Apocynaceae	Jangli Karonda	Shrub	52.3	14.88 ±1.9
8.	*Holarrhena pubescens*	Apocynaceae	Dudhi	Shrub	54.2	16.25 ±2.4
9.	*Calotropis gigantea*	Asclepiadaceae	Akawa	Shrub	25.0	6.54 ±0.8
10.	*Calotropis procera*	Asclepiadaceae	Chota Akawa	Shrub	28.2	7.12 ±0.9
11.	*Flacourtia indica*	Bixaceae	Kanker	Shrub	38.4	10.15 ±1.7
12.	*Boswellia serrata*	Burseraceae	Salai	Tree	45.0	21.12 ±3.5
13.	*Garuga pinnata*	Burseraceae	Kekad	Tree	15.4	5.75 ±0.9
14.	*Anogeissus latifolia*	Combretaceae	Dhaora	Tree	72.5	32.45 ±4.8
15.	*Terminalia alata*	Combretaceae	Saja	Tree	82.0	48.12 ±7.1
16.	*Terminalia arjuna*	Combretaceae	Arjun	Tree	25.0	11.45 ±1.8
17.	*Terminalia bellirica*	Combretaceae	Bahera	Tree	28.4	13.12 ±2.1
18.	*Terminalia chebula*	Combretaceae	Harra	Tree	22.1	10.88 ±1.7
19.	*Shorea robusta*	Dipterocarpaceae	Sal	Tree	92.5	82.15 ±8.6
20.	*Diospyros melanoxylon*	Ebenaceae	Tendu	Tree	78.5	38.12 ±5.2
21.	*Jatropha curcas*	Euphorbiaceae	Ratanjot	Shrub	18.2	4.95 ±0.6
22.	*Jatropha gossypiifolia*	Euphorbiaceae	Lal Ratanjot	Shrub	22.5	6.12 ±0.9
23.	*Ricinus communis*	Euphorbiaceae	Arandi	Shrub	12.0	3.12 ±0.4
24.	*Desmodium gangeticum*	Leguminosae	Salparni	Shrub	42.0	11.45 ±2.3
25.	*Flemingia chappar*	Leguminosae	Kasraut	Shrub	40.5	11.66 ±1.4
26.	*Flemingia macrophylla*	Leguminosae	Ban-chana	Shrub	33.2	9.78 ±1.2
27.	*Indigofera cassioides*	Leguminosae	Birhul	Shrub	44.5	13.12 ±1.8
28.	*Indigofera tinctoria*	Leguminosae	Neel	Shrub	20.0	5.34 ±0.7
29.	*Mimosa rubicaulis*	Leguminosae	Aila	Shrub	15.5	4.22 ±0.5
30.	*Senna occidentalis*	Leguminosae	Chakunda	Shrub	45.8	1.12 ±1.9
31.	*Tephrosia purpurea*	Leguminosae	Sarphonka	Shrub	48.2	13.45 ±2.2
32.	*Butea monosperma*	Leguminosae	Palash	Tree	65.0	28.44 ±4.2
33.	*Cassia fistula*	Leguminosae	Amaltas	Tree	32.1	12.66 ±2.0
34.	*Pterocarpus marsupium*	Leguminosae	Bija	Tree	35.6	15.88 ±2.4
35.	*Woodfordia fruticosa*	Lythraceae	Dhawai	Shrub	62.5	20.12 ±3.1
36.	*Bombax ceiba*	Malvaceae	Semal	Tree	18.2	6.88 ±1.1
37.	*Azadirachta indica*	Meliaceae	Neem	Tree	28.6	9.55 ±1.4
38.	*Syzygium cumini*	Myrtaceae	Jamun	Tree	45.8	22.12 ±3.4
39.	*Nyctanthes arbor-tristis*	Oleaceae	Harsingar	Shrub	52.0	15.66 ±2.1
40.	*Ziziphus mauritiana*	Rhamnaceae	Ber	Shrub	55.0	16.88 ±2.5
41.	*Ziziphus nummularia*	Rhamnaceae	Jharberi	Shrub	42.1	11.22 ±1.8
42.	*Ziziphus oenoplia*	Rhamnaceae	Makoh	Shrub	46.5	13.55 ±2.0
43.	*Gardenia gummifera*	Rubiaceae	Dikamali	Shrub	28.5	7.45 ±1.0
44.	*Gardenia resinifera*	Rubiaceae	Dongar Kuru	Shrub	31.0	8.12 ±1.3
45.	*Ixora pavetta*	Rubiaceae	Lokandi	Shrub	25.4	6.88 ±1.1
46.	*Pavetta indica*	Rubiaceae	Papiri	Shrub	21.4	5.75 ±0.8
47.	*Mitragyna parvifolia*	Rubiaceae	Kadam	Tree	22.5	8.92 ±1.3
48.	*Aegle marmelos*	Rutaceae	Bael	Tree	42.4	18.12 ±3.1
49.	*Dodonaea viscosa*	Sapindaceae	Vilayati Mehndi	Shrub	22.1	5.88 ±1.1
50.	*Schleichera oleosa*	Sapindaceae	Kusum	Tree	40.2	19.45 ±3.1
51.	*Madhuca longifolia*	Sapotaceae	Mahua	Tree	62.4	30.12 ±4.5
52.	*Datura metel*	Solanaceae	Kala Dhatura	Shrub	15.4	4.12 ±0.5
53.	*Solanum virginianum*	Solanaceae	Bhatkataiya	Shrub	18.4	4.88 ±0.7
54.	*Helicteres isora*	Sterculiaceae	Marorphali	Shrub	58.6	18.44 ±2.8
55.	*Sterculia urens*	Sterculiaceae	Kullu	Tree	12.4	4.55 ±0.7
56.	*Clerodendrum infortunatum*	Verbenaceae	Bhant	Shrub	35.0	9.22 ±1.5
57.	*Lantana camara*	Verbenaceae	Putus	Shrub	85.0	24.55 ±3.5
58.	*Vitex negundo*	Verbenaceae	Nirgundi	Shrub	35.6	9.44 ±1.6
59.	*Tectona grandis*	Verbenaceae	Teak	Tree	68.4	45.55 ±6.2

Discussion

The present observation revealed 59 distinct plant species (36 shrub and 23 tree species) in villages of Saraipali and Damdarha within GW. Indigenous communities (e.g., Baiga and Gond tribes) of the sanctuary and nearby regions depend on local forests for subsistence and primary

healthcare (Ahirwar & Bhoi, 2025) [1]. They generally utilize shrubs and trees for traditional medicine, food, shelter and cultural rituals (Towns & van Andel, 2016; Awoke *et al*., 2024) [2, 35]. Traditional healers (vaids) frequently prepare barks, leaves and roots as juices, pastes, or decoctions to treat ailments (Ahirwar & Bhoi, 2025) [1]. Present study showed that Leguminosae family was dominant in study sites. *D. gangeticum, F. Chappar, F. Macrophylla, I. cassioides, I. tinctoria, M. rubicaulis, S. occidentalis, T. purpurea, B. monosperma* and *C. fistula* were observed in GWS during present study. Herbs, shrubs and trees belong to Leguminosae (Fabaceae) family and are extensively utilized in traditional medicine systems by tribals (Sharma & Kumar, 2013) [30]. Leguminosae is 3rd largest family of Angiosperms as well (Dewangan & Acharya, 2017) [6]. Therefore, ecological profiling of shrub and tree plant species in the sanctuary can mitigate the ongoing deterioration of traditional knowledge among indigenous tribes and promote sustainable use of plant-derived resources.

The families Combretaceae and Rubiaceae also contributed significantly to the study area. These families have been reported for their notable presence in moist and dry deciduous forests range of Raigarh district of Chhattisgarh state which is nearby region of GWS (Naidu *et al*., 2017) [18]. Combretaceae family comprises of timber trees and lianas (Rahate *et al*., 2019) [29] whereas Rubiaceae family consists of understory shrubs, herbs and creepers (Mariod *et al*., 2017) [14]. The *S. robusta* tree was noted with dominant presence with maximum frequency of 92.5% during present study sites. Singh *et al*. (2024) [33] also reported *S. robusta* as the dominant tree, covering approximately one-third of total forested area of tropical moist and dry deciduous forests in Chhattisgarh. Trees such as *S robusta* and *T grandis* possess highest IVIs, which significantly enhances their status as predominant structural elements within the GWS ecosystem. Indigenous communities depend on these canopy species for timber, fuel and NTFPs. Conversely, shrubs e.g., *S. occidentalis* exhibit lower ecological dominance. However, their cultural significance remains considerable. The forest is generally considered a natural repository of plant-derived medicinal compounds. Shrubs do not provide timber but they have diverse range of notable secondary metabolites that could be effective for the treatment of variety of ailments. Chhattisgarh forests have been reported to undergo significant deforestation as a result of rapid urbanization and industrialization for decades (Singh *et al*., 2025) [32]. This has led to considerable forest fragmentation and habitat destruction along with tribal displacement in Raigarh region (Kujur & Kumar, 2017) [11]. In line, human-induced forest fires during the dry season, collection of tendu leaves, collection of Mahua flowers, excessive exploitation of NTFPs and similar anthropogenic activities are severely damage forest ecology and biodiversity in Sanctuaries.

Conclusion

A systematic ecological profiling of tree and shrub vegetation have been done within Saraipali and Damdarha villages of GWS. Present research was undertaken with an aim to document ecological profile of indigenous plant species in tropical deciduous forests of GWS. A total of 59 distinct plant species have been recorded in the study sites of GWS. The present observation indicates dominance of Leguminosae family and canopy trees over understory shrubs. Notably, *S. robusta*, *T. alata*, and *T. grandis* were dominant with IVI. However, present study is limited by its constrained geographic sampling area (restricted to two village sites) and its primary focus on woody perennials (trees and shrubs). This baseline data could provide a vital foundation for ethnobotanists. Future research should focus on expanding ecological sampling across more GWS sites to study ground flora and map these ecological metrics to indigenous ethnobotanical knowledge.

Acknowledgement

The author expresses thankfulness to forest staff of GWS for field work. I would also like to thank Google Lens for preliminary identification of plants in correlation with Bentham & Hooker (1876) and Grammarly Pro for its help to spelling checks and sentence clarity.

Funding Sources

The author did not receive any financial support for this research, authorship, or publication.

Conflict of Interest

There is no conflict of interest between authors.

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

This research did not involve any human participants, animal subjects, or materials requiring ethical approval.

Informed Consent Statement

This study did not involve human participants, and therefore, informed consent was not required.

Permission to Reproduce Material from Other Sources

Not Applicable

Refrecences

1. Ahirwar RK, Bhoi DK. Ethnobotanical secrets of the Baiga tribe in Chhattisgarh Central India. Scientific Reports,2025:15(1):38130. https://doi.org/10.1038/s41598-025-21403-w
2. Awoke A, Siyum Y, Awoke D, Gebremedhin H, Tadesse A. Ethnobotanical study of medicinal plants and their threats in Yeki district, Southwestern Ethiopia. Journal of Ethnobiology and Ethnomedicine,2024:20(1):107. https://doi.org/10.1186/s13002-024-00748-y
3. Behboudian M, Emami-Skardi MJ, Anamaghi S, Santos Ferreira CS, Wang-Erlandsson L, Halbac-Cotoară-Zamfir R, et al. Social resilience of tropical forest ecosystems: A systematic review of core principles and their application. Journal of Environmental Management,2025:394(127319):127319. https://doi.org/10.1016/j.jenvman.2025.127319
4. Bentham G, Hooker JD. Genera plantarum ad exemplaria imprimis in herbariis Kewensibus servata definita (Vol. 2). L. Reeve & Co, 1876. https://doi.org/10.5962/bhl.title.747
5. Bhalla A. Chhattisgarh biodiversity strategy & action plan (CBSAP). Government of Chhattisgarh,

2003. https://forest.cg.gov.in/cms/media/50711938-bd9c-40d5-8396-2d8fbf7d069d_1B.pdf
6. Dewangan P, Acharya V. Diversity of family *Leguminosae* in Raipur district of Chhattisgarh (India). Indian J. Applied & Pure Bio.,2017:32(1):1–8. https://www.biology-journal.org/fulltext/v32i1/ijapb32-1-1.pdf
7. Gupta S, Saxena S. Ecosystems, biomes, and ecological interactions. In Biotechnology Innovations for a Sustainable Future (pp. 709–728). Springer Nature Singapore, 2026. https://doi.org/10.1007/978-981-97-9859-9_35
8. Jain SK, Rao RR. A handbook of field and herbarium methods. Today & Tomorrow's Printers and Publishers, 1977. https://ttpp.in/
9. Jeyaprakash K, Lego YJ, Payum T, Rathinavel S, Jayakumar K. Diversity of medicinal plants used by Adi community in and around area of D' Ering Wildlife Sanctuary, Arunachal Pradesh, India. World Scientific News, 2017, 65, 135–159. https://worldscientificnews.com/wp-content/uploads/2024/02/WSN-65-2017-135-159.pdf
10. Khare N, Rout S, Sahoo G, Ray M, Prusty M, Prusty AK (Eds.). Agroforestry: Prospective, strategies and future aspects. Taran Publication, 2021.
11. Kujur N, Kumar S. Impact of industrialization and displacement on tribal groups (special reference to various industries of Raigarh district (Chhattisgarh)). International Journal of Current Research,2017:9(7):53719–53723.
12. Kumar A, Khanna KK, Jha AK. Forest types of Chhattisgarh. Indian Journal of Forestry,2003:26(4):401–405.
13. Liu JJ, Xu Y, Shan YX, Burgess KS, Ge XJ. Biotic and abiotic factors determine species diversity–productivity relationships in mountain meadows. Journal of Plant Ecology,2021:14(6):1175–1188. https://doi.org/10.1093/jpe/rtab064
14. Mariod AA, Saeed Mirghani ME, Hussein I. *Vangueria madagascariensis* (*Rubiaceae*) as New Oil Source. In Unconventional Oilseeds and Oil Sources (pp. 167–180). Elsevier, 2017. https://doi.org/10.1016/B978-0-12-809435-8.00028-7
15. Mishra H, Singh M. The significance of wildlife sanctuaries for Indian agriculture. Indian Farmer,2023:10(5):243–246. https://indianfarmer.net/uploads/IndFarmVol10Issue05_17.pdf
16. Mucina L. Biome: evolution of a crucial ecological and biogeographical concept. The New Phytologist,2019:222(1):97–114. https://doi.org/10.1111/nph.15609
17. Muller-Dombois D, Ellenberg H. Aims and methods of vegetation ecology. John Wiley & Sons, 1974.
18. Naidu V, Kanungo VK, Bahadur AN. Diversity of forest tree in the reserve forest of Bhupdeopur of district Raigarh, Chhattisgarh. Research Expression,2017:2(2–3):51-55. https://ir.govtsciencecollegedurg.ac.in/IRDOCUMENT/14.pdf
19. Naik ML, Patel SK, Kanungo VK. Ethnomedicines of Barnawapara Wildlife Sanctuary, Chhattisgarh, India. International Journal of Plant and Environment,2024:10(03):59–68. https://doi.org/10.18811/ijpen.v10i03.06
20. Nzabarinda V, Bao A, Tie L, Uwamahoro S, Kayiranga A, Ochege FU, et al. Expanding forest carbon sinks to mitigate climate change in Africa. Renewable and Sustainable Energy Reviews,2025:207(114849):114849. https://doi.org/10.1016/j.rser.2024.114849
21. Odum EP. Fundamental of Ecology. Saunders Co., Philadelphia, 1971. https://www.geobotany.org/library/pubs/Mueller-Dombois1974_AimsMethodsVegEcol_ch5.pdf
22. P Kumaran NK, Padmalal D, Nair MK, Limaye RB, Guleria JS, Srivastava R, et al. Vegetation Response and Landscape Dynamics of Indian Summer Monsoon Variations during Holocene: An Eco-Geomorphological Appraisal of Tropical Evergreen Forest Subfossil Logs. PLoS ONE,2014:9(4):e93596. https://doi.org/10.1371/journal.pone.0093596
23. Pandey A. Diet analysis of gaur, *Bos gaurus* (Smith, 1827) by microhistological analysis of fecal samples in Gomarda Wildlife Sanctuary, Raigarh, and Chhattisgarh, India. International Journal of Recent Scientific Research,2019:10(03C):31339–31343.
24. Patel SK. Ethnomedicinal plants employed by tribal communities for prevention and treatment of diabetes in Gomarda Wildlife Sanctuary, Chhattisgarh, India. In Natural medicine and tribal healers of India (p. 246). Abhijeet Publication, 2024.
25. Patel SK, Kanungo VK, Nag G. Dye-yielding plants of Gomarda Wildlife Sanctuary, Chhattisgarh, India. Annals of Plant and Soil Research,2025:27(1):105–110. https://doi.org/10.47815/apsr.2025.10442
26. Patel SK, Kanungo VK, Naik ML. Phytosociological assessment and diversity of herbaceous vegetation in Gomarda Wildlife Sanctuary, Chhattisgarh, India. Indian Journal of Ecology,2025:52(2):306–311. https://doi.org/10.55362/IJE/2025/4493
27. Patel SK, Kanungo VK, Nag G, Naik ML. Status of IUCN red listed threatened flora in Gomarda Wildlife Sanctuary of Chhattisgarh, India. GIS Science Journal,2024:11(3):372.
28. Patel SK, Kanungo VK, Sharma AK, Dixit AK. Ethno-medicinal plants of Gomarda Wildlife Sanctuary Raigarh, Chhattisgarh, India [Conference abstract]. Nat Conf Rec Adv & Tren Biotech, 2020.
29. Rahate S, Hemke A, Umekar M. Review on *Combretaceae* family. Int. J. Pharm. Sci. Rev. Res.,2019:58(2):22–29. https://globalresearchonline.net/journalcontents/v58-2/04.pdf
30. Sharma M, Kumar A. *Leguminosae* (*Fabaceae*) in tribal medicines. Journal of Pharmacognosy and Phytochemistry,2013:2(1):276–283.
31. Sharma RP. Biodiversity in Chhattisgarh forest region CG. International Journal of Education and Science Research Review, 2019, 6(3). https://ijesrr.org/publication/61/299.%20may%202019%20ijesrr.pdf
32. Singh A, Anjum A, Shreshtha S, Sharma P, Thakur KK. The environmental degradation of Chhattisgarh: A case study of central level challenges. Innovation and Integrative Research Center Journal,2025:3(4):363–

373. https://iircj.org/wp-content/uploads/37.The-Environmental-Degradation-of-Chhattisgarh-A-Case-Study-of-Central-Level-Challenges.pdf
33. Singh S, Dixit B, Raj A, Kumar A, Baswanth V. Anthropogenic footprints on Sal Forests: A quantitative assessment of phytosociological attributes and diversity in an Indian Biosphere Reserve. Next Sustainability, 2024, 6, 100216. https://doi.org/10.1016/j.nxsust.2025.100216
34. Sujithra P, Sobhana E, Elango K, Vijayalakshmi G, Arunkumar P. Protected areas in biodiversity conservation of India: An overview. In Biological Diversity: Current Status and Conservation Policies (pp. 67–76). Agro Environ Media - Agriculture and Ennvironmental Science Academy, Haridwar, India, 2021. https://doi.org/10.26832/aesa-2021-bdcp-04
35. Towns AM, van Andel T. Wild plants, pregnancy, and the food-medicine continuum in the southern regions of Ghana and Benin. Journal of ethnopharmacology, 2016, 179, 375–382. https://doi.org/10.1016/j.jep.2016.01.005
36. Wei X, Jones J, Hou Y, Liu S, Asbjornsen H, Zhang Z, et al. Local considerations are the key to managing global forests for water. Science Bulletin,2025:70(4):448-451. https://doi.org/10.1016/j.scib.2024.11.045