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Diversity of Adult Trees in Two Different Forest Types of Tropical Forest of District Balaghat Madhya Pradesh

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ABSTRACT

A study was conducted to analyze the phytosociological structure of two types of Tropical Forest of district Balaghat, Madhya Pradesh viz. Sal Forest (SF) and Teak Forest (TF). The objective of the current study was to understand the diversity of adult trees present in that forest along with their stem density per hectare, basal area per hectare and Importance Value Index. In the present study 12 plots of 50 x 50 m was laid down in each forest type and it was further divided into 25 sub plots of 10 x 10 m and individual trees having ≥ 10 DBH (Diameter at Breast Hight) were recorded and ecological parameters are studied. A total of 50 Angiosperm species belong to 41 Genera and 24 Families was recorded during this study.

Keywords: Tree Diversity; Importance Value Index; Basal area; *Shorea robusta*; *Tectona grandis*

INTRODUCTION

Most rural communities, particularly those in developing nations, rely on forests as their main source of income to meet their needs for fuel wood, building materials, medicinal herbs, socioeconomic functions related to their cycles, water table stabilization, water retention and filtration, bank erosion prevention, and habitat for flora (Dybala et al. 2019, Egbe et al. 2019, Krzeminska et al. 2019). An enormous threat to the ecology has been posed by anthropogenic activities such tree harvesting for the construction of houses and canoes, fuel wood gathering, and forest conservation on local farmlands (Egbe et al. 2021, Whelan 1995). As an ecosystem made up of trees and a wide variety of biological diversity, forests serve as a home for native

ISSN PRINT 2319 1775 Online 2320 7876

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people, a resource for storing carbon, and a provider of ecosystem services (Chazdon et al., 2016). The vegetation of the forest contributes significantly to the global carbon cycle, accounting for a sizeable portion of the C pool and nutrient supplies. Environmental elements like terrain and climate have a direct impact on the structure and content of forests (Currie, 1991). A useful method for examining regional-scale biogeographic patterns is the assessment of the plant variety in these now-gone woods (Gordon & Newton, 2006). One of the most varied vegetation kinds on earth, semi-evergreen woods are also one of the least researched.

Tropical dry forests are frequently less diverse than lush forests. However, Neotropical dry deciduous forests have a vast variation. Tropical dry woods are frequently less diverse than lush forests (Kodandapani et al., 2004). However, Neotropical dry deciduous forests have a large range of species. Tropical dry forests, which account for around 42% of all tropical forested area, are the least protected and most devastated ecosystems in the world (Kodandapaniet al., 2004; Ray et al., 2019; Isbell et al., 2013). Tropical dry woods are defined differently by many specialists around the world. Tropical dry forests are those that have seasonal rainfall followed by extended dry spells. The current study aims to investigate the structural composition and their different ecological aspect of species present in Teak forest (TF) and Sal forest (SF) in the dry deciduous forest of Balaghat district of Madhya Pradesh comes under forest sub type 5A/ C1b Dry Teak Forest and 5B / C1c Dry Peninsular Sal Forest classified by Champion and Seth (1968).

FIELD DATA COLLECTION

Total of 24 (12 for each forest type) transects of 50 m × 50 m each were selected for the detailed study of trees 25 (10 m × 10 m) quadrats were laid in each sub-plot (Misra, 1968 and Kershaw, 1973). Land coordinates were recorded with the help of GPS.Trees were considered to be individuals ≥ 10 cm DBH and were measures at 1.3 m above from the base (Knight, 1963).The data were quantitatively analyzed for density, frequency and IVI (Curtis & McIntosh, 1950; Misra, 1968).The plant species were identified using the flora of Madhya Pradesh (Verma et al. 1993; Mudgal et al. 1997; Singh et al. 2001), also by consulting Prof. P. K. Khare and the herbarium of Department of Botany, Dr. Harisingh Vishwavidyalaya, Sagar, Madhya Pradesh and by using Forest Department of Madhya Pradesh's official data.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

DATA ANALYSIS

Ecological measurements

The floristic data were quantitatively analyzed forbasal area, relative density, relative frequency andrelative dominance. Importance Value Index (IVI) for the tree species was determined as the sum of therelative density, relative frequency and relative dominance.

Basal area (m^2) = $\pi D^2 / 4$ where D = DBH

Frequency = (No. of quadrats in which species occurred / Total no of quadrats studied) x 100

Relative Frequency (R. F.) = (Frequency of occurrence of species / Total frequency of occurrence of all species) x 100

Relative Density (R. Den.) = (Total number of individuals ofspecies / Total number of individuals of all species) ×100

Relative dominance (R. Dom.) = (Total basal area of species/ Total basal area of all species) ×100

Importance Value Index (IVI) = Relative Density + Relative Frequency + Relative Dominance

RESULTS

Forest structure and species composition

A total of 4008 individual no stem/ha were found in Sal Forest having mean valueof 334 ± 149 stem/ha dominated by *Shorea robusta Gaertn.f.* species (stem density 2404 stem/ha). In SF 37 angiosperm species was found which belongs to 21 families and 33 genera and in Teak Forest total 3056 individual no stem/ha was found having mean value of 229.01 ± 19.08 stem/ha. In TF there are 35 angiosperm which belongs to 19 families and 31 genera, this forest was dominated by *Tectona grandis L.f.* tree having stem density of 1384 stem/ha. Figure 1 showing the study area location on the map.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

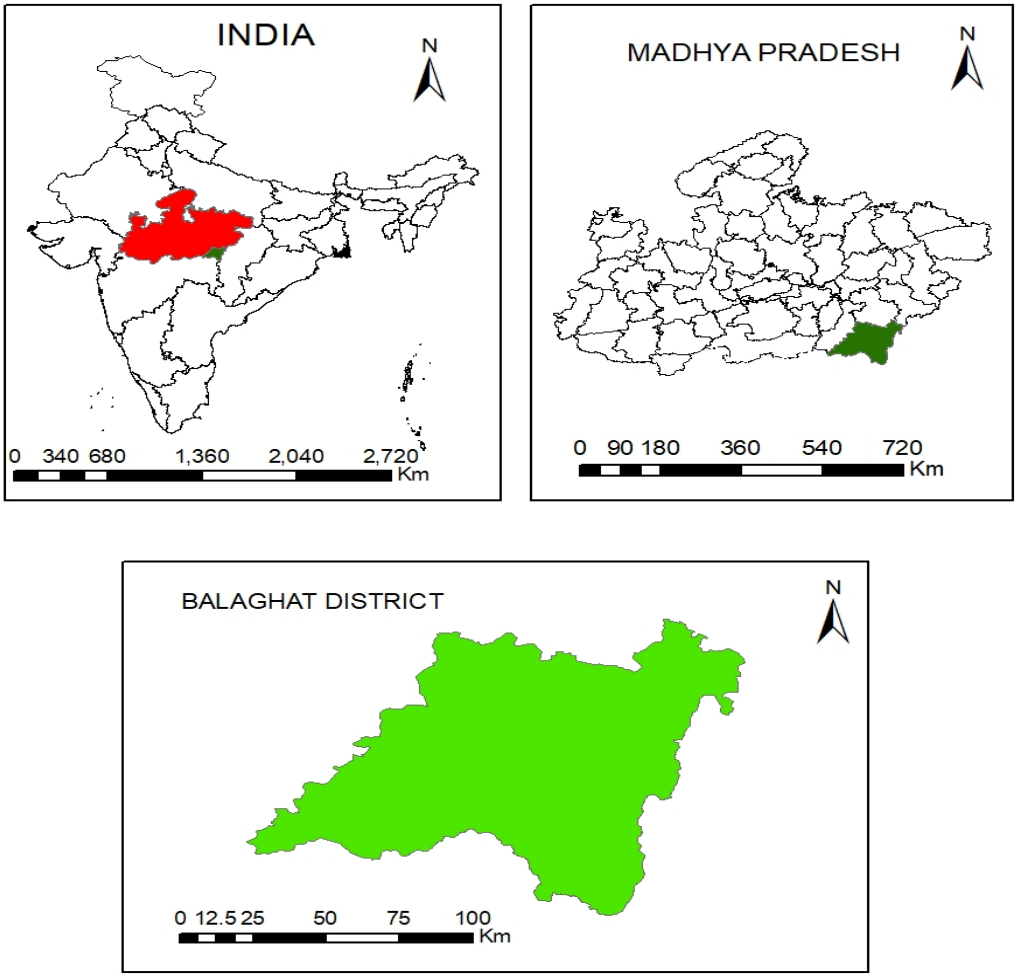

Figure 1: Location Map of the study area showing Balaghat district

Basal area and Importance Value Index (IVI)

In the teak forest (TF) *Tectona grandis* L.f. have highest basal area and IVIvalue 122.58 $M^2ha^{-1}$and 150.7 followed by *Ehretialaevis* Roxb. 14.09 $M^2ha^{-1}$and 19.92 respectively. In shal forest *Shorea robusta Gaertn.f* have highest basal area 198.74 $M^2ha^{-1}$and 183.2 followed by *Terminalia tomentosa* Wight & Arn. 16.04 M^2ha^{-1} and 28.26 respectively. Table 1 showed the Density (Stem/ha), Basal Area (M^2ha^{-1}) of all tree species present in selected forests. Table 1 showed the basal area (BA) and Importance Value Index (IVI) of both the forest type.

Table 1: Density (D), Basal Area (BA) and Importance Value Index (IVI) of tree species present in TF and SF

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

S. No.	Species	TF			SF		
		D	BA	IVI	D	BA	IVI
1.	*Albizia lebbek* (L.) Benth.in Hook.	-	-	-	4	0.5482	1.227
2.	*Anogeissus latifolia* (Roxb.ex DC.) Wall.exGuill.&Perr.	-	2.352956	5.038	92	23.813	6.669
3.	*Bauhinia malabarica*Roxb.	-	-	-	-	0.350232	0.717
4.	*Bauhinia racemosa*Lamk.	4	0.061656	0.312	4	0.05406	0.215
5.	*Bauhinia retusa* Roxb.	-	-	0.6	-	-	-
6.	*Bombax ceiba* L.	-	-	-	12	0.816132	1.02
7.	*Bredelia retusa* (L.) Spreng.	4	0.523416	-	16	2.02722	1.796
8.	*Buchananialanzan*Spreng	92	1.37644	6.426	32	1.228352	2.246
9.	*Butea monosperma*(Lamk)	24	0.587064	2.132	68	1.601172	7.387
10.	*Careya arborea*Roxb.	16	0.36942	1.263	4	0.064492	0.463
11.	*Casearia ellipticaWilld.*	8	0.147908	0.647	4	0.05538	0.461
12.	*Casearia graveolens*Dalz.	-	-	-	44	1.2928	3.214
13.	*Cassia fistula* L.	28	0.456896	2.705	4	0.17914	0.357

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

14.	*Catunaregam spinosa* (Thunb.)	12	0.264576	0.827	-	-	-
15.	*Cordia dichotoma*G.Forter.	12	2.35488	1.537	-	-	-
16.	*Cordia macleodii* (Griff.) Hook.f.	12	1.991808	1.643	-	-	-
17.	*Dalbergia sissoo*Roxb.	4	0.714652	0.564	-	-	-
18.	*Dillenia indica* L.	4	0.09218	0.35	4	0.080256	0.229
19.	*Diospyros melanoxylon*Roxb.	164	16.33346	20.32	8	0.110624	0.554
20.	*Ehretia aspera*Willd.	-	-	-	4	0.159188	-
21.	*Ehretialaevis*Roxb.	-	14.09288	19.92	-	-	0.209
22.	*Ficus amplissima* Sm.in Rees.	-	-	-	8	0.833432	0.584
23.	*Ficus religiosa* L.	-	-	-	4	2.4436	1.109
24.	*Flacourtia indica* (Burm.f.)	8	0.214076	0.728	4	0.381856	0.363
25.	*Gardenia latifolia* Ait.in Hort.	-	-	-	4	0.107132	0.335
26.	*Gardenia resinifera* Roth.	88	1.315344	6.026	-	-	-
27.	*Grewia tilifolia*Vahl,Symb.	-	-	-	12	0.353356	0.642
28.	*Haldinia cordifolia* (Roxb.)	-	-	-	40	3.028084	2.903

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

29.	*Holarrhenapubescens* (Buch.-Ham.) Wallich ex G.Don.	4	0.03 3844	0.22 1	-	-	-
30.	*Ixora pavetta*Andr.	20	0.36 4188	1.47 7	-	-	-
31.	*Lagerstroemia parviflora*Roxb.	20	0.40 5516	1.56 3	112	2.82 9688	8.52 7
32.	*Lanneacoromandelica* (Houtt.)	108	6.77 6976	13.42	92	6.00 476	6.65 1
33.	*Madhuca longifolia* var. latifolia	88	4.18 7072	8.05 2	36	1.34 9896	2.33 5
34.	*Mallotusphilippensis* (Lam.) Muell.	-	-	-	20	0.58 8764	1.26 4
35.	*Miliusa tomentosa* (Roxb.)	284	11.6 2242	25	16	0.49 1808	0.90 8
36.	*Mitragyna Parvifolia* (Roxb.) Korth.	28	1.40 6596	2.21 4	4	0.11 4648	0.19 2
37.	*Ougeiniaoogeinsis* (Roxb.) Hockher.in Ann.	24	1.90 0944	2.55 7	128	6.80 98	7.47 1
38.	*Phyllanthus emblica* L.	16	1.31 694	1.75 8	28	0.55 8452	1.57 7
39.	*Pongamia pinnata* (L.)	24	5.63 3804	2.56	-	-	-
40.	*Pterocarpus marsupium* Roxb.	-	-	-	20	1.13 1264	1.84 5
41.	*Schleicheraoleosa* (Lour.)	12	2.58 3676	2.13	16	1.78 2016	1.67 4
42.	*Semecarpus anacardium* L.F.	-	-	-	76	2.14 3004	4.95 5

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

43.	*Shorea robusta* Gaertn.f.	-	-	-	240 4	198. 7447	183. 2
44.	*Syzygium cumini* (L.) Skeels.	16	0.26 7996	1.27	92	9.44 1468	9.50 6
45.	*Tamarindus indica* L.	8	2.15 1144	1.57	-	-	-
46.	*Tectona grandis* L.f.	13 84	122. 5849	150. 7	-	-	-
47.	*Terminalia bellirica* (Gaertn.) Roxb.	12	0.40 9604	1.21 3	-	-	-
48.	*Terminalia chebula* Retz.	12	0.45 1528	0.86	36	0.90 9808	2.74 1
49.	*Terminalia tomentos a* Wight &Arn.	92	4.19 856	9.00 7	460	16.0 493	28.2 6
50.	*Ziziphus xylopyrus* (Retz.)Willd.	40	0.68 8556	2.96	124	2.91 8628	6.13

DISCUSSION

In recent decades, number of researchers hasreported diversity of trees present in different forest types. In this regards, In the Trans-Himalayan region of Ladakh, Kala & Mathur (2002), used the point intercept approach to analyze the distribution of vegetation along an altitudinal gradient and discovered six plant groups with 74 plant species. In two independent tropical forest sites in the Garhwal Himalaya, Kumar & Bhatt (2006), compiled data on floristic diversity and abundance-to-frequency ratios of tree, shrub, and herb species. They found that there were 33 and 34 tree species present, with 599 and 714 individuals ha^{-1}, respectively. 13 plant communities and 77 species were detected by Malik et al. (2007) during their phytosociological observations of the Pir Chinasi hills in Jammu and Kashmir. Chawla et al. (2008) conducted a survey of the plant species diversity along the Bhabha Valley's altitudinal gradient and found 313 species of higher plants classified into 204 genera and 68 families. In

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

their 2008 analysis of the regeneration capacity and community structure of the natural forests in the Gangotri Valley, Dhaulkhandi et al. (2008) found that the tree density and basal area were, respectively, 820 individuals per hectare and 2.69 M^2 per hectare. In the sub-alpine zone of the west Himalaya, Gairola et al. (2008) evaluated the forest vegetation pattern over the altitudinal gradient (2800-3600 m asl.) and discovered that tree density and basal area varied from 243 to 843 individual's ha^{-1}.

In the present study we have found various plant species in teak and shal forests of Balaghat district (Table 1). Similar to this, Pokhriyal et al. (2009) discovered a total of 27 and 24 tree species in their study of the species richness, diversity, and composition in *Anogeissus latifolius* mixed forests in the Pathri Rao and Phakot watersheds of the Garhwal Himalaya. In the oak and pine forests of the Garhwal Himalaya, Singh et al. (2009) examined the community composition and soil characteristics. They found that the tree density and basal area varied between 100 and 660 individuals per hectare and 500 and 560, respectively, and between 2.84 and 41.08 and 26.79 and 56.94 metres per hectare. Figure 2 showed the total teak and shal trees present in TF and SF forest types of district Balaghat Madhya Pradesh central India.

Figure 2: Number of adult teak and shal trees present in TF and SF

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

Panda and Das (2004) released the Flora of Sambalpur, Orissa after conducting a thorough survey. Reddy et al. (2007) quantified the floristic inventory of tropical forests in the Eastern Ghats of Orissa that varied in dominance, composition, diversity, and structure and reported that tree species, tree density, mean basal area, and Shannon-185 species of trees, 527-665 individual's ha^{-1}, 43.51 m^2 ha-1, and 4.3-5.46 respectively. Kar et al. (2009) reported 151 tree species after surveying the structure, composition, and diversity of tree species in tropical deciduous forests in the Keonjhar district of Orissa. 38 tree species were identified by Rout et al. (2018) who studied the floristic diversity of the Kuldiha wildlife sanctuary in Odisha. Similar investigation was done on the phytodiversity of tree species in the Kuldiha wildlife sanctuary by Saravanan et al., (2019). Pradhan et al. (2019) recorded 78 tree species under 66 genera and 33 families after studying diversity, population structure, and regeneration potential of tree species in five sacred forests in western Odisha. Tree densities varied from 248 to 1745 individuals per hectare and from 11.33 to 24.35 m2 per hectare, respectively. By constructing 47 belt transects (50 m 100 m), Kumar & Saikia (2020) examined the dominant pattern of shal (*Shorea robusta*) forests in Ranchi, Jharkhand, eastern India, and discovered 137 plant species organized into 51 families. There were 397 individuals per hectare of trees and 262.5 m2 per hectare of basal area in total.

CONCLUSION

This study estimates the tree species composition analyze the *Shorea robusta* and *Tectona grandis* species composition and diversity in the dry deciduous forest of Balaghat district of Madhya Pradesh. The objective of the current study was to understand the impact of teak forest and shal forest on the tree species diversity in the Balaghat district of Madhya Pradesh. A total of 947 trees belonging to two different plant species, 2 genera, and 2 families. *Tectona grandis* was the dominant tree species in the Teak forest (TF) while *Shorea robusta* second most dominant tree species in the (Shal forest) SF.

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Research paper UGC CARE Listed (Group -I) Journal Volume 11,S Iss 3, Dec 2022

Conflict of Interest: The author declares that theydo not have any conflict of interest.

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