Regeneration status of *Pterocarpus santalinus* (Red sanders) dominated tropical dry deciduous forest of Eastern Ghats in Andhra Pradesh.

Abstract

Tropical dry deciduous forest regeneration dynamics are essential markers of biodiversity and ecological health. This study assesses the regeneration state of tree species in the Rajampet range, identifying a variety of patterns impacted by both natural and man-made influences. The study documented a total of 1391 adult individuals, 617 saplings, and 1646 seedlings from 61 species. *Pterocarpus santalinus* and *Chloroxylon swietenia*, two dominant species, showed "fair" regeneration potential, while *Phyllanthus emblica* and *Azadirachta indica* showed "good" regeneration potential. Nevertheless, a few species showed no regeneration, such as *Bauhinia racemosa* and *Albizia amara*. Overall Rajampet range regeneration is classified as 33.31 percent of species as "fair," 9.28 percent as "new," 15.38 percent as having "good" regeneration, and 43.08 percent as lacking. The study emphasizes how important biotic and abiotic factors are in determining patterns of regeneration and how specific approaches to forest management are required to solve recruitment issues and maintain biodiversity.

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Keywords: regeneration, biodiversity, ecological health, biotic and abiotic factors

Introduction

The nature of a dry deciduous forest community's and species diversity greatly depends on its regeneration potential as well as the level of biotic pressure it faces. The regeneration status of the vegetation reflects the health of the forest ecosystem (Yadav *et al.*, 2019). Globally, tropical dry deciduous forests are rich in biodiversity and have distinctive characteristics (Gentry, 1995; Medina, 1995). It is the ability of a species to complete the life cycle (Singh *et al.*, 2016) that is crucial to the existence of species in a community under variable environmental conditions (Khumbongmayum *et al.*, 2005). Any species' regeneration depends on a specific range of habitat conditions that determine its geographic distribution (Grubb, 1977). For both ecologists and foresters, it is crucial to understand how forest tree species regenerate (Silk *et al.*, 2003). The regeneration status was studied based on an inventory method. Seedlings, saplings, and tree species were used to determine species regeneration status (Fayiah *et al.*, 2018). The biotic and abiotic factors affect forest regeneration (Yadav *et al.*, 2017; McDonald *et al.*, 2010; Grubb, 1977). Viability of forest population rapidly changed due to

environmental changes (Condit *et al*., 1996; Stork, 2010), local habitat characters (Chaturvedi *et al*., 2012), and community composition (Sagar *et al*., 2008), while insects, disease, herbivores, and competing vegetation will also influence forest regeneration (Ward *et al*., 2006).

Methodology

The present investigation was carried out in the tropical dry deciduous forest of Kadapa district, Andhra Pradesh, India. The study site includes the Rajampet Forest Range forest stand, which has diverse vegetation attributes and is representative of the region's vegetation. The area is situated at 14.19543°N latitude and 79.15847°E longitude. The study region reflects a tropical climate with an average temperature of 19^0 C (January) to 36^0 C (May). The total average annual precipitation is about 1045 mm. It grows very well on dry, hilly, often rocky ground and prefers mostly lateritic and gravelly soil (Purkayastha, 1996). The forests are mostly tropical (i.e., dry deciduous, dry deciduous scrub, and moist deciduous) over the entire region (Champion and Seth, 1968). The stratified random sampling was done and laid out on a 31.62 m x 31.62 m plot in the study area. The trees were measured within the main plot, and the girth at breast height (GBH) of individuals was measured at species level. Within the main plot, a 3 x 3 m quadrate was employed for the regeneration study. Individuals of all species encountered in each quadrate were counted and their girth measured. Individuals with ≥30 cm girth (gbh) were considered adults. Saplings with ≥10 cm to < 30 cm girth and seedlings with < 10 cm girth were identified. The status of the regeneration of species was determined based on the population size of seedlings, saplings, and adults, following a modification of the method used by Khumbongmayum *et al.* (2006), Shankar (2001), and Khan *et al.* (1987).

(a) Good regeneration, if seedlings > saplings > adults;

(b) Fair regeneration, if seedlings > or ≤ saplings ≤ adults;

(c) Poor regeneration, if a species survives only in sapling stage, but no seedlings (though saplings may be or = adults);

(d) None, if it is absent both in sapling and seedlings stages, but found only in the adults

(e) New, if a species has no adults, but only saplings and/or seedlings.

Map 1 :location map of study area, Kadapa district

Comment [TP3]: Add total area of Rajampet forest range

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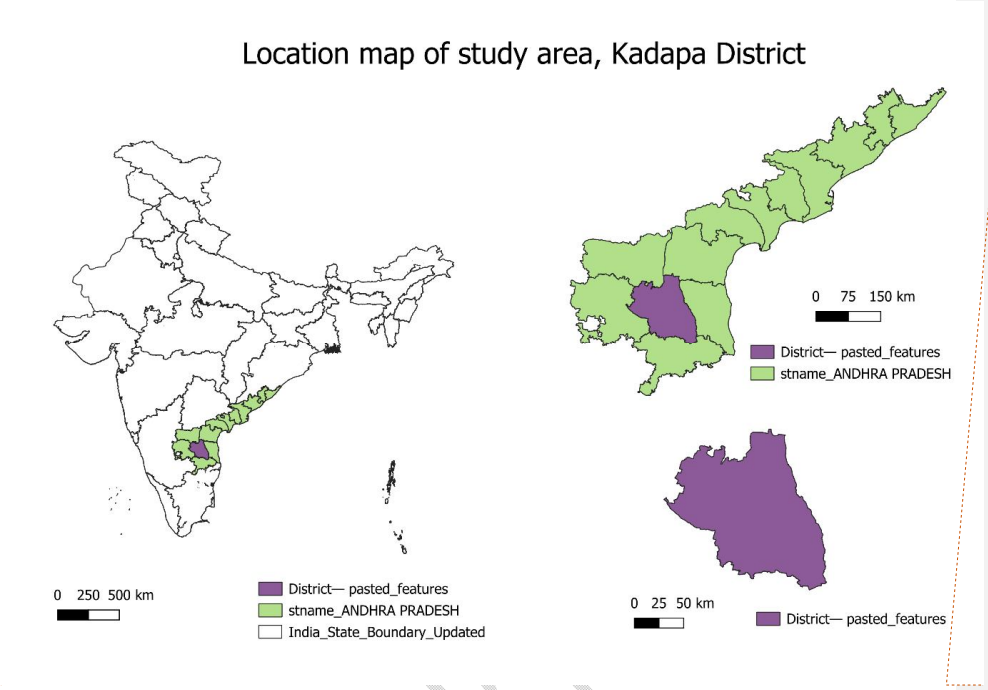

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Results

Tree regeneration status estimates for the Rajampet range

Species-wise tree regeneration status for Rajampet range is presented in table 1. A total of 1646 seedlings, 617 saplings and 1391 adults belonging to 61 species were recorded in the Rajampet range. The forest was mainly dominated by Red sanders and their associates. The regeneration status of Rajampet range can be described having 15.38%, 32.31%, 9.28 and 43.08 of total species recorded as good, fair, new and no regeneration (fig:1) respectively. The regeneration status of tree species in the Rajampet range presents a varied pattern, with several species demonstrating significant regeneration potential, while others exhibit limited or no regeneration. *Pterocarpus santalinus*, a key species in the region, shows substantial regeneration with 382 seedlings, 142 saplings, and 280 adult individuals, classifying its regeneration as "Fair." Similarly, *Chloroxylon swietenia* displays a robust regeneration trend, with 221 seedlings, 82 saplings, and 180 adults, also categorized as "Fair." Species such as *Anogeissus latifolia*, *Hardwickia binata*, and *Strychnos nux-vomica* contribute to the overall fair regeneration status, each showing moderate numbers of juveniles and mature individuals. On the contrary, species like *Albizia amara*, *Cassine glauca*, and *Bauhinia racemosa* demonstrate no

regeneration, as no seedlings or saplings were observed. Notably, *Azadirachtaindica*, *Lagerstroemia parviflora*, and *Phyllanthus emblica* exhibit "Good" regeneration, indicating better recruitment and future population sustainability. The overall regeneration status of the tree community in the Rajampet range is assessed as "Fair," with certain dominant species thriving, while others face challenges in recruitment and regeneration.

Table 1: **Tree regeneration status recorded for the Rajampet range**

Sl.no	Scientific name	Seedlings	Saplings	Adults	Regeneration Interpretation
1	*Albizia amara*	0	0	2	None
2	*Albizia odoratissima*	0	0	3	None
3	*Anogeissus latifolia*	124	65	138	Fair
4	*Azadirachta indica*	5	0	1	Good
5	*Bauhinia racemosa*	0	0	3	None
6	*Bredeliamontana*	5	2	0	New
7	*Bridelia retusa*	8	0	2	Good
8	*Buchanania axillaris*	16	9	22	Fair
9	*Butea monosperma*	3	0	0	New
10	*Canthiumdidymum*	0	0	5	None
11	*Cassia fistula*	9	3	17	Fair
12	*Cassine glauca*	0	0	2	None
13	*Chloroxylon swietenia*	221	82	180	Fair
14	*Cleistanthuscollinus*	0	0	4	None
15	*Croton scabiosus*	32	11	27	Fair
16	*Dalbergia latifolia*	0	0	4	None
17	*Dalbergia paniculata*	18	10	18	Fair
18	*Diospyros chloroxylon*	0	0	5	None
19	*Diospyrous melanoxylon*	11	0	3	Good
20	*Dolichandrone atrovirens*	104	55	76	Fair
21	*Dolichandrone falcata*	0	0	9	None
22	*Drypetessepiaria*	0	0	2	None
23	*Ehretia Laevis*	0	0	1	None
24	*Erythroxylummonogynum*	0	0	8	None
25	*Ficus amplissima*	0	0	2	None
26	*Ficus glomerata*	0	0	7	None
27	*Gardenia gummifera*	98	26	45	Fair
28	*Gardenia resinifera*	13	4	21	Fair
29	*Givotiamoluccana*	0	0	9	None
30	*Givotiarottleriformis*	14	5	8	Fair
31	*Grewia americanus*	0	0	6	None
32	*Grewia orbiculata*	96	32	48	Fair
33	*Gyrocarpus assiaticus*	0	0	8	None
34	*Hardwickia binata*	86	28	56	Fair

35	*Ixora pavetta*	0	0	8	None
36	*Lagerstroemia parviflora*	7	3	2	Good
37	*Lanneacoromandelica*	12	0	17	Fair
38	*Limoniaacidisima*	0	0	2	None
39	*Madhuca longifolia var. latifolia*	0	0	3	None
40	*Mallotusphilippensis*	6	5	0	New
41	*Mangifera indica*	2	4	0	New
42	*Manilkara hexandra*	0	0	9	None
43	*Mimosa prainlana*	23	9	32	Fair
44	*Mitragyna parviflora*	4	2	0	New
45	*Phyllanthus emblica*	14	13	2	Good
46	*Plecospermum spinosum*	0	0	10	None
47	*Polyalthiacerasoides*	0	0	5	None
48	*Pongamia pinnata*	3	0	8	Fair
49	*Psydraxdicoccos*	0	0	2	None
50	*Pterocarpus marsupium*	14	5	27	Fair
51	*Pterocarpus santalinus*	382	142	280	Fair
52	*Pterospermumxylocarpum*	0	0	11	None
53	*Randai spinosa*	6	0	4	Good
54	*Semecarpus anacardium*	0	0	3	None
55	*Soymida febrifuga*	8	5	12	Fair
56	*Strychnos nux-vomica*	39	11	18	Fair
57	*Strychnos potatorum*	93	13	26	Fair
58	*Syzygium alternifolium*	52	21	62	Fair
59	*Syzygiumcumini*	7	4	0	New
60	*Terminalia alata*	0	0	28	None
61	*Terminalia chebula*	12	6	9	Fair
62	*Terminalia pallida*	17	11	9	Good
63	*Terminalia tomentosa*	0	0	11	None
64	*Uvaria tomentosa*	13	8	4	Good
65	*Wrightia tinctoria*	25	0	18	Good
66	*Ziziphus glabrata*	15	7	18	Fair
67	*Ziziphus xylopyrus*	29	16	11	Good
	Overall total	**1646**	**617**	**1391**	**Fair**

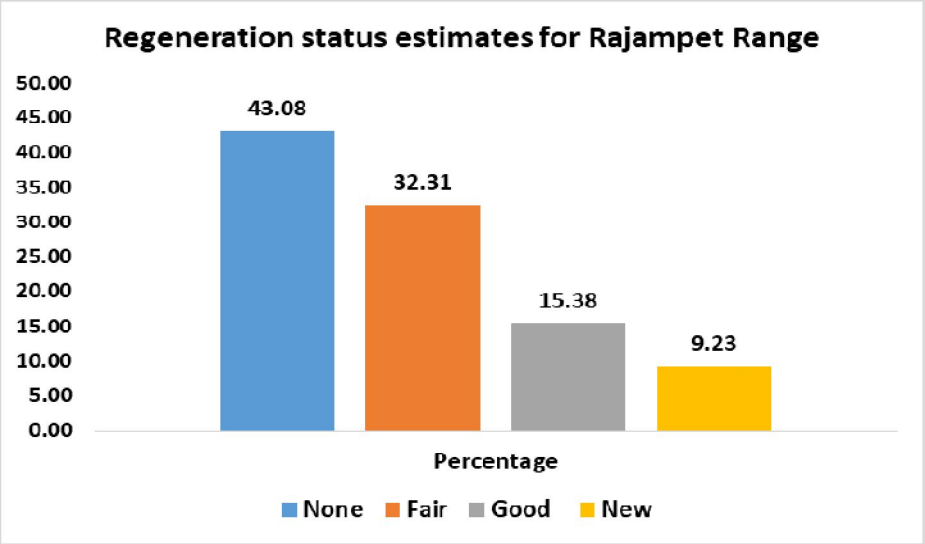

Fig 1: **Regeneration status estimates for Rajampet Range**

Discussion

Red Sanders (*Pterocarpus santalinus*) and *Chloroxylon swietenia* are the only species to have shown significant regeneration, while other species have shown good, fair, or no regeneration. Forest health and sustainability depend on a mix of species with different regeneration potentials in tropical regions (Jones *et al*., 1994). Similarly to Rajampet, studies of Chhattisgarh's Sal forests show that dominant species can regenerate strongly (Abhishek Raj, 2018), suggesting that major canopy species promote a stable community structure. However, some species in the Rajampet range, like *Albizia amara* and *Cassine glauca*, exhibit no regeneration. This is similar to other studies that found certain species largely restricted to the tree stage without seedlings or saplings, possibly due to biotic pressures and limited resources (Fayiah *et al*., 2018;Mishra*et al*., 2013). Factors influencing regeneration, including canopy gaps, soil nutrient availability, light density, and biotic pressures, are well documented (Prakasham *et al*., 2016; Chaubey and Sharma, 2013; Singh *et al*., 2021). For instance, heavy grazing, fire, and soil nutrient depletion have adversely impacted seedling establishment in the Western Ghats (Murthy *et al*., 2002). In Rajampet, such factors may similarly affect species with no regeneration, suggesting the need for protective measures to support species with limited recruitment.

This limited regeneration is common in tropical forests, where anthropogenic pressures like grazing and fire impact juvenile growth and seedling establishment (Murthy *et al*., 2002; Saberwal, 1995). Furthermore, tropical dry forests often exhibit a "reverse J-shaped" distribution, indicative of continual recruitment for some species but not all, leading to a future shift in species composition (Subashree*et al*., 2020). In Rajampet, species like *Azadirachta indica* and *Phyllanthus emblica* exhibit "good" regeneration, suggesting promising recruitment similar to the oak-dominated forests of Garhwal Himalaya, where significant regeneration efforts for certain key species are advised due to concerns over long-term sustainability (Sing *et al*., 2016).

Conclusion

Overall, the Rajampet range's regeneration status aligns with trends observed in other tropical forests, emphasizing the importance of ecological and anthropogenic factors in shaping regeneration patterns. Effective forest management strategies addressing both ecological needs and anthropogenic pressures are critical to enhancing regeneration and sustaining biodiversity in these ecosystems.

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