Composition and importance value of tree-families in undisturbed and disturbed moist tropical forest of eastern Nepal

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Abstract

Topical forest disturbances have reduced the tree species diversity and thereby, the ecosystem services provided by them. Present study was carried out to understand the status of tree-families in terms of their dominance in the undisturbed and disturbed stands of moist tropical forest in eastern Nepal. As per the result, the dominant family in both the forest was Dipterocarpaceae, with family importance value of 53.6 and 53.9 in undisturbed and disturbed stands, respectively. The second dominant family in both forest stands was Rubiaceae.

Key words: Family importance value; density; frequency; basal coverage; Sunsari district

Introduction

Tropical forests, covering only 7% of the earth's land surface, comprise 52% of total global forests. The tropical forests are the store house of valuable timber and non-timber products which have been sources of livelihood of many people. Tropical forests of Nepal comprise 1878000 ha of natural forest (FRSC, 1994) and are located in Terai and Siwaliks. Forest resources play an important role in the economy of Nepal contributing 4.3% to the GDP.

Importance value of species/family is a measure of how dominant a species/family is in a given forest. It is a standard tool used by foresters and researchers to inventory a forest. Foresters generally do not inventory a forest by counting all the trees as it is a very tedious work, but by locating points in the forest and sampling a specified area around those points. Importance value index (IVI) shows the ecological importance of a species or a family in an ecosystem. Each of these values is expressed as a percent, and ranges from 0 to 100. The Importance Value is the sum of these three measures, and can range from 0 to 300.

The family importance value (FIV) depends upon the relative frequency, relative density and relative dominance of families in a forest. A high importance value indicates that family "A" is well represented in the stand because of some combination of a large number of individuals of species of family "A" compared with other families in the stand, or a smaller number of individuals of species of family "A", but having higher diameter of trees as compared with others in the stand.

Several ecological parameters regarding the tree species in tropical forests have been studied. But the studies concerning the family importance value are very rare. Present study is mainly designed to fulfill the gap in the knowledge of family content, diversity and FIV in moist tropical forest of eastern Nepal.

Materials and Methods
Study area

Present study was conducted in a Sal (*Shorea robusta* Gaertn.) dominated moist tropical forest of Sunsari district, eastern Nepal (latitude N 26°41' to 26°50' and longitude E 87°09' to 87°21') laying within the altitude range of 220 to 370 m, msl (Fig. 1). The total area occupied by the forest is 11394 ha. The forest is bordered by the *Siwalik* hills in the north, Gangetic alluvial plain with dense settlements in the south, Saptakoshi river (largest river of Nepal) in the west and Morang district in the east.
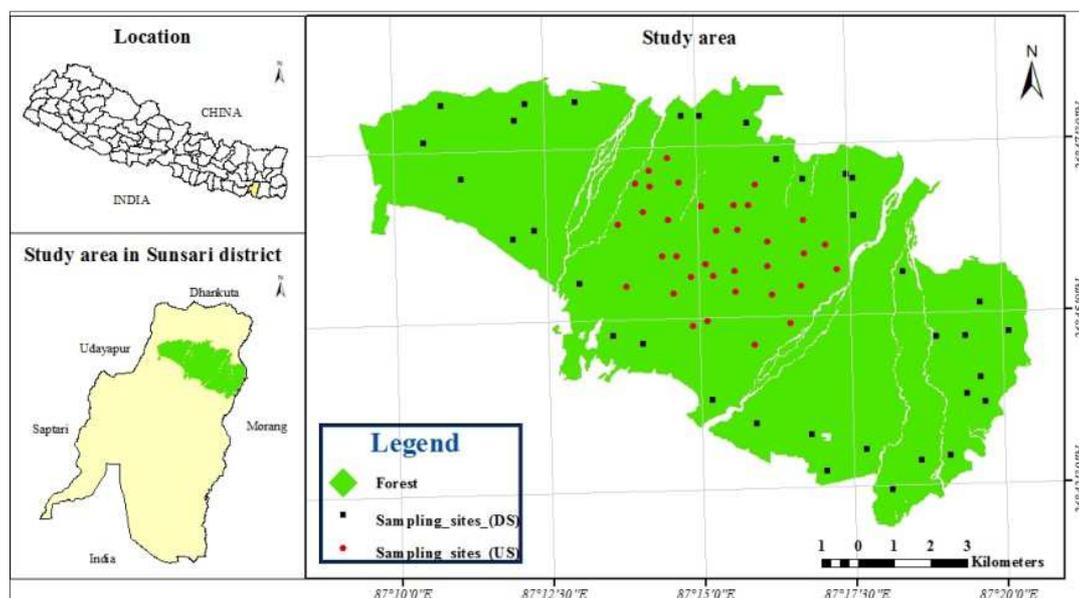

Figure 1. Map of the study area (tropical forest of Sunsari district, eastern Nepal).

The climate is tropical and monsoon type with three distinct seasons: dry and warm summer (March to May), wet and warm rainy (June to October), and dry and cool winter (November to February). The mean monthly minimum and maximum air temperature during 2005–2014 ranged from 10.9 to 25.3°C and 22.6 to 33.2°C, respectively. The average annual rainfall for the period was 1998.6 mm (Fig. 2). Pronounced rainfall occurred during the months of June to September. Relative humidity was higher in rainy season with highest value in August (92%).

The central part (core area) of the forest is relatively undisturbed, while the peripheral part is affected by disturbance activities as removal for timber, livestock grazing, fuel-wood and litter collection, tree lopping, removal of poles for house-hold constructions and forest fires. The topstory of forest is dominated by *Shorea robusta* (Dipterocarpaceae), associated with *Adina cordifolia*, *Careya arborea*, *Dillenia pentagyna, Terminalia allata, Terminalia bellirica, Terminalia chebula, Lagerstroemia parviflora* etc. *Clerodendron infortunatum*, and *Murraya koenigii* are some of the main shrub species while *Chromolaena odorata* and *Achyranthes aspera* are dominant herbs.
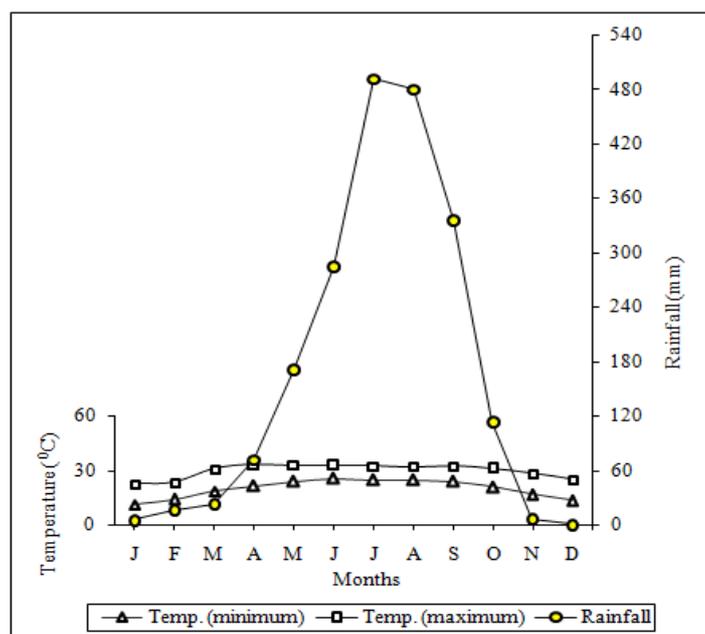
Figure 2. Ombrothermic representation of the climate of moist tropical forest region of Sunsari district, eastern Nepal, 2005-2014. (Source: Dept of Meteorology, Dharan, Nepal)

Sampling and vegetation analysis

For the present study, central part of the forest was treated as undisturbed forest (UF), and peripheral part as disturbed forest (DF). Altogether, seventy permanent experimental plots, thirty five each in UF and DF were randomly established. Stem of tree-species having ≥ 10 cm girth at breast height (GBH) were considered as trees (Lalfakawma *et al.*, 2009). For the analysis of trees, sampling plot of 20 m × 20 m was used in the both forests. Girths of all tree species recorded within the sampling plots were measured at their breast height (1.37 m from soil). Plant species were identified for families, genera and species with the help standard literatures.

Results

Tree species content

In the present study, 981 individuals of trees were recorded which belonged to 60 species, 51 genera, and 32 families. Out of these, 57 species were present in UF, 38 in DF and 35 were common to both forest stands. The number of species found only in UF was 22, whereas that in DF was 3. It showed 74% similarity between UF and DF as per the Sorenson's similarity index.

Family diversity

Altogether, 32 families were present in UF but only 22 families (69% of UF) were represented in DF (Tables 1, 2). Based on number of individuals, the dominant families in both forest stands were Dipterocarpaceae (with 140 trees in UF and 90 trees in DF) and Euphorbiaceae (95 trees in UF and 41 trees in DF). Based on species, the largest families

were Euphorbiaceae (with 6 species) in UF and Euphorbiaceae and Mimosaceae (each with 4 species) in DF. On the basis of basal area, Dipterocarpaceae (33.9 m^2 ha^{-1}), Rubiaceae (23.9 m^2 ha^{-1}) and Lythraceae (14.4 m^2 ha^{-1}) were dominant families in UF, whereas Rubiaceae (14.1 m^2 ha^{-1}), Dipterocarpaceae (12.5 m^2 ha^{-1}) and Combretaceae (6.7 m^2 ha^{-1}) were dominant in DF.

Family importance value (FIV)

In terms of family importance value, Dipterocarpaceae occupied the top rank (scoring of 53.6 in UF and 53.9 in DF) followed by Rubiaceae (31.6 in UF and 41.7 in DF) and Euphorbiaceae in UF (28.4) and Combretaceae in DF (32.3) (Tables 1, 2).

Table 1. Family composition and Importance Value (FIV) in undisturbed forest stand of moist tropical forest in Sunsari district, eastern Nepal.

SN	Family	Basal area (m^2 ha^{-1})	Relative density	Relative diversity	Relative basal area	FIV
1	Dipterocarpaceae	33.87	21.44	1.75	30.36	53.55
2	Rubiaceae	23.86	8.42	1.75	21.38	31.56
3	Euphorbiaceae	3.65	14.55	10.53	3.27	28.35
4	Lythraceae	14.36	11.18	1.75	12.87	25.8
5	Combretaceae	11.97	7.2	7.02	10.72	24.94
6	Myrtaceae	4.56	3.83	5.26	4.08	13.18
7	Mimosaceae	1.86	2.6	8.77	1.67	13.04
8	Anacardiaceae	2.49	2.6	5.26	2.23	10.1
9	Moraceae	0.48	0.92	7.02	0.43	8.36
10	Alangiaceae	1.19	5.51	1.75	1.07	8.34
11	Sapindaceae	3.75	2.6	1.75	3.36	7.72
12	Apocynaceae	0.91	3.37	3.51	0.82	7.7
13	Caesalpiniaceae	0.32	1.84	5.26	0.28	7.38
14	Dillaniaceae	2.81	2.91	1.75	2.52	7.18
15	Papilionaceae	0.6	2.3	3.51	0.54	6.35
16	Ebenaceae	0.72	2.91	1.75	0.65	5.31
17	Bombacaceae	3.03	0.77	1.75	2.72	5.24
18	Verbanaceae	0.05	0.46	3.51	0.05	4.02
19	Ulmaceae	0.02	0.46	3.51	0.02	3.99
20	Burseraceae	0.28	0.61	1.75	0.26	2.62
21	Ehretiaceae	0.25	0.61	1.75	0.22	2.59
22	Tiliaceae	0.07	0.46	1.75	0.06	2.27
23	Sterculiaceae	0.03	0.46	1.75	0.02	2.24
24	Meliaceae	0.07	0.31	1.75	0.06	2.12
25	Cordiaceae	0.04	0.31	1.75	0.04	2.1
26	Aceraceae	0.03	0.31	1.75	0.03	2.09
27	Cornaceae	0.01	0.31	1.75	0.01	2.07
28	Sapotaceae	0.09	0.15	1.75	0.08	1.99
29	Elaeagnaceae	0.08	0.15	1.75	0.07	1.98
30	Rutaceae	0.08	0.15	1.75	0.07	1.98
31	Bignoniaceae	0.02	0.15	1.75	0.02	1.92
32	Rhamnaceae	0.02	0.15	1.75	0.01	1.92
	Total	111.6	100	100	100	300

Table 2. Family composition and Importance Value (FIV) in disturbed forest stand of moist tropical forest in Sunsari district, eastern Nepal.

SN	Family	Basal area (m^2 ha^{-1})	Relative density	Relative diversity	Relative basal area	FIV
1	Dipterocarpaceae	12.47	27.44	2.63	23.85	53.92
2	Rubiaceae	14.12	9.45	5.26	26.99	41.70
3	Combretaceae	6.69	11.59	7.89	12.80	32.28
4	Euphorbiaceae	1.99	12.50	10.53	3.80	26.83
5	Sapindaceae	5.19	5.18	2.63	9.92	17.74
6	Mimosaceae	1.86	3.66	10.53	3.55	17.73
7	Myrtaceae	1.62	3.35	7.89	3.10	14.35
8	Alangiaceae	0.66	8.23	2.63	1.26	12.13
9	Dillaniaceae	2.03	3.05	2.63	3.88	9.56
10	Caesalpiniaceae	0.81	2.44	5.26	1.55	9.25
11	Anacardiaceae	0.74	1.22	5.26	1.41	7.90
12	Bombacaceae	1.89	1.52	2.63	3.61	7.76
13	Rutaceae	0.46	3.35	2.63	0.88	6.87
14	Apocynaceae	0.16	1.22	5.26	0.30	6.78
15	Moraceae	0.28	0.91	5.26	0.53	6.71
16	Ulmaceae	0.04	0.61	5.26	0.07	5.94
17	Lythraceae	0.62	1.52	2.63	1.19	5.35
18	Sapotaceae	0.43	0.61	2.63	0.83	4.07
19	Bignoniaceae	0.12	0.91	2.63	0.22	3.77
20	Ehretiaceae	0.01	0.61	2.63	0.02	3.26
21	Burseraceae	0.11	0.30	2.63	0.20	3.14
22	Tiliaceae	0.02	0.30	2.63	0.03	2.97
	Total	52.3	100	100	100	300

Discussion

The plant biodiversity status of any forest is mainly reflected by the tree species content and their family composition. As per the species content, undisturbed and disturbed forests are 74% similar to each other. The 26% dissimilarity between them reflects the consequence of disturbance. Some of the tree species in DF are represented by single individuals indicating their possibility to local extinction in near future, unless any conservation measures are taken. Some of the tree species like *Shorea robusta* and *Haldina cordifolia* are heavily exploited by local people. In spite of this, their population is relatively high even in DS, indicating their high regeneration potential.

The species composition in the undisturbed and disturbed stands of present forest is more or less similar, which may be attributed to the similar topography, soil and climatic conditions. The representation of 13 species (22.8%) with single individual in UF might be due to unfavorable regeneration conditions and lack of appropriate habitat or both. Sagar *et al.* (2003) and Upadhaya *et al.* (2004) also reported the presence of either one or two individuals of some tree species in Indian dry tropical and sub-tropical forests, respectively. The variation in family importance value (FIV) in the studied forests is the result of their variations in tree density, frequency and dominance. The reduced density in DF was largely attributed to a low proportion of young trees, which might be due to the selective cutting of

straight boles of tree for use as poles by local people. The variation in the forest stand density in tropical forests of world is mainly due to variation in biogeography and habitat disturbance (Mani & Parthasarathy, 2009). The stand density of the present forests are comparable with that for tropical forest of Bardia, Nepal (Shrestha & Jha, 1997) and lower to tropical dry evergreen forest of India (Anbarashan & Parthasarath, 2013).

In the present study, dominance was expressed in terms of basal coverage (area). Basal coverage reflects stand volume or biomass. The basal area of trees in DF was reduced by 53.1%. This reflects the removal of large and old trees. The high density and basal coverage of *Shorea robusta* in both the forests suggests the dominancy of it, thereby scoring high FIV. The higher basal area of trees in the UF ($111.6 \text{ m}^2 \text{ ha}^{-1}$) is fairly higher to that in other tropical forests of Bardia and western terai of Nepal as reported by Shrestha and Jha (1997) and Timilsina *et al.* (2007). The high basal area resulted from very high stocking of the middle-size class (160-210 cm GBH) trees and also due to the availability of very larger size-classes (up to 610 cm GBH) older trees in fair number.

Conclusions

The disturbance activities in the present forest have resulted in the less species content, density and basal coverage of tree species; and finally, low value for family importance value. To maintain the species and family content in the present forest, conservation activities should be extended immediately by the concerned authorities.

Acknowledgements

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