Tree diversity of Pasighat town of Arunachal Pradesh

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Abstract
This study was carried out to assess the tree species diversity and distribution in Pasighat town of Arunachal Pradesh. Trees are important component of vegetation because of their economic value to mankind. There is high pressure on forest estates due to high demand on forest economic resources as a result of geometric increase of human population in the region. The results of the study showed that a total of 103 tree species representing 85 genera and belonging to 45 families were recorded from the study area. Fabaceae with 19 species was the dominant family of tree species. Co-dominant families were Rutaceae, Meliaceae, Anacardiaceae, Arecaceae, Moraceae, Myrtaceae, Lauraceae, Euphorbiaceae and Sapotaceae. The structural pattern showed a heterogeneous distribution of trees which is the chief character of forests of Eastern Himalaya. The area is rich with diverse plant species and by obtaining proper information about it, prime efforts can be made to conserve it.

Keywords: Tree, species, diversity, Himalaya, regeneration

Introduction
India is a treasure chest of biodiversity which hosts a large variety of plants and has been identified as one of the eight important “Vavilovian centres of origin” and crop diversity (Anil et al., 2014) [1]. India accounts for 8% of the total global biodiversity with an estimated 49,000 species of plants of which 4900 are endemic (Kumar and Asija, 2000) [13]. Himalayas are one of the largest and youngest mountain chains in the world and cover roughly 10 percent of India’s total land surface. The Himalayan region harbors nearly 10,000 plant species constituting approximately 2.5% of the global angiosperm diversity of which over 4,000 are endemics (Kumar and Pandit, 2018) [14]. The diverse climate and varied environmental conditions prevailing in the Himalayas support diverse habitat and ecosystems with equally diverse plant forms. Variation in terms of its size, climate and altitudinal ranges have created environment which are unique and characteristics of these regions only. It provides important habitat to the flora and fauna including 9000 species of angiosperms, hence it is considered as biodiversity hotspot.

However, rapid increase in human population created an environmental imbalance in urban as well as in rural areas in most part of the country. It is estimated that 50% people are now living in less than 3% of the earth’s urbanized surface. In addition, on the face of climate change, adaptation and mitigation actions for cities in India are critically required where the urban population is likely to grow by around 500 million over the next 50 years (Pandey and Kumar, 2018) [16]. The impacts of uncontrolled population, industrialization and urbanization on biodiversity are clearly visible in form of rapid, large and frequent changes in land and resource use, increased frequency of biotic invasion, reduction in species number, creation of stresses and the potential for changes in climatic systems (Bargali et al., 2013) [2]. The continuous elimination and other anthropological activities have resulted in loss of biodiversity. If these naturally occurring plant resources are not timely conserved, then they may become extinct, and this genetic erosion coupled with soil erosion may retard the prospects of future economic development and welfare of people. Trees are important to mankind not only economically, environmentally and industrially but also spiritually, historically and aesthetically, for they sustain human life through direct and indirect gains by providing a wide range of products for survival and prosperity (Seth, 2003) [21]. Trees play a great part in making the environment beautiful and refining the minds of inhabitants. Beside environmental services urban forests and trees have positive impacts on the physical and
psychological healthiness of the human being, provide healthy environment for stressed residents of city (Schroeder and Anderson, 1984; Hunter, 2001) [20, 8]. Arunachal Pradesh (26°28'-29°30’ N and 91°30'-97°30’ E) is recognized as global biodiversity hotspot and forms a complex hill system of Siwalik and Himalayan origin. It is criss-crossed by six major rivers and their tributaries (Damand Kumar, 2018) [4]. Pasighat is the oldest town of Arunachal Pradesh. The town was established in 1911 by the Britishers. It is the headquarter of the East Siang district. The town is spread over in an area of 14.6 km². The town got its name from the ‘Pasis’ an Adi tribe of the area. The British Government had appointed a Political Officer for the area. Due to its ‘strategic’ situation where the Siang leaves the mountains, Pasighat has been often called the gateway to the state of Arunachal Pradesh. In the process of development, the existing natural ecosystems are disturbed and artificial ecosystems are established and new plants to the area were introduced either for shade, avenue, timber etc. By virtue of its location, the town falls under the Northern Tropical wet evergreen forest type (Champion & Seth, 1968) [3], these forests are the most species rich terrestrial ecosystems in the tropics of South-East Asia. Unfortunately, anthropogenic interference and infrastructural development in the last few decades have seen a major transformation of once pristine landscape in this region which highlights the need to undertake the present investigation. During the last two decades, Pasighat has experienced a tremendous change in its dimensions, this town is of economic significance to the Central Arunachal as it is the main business area for the people of East Siang, Upper Siang and Dibang valley. This town also has historical significance. Keeping the economic, strategic, historical and ecological significance of the town, the present study was undertaken to know the tree diversity of the town area with a view that such information would be helpful to the planners for the conservation of the rich biodiversity of the town. Knowledge on tree species diversity and distribution would serve as baseline information to know the status of the tree species in the study area; which is basic in understanding regeneration processes, such as tree growth, tree mortality, under-story development, and the spread of disturbances (Isango, 2007; Francisco et al., 2017) [9, 5].

![Map of Arunachal Pradesh](image)

**Fig 1:** Map of Arunachal Pradesh

**Study site**

Pasighat is situated in the foot hills of Eastern Himalayan range near the banks of the River Siang at an average elevation of 153m AMSL. The latitude of Pasighat is 28°04’ N and longitude is 95°22’ E. The climate is hot and humid in summers and temperate during winters. The average daytime temperature varies from around 32 °C in summer to around 23 °C in winter. The monsoon starts in the month of June and often remains active upto September.
Methodology

In the course of investigation, frequent explorations were made for collection during different seasons. Intensive field survey was done with the help of students, field workers and local inhabitants for the identification of plant species. The tree species growing naturally, cultivated and introduced were collected from different localities like, roadside, gardens, parks, cultivated areas, residential areas, schools, hospitals and other Government premises during 2013-2016. Efforts were made to collect species during flowering and fruiting stage for identification of species. The plants were identified with the help of Flora of British India, Flora of Assam, Flora of Namdapha, Working Plan of Pasighat Forest division and local people. Biodiversity values and ecosystems services are tangible and intangible benefits provided by the species are based on the utility to local inhabitants and also from other secondary literature.

Results and discussion

The stability of ecosystem depends upon its biodiversity, which is the sum total of all flora and fauna. Biodiversity is desirable indicator of environmental health, as the environmental stresses are expressed at different levels of biological organization. Biodiversity can be measured at three levels namely, genetic diversity, species diversity and habitat/ecosystem diversity. A total of 103 tree species representing 85 genera belonging to 45 families were recorded from the study area. Fabaceae with 19 species was the dominant family of tree species. Co-dominant families were Rutaceae, Meliaceae, Anacardiaceae, Arecaceae, Moraceae, Myrtaceae, Lauraceae, Euphorbiaceae and Sapotaceae. The structural pattern showed a heterogeneous distribution of trees which is the chief character of forests of Eastern Himalaya. Some of the tree species are reported as dominating canopy elements for low land area in the North East region (Kaul & Haridassan, 1987; Proctor et al., 1998) [11, 18]. On the riverine areas leguminous species showed dominance and although they are considered to be seral in nature, their progression to climax does not takes place (Mohan & Puri, 1955) [15]. The species richness of the studied area is close to the floristic richness recorded in the various parts of Western Ghats, another global hot spot of biodiversity, which varied from 17 species in Kalakad Mundanthurian Tiger Reserve (Ganesh et al., 1996) to 92 species in Kadamakal Reserve (Ghate et al., 1988) [7].

The enumerated species belonged to 45 families in the present study area. It falls well within the range of 16-58 families found in the tropical forests (Swamy et al., 2000; Parthasarathy & Karthikkeyan, 1997) [22, 17]. The comparative species dominance in any given area is a function of tree (Keel & Prance, 1979) [12] and past damage (Jacob, 1987, Swamy et al., 2000) [10, 22]. The dominance of few species could be attributed to the evolution and colonization of the species in various stages of development, varied environmental conditions also results in accumulation of diverse species in the area (Richards, 1996) [19].

Biodiversity values and ecological services

Biodiversity values and ecosystems services are tangible and intangible benefits provided by the species. Based on the utility to local inhabitants and also from other secondary literature, these were grouped into timber, fruit, ornamental, medicinal, fodder, NTFP yielding trees and exotic categories.

Trees of timber value

The species of timber value are Ailanthus grandis, Duabangagrandiflora, Canarium strictum, Acrocarpus fraxinifolius, Terminalia myriocarpa, T. arjuna, T. chebula, Castanopsis indica, Mesua ferrea, Chukrasia tabularis, Tectona grandis, Gmelina arborea etc.

Trees of Fruit value

The tree species where fruit has economic value are Annona squamosa, Dillenia indica, Eleocarpus floribundus, Emblica officinalis, Artocarpus heterophyllum, Psidium guajava, Syzygium cumini, Zizyphus, Prunus, Aegle, Citrus, Litchi etc.
Trees of ornamental value
The trees with beautiful foliage, inflorescence, flowers, and aesthetic value found in the study area are, Polyaltheia, Alstonia, Cäsia fistula, Delonix, Peltophorum, Mimosa, Anthocephalus indicus, Araucaria spp., Bauhinia variegata, Caesalpinia pulcherrima, Callistemon lanceolatus, Jacaranda mimosaefolia, Lagerstroemia speciose, Michelia champaca etc.

Table 1: Enumeration of tree species of Pasighat Town (Arunachal Pradesh)

| S. No. | Name of Species                                      | Common Name       | Family    |
|--------|------------------------------------------------------|-------------------|-----------|
| 1      | Acacia catechu Wild.                                 | Khoira, Khyar     | Fabaceae  |
| 2      | Acacia auricilformis Benth.                          | Golden shower     | Fabaceae  |
| 3      | Acacia mangium Wild.                                 | Australsabool     | Fabaceae  |
| 4      | Acrocarpus fraxinolius Arn.                          | Silchhal, Mandane | Fabaceae  |
| 5      | Aegle marmelos L.                                    | Bael tree         | Rutaceae  |
| 6      | Alstonia grandi Prain                                | Dorpat            | Simaroubaceae |
| 7      | Albizia chinensis (Osbeck) Merr.                     | Koroi, Chakua     | Fabaceae  |
| 8      | Albizia Lucida Benth.                                | Mauj              | Fabaceae  |
| 9      | Albizia procera Roxb.                                | Siris             | Mimosoideae |
| 10     | Alstonia scholaris (L.) R. Br.                       | Sattin, chatin    | Apocynaceae |
| 11     | Anona macranthia King                                | Amari             | Anacardiaceae |
| 12     | Anacardiun occidentalis L.                            | Kaju              | Anacardiaceae |
| 13     | Annona squamosa L.                                   | Sitaphal          | Anonaceae |
| 14     | Neolamarckia cadamba (Roxb.) Bosser                  | Kadam             | Rubiaceae |
| 15     | Araucaria spp.                                        | Araucaria         | Araucariaceae |
| 16     | Areca catechu L.                                     | Tamul             | Areceae |
| 17     | Artocarpus chaplasha Roxb.                           | Sam               | Moraceae |
| 18     | Artocarpus heterophyllus Lamk.                       | Jackfruit         | Moraceae |
| 19     | Averrhoa carambola L.                                 | Kamarak           | Oxalidaceae |
| 20     | Azadirachta indica A.Juss.                           | Nim, nimgachhi    | Meliaceae |
| 21     | Bauhinia variegata L.                                | Bogakatra         | Fabaceae |
| 22     | Bixa orellana L.                                     | Sinduri           | Bixaceae |
| 23     | Bombax ceiba L.                                      | Himalo, simul     | Bombacaceae |
| 24     | Caesalpinia pulcherrima (L.) Sw.                     | Peacock Flower    | Fabaceae |
| 25     | Callistemon lanceolatus Sweet.                       | Bottle brush      | Myrtaceae |
| 26     | Canarium resiniferum Roxb.                           | Dhuna             | Burseraceae |
| 27     | Canarium strictum Roxb.                              | Dhuna             | Burseraceae |
| 28     | Carica papaya L.                                     | Papaya            | Cariceae |
| 29     | Cassia fistula L.                                    | Honalu, amultash  | Fabaceae |
| 30     | Cassia javanica L.                                   | Pink shower       | Fabaceae |
| 31     | Castanospsis armata Roxb.                            | Taongasing        | Fagaceae |
| 32     | Castanospsis castanacarpus Spach.                    | Angkehe           | Fagaceae |
| 33     | Castanospsis indica (Roxb. ex Lindl.) A.DC.          | Katus, Hinguri    | Fagaceae |
| 34     | Chelidonium album L.                                 | Honey berry tree  | Ullmaceae |
| 35     | Chukrasia tabularis A. Juss.                         | Bogapoma          | Meliaceae |
| 36     | Cinnamomum camphora (L.) Presl.                      | Kapur             | Lauraceae |
| 37     | Cinnamomum cassia Daphne Meiun.                      | Gonserai          | Lauraceae |
| 38     | Cinnamomum tamala Fr. Nees.                          | Teipatta          | Lauraceae |
| 39     | Cinnamomum verum Presl.                              | Dalchini, Siripori| Lauraceae |
| 40     | Citrus reticulate Blanco                              | Mandarin          | Rutaceae |
| 41     | Citrus limon Burm.                                   | Lemon             | Rutaceae |
| 42     | Cocos nucifera L.                                    | Nariyal           | Arecaceae |
| 43     | Cocos nucifera L.                                    | Nariyal           | Arecaceae |
| 44     | Dalbergia sissoo Roxb.                               | Sissu             | Fabaceae |
| 45     | Delonix regia Raf.                                   | Radhachura        | Fabaceae |
| 46     | Dillenia indica L.                                   | Outenga, sompa    | Dilleniacae |
| 47     | Duabanggranderflora Roxb.                            | Khokan            | Lythraceae |
| 48     | Diospyryum binecarifurum (Roxb.) Hook. f. ex Bedd.   | Banderdima        | Meliaceae |
| 49     | Elaeis guineensis Jacq.                              | Oil palm          | Arecaceae |
| 50     | Elaeocarpus floribundus Roxb.                         | Jalpai            | Elocarpaece |
| 51     | Emblica officinalis Gaertn.                           | Amloki            | Euphorbiaceae |
| 52     | Eucalyptus spp.                                      | Eucalyptus        | Myrtaceae |
| 53     | Ficus benghalensis L.                                | Banyan            | Moraceae |
| 54     | Ficus religiosa L.                                   | Pipal tree        | Moraceae |
| 55     | Gmelina arborea L.                                   | Gomari, Gamar     | Verbenaceae |
| 56     | Grevillea robusta A.Cunn. ex R.Br.                    | Silver Oak        | Proteaceae |
| 57     | Grewia dispersa Roxb                                  | Kakkri            | Tiliaceae |
| 58     | Hemitiera macrophylla Wall. ex Kurz                  | Sundari           | Sterculiaceae |
| 59     | Hevea brasiliensis (Willd. ex A.Juss.) Mill.Arg.     | Rubber            | Euphorbiaceae |
| 60     | Jacaranda mimosaefolio D.Don                          | Blue Gumehar      | Bignoniaceae |
| 61     | Jatropha curcas L.                                   | Ratanjot          | Euphorbiaceae |

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Table 2: Tree species distribution according to their families

| Sr. No. | Family                  | Number of species |
|---------|-------------------------|-------------------|
| 1.      | Fabaceae                | 19                |
| 2.      | Rutaceae                | 3                 |
| 3.      | Simaroubaceae           | 1                 |
| 4.      | Mimosoideae             | 1                 |
| 5.      | Apocynaceae             | 1                 |
| 6.      | Meliaceae               | 5                 |
| 7.      | Anacardiaceae           | 3                 |
| 8.      | Annmoniaceae            | 1                 |
| 9.      | Rubiaceae               | 1                 |
| 10.     | Aracniariaceae          | 1                 |
| 11.     | Areaceae                | 5                 |
| 12.     | Moraceae                | 7                 |
| 13.     | Oxalidaceae             | 1                 |
| 14.     | Bixaceae                | 1                 |
| 15.     | Bombacaceae             | 1                 |
| 16.     | Myrtaceae               | 4                 |
| 17.     | Burseraceae             | 2                 |
| 18.     | Caricaceae              | 1                 |
| 19.     | Fagaceae                | 3                 |
| 20.     | Ulmaceae                | 1                 |
| 21.     | Lauraceae               | 5                 |
| 22.     | Cymaceae                | 1                 |
| 23.     | Dilieniaceae            | 1                 |


| Sr. No. | Plant species number range | Number of belonging family |
|---------|-----------------------------|-----------------------------|
| 1.      | 0-4                         | 40                          |
| 2.      | 5-8                         | 4                           |
| 3.      | 9-12                        | -                           |
| 4.      | 13-16                       | -                           |
| 5.      | 17-20                       | 1                           |

**Table 3:** Range of distributed tree species with their family

**Conclusion**

Based on the result of this finding in the study area, a total of 103 tree species belonging to 85 genera and 45 families were enumerated in the study area. The results also revealed that Fabaceae had the highest number of tree species (19). There is the need to make proper implementation of conservation and sustainable management strategies. State departments should design programmes to create awareness among the people to understand the need of protecting tree species in the surrounding area.

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