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Tree Diversity of Kaithal District Haryana, India

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Abstract – The number of various species (richness) and their abundance are used to calculate tree diversity. Tree diversity is often quantified using indexes or statistics that combine the number of species, referred to as richness, with the abundance, significance, or evenness of tree species, referred to as evenness. Plant variety, according to decades of grassland biodiversity study, is a critical driver of ecosystem functioning, increasing primary production and herbivore resistance. Also considered in the research were trees, tree diversity, stand structure, and community makeup. Species richness and diversity, Species diversity indexes and statistical computing, Differences in development across species, tree species classification based on their usage

Keyword – Tree, Diversity, Tree Species Diversity

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INTRODUCTION

As defined by botany, trees are perennial plants having an extended stem or trunk that supports branches and leaves in the majority of species. In various contexts, the term "tree" may refer to solely wood plants with secondary growth, plants that may be used as lumber, or plants that reach a certain height. The higher palms, tree ferns, bananas, and bamboos are all considered trees in a broader sense. Plant species that have developed a trunk and branches in order to compete for sunlight are not a single taxonomic category, but rather a collection of several species. The lifespan of a tree may range from a few hundred to several thousand years. For the last 370 million years, trees have been thriving. Three trillion mature trees are believed to exist in the earth. Having a wide variety of tree genetics is essential to restoring landscapes. There must be a wide range of genetic variety in tree populations for long-term vitality and survival. Pests and illnesses, as well as the consequences of global warming, are better able to withstand it. An ecosystem's species diversity is defined as the total number of species and the relative abundance of each individual species present. When all species are present in equal numbers, the region has the most diversity. Forest tree composition may be used as a measure of species variety by assessing its richness and evenness. Forest biodiversity is measured by the variety of tree species that may be found there. The evenness of a population is determined by comparing the total number of individuals in each species.

Trees play a crucial role in the forest ecosystem because they have a large impact on forest microclimate (the amount of light, moisture, and temperature available in the forest), create litter, humus, and deadwood, and support a wide variety of microhabitats. It follows from this that a wide range of plant and animal species may be found in the forest (e.g. fungus, insects, and herbs). Forests with more than one species of tree tend to have a greater variety of trees.

For example, it is a matter of debate as to how many species of trees may be counted. Tree species diversity may be quantified in a variety of ways (from small inventory plots through forest stands to regions). The more land a region covers, the more tree species are likely to exist. On what size plot can we expect to find "complete variety" of tree species? This raises doubts about the usefulness of NFI-based data since the size of an inventory plot is often significantly less. For example, whether three tiny one-species forest stands, each with a different species, should be deemed less beneficial than the occurrence of a huge three-species stand is controversial.

Trees

Trees are one of nature's most impressive works of art. As defined by a forester, tree species are perennial woody upright plants that may reach a height of 3 to 4 meters, have an attractive crown of leaves, and have a diameter of 7.5 cm at 1.35 meters above ground level. A tree is born, grows, and then perishes. The trees that make up forests are a priceless cultural legacy that has a significant impact on a country's economic well-being. Environmental pollution is reduced by trees having a rough, coriaceous, and sticky leaf surface. There is a forest when trees grow in close proximity to one other; this creates an environment in which a plant and animal succession may take place. We owe our

existence to trees since they've played a crucial part in shaping us into who we are today. From the time we are born until the time we die trees line up with our lives. Throughout history, trees have shaped our sense of beauty and endowed us with the ability to love, serve, sacrifice, and maintain balance. They are essential to human existence and must be protected. For millennia, man has shared the Earth with trees, which are fundamental aspects of our world and have been there with him from the beginning of time. All living things in a forest are protected from the elements by the dense canopy of trees that around them. You might have a combination of evergreen and deciduous trees.

Tree diversity, stand structure, and community composition

Tropical dry forests are not as varied as other tropical forest types, but they nevertheless have a respectable number of species and a wide variety of living forms [1]. Dry forests are found all over the world in a variety of climates, with dry and wet periods occurring at random. According on the length of a dry spell as well as the quantity of rainfall and altitude, the forest's shape and function fluctuate. Species diversity, stand structure and species composition, density, growth, and survival of tree species are all affected by local microclimatic conditions. These unique and temporal fluctuations in tree species' habitats determine their habitat differentiation and habitat specialization.

The globe's forests have been decimated by human activity in many parts of the world, notably those in tropical areas. [2] Human population impact on natural ecosystems has grown substantially over the last five decades, and half of the surviving tropical forests have already been degraded, including old-growth and secondary forests. In recent decades, the rapid depletion/degradation of tropical forest vegetation has been widely discussed. One-third of the environmentally required hectare age of deep forest cover has been reduced in India. Seventy-two percent of the country's forest land is no longer capable of being regenerated. The inhabitants of tropical nations rely on forest biodiversity as a natural (biomass) resource basis for their existence. As a result, the loss of tropical forests may have a significant impact on economic development. The angiosperms, which make up the majority of India's vascular flora, are among the most vulnerable. [3]

Anthropogenic disturbances are destroying the Indian peninsular tropical forests at an alarming pace, and they are being replaced by forests with a reduced species composition or land use patterns altered. Natural and man-made disturbances impact forest dynamics and tree variety at local as well as regional scales, resulting in changes in forest structure and composition.

For long-term ecological study, quantitative plant inventories are a critical component. Tropical forest ecosystems need long-term research of tree population dynamics to better understand their conservation requirements. [4] Researchers may get insight into regional disturbance regimes and major biota's reaction to various forms of disturbance via long-term investigations.

Scientific information about habitat composition, structure, and dynamics, as well as the effects of current management practices on forest ecosystems, may be gained by monitoring. Species diversity in trees is assumed to be maintained via forest dynamics, which has sparked interest in tree mortality and forest dynamics. In addition, long-term studies of forest dynamics endangered by human activity are extremely relevant.

Many studies have revealed that tropical forests experience dynamic wide-ranging variations in species composition and structure throughout long-term monitoring of tree diversity in diverse tropical forests across the globe. In order to better understand the conservation needs of tropical forest ecosystems, long-term studies of tree population dynamics are essential. [5]

LITERATURE REVIEW

Sevda Turkis, Emire Elmas (2018) The number of individuals of each species, the number of species, and the total number of individuals are utilised to calculate each kind of important value index. Between 2014 and 2016, researchers conducted this research in Yenice Woods' mixed and pure beech and oak forests at Kavakli and Citdere Nature Reserves Areas. Each tree species' Importance Value Index (IVI) was generated and used to examine changes in the floristic mix. Abies nordmanniana (Stev.) Spach subsp. bornmulleriana (Mattf.) Coode et Cullen (157.08 percent) is the dominating species in the significant vDOXH RI.DYDNO 1DWXUH Reserves Area (NCA) in wooded regions. Fagus orientalis L. (percent 145.1) is the leading species in the Citdere Nature Reserves Area forest area, according to the findings of the important value index. Species richness and diversity are crucial for Evenness at P 0.05 in the Kavakli field. Precipitation, slope aspect, and soil moisture all have a role in maximizing the impact of species establishment in the region. Because of the increase in tree species richness and variety, the Kavakli and Citdere regions have seen a rise in their species diversity as well. [6]

Suganthi Kanagaraj, Muthu Selvaraj (2016) Studying forests has become more popular due to a growing appreciation for their role in providing essential ecosystem services such as medicinal plants and timber as well as climate regulation. Research in the Pachamalai reserve forest in the Eastern Ghats of Tamil Nadu state is being conducted to determine the species diversity, composition, and distribution patterns of trees. The

data was gathered using the quadrant approach, which included creating grids of 10 x 10 m at elevations ranging from 230 to 930 m, with intervals of 50 m. Over the course of three hectares, we counted 73 tree species from 35 families, totaling 1372 individuals. The Fabaceae family of tree species was by far the most widespread (21 species). Pongamia pinnata had the greatest tree species density, whereas Tamarindus indica had the highest basal area density. Shannon-Weiner index (3.916), Simpson index (0.0206), and Margalef index were used to compile the species list (9.9667). The greatest diversity of species was found in the medium elevation range of 580 to 780 metres, as the gradient of elevation increased. Researchers hope their findings will aid in forest resource management, which is critical for preserving biodiversity and mitigating climate change. [7]

Ravinder Kaur, Nidhan Singh (2016) 345 angiospermic plants belonging to 245 species and 77 families were documented during a comprehensive investigation of the Karnal District, Haryana, to evaluate the floral diversity. 218 genera, and 69 families, comprise a total of 309 species of dicotyledons; 36 species of monocotyledons make up the remainder (27 genera & 8 families). Herbs make up the majority (56.81 percent), with trees making up 18% of the total, shrubs making up 14%, and climbers making up 9%. There are 47 species in the Fabaceae family, followed by Asteraceae, Poaceae, and Malvaceos on the angiosperm family tree. There are eight species of Ipomoea, followed by Solanum (seven), Euphorbia, Sida, Cyperus, and Ficus in this genus. As a result of these findings, managers and conservationists may better plan for and care for the region's rich plant life. The botanical name, family name, local name, habit, and distributional status of each species are included in the list of plants. [8]

Suspense Averti Ifo, Jean-Marie Moutsambote (2015) An inventory of fifteen 0.25 acre plots planted along distinct kinds terra firme, seasonal flooding and flooded terra forests in the northeastern Republic of Congo was used to study tree species variety, richness and resemblance in the region's tropical rainforests. All trees having a DBH 5 cm were measured in all of the plots planted. With the use of these metrics, we could observe how the tree community varied not just across plots but also between main forest and secondary forest. Recorded species and families included 114 species and 35 families in the 3.75-hectare area. As far as families are concerned, Euphorbiaceae ranked highest in terms of number of species with 12, followed by Fabaceae-Mimosoideae (10), Phyllanthaceae (6), and Guttiferae (4). (6 species). On the general, the research area's biodiversity did not differ substantially across plots (3.75 ha). Shannon's index was found to be lowest in plot 11 (H = 0.75) and highest in plot 12 (4.46; H = 4.46) Using panels P11 and P15, this index has values ranging from.23 to.95. Impfondo-forest Dongou's has a wide variety of trees, according to the findings. Conservation of tropical forest biodiversity in this region might benefit from knowledge on tree species structure and function.[9]

Mahabir Singh and Manoj Kumar (2013) the purpose of this article was to chronicle the variety of plant species present in the Jind area of Haryana, India, along with their vernacular names, habits, and locations. There has never been a plant diversity research like this one done in the area. A total of 282 plant species belonging to 76 families have been found in this region during the current investigation. According to the report, a growth in human population and an increase in demand for natural resources are causing an imbalance in the ecosystem. As a result, a thorough understanding of plant variety might play a significant role in conservation and sustainable use of the available resources. [10]

RESEARCH METHODOLOGY

The current study's relevant material was gathered from different libraries, published literature, and the Internet. Herbaria, floras, and other previously published work from around the area were also used as sources. For the creation of herbarium, the tree specimens were transferred to the laboratory, pressed, dried, and stored. This was accomplished using standard approaches. The tree species were recognized as much as possible by contacting local residents about their local/ vernacular names. The final conformance was determined in the lab using 'floras' and other existing material. At the Forest Research Institute's herbaria, several unidentified species were identified, and the socio-economic impact of all tree species in a ward was assessed. The occupants were given a brief questionnaire to fill out depending on their willingness to participate. The respondents were divided into two age groups: 20-40 and 40-60 years old. For this aim, both men and women were questioned.

Species diversity indices and statistical computation

The total number of tree species in a given sample area is known as species richness (S). Simpson, Shannon–Wiener, and Shannon Evenness were selected among a variety of species diversity indexes. The Simpson index is a measure of the likelihood that a second individual chosen from the same population (vegetation community) would be of the same species as the first. The Shannon-Wiener index measures a vegetative community's species heterogeneity. The Shannon Evenness (HE) relates to the pattern of individual distribution between species. The Shannon index (H) was divided by the natural logarithm of species richness to arrive at this value.

$$HE = H / \ln S$$

Species richness (the number of tree species per plot), the Shannon index of variety at the species

level per plot, and the reciprocal of Simpson's diversity index were used to measure diversity. The Shannon index of diversity (H) is one of the most often used indices for quantifying biodiversity in community ecology, and it is defined as:

$$H = -\sum_{i=1}^{n} pi * Inpi$$

Collection of phenological and meteorological data

Visual observations were undertaken at chosen research locations at intervals of ten to twenty days to capture phenological characteristics. Binoculars were utilized to study the phenophase of towering trees up close. Five to ten mature individuals (>30 cm girth) of each tree species were selected based on the abundance of the tree species.

The phenological parameters used in this investigation are as follows:

- Leaf bud formation
- Leaf flushing (Leaf emergence)
- Flowering (initiation, full and cessation)
- Fruiting (initiation, full and shedding)
- Leaf senescence and Leaf fall

DATA ANALYSIS

Species richness and diversity

Observations reveal that the jurisdiction of Kaithal Municipal Corporation comprises of 4, 40,969 number of trees belonging to 117 species, 95 genera and 42 families. Species composition is dominated by a small cohort of popular species. The top twenty five species each contributing >1% include Azadirachta indica, Prosopis juliflora, Holoptelea integrifolia, Leucaena leucocephala, Polyalthia longifolia, Dalbergia sissoo, Syzygium cumini, Mangifera indica, Moringa oleifera, Phyllanthus emblica, Cassia fistula, Cassia siamea, Delonix regia, Zizyphus mauritiana, Tectona grandis, Ailanthus excelsa, Roystonea regia, Anogeissus pendula, Pongammia pinnata, Ficus religiosa, Acacia catechu, Albizia lebbeck, Eucalyptus umbellata, Aegle marmelos, Artocarpus heterophyllus which in turn collectively represent almost 90% of the total species.

Present study indicates that genus Ficus is represented by maximum number of species i.e. 07 (6.1%), followed by the genus Acacia with four species (3.5%). Genera like Bauhinia, Cassia and Terminalia are represented by three species each (2.6%) and eight genera viz. Albizia, Artocarpus, Ceiba, Dalbergia, Lagerstroemia, Prosopis, Syzygium and Tabebuia are each represented by two species (1.7%). The remaining 79 genera are represented by single species each (0.9%).

Entire recorded tree species belong to 42 families dominated by the family Bignoniaceae (29.3%) with 12 genera. Other dominating families of the study area include Mimosaceae, Caesalpiniaceae and Moraceae with 10 genera each (24.4%). Fabaceae has been represented by 9 genera (22%), Arecaceae by 6 (14.6%) and Bombacaceae by 5 (12.2%). Combretaceae, Rubiaceae and Myrtaceae are represented by 4 genera each (9.8%) and Sapindaceae and Sapotaceae by 3 genera each (7.3%). Seven families namely Rutaceae, Apocynaceae, Lythraceae, Meliaceae, Lamiaceae, Tiliaceae and Euphorbiaceae were each represented by two genera contributing a total of 29.3% to the family composition. Remaining 23 families like Simaroubaceae, Cornaceae, Averrhoaceae, Meliaceae, Ebenaceae etc. are represented by a single species each, thus contributing a total of 56% to the family composition of the study area.

S. No	Name of Species	Vernacular/Local Name	Family
1	Acacia auriculiformis A. Cunn. ex Benth.	Australian babool	Mimosaceae
2	Acacia catechu (L.) Willd., Oliv.)	Khair	Mimosaceae
3	Acacia leucophloea (Roxb.) Willd.)	Reunja	Mimosaceae
4	Acacia nilotica (L.) Willd. ex Delile	Baboo	Mimosaceae
5	Adansonia digitata L.	Gorakh Imli	Bombacaceae
6	Aegle marmelos (L.) Correa	Bel	Rutaceae
7	Ailanthus excelsa Roxb.	Maharukh	Simaroubaceae
8	Alangium salvifolium Lamarck	Akol	Cornaceae
9	Albizia lebbeck (L.) Benth.	Kala Siris	Mimosaceae
10	Albizia procera (Roxb.) Benth.	Safed Siris	Mimosaceae
11	Alstonia scholaris L. R. Br.	Saptaparni	Apocynaceae
12	Anogeissus pendula Edgew.	Kardhai	Combretaceae

Difference in growth across species

Although various species grow at different rates, the size class distribution of tree species gives a pretty consistent general picture of changes in species selection through time. We used size class distributions to distinguish between species that have been planted over a number of years (which should have a more evenly distributed dimension/structure), species that have been selected for planting recently (whose distribution should be dominated by smaller trees), and species that have been planted widely in the past and recently been discontinued, despite the fact that data on earlier species distributions is not available for Gwalior city (whose distribution should therefore be dominated by larger trees).

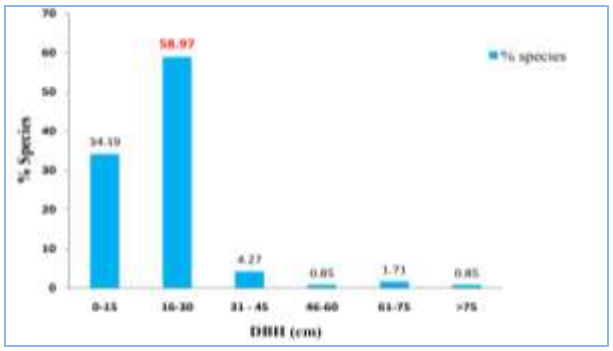

Fig. 1: Proportion of different tree species according to various DBH classes.

indicates that the present study area is dominated by individuals of 16-30 cm DBH size class category accounting for over 58% of the total species, which in-turn signify that most of the trees are young and recently planted. This size class (16-30 cm) is represented by the individuals of Acacia nilotica, Aegle marmelos, Millingtonia hortensis, Prosopis juliflora, Ehretia laevis etc. The size class distribution of 0–15 cm followed the 16–30 cm class and represented by over 34% of the total species. This class is mostly dominated by the individuals of Prosopis juliflora, Leucaena leucocephala, Livistona chinensis, Morinda pubescens, Moringa oleifera, Morus alba, Phoenix sylvestris and Phyllanthus emblica etc. Kaithal is a city and municipal council in the Kaithal district of the Indian state of Haryana. Kaithal was previously a part of Karnal district and later, Kurukshetra district until 1 November 1989, when it became the headquarters of the Kaithal. Little natural vegetation remains in Haryana. Eucalyptus trees are planted along the highways and in wastelands. Shisham (Dalbergia sissoo) trees grow along the roads and canals in the northern half of the state, while small, spiny kikar (Acacia arabica) trees and scrub are found in southern and southwestern Haryana.

Tree species according to their uses

During survey, information on all the tree species, regarding their uses was collected from the inhabitants through questionnaires. It was observed that most of the tree species (29%) are used occasionally for certain medicinal purposes followed by ornamental uses (20%). 18% tree species have been planted near avenues and roads for their aesthetic value. Fruit yielding/economical nature was represented by 11% tree species, 7% for religious nature and 6% tree species were used for fuel purposes

S. No	Name of species	Medicinal	Timber	Religious	Economical /Fruit Yielding/ Vegetable	Fuel	Aesthetic	
							Ornamental	Avenue/ Road
1	Acacia auriculiformis	-	+	-	-	+	+	-
2	Acacia catechu	+	-	+	+	-	-	-
3	Acacia leucophloea	+	+	-	-	+	-	-
4	Acacia nilotica	+	-	-	-	-	-	-
5	Adansonia digitata	+	-	+	-	-	+	-
6	Aegle marmelos	+	-	+	+	-	-	+
7	Ailanthus excels	+	-	-	-	+	-	+
8	Alangium salvifolium	+	-	-	+	-	-	+
9	Albizia lebbek	+	+	-	-	-	-	+
10	Albizia procera	+	-	-	-	-	-	+
11	Alstonia scholaris	-		-	-	-	+	+
12	Anogeissus pendula	+	-	-	-	+	-	-
13	Anthocephalus chinensis	+	-	-	-	-	-	+
14	Artocarpus heterophyllus	-	-	-	+	-	-	-
15	Averrhoea carambola	+	-	-	+	-	-	-
16	Azadirachta indica	+	-	+	-	-	-	+
17	Bauhinia purpurea	-	-	-	-	-	+	+

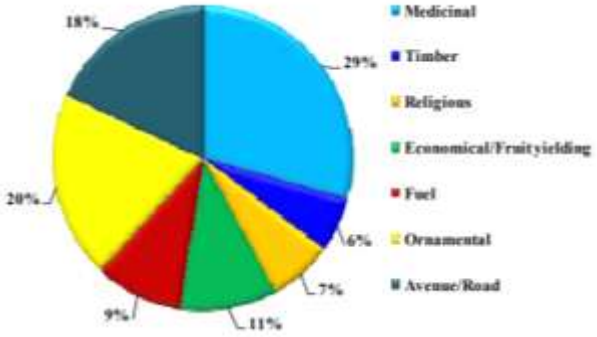

Fig. 4.12 Percentage of tree species according to their uses

CONCLUSION

A Conducted a species diversity analysis and described that the study area has more species diversity, stand density and basal area. The diversity richness of indigenous forest shows considerable variation in occurrence of species between different altitudes. Most of the species in the study area have medicinal value and socio-economic importance. Therefore, there is a need for necessary action towards sustainability of forest and conservation of species at large. The most important conservation measure is environment education, explaining the importance of forest ecosystem to the villagers. The implementation of the conservation activities leads to a natural regeneration, climate change mitigation and to protect the biodiversity for future generations. Standard methods were used for the preparation of herbarium. Local names of tree species were asked from local people, later identified in laboratory with the help of floras. Final conformity of identification was done at Herbaria of Forest Research Institute, All the tree species in a ward were evaluated for the socio-economic aspect of the local inhabitants. A

short questionnaire was framed for the residents, based on their willingness to respond. The respondents were of different age groups viz,

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