

Chapter 15

A review on floristic diversity with special reference to Jharkhand

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Received:-

08th September, 2023

Accepted:-

21st October, 2023

Published:-

(online)

27th October, 2023

ABSTRACT:- A review of the floristic studies was made. In which an endeavor has been made to include important floristic work in and around the globe with special emphasis on floristic studies in the state of Jharkhand. Floristic diversity, also called plant diversity, refers to the range of plant species, genera, families, and distributions within a given geographic region or environment. It is essential for preserving ecological harmony and overall biodiversity. Since different plant species perform a wide range of ecological activities, including oxygen production, soil enrichment, and habitat for varied fauna, higher levels of floristic diversity are a sign of a healthy and robust ecosystem. Understanding and preserving floristic diversity is crucial for conservation efforts, sustainable resource management, and tackling the environmental issues brought on by our quickly changing world. Additionally, it is highly valuable for research, instruction, and enhancing our comprehension of the natural world.

Keywords: Floristic, Jharkhand, diversity, environment, biodiversity



Citation: Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand. *Advances in Bioscience: Exploring Frontiers of Discovery, Vol. 1*, ISBN: 978-93-5913-645-5. pp. 215-236. <https://10.5281/zenodo.10034342>
Editor: Dr. Anand Kumar Thakur, Email id: fnruanand@gmail.com

INTRODUCTION

The term flora in Latin means “Goddess of the Flower.” Flora, a united term for a group of plants that start in a particular place. The entire plant kingdom is represented by the same name. The flora and fauna play a very important role in the existence of human being. Flora specially is responsible for the release of oxygen for the survival of all life forms. These flora/plants are beneficial for the human being. They provide a variety of ecosystem services, food, fiber, fuel and fodder, medicinal plants, timber, gums, resins, etc. Besides, these floras enhance the aesthetic value and present a picturesque panorama as well as landscape. However, gradually due to advanced human civilization, they started acting as brutal parasites on green matter i.e., green plants. A floristic study is the document of all the species of plants found within a certain geographical area. The large-scale floristic projects include the development of keys, detailed descriptions, and Plant illustrations, even some may contain a simple inventory of species found in an area e.g., large-scale floras like the Flora of North America, British Flora of India, etc.

MATERIALS AND METHODS

The available literature both online and offline resources about the floristic studies conducted around the globe was referred to and compiled to make the review on the floristic studies. Only a few pieces of literature available regarding the floristic studies on the globe, which were available before me, have been referred to in the current review. Indian floristic work has also been referred to in detail. Whereas, the maximum effort has been given to include the floristic work done in the state of Jharkhand based on the available literature survey.

ANGIOSPERMS FLORISTIC DIVERSITY

Man is the only animal that does not have to begin a new and fresh generation but can take advantage of the knowledge accumulated through the century. This fact has particular importance in dissertations, research, or writing a review, which we have seen operated as a continuous function of ever-closer appreciation of the truth. Indeed, a problem is directly or indirectly related to the investigation. The success of the present research up to some extent depends on the previous research work, which we call the related literature. Literature is that mirror that reflects the past view and presents the future perspective.

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

Review of related literature is an important research effect as it provides a comprehensive understanding of what is known about the topic. The review of related literature means considering examining observing or viewing again the past event, facts, viewpoints, or ideas for a deep insight into the present problem. The prime objective of related literature is to allow the research insight into suggestions about research methodology. It was found that many studies reviewed may not be directly related to the present study but they provide support to the present investigation.

The present review dealt with the deals of Angiospermic, and floristic diversity. The work on Angiospermic diversity or floristic reviews begins with Adanson's (1763) Flora, which is one of the pioneer flora of the world¹. In India establishment of the Asiatic Society of Bengal, in the Year 1774 A.D. by Sir William Jones, marked the beginning of a scientific tradition in India for the Study of Nature and Man and piloted several research and publications on these subjects.

Since then, the administrators of British, missionaries, travelers, and a few other anthropologically oriented persons composed information on tribal and rural groups and compiled about their culture and life in the Journal of Asiatic Society of Bengal (1784), Indian Antiquary (1872) and later in the Journal of Bihar and Orissa Research Society (1915) and Man in India (1921). As far as present floristic work is concerned, the Botanical Survey of India is doing a tremendous job to bring out the flora of India. The Botanical Survey of India is the pioneer and leading institute responsible for identifying and exploring the plant diversity of India. Before India's independence, several workers contributed their knowledge in compiling the flora of different regions of the nation, a pioneer among them are Beddom (1869-1874)², Cooke (1901-1908)³, Collet (1902-1921)⁴, Talbot (1909)⁵, Fyson (1915-1920)⁶, Gamble and Fisher (1915-1936)⁷, Haines (1921-1925)⁸ and others. Since then, several floristic works have been done at the local district and state level to contribute to India's flora. This work was followed with several district flora by the Botanical Survey of India as well as the university level few among them have been cited. Flora of the Indian Desert⁹ and its supplement by Bhandari and Vyas (2019)¹⁰, Flora of the Upper Gangetic Plain and the adjacent Siwalik and Sub-Himalayan tracts¹¹, Flora of Ranchi¹², Flora of Saran¹³, Flora of Rajasthan¹⁴. Later the

work on state Flora initiated like Flora of Bihar analysis¹⁵, and the Flora of Orissa¹⁶. As far as literature available in the floristic work in India is, concerned Flora of British India is a well-documented flora of India, which is an important flora of the nation.

ANGIOSPERMS FLORISTIC DIVERSITY OF JHARKHAND

Many floras at the regional level were initiated in Jharkhand i.e., was once the Combined Bihar before 2000, the important flora of Bihar and Orissa Haines (1921-1925)⁸ and its supplement Mooney (1950) is the initial work in this way¹⁷. Bengal plants are known flora of the neighboring state of West Bengal¹⁸. Flora of Ranchi¹², Flora of Saran District¹³, Botany of Ranchi¹⁹, Flora of Bhagalpur²⁰, Flora of Hazaribag District²¹, Flora of Palamau District²². Alien Invasive Flora of Santhal Pargana²³, Aquatic and semi-aquatic Angiosperms of Flora of Lohardaga²⁴, and Aquatic and Semi Aquatic Angiosperms of Jharkhand²⁵. Ghosh (1971)¹² did the first district-level floristic studies of combined Bihar. Now Jharkhand, the flora of Ranchi in two volumes, Mukherjee (2019)²⁶, had done a detailed study on the aquatic and semiaquatic flora of Jharkhand in two volumes. The two important reference books, which cover comprehensive, accounts of the floristic, ethnobotany, and taxonomic work of the state the first one by Mukherjee and Bondya (2018)²⁷ in Biodiversity, Taxonomy, and Conservation as well as Ethnobotany, Cultivation, and Utilization of Plants by Kumar and Mukherjee (2020)²⁰. Das (2018)²⁸ did her study on The Floristic and Ethnobotanical Studies of the Dumka District of Santhal Pargana with special reference to under-utilized plants vis-a-vis their conservation. A comprehensive account of the alien Invasive Flora of Santhal Pargana, Jharkhand, (India) is published in the form of a book with the same title that is a pioneer work on the alien invasive flora of Santhal Pargana²⁹. As far as literature available on floristic studies of Pakur district is concerned only a few pieces of literature are available, important among them is Studies on the Weed Diversity in Pakur, District of Jharkhand published by Mukherjee (2011)³⁰. Another work is on plant species found in and around Sidpahari black stone mining area and its impact on plants Jha and Mukherjee (2021)³¹. The work related to mining i.e., land degradation due to black stone mining in Pakur: Need Eco- restoration is published by Jha and Mukherjee (2021)³¹, Medicinal uses of Plants of family Asteraceae of Amrapara block of Pakur is also done by Jha and

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

Mukherjee (2021)³¹, Studies on aquatic microphytic diversity in ponds of Pakur done by Mukherjee and Kumar (2021)³². Some of the floristic work along the mining areas of different areas and its impact on biodiversity has been summarized in the current review.

ANGIOSPERMS FLORISTIC DIVERSITY IN THE OTHER PARTS OF INDIA

A study conducted by NITI Aayog, New Delhi, under the name "Socio-economic Impact Study of Mining and Mining Policies on Livelihoods of Local Populations in the Vindhyan Region, Uttar Pradesh" was conducted at the Centre for Social Forestry and Eco-Rehabilitation, Allahabad. The main objectives of the survey were to study the major mining areas in the Vindhyan Region of UP and, to study the consequence of the Government Mining Policy on mining in the area and its activities on the socio-economic condition of the localities and their dependency on mining for their livelihood sustainability. The effect of mining activities on the vegetation of the region and soil characteristics was also studied. The stones are removed by boring, blasting, and transportation to the crusher mills for advanced processing.

All the study sites are rich sources from a plant biodiversity point of view. From the entire sites, 96 different plant species belonging to 36 families and 88 Genera have been noticed and can be categorized under endangered species. The mining action directly destroys the plants' cover. The site where boring as well and blasting was done; it did not contain any type of species of plant in its topsoil. The inventory studies of plant biodiversity at the study sites indicate that all the sites contain approximately equal status of the plant species except Khanak, which has the highest diversity than other sites. The total numbers of species at the entire six sites show a little difference in species. The Khanak has the largest number of total species. The difference in the total species is due to the level of mining, total area covered, and interferences of the local people at the sites for grazing, fodder, fuel wood timber, etc. In the study "Impacts of stone mining as well as crushing on stream characters and vegetation health of river Dwarka basin of Jharkhand as well as West Bengal Eastern India" found that out of the total researched basin, 14.93% area is potential for dust vulnerability. Within this zone, 581 numbers of streams having a length of 713 km are found to be highly affected. Channel bed aggradations,

increasing sediment load within the water, and degradation of water quality beyond permissible limits are some evident effects of dust emissions and spreading.

Continuous deposition of such stone dust over vegetation causes qualitative degradation of vegetation. Due to mining activities, the removal of prestigious forests has been rapidly degrading. Certainly, this fact is not solely responsible for deteriorating forest quality. Coarse grain laterite soil and mass-scale soil erosion (6- 8t/ha/y) are other controlling factors for tree felling and degradation of vegetation. The formation of a dust layer on the plant body damages plant tissue, which reduces the rate of photosynthesis. Dust particles emitted from stone-crushing activity reduce the pigmentation in plant leaves the quality of air parameters recorded at some locality like Lalpahari, and Baramasia provides an idea about the reason how air becomes dusty and suffocating during daytime when all the crushing units work together on the roadsides. The dust from the crusher appears cloud-like in the area beside the throughout the area including the neighboring forest areas. Due to this, the transparency of air is much reduced. The quantity of stone dust in the air at the sites of the crusher was four to seven times more than the standard norms in India. It was noted that the Suspended Particulate Matter (SPM) was highest in winter and lowest during the rainy season. The dust falling in jars of glass was found to be higher in summer in comparison to winter at Lalpahari. The value (Lalpahari) in summer increased sixteen times compared to the control Ballavpur Wild Life Sanctuary (BWLS). The deposition of dust on the leaf surface was maximum in summer and minimum in the rainy season. The quantity of dust falling in all three sites of Lalpahari in all the seasons increased that in BWLS. About fourteen times higher, dust fall was observed on the leaf surface of *Madhuca indica* in site one compared to the control site in summer. The study also concludes that plantation is necessary to protect the natural environment in the Asansol-Raniganj area.

Aldhebian and Howladar (2015), in their study "Floristic Diversity and Environmental Relations in Two Valleys, South West Saudi Arabia", stated that vegetation of the study revealed the dominance of members of the family Asteraceae, Fabaceae and Solanaceae in the different habitat³³. The life-form spectrum of the study areas exhibited predominant phanerophytes and therophytes. Species

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

diversity and dominance are related to soil physical characteristics and variation of habitat types. Vegetation groups in Baida habitats are more diverse than those in Ben Amir. The complex of environmental factors such as soil, and geology, decides the vegetation of any area and the vegetation of adjoining regions affects it.

Rettalack and Dilcher (1986), explained about Cretaceous Angiosperms Invasion of North America, Cretaceous Research, 227-252 found that the geological occurrence of early and mid-Cretaceous angiosperm fossils reveals much about the nature and early dispersal of Cretaceous Angiosperms plants³⁴. They appear to have migrated first into the Atlantic coast from the south and east during Barremian or Aptian time. They reached California by Aptian or Albian time, presumably via coastal regions of southern North America. When the Interior Seaway was established linking the Caribbean region with the Arctic during the Middle Albian time, angiosperms dispersed as rare elements of coastal Vegetation as far north as Alberta. The first angiosperms reached Alaska during the latest Albian marine regression, but are perhaps more likely to have reached Alaska from the west than from the south.

Angiosperms dominate mega fossil floras of Cenomanian and younger age in most of North America but are comparably abundant as mega fossils in Turonian and younger rocks in Alaska. Mishra and Arvind, (2015) conducted a survey on "Floristic Diversity of Angiosperms with special reference to their medicinal properties from the Kota district of Rajasthan, in which a total of 133 species representing 99 genera distributed in 46 families were recorded, this includes 94 species of canopy and understory trees, 22 species of shrubs and 15 species of herbs³⁵. The important families found were Leguminosae with 30 species, then Moraceae (7 spp.), Combretaceae and Rubiaceae (5 spp.), Euphorbiaceae, Apocynaceae and Tiliaceae (Four spp.). The dominant genera include *Ficus* (Six spp.), *Acacia* and *Grewia* (4 spp.), *Terminalia*, *Albizia*, *Indigophera*, *Dalbergia*, *Ziziphus* and *Tamarix* (Three spp.) each. Many species have been recognized as important medicinal plants for various properties. For effective treatment, decoction or infusion of different parts of plants such as bark, fruit, leaves, roots, seeds, and latex are used. Out of 133 species, most of the species represent antioxidant, antibacterial, anti-inflammatory, anti-HIV-1,

antitumor, antiulcer, hepatoprotective, and analgesic activity. Many species are also used to cure various diseases such as diarrhea, hemorrhages, bronchitis, arthritis, kidney stones, etc., and for respiratory, digestive, urinary, and skin disorders. The largest families recorded in terms of the number of genera were Compositae (14), Gramineae (10), Leguminosae (9), Caryophyllaceae (6), and Asclepiadaceae, Cruciferae, Scrophulariaceae and Zygophyllaceae (four for each). The study exposed that Gebel Elba Park is more dissimilar in comparison to other well-studied phytogeography territories in Egypt.

Swaine *et al.* (2011)³⁶, found in the case study "Diversity distribution and floristic differentiation of the coastal lowland vegetation: implications for the conservation of the Brazilian Atlantic Forest", that the coastal lowland vegetation comprises two distinctive floristic groups representing forests and scrubs that occur in wetter climates (Ombrophilous lowland forests) in the Brazilian states of Santa Catarina, Parana, and Sao Paulo and drier climates of Espirito Santo, Rio de Janeiro (Restinga-Northern group) and the Rio Grande do Sul (Restinga-Southern group) states. The floristic and historical relationships among Ombrophylous lowland forests and resting imply that the conservation initiative should be more conservative and should be treated together at all coastal lowland vegetation as the biodiversity hotspot Six species were considered endemic to the area while twenty-seven were endangered. The dominant families were Asteraceae, Fabaceae, and Poaceae. The flora of Jabal Fayfa shows a high degree of monotypism. Altogether total of twenty families (28.57%) were represented by a single species, and 180 genera (75.00%) were monotypic. The recorded flora consists of 70.09% perennials and 29.91% annuals. Phanerophytes and therophytes were the most frequent life forms.

Phytogeographical examination exposed that the elements of bioregional of the Saharo-Arabian/Sudano-Zambezian chorotype were the most dominant chorotypes (35.48%), Showing 2/3rd of the floristic structure in Jabal Fayfa. Devi and Yadava (2006)³⁷, Studied the floristic diversity of the *Dipterocarpus tuberculatus*-dominated forest in Manipur located on the Indo-Myanmar Border, northeastern India. For it, a total number of 123 species belonging to 48 families were recorded. The quantitative feature like density and importance value index among

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

species was very much different. In this study, the diversity index of herbs and shrubs was found to be higher than the tree species. The concentration of dominance was recorded as highest in tree species. The presence of a low number of higher girth class of tree species and a higher number of saplings and seedlings indicates that the present forest is young exhibiting frequent regeneration. In this study, about 31 of 273 taxa of 35 families and 169 genera among vascular plants were recorded. Phytogeographically, the listed species were classified into three groups; monoregional, biregional, and pluriregional. Twenty-four species were listed as cosmopolitan, paleotropical, or pantropical.

Kamble and Yele (2020)³⁸, worked on a floristic survey of monocotyledon plants from Man Tehsil of Satara District Maharashtra, the results of the study indicated that there was diversity in the monocot plants in the study area. A total number of 68 monocot plant species were recorded belonging to 19 families. All the species are classified into 62 genera. Poaceae was the largest family with 22 species, Commelinaceae represented 11 species with the second largest number and it was followed by 08 species from Araceae. The maximum genera represented from Commelinaceae were *Commelina* and *Cyanotis* with three species each. It is followed by *Pennisetum* from Poaceae with 2 species and all remaining 59 genera were represented by only a single species each.

Cowling and Lombard (2002)³⁹ studied heterogeneity, speciation - extinction history and climate: Explaining regional plant diversity patterns in the Cap Floristic region, in the study they concluded that regional diversity patterns in the Cape Floristic Region were the products of diverse speciation and extinction histories leading to different steady-state diversities. They found

- (i) greater Pleistocene climatic stability in the west that would have resulted in higher rates of speciation and lower rates of extinction than in the east, where for most, Pleistocene climates did not favour Cape lineages; and
- (ii) the more seasonal and reliable rainfall regime in the west would have favored non-sprouting plants and, hence, higher speciation rates and lower extinction rates, than in the east. The weak topography pattern of diversity in the west arises from higher speciation rates and lower extinction rates in the topographically

complex mountains, rather than from the influence of environmental heterogeneity on diversity. Ahmad *et al.* (2012)⁴⁰ Found that medicinally important species like *Ajuga bracteosa*, *Mallottus philippinensis*, *Butea monosperma*, and *Zanthoxylum armatum* are critically endangered not only locally, but also in the whole region. 27 Among endangered species, *Cissus carnosa*, *Juglans regia*, *Olea ferruginea*, *Phyllanthus emblica*, and *Viola canescens* found notable species because they were at high risk of extinction.

A total number of 112 plant species belonging to 97 genera and 51 families were analyzed, out of these 84 spp. (42.71%) species are used in medicinal, followed by fodder 35 spp. (18.23%), marketing 26 spp. (13.54%), fuel 24 spp. (12.50%) and ornamental 14 spp. (7.29%). The most frequently used plant parts are leaves 77 spp. (27.50%). They are followed by stem 49 spp. (17.50%), fruits 46 spp. (16.43%), seeds 40 spp. (14.29%), flowers 36 spp. (12%), and roots 32 spp. (11.43%, Fig. 3). They found that the majority of plants are herbs 56 spp. (50%), followed by trees 32 spp. (18.75%), shrubs 21 spp. (18.75%), and climbers 3 spp. (2.68%). Dwivedi *et al.* (2018)⁴¹, observed that angiospermic flora in the four trails is represented by 100 species belonging to 82 genera and 34 families. The finding of the study reveals that *Ziziphus nummularia* (Rhamnaceae) is the dominant shrub followed by an invasive species, *Lantana camara* (verbenaceae) which is a co-dominant species in the flora. On the other hand, in their quadrat analysis, it has shown that *Stellaria media* (Caryophyllaceae) is the dominant herb while *Setaria italica* (Poaceae) is a co-dominant species. It also shows that the disturbed trails have more frequency/ distribution of invasive weeds like *Lantana camara* and *Parthenium hysterophorus* compared to the native flora.

Jayakumar *et al.* (2011)⁴² found that the florist diversity assessment is tried at local and regional levels to understand the present status and to make effective management strategies for conservation. In this regard, various sampling techniques and measurement methods are followed based on the objectives of the studies, and in the majority of the studies, the availability of time, money, and manpower is the major constraint. The sampling methods should satisfy the objective of the study and also bring out the inherent diversity status of a region of investigation. The measurement of stem size in the field is the major

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

issue in diversity studies where a unanimous decision should be achieved among the studies in relation to the threshold of the girth of a stem considered a tree and the height at which it is to be taken from the ground. Sample size in a floristic diversity study is an important issue, which determines the success and failure of a diversity study to bring out the true diversity status. It is found that much attention should be paid to this issue in determination of the sample size, and distribution of the samples. Although remote sensing is a handy tool to study vegetation at the community level, the applicability of the same at the species level is impractical in the present context with available advancements. Two of the Spermatophytes are Gymnospermae while 485 of them are Angiospermae (98 Monocotyledones and 389 Dicotyledones). The 29 dominant families in taxa are Fabaceae (Fifty-five - Asteraceae, Forty-Nine Poaceae, Twenty-Eight Brassicaceae, and Twenty-Seven Fabaceae).

Phytogeographic basics are listed in order as Euro-Siberian 247 (49.1%), Irano-Turanian 17 (3.4%), Mediterranean 6 (1.2%), multiregional-unknown phytogeographic root 233 (46.3%). Hemicryptophytes are found to be the richest with 224 (44.5%) taxa, followed by cryptophytes 144 (28.6%), therophytes 53 (10.5%), chamaephytes 59 (11.7%), phanerophytes 19 (3.8%), vascular parasites 2 (0.4%), nanophanerophytes/chamaephytes 1 (0.2%) 37 and hydrophytes one (0.2%). Thirty-four endemic taxa were determined (6.7%). Thirteen taxa were found to be threatened in the research area and determined that *Sorbus caucasica* Zinserl. var. *yaltirikii* Göksin population has fallen into a Critically endangered category with only 2 individuals in the study area. Muratet et al. (2008) in a case study on 38 evaluated Floristic Diversity in urban areas as a basis of habitat management found that a total of 626 vascular plant species were observed and found that habitats with the highest index of floristic interest 25 (IFI) found to be typically situated in semi-natural environments/ environments with moderate human impact. It also found that neighboring (Urban) structures were found to be a significant influence on the floristic interest in sites. Pourbabaei and Navgran (2011)⁴³ conducted a study and concluded that Zagros can be divided into two parts: northern and southern. Northern Zagros is determined on the basis of the distribution of *Quercus infectoria* Oliv. and *Q. libani*

Oliv. Southern Zagros is also determined based on the distribution of *Quercus brantii* Lindl. The Lebanon oak was present in all aspects, but it had the most population in the eastern aspect and also this species was preferred northern aspect due to high ecological needs. Most of the population of Lebanon oak was found from 1600 to 1750 m above sea level elevation because of suitable humidity and edaphic conditions. In fact, the elevational distribution of Lebanon oak is as spindle shape, that is, the population of this species increases when the elevation is increasing and the population decreases in higher elevations. The disturbance is approximately high in elevation of 1500 m above sea level, as a result, herbaceous, and other woody species have been dominated, and Lebanon oak decreased. Therefore, in order to rehabilitate the northern Zagros, it is recommended that the plantation of Lebanon oak be greatly conducted in the mentioned aspects and elevations. Regarding plant species, diversity, and richness are considerable in the studied area, so it is better that this site is considered as a genetic reservoir.

The Stream and Wetland Assessment Management Park (SWAMP) project created a wetland-stream complex that encompasses a wide array of microenvironments and hydrology. These diverse habitats were designed to facilitate Ecosystem diversity-enhanced pathways meant for ecological succession through restoration⁴⁴. Survey plots were made in four forest gaps in palustrine wetlands, each containing a low marsh and a high marsh. During 5 years of recovery from the soil disturbance and removal of upland vegetation, the wetland species richness slowly increased from twenty-four to thirty-eight species in the low marshes, where waterlogged conditions prohibited upland species invasions. On the other hand, Upland species richness declined quickly from sixty-nine to twenty-nine species in due course in the high marsh, now possibilities to increase flooding. The successional patterns of species suggest a slow turnover in the wet low marsh, but faster turnover in the moist high marsh. Following the intermediate disturbance hypothesis, it is observed that high marsh species richness reaches its maximum in the 1st year of the survey of vegetation while even after five years plant diversity in low marsh has yet to peak. The *Ligustrum sinense* (Chinese privet) once widespread was decimated following the SWAMP restoration. However, the exotic invasive species, *Micro stegium vimineum* (Japanese stilt grass)

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

dominated the floodplain except for the wettest low marsh sites showing the successional patterns of increase in wetland species after restoration. Panda *et al.* (2013)⁴⁵, in their case study. An inventory of landscape-level plant diversity and population in the northern part of the Eastern Ghats area of India comprises typically dry deciduous and moist deciduous forests. In this study, 444 transects of 0.5 ha (5 × 1000 m) area each were used for enumerating trees.

Diversity and density of herbs, shrubs, lianas, and regeneration of tree species were assessed from 5 × 5 m size plots within transects. Altogether 882 species belong to 532 genera and 129 families were recorded comprising 263 species of, 78 shrub species, 138 climbers/twiners species, and 403 herbs species. *Shorea robusta*, *Lannea coromandelica*, *Madhuca indica*, and *Diospyros melanoxylon* were found to be the most predominant tree species where members of Rubiaceae, Euphorbiaceae, Fabaceae, and Combretaceae contribute to Maximum Species Richness, stand density, and basal area. The stand density ranged from 268 to 655 stems ha⁻¹ while the basal area varied from 6.65 to 22.28 m² ha⁻¹. The Tree density and species richness decreased with increasing girth class; the highest no. of species and maximum density were recorded for the thirty to sixty cm girth class. Shannon-Weiner Index and Simpson Index varied in the range of 1.85-2.05 and 0.013-0.018, respectively. Regeneration among many tree species was observed to be poor.

Jaffre (1993)⁴⁶ studied New Caledonia, which is well known for its strange and rich flora and for its widespread outcrops in ultramafic rocks. The complete floristic diversity, and that of two principal the 'maquis miniers' and the dense humid forest, were analyzed. From their case study they found that, despite several groups rich in species, the whole diversity of the flora of ultramafic rocks in New Caledonia is attributed above all to the plethora of environmental conditions that have permitted the establishment of species with varied requirements and degrees of tolerance. The richness and uniqueness of the present-day flora of New Caledonia, though certainly derived in part from its Gondwanian origin and ancient isolation, was also a result of the presence of important outcrops of ultramafic rocks. The latter have permitted post-Eocene differentiation of new species as well as the survival of relict species under conditions of unfavorable mineral

nutrition, where they have benefitted from less severe interspecific competition. The data collected on the floristic diversity in New Caledonia serve as a basis for comparative studies, not numerous, among the floristic diversity of vegetation in ultramafic rocks in the tropical environment.

Narayanaswamy (2011)⁴⁷, In a case study “Exploring the Floristic Diversity and Economic Value of Plant Species in Three Selected Sacred Groves of Pudukkottai District, Tamil Nadu, India” found that the sacred groves are small patches of native vegetation traditionally protected and managed by local communities which act as a nursery and storehouse of many medicinal plants. Groves are a rich heritage of India and play an important role in the religious and socio-cultural life of the local people. These ecosystems harbour many threatened, endangered, and rare plant and animal species. Even the smallest groves harbor some old and superb specimens of trees and climbers. The study has been carried out in three selected sacred groves namely Pulvayal, Mylappatti, and Kallampatti of Pudukkottai District, Tamil Nadu, India, to assess the current floristic composition and their status of availability in the area. About 66 species were collected from Pulvayal grove (Shivan kovil), Marayappatti grove (Ayyanar kovil), and Kathavampatti grove (Muneeswarar kovil) of Illuppur Taluk, Pudukkottai district, Tamil Nadu, South India. One endangered species, viz. *Cayratia pedata* was recorded in the sacred grove of Pulvayal. Rare plant species like *Alangium salvifolium*, *Barleria cuspidata*, *Enicostem maaxillare*, *Gymnema sylvestre* and a very rare plant species like *Phyllanthus reticulatus* were recorded from the study.

Ninama *et al.* (2020)⁴⁸, perform a case study which study provides information on exotic plant species in the Delmi range of the Dhar district region. The study reveals that the local people have great expertise with the plants of their own environment. The occurrence of a number of exotic plant species has enhanced the area. The distribution of notorious weeds has had a strong effect on native flora since many of these replaced much of the indigenous species probably because of their strong harmful effect. A total of 93 taxa has been recorded from the study area which exhibits, the rich and varied assemblage of angiosperm plant diversity. Krassilov and Bacchia (2012)⁴⁹, In their case study, concluded that The Gara Sbaa florule of southeastern Morocco is a

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

"mixed" assemblage of "Wealden-type" ferns and gymnosperms and relatively advanced angiosperms. Scattered over the limestone lamellae and size sorted, the plant debris might have been transported by a high-tide ebb or tsunami backwash from over the tidal flat and adjacent dry land. The age range of the Gara Sbaa limestone is late Middle early Late Cenomanian based on stratigraphic correlation. The floral is almost similar to the latest Middle Cenomanian Nammoura assemblage of northern Lebanon because of *Pseudotorellia* and xeromorphic aspects of small serrate angiosperm leaflets, but differ in the numerically more prominent fern-gymnosperm component, with *Coniopteris*, *Sulcatocladus robustus*, *Pseudotorellia* (*Tritaenia*) *linkii*, and *Frenelopsis* cf. *teixierae*, giving it a somewhat more archaic aspect. Ponnuchamy *et al.* (2013)⁵⁰ conducted a study regarding a floristic study on 8 herbs and climbing plants at Puducherry, South India: An approach to Biodiversity Conservation and Regeneration through Eco restoration in their study the species were classified 2 into 3 categories depending on their occurrence status, namely, (1) Naturally Occurring, (2) Naturally Regenerated and (3) Introduced. The current study focuses only on two life forms, the Herbaceous, and the Climbing plants. From this study, they found that a large number of naturally occurring herbaceous, 172 climbing species, and a reliable number of 44 naturally regenerated species are now observed because of eco-restoration. Lowland herbaceous species also established themselves in the form of green cover at ground level. Presently, parts of the area with fertile soils and rich floristic composition have the herbaceous life form represented by one hundred sixty-five species belonging to One hundred and five genera and Thirty-seven families, and the climbers represented by Sixty-eight species belonging to Fifty-four genera and Twenty-five families. 'Genus to family' and 'species to genus' ratios reflect the establishment of diverse vegetation in the study area. Nearly 1/3rd of the species was observed with flowering all through the years and about 1/2 of the species were observed at fruiting condition throughout the year.

Rawat *et al.* (2013)⁵¹ conducted a study on the Kandi region of Hosiyarpur, Punjab, in their study they found a total number of 176 plant species belonging to 57 families and 133 genera from the study site. Out of these 176 plants, 175 were angiosperms and one was gymnosperm. The dicotyledons contribute 78.3% (137 species and 105

genera) whereas monocotyledons contribute 21.7% (Thirty-eight species and twenty-seven genera). Poaceae was the dominant family with thirty species and Twenty-one genera. Other important families were Papilionaceae, Caesalpiniaceae, Euphorbeaceae, Apocynaceae, Acanthaceae, and Mimosaceae. The dominant life form was (36.9%) trees, followed by (22.7%) shrubs, (17.1%) grasses, (13.6%) herbs, (8.5%) climbers and (1.1%). Kumar *et al.* (2018)⁵² in a study reported 154 plant species in 128 genera and 55 families. From this study, they found that there is vast diversity in species of plants in the Steel City Rourkela of Odisha. Taxa included monocotyledonous and dicotyledons. Asteraceae contributed the largest number with 12 species, followed by Apocynaceae and Caselpinaceae with 9 species, Euphorbiaceae contributed 7 species, and Fabaceae and Malvaceae contributed 6 species each of the identified species, most were trees 18 (45) and herbs (49); shrubs were also common (28). Climbers were rare (20) and grasses were the least common (5). The most common usage classifications of taxa were medicinal (53), ornamental (43), edible (33), common weed (23), timber (14), and cultural (2). The study reflects that the largest number of medicinal plants belong to the tree group.

COMMON IMPORTANCE OF ANGIOSPERMS FLORISTIC PLANTS

The most common medicinal plants are *Triumfetta pentandra*, *Leonotis nepetifolia*, *Passiflora foetida*, *Borehivia diffusa*, *Terminalia bellarica*, *Paderia foetida*, *Saraca asoka*, and *Abutilon indicum*; edible plants are *Dioscorea bulbifera*, *Amaranthus spinosus*, *Annona reticulata*, *Annona squamosa*, *Artocarpus heterophyllus*, *Commelina benghalensis*, *Dillenia indica*, *Dioscoreaalata*, *Embllica officinalis*, and *Mitragyna parviflora*; common weeds are *Pelisetum penicellatum*, *Ipomea carnea*, *Tridex procumbens*, and *Xanthium strumarium*; common cultivated plants are *Peltophorum pterocarpum*, *Allamanda cathartica*, *Bauhinia acuminata*, and *Canna indica*. In addition, it was found that the local tribal people who inhabit that area resort to deforestation for gathering timber. Along with that, in some areas, the forest was found to be burnt too, in order to get rid of wild rodents, which were known to harm the crops a lot. Identification of plant species led to the knowledge of the existence of some rare plant species, of which much abundant were *Rauwolfia serpentina* and *Mucuna gigantean*. These plants have been recognized as rare plants in the state of Odisha. Their

Mukherjee, P. & Jha, A.K. (2023). A review on floristic diversity with special reference to Jharkhand.

habitats can be harmed by the advent of mining activities. The undisturbed stand represents a natural forest where no stone mining activity was done in the past. The moderately disturbed forest stand represents the secondary forest where the stone mining activity was done 7 years back and the highly disturbed forest stand where sandstone mining was done recently (two years back). Mukherjee and Kumar (2020) did an extensive survey in the state of Jharkhand from the year 2014 to 2019 was conducted on aquatic and semiaquatic Angiosperms of Jharkhand has revealed that 272 species, belonging to 157 genera, distributed over 67 families of angiosperm. 9 Among 272 Aquatic and semi-quatic Angiospermic species 137 were monocotyledons distributed in 80 genera and 23 families as 135 taxa are dicotyledons belonging to 77 genera and 44 families. The largest aquatic genus is *Cyperus* (20), followed by *Lindernia* (8), and *Fimbristylis* (8) each, *Perscaria* with (6), *Eragrostis* (5), *Murdania*, *Oldanlandia*, *Rotala*, *Heliotropium*, *Hygrophila*, *Alternanthera*, *Comellina* all with four species and whereas *Nymphaea*, *Ammania*, *Blumea*, *Eriocaulon*, *Nymphoides*, *Utricularia*, *Potamogeton*, *Eleocharis* with three species each.

Mukherjee and Ghosh, (2015)²⁴ published a paper on aquatic and semi-aquatic angiosperms of Lohardaga in which they reported 215 4plant 5 plant species, belonging to 128 genera among 58 families of angiosperms based on an extensive survey between the years 1994 to 2012. Verma and Pandey (2008)⁵³ did a study on Floristic Studies of Aquatic and Semiaquatic Angiosperms of Ratu Maharaja Pond, Ranchi, Jharkhand. They found 14 Thirty-two aquatic and semi-aquatic species from the pond belonging to Twenty-two families and twenty-six genera. Out of these, twelve families belong to the dicot having twelve genera and sixteen species, whereas the ten family belongs to the monocot having fourteen genera and Sixteen species. Mukherjee and Kumar (2020)²⁵ reported on the invasive aquatic and semi-aquatic plant species of Santhal Pargana from the Year 2011 to 2016 and found that these plants are responsible for the loss of native aquatic biodiversity. Some of these plants have great sources of food. The aesthetic importance of these plants cannot be ignored. A total of 42 invasive aquatic and semi-aquatic plant species of Santal Parganas, belonging to 18 families and 32 genera were reported from this region. Out of those 12 families belong to dicotyledons having 21genera and 26 species whereas 6 families

belong to monocotyledons, having 11 genera and 16 species. Recently Jha (2022)⁵⁴ published her thesis on the topic “Angiospermic Diversity in and around Black Stone Mines of Pakur with Special Reference to Their Impact on Plants and Environment”.

CONCLUSION

Although a large number of workers have done their work on floristic studies of different parts of the world including regional, state and the countries flora. The aquatic and wetland floras, Invasive floras, herbaceous flora, Terrestrial flora, etc. Still, large areas of the world are unexplored. Millions of plants are still unidentified. Due to various environmental, climatic, and anthropogenic reasons, plant species are becoming endangered or extinct without identification. Proper and planned studies are required to compile the flora of the World, India, and Jharkhand. Our state is rich in floristic diversity but still, larger parts of the state are unexplored.

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