International Journal of Research in Engineering, Science and Management
Volume 8, Issue 9, September 2025
https://www.ijresm.com | ISSN (Online): 2581-5792

Floristic Diversity and Ecological Significance of the Malvaceae Family in Madhya Pradesh, India

Rohit Kumar[1*], Santosh Kumar Agnihotri[2]
[1]*Research Scholar, Department of Botany, Avdesh Pratap University, Rewa, India*
[2]*Professor, Department of Botany, Government Model Science College, Rewa, India*

***Abstract*: The Malvaceae family, known for its significant ecological and economic roles, exhibits remarkable floristic diversity in Madhya Pradesh, India. This paper examines the taxonomy, phylogenetic classification, chemical diversity, historical presence as documented in fossil records, and ecological distribution of Malvaceae in the region. With biodiversity hotspots such as the Satpura and Vindhya ranges, the state provides a vital refuge for endemic and medicinally important species. The study also addresses contemporary threats such as habitat loss and climate change while underscoring the relevance of conservation strategies grounded in floristic assessments. This work integrates current botanical research with regional ecological data to provide a comprehensive understanding of the diversity, importance, and conservation needs of the Malvaceae.**

***Keywords*: Ecological Significance, Malvaceae, Floristic Diversity, Taxonomy.**

1. Introduction

The Malvaceae family comprises herbs, shrubs, and trees found across tropical and subtropical regions. Species such as Gossypium (cotton), *G. hirsutum*, *G. barbadense, Hibiscus*, *H. rosa-sinensis* (ornamental), *Theobroma cacao* (source of chocolate), *Malva sylvestris* (Mallow), *Alcea rosea* (Hollyhock) and *Abelmoschus* (okra) are not only economically valuable but also contribute significantly to the structure and function of the ecosystems in which they thrive. This paper evaluates the floristic diversity of Malvaceae in Madhya Pradesh, highlighting the species richness, taxonomic structures, chemical profiles, and conservation needs associated with this essential family.

Madhya Pradesh, situated at the heart of India, boasts a diverse topography that ranges from dense forests and riverine systems to rocky plateaus and semi-arid zones. This heterogeneity fosters a wide range of microhabitats, making it a biodiversity-rich state. Its climatic diversity—encompassing dry deciduous, moist deciduous, and tropical forests—offers ideal ecological conditions for numerous Malvaceae species.

2. Floristic Diversity Assessment

Floristic diversity refers to the variety and richness of plant species within a defined geographic region. It is a key indicator of ecosystem integrity, evolutionary processes, and habitat stability. In a complex ecological matrix like Madhya Pradesh, where diverse physiographic and climatic zones intersect, floristic assessments are vital for detecting ecological degradation, identifying hotspots of endemism and guiding sustainable land-use and conservation policies.

Metrics such as species richness, alpha and beta diversity, and the Floristic Quality Index (FQI) are commonly used to evaluate ecosystem health and conservation value (Mishra & Rawat, 2012; Jurasinski *et al*., 2009).

A. Definition and Importance

Madhya Pradesh hosts several endemic and endangered plant species that demand urgent conservation attention. Species from families like Malvaceae play important roles in sustaining ecological processes and preserving traditional knowledge systems (Chauhan & Dwivedi, 2013). Floristic diversity encompasses the species richness and composition of plant communities within a geographical region. Evaluating this diversity provides insights into ecosystem health, evolutionary processes, and conservation requirements. In Madhya Pradesh, where climatic and topographical variations intersect, floristic assessments are especially valuable in detecting ecological change and planning sustainable development strategies. The Vindhya Range supports diverse plant communities adapted to rocky plateaus, shallow soils, and semi-arid valleys. Several Malvaceae species including *Hibiscus micranthus* and *Sida acuta* contribute to the region's floristic and ethnobotanical richness (Pandey & Verma, 2014). The Floristic Quality Index (FQI), which combines species richness with species-specific coefficients of conservatism, is a useful tool for evaluating ecosystem health and floristic integrity (Andreas, Mack, & McCormac, 2004). Its application in Madhya Pradesh's dry deciduous forests has helped identify areas of high conservation priority (Mishra & Rawat, 2012).

B. Methodologies

The assessment of floristic diversity involves field surveys, herbarium specimen analysis, GIS mapping, and ecological modeling. In regions like the Satpura and Vindhya ranges, these methods have revealed habitat-specific assemblages of Malvaceae species, helping delineate ecological niches and biodiversity corridors.

*Corresponding author: rohitmalviya200017@gmail.com

3. Taxonomic Classification of Malvaceae

The Malvaceae family includes approximately 4,225 species classified under nine subfamilies, including economically significant genera such as *Gossypium* (cotton) and *Theobroma* (cacao) (Zhong *et al.*, 2024; Cvetkovic *et al.*, 2021). Recent advancements in molecular phylogenetics have led to the identification of new tribes and redefined the taxonomic boundaries of this group (Colli-Silva *et al.*, 2025).

These revisions are grounded in phylogenomic analyses, which combine genetic, morphological, and ecological data to better understand evolutionary histories and relationships. For instance, the genus *Hibiscus*, known for its extensive variation in flower morphology, has been extensively analyzed using chloroplast genome sequencing, revealing cryptic speciation and hybridization events.

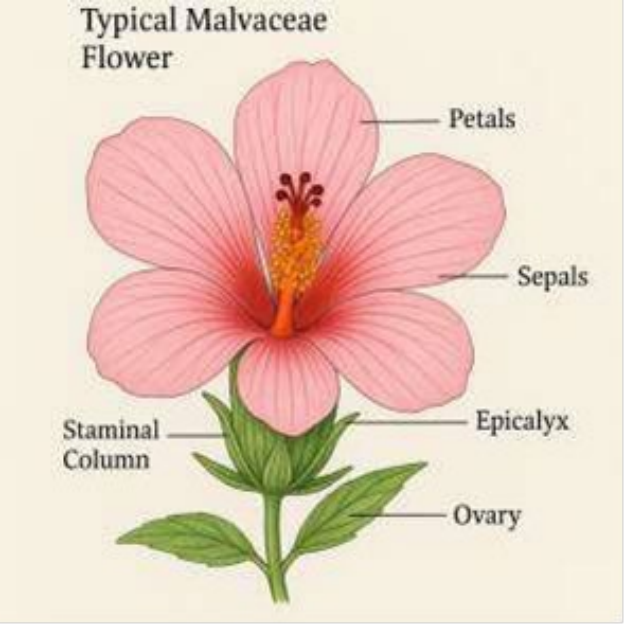

Fig. 1. Malvaceae flower

Habit: Mostly herbs, shrubs, and trees. *Leaves*: Alternate, often palmately lobed or veined, with stellate (star-shaped) hairs. *Stipules*: Usually present. *Flowers*: Bisexual, actinomorphic (radially symmetrical) 5 petals and 5 sepals (sepals often fused). Epicalyx (extra whorl of bracts) often present. Stamens often united into a staminal column (Fig 1.1). Fruits: Capsules, schizocarps, or berries. Seeds: Usually with a mucilaginous coating.

4. Chemical Diversity and Medicinal Potential

A. Flavonoid Profiles

Species in the Malvaceae family are known for their rich secondary metabolite composition, particularly flavonoids, phenolic acids, and terpenoids, which exhibit significant pharmacological activity. Among these, quercetin and kaempferol are the most frequently identified flavonoids, noted for their:

- Antioxidant activity (scavenging free radicals)
- Anti-inflammatory properties (COX inhibition)
- Antimicrobial and antifungal effects (Vadivel, 2016)

These compounds also serve chemotaxonomic functions, helping distinguish closely related taxa within Malvaceae, especially in genera like *Hibiscus* and *Abelmoschus*. Phytochemical fingerprinting techniques such as HPLC, TLC, and GC-MS have been employed to profile species such as *Sida cordifolia*, *Abelmoschus esculentus*, and *Hibiscus sabdariffa*—all of which are native or cultivated in Madhya Pradesh.

B. Ethnomedicinal Relevance

In the tribal regions of Madhya Pradesh—notably Pachmarhi, Amarkantak, and parts of the Satpura hills—Malvaceae species are widely used in traditional medicine by ethnic groups like the Gond, Baiga, and Korku. Documented medicinal uses include:

Sida cordifolia: Treatment for asthma, nerve pain, wounds, and inflammation.

Abelmoschus manihot: Used as a nutritional tonic, with leaves consumed during pregnancy and convalescence.

Hibiscus rosa-sinensis: Flower extracts used for menstrual regulation and hair growth. Phytopharmacological studies have supported many of these uses, confirming bioactive potential and pointing to possible development of plant-based therapeutics (Dwivedi & Sinha, 2013; Vadivel, 2016).

Indigenous tribes in Madhya Pradesh, particularly in regions like Pachmarhi, use Malvaceae species for treating ailments such as fever, wounds, digestive issues, and inflammation. These traditional applications are now supported by phytochemical analyses that validate their bioactive potentials.

5. Fossil Records and Historical Distribution

Fossil records from the Deccan Intertrappean beds have revealed the presence of Malvaceae, especially the Malvoideae subfamily, during the Late Cretaceous period (Manchester *et al*., 2023). These paleobotanical findings underscore the ancient lineage and adaptive resilience of the family in Central India.

Such fossil evidence helps reconstruct past climate conditions and migration patterns, indicating that the current diversity of Malvaceae in Madhya Pradesh may be a result of millennia of climatic oscillations and geological transformations.

6. Biodiversity Hotspots in Madhya Pradesh

Madhya Pradesh, centrally located in India, harbours a rich variety of ecosystems ranging from moist deciduous forests to dry scrublands, making it a crucial floristic zone in central India. The state's ecological diversity supports numerous species of the Malvaceae family, many of which are endemic, medicinally important, or ecologically significant.

A. Pachmarhi Biosphere Reserve

Located in the Satpura range, the Pachmarhi Biosphere Reserve is a UNESCO-listed site known for its high endemism and ethnobotanical wealth. It harbours multiple Malvaceous species, including rare and medicinal types, in habitats ranging from deciduous forests to riverine corridors. In this range, high floral diversity and significant ethnobotanical knowledge are

preserved by tribal communities, including the use of Malvaceous species for medicinal and cultural purposes (Rathore & Singh, 2012).

B. Kanha and Satpura National Parks

These national parks provide crucial habitats for flora and fauna, including Malvaceae taxa adapted to dry deciduous and moist tropical conditions. Restoration ecology projects in these regions often involve reintroducing native plant species, including those from Malvaceae, to support wildlife and enhance biodiversity. Kanha National Park supports a wide diversity of native flora, including members of the Malvaceae family, which contribute to the ecosystem through their roles in pollinator support, medicinal resources, and understory vegetation structure (Verma & Bharti, 2015). Satpura National Park, part of the Satpura range, is known for its diverse plant communities, including several species from the Malvaceae family. These species play vital ecological roles in forest regeneration, and many are used traditionally for medicinal purposes (Sharma & Kothari, 2011)

C. Amarkantak and Vindhya Ranges

The Amarkantak region is not only a biodiversity hotspot but also a center of traditional healing practices. Tribal communities such as the Baiga and Gond use several Malvaceae species, including *Sida cordifolia* and *Abelmoschus manihot*, for treating ailments like fever, wounds, and inflammation (Dwivedi & Sinha, 2013). The Vindhya Range supports diverse plant communities adapted to rocky plateaus, shallow soils, and semi-arid valleys. Several Malvaceae species—including *Hibiscus micranthus* and *Sida acuta*—contribute to the region's floristic and ethnobotanical richness (Pandey & Verma, 2014).

7. Economic and Agricultural Importance

A. Cotton (Gossypium Spp.)

Cotton cultivation has deep economic roots in Madhya Pradesh, particularly in the Nimar and Malwa regions. However, the introduction of genetically modified (Bt) cotton has raised concerns about its ecological impact, including the displacement of native species and increased agrochemical use.

B. Okra (Abelmoschus Esculentus)

Another economically vital crop, okra is extensively cultivated and plays a role in nutritional security and income generation. However, its cultivation must be balanced with the conservation of wild relatives, which are essential for genetic improvement programs.

8. Conservation Challenges

A. Habitat Loss

Expanding agriculture, urbanization, and industrial activities pose serious threats to the natural habitats of Malvaceae species. Deforestation and fragmentation reduce viable populations and gene flow, endangering endemic taxa.

B. Climate Change

Altered precipitation patterns and rising temperatures are expected to shift plant distribution ranges, potentially leading to local extinctions. Species with narrow ecological amplitude are particularly vulnerable.

C. Invasive Species

Agricultural expansion has led to the introduction of non-native plant species that compete with indigenous Malvaceae species for resources, sometimes outcompeting them and altering ecological dynamics.

9. Recommendations and Future Directions

1. *Integrative Conservation*: Implement conservation plans that combine in situ (within natural habitat) and ex situ (botanic gardens, seed banks) strategies to safeguard genetic diversity.
2. *Community Engagement*: Empower local communities through ethnobotanical documentation, sustainable harvesting practices, and participation in biodiversity monitoring.
3. *Research and Taxonomy*: Expand molecular phylogenetic studies and metabolomics research to uncover cryptic diversity and support taxonomic clarity.
4. *Policy Integration*: Integrate biodiversity conservation into agricultural policies to minimize the negative impacts of intensive farming on native plant communities.
5. *Educational Outreach*: Promote environmental education focused on the importance of native plant families like Malvaceae for ecosystem services, traditional medicine, and cultural heritage.

10. Conclusion

The Malvaceae family in Madhya Pradesh represents a vital component of the state's floristic heritage. Its species are not only ecologically indispensable but also economically and culturally significant. From ancient fossil records to modern taxonomic revisions, this plant family's story is deeply intertwined with the landscape and people of central India. With growing pressures from anthropogenic and climatic changes, there is an urgent need to recognize, study, and conserve this botanical treasure.

References

[1] Andreas, B. K., Mack, J. J., & McCormac, J. S. (2004). Floristic Quality Assessment Index (FQAI) for vascular plants and a methodology for use in wetland assessment in Ohio. *Ohio Environmental Protection Agency*, pp. 39.

[2] Chauhan, N. S., & Dwivedi, S. (2013). Endemic and endangered plant species of Madhya Pradesh: A critical review for conservation planning. *Indian Forester*, 139(1), 83–89.

[3] Colli-Silva, M., Garcia, F. C., & Baum, D. A. (2025). Phylogenomic reclassification of Malvaceae: Resolving deep relationships and tribal boundaries using genome-scale data. *Annals of Botany*.

[4] Cvetkovic, T., Marković, M., & Petrovic, A. (2021). Phylogenetic relationships and biogeographic patterns in Malvaceae: Insights from nuclear and plastid markers. *Botanical Journal of the Linnean Society*, 196(3), 321–338.

[5] Dwivedi, S. N., & Sinha, R. (2013). Ethnomedicinal uses of plants by tribal communities in Amarkantak Biosphere Reserve, Madhya Pradesh, India. *Journal of Medicinal Plants Research*, 7(27), 2015–2021.

[6] Jurasinski, G., Retzer, V., & Beierkuhnlein, C. (2009). Inventory, differentiation, and proportional beta diversity: A consistent terminology for quantifying species diversity. *Oecologia*, 160(3), 507–513.

[7] Kala, C. P. (2005). Ethnomedicinal botany of the Apatani in the Eastern Himalayan region of India. *Journal of Ethnobiology and Ethnomedicine*, 1(11), 1–7.

[8] Manchester, S. R., Srivastava, R., & Sharma, M. (2023). Fossil Malvaceae from the Deccan Intertrappean Beds: Insights into Late Cretaceous floristic assemblages in India. *Palaeobotany and Palynology*, 309, 104730.

[9] Mishra, B. P., & Rawat, G. S. (2012). Application of floristic quality index for evaluating forest health in tropical dry deciduous forests of central India. *Tropical Ecology*, 53(3), 329–341.

[10] Pandey, A. K., & Verma, S. C. (2014). Floristic diversity and ecological assessment of the Vindhya hills with special reference to endemic and medicinal plants. *Tropical Plant Research*, 1(2), 26–32.

[11] Rathore, M., & Singh, S. (2012). Biodiversity and ethnobotanical relevance of Pachmarhi Biosphere Reserve, Madhya Pradesh, India. *Indian Journal of Traditional Knowledge,* 11(2), 279–283.

[12] Rawat, G. S., & Uniyal, V. K. (2010). Land use change and its impact on plant diversity in central Indian dry deciduous forests: A landscape-level analysis. *Journal of Environmental Biology*, 31(5), 765–772.

[13] Sharma, B. D., & Kothari, M. J. (2011). Floristic diversity and conservation significance of Satpura National Park, Madhya Pradesh, India. *Indian Journal of Forestry*, 34(3), 311–318.

[14] Vadivel, V. (2016). Flavonoid profiles and their pharmacological significance in Malvaceae species. *Phytochemistry Reviews*, 15(4), 735–744.

[15] Vadivel, V. (2016). Flavonoids in Malvaceae: Pharmacological and Chemotaxonomic Perspectives. *Journal of Medicinal Plant Research*, 10(12), 1234–1245.

[16] Verma, A., & Bharti, R. (2015). Floristic composition and ethnobotanical studies of Kanha National Park, Madhya Pradesh, India. *Journal of Biodiversity and Environmental Sciences*, 6(4), 456–463.

[17] Zhong, J., Li, X., & Kumar, R. (2024). Taxonomic overview and phylogenetic revisions in the Malvaceae family based on molecular markers. *Journal of Plant Systematics and Evolution*, 310(2), 145–163.