Environment and Ecology 44 (3) : 549—556, July—September 2026
Article DOI: https://doi.org/10.60151/envec/DQYW9457
ISSN: 0970-0420 (Print), ISSN: 3049-3625 (Online)

Indian Floral Diversity and Plant Conservation Issues

Soma Chanda, Tripti Bouri

Received 25 February 2026, Accepted 17 June 2026, Published on 17 July 2026

ABSTRACT

India harbors exceptional floral diversity shaped by steep climatic and topographic gradients across four global biodiversity hotspots. Plant diversity, with almost 500,000 species, serves human needs and plays a major role in the natural ecosystem. Anthropogenic pressure of population growth and industries has put natural resources in rapid decline. Habitat fragmentation, loss, degradation, destruction, resource overexploitation, alien species invasion, air pollution, nitrogen deposition, and climate change are the drivers of the decline in plant diversity. A conservation framework and priority actions for research and policy are essential. The world community is now very much concerned about the sustainable use of natural resources and the quality of the environment for both present and future generations. Environmental ethics, past and modern practices for the conservation of the forest resources have gaining priority in world wide. Different global strategies like agroforestry systems, utilization of different scientific and technical expertise, public participation and and different policies have taken into consideration for the conservation of natural resources. Further research on ecology and socioeconomic mechanisms associated with natural resources is needed to be understood and implemented in biodiversity conservation. The objective of this paper is to evaluate the current state of biodiversity in India, identify the primary drivers of its decline, and examine the conservation efforts implemented by the government, scientific community, businesses, and indigenous communities to preserve the nation's abundant natural legacy. It is in our collective economic and environmental interest to practice sustainable forest development at the national, regional, and global levels.

Keywords Biodiversity, Hotspots, Conservation, Natural ecosystem, Overexploitation.

INTRODUCTION

India is recognized as one of the World's mega-diverse nations, harboring nearly 47000 plant species, accounting for about 12% of global flora. Four global biodiversity hotspots - the Himalaya, Indo Burma, Western Ghats, and Eastern Himalayas- contribute significantly to its floristic richness and high levels of endemism. The flora includes an exceptional di-

Dr. Soma Chanda[1]
Assistant Professor, Department of Botany, South Calcutta Girls' College, 72 Sarat Bose Road, Kolkata 700025, India

Dr. Tripti Bouri[2]*
Assistant Professor, Department of Botany, Bankura Sammilani College, Kenduadihi, Bankura 722102, India

Email: tbouribot@gmail.com
*Corresponding author

versity of angiosperms, gymnosperms, pteridophytes, bryophytes, lichens, and fungi, many of which are ecologically, medicinally, and economically important. However, Indian plant diversity faces multiple conservation challenges. These include habitat loss and fragmentation due to agriculture, urbanization, and industrial expansion, as well as over-harvesting of timber and medicinal plants. Anthropogenic pressure of population growth and industries has put natural resources in rapid decline. Hence, plant diversity must be restored to prevent extinction and ensure sustainable use of plant materials for present and future generations. Globally, the rapid decline in biodiversity has several implications for ecosystem functioning and stability, and this impacts our way of life (Hautier *et al.* 2015). With limited evidence, many species remain unknown, which could prove useful in the future and serve as a defense boundary to protect plants in their natural environment (Breman *et al.* 2021). Since floral diversity is vital to many sectors, including agriculture and medicine, its preservation is necessary to ensure the health of current and future generations (Chaudhary and Shringi 2017).

Recognizing biodiversity

The terms "bio" (life) and "diversity" (variety) are combined to form the term "biodiversity," which describes the vast array of living things and how they interact with one another in ecosystems. It includes species diversity, genetic variation within species, and the ecosystems that they create. Biodiversity is one of nature's most precious resources and is necessary for preserving ecological equilibrium. According to international accords, biodiversity encompasses "variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems." The complex web of life on Earth depends on every species, including microorganisms, plants, and animals.

India: an incredibly diversified country

"Floral diversity" refers to the range of plants that existed in a certain location at a certain period. It generally refers to the range of naturally occurring native or indigenous flora. Flora, a Latin word meaning "flower," is the name of the plant goddess. So far, 215,644 of the 298,000 anticipated plant species have been identified and catalogued. According to the Environmental Information System (ENVIS) on Floral (Plant) Diversity, 8,600 of the expected 16,600 plant species have been identified from the ocean (Rathoure and Patel 2020).

The angiosperms, or flowering plants, are the largest and most diverse group of living plants in the kingdom of plants. Approximately 3,50,000 species of flowering plants, categorized into 416 families and 14,559 genera, have been identified to date, making up nearly 90% of all known terrestrial plant species (Rajbala 2021). The angiosperms are the youngest of the major lineages of green plants, having emerged and spread during the Ordovician epoch, some 500–470 million years ago (Sanderson *et al.* 2004).

Food and fiber are the two most important goods that floral diversity provides for human well-being. Several plant species and their diverse settings have yielded an abundance of compounds for human health. Plant species act as a "safety net" to ensure that we will always have access to food. We can choose from a variety of foods for a balanced, healthful diet. We can utilize wood fuel, a cheap and alternative energy source, to heat our homes, cook, and boil water. Floral diversity triggers a photosynthetic response that allows us to breathe clean air. Herbs used in ethnomedicine can be used to provide traditional therapies. The variety of flowers provides us with several advantages, such as raw materials for the manufacture of clothing, building materials, ornamental objects, ecotourism, cosmetics, pharmaceuticals, and personal hygiene goods. Plant diversity provides research value, much like a botanical garden, conservation area, or natural habitat for teaching and study (Jeph 2019). A wide variety of natural habitats, including forests, grasslands, wetlands, coastal and marine areas, and desert ecosystems, are supported by this enormous geographic and climatic heterogeneity, and they all add to the nation's exceptional biodiversity.

Loss of plant diversity

Habitat fragmentation, loss, degradation, destruction,

resource overexploitation, alien species invasion, air pollution, Nitrogen deposition, and climate change are the drivers of the decline in plant diversity. Deforestation leads to forest. land conversion to pasture land and commercial crops in tropical regions (Behera and Bhadra 2024).

Reduction in plant diversity promotes non-forest habitats, which are threatened by agricultural development and mining activities. The continuous drop in biodiversity is widely acknowledged; more concerning, this trend shows no sign of abating; in fact, it may even worsen. Biodiversity loss causes less ecosystem production, diminishes nature's resilience, and lowers ecosystem services and species interactions. Plantations can negatively affect biodiversity if they replace biologically rich native grassland or wetland habitats (Wagner *et al.* 2006). Also, plantations can have either positive or negative impacts on biodiversity depending on management practices (Quine and Humphrey 2005). Plantations may act as corridors, sources, or barriers for different species, and a tool for landscape restoration (Parrotta 2002). Other forestry mitigation options, such as reducing deforestation, agro-forestry, multi-species plantations, and sustainable native forest management, lead to biodiversity conservation.

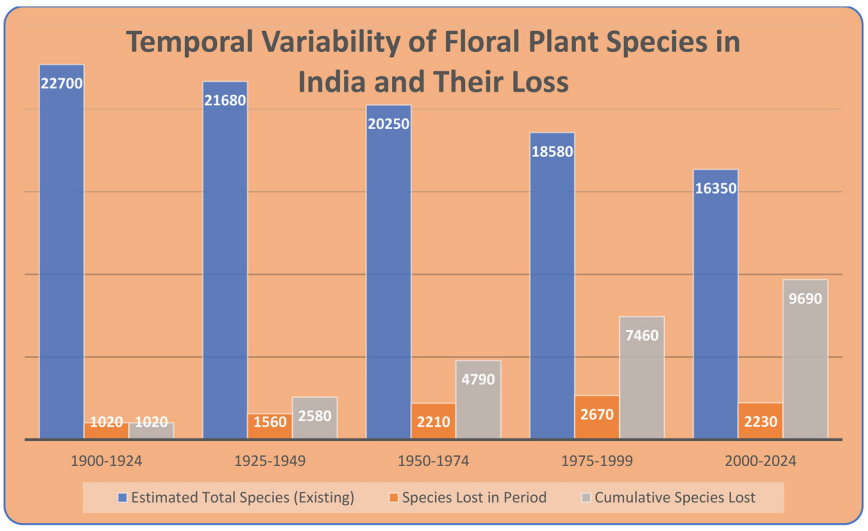
In India nearly 7–8% of the world's known plant diversity is found, having the highest endemism with the Himalayas, Western Ghats, and Andaman & Nicobar Islands. However, growing ecological pressures have hastened the reduction in biodiversity and seriously endangered native plants (Mohan 2021). The bar graph emphasizes the gradual extinction of species and shows the estimated changes in floral plant species diversity in India throughout various historical periods (Fig. 1).

In India, more than 54,000 plant taxa, including angiosperms, gymnosperms, pteridophytes, bryophytes, fungi, algae, lichens, and microorganismsare found, according to the Botanical Survey of India (Kumar *et al.* 2021). The International Union for Conservation of Nature Red List now lists several hundred plant species as vulnerable.

Causes of biodiversity loss

Habitat destruction

The most serious threat to biodiversity is the extensive loss of natural habitats, which is mostly brought on by human activities, including highway construction, drainage, urbanization, agriculture, mining, industry,



Sources: BSI : Plant Discoveries Reports and National Flora Database
IUCN : Nature Red List Database

Fig. 1. The temporal variability of floral plant species.

and dam construction. Species are compelled to adapt, move, or risk extinction from illness, malnutrition, or predation when their habitats are destroyed or changed.

Hunting and poaching

In the past, people have hunted animals to survive. However, the demand for animal goods, including hides, skins, tusks, antlers, meat, musk, fur, and other derivatives used in medicines, cosmetics, fragrances, and ornamental objects, has made commercial hunting a serious concern. The tiger (for its bones and skin), jackal (for fur), elephant (for ivory), crocodile and gharial (for skin), musk deer (for musk), and rhinoceros (for its horn) are among the animals that are targeted in India.

Overexploitation

Several commercially and ecologically significant species have been depleted or gone extinct as a result of the overexploitation of biological resources. This encompasses not just animals and plants with commercial value but also rare species. The overexploitation of marine animals, such as fish, mollusks, sea cows, and sea turtles, has also had a negative impact on their populations and caused several species to go extinct.

Gathering for scientific research and zoos

Around the world, wild animals are frequently gathered for zoo exhibits, biological study, and medical studies. The decrease in biodiversity is also a result of this practice

Exotic species introduction

Native species frequently face fierce competition for food, space, and other resources when non-native (exotic) species are introduced into new environments. Native plants and animals may be displaced or endangered by this competition.

Deforestation

Rapid deforestation is another significant factor contributing to the loss of biodiversity, and it is mostly caused by pressures from development and population increase. Fuelwood extraction, infrastructural development, shifting cultivation, settlement growth, and industrial demands for timber in industries like plywood, paper, pulp, and furniture are important causes.

Biodiversity and resilience

Long-term observations of water, nutrient, and carbon dynamics, changes in the plant diversity effect over time, and the accompanying plant-microbial interactions. The concentrations of the quantitatively most important nutrients, nitrate, and phosphate in soil solution decreased in time, shifting in the microbial community compositions, and over time, the role of plant-derived inputs becomes increasingly important for ecosystem functioning. In addition to ensuring the delivery of services, the richness of plant species strengthens plant-microbial interactions, which over time reinforce other ecosystem functions as productivity in relation to ecosystems' capacity to continue operating under a variety of conditions, stresses, or disturbances. In this case, the biodiversity of any particular area acts as a buffer (Barik *et al.* 2018). The species operate optimally under different environmental conditions, which replace each other to maintain basic ecosystem processes. The overlap in functionality, combined with differences in ecological preferences, enhances the productive capacity.

Global strategies for plant conservation

All over the world the scientists have shifted their mode of interest to document the phyto diversity in war footing. This is very effective and urgently conserves wild flora, medicinal plants, as well as various phyto diversities of various landscapes. In association with that use of floral resources is very important in sustainability and equity. It is also essential to promote education and awareness about plant diversity and its role in sustainable livelihoods, and its importance to all life on earth. Moreover, the development of capacities for the implementation of the conservation strategy.

Sustainable development

Sustainable development emphasizes meeting present

human needs without compromising the ability of future generations to meet their own needs. Forest conservation plays a critical role in achieving sustainable development by maintaining ecological balance, supporting biological diversity, regulating climate, and, most importantly, sustainable livelihoods (Prins *et al.* 2023). Sustainability has emerged as a global priority in response to escalating environmental degradation, climate change, and resource depletion. Forest which covers proximately one third of the Earth's land surface, are among the world's most valuable natural resources.

Sustainability is also defined as the ability to make responsible decisions in using and allocating resources to economic and non-economic activities in an effort to achieve certain desired social, economic, and environmental outcomes (Grant 2010).

Agroforestry system

Globally, one-tenth (10%) of the earth's land surface is being used for the cultivation of different crops. However, the rest of the 90% land surface consists of mountains (20%), pastures (20%), deserts (20%), snow-ice (20%), and land with no soil (10%).

The Agroforestry concept was developed in tropical regions within the context of developing countries, where initially land shortage brought about by the rapid population growth of Indigenous peoples demanded efficient protection systems for both food and wood resources.

Agroforestry is a multidisciplinary and multifunctional land use system that originated from various traditional cultivation practices of trees, crops, and or pasture carried out in the same piece of land by rural as well as urban communities since time immemorial in parts of the world.

Many ways have been formulated for the conservation of natural resources in sustainable ways:

i) Scientific and technical expertise: It includes data analysis, modelling, and understanding the biophysical limits of the biosphere. Experts in fields like ecology, climate science, engineering, and economics can provide crucial insights into the challenges and potential solutions for sustainability.

ii) Integration of knowledge: Expert knowledge needs to be integrated across disciplines to address complex issues like climate change, resource depletion, and biodiversity loss.

iii) Public participation: It is the most important criterion for the conservation of natural resources. Because people's awareness and different traditional ways of nature conservation are the topmost areas. Different policies and joint forest management strategies are very important for this purpose.

Way forward

Conservation education, people's participation in conservation reserves and community care, Restoration and degraded habitats, and recovery of threatened species, and, most important is Enabling Policies and Legislation. Maintain the plant species diversity which supports human nutrition, health and well-being. Build capacity, expertise, and appropriate policies for effective conservation, research and sustainable use of plant diversity. In association with the recognition of the value of ecosystem services provided by the plants, take necessary steps to sustainably use them. In the post 2020 global strategy for plant conservation, are include studies and effectively conserves all plant species and areas important for plant diversity. Restore degraded ecosystems using appropriate native plant species. Maintain viable populations of threatened wild plant species using ex-situ and in-situ measures.

Biodiversity encompasses various levels of variation in the natural world, including genetic, pecies and ecosystem diversity. It has various environmental, cultural, social, economic, medical, scientific, educational, and aesthetic values. However, biodiversity is being lost rapidly due to natural and anthropogenic factors. Threats include agricultural expansion, overexploitation, urbanization, pollution, forest fires, exotic species invasion, Genetically Modified Organisms (GMOs), and global climate change. In this present scenario biodiversity conservation is very much essential in both natural and artificial mode.

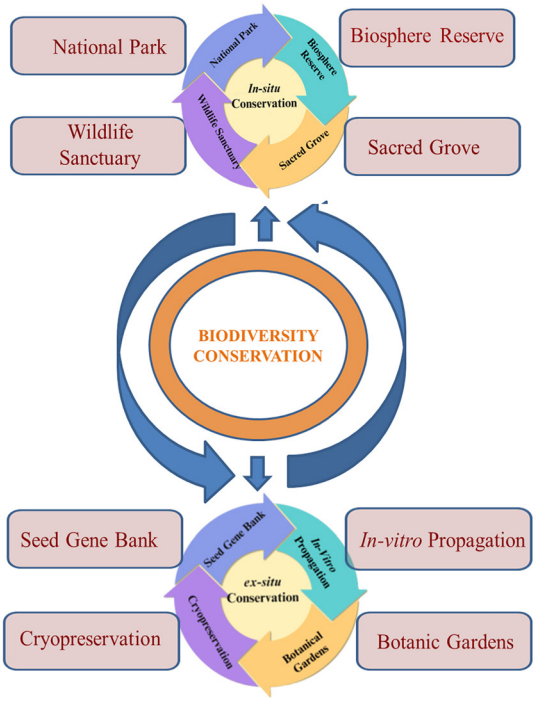


Fig. 2, Model of Biodiversity Conservation (Behera and Bhadra, 2024).

According to Behera and Bhadra, 2024 in (Fig. 2) some conservational approaches have been shown in both exsitu and insitu conservation. In-situ conservation is the process of maintaining or recovering viable species populations in their natural habitats, particularly for domesticated or cultivated species. Considering the exsitu conservation for the rapid propagation and linkages different biotechnological methods like invitro propagation, seed gene bank, cryopreservation methods also getting priority in thrust area of research.

Traditional way of biodiversity conservation

Traditional herbal medicine has a long history in India, which can help with scientific and cultural studies. Ethnobotanists can study wild plants and their medicinal properties with the help of diverse flora and indigenous tribes. Combining ethnobotanist knowledge with pharmacological findings can lead to productive drugs. India's flora is diverse, with 45,000 plant species and over 400 ethnic groups (Tailang 2014). Conservation of sacred Groves are the most important traditional way of Biodiversity conservation. In the year 2008, Bhakat and Sen described ethnomedicinal plant conservation through sacred groves in different tribal dominated areas. (Bahera *et al* 2024) focused some light on scope, dependence, and livelihood importance of NTFPs for their daily needs and source of income. According to them about 275 million poor rural and tribal people in India depend at least in part on NTFPs. They also reported that, In India, nearly equal to 3,000 plant species produce NTFPs that are valuable economically. From small-scale forest-based industries, up to 50% of the income of around 25% of India's rural labor population is generated.

The IUCN Red List is crucial for biodiversity conservation, but limited resources must focus on species vulnerability, biological distinction, ecosystems, and ecological, social, and economic worth (Barnes and Delborne 2021). There is an urgent need for the conservation of plant diversity to ensure ecological balance, economic sustainability, cultural preservation, and the overall well-being of its people (Niesenbaum 2019). The conservation and sustainable management of this diversity are crucial for maintaining the ecological balance.

The challenges ahead

The world community is now very much concerned about the sustainable use of natural resources and the quality of the environment for both present and future generations. There is an increasing move toward environmental ethics, including: use and not abuse; reduce environmental stress; recycle; and do more with less. Particularly in industrialized countries, the general public is also very concerned about past and current forestry practices worldwide, especially forest degradation and deforestation in tropical regions, forest degradation in industrialized countries, and environmental degradation associated with the manufacture of certain forest products. The challenge of practicing sustainable development as described above may be pursued through several specific actions, including research. forest and environmental policy; forestry practices and management; and international cooperation in developing criteria for sustainable forest

development, the transfer of technology, and financial assistance (Ozili 2022).

Practising sustainable forest development through forest management ecosystems for their multiple benefits and the value addition of relatively more costly, high-demand forest products. However, failure to practice environmentally sound forest management is likely to lead to prohibitive future costs. As it is in our collective economic and environmental interest to practice sustainable forest development at the national, regional, and global levels, there is a need to develop an appropriate international policy and institutional framework to foster global technical and financial cooperation (Maini 1991).

CONCLUSION

A broad review of the concept of sustainable forest management is now necessary in light of the different factors. Documentation of Indigenous Knowledge (IK) and the scientific implementation of these practises are urgently required. The present concept, largely unchallenged by those inside the forest sector, no longer reflects reality at the social, institutional, and policy level. If this concept is not revised, there is a real possibility of forest issues becoming invisible and misunderstood by policy and decision makers for the reasons we have described above. In particular, the driving idea of balance between the functions/services of the forest could be lost in a conflict between policy communities focused on specific aspects such as climate change mitigation, energy provision, or biodiversity conservation.

In order to sustain ecological stability, vital ecosystem functions, and human livelihoods, floral diversity must be preserved. This overview emphasizes how important functions, including nutrient cycling, soil preservation, climate management, and the production of food, medicine, and raw materials, are supported by plant diversity. However, plant variety is being eroded at an alarming rate due to growing stressors such as habitat fragmentation, land degradation, and human pressures. Based on our analysis, we conclude that the concept of sustainable forest management, joint forest management, uses of Non-Timber Forest Products, alternative income generation of the forest dwellers, sustainable uses of phyto resources, and religious myths of biodiversity conservation, as formulated at present, in Europe and elsewhere, is no longer fit for purpose. Further research on ecology and socioeconomic mechanisms associated with natural resources is needed to be understood and implemented in biodiversity conservation. Forests are vital for the tribal people. Therefore, a fundamental review of the concept is necessary, which reflects all today's demands on forests, as well as the developing institutional context.

The significance of both conventional and contemporary conservation strategies—such as in-situ and ex-situ techniques, biotechnological interventions, and sustainable land management techniques—is emphasized in this work. It highlights the critical need for improved legislative frameworks and cooperative action to guarantee the long-term preservation of plant diversity, which is still essential for ecological sustainability and the welfare of future generations. It does this by emphasizing integrated, interdisciplinary efforts.

REFERENCES

Barik, S. K., Chrungoo, N. K., & Adhikari, D. (2018). Preface: Conservation of Threatened Plants of India. *Current Science,* 114(3), 468–469. http://www.jstor.org/stable/26495101

Barnes, J. C., & Delborne, J. A. (2021). The Politics of Genetic Technoscience for Conservation: The Case of Blight-Resistant American Chestnut. *Environment and Planning E: Nature and Space.* https://dx.doi.org/10.1177/25148486211024910

Behera, D., Kanungo, A. P., Dash, S. S., & Prangya, S. (2024). Non –timber forest products (ntfps) for sustainable livelihood of indian tribals; Futuristic Trends in Agriculture Engineering & Food Sciences; IIP Series, Volume 3, Book 10, Part 2, Chapter 2; ISBN: 978-93-5747-595-2.

Behera, S., & Bhadra, A. (2024). Plant diversity conservation issues and challenges: A review, 11(3). *Plant Science today.* https://doi.org/10.14719/pst.3778

Bhakat, R. K., & Sen, U. K. (2008). Ethnomedicinal Plant Conservation Through Sacred Groves. Tribes and Tribals, special volume No. 2: 55-58.

Botanical Survey of India. Plant Discoveries Reports and National Flora Database.

Breman, E, Ballesteros, D., Castillo-Lorenzo, E., Cockel, C., Dickie, J., Faruk, A., & Ulian, T. (2021). Plant diversity conservation challenges and prospects: the perspective of botanic gardens and the Millennium Seed Bank. Plants.

10(11), 2371. https://doi.org/10.3390/plants10112371
Chaudhary, M., & Shringi, S. K. (2017). Floristic composition of Beer Jhunjhunu Conservation Reserve of Rajasthan, India. *The Biobrio,* 4(1&2), 244-258.
Grant, L. K. (2010). 'Sustainability: From Excess to Aesthetics.' Behavior and Social Issues, 19 (1): 7-47.
Hautier, Y., Tilman, D., Isbell, F., Seabloom, E. W., Borer, E. T., & Reich, P. B. (2015). Anthropogenic environmental changes affect ecosystem stability via biodiversity. *Science*, 348 (6232), 336–340. https://doi.org/10.1126/science.aaa1788
International Union for Conservation of Nature Red List Database.
Jeph, A. (2019). Significance and major threats to floral diversity. *International Journal of Education, Modern Management, pplied Science & Social Science*, 1(4):36-39.
Kumar, P., Panwar, G. S., & Singh, S. K. (2021). A Brief Analysis of IUCN Red Listed Threatened Plants of India. *Indian Forester,* 147(12):1155-1171
Maini, J. S. (1991). *Towards an international instrument on forests.* Paper prepared for intergovernmental consultation, Geneva. Ottawa, Forestry Canada.
Mohan, V. (2021). Botanical Survey of India adds 267 plant species to the country's flora. The Times of India.
Niesenbaum, R. A. (2019).The integration of conservation, biodiversity, and sustainability. *Sustainability*, 11(17), 4676. https://doi.org/10.3390/su11174676
Ozili, P. K. (2022). Sustainability and Sustainable Development Research around the World. *Managing Global Transitions,* 20(3). https://doi.org/10.26493/1854-6935.20.259-293
Parrotta, J. A. (2002). Restoration and management of degraded tropical forest landscapes. *In Modern Trends in Applied Terrestrial Ecology.* R. S. Ambasht and N. K. Ambasht (eds.), Kluwer Academic/Plenum Press, New York, pp. 135-148 (Chapter 7).
Prins, K., Köhl, M., & Linser, S. (2023). Is the concept of sustainable forest management still fit for purpose?. *Forest Policy and Economics,* 157, 103072.
Quine, C., & Humphrey, J. (2005). Stand Management and Biodiversity. *In International Conference: Biodiversity and Conservation Biology in Plantation Forests.* Bordeaux, France. https://www.plantedforests.org/es/biodiversite-and-conservation-biology-in-plantation-forests/
Rajbala. (2021). Floral diversity degradation and its conservation. *International Journal of Advanced Academic Studies*, 3(4): 146-148. https://www.doi.org/10.33545/27068919.2021.v3.i3b.1471
Rathoure, A. K., & Patel, H. C. (2020). Techniques to assess plant diversity: Floral biodiversity assessment. In: Current state and future impacts of climate change on biodiversity. Biohm Consultare Pvt. Ltd.,P 1-14.
Sanderson, M. J., Thorne, J. L., Wikström, N., & Bremer, K. (2004). Molecular evidence on plant divergence times. *American Journal of Botany,* 91(10):1656-1665. https://doi.org/10.3732/ajb.91.10.1656
Tailang, M. (2014). Ethnomedicinal plants used by some Indian tribe. *World Journal of Pharmaceutical Research*, 4(1), 549-558.
Wagner, R. G., Little, K. M., Richardson, B., & Mcnabb, K. (2006). The role of vegetation management for enhancing productivity of the world's forests. *Forestry,* 79(1), 57-79.