



Arboretum - Way to Sustainability and Ex-situ Conservation

Vennila S.^{1*}, K. Kumaran², N. Jothika², C. Cinthia Fernandez³ and S. Kala⁴

¹Dept. of Agronomy, Agricultural College and Research Institute, TNAU, Tiruvanmalai, Tamil Nadu (606 753), India

²Dept. of Forest Biology and Tree Improvement, Forest College and Research Institute, TNAU, Mettupalayam, Tamil Nadu (641 301), India

³ICAR-Krishi Vigyan Kendra, Nilgiris, TNAU, Tamil Nadu (606 753), India

⁴Dept. of Agricultural Research and Education, ICAR-Indian Institute of Soil and Water Conservation Research Centre, Kota, Rajasthan (324 002), India



Open Access

Corresponding Author

Vennila S

✉: vennila.s@tnau.ac.in

Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Vennila *et al.*, 2023. Artificial Intelligence in Agriculture. *Biotica Research Today* 5(3), 258-260.

Copyright: © 2023 Vennila *et al.* This is an open access article that permits unrestricted use, distribution and reproduction in any medium after the author(s) and source are credited.

Abstract

An arboretum represents the accumulated knowledge of hundreds of years of plant identification, taxonomy, collecting, horticulture and curation. They also have the land and facilities, such as breeding nurseries, tissue culture laboratories and seed banks, required to maintain genetically diverse tree collections in the long term. With these strengths and assets, arboretums are in a unique position to play a significant role in mitigating the global tree biodiversity crisis through *ex situ* conservation.

Keywords: Arboretum, Biodiversity, *Ex-situ* conservation, Garden

Introduction

An arboretum is a botanical garden where the living collection of trees are maintained which also includes others woody lianas. In other words, arboretum is defined as an area which consists of trees as the dominant plant type. Arboreal garden is an *ex-situ* conservation methodology for rare and vulnerable tree species. *Ex-situ* conservation literally means, "Off-site conservation". It is the process of protecting an endangered species of plant or animal by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. Globally, 10% of all trees (> 8,000 species) are threatened with extinction. Although protecting a threatened species in its natural habitat (*in situ* conservation) is the ideal and most effective way to prevent extinction, there is a growing realization that complementary protection efforts outside a species' natural habitat (*ex situ* conservation) are also crucial for species' survival. A small population size or an imminent threat could render *in situ* conservation of a tree species unviable, making *ex situ* conservation the only option to prevent its immediate extinction. Storage in a seed bank is the most economic and practical way to protect tree

species, but many trees, such as oaks, cannot be stored using existing technologies. These 'exceptional' species must be housed in living collections. Furthermore, while threatened tree species are growing in living collections, experts can study how they develop, reproduce, and combat disease, and how they might respond to climate change and assisted migration efforts. The field of *ex situ* conservation by botanical gardens and arboreta (henceforth referred to as gardens) has been developing since the 1980s. Since the first International Botanic Gardens Conservation Congress, in 1985, governments and non-profit organizations have been working to stimulate greater involvement by gardens in plant conservation. Following the 1985 Congress, Botanic Gardens Conservation International was founded to support and coordinate the conservation activities of gardens worldwide. It also promotes and evaluates the progress of national and international conservation policy initiatives, such as the Global Strategy for Plant Conservation, which outlines 16 targets and the International Agenda for Botanic Gardens in Conservation. There are several resources available to guide *ex situ* conservation efforts, such as the IUCN Red List and Nature Serve threat status listings.

Article History

RECEIVED on 26th February 2023

RECEIVED in revised form 17th March 2023

ACCEPTED in final form 18th March 2023

There are databases available for searching collections of living plants, confirming taxonomic identity and exploring distribution maps. Though the resources are available, challenges to *ex situ* tree conservation still exist and much work is needed to improve the conservation quality of living tree collections in gardens. Many threatened trees are underrepresented in *ex situ* collections and genetic breadth is limited. The floral diversity in India is majorly concentrated in the 4 biodiversity hotspots, namely Eastern Himalayas, Western Ghats, Northeast India and Andaman Islands (Indo-Burma) and Nicobar Island (Sundaland), out of 36 biodiversity hotspots recognized in the world (Kong *et al.*, 2021). These floristically significant areas exhibit exceptional concentration of endemic species and also experiencing loss of habitat with higher occurrence of threatened plant species. Though the geographical area cover of the country represents about 2.4% of the world's total landmass, it harbours a total of 47,513 plant species (Arisdason and Lakshminarasimhan, 2020) out of about 0.4 million hitherto known in the world, representing as much as 11.4% of world flora. About 28% of plants that occur in India are endemic to the country (Singh, 2020). The angiosperms forms the most dominant and conspicuous vegetation cover comprising of over 18,000 species which represents more than 11.4% of the world's known flowering plant species. Out of the 511 recognized plant families 315 families with more than 4,000 genera are represented in the Indian flora of which Poaceae is the largest family with about 260 genera and more than 1200 species. Over 60 families of flowering plants are monotypic represented by just one species in India like Turneraceae, Illiciaceae, Ruppiaceae, Tetracentraceae, *etc.* Impatiens, Carex, Dendrobium, Habenaria, Rhododendron, Taraxacum, Astragalus, Saussurea, Ficus, Primula, *etc.* are some of the dominant genera of flowering plants (Pandey, 2019). About 15% species of vascular plants are of trees which include some of the highly valued timber species of the world. Species in certain groups like Orchids, Bamboos, Rhododendrons, Citrus, Hedychiums, Impatiens, Pedicularis, Primulas, *etc.* exhibit remarkable diversity in this country. The world plant species between 22% and 47% are endangered. Roughly 1/4th of all plant species in the world are at risk of being endangered or going extinct. Out of the 387 Indian plants listed under the International Union for Conservation of Nature's Red List, 77 have been enlisted as 'critically endangered', six are 'extinct' and two are 'extinct' in the wild (Sundararaju, 2020). The IUCN is an international organization working in the field of nature conservation and sustainable use of natural resources. *Ex-situ* conservation has several purposes like rescuing threatened germplasm, produce material for conservation biology research; bulk up germplasm for storage in various forms of *ex situ* facility; supply material for various purposes to remove or reduce pressure from wild collecting; grow those species with recalcitrant seeds that cannot be maintained in a seed store; make available material for conservation education and display; and produce material for reintroduction, reinforcement, habitat restoration and management. Arboretums might be a part of a botanical garden or can be planned and designed apart from botanical gardens. The

term arboretum was first coined by John Claudius Loudon in 1833, although the concept of an arboretum has been around for much longer. Arboreta, across the globe, are practicing it as a field laboratory for scientific research. It also involves in promoting conservation, and engaging public outreach and education to protect and preserve trees. It is a place for contemplation or recreation. Trees in living collections can represent diversity from different regions or from different scientific plant groups. Urban environments can cause challenges for tree growth. Arboreta share their latest research through outreach and education so cities, neighbourhoods and colleges where the dedication to preserving the beauty and ecological functions of our biodiversity hotspot.

Important Arboretum in World and India

1. Kew Gardens, London
2. Arnold Arboretum, Boston
3. Holden Arboretum, Ohio
4. Acharya Jagadish Chandra Bose Indian Botanic Garden, Kolkata
5. Chandigarh Botanical Garden & Nature Park
6. Government Botanical Gardens, Ooty
7. Tropical Botanical Garden and Research Institute, Thiruvananthapuram
8. Semmozhi Poonga, Chennai

The Arboretum promises to be a rewarding experience to visiting students especially biology students. Trees serve as part of the University's green infrastructure providing unaccounted services that improve air quality, reduce atmospheric pollutants and greenhouse gas emissions, mitigate urban heat islands, conserve energy, and contribute to offsetting climate changes along with the improvement in faunal diversity like butterflies attraction. With this view, arboreal garden established at Forest College and Research Institute, Mettupalayam which is one among the constituent colleges of Tamil Nadu Agricultural University. The plot of the arboreal garden extends to an area of 7.5 acres and maintained by the Institute as a forest ecosystem with well protected barbed wire fencing. The terrain of the arboretum is gently sloping from the road side towards the east. The arboretum was laid out based on the Bentham and Hooker classification and the species were planted at the espacement of 4 m × 4 m. The present studies carried out for over five year duration showed presence of 264 angiosperm plants belonging to 67 families and 4 gymnosperms of 2 families. A complete phytospectrum portrayed a total of 268 species belonging to 69 families. The seven dominant families are *viz.*, Fabaceae (51 spp.), Moraceae (14 spp.), Myrtaceae (17 spp.), Bignoniaceae (10 spp.), Euphorbiaceae (9 spp.), Meliaceae (11 spp.) and Combretaceae (7 spp.). Similarly dominant genera are *Ficus* (11 spp.), *Acacia* (9 spp.), *Albizia* (7 spp.), *Terminalia* (7 spp.), *Syzygium* (7 spp.) and *Eucalyptus* (6 spp.).

The Functions of Arboreal Gardens

An arboretum differs from a botanical garden in that the

emphasis is placed on the growing of woody plants in the arboretum; whereas, in the botanical garden emphasis is not placed on the growing of any particular kind of plant, but all types are grown. Large rock gardens and expensively operated rose gardens are frequently found in an arboretum or botanical garden but these are not essential parts of either.

Scientific Research

Arboreal gardens are good locations for many branches of scientific research. Arboreal gardens not only serve as taxonomic and systematic research centers, but they also play an important role as valuable sources of plant ecology data collection such as phenological indication of climate change, plant physiology and plant growth tactics, and plant animal interactions. Arboreal gardens can provide a large set of species to study functional trade-offs between species traits and plant performance. Arboreal gardens are suitable locations for investigations into pollination ecology, seed dispersal, plant conservation genetics and naturalization of alien species.

Conservation and Utilization

The conservation of living plants in gardens, especially of species that are threatened in the wild, has a long tradition and has greatly contributed to our understanding of threatened species. *Ex situ* conservation is defined as the conservation of components of biological diversity outside their natural habitats. *Ex situ* conservation, which plays an important role in saving threatened plant species, is generally associated with botanical gardens. One of the major objectives of arboreal gardens is to create and support collections of native taxa, and to build and maintain stocks of plants for *ex situ* conservation and sustainable utilization of plant resources in the world. A basic framework for integrated plant species conservation in a botanical garden includes identification and management of threats, long-term *ex situ* and/or *in situ* germplasm storage, research and development information management, horticulture and living collections, conservation priorities, and environmental education.

Education

In Arboreal gardens collections of plant are displayed according to families, genera or habitats and can be used for instruction or demonstration purposes. Arboreal gardens also provide information to public about identification of native and exotic plant species, methods of propagation and supply plant materials for educational purposes.

Aesthetic Appeal

As arboreal gardens harbor large collections of native and exotic plants, they have an aesthetic appeal. They attract large number of visitors for observation of general plant diversity as well as exotic and curious plants.

Conclusion

This arboreal garden thus plays a key role in *ex situ* conservation along with educating people about the importance of species existing in these gardens. The arboretum also helps in conducting research studies on the threatened species and may also lead to an understanding of the reasons behind the population decline in natural habitats. The multiplication of the threatened plants and its planting in natural habitats could be one of the ways by which the plant populations could be prevented from extinction in the natural habitats in a sustainable manner.

References

- Arisdason, W., Lakshminarasimhan, P., 2020. Status of plant diversity in India: An overview. ENVIS Centre, Ministry of Environment & Forest, Govt. of India. Available at: http://www.bsienvi.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx. Accessed on: 24th February, 2023.
- Kong, X., Zhou, Z., Jiao, L., 2021. Hotspots of land-use change in global biodiversity hotspots. *Resources, Conservation and Recycling* 174, 105770.
- Pandey, R., 2019. Plant diversity in India - Role in economic development: A Report. *International Journal for Research in Engineering Application & Management* 4(10), 154-157. DOI: 10.18231/2454-9150.2018.1300.
- Singh, S., 2020. Floristic diversity of India - An overview. *International Journal of Biological Research and Development* 10(2), 25-34.
- Sundararaju, V., 2020. India must protect its rare, unique and endangered plants and trees. Down to Earth. Available at: <https://www.downtoearth.org.in/blog/wildlife-biodiversity/india-must-protect-its-rare-unique-and-endangered-plants-and-trees-72063>. Accessed on: 1st March, 2023.