

Case Study

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Ficus Tree Transplantation at the Longest Distance in Rajasthan, India by Forest Department

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ABSTRACT

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Trees and Forests provide essential ecosystem services, health-related, economic and social benefits to people, but infrastructure expansion often necessitates the removal of established trees. Transplantation offers a sustainable alternative, allowing the conservation of mature trees while accommodating urban development. This study presents a successful case of transplanting a *Ficus benghalensis* tree of height 15.2 meters over an unprecedented road distance of 225 km in Rajasthan, India. We discuss the methodologies, challenges, and post-transplantation care that ensured the tree's survival. This case contributes to urban forestry by demonstrating the feasibility of large-scale tree relocation as a conservation strategy for heritage and ecologically valuable trees in urban landscapes. This article reviews the successful story of the longest distance tree transplantation for the huge *Ficus benghalensis* in the world.

Introduction

History and present status of tree relocation/transplantation

Tree transplantation has been practiced since ancient times, with records dating back to 2000 B.C. Egyptians translocated large trees to Egypt from far away locations using ships (Campana *et al.*, 1999). In 1869, Engineer John Y. Culyer designed two large, horse-drawn "tree moving machines". This innovation enabled the transplantation of approximately 600 trees, each with a circumference of around five feet, from the construction site of Prospect Park in Brooklyn, New York, to alternative locations (Landmarks P. C. *et al.*, 1975).

In India, the protection of trees outside forest areas is governed by specific legislation, including the Delhi Preservation of Tree Act-1994, and Tree Transplantation Policy -2020 of the Government of Delhi. However, these laws are not uniformly enforced across different states. Notably, as early as 1972, the Delhi government translocated 25 trees from Zakir Hussain Marg and Moti Bagh to Pragati Maidan, New Delhi (Hindustan Times *et al.*, 2019).

In Karnataka, India, Forest Department, transplanted a total 457 trees of fourteen species. However, the survival rate of species such as *Azadirachta indica*, *Aegle marmelos*, *Zizyphus* species and *Eucalyptus* was zero. While the survival rate of *Ficus benghalensis* (Bargad)

was 95%. All the transplanted trees belonged to a girth class below 70 cm, except four *Ficus benghalensis* and one *Ficus religiosa*, which were 1.0 to 1.5 meters respectively in girth. All these five trees showed healthy growth post transplantation (Kshirsagar *et al.*, 2018).

Indian Council of Forestry Research Education (ICFRE) has been assigned the task by the Ministry of Environment Forest and Climate Change (MoEF&CC) for conducting survey on the best technological solution for the different types of trees and their suitability for tree transplantation. Forest Research Institute (FRI), Dehradun requested 17 States and Union Territories to share practices and technologies used by them for tree translocated. Data received from 12 States and Union Territories yielded key results. First, the survival of trees with a diameter of above 70 cm was found to be significantly lower in comparison to the trees of lower diameter class. Second, the maximum distance of relocation was 78 kilometers by Ahilyaganj Forest Block, Mathura, Uttar Pradesh. Third, the total height of tree after relocation is not mentioned because as per normal practice tree was cut/chopped/topped at certain height (Silviculture *et al.*, 2021).

During 2009-2010 Gujrat Forest Department, India translocated 2850 trees of 35 species; during 2016-17 Gadag Forest Department and District Administration, Karnataka, India translocated around 500 trees of 14 species; during 2017 Ranchi Industrial Area Development Authority, Ranchi, Jharkhand, India translocated 128 trees; During 2018-19, more than 400 trees translocated at Gorewala International Zoo and Rescue Centre, Gorewala, Maharastra, India; during 2016 around 30 trees translocated from Pollachi-Coimbatore highway to nearby government premises. In all the cases, the distance of tree translocation was not more than 20 kilometers approximately (Kumar *et al.*, 2022).

Internationally, one of the most extraordinary feats of tree transplantation occurred in Perth, Australia, where a mature *Boab* tree (*Adansonia gregorii*), estimated to be 750 years old and weighing approximately 36 tonnes, was relocated over 3,200 kilometers from the Kimberley region to Kings Park, Western Australia. The tree was transplanted to make way for the construction or realignment of the Great Northern Highway in Kimberley, Western Australia. This transplantation, completed in July 2008, is recognized as one of the longest distances over which a tree of such magnitude

has ever been successfully transported. The transplanted ancient boab tree is known as Gija Jumulu. Gija refers to the Gija people, the traditional owners of the land where the boab tree originated from in the East Kimberley, Jumulu means boab tree in the local language. The project not only required specialized engineering and logistics but also highlighted the cultural and ecological significance of preserving heritage trees (Courtney *et al.*, 2010).

Need of Tree Transplantation

Trees provide plenty of ecological, health-related, economic and social benefits (Singh *et al.*, 2023 & Logesh *et al.*, 2023). Urbanization, road widening projects and development projects i.e. Solar panel establishments, grand factories, airports, mines and mineral projects in many parts of the country lead to the removal of various flora and a large number of huge and old trees every year. This extensive tree loss not only disrupts ecosystems but also results in a significant loss of stored carbon that has accumulated over long periods—often spanning several decades to over a century. The removal of mature trees releases substantial amounts of carbon dioxide back into the atmosphere, contributing to climate change. Compensatory afforestation may take decades, if not a century, to replace this amount of lost carbon (Lewis *et al.*, 2019). To stop and minimize this detrimental trend the concept of transplanting trees between sites is gaining momentum. Tree transplantation process involves great engineering and arborist skills accepting collective teamwork and resources.

Recognizing the importance of preserving trees, the Tree Transplantation Policy (TTP), 2020 was approved by State Cabinet, Government of the National Capital Territory of Delhi (Government of India *et al.*, 2020). As per TTP- 2020, a minimum of 80% affected trees from all development projects, must be transplanted scientifically. As per the para - 7 of TTP - 2020 Department of Forest & Wildlife, Government of NCT of Delhi, New Delhi issued an order about the list of impanelled agencies for tree transplantation in Delhi (Government of NCT *et al.*, 2021).

A notable case of tree transplantation occurred in Hanumangarh, Rajasthan, where the Municipality of Hanumangarh, under Department of Local Self Government (LSG), Urban Local Bodies (ULB), Government of Rajasthan proposed the development of a

resident colony. The planned plots were intended to be sold or auctioned but a mature *Ficus benghalensis* (*Bargad*) tree stood on one of the plots designated for sale. Owing to its religious value, people protest for the removal of the tree. As a result, it was decided to transplant the tree. Therefore, then Principal Chief Conservator of Forests and Chief Wildlife Warden, Jaipur, Rajasthan, Mr. Arindam Tomar ordered to then Deputy Conservator of Forests (Wildlife) Bikaner Dr. Sunil Kumar Gaur to relocate the Bargad tree at under constructing site of Marudhara Biological Park Bikaner (Rajasthan).

Tree and Sites specifications

The height and Girth at Breast Height (GBH) of transplanted *Ficus benghalensis* (banyan) tree were 15.2 meters and 2.89 meters respectively at time of relocation.

The mother site of the tree was in Hanumangarh, Rajasthan, India, with geographical coordinates 29°36'59.87"N and 74°17'49.21"E. The tree was transplanted to Marudhara Biological Park in Bikaner, Rajasthan, India, located at 28°07'03.95"N and 73°21'16.67"E. Given the substantial environmental and climatic differences between the mother site and the transplantation site, a comparative analysis of atmospheric conditions between these locations provides critical insights into the adaptability and long-term survival prospects of the tree in its new habitat.

The road distance and aerial distance between the mother site and the transplanting site of the tree are 225 km and 190 km respectively, which is the longest tree transplantation distance of a huge *Ficus benghalensis* tree in the world.

Materials and Methods

Season of transplanting

The timing of tree transplantation plays a crucial role in ensuring the survival and healthy establishment of the transplanted tree. Ideally, trees should be transplanted just before the onset of the growing season, during the dormant stage of the plant. Winter and rainy seasons are generally not suitable for tree transplantation. The most appropriate time for tree transplantation is just 5-10 days before the onset of the spring season (*Vasant/Basant Ritu*) or the first fortnight of the spring season. Therefore,

Ficus benghalensis tree was lifted from Hanumangarh on 14 February 2022, arrived at Bikaner on 14 February 2022 at around 10 p.m. and relocated/transplanted at Marudhara Biological Park, Bikaner on 15 February 2022.

Treatment of Destination/transplanting site/replanting site/pit

Pit Size: - The dimension of the pit can be determined by the depth and firmness of the root ball. In general, the dimensions of the pit should be 1.5 times the dimensions of the root ball or pit must have at least two to three feet extra space in the pit after placing the root ball of the replanting tree.

Preparation of pit: - Tree roots will not tolerate highly compacted, infected, mal-nutritional, dried-rough, and foreign soil. So, pit should be treated with proper sunlight, anti-fungal/anti-bacterial/anti-termite, dung slurry, organic manure, vermi-compost, Farm-Yard-Manure, mother soil/fertile soil, and moisture. These things provide very comfortable root surroundings.

To provide comfortable root zone, following procedure was adopted: - Pit was dug seven days before and the dimension was 3 meter (width) × 3 meter (length) × 3.5 meter (depth). Pit was left untouched for three days to absorb maximum sunlight.

On the fourth day approximately 60 cm thick layer of forest soil was spread in the pit and started watering twice in day with anti-bacterial/anti-fungal water solution.

On fifth day approximately 30 cm thick layer of a mixture of two years old goat manure and well-treated particle soil is spread in the pit and watered twice in day with anti-bacterial/anti-fungal water solution.

On sixth day approximately 15 cm thick layer of two years old goat manure was spread in the pit and watering twice in day. Now, the 3.5 meters deep pit has become around 2.5 meter deep.

Treatment of tree at source site before translocating

The soil surrounding the tree should be full of moisture before the lifting of the tree. This will help to soften the

soil so that trees can be lifted easily. Therefore, two days before area below the tree was cleaned, and we provided adequate watering to the tree. On the next day two-foot-deep trench was dug around the bole of the tree at a distance of six feet from the tree trunk. On morning of the 14-02-2022 trench was deepened two feet more and filled with water. The tree was bathed so the tree could attain moisture and can tolerate the shock.

Lifting of tree from Hanumangarh and transporting the tree to Bikaner

Before lifting of tree the soil must be loosened. Tree trunks should be properly tied with strength enough ropes and chains, provided that trunk must not be damaged due to ropes and chains. Moisture must be retained by the tree and must be protected from the heat sock during the whole journey.

The tree was worshiped by the local people due to their religious beliefs before the lifting of the tree. Local people religious faith, awareness to save the old & big tree and public outrage are the main reasons of transplanting the tree.

Owing to above cause local administration also helped to Bikaner Wildlife Forest Department at Hanumangarh. Local people did not allow the pruning of the tree due to their religious faith, so the tree was not pruned at Hanumangarh.

One JCB (Joseph Cyril Bamford) Machine, two hydro crane machines, one water tank of the fire brigade and one truck trailer (RJ O7 GD 6602) were used in lifting, watering, bathing and transporting the tree. The tree is lifted up in the air and then laid to a sleeping position with its root facing towards the engine of the truck trailer. Root was covered with the mother soil and the whole root ball was covered with tarpaulin. The extra mother soil was also collected from the site to fill the transplanting sites of pit.

The tree was tightly fixed on the truck trailer, several cushions were also used to save the tree from jerk and injury. The vehicle was moved at a very slow speed to avoid any jerks, mishaps or accidents. As the distance between Hanumangarh and Bikaner is very long as 225 km, so to retain moisture, the tree was bathed after every 60-75 kilometers journey. The tree was fetched to Marudhara Biological Park, Bikaner around 10 pm on dated 15-02-2022.

Treatment and placement of the Bargad tree into the pit at Marudhara Biological Park, Bikaner

On the morning of 15-02-2022 tree was bathed. Some extra side branches of the main trunk were pruned to avoid extra evaporations of water and to avoid the dehydration of the tree. Cutting place of tree was coated with wax to avoid the cracks and extra evaporation. Top soot and branches remain uncut/untouched/unchopped to retain the same height of the tree before and after the transplanting of the tree.

The pit was watered and mother soil fetched from Hanumangarh spread in the pit of 50 cm height and then approximately 10 cm layer of two years old goat manure spread in the pit.

The tree was erected slowly with the help of two hydro cranes and JCB. commercially available rooting hormone containing Indole Butyric Acid (IBA) and organic growth promoters derived from *Avena sativa*, *Agave americana*, and *Adenium* was applied to stimulate root development and improve post-transplantation survival. Then, the tree was lowered into the pit and placed perpendicular to the ground at the centre of pit. A plastic pipe was placed into the root ball to use in the future for any treatment of the tree as required. Mother soil fetched from hanumangarh poured on the root ball into the pit. Soil around the trunk of tree was properly compressed and planed. *Thanwala* of tree was prepared and the watered the tree.

Post transplanting care of the tree

After transplanting a tree, the first year look after is very important for the tree. Monitoring and looking after of first year's harsh climatic conditions like extremely hot days, *loo* (hot dried wind during summer), extreme cold days, new climatic conditions are very crucial for the survival of the tree because during this period tree adjusts itself to face the new adverse circumstances and settle accordingly.

Weeding out, watering, and hoeing are carried out regularly. The tree was bathed daily before 11 a.m. to control the temperature up to the rainy season (05 July 2022). Green nets were put all around the tree and covered with dry bushes such as *Laptadenia pyrotechnica* (*Khimp*) wrapped around the trunk to protect the tree from the scorching heat, extreme cold, and loo.

Fig.1 (A) Initially tree at Hanumangarh, Rajasthan, (B) Finally at tree Bikaner, Rajasthan

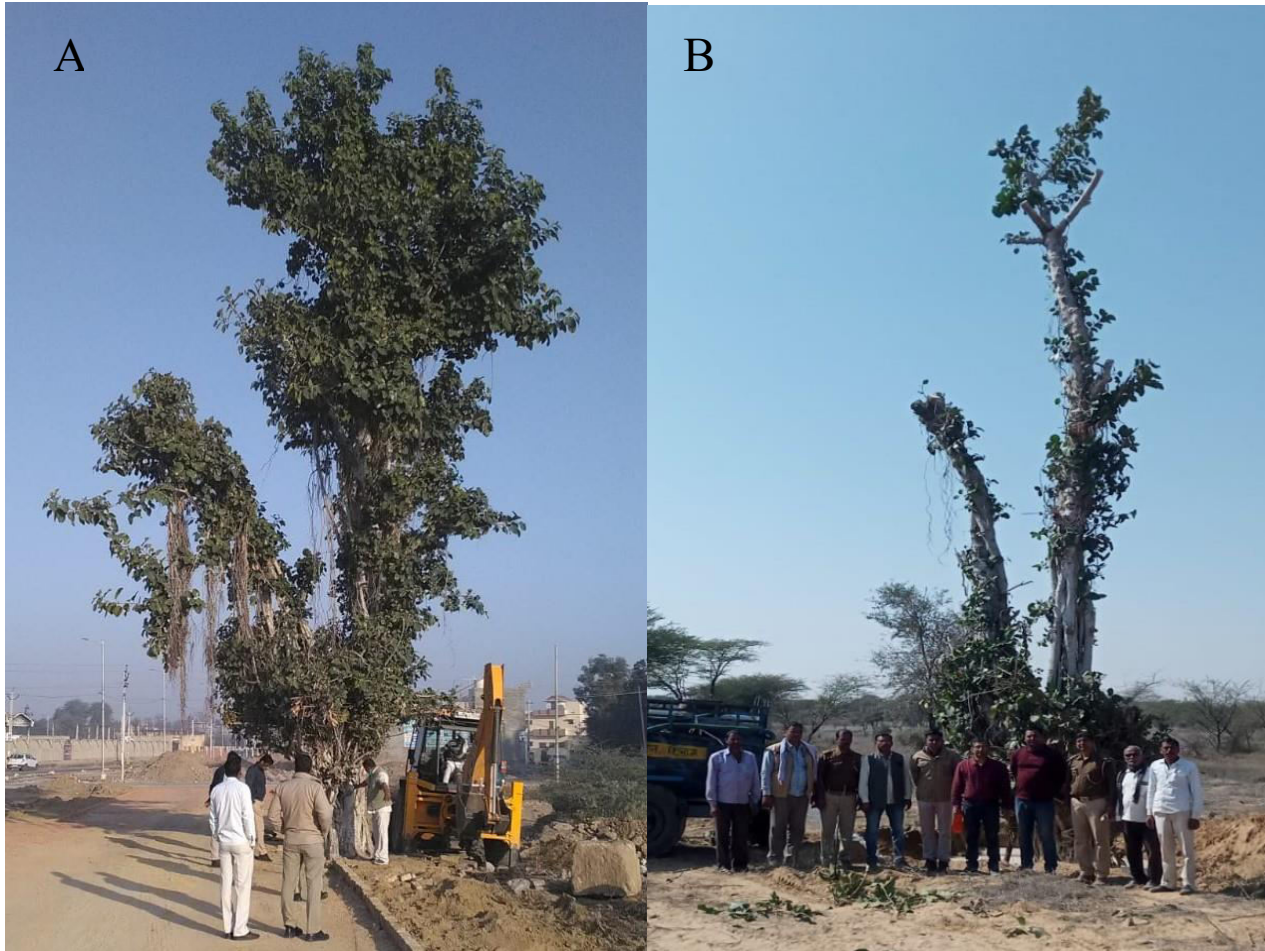


Fig.2 Google Earth image of the Ficus tree locations before and after tree transplanting

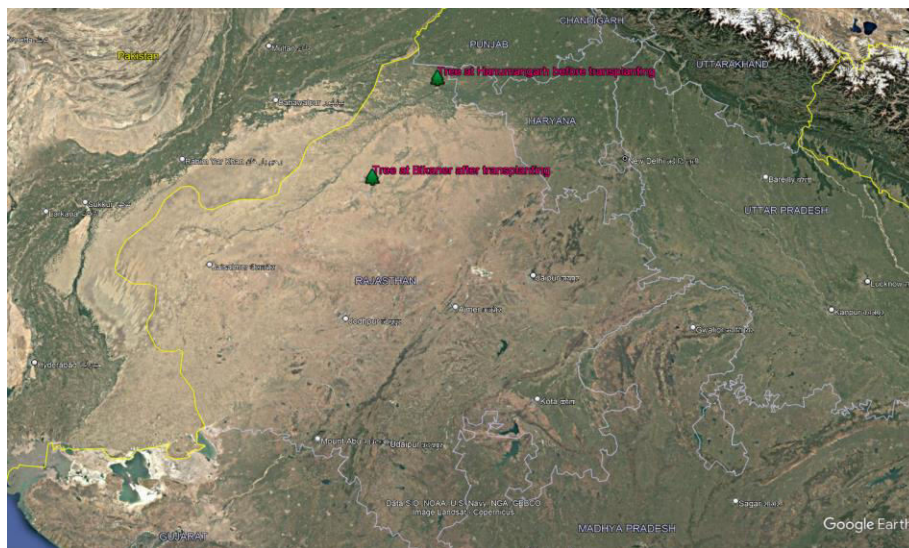


Fig.3 Pit preparations at transplanting site



Fig.4 Preparing *Ficus benghalensis* tree (on dated 14-02-2022) before lifting from Hanumangarh, Rajasthan



Fig.5 Tree is loaded on trolla (truck)



Fig.6 Sequential stages of fixing the *Bargad* (*Ficus benghalensis*) tree on 15-02-2022 at Marudhara Biological Park, Bikaner, Rajasthan — (A) lifting with cranes, (B) lowering into the pit, (C) positioning and fixing and (D) stabilization with soil using excavators.

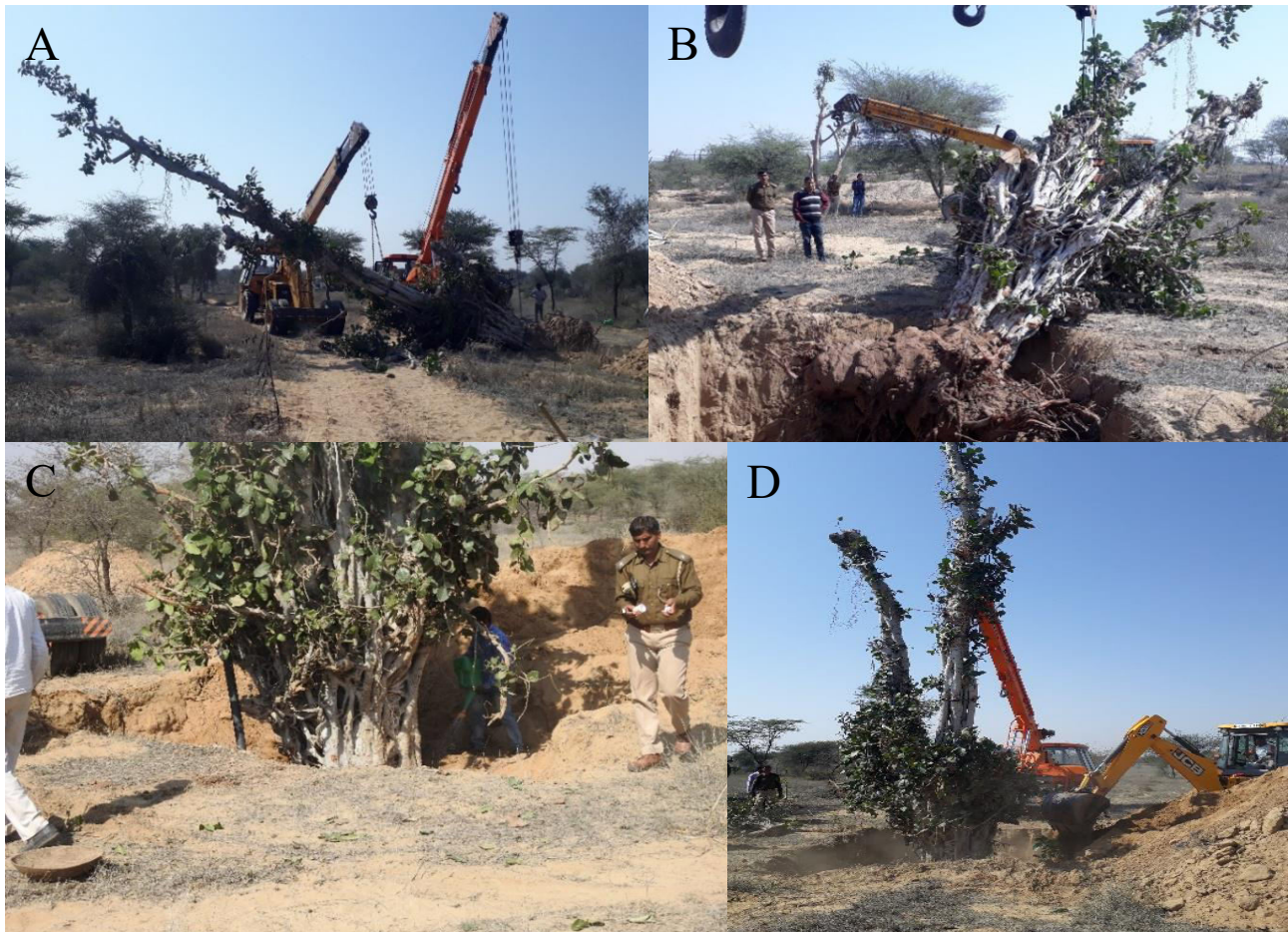


Fig.7 Recovery and growth progression of the transplanted *Ficus benghalensis* tree at Marudhara Biological Park, Bikaner from 17 February 2022 to 25 December 2025. The sequence shows post-transplant stabilization, bud emergence, leaf flush and canopy development over the time.

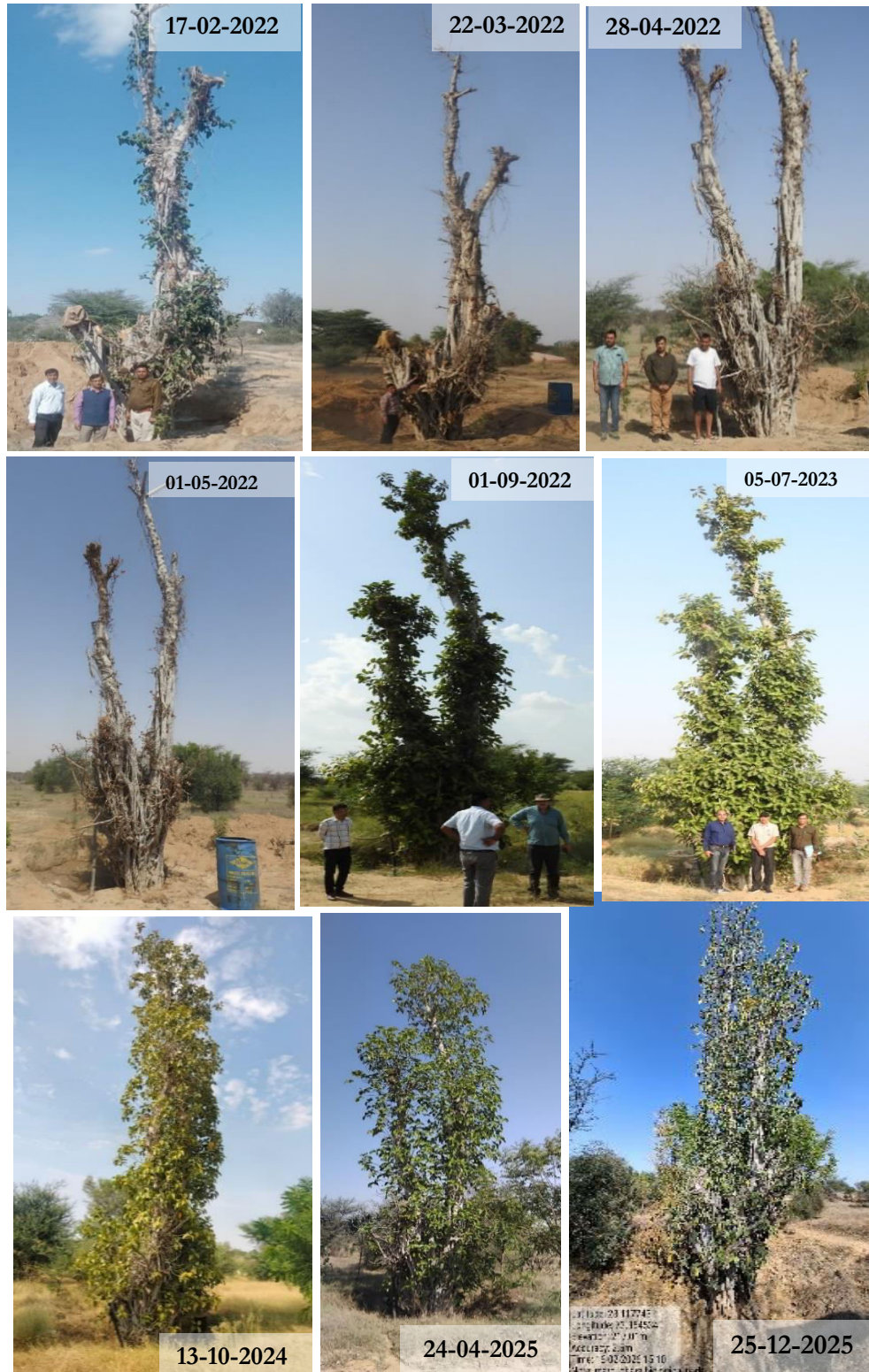


Table.1 Comparable climatological conditions between sites acquired by India Meteorological Department (IMD).

City	Average annual rain fall	Average rainy days	Maximum Temperature	Minimum Temperature	Average Temperature
Hanumangarh	295 mm	15	45.3 °C	4.3 °C	25.4 °C
Bikaner	229 mm	19	47.0 °C	7.4 °C	28.1 °C

Smoke was also used to save from extreme cold during the last fortnight of November – December – the first fortnight of January. Installed plastic pipe is also used to provide root hormones, anti-fungal treatment to the tree. By regular looking after, inspections, and by motivating staff, the tree survived successfully.

In conclusion, Forest Department Rajasthan successfully transplanted a *Ficus benghalensis* tree of height 15.2 meters and Girth at Breast Height (GBH) 2.89 meters from Hanumangarh (mother site) to Marudhara Biological Park (transplanting site) Bikaner, Rajasthan, India.

The road distance and aerial distance between the mother site and the transplanting site of tree are 225 kilometers and 190 kilometers respectively; which is the longest distance tree transplantation for the huge *Ficus benghalensis* in the world.

The success of this transplantation underscores the potential of tree relocation as a viable conservation strategy within the framework of urban forestry, climate resilience, and biodiversity conservation. As cities expand, the need to integrate large-scale tree transplantation into urban planning becomes critical for achieving carbon sequestration goals, mitigating urban heat island effects, and preserving native tree species. Future policies should prioritize standardized transplantation techniques, improved survival rates, and enhanced post-transplantation monitoring to ensure that urban forests continue to thrive amid rapid development. This case study highlights the importance of scientific planning, technological advancements and community participation in securing a greener and more sustainable future.

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Author Contributions

Sunil Kumar Gaur: Investigation, formal analysis, writing—original draft.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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