

Conservation biology of *Tamarix indica* an endangered species of Agra region

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Abstract

Tamarix indica operates as an endangered species throughout Agra because habitat destruction and actions by humans and climate fluctuations put the species at risk. This research evaluates *T. indica's* ecological significance by studying its distribution zones and identifies the barriers that prevent its conservation. *Tamarix indica* (Tamaricaceae) produces flowering canopy from July to September in the Agra ecological region and takes the form of an evergreen tree or bush. Each flower of *Tamarix indica* contains bisexual reproductive parts and grows from racemose inflorescences. The petals of the flowers are immensely short and contain a bracteate calyx with 4-5 obovate lobes which are scabrous. Each of the four to five obovate petals displays reddish-purple coloration and infringed edges along with a small notch at their tips. The stamens exist in 4 to 12 numbers arranged in two series where they grow close to the nectary disc. The cone-shaped ovary develops numerous ovules which rest on a base portion of the ovary wall during placentation. The stigma shows a 3-4 lobed shape that ends in a capitate structure. Inside the capsule of *Tamarix indica* are many seeds. The primary method of pollination exists as entomophilous activity which gets executed mainly through honey bees. The area surrounding Taj Mahal city in Agra where urbanization coexists with fragmentation has inhibited pollinator migration which leads to decreased reproduction success along with endangering the species into extinction in the region. *Tamarix indica* functions as an ecosystem stabilizer because it sustains biodiversity and decreases water loss according to this research study. Population studies in the field and through ecological evaluations have discovered a decrease in the population which proves the immediate need for conservation activities. The document presents vital conservation approaches which combine habitat restoration and ex-situ conservation and community engagement to defend this essential species from becoming extinct. The study data indicates that successful sustainable conservation depends on both scientific methods and policy-backed support.

Keywords: *Tamarix indica*, Conservation biology, Endangered species, Habitat restoration, Agra region, Ex-situ conservation, Biodiversity conservation

Introduction

The Indian Tamarisk (*Tamarix indica*) functions as an essential woody plant which delves into ecological functions in arid and semi-arid zones. Through its primary function *Tamarix indica* contributes to soil erosion prevention as well as groundwater retention alongside biodiversity maintenance. The species now faces critical dangers from habitat loss together with excessive harvesting practices combined with climate change conditions that resulted in its endangered position in the Agra region. Global concern of foreign plants about deforestation and degradation of ecological communities makes floral biology an important area field of conservation Protection and conservation species requires research (Ratheke and Jules, 1993) [3], nation of endangered plant a detailed knowledge of floral biology of endangered species to be conserved Present (Sedgley and Griffi Paper Griffin, 1989) [4], with the study morphology of *Tamarix indica*, an endangered species of Agra region in relation to its conservation. The study examines the

numerous reasons that cause population decreases while developing preservation methods for its lasting management.

Ecological Significance of *Tamarix indica*

The ecosystem at riparian areas and saline regions heavily relies on *Tamarix indica* plants. *Tamarix indica* stands out because it can survive both dry conditions and high salt levels which makes it an excellent choice for restorative ecology work. The plant contributes to:

- Through its presence the soil performs two functions which include stabilizing riverbanks and protecting soil from erosion.
- The plant helps sustain groundwater levels because of its water retention capabilities which decrease soil water loss due to evaporation.
- Biodiversity Support: Provides habitat and food for various birds, insects, and small mammals.



Fig 1: *Tamarix indica* at different places

Materials and Methods

Scientists investigated how *Tamarix indica* flora grows throughout the different locations of Agra's Keetham Runkata Bichpuri region. Flowering phenology researchers observed marked trees in the population numerous times across different seasons throughout a year. Shivanna and Rangaswami (1992) [5] provided the methods for analysis of floral morphology and floral biology. Scientists recorded pollinators systematically along with their population numbers and observed their frequencies of visiting the flowers.

Factors leading to endangerment

Various human activities along with environmental elements have caused *Tamarix indica* populations to decrease in the Agra region.

- Expansion of agricultural land together with infrastructure projects and deforestation activities have caused the disappearance of habitats.
- People have cut down vast numbers of *Tamarix indica* trees for medical applications and timber together with fuelwood purposes which has caused its numbers to drop dramatically.
- Climate Change together with increasing temperatures and change in soil salinity and erratic rainfall patterns causes negative impacts on *Tamarix indica's* ability to grow naturally and restore itself.
- The competition against invasive plants from different species has damaged its natural habitat and reduced both seed survival probabilities and seed germination rates.
- The habitat has suffered degradation because of industrial together with agricultural pollution that is most intense along riverbanks.

Conservation strategies

A comprehensive strategy needs implementation to maintain *Tamarix indica* survival.

1. In-situ conservation

- The establishment of conservation zones across Yamuna River territories and natural domains forms part of protected areas and reserves.
- Sustainable Land Management entails the practice of eco-friendly agriculture alongside afforestation methods which preserve ecological stability.
- Community Participation: Involving local communities in conservation efforts through awareness programs and sustainable resource management.

2. Ex-situ conservation

- Botanical Gardens and Seed Banks: Establishing seed banks and nurseries for *Tamarix indica* propagation.
- Tissue Culture and Genetic Conservation involves creating propagation methods by utilizing tissue culture for protecting genetic variety while increasing plantation scale.
- The government along with NGOs should organize large-scale plantation efforts as a part of reforestation programs.

3. Policy and legal measures

The implementation of laws will protect *Tamarix indica* habitats from destructive environmental practices.

- The law requires Environmental Impact Assessments as a necessary step for any developmental project which involves *Tamarix indica* habitats.
- Sustainable Harvesting Guidelines should establish controlled harvesting practices which stop over exhausting resources.

4. Role of research and technology

- The implementation of scientific research along with technological progress makes conservation work feasible.
- Satellite data paired with GIS Mapping supports the monitoring process of *Tamarix indica* distribution changes

by providing remote sensing capabilities.

- Genetic Studies: Understanding genetic diversity for better breeding and conservation programs.
- Analysis of water resources along with examination of soil salinity helps researchers develop proper conservation plans.

Results and Discussion

Study sites and population density

Tamarix indica from the Tamaricaceae family shows up as a tree which possesses slender branches arranged in a feathery fashion. *Tamarix indica* displays pinkish-purple flower blooms during rainy season July–September that welcome pollinators consisting of honeybees and butterflies.

Tamarix indica flourishes throughout dry habitats and populates three locations of the Agra territory: Keetham, Runkata, Bichpuri and along the Yamuna River and in extensive saline grounds.

Floral morphology

Each raceme of *Tamarix indica* contains tiny flowers with an average size of 4 ± 0.2 mm. The flowers appear purplish-pink and contain two bracteates as well as bisexual characteristics. The calyx holds between four to five green prolonged sepal shapes with lobed features. The two petals of *Tamarix indica* exhibit obovate shape and have purplish-pink colours. Four to twelve stamens extend in two groups and locate near the nectar producing disc. The ovary has a conical shape while multiple ovules develop from its base with parietal placentation. The stigma has 3–4 sections along with a capitate structure. Many tiny seeds (about 1 mm each) contained inside the capsule are equipped with small hair tufts that serve as wind-dispersal agents. A seed dispersal mechanism by water exists.

Pollination

Tamarix indica depends on insects for pollination because its reproductive strategy is described as entomophilous. The pollinators *Apis indica* along with halictid bees and *Micropis florea* butterflies and others primarily visit new flowers to gather pollen. Insects travel to the flowers continuously but show their highest level of activity in the morning under cloudy conditions. The pollination function of hoverflies is more effective than beetles despite their visual resemblance to bees and wasps. The flowering environment attracts sunbirds to join the insect population although they rarely show themselves compared to other flying visitors.

This study demonstrates that *Tamarix indica* fruit formation depends on how densely the population grows together with the extent of pollinator visits and the seasonal weather patterns especially during the rainy months. Regular maintenance of *Tamarix indica* by both plant cutting and disturbance of native vegetation stems disrupts the normal functioning between plants and their pollinators. The ecological systems remain disrupted by these disturbances thereby threatening the survival of this species to extinction. The plant *Tamarix indica* serves vital social-economic purposes because it acts as an essential biological maintenance element (Sedgley and Griffin, 1989) [4].

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Agricultural regions of the Agra district have been using *Tamarix indica* as a shelter tree due to its tolerance of drought conditions and salt damage. Human activities which involve clearing natural habitats by building farms and developing urban areas and overusing resources create serious threats to the continued existence of this species.

The study provides essential information about *Tamarix indica* adaptations together with its ecological significance while underlining the requirement for ecosystem balance protection (Draber *et al.*, 1998; Dal, 2013). The achievement of conservation objectives for threatened species demands intense research to be carried out in this field (Marbaniang *et al.*, 2018; Marbaniang and Venugopal, 2015) [2, 1].

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