

Prosopis juliflora – A Myth and Reality to the Current Development Scenario in Tamil Nadu

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ABSTRACT

Invasion of Prosopis juliflora augmented positive and negative impact on rural communities of Tamil Nadu. Even though it has been introduced for soil reclamation and fire wood in Tamil Nadu, its spread through the deep root system, high water use efficiency, Allelopathy effects have scored higher significant towards the eradication in Tamil Nadu. In the present study was to identify the spread and impacts of Prosopis juliflora on rural communities and their mythological aspects towards the Prosopis juliflora. The investigation shows that, it has dominated the drier parts of Tamil Nadu and extending towards the irrigated area because of poor management and seven myths viz., Invasive species through abundant seed production, Depletes water table through Root Development, Sterility problems due to consumption of pods, Negative biotic associations, Reduce soil fertility, Allelopathy and Restricted utilization except fuelwood were identified which are prominent among the rural livelihoods and discussed briefly.

Key words: *Prosopis juliflora, Invasive species, Ground water depletion, Allelopathy, Deep root.*

INTRODUCTION

Prosopis juliflora was declared as Royal plant and special protection was given while introducing into the state of Jodhpur in 1940. The main aim of the introduction of *Prosopis juliflora* was to reclaim the saline and alkaline soils and extending the utility as firewood. In spite of that *Prosopis juliflora* is used for the varied utility. It includes fuel wood, charcoal production, light construction work, furniture industry, Honey production, Tannin, Dye, medicine and biocontrol agent for pest and diseases.

Prosopis juliflora has the positive as well as negative impacts on the rural

livelihood. In the positive side, wood is a good source of fuel and charcoal, pods of this species rich in sugar, protein and carbohydrate and act as a source for livestock populations. They also fix nitrogen in the soil. Their leaf extracts act as the biocontrol agent. *Prosopis juliflora* reclaims the problem soils and convert into more productive soils. Besides these positive impacts, it also has negligible negative influences on the rural livelihood. Present study envisages the invasiveness and mythological impacts of the *Prosopis juliflora* on society in Tamil Nadu.

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Invasiveness

The Mexico origin of Mesquite (*Prosopis juliflora* var. *juliflora*) was initially introduced to Sindh province of India in 1857¹⁴ and spread to rest of the states. In 1877, *Prosopis juliflora* seed was received and it was sown in Andhra Pradesh¹⁷. In course of time, *Prosopis juliflora* was introduced into Rajasthan in 1913 (Muthana and Arora) and further seeds were supplied to other neighbouring states for introduction and cultivation. Now, it is widely distributed throughout India except Jammu and Kashmir, Himachal Pradesh, Sikkim and Arunachal Pradesh.

For the invasion of *Prosopis juliflora*, there are three schools of thought which substantiate the spread and succession of *Prosopis juliflora* in the native range as well as in the introduced geographical distribution.

Three main schools of thought

The first is natural invasions proposed by ecologists² who suggested that *Prosopis* created the 'islands of succession' in the initial establishment in an arid land. These 'islands' provide ameliorated conditions which aid the establishment of an increasing number of plants, and the ecosystem will stabilize over time.

The second sets of theories are by weed scientists, who state that *Prosopis* is just one of many weedy species that have a competitive advantage over native plants and require eradication or control²¹.

The third theory states that woody legumes have a competitive advantage only in ecosystems where soil nitrogen levels are very low¹⁰ and management interventions should be aimed at minimising the nitrogen harvested as forage, and increasing soil fertility, which will reduce the competitive advantage of *Prosopis* over other species.

Mythological Impacts

The prevalent myths about the *Prosopis juliflora* have created the positive and negative impacts on rural livelihoods. In the current development scenario in Tamil Nadu caused the total eradication of *Prosopis juliflora* based on the Myth without knowing its reality in scientific manner. The Myth and realities of *Prosopis juliflora* are discussed below.

1. Invasive species through abundant seed production
2. Depletes water table through Root Development
3. Negative biotic associations
4. Reduce soil fertility
5. Allelopathy

1. Invasive species through abundant seed production

Reality

Prosopis juliflora is an invasive species but not due to abundant seed production because the seed production is very low in *Prosopis juliflora*. The study by De Oliveira and Pires⁶ estimated that 129 mature fruits would be produced out of 10000 *Prosopis juliflora* flowers. It shows an efficacy of 1.29% in flower to fruit production.

A long term study in northern India found *P. juliflora* as the pioneer species in denuded or abandoned ravines⁵. It proceeded to colonize rapidly, with cover increasing in year two, three, four, five and ten after initial establishment, from 1-5%, 5-15%, 10-20%, 20- 50% to 35-90% respectively. It dominated sites under severe biotic and edaphic conditions.

2. Depletes water table through Root Development

Reality: *Prosopis juliflora* uses the deep tap root to search the ground water and lateral root for the use of infrequent rainfall. Due to the presence of deep tap root, the water table in the *Prosopis juliflora* invaded area is low as compared to land uses like grassland, pasture lands.

The study by Dzikiti *et al.*⁹, investigates the water relations, effects of tree clearing, and the seasonal dynamics of groundwater use by an invasive *Prosopis* stand by comparing *Prosopis* stand with the cleared area. Transpiration rates were reduced by adopting structural and physiological adaptations to the low rainfall and low water holding capacity of the soils through developing narrow sapwood areas and by closing their stomata. The trees abstracted groundwater as evidenced by the decline in borehole water levels in the *Prosopis* stand

when the trees were transpiring. Groundwater savings of up to 70 m³/ month could be achieved for each hectare of *Prosopis* cleared.

3. Negative biotic associations

Reality

In respect to plant associations, *Prosopis juliflora* has a Negative influence on Native species. Even though it has the negative effect; it can allow the certain species to grow in the affinity of *Prosopis* invaded area. On the other hand, *Prosopis juliflora* has the negative faunal associations lead to the changing of the habitat and threatening the faunal diversity.

Plant association

Plant associations vary through the native range of the *P. juliflora* but some common genera are observed. The native range covers a large geographical area along the Pacific coast from southern Peru to Mexico. Besides *Capparis spp.* and *Cordia spp.*, five woody legume genera are common associates of the *P. juliflora*; *Acacia*, *Caesalpinia*, *Cercidium*, *Parkinsonia* and *Pithecellobium*. Several species of these genera are widespread throughout the range of other American *Prosopis* species. While *Acacia spp.* are found at all altitudes, other associated species appear to dominate at certain altitudes, such as *Cercidium spp.* and *Parkinsonia aculeata* at low altitudes and *Caesalpinia spp.* and *Pithecellobium spp.* at higher elevations¹⁶.

Faunal association

The study by Chandrasekaran *et al.*⁴, shows the Negative impact of *P. juliflora* on nesting success of birds in Vettangudi Bird Sanctuary, which comprises three village ponds, viz. Periya and Chinna Kollukudipatti and Vettangudipatti in Sivagangai district, Tamil Nadu, South India. This study clearly shows that the invasive tree *P. juliflora* poses a significant threat to the nesting success of wetland birds. The available literature on the impacts of invasive plants on bird diversity highlights the following facts: (i) they can draw the birds into new areas which are previously unsuitable for them and expose them to unfamiliar risk; (ii) alter local bird assemblage pattern; (iii) alter prey–predator interaction; (iv) change the nesting season; (v)

increase the rate of nest predation and (vi) provide low-quality habitats

4. Reduce soil fertility

Reality

P. juliflora exhibits the ability to improve soils via biological nitrogen fixation, leaf litter addition and incorporation, nutrient pumping, changes in soil structure and soil fauna and microbial populations. It is generally accepted that *Prosopis* species ameliorate the soils in which they grow although some authors note that soils receiving *P. juliflora* litter are always of low fertility. However, the ability of *Prosopis* to fix nitrogen may be severely reduced in highly saline or alkaline soils or where phosphorus is limiting. These results can be substantiated by the following studies.

Individual *P. juliflora* trees were estimated to fix 31 g N/year by Diagne and Baker (1994), which was considered satisfactory, but only 5.5 g N/year by Diagne (1992). At a density of 400 trees/ha, these estimates correspond to an accumulation of 2.2-12.4 kg N/ha/year. Aggarwal¹ found no effect of *P. juliflora* on organic matter but reported increases in soil microbial populations under the crowns of *P. juliflora* trees in India. Singh¹⁸ noted significant increases in soil carbon under a *P. juliflora* plantation after 8 years, with mean soil carbon content increasing from 0.12% to 0.58% over 20 years.

Trees also appear to reduce salinity and alkalinity in soils on which they are grown and highly alkaline soils (pH 10) can be neutralised by *P. juliflora* plantations³. *P. juliflora* is tolerant to very high pH (over 10.5) but will not grow well in soils with a pH 9 or above unless supplemented with manure and calcium sulphate¹⁸. Considerable research has been undertaken in India on the reclamation effect over time¹⁸. *P. juliflora* was found to improve physical and chemical properties of soil by decreasing pH, electrical conductivity and exchangeable sodium levels, and by increasing infiltration capacity, organic carbon, total nitrogen, available phosphorus and exchangeable calcium, magnesium and potassium levels³.

5. Allelopathy

Reality

Prosopis juliflora has the allelopathic effect on germination as well as in seedling establishment. It has the autotoxic effect which affects the young *Prosopis* seedlings establishment from the seeds. These can be proved by the following studies.

The allelopathic effects of the *Prosopis juliflora* were studied by Getachew et al.¹¹, on seed germination and seedling growth of *Acacia nilotica*, *Acacia tortilis*, *Cenchrus ciliaris* and *Enteropogon rupestris*. Its growth characteristics and dense thicket formation restrict light to the ground flora and hence diminishes plant diversity. Leaf, bark and root aqueous extract of *P. juliflora* at 0, 0.5, 0.8, 1, 2 and 6% were prepared and their effect studied on germination percentage and seedling growth of the study plant species. Germination of *A. nilotica* and *A. tortilis* was not affected by all aqueous extracts of different organ parts of *P. juliflora* while leaf and root extracts at higher concentrations inhibited germination of *C. ciliaris* and *E. rupestris*. Heavy accumulation of toxic substances at under canopy soil of *P. juliflora* may be one of the reasons for its invasiveness and low plant diversity.

Autotoxicity

Autotoxicity of *P. juliflora* has been observed on seed germination and subsequent seedling development²⁰. Lahiri and Gaur¹³ found decreased shoot and particularly, root growth of a range of plants following treatment with *P. juliflora* leaf extract. Fresh leaf extracts of *P. juliflora* were found to have greater negative effects on germination than extracts from stems, dry litter or fruit by Sundaramoorthy et al¹⁹.

CONCLUSION

Prosopis juliflora is grown in the ravine area, gully affected area, salt affected and alkaline soils. It has been proven that *Prosopis juliflora* is used for the reclamation of soils and also it has the fodder value, Medicinal value and wood is used for the production of activated carbon. Even though it has the varied utility, it

cannot be grown in the cultivated area where it invades the native species as well. In the current situation in Tamil Nadu, invasion of *Prosopis juliflora* is can be managed instead of total eradication. *Prosopis juliflora* has a tremendous impact on the society positives and vice versa. Their benefits can be extracted with maximum utility and Negative impacts can be minimized through proper management of *Prosopis juliflora*.

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