Tamil Nadu Forest Department,
Forest Headquarters,
Guindy - Velachery Main Road,
Guindy - 600 032.
www.forests.tn.gov.in

Tamil Nadu Forest Department

TN PIPER

TAMIL NADU POLICY ON INVASIVE PLANTS AND ECOLOGICAL RESTORATION

TAMIL NADU POLICY ON INVASIVE ALIEN PLANT SPECIES AND ECOLOGICAL RESTORATION OF HABITATS

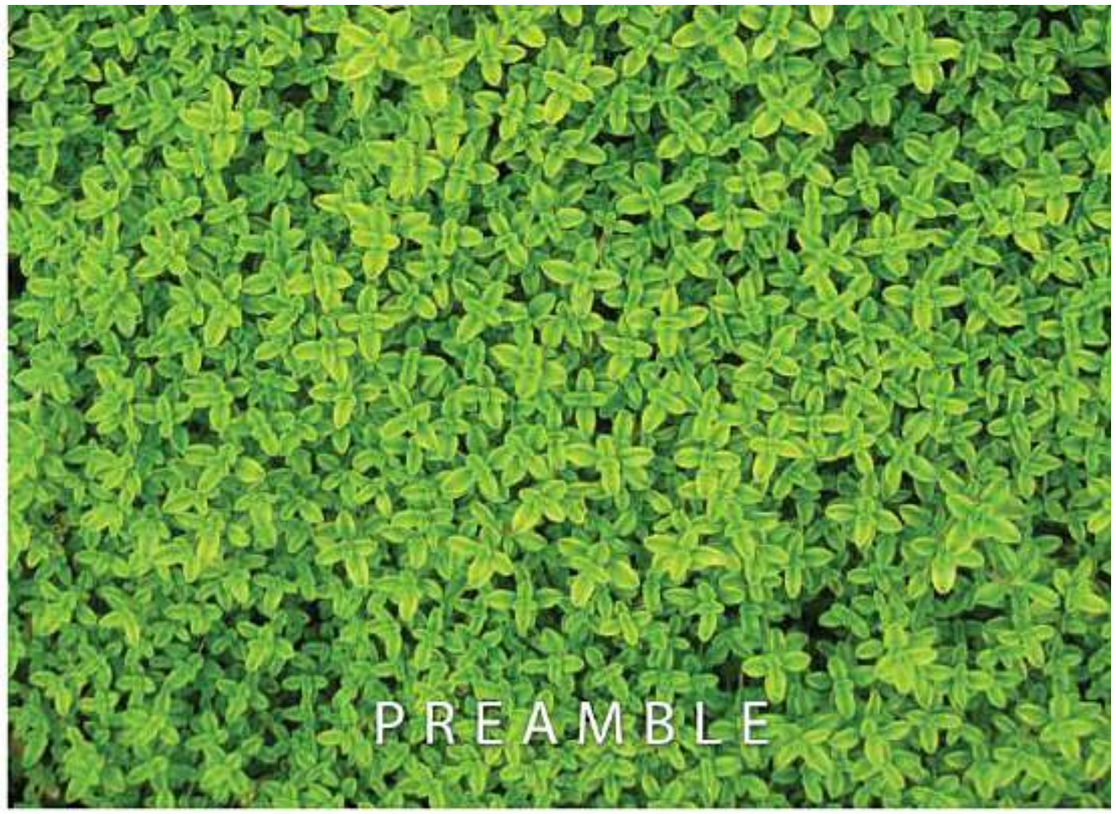
Short title

Tamil Nadu Policy on Invasive Plants and Ecological Restoration

TN PIPER 2022

TN PIPER 2022

Contents



PREAMBLE

This policy aims at the prevention of unintentional or deliberate introduction of invasive alien plant species and the identification, prevention of spread, appropriate control and eradication of all invasive alien plant species in terrestrial and wetland ecosystems of Tamil Nadu state. Appropriate measures to control and eradicate invasive alien plant species must always be supported by rigorous research and monitoring, along with proper ecological restoration of natural habitats. The control and management of invasive alien plant species requires the participatory efforts of diverse stakeholders including government authorities and local administration, civil society and academic institutions, industries and businesses, and local communities including farmers, fishers, and forest dwellers, and the general public.

BACKGROUND

Invasive alien species are now globally recognised to cause serious economic and environmental damage, affect ecosystem and human health, and threaten the conservation of biological diversity. Invasive species are considered one of the most significant threats to conservation of biodiversity due to their impact on native species in ecosystems around the world. Besides loss of biodiversity, other effects of invasive alien species include arrested natural regeneration of native species, loss of ecosystem functions and services such as pollination and dispersal, hydrological impacts and depletion of ground water, increased vulnerability of invaded areas to fires, physical disruption of habitat, reduction of forage, economic losses, decreased agricultural productivity and soil characteristics, and human health impacts. By spreading widely into different ecoregions that have their own suites of native species and endemic species, they bring about a form of biotic homogenization and loss of floral uniqueness (Yang et al. 2021).

Characteristics of Invasive Alien Species
(based on ICFRE 2019, Martenset al.2021)

1. Non-indigenous
2. Originating from a similar climate
3. Abundant in natural range, history of invasiveness outside that range
4. No natural enemies
5. Adaptability and wide distribution in different habitats
6. Invasive, competitive, sometimes allelopathic or parasitic
7. Rapid reproduction, high seed dormancy
8. Fast growth and early maturity
9. High and efficient dispersal ability

Globally, 6075 plant species are known to be invasive in different parts of the world (Wills 2017). Studies in India indicate that about 8.5% of the plant species in India are alien to the country (Khuroo et al. 2012), and includes, at present, at least 756 cultivated aliens,1388 other alien species, and 25 cryptogenic species (Pant et al. 2021). The 1388 alien species include 220 invasive alien species, 237 naturalized species (as per Inderjit et al. 2018, GloNAF data base) and 931 casual alien species. A large number of alien species including invasive aliens, casual aliens, and naturalised species occur within the state of Tamil Nadu (see Appendix).

The State Government recognised the serious and pertinent need to evolve a comprehensive policy based on practical strategies and best practices for management of invasive alien plant species in forest areas. As a result, the Government announced on the floor of the Legislative Assembly on 3rd September 2021 the proposed formulation of a Policy on removal of alien species in forest areas of Tamil Nadu for eco-restoration of forest areas infested with invasive weed species. Consequently, the State Government constituted a 3-member committee tasked with drafting the Policy by G.O.(D). No.158 dated 1st November 2021. During the meetings and deliberations of the committee and consultations with subject experts, it was emphasised that as forest areas are distributed across the state, control and removal of alien species also requires similar efforts in the wider landscapes around these areas from where species can continue to colonise and spread into forest areas.

Therefore, in order to be effective, the Policy would need to consider and develop a comprehensive formulation with an extended scope as defined below. Subsequently in March 2022, the Tamil Nadu Government by G.O. (Rt) No. 137 dated 23 February 2022 constituted seven study groups to undertake visits to different states to study the challenges posed by various invasive alien species, especially *Prosopis juliflora,* and document management strategies in the different locations. Learnings from the study visits are incorporated in the policy wherever relevant.

SCOPE AND VISION

Scope

This Policy is restricted to invasive alien plant species of Tamil Nadu within the geographical and taxonomic scope further detailed below.

This Policy extends to the whole state of Tamil Nadu including rural, urban, agriculture, and community lands, including all terrestrial and fresh water ecosystems. Marine areas and marine ecosystems are excluded.

The taxonomic scope of the Policy is restricted to vascular plant species of the Clade Tracheophyta, which includes club mosses, horsetails, ferns, gymnosperms including conifers, and angiosperms (flowering plants).

The Policy requires the involvement of all relevant stakeholders, including the State Government, statutory authorities and departments including Forest, Revenue, Agriculture, Horticulture, Wetlands and Coasts, Commerce, Highways, Electricity, and others, academic and research institutions, non-governmental organisations, local bodies and local communities (particularly indigenous and tribal communities).

Vision

To prevent, detect early, control, manage, and eradicate invasive alien plant species along with ecological restoration of natural habitats, and enhancing knowledge base through research and monitoring in the lands of Tamil Nadu.

DEFINITIONS

Key definitions related to this Policy listed below are developed from earlier literature (Pyšek et al.2004, ICFRE 2020). **Note that, for the purposes of this Policy, these are defined on the basis of ecosystems within the geographical limits of Tamil Nadu state.**

Native plants

Plant species that have occurred naturally or continue to occur in specific natural ecosystems of Tamil Nadu without human involvement or that have arrived there without intentional or unintentional intervention of humans from another area in which they are native.

Note: Plant species that are native to other parts of India but do not naturally occur within Tamil Nadu are not considered native species in this policy. This definition excludes products of hybridization involving alien taxa since human involvement in this case includes the introduction of an alien parent.

Synonym: indigenous plants

Alien plants

Plant species whose presence in an ecosystem in Tamil Nadu is due to intentional or unintentional human involvement, or which have arrived in Tamil Nadu by the expansion of its range from an area where it is already recorded as an alien.

Note: The term alien also includes all non-native taxa under cultivation. Many alien taxa that are currently not categorised as casual aliens, naturalized plants, or invasive plants, may become such in the future.

Synonyms: exotic plants, introduced plants, non-native plants, non-indigenous plants

Invasive species

Invasive plants are species that produce reproductive offspring, often in very large numbers, including at considerable distances from the parent plants and at varying altitudes, and having the potential to spread over a large area and into natural ecosystems.

Note: Alien taxa not currently classified as invasive may become invasive in the future, as populations increase, reach optimum habitats, or through adaptive genetic changes, arrival of key mutualist partners or new genotypes in their new range.

Synonym: noxious species, super-invaders

Invasive alien

Invasive alien species are species that are alien to an ecosystem in Tamil Nadu and are also an invasive species with the potential of spreading over large areas.

Note: This is a subset of alien species that are invasive. Together with casual aliens and naturalised species as defined here, they constitute the complete list of alien species of the state.

Synonym: exotic invasives, non-native invasives, non-indigenous invasives

Casual alien

Plants that are alien to ecosystems in Tamil Nadu that may flourish and even reproduce occasionally outside cultivation in an area, but that eventually die out because they do not form self-replacing populations, and rely on repeated introductions for their persistence.

Note: This is a subset of alien species that are not invasive at present, but could possibly

become invasive in future, due to many factors such as climate change, introduction of new genotypes, arrival of mutualistic species and so on. Together with invasive aliens and naturalised species as defined here, they constitute the complete list of alien species of the state.
Synonym: occasional escapes, waifs, ephemeral taxa, alien vagrants

Naturalised

Alien plants that sustain self-replacing populations in ecosystems for at least 10 years without direct intervention by people (or inspite of human intervention), being capable of independent growth and recruitment, usually near adults, but which do not typically invade into natural, modified, or man-made ecosystems.
Note: In other definitions (e.g., Pyšek et al.2004) invasive plantsare considered a subset of naturalised species, but that can be confusing and is not the definition adopted here. Naturalised species are considered as alien species that are non-invasive. Unlike casual aliens, naturalised species are known to sustain self-replacing populations. How long a species must persist to be considered naturalized is inevitably arbitrary, and hence affects how the definition should be used in practice.
Synonym: established species

Weeds

Plants (alien or native to ecosystems in Tamil Nadu) that grow in sites where they are not wanted and which have detectable economic or environmental impact or both.
Interpretation: This term is not defined in biogeographic terms but is widely used in agricultural, horticultural, and ecological contexts. An anthropocentric term, weed indicates a plant considered to interfere with specific human objectives for an area whether crop field, forest, or other natural or human use area. As weed is a loosely-used term in agricultural and common parlance, where even native plants are sometimes called weeds, this term is not used in the present policy and is provided here only for explanatory purposes.
Synonyms: pests, harmful species, problem plants

Cryptogenic species

Plants that have not yet been determined to be native or alien as the region of origin remains unknown at present.
Note: Cryptogenic species may be invasive or non-invasive.
Synonyms: plants of unknown origin

Ecoregion

Ecoregions are relatively large units of land containing a distinct assemblage of natural communities and species, with boundaries that approximate the original extent of natural communities prior to major land-use change.
Note: Eco regions are defined as per Olson et al.(2001), and can be taken to represent distinct biotas that are nested within the biomes and biogeographic realms. The eco region framework enables comparisons among different areas and the identification of representative habitats and species assemblages, which is a key concern in invasion biology and ecological restoration.
Synonyms: regional ecosystem

OBJECTIVES

- To develop a comprehensive policy framework for invasive alien plant species control and management in terrestrial and freshwater ecosystems along with ecological restoration of habitats in Tamil Nadu

- To identify and list invasive alien plant species of Tamil Nadu, demarcate and assess the area infested, and prioritise problematic invasive alien plant species for appropriate removal or control measures

- To link invasive alien plant species management with appropriate methods and measures for ecological restoration of natural habitats to revive native ecosystems and species of Tamil Nadu

- To identify the best practices and Standard Operating Procedures for removal, disposal, and elimination of priority invasive alien plant species in Tamil Nadu

- To strengthen the management response and identify appropriate legal and institutional mechanisms

GUIDING PRINCIPLES

The following eight principles provide a framework to define, plan, execute, and measure all aspects of invasive alien species removal and ecological restoration efforts undertaken under this Policy

1. Principle of avoidance/ prevention

The introduction of any new alien species, not currently occurring within Tamil Nadu, must be prohibited, if it is a known invasive in other regions of India or in any other part of the world. No introduction of any other alien species should be permitted in the state unless: (a) there are strong economic reasons (e.g., new crop) or environmental reasons (e.g., biological control) for their introduction, and (b) no alternative species is available among the native species of Tamil Nadu that can perform the same or similar function, and (c) the species is conclusively found to be safe after thorough screening, risk assessment, quarantine, and multi-year trials with phyto-sanitary measures in representative ecosystems, conducted and published by an independent research body.

2. Principle of safety and precautionary approach

For casual and naturalised alien species for which present information suggest that they are not invasive or for which no information is presently available on their invasiveness, a bio-safety and precautionary approach will be adopted aiming to minimise their further spread along with monitoring to detect early signs of invasion if any.

3. Principle of removal with restoration (R&R)

Removal of invasive alien plant species and ecological restoration should go together. No removal should be carried out without a clear plan for ecological restoration to revive the corresponding local native ecosystems (whether grass land or forest or wetland). Such invasives removal and ecological restoration should be designed in a context-specific manner. For instance, it is important to assess in a site-specific manner the existing regeneration of native species, the correct target original native ecosystem, and carry out ecological restoration in a manner that tackles all alien species found on the site and not just one or two problem species.

4. Principle of minimal intervention

For ecological restoration to be effective, disturbances related to the intervention should be minimal such as to prevent further invasion or secondary invasion of disturbance-adapted alien species. This implies avoiding heavy machinery such as earth movers and bull-dozers, massive earth works, check dams, and concretisation. The principle aims to achieve as natural a state as possible with minimal disturbance or artificial structures, and better potential for recovery of native species.

5. Principle of prioritisation of invasion front

Efforts to remove, control, or eradicate invasive alien species should as far as possible prioritise areas at the invasion front (where invasion is just entering into a natural ecosystem). These areas are more feasible and important, as well as have higher potential for recovery of native vegetation from remnant native plants in the area.

6. Principle of continuous implementation, research and monitoring

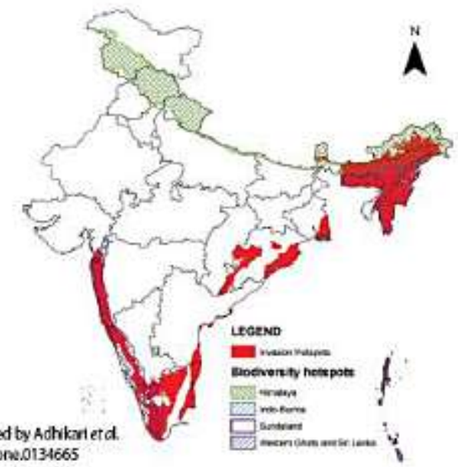
Tackling invasive alien plant species requires sustained and long-term efforts that are both scientifically informed and implemented. Implementation should therefore also go hand-in-hand with continuous systematic research and monitoring. Results of such research and monitoring should be used in an adaptive management framework and be disseminated to create awareness and expand the knowledge base on invasive alien plant species.

7. Principle of promotion of native species

The protection and propagation of native plant species of Tamil Nadu shall be encouraged as far as possible in all areas including botanical gardens, agroforestry areas, forest nurseries, government and college campuses, and public lands. The Tamil Nadu Forest Department nurseries may be strictly restricted to growing native plant species only and completely avoid all harmful alien species.

8. Principle of tolerance

While all invasive alien species should be tackled, this policy recognises that not all alien or exotic (non-native) species are necessarily harmful. Species that are known to be relatively benign and are naturalised and non-invasive in nature (e.g.,gulmohar, *Delonix regia*, and neem, *Azadirachta indica*), shall not be targeted for removal or control measures in cultural landscapes (urban areas, farms etc.), while they may be included in removal and restoration efforts within natural areas such as Wildlife Sanctuaries, Tiger Reserves and National Parks.



Map: Invasion hotspots in India delineated by Adhikari *et al.* (2015).https://doi.org/10.1371/journal.pone.0134665

ALIEN AND INVASIVE ALIEN PLANT SPECIES OF TAMIL NADU

As per a recent comprehensive review (Pant et al. 2021), 2503 vascular plant species have been reported as alien species in the country. This include 756 cultivated aliens and 1747 other species of which 1388 were categorised as alien, 334 re-categorised as native, and 25 as cryptogenic (regions of origin unknown). Further, from the list of 1388 alien species identified, 220 were categorized as invasive alien plant species by consulting the GRIIS database, 237 as naturalized aliens (Inderjit et al. 2018, GloNAF database), and the remaining 931 species were categorised as casual aliens' (Khuroo et al. 2012).

A recent compendium of plants of Tamil Nadu recorded a total of 6,723 taxa (species), of which 4,264 are native species found in the wild and the remainder 2,459 species are non-native alien species, comprising nearly 36.6% of the state's flora, a majority of which are cultivated and ornamental plants (Narasimhan and Irwin 2021). As the authors indicate, Tamil Nadu has always been a hot-bed of introduced species since colonial period. Increased urbanization, presence of a considerable number of ornamental plant collectors and specialized plant nurseries catering to the needs of the public favor the presence of a high number of cultivated [alien] plants. However, they also go on to state (Narasimhan and Irwin 2021) that, -To our knowledge the cultivated [alien] plant list of Tamil Nadu included in this compendium is not complete as the exotics continue to get imported into the state through flourishing horticultural trade. Besides known invasive alien species, a large number of these alien species under cultivation or horticultural use are potential invasive species, as already witnessed by examples such as *Opuntia spp.*, *Sphagneticola trilobata* and others. This indicates the extent and seriousness of the invasive alien plant species problem in the state of Tamil Nadu.

A recent analysis of invasive alien plant species in India through ecological niche modelling identified invasion hotspots in the country (Adhikari et al. 2015) as can be seen from the map below. The State of Tamil Nadu, predominantly the Western Ghats are among the chief invasion hotspots in the country.

CATEGORISING ALIEN AND INVASIVE IN TAMIL NADU

The definitions of alien and invasive alien plant species adopted for this Policy have been on the basis of ecosystems within the geographic limits of Tamil Nadu state. This is in concordance with the earlier definition, proposed by Narasimhan et al. (2009), for such invasive alien species: A non-native species to the ecosystem or country under consideration that spreads naturally, interferes with the biology and existence of native species, poses a serious threat to the eco system and causes economic loss. Using the local ecosystem-based definition as used here, the following categories of invasive alien species can be recognised.

Alien plant species that occur in the state of Tamil Nadu:	*Invasive alien species corresponding to the different categories of aliens above:*
National alien: Species alien to India	**National invasive alien:** Species alien to India and is invasive
State alien: Species native to India but alien to Tamil Nadu	**State invasive alien:** Species native to India but invasive alien in Tamil Nadu
Ecoregional alien: Species native to some ecoregions of Tamil Nadu but alien in others	**Ecoregional invasive aliens:** Species native to some ecoregions of Tamil Nadu but invasive alien in others

This policy defines alien species relative to the ecosystem within Tamil Nadu rather than the country (India) alone. Some species that are native to other parts of India (e.g., Himalaya), are alien species for Tamil Nadu if they occur within the state (for example, *Prunus cerasoides, Mucuna bracteata, Alnus nepalensis, Tetradium fraxinifolium, Koenigia mollis* (Syn. *Polygonum molle*). Hitherto, most of the attention has however been on National invasive alien species.

DIVERSITY OF ALIEN AND INVASIVE ALIEN SPECIES IN TAMIL NADU

The State of Tamil Nadu has a significant number of alien, casual alien, naturalised, and invasive alien species. Almost all attention has been on invasive alien species that are non-native to India (National invasive alien, as defined here), with much less attention paid to State invasive aliens and Ecoregional invasive aliens.

Some of the available information from different sources listed below are summarised, and have been used to prepare a comprehensive list of species for the purposes of the Tamil Nadu Policy on Invasive Alien Species, the present document.

1. Narasimhan et al. 2009 reported a large number of National invasive alien plant species within the state of Tamil Nadu. This study reported 1226 alien species in Tamil Nadu, including 756 cultivated species, 200 invasive alien species, and 56 cultivated species that also occur as escapes'. Since their definitions do not strictly match with the definitions used here, the categorisation of these species as naturalised and casual alien is not available.

2. According to the TNENVIS centre online portal, 1274 alien species occur in Tamil Nadu, of which 998 plants occur under cultivation, and 276 species are either potentially invasive or have turned invasive. (http://tnenvis.nic.in/tnenvis_old/IASintamilnadu.htm).

3. A 2012 publication that listed 60 prominent invasive alien plant species in India, included several species known to be invasive in Tamil Nadu (Kohli et al. 2012). Chapters in the same volume addressing regions in Tamil Nadu also reported 47 invasive alien species from Western Ghats (Rao and Sagar 2012) and 7 major invasives from the southern Eastern Ghats (Parthasarathy etal.2012).

4. The ILORA database (Pant et al. 2021) lists 449 plant species whose occurrence within Tamil Nadu is known from existing literature and confirmed by occurrence records. Of these, 150 species were reclassified as native species. The remaining 299 alien species, included 133 invasive alien species, 93 Casual Alien species, 70 Naturalized species, and 3 Cryptogenic species.

5. Recent studies have also identified some additional species as invasive aliens in Tamil Nadu. For example:

a Robusta coffee (*Coffea canephora*), a cultivated species, is known to be invasive, including into closed-canopy forests adjoining plantations (Joshi et al. 2009).

b *Montanoa hibiscifolia* is another recently confirmed invasive alien species found in the Nilgiris and the Anamalais (Udhayavani and Ramachandran 2017).

c The African umbrella tree (*Maesopsis eminii*), grown as shade in coffee plantations, is known to be invasive in forests adjoining plantations (Parthasarathy et al.2012, Joshi et al. 2015).

d Aquatic species such as *Limnocharis flava* (Rao and Sagar 2012) and climbers such as *Mucuna bracteata* (Sundararaju 2018) are reported as invasive in some parts.

e The Expert Committee of the Madras High Court [Madurai Bench, in their Fourth Interim Report, in W.P. (MD) No.3633/2014, 13763/2016 and 7606/2017] listed 40 species of invasive alien plants in the Nilgiris of Tamil Nadu, including species such as *Clidemia hirta* not listed in earlier studies or databases.

f At least 45 species of *Eucalyptus* are known from Tamil Nadu (Narasimhan and Irwin 2021) and while all are alien species, only a few (e.g., *E. grandis, E. globulus*) are planted extensively in the State. Most *Eucalyptus* species are cultivated and used for pulpwood, fuelwood, and the paper industry and are not known to be invasive. However, recent studies do indicate that in the Palani Hills, some *Eucalyptus* species have invaded grasslands (chiefly: *E. citriodora, E. globulus, E. grandis, and E. saligna*) and require attention in the Palani Hills, which is an important conservation landscape in Tamil Nadu.

Based on the above databases and studies, a compiled list of species is presented in this document:

APPENDIX 1: Invasive Alien Plant Species of Tamil Nadu
APPENDIX 2: Casual Alien Plant Species of Tamil Nadu (ILORA)
APPENDIX 3: Naturalised Plant Species of Tamil Nadu (ILORA)
APPENDIX 4: Cryptogenic Plant Species of Tamil Nadu (ILORA)

Priority Invasive Alien Species in Tamil Nadu

Based on the list of invasive alien species in Appendix 1 and reference to other sources, including the IUCN 100 of the World's Worst Invasive Species, and their relative prevalence and intensity of known invasion in Tamil Nadu, the following 23 Priority Invasive Alien Plant Species / taxa are identified for the state:

1. *Acacia wattles*
2. *Antigonon leptopus*
3. *Calopogonium mucunoides*
4. *Cenchrus clandestinus*
5. *Cestrum nocturnum / aurantiacum*
6. *Chromolaena odora*
7. *Cytisus scoparius*
8. *Eucalyptus sp. (Palani Hills)*
9. *Ipomoea carnea*
10. *Lantana camara*
11. *Leucaena leucocephala*
12. *Ludwigia peruviana*
13. *Maesopsis eminii*
14. *Mikania micrantha*
15. *Montanoa spp.*
16. *Mucuna bracteata*
17. *Opuntia spp.*
18. *Parthenium hysterophorus*
19. *Pontederia crassipes*
20. *Prosopis juliflora*
21. *Senna spectabilis*
22. *Sphagneticola trilobata*
23. *Ulex europaeus*

AREA UNDER INVASIVE ALIEN SPECIES IN TAMIL NADU

Accurate published estimates of area under invasive alien species across the entire state of Tamil Nadu are presently unavailable. The few estimates that are available cover only a small number of invasive alien species that are wide spread or well known enough to have attracted the attention of researchers and managers in the past. Available estimates tend to be approximate and confined to areas within Forest Divisions under the control of the Tamil Nadu Forest Department. There have been two recent efforts to compile area under major invasive alien species in the Forest Divisions of Tamil Nadu:

1. Expert Committee constituted by Honourable High Court of Madras, Madurai Bench

The expert committee constituted under the Honourable High Court of Madras circulated a questionnaire to all Forest Divisions to report back their estimates of the area under 17 listed Invasive Alien Species (and any others) in their Respective Divisions at the Range level. According to this report, the area under 5 major invasive alien species are as follows: *Lantana camara* (185,000 ha), *Prosopis juliflora* (56,000 ha), Acacia mearnsii (wattle, 22,400 ha), Senna spectabilis (2,400ha), and Opuntia sp.(2,300 ha), together affecting a total area of 268,100 ha.

2. Invasive Alien Species Policy drafting committee (present committee)

An effort was made under the aegis of the present committee to compile estimates of area under seven major invasive alien plant species of Tamil Nadu from various Forest Divisions of the state. As per this effort, compiled division-wise, there is about 3,18,000 ha affected by seven invasive alien species. Although both data sets are compiled by the Tamil Nadu Forest Department from various divisions, the significant differences in estimates from these two sources as tabulated below suggest that these figures should be taken as broad approximations.

Estimated Area under some major invasive alien plant species in Tamil Nadu

Species	TNFD estimate for HC committee (ha)	TNFD estimate for present committee (ha)
Wattles (*Acacia*)	22,400	16,110
Chromolaena odorata	11,532	46,057
Eucalyptus sp.	6,780	2,029
Lantana camara	1,85,000	1,66,152
Parthenium hysterophorus	12,150	47,583
Prosopis juliflora	56,000	19,937
Senna spectabilis	2,400	20,174
Opuntia sp.	2,300	-
Pinus sp.	2,700	-
Total	**2,68,100**	**3,18,041**

3. Estimating and monitoring area under invasive alien species

The absence of accurate state-wide estimates of area under invasive alien species and related intensity of invasion (e.g., percentage cover or density of invasive plants per hectare) indicates a crucial research and monitoring need for the state of Tamil Nadu. These may be obtained on priority basis in the future by different approaches including:

(**a**) Remote-sensing based estimation: Analysis of satellite imagery and other remote sensing data can be used to estimate areas under invasion and prioritise areas for restoration. For instance, an assessment by Arasumani et al. 2020 highlights that 262 km^2 (69%) of montane grasslands in the Palani Hills and 180 km^2 (58%) of montane grasslands in the Nilgiri landscape have been lost due to exotic tree invasion and agricultural expansion. Building on this study and the shola grassland restoration efforts of Tanya Balcar and Robert Stewart of Vattakanal Conservation Trust, Kodaikanal, priority areas for montane grassland restoration were identified (Fourth Interim Report of the expert committee of the High Court of Madras, Madurai Bench, dated 27 November 2020).

(**b**) Citizen Science: Citizen science has grown to be a very popular and effective way to involve large numbers of interested people in large-scale monitoring surveys and documentation. Portals such India Biodiversity Portal, iNaturalist, eBird, other digital apps, and many other citizen initiatives have been very effective in documenting biodiversity and monitoring distribution and changes in the abundance of species. The Tamil Nadu Forest Department along with the Keystone Foundation, Kotagiri, and ATREE, Bengaluru, have also developed and used a mobile app for monitoring invasive plant species in the Nilgiris as a citizen science effort. Citizen science should therefore be leveraged for Invasive Alien Plant Species monitoring in the state.

(**c**) Field Research and monitoring studies: Systematic and rigorous field research on alien and invasive alien plant species should be fostered, encouraged and conducted by research institutions (government and NGOs), academic institutions and universities and the research wing of the Tamil Nadu Forest department. Long-term research and ecological restoration studies should be, in particular, supported and encouraged.

(**d**) Biennial survey of invasive alien plant species: A biennial survey of invasive alien plant as envisaged under this policy (see later) will also provide valuable evidence of distribution and prevalence and reveal accurate estimates of area under various invasive species in the State.

INVASIVE ALIEN CROPS, COVER CROPS, AND SHADE TREES

The list of invasive alien plant species in Tamil Nadu (Appendix 1), includes a few species that are grown as agricultural crops, used as ground cover, or planted as shade trees in coffee plantations. These require separate consideration as curtailing their cultivation may be undesirable due to livelihood impacts or as it may affect production of associated crops. This policy therefore proposes the following approach to these species:

Invasive Alien Agricultural crops: Nothing in this policy shall prevent the continued cultivation of *Coffea canephora* (Robusta coffee) and *Psidium guajava* (Guava) in areas where they are currently under cultivation or in homesteads and gardens for *bona fide* personal uses. The main focus shall be on containment of these species within existing agricultural areas, and focus of removal and restoration shall be on adjoining natural ecosystems, particularly forest areas, only. The State Government may, through consultations with stakeholders impose regulations on further expansion of area under cultivation of species like *Coffea canephora* and *Psidium guajava*.

Invasive Alien Ground Cover crops: Ground cover crops such as *Calopogonium mucunoides, Mucuna bracteata*, and *Sphagneticola trilobata* shall be similarly restricted to existing areas where they are used with other crops. The main focus shall be on containment within these areas, and removal and restoration from surrounding natural ecosystems, particularly forest areas only. The State Government may similarly restrict expansion of areas under these cover crops and also work to find alternative non-invasive replacements for these species by working with research institutions and related plantation sector bodies and boards (e.g., Rubber Board, Tea Board, Coffee Board, Tea Research Institute, United Planters' Association of South India, etc.).

Invasive Alien Shade Trees: Where tree species such as *Maesopsis eminii, Spathodea campanulata,* or any other tree species listed in Appendix 1 that is used as a shade tree, are concerned, removal en masse of such trees can have deleterious effects and is not recommended. Instead, the plantation sector (such as coffee, cardamom, pepper, vanilla, and tea) should be involved as a key stakeholder to design a phase-wise gradual transition away from such invasive alien species to suitable native tree species. Research on identification of alternative native shade trees may be encouraged and private plantations encouraged to gradually replace invasive alien species with native species in the long run. Where such shade tree species have invaded into forest areas or natural ecosystems, they can be targeted for removal and restoration as under this policy.

ECOLOGICAL RESTORATION: PRINCIPLES AND PRACTICES

What is ecological restoration?
As defined by the Society for Ecological Restoration (SER 2019): *Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.*

Ecological restoration includes any activity that has the objective of achieving substantial ecosystem recovery relative to an appropriate reference model or benchmark site, regardless of the time required to achieve recovery. Such benchmark or reference sites used for ecological restoration projects are informed by native or original ecosystems, including many traditional cultural ecosystems that have different degrees of traditional use without causing degradation.

STAGES OF ECOLOGICAL RESTORATION

The major stages of ecological restoration include:

- **Initial mapping and degradation assessment** of historical and current causes and levels of degradation
- **Site selection and prioritisation** for restoration.
- **Field survey and site assessments** of species composition and vegetation status
- **Selection of original and benchmark ecosystems** is a crucial step that requires identification of correct native or original ecosystem and the selection of appropriate benchmark or reference sites for the site to be restored.
- **Control of degradation** through proper identification and removal or limitation of identified proximate causes of degradation (e.g., control of erosion, fire, pollution, overgrazing, invasive species, over-exploitation of firewood and forest produce).
- **Project planning** with activities and time lines for ecological restoration, including for native plant nursery and other resources that may required.
- **Project implementation** of plans and activities (such as raising plants in nursery, site protection measures, invasive species removal, and planting of appropriate native species (with reference to baselines and benchmarks identified).
- **Continuous monitoring,** including photo-point monitoring and plot-based or other methods to assess recovery based on selected measurable indicators.
- **Recovery assessment** following restoration through scientific methods using measurable indicators and course correction.

What is recovery

Recovery is a very important foundational concept in ecological restoration theory and practice, which is used to determine how much of the original native biological diversity, habitat structure, and ecosystem function and other measurable attributes or indicators have returned or been revived due to restoration.

In the context of restoration, recovery means the process of returning to similar conditions as reference sites:

- The natural **structural diversity** and characteristics of the ecosystem such as multi-layer vegetation and tree canopy cover,
- The natural **ecosystem function** dynamics and attributes such as pollination, seed dispersal, decomposition and nutrient cycling, and
- The characteristic **species composition** and biodiversity of native species assemblages of the ecosystem, such as the plants, animals, fungi, and other life forms found in reference sites.
- The physical conditions such as water availability, micro-climate, and substrate of the site
- The absence of threats such as invasive alien species, contamination that led to the degradation in the first place, and
- The external exchanges such as landscape flows of water and minerals, animal movement, and gene flows.

These aspects are characterized by the Ecological Recovery Wheel which is part of the Society for Ecological Restoration (SER) *International Principles and Standards for the Practice of Ecological Restoration.*

They can be used for designing and implementing restoration, and for assessing progress as compared to a reference model or benchmark site by tracking recovery on various attributes or indicators as illustrated in the Figure (Gannet al. 2019).

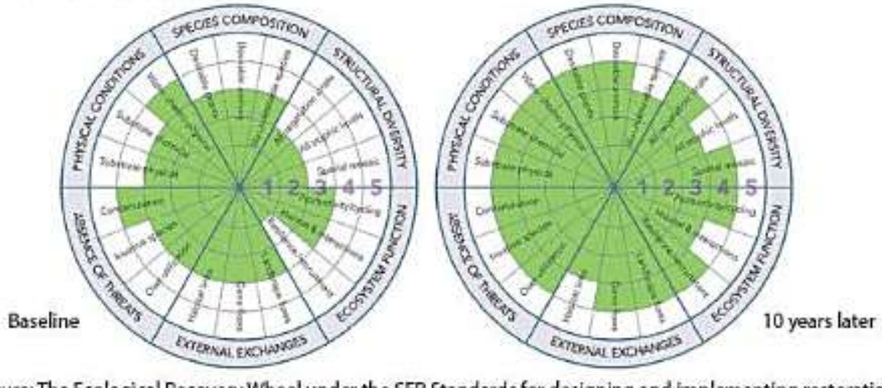


Figure: The Ecological Recovery Wheel under the SER Standards for designing and implementing restoration, and for assessing progress as compared to a reference or benchmark site (from: Gannet al. 2019).

Indicators of recovery need to be selected for each ecoregion and in relation to the original ecosystem that is being restored. **Structural diversity indicators** of recovery may include variables such as tree density, basal area, and canopy cover (in forests), grass cover and grass height (grasslands), percent open water (in wetlands). **Ecosystem Function Indicators** may include aspects such as carbon stocks and sequestration, hydrological measures, seed dispersal and regeneration, and soil nutrient status and cycles. **Species Composition indicators** of recovery could include the number or diversity of native species (especially those found in benchmark sites), composition of the assemblage (percentage similarity with benchmark sites), and absence of undesirable species. **Physical Condition Indicators** such as soil temperature and moisture, light availability and micro-climate, can be monitored to see how closely they are approaching the benchmark sites. **Indicators of Absence of Threats** may include decline or absence of invasive species, incidence of disturbances and reduction in pollution levels. **External Exchange indicators** may include resumption of animal movement as assessed by camera trap evidence, genetic exchange, improved streamflows, and so on.

HOW TO IDENTIFY BENCHMARK SITE

Ecological restoration should always be targeted towards a goal. Setting goals and indicators for restoration requires identification of suitable reference or benchmark sites. A benchmark site is meant to be the ultimate target or aspiration of restoration. A benchmark site may be selected based on one or more of the following approaches:

1. Pre-disturbance condition: Benchmarks can be based on available information on how the restoration site itself was prior to being degraded, damaged, or destroyed. For instance, if plant and animal surveys were carried out before logging or mining of a site, or if earlier forest Working Plans detailed the information, these could be used. Such information is, however, rarely available and one may need to use one of the following approaches.

2. Undisturbed nearby original ecosystem: Benchmarks can be selected as relatively undisturbed areas nearby the restoration site. These could be a Protected Area such as National Park or Wildlife Sanctuary that has almost intact original ecosystems. Care should be taken to match the corresponding vegetation, for instance natural grasslands as benchmark for grassland restoration sites, wet evergreen forests as benchmark for wet evergreen forest restoration sites and so on. The benchmark can be selected from such nearby locations (within the same forest range and ecoregion) of a similar elevation, rainfall, and soil type, which contain complete or near-complete communities of native plants and animals.

3. Historical information: Historical information may be available for an area, in the form of old photographs, flora volumes produced from a time prior to major disturbance, old gazetteers and maps, and accounts and descriptions from the colonial period.

4. Indigenous knowledge: Indigenous people such as the Toda of the Nilgiris, Kadar of the Anamalai, and many other tribal communities and forest dwellers have a deep first-hand knowledge of their landscape which is often integrated with their stories, customs, beliefs, rituals, and ways of life. Their knowledge, nomenclature, and uses of native plant landscapes can be consulted to identify suitable benchmark sites and native species for restoration.

WHERE IS ECOLOGICAL RESTORATION NEEDED

Ecological restoration may be necessary in sites that have been degraded, damaged or destroyed due to:

- Heavy infestation with invasive alien plant species, weeds and vines, choking natural vegetation
- Depletion of soil seed bank and isolation of ecosystems from intact ecosystems that serve as seed sources
- Monoculture timber / industrial plantations or other agricultural, horticultural, or agroforestry crops
- Mining, loss of top soil, settlements, or other land-use
- Disturbances from linear infrastructure intrusions such as roads, powerlines, railway lines, canals, and barriers
- Loss or depletion of soil nutrient status and symbiotic mycorrhizal fungal populations
- Clear-felling of timber, fires, landslides, landslips, earth works, and other disturbances

LANDSCAPE APPROACH AND PRIORITISING AREAS FOR RESTORATION

The effectiveness of invasive alien species removal followed by ecological restoration can be improved by taking a whole-landscape approach and prioritising locations for implementation based on ecological conservation, and local community needs. Priority sites may include, for instance:

- Invaded sites within or along the edges (buffer areas) of Protected Areas significant for biodiversity such as Wildlife Sanctuaries, National Parks, and Tiger Reserves
- Habitats of particular threatened or endemic species,
- Riverine tracts, stream sides, swamps, and water catchments important for wildlife or downstream communities
- Sites at the invasion front still containing remnant natural vegetation that can accelerate recovery after removal of invasive alien species
- On hilly terrain from ridge towards valley to reduce downhill seed deposition and spread
- Edges of habitat fragments and corridors linking habitat fragments
- Strips along linear infrastructure intrusions such as roads, railway lines, powerlines, firelines, and canals

INVASIVE REMOVAL METHODS

Invasive removal methods can be broadly categorised into the following:

- **Mechanical:** main method to be prioritised, as removal by hand and using implements
- **Chemical:** only limited, targeted use to be permitted in agricultural landscapes, and strictly prohibited in natural ecosystems
- **Bio control:** to be avoided as they mainly use alien species as agents

Mechanical Methods: Mechanical methods for removal of invasive alien species include removal by hand or through machinery. Removal by hand should be prioritised as the main method as far as possible. This is because mechanical removal by hand can be carefully targeted at the invasive alien species, it causes minimal disturbance to habitat, it minimally affects native species, and it provides employment to local communities in the operation. Removal by hand and physical labour using implements such as mattocks, billhooks, spades, axes, and mammotys, should therefore be the primary approach used for invasive removal.

Local people, especially forest dwelling communities, tribals, and others should be involved and employed in the removal operations. They have a better knowledge of the landscape and are able to correctly identify invasive alien species that should be removed and the native species should be left undisturbed. Mechanical removal methods should be tailored to the species, but may include any or all of the following:

- Hand-pulling to uproot invasives (especially when earth is soft and plant can be extricated with roots; this works for many herbaceous species and shrubs such as *Mikania micrantha, Chromolaena odorata)*. Uprooting should ideally be carried out before flowering and seeding of the plant.

- Cutting of flowering branches before seeding: this is to reduce the fruiting and seed load at the site; can be subsequently followed by removal of the plant with roots. This method can be applied for species such as *Montanoa hibiscifolia* to prevent flowering that will result in excessive fruiting and seeding.

- Cut and dry method for climbers: climbers such as *Mikania micrantha* that grow over and smother other vegetation, may be cut near the base and allowed to dry on the existing vegetation (as pulling to remove may not be always possible or may damage other sensitive native plants). Care should be taken to uproot the main stem as far as possible and not allow cut materials to remain in contact with the soil as they may sprout again.

- Cut root-stock method: This method, which involves removal of branches and above-ground foliage (with billhook or machete) and followed by uprooting of rootstock (using mattocks) can be applied to species such as *Lantana camara*. Cut foliage material and branches may have to be removed from site to prevent twigs in contact with soil from sprouting vegetatively, root stocks removed can be upturned and left on site or used as fuelwood after drying out.

- Girdling and felling of trees: trees may be girdled (ring-barked) and left standing to dry out (with repeat visits to remove any coppicing shoots until the tree dies), or felled if necessary.

USE OF MACHINERY IS TO BE AVOIDED IN MECHANICAL REMOVAL AS FAR AS POSSIBLE.

Although mechanical methods could include use of machinery such as chainsaws, earth-movers, and JCBs, heavy machinery should not be used as far as possible because they cause more extensive damage to habitat, destroy native species along with alien species, and do not involve or employ local communities as they are mostly done through contractors. Damage to habitat due to earth movers and JCBs often leads to secondary invasion by the same or other invasive alien species. Machinery should therefore be used only in very minimal or unavoidable cases, such as uprooting of roots of large trees, only if it cannot be removed or destroyed through other means, and should be carried out without damaging the habitat. New roads and tracks should not be created through invasive removal and restoration sites due to the use of heavy machinery.

Chemical Methods: involve the use of herbicides and other agro chemicals to kill plants through methods such as spraying, dousing, wetting, or direct application on stem after removal of bark. Chemical methods should not be used in natural ecosystems, such as grasslands, forests, wetlands, and Protected Areas such as wildlife sanctuaries, national parks, tiger reserves, etc. This is because many agrochemical herbicides in use today are known to have high environmental toxicity and are hazardous to human and animal life. Herbicide application can be considered, wherever appropriate for a particular invasive alien species in other landscapes such as agricultural areas where they are already in use. Herbicides and pesticides that are classified under the WHO classification of pesticides as Extremely hazardous (Class Ia), Highly hazardous (Ib) and Moderately hazardous (II), should be avoided for such operations.

Biocontrol Methods: involve the use of other biological pest and disease agents that attack invasive alien species. As biocontrol agents tend to be non-native or alien species themselves, biocontrol methods are discouraged in all areas. Biocontrol agents are often tested in laboratory or limited field conditions, but always pose an additional risk of becoming new invasive species in their own right and therefore should be generally avoided.

ECOLOGICAL RESTORATION METHODS

1. Passive restoration or natural regeneration

This method involves minimal direct intervention in the site beyond removal of external threats as far as possible and then allowing the site to recover naturally. It is likely to be more applicable in sites where the main causes of degradation can be curtailed or removed and the extent of degradation has been minimal. This may include sites such as forests that have been selectively logged many years ago and subsequently protected, areas where the soil is still intact, degraded grasslands or other ecosystems adjoining larger tracts of relatively intact ecosystems, and so on. In such cases, passive restoration or natural regeneration can be adopted. When a degraded site adjoins a larger intact ecosystem, animals and seeds of plants can more easily arrive and establish themselves overtime on the degraded area, and hence a passive approach may suffice.

2. Assisted regeneration methods

Assisted regeneration methods involve activities that foster the natural recovery or regeneration of a site, through minimal interventional activities. This may include aspects such as freeing up seedlings from smothering weeds (vine removal), gap planting with native species in logged forest, direct seeding (broadcast or dibbling of seeds of suitable native plant species), or lining ponds with expansive clay aggregate to slow down infiltration at waterholes. Such methods may work better in sites of intermediate or moderate degradation, by kick-starting or catalyzing the natural processes of secondary succession that help an ecosystem recover.

3. Active restoration methods

These methods involve active interventions designed to counter past degradation and speed up recovery. This may involve actions like targeted removal of invasive alien species of plants, planting of native plant species, modifying soil parameters through addition of mulch or fertiliser. In active restoration, care must be taken to ensure that all pre-existing native plant species are retained on the site while applying restoration interventions. These active restoration methods may be most appropriate in sites that have faced moderate levels of degradation or are more isolated from intact natural ecosystems. Active restoration is often more labour and time intensive than passive or assisted restoration methods.

4. Reconstructive restoration methods

Sites that are extremely degraded may be difficult to restore by any of the above methods. In such cases, a reconstructive restoration approach could be adopted. This approach involves trying to recover the site through more fundamental step-by-step rebuilding of the components of an ecosystem. Examples of reconstructive restoration may include an attempt to thoroughly clean-up a polluted stream flowing through a site, sourcing and spreading or re-spreading top soil over mine spoils' to subsequently replant these areas with a high diversity of native plant species.

Ecological restoration methods implemented in specific sites may involve a combination of the above methods. For instance, an active restoration method (e.g., removal of *Prosopis juliflora*), may be accompanied by passive restoration (retention of native trees), and assisted restoration (assisting the regeneration of perennial native grasses).

Ecological restoration that involves active planting of native species should aim to bring back a diversity of native species that can serve multiple purposes as habitat or food for native animals, and species that may supplement needs of local people including minor forest produce. In addition, ecological restoration should target native species of different life-forms (trees, shrubs, climbers, herbs and grasses) as in the specific natural ecosystem benchmarks, rather than restrict to just one life form (e.g., only trees).

INVASIVE ALIEN SPECIES REMOVAL AND ECOLOGICAL RESTORATION

Invasive Alien Species Management

The management of invasive species encompasses the prevention, mitigation, containment and restoration activities which needs meticulous planning of operational and administrative tasks. Better way of planning is to organize the tasks into an annual / periodic work cycle which would serve as an easy record of reference for those responsible for implementation but may or may not be part of the planning process. The thumb rule shall be that invasive plant eradication activity at any infested site should be continuously monitored and invariably succeeded by ecological restoration at the site with minimal delay or time-gap to derive the desired result.

The systematic planning and implementation process herein is referred to as the Invasives Removal and Restoration Protocol (IRRP). The protocol defined here ideally speaks about addressing the invasive species in forest areas and specifically concerns the Forest Department. In fact, the control and removal of invasive flora needs to be planned and implemented on a landscape level irrespective of the ownership and characteristics of the land for desired outcome. Accordingly addressing the forest lands alone, sparing the invasive infested land fragments/ fringes is highly irrational and very likely to fail the very objective, as the alien invasive species have the potential to escape such infested areas and spread to natural settings/ invasive eradicated areas. Hence control and removal of alien species requires similar efforts in the non forest areas too.

For the best outcome, the policy vests the onus of developing an IRRP for non-forest areas with the concerned Departments/ organisations dealing with the land, through systematic planning and engagement, duly facilitated and approved by the District Level Implementation Committees concerned.

This would help to accommodate the variations with respect to site conditions, species to be managed, resources (men and material) and expertise at hand, public interest, laws of the land etc. However, the process and progress of implementation of IRRP irrespective of forest/ non-forest lands have to be dicussed, monitored and evaluated by the District level committee as mandated under this policy.

The IRRP may include the following stages:

- **Preparation of IRR Plan:** Mapping of invasives, stratifying and selecting area, identification of benchmark sites or reference ecosystems to guide restoration, re-vegetation planning, local workstudy, demarcation of work area, preparation of plan of operation
- **Plan Approvals:** Plan approvals to be sought and obtained as required for pro-rata, work area, benchmark sites, native plant nursery, and periodic plan of operations (PPO)
- **IRR Plan Implementation:** Implementation of invasives removal, survey of native vegetation in benchmark sites, native plant nursery establishment, ecological restoration after removal, setting up monitoring photo points, periodic plan and calendar of operations
- Continuous Monitoring: Continuous long-term monitoring using photo-points, quadrat sample plots, perambulation survey, and assessment by evaluation committee, record keeping and mid course-correction.

These stages are explained in greater detail below:

A. Preparation of IRR Plan

The plan referred to herein is a comprehensive plan for invasive plant management pertaining to the division detailing the operational procedures and legal as well as field requirements aimed at successful natural recovery of site as well as to avoid, minimize or mitigate potential negative impacts to the ecosystem and humans. It may include basic details and statistics of the area, operational risk management, training and capacity building requirements of implementing field staff / personnel, methodology adopted for eradication etc. in addition to the following.

1. ***Invasive Species and Area Mapping -***

The areas invaded by invasive plants are to be mapped Range wise by involving personnel and assistance of technology including remote sensing and GIS and a final consolidated divisional map needs to be prepared. Adequate ground truthing has to be ensured to differentiate overlapping species in the same area. The map should be comprehensive enough to depict species wise and area wise details of invasive species of the Division.

2. ***Density mapping for target species –***

For the ease of operation, species wise reference maps illustrating the density of infestation (high, medium and low) of the target / priority invasive species has to be prepared Range wise so as to apportion large area into several smaller units beat wise for management.

3. ***Conduct of Local work study –***

Once the details of infested area, species and density are known, work studies are suggested to be conducted in different density areas to arrive at Forest Schedule of Labour (FSL) for species / overlapping species wherein data is deficient / FSL is not available. This data will help the budget planning. The FSL is influenced by various factors like slope, accessibility/ remoteness, age and density of invasive species, site characteristics, methods of removal, workmanship, labour productivity etc and hence precise monitoring is inevitable. The area for local work study is to be approved by the Circle Head of the department under whose supervision the entire exercise has to be performed and data recorded. It is worthy enough to record data and arrive FSL / FSR through local work studies for infested areas with overlapping species area.

4. ***Demarcation of treatment area –***

The available maps of species, area and density of invasive spread will ease the task of arriving effective area which is referred as the treatment area. The treatment area will be the management unit for which a specific plan of operation for defined period will be prepared for implementation. Also refer section- *Landscape Approach and Prioritising Areas for Restoration* to select and demarcate areas. The order of precedence of treatment areas may be in the following order (category one needs the immediate attention):

Category1: Invasion front where invasive abundance is low and remnants of native plant composition is available to stimulate regeneration and recolonisation

Category 2: Invaded sites of biodiversity importance such as those within or along the edges (buffer areas) of Protected Areas such as Wildlife Sanctuaries, National Parks, and Tiger Reserves, or are habitats of particular threatened or endemic species

Category 3: Higher reaches of slopes where removal can prevent propagule pressure down-slope (through gravity, drift, run-off, or other dispersal)

Category 4: invaded sites of watershed importance such as riverine tracts, stream sides, swamps, and water catchments important for wildlife or downstream communities

Category 5: disturbed invaded sites along edges of habitat fragments and corridors linking habitat fragments, strips along linear infrastructure intrusions such as roads, railway lines, powerlines, firelines, and canals, or other disturbed areas.

5. ***Identification and Survey of Benchmark Sites –***

Suitable, relatively intact natural ecosystems that can serve as benchmark or reference sites for ecological restoration will be identified within the same habitat / forest type / eco-region within the Division and the same shall be surveyed to determine native plant communities that can serve as good choice of species for the nursery and restoration activities. Benchmark sites are to be regularly visited. Monthly comparisons of the treatment sites with such control areas are valuable to monitor the desired outcome as these untreated areas provide useful benchmarks.

6. *Restoration Planning* – The optimal restoration strategy for a site may involve passive or active restoration or a combination of methods depending on the remnant native vegetation and density of invasive species. Advance planning for a native plant nursery is a precursor for any successful planting operation. The choice of species and number corresponds to the size and characteristics of the area chosen for treatment and with reference to native species in the benchmark sites. Nursery journals have to be meticulously maintained with necessary details of nursery site, soil characteristics, choice of species, various inputs / raw materials and periodicity of various operations, methods of propagation, source of propagule, costing etc. with the essential data being periodically updated.

7. *Preparation of Periodic Plan of Operations (PPO)*– A Periodic plan of Operations needs to be prepared at the Division level indicating identified treatment area, target species and prescribed schedule of operations (with annual break up), methodology, workforce, workskill, budget, monitoring (follow up) etc. The purpose of the periodic plan is to have a focused approach with an assured budget for earmarked operations in any treatment area. The plan should align itself with existing guidelines and may incorporate inputs from various committees / experts suggested herein and schedule invasive plant management tasks for upcoming field season. There should be scope for minor adjustments to the treatment protocols or priorities prior to the next season (at least six months in advance) based on post season results and pre season planning as part of adaptive management cycle which would maximize the success potential.

B. PlanApprovals

8. *Approval of pro-rata by Competent Authority* – The local work study conducted in an approved work area facilitates in arriving FSL for that area. This FSL serves the basis for finalizing cost per unit area i.e., the pro-rata for that work area. The pro-rata for any treatment area is to be approved by a competent authority at the Circle level under whose supervision the entire exercise is to be performed and data recorded

9. *Approval of the treatment area, benchmark sites, and revegetation plan by Competent Authority* - The identified treatment area, benchmark sites, and revegetation strategy are to be approved by a competent authority at the Circle level.

10. *Approval of the Periodic Plan of Operation* – The PPO is a plan document comprising a series of annual action plans to be accomplished over a fixed time span with specified treatment prescriptions year after year. The prescriptions range from the whole gamut of operations from site protection, prevention, control and eradication of invasive plant to successful restoration of the treatment site including post-planting treatments. This document needs to be carefully planned with vision and needs prior approval from the competent authority at the Circle level.

C. IRR Plan Implementation

The implementation of invasive species removal and restoration by following a Standard Operating Protocol (SoP) / field manual will streamline the process of implementation. This SoP / field manual containing the step by step instructions to carry out the implementation of invasive species removal will help implementing partners to follow the approved operations in a fixed time schedule. This will form basic guiding document for labourers and implementing partners apart from the authorities, and the implementation shall be overseen by the District-level Implementation Committee proposed under this policy.

11. *Applying the approved IRR plan*– Having completed the preparatory phase with approval of the Invasives Removal and Restoration Plan and budget, the operative process comes into play with the field implementation and continuous monitoring. Capacity building of implementing staff is a priority before commencing the operations in the field. The actual exercise can be demonstrated in the field with the help of identified experts to give a hands-on experience to the field staff and personnel involved.

D. Continuous Monitoring

12. *Fixation of Monitoring Photo Points (MPPs)* –

Upon demarcating the area of treatment, it is highly essential to fix Monitoring Photo Points that are well defined on each site. Each MPP will have four points; the standing point and the photo point. The number of MPP per hectare can be 4 (four). Photographs will be captured at various stages of the implementation ie. before, during and subsequently after the removal process.

13. *Invasive Species Removal Journal (ISR Journal)* – Precise and elaborate data keeping should be an integral part of the invasive management programme. Record keeping facilitates historical evidence of activities and also ensures ways and means to compare results and improvise our future efforts in invasive plant management. An ISR journal, envisaged on the lines of a plantation journal is a step toward record-keeping to accurately and elaborately capture the entire invasive eradication process and may include the following particulars.

Check list of particulars to be incorporated in ISR Journal

- **a)** Brief description of the Landscape and Division
- **b)** Brief description of the treatment area (Basic details: boundary description, location, slope, altitude, vegetation structure, forest type with dominant species, major wildlife etc. and other notable characteristics)
- **c)** Topo sketch and location sketches of Treatment Area
- **d)** Details of Major invasive plants and density maps (Range and Division)
- **e)** Techniques adopted for removal (specify methodology)
- **f)** Composition of Native vegetation and ecological indicators (before and after Removal: Ecological indicators refers to an organism / organisms that can provide information about the health and sustainability of an ecosystem. For instance abundance of earthworms indicate good soil nutrient cycling; several birds and butterflies species indicate better habitat health.)
- **g)** Details of Monitoring Photo Points (enclose multiple photos statge-wise; before, during and after removal)
- **h)** Administrative and Technical sanction orders and Approval copies
- **i)** Nature of removable plant material and Rough estimate (if any) and method of disposal and benefits accrued (revenue) if any
- **j)** Details of implementing team
- **k)** Details of Perambulation team and report (Perambulation certification after Strip method).
- **l)** Suggested Composition of Perambulation team (wi th minimum 5 members):
  - ACF / Senior Range Officer,
  - Range Officer having jurisdiction
  - Forester having jurisdiction
  - Local expert / botanist, and
  - VFC / EDC representative
- **m)** Remarks
- **n)** Inspection notes of officials

14. *Perambulation by Strip method* – Once the removal operation is over, the area needs to be fully perambulated (100%) by a designated perambulation team. To have a proper assessment, the methodology recommended is strip perambulation by dividing the operative unit area into strips of uniform width say.10 m, wherein the team have to screen the entire strip area for new recruits of the same invasive species (reinvasion) or other invasive species (secondary invasion). The activity involves removal of the new recruits and counting them to see the magnitude of reinvasion / secondary invasion in any unit area so as to plan subsequent removal programme and restoration method in the same area. The time of perambulation is based on the germination vigor of the invasive species i.e., immediately after the removal process in the area.

15. *Perambulation Report* – The team headed by field superior (Forest Range Officer or Assistant Conservator of Forests) will prepare a report to the effect signifying the removal work carried out and the perambulation findings made. This will be incorporated in the IRS journal.

16. *Laying Monitoring Sample Quadrats* – As dispersal of invasive species is influenced by several factors, it is essential to monitor its influence in the AOUs in a long term basis to develop future course of scientific action. Hence, monitoring sample plots are to be laid at a sampling intensity of 1 plot of 10 m x 10 m for every 5 hectares. New recruits of same invasive species, secondary invasion, pioneers of native species, grass cover etc. are to be studied to facilitate restoration process.

17. *Evaluation Committee Report* – An evaluation committee preferably at the circle level is to be constituted to oversee and review the entire process and the committee shall submit report to the Circle Head.

Suggested Composition of Evaluation Committee (with minimum 3 members)

- **DFO / Division Head**
- **ACF / Senior Range Officer**
- **Local expert / Botanist**

18. *Periodic Maintenance* – Based on the field perambulation report and the Evaluation committee report on the Annual Operating Units (AOU), the plan for subsequent removal and other operations in the next year (first year) or the subsequent years (second, third, fourth and further) is formulated.

LEGAL AND REGULATORY FRAMEWORK

The formulation of this comprehensive policy with a legal framework aims in regulating political and social complications apart from the conflict of interests that the invasive species has created on various sections of the society including the socio-economic bearing. While curbing the prevailing species, the social and commercial services it renders currently imposes cost on the society and the Government. This policy envisages accounting the ecological security and sustainability needs with thrust on retrieving our natural areas from the deleterious effects of the invasive alien plant species by effective and adequate sensitization to overcome the impediments.

Invasive alien plant species have been a long persisting problem in Tamil Nadu owing to the large scale introduction of myriad species for various reasons (mostly commercial / socio economical) in the past whereas the negative impacts of their introduction and undesirable effects on natural spaces are little understood or being recognized much later and at a slower pace.

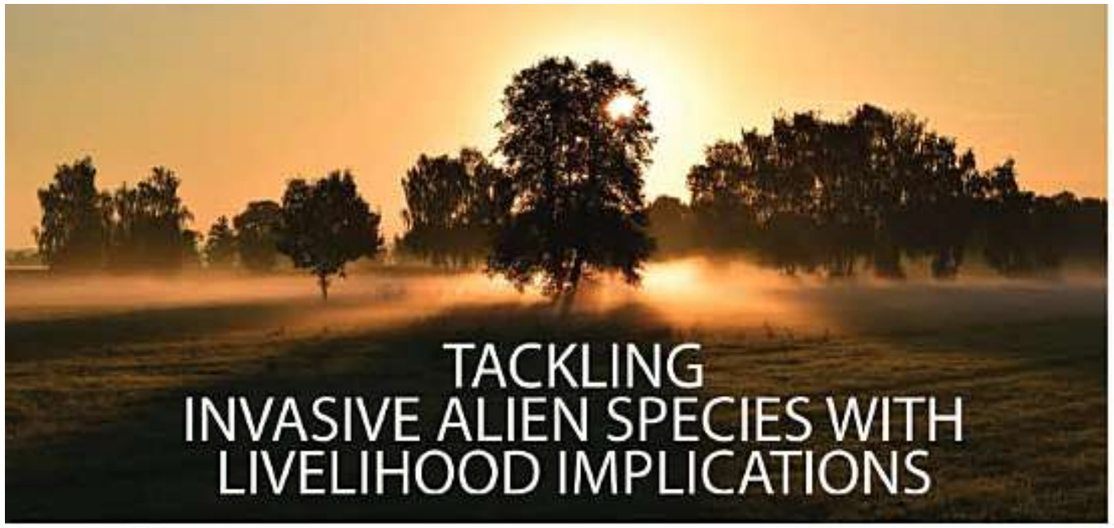
The policy aims to develop a uniform legal and regulatory approach that was not prevalent in the state. The regulatory mechanism will stress upon streamlining fund flow to avoid sporadic approach, thus, preventing re-invasion and secondary invasion in invasive cleared pockets adopting a holistic approach and continuous implementation.

The policy aims to collate the several agreements and negotiations in different international conventions, treaties and protocols including Convention on Biological Diversity, Convention of International Trade on Endangered Species of Flora and Fauna, International Plant Protection Convention, Convention of Migratory species, Ramsar Convention among others. Emphasis on invasive species made in these agreements will be laid upon and aggregated.

Several legislations are enacted within the mainland which are made with a purpose like The Plant Quarantine (Regulation of Import to India) Order 2003, Indian Biological Diversity Act, 2002, The Environment (Protection) Act, 1986, Agriculture Pests and Diseases Act, 1914, Wildlife (Protection) Act, 1972 etc.

The efforts to contain the invasives were fragmented and uncoordinated though the problems and impacts of invasive alien plant species cut across sectors such as Forestry, Horticulture, Agriculture, Environment and Commerce and the results have been short of the desired outcome.

As the spectrum of invasive problem is far and wide infringing the jurisdiction of various departments or wings of the Government and otherwise, an institutional mechanism with defined roles and responsibilities aiming at concerted effort to deal with the regulatory mechanism is the focus of this policy.



TACKLING INVASIVE ALIEN SPECIES WITH LIVELIHOOD IMPLICATIONS

Complete eradication of specific invasive alien species from the entire landscape of Tamil Nadu may raise associated issues when the species has other local uses that are not substituted. For example, *Prosopis juliflora*, despite not being cultivated, has spread over large area and is currently used by local people in the semi-arid to arid parts of the state for a variety of uses including construction materials, charcoal, fuelwood, and fodder (pods). Eradication of *P. juliflora* in such areas may increase pressure on adjoining forest areas to meet fuelwood and fodder needs and lead to degradation. The species may be eradicated over parts of the state including all Protected Areas, forested landscapes, and areas in and around wetlands, and in the wetter districts. However, considering the socio-economic aspects of the drier districts where livelihoods are entwined with *P. juliflora*, it is desirable to have a separate utilization-based management model for sustainable management and control of the species in these districts. A two-pronged model with different approaches may therefore be evolved for the two regions of the state.

REMOVAL OF INVASIVE PLANT MATERIALS FROM PROTECTED AREAS AND TIGER RESERVES

The activity of removal of invasive alien plant species is bound to generate substantial quantity of plant material which necessitates judicious intervention and proper disposal mechanism, which may facilitate ecological restoration efforts. For certain species mostly herbs and vines, green matter such as leaves / twigs may be heaped at the site or used as mulch, whereas significant amounts of woody material accumulated out of tree invasives have to be managed with caution.

Such woody material poses challenge to the wild animals in effective habitat utilization besides imposing the threat of fire hazards due to accumulation on the forest floor or in the vicinity of the removal site. In certain cases, the invasive plant material is an economic commodity. Invasive plant materials may also be important as fuelwood sources for the local community, and it is essential for the field managers to weigh the impacts of removal on demand and supply of fuelwood for local people and the risk of impending pressure on forests for fuelwood in the aftermath of removal of invasive woody stands from the vicinity of the villages.

The introduction of these invasive plant materials to prevailing markets as goods to fulfill various commodity needs may fetch monetary returns that can be ploughed back to the invasive species management and habitat improvement measures. However, the removal and use of such material poses managerial hurdles in Protected Areas due to statutory restrictions which needs revisit/ amendment or righteous interpretation. In order to augment the protection status of the forests, many Reserved Forests / priority conservation areas have been declared as Protected Areas i.e. wildlife sanctuaries, national parks and conservation reserves apart from declaring them as Tiger Reserves.

Under sub-section 12(B) of section 2 of the Wild Life Protection Act, 1972, all plants and plant materials whether found in or brought from a forest comes under the definition of forest produce. Consequently, invasive alien plants and their plant parts too fall within the ambit of the said definition. This brings them under the purview of Section 29 of the said Act which implants curbs on the exploitation or removal of any forest produce from a Protected Area except for meeting the personal bonafide needs of the people living in and around. In order to implement the invasive alien plant species removal and ecological restoration efforts in such areas, this policy proposes that all invasive plants enlisted in this policy shall be legally exempted from the definition of Forest Produce to enable easing of implementation of this policy. It is further suggested that:

a) the material is removed following approved protocols and followed by ecological restoration process as elaborated in this policy

b) the material is removed by the Government agency in a manner as prescribed by the Nodal Agency.

c) the material is handled, sold, stored, utilized, or otherwise disposed of by the Government agency in a manner as prescribed by the Nodal Agency in an evolved mechanism wherein the fund so generated shall be used for implementation of IRRP and habitat improvement activities.

d) Where the proper removal or exploitation of the material is unfeasible (such as due to steep slopes, inaccessible locations etc.), the material may be deployed on site to provide mulch, or placed along contours to prevent erosion and conserve soil moisture, or in any other such way as prescribed by the Nodal Agency for such cases.

JUDICIAL CLARIFICATION ON REMOVAL OF INVASIVE SPECIES FROM PROTECTED AREAS AND TIGER RESERVES

The Honorable High Court of Madras while hearing the Writ Petition WP(MD) No. 7606/ 2017 and other batch cases on 19th April 2022, initiated a detailed deliberation on the scope and applicability of section 29 of the Wildlife (Protection) Act, 1972 on the removal of invasive species and exploitation of surplus plant material.

The Court referred to an earlier order of the Division Bench of the same Court dated 11.01.2019 which held as follows:

During the course of arguments, a doubt has been raised on the scope and applicability of Section 29 of the Wildlife (Protection) Act, 1972 and it has been stated that probably permission from the National Board of Wildlife is required for the approval of commercial allotment of the surplus materials of the exotic species. We do not think so. The aforesaid provision has got no application for the steps taken in protecting the forest by removing the alien species. Therefore, for removing the alien species, Section 29 of the Wildlife Protection Act, 1972 would not be a bar. Further, the amount augmented will be used only for the laudable object of removal of exotic species along with the rehabilitation. When once species is termed to be invasive then it has to be necessarily removed. A commercial usage is only secondary. By one stroke, we can augment income by a successful process of eliminating the invasive species, create employment, reduce transport cost apart from efficient utilization. It may also enhance employment generation and opportunities. Further, this might preempt the illegal cutting and usage of forest trees as energy. The learned Counsel appearing for the Standing Committee of National Board for Wildlife has got no objection for utilizing the removed species. In fact, it is the specific case of the State Government that the recommendation made by the Basuviah Committee is being implemented. The process of removal has already begun. After all, one has to keenly look at the object of the enactment, including the Forest Conservation Act 1980 and the mandate of the Constitution, which is to protect the environment.

The Hon'ble Court found it also relevant to note the clarifications offered by the Hon'ble Supreme Court of India in T. N. Godavarman Thirumulpad (89) Vs. Union of India and others ((2006) 10 Supreme Court Cases 486) as follows:

"None of the States has filed any objection to the recommendations of CEC made in paras 14 and 15 in relation to clarification about allowing conservation and protection related activities for better management of the protected areas. The recommendations contained therein are, accordingly, accepted and the order dated 14-02-2000 [T.N.Godavarman Thirumalpad (27) v. Union of India, (2002) 10 sec 634] is clarified accordingly. Accepting the said recommendations, we direct as under:

A) Various activities such as removal of weeds, clearing and burning of vegetation for fire lines, maintenance of fair weather roads, habitat improvement, digging temporary waterholes, construction of antipoaching camps, chowkies, checkposts, entry barriers, water towers, small civil works, research and monitoring activities, etc. are undertaken for protection and conservation of the protected areas and therefore permissible under the provisions of Section 29 of the Wildlife (Protection) Act, 1972. These activities are necessary for day to day management of the protected areas besides they do not involve any type of commercial exploitation.

The activities above mentioned are permissible under the various provisions of other environmental laws as well.

B) The order dated 14-02-2000 [T.N.Godavarman Thirumalpad (27) v. Union of India, (2002) 10 sec 634] will not be applicable to the following activities provided that they (i) are undertaken as per the management plan approved by the competent authority; (ii) are consistent with the provisions of the Wildlife (Protection) Act, 1972; (iii) are undertaken consistent with provisions with the National Wildlife Action Plan; (iv) are in conformity with the guidelines issued for the management of the protected areas from time to time; and (v) the construction and related activities are designed to merge with the natural surroundings and as far as possible use forest friendly material.

Habitat improvement activities

Weed eradication, maintenance and development of meadows/grassland required for wild herbivores which are prey base for the carnivores, digging and maintenance of small waterholes and small anicuts, earthen tanks, impoundment of rain water, relocation of villages outside the protected areas and habitat improvement of areas so vacated'

In the light of the above, the Court summarised that invasive plants are weeds which degrade the natural ecosystem and remarked that the Hon'ble Apex Court itself has granted permission for removal of weeds for protecting the entire forest. Further the Hon'ble High Court has clarified that there need not be any apprehension on the part of the Department for removing alien invasive plants which are threat to the existing forest cover.

Accordingly, the Hon'ble High Court issued the following directions for compliance.

a) Invasive alien species can be removed from protected areas namely Tiger Reserves, Sanctuaries and National Parks in the State of Tamil Nadu and the same can be sold in open market at competitive price;

b) The sale proceeds realized by selling the invasive species should be maintained in a separate corpus account to be informed to this Court. The periodical statement of the removal of exotics consisting of the area of removal, quantity of invasive species removed and sold and sale proceeds realized thereof should be filed once every three months before this Court;

c) The details of expenses incurred out of the amount realized by selling the removed invasive alien species towards further removal including the extent thereof, maintenance of habitat and restoration of endemic species should be filed before this Court once in 3 months;

d) The local tribal communities shall be given the first choice for utilizing the removed invasives for making furniture out of *lantana* and other value additions;

e) Allotment of invasive species to the State owned Corporation like TANTEA, TNPL, etc., should be prioritized.

f) Local tribal people should be engaged in removal of Invasive species and first priority to be given to them.

The Hon'ble High Court through this decisive and befitting judgement has sent out a strong message that the very object of removal of invasive alien species is very closely aligned with the protection of the flora and fauna. Further the State Government is entrusted with the onus of complying the above directions scrupulously without awaiting any permission as required under section 29 of Wildlife Protection Act, 1972.

This order clarifies that

- The invasive removal and disposal can be done commercially to facilitate large scale removal of invasive alien species in any type of forest area.
- The income so generated needs to be parked with the Forest Department through VFCs, EDCs, ETMCs, Foundations etc., which are local registered organisations of the department and be ploughed back for conservation and further habitat enrichment.
- The involvement of tribal communities in invasive removal and restoration has to be encouraged and facilitated.

The important directions provide legal remedy to the restrictions so interpreted in the Wildlife Protection Act and paves way for smooth and speedy execution of invasive removal and disposal enabling commercial exploitation in the larger interest of protection of forests and wildlife.

CAPACITY BUILDING, TRAINING AND OUTREACH

As there may be conflicting interests involved in efforts against ecosystem degradation through tackling invasive species Vs community benefits from the invasive plant species, outreach to communities to educate them on the ill effects and negative impacts of invasive species on ecosystems and local biodiversity is required. Greater emphasis needs to be placed on ecosystem restoration from invasives through public involvement and coordinated actions.

Involving competent institutions, right infrastructure, right information, traditional knowledge, trained personnel with appropriate skill sets, technology, apart from knowledge on the ecology and biology of the invasive plant species and its ecosystem impact are necessary for setting effective management. Capacity building training, information exchange and networking are therefore of utmost significance for judicious management of invasive species.

It is essential to demonstrate a holistic approach to all stakeholders through scientific outreach methods and training that can strengthen the functional capacity of all stakeholders individually and collectively.

ACTION POINTS FOR CAPACITY BUILDING, TRAINING AND OUTREACH

The following actions with targeted results can be undertaken for capacity building, training, and outreach:

- Comprehensive scientific understanding of invasive alien species and ecological restoration should be inculcated to students and trainees in Forestry, Agriculture, Horticulture, and Development sectors by incorporation of relevant material developed by research institutions into their respective curriculum in State Forestry Colleges, Agricultural Universities and other related Departments
- Efforts are required to build the functional capacity of all the stakeholders with primary emphasis on the managers involved in invasive alien species management through regular trainings and other efforts, including certificate courses and workshops conducted by scientists and managers with experience in ecological restoration and invasive species management
- Action plan to prohibit cultivation or planting of invasive alien plant species in the state, including in Government and private nurseries, Government and industrial campuses and sites, forest areas, and remove or destroy existing invasive alien plant species in these nurseries and sites
- Creation of an open-access online database and portal on casual alien, invasive alien, naturalised, and cryptogenic species of Tamil Nadu is a crucial need
- A photographic field guide to alien and invasive alien plant species with guidance on basic concepts can be developed to serve as a basic reference guide to the managers, regulators, and other stakeholders

- Establishing linkages with research and academic institutions to gain technical knowledge, research results and dissemination of information on the invasive species
- Research on alien and invasive alien species in natural and man-modified ecosystems of Tamil Nadu can be encouraged through various channels including facilitating permits for research in Protected Areas and coordinated multi-institution long-term monitoring efforts, and creating a fund or grants-in-aid for research on invasive alien species
- Knowledge on the Acts and Rules, regulations, protocols and guidelines framed for the purpose need to be imparted to all the stakeholders
- Phyto-sanitary measures need to be diligently developed as protocols and conveyed through outreach to all stakeholders
- Inter-departmental training programs are to be organised to facilitate free information exchange, rapport, and coordinated efforts
- Technical Support Groups are to be created with strong network among them for active sharing of information and challenges
- Sensitization and education of student communities for building future social consciousness by incorporating the subjects of invasive alien species and ecological restoration into school and college curricula is required, with education to be imparted through trained personnel
- E-commerce platforms need to be educated and screened for non-native plant species trade, and legally prohibited from trading in invasive alien species and regulated in trade in other species
- Product development from invasive plant material are to be promoted through coordinated research activities involving the various stakeholders

PARTNERSHIPS AND STAKEHOLDERS

Effective management of invasive alien plant species requires involving and working in partnership with a range of stakeholders. Invasive alien plant species have entered Tamil Nadu through various introduction pathways, chiefly horticulture, imports for industrial uses, forestry, and agricultural escapes. Once introduced, invasives expand and spread due to multiple factors such as disturbance to habitats, water impoundments, linear infrastructure intrusions, and nurseries and horticultural trade. Tackling invasives thus requires the involvement of multiple sectors, both for prevention of future introductions and containment and control of existing invasives.

The ornamental horticulture industry (including Botanical Gardens, nursery owners, Horticulture Department and related institutions, and landscapers) is a key stakeholder as this is the major pathway for the introduction of alien plant species across the globe, across the nation and across the state. An important task to undertake is a comprehensive weed risk assessment of plants in cultivation in the state, to identify species that are safe versus those that pose potential invasion risk. Nursery owners and other stakeholders would need to be made aware of the serious risks and be brought on board through outreach and incentives to avoid further propagation and sale of high risk species / invasive alien species and regulate the sale of other risky species.

Besides the Horticulture sector, other key sectors to involve as stakeholders in this process include Government Departments and institutions related to agriculture, forests, biodiversity, public works, highways, tourism, and education. A stakeholder engagement matrix is presented below indicating key stakeholders and corresponding aspects. They may be involved in or partnered within efforts to remove invasive alien species and carry out ecological restoration. Stakeholder engagement under this policy will specifically aim to and promote:

- Better understanding and awareness of invasive alien plant species of Tamil Nadu and their impacts and need for management and ecological restoration
- Enhanced scientific information generation and knowledge exchange with stakeholders
- Education and outreach to achieve a shared understanding of the roles and responsibilities of government, civil society, local communities, and industry in invasive alien species removal and restoration efforts
- Continuous research and monitoring and an adaptive management approach to invasive alien species removal and restoration programs
- Strategic collaborations among stakeholders for better invasive alien species management and ecological restoration outcomes.

Stakeholder engagement matrix (all relevant stakeholders are marked with a X, and key stakeholders for specific aspects are marked as **)

Stakeholder	Preventing introductions	Planning invasive removal and restoration	Implement-ation of removal and restoration	Disposal and use of removed materials	Research and monitoring	Education and outreach
State Government	**	X	X	X		
Forest Department	**	**	**	**	**	**
State Biodiversity Authority	**	**	X	X	X	**
Horticulture Department	**	X	X			**
Botanical Gardens	**	X	X			**
Agriculture Department	**	X	X			**
Highways	X	X	X			X
Electricity	X	X	X			X
Public Works	X	X	X			X
Tourism	X					X
State-level Invasives Committee	**	**	X	**	**	**
Local-level Invasives Committee	X	**	**	**	**	**
Forest Dwellers and Local Communities	**	**	**	**	**	**
Plantation Boards and estates (Tea, Coffee, Rubber, Spices etc)	**	X	X	**	X	X
Research Institutions (Govt. and NGO)	X	**	**	X	**	**
Civil Society and Community Organisations		X	**	**	X	**
Nurseries	**	X	X			X
Private Land owners	X		X			X
Institutional Campuses (Govt And private)	**		X			X
Commerce and Industry	**	X	X	**		X
National agencies including Customs Department, Airport and Port Authorities, and National Bureau of Plant Genetic Resources	**	X			X	**

RESEARCH, MONITORING, EVALUATION, AND REPORTING

Invasive alien plant species management and ecological restoration are science-based programs that need close and systematic research, monitoring, evaluation, and reporting (RMER). This can help identify and assess risks and impacts of invasive alien species, appropriate and effective removal and restoration methods, assess efficacy of removal and restoration methods by monitoring recovery, identify best practices and standard operating procedures (SOPs), and determine suitable uses of removed and disposed plant material. RMER can assist in adaptive management, by which the results of monitoring and evaluation are used to inform, guide, and even reorient invasives management and ecological restoration methods. It can also be used to identify, track, and measure community benefits and involvement in these efforts.

In Tamil Nadu, there are many dedicated organisations, academic institutions, and Universities involved in research on invasive species whose results can guide the management of invasive alien plant species. Universities and colleges, research institutions under government departments (State Forest Research Institute, Institute of Forest Genetics and Tree Breeding, and Forest College and Research Institute) and boards (e.g., Tea Research Institute, Horticulture College and Research Institute etc.), and NGOs (e.g., Keystone Foundation, ATREE, Nature Conservation Foundation, WWF etc.) may be encouraged and supported to develop long-term research and monitoring programs. Utilising their expertise and knowledge is vital to help achieve the goals of this policy and identify and adopt the best ways and means to do so effectively and within a shorter time frame.

Inter-departmental linkages with assigned responsibilities are a precursor to proper implementation. Importantly studies on economic and ecological costs to the natural ecosystems and cropping systems due to invasive alien species are to be encouraged and reports compiled. The problem of invasive species in natural habitats have to be tackled scientifically based on vetted action plans supported by accepted principles and practices, continuous monitoring and dedicated funding mechanisms aimed at phased removal and restoration. The knowledge and experience of local communities, particularly forest dwellers and tribals, can also be tapped into, and the local people involved in research and monitoring efforts.

Research should also focus on identification of suitable replacement native species for invasive alien species in current use as firewood, shade, pulpwood etc. This may include research to identify and propagate native species that can serve as alternative fast-growing firewood species, shade tree species in plantations, avenue trees, fodder, medicinal and pulpwood/ industrial species.

Citizens also need to be involved in research and monitoring through citizen science efforts such as through existing portals (India Biodiversity Portal, iNaturalist) or by developing customised mobile apps and information systems specifically for the purpose of invasive alien species research and monitoring. This will allow any interested citizen to report occurrence of species, document distribution, abundance patterns, and aspects such as phenology (flowering, fruiting, seed set) patterns across the state.

INFRASTRUCTURE AND INSTITUTIONAL FRAMEWORK

The complex task of managing invasive alien plant species requires supporting infrastructure, supporting funding mechanisms, and a robust institutional framework for implementation by governmental agencies and other stakeholders. The institutional arrangements outlined here are based on the shared responsibility of different stakeholders, and proposes a stratified arrangement at two levels viz., a state-level nodal agency and committee, and district level committees. The objectives and operations of these institutional arrangements may evolve in future based on the needs and current challenges at that point in time.

NODAL AGENCY FOR INVASIVE ALIEN SPECIES
(STATE COORDINATING AUTHORITY)

The Tamil Nadu Biodiversity Board will function as the Nodal Agency in implementing and coordinating all matters related to this policy. It shall serve as the state level institution in this regard. The Nodal Agency shall have the following major roles:

- It shall directly address the invasive plant species related issues and bring it to the knowledge of the government and / or provide advice for immediate / recommended actions.
- Constitute a state-level Invasive Alien Plant Species Advisory Committee as outlined below.
- Coordinate a biennial estimation on invasive alien plant species and their spread / distribution in the forest areas of Tamil Nadu, involving the Tamil Nadu Forest Department, Research institutions, NGOs, and other stakeholders including the general public

State Level Advisory Committee

A standing advisory committee is to be constituted at state level to perform advisory roles to the Government in all spheres of invasive alien plant species and its management. The committee shall constitute the following members / institutions.

Chairperson	Member Secretary, Tamil Nadu Biodiversity Board
Member	Director, Department of Environment
Member	Director, Department of Agriculture
Member	Director, Department of Horticulture
Member	Director, Department of Animal Husbandry
Member	Vice Chancellor,Tamil Nadu Agricultural University
Member	Nominee from the Law Department (not below Joint Secretary level)
Member	Nominee from the Finance Department (not below Joint Secretary level)
Member	Nominee from the Transport Department (not below Joint Secretary level)
Member	Nominee from the Public Works Department (WRO) (not below Joint Secretary level)
Member	Nominee from the Natural Resources Department (not below Joint Secretary level)
Member	Nominee from the Tourism Department (not below Joint Secretary level)
Member/(s)	Two members from governmental institutions having expertise in management and research on invasives
Member/(s)	Three experts (non-governmental) in the field of invasive management, restoration ecology and biodiversity
Member Secretary	Chief Conservator of Forests (Research) nominated by the Principal Chief Conservator of Forests.

Special invitees and subject experts may be called for meetings based on need for assistance in the respective subjects including members from other Departments such as Customs, Highways, etc.

Functioning of the committee: The Nodal Agency will develop rules for functioning, including frequency of meetings, quorum, formulation of agenda and minutes, website etc.

Mandate of the committee: The advisory committee shall look into the following areas

a) Identify and innovate methodologies for invasive plant species control, disposal, and ecological restoration

b) Identify, screen, assess, prohibit or regulate materials involving alien or invasive alien plant species or their introduction and use in the state

c) List or de-list any plant species as native, casual alien, invasive alien, naturalised, or cryptogenic for the state of Tamil Nadu based on research findings and maintain an up-to- date comprehensive and open-access database of the same

d) Develop and monitor co-odination at state level

e) Establish inter-governmental coordination and relationships and inter-state collaboration in invasive alien species management

f) Conduct weed risk assessment on various plant species identified as potential species of invasive character

g) Direct, conduct or coordinate institutions to perform Environment Impact Assessment in various projects in relation to invasive alien plant species risk dimension

h) Advice on decisions involving trans - boundary transactions

i) Evolve methodologies, policies, legal innovations and others for invasive plant species management

j) Impart and promote research, education and development in addressing invasive alien species related subjects

k) Promote location specific plans and thematic plans in management including tourism, trade etc.

l) Examine and coordinate inter-departmental activities and projects

m) Anticipate and handle invasive plant species related threats and risks

n) Coordinate institutes and organizations in implementing the policy

o) Encourage database development in invasive plant species spread, control measures, management and its impact on biological, social, cultural, economical and ecological aspects

p) Promote eco-friendly approaches and informed ecological restoration of natural ecosystems using native species appropriate to each local ecosystem as part of invasive alien species management

q) Identify stakeholders and interface and involve them in relevant aspects of the policy

r) Standardize effectiveness in all spheres

Apart from the above, the committee will focus on any matter pertinent to invasive alien plant species and their management to render necessary advice to the government.

DISTRICT LEVEL IMPLEMENTATION COMMITTEE

District level committees play a crucial role in institutionalizing implementation of the invasive species policy. District level committees are mandated to look after the implementation process, identify vital challenges, monitor long term changes, and evaluate the implementation and its progress. The District level committees shall work in coordination with the state-level committee under the overall umbrella of the Nodal Agency. The District level committee shall comprise of the following members:

Chairperson	Conservator of Forests heading the concerned circle
Member	District Collector of the respective district
Member	One member from the field of Botany from recognized government institution in the circle / district
Member	One member from the Department of Agriculture / Horticulture / Animal Husbandry/ land owning Department in the circle / district
Member	Two non-governmental members from the field of ecological research, preferably with experience in ecological restoration and invasive alien species management
Member	Two non-governmental members: one from an organisation engaged in social work or livelihoods, and one representative from local gram sabha
Member(s)	All DFOs / Division heads (except the senior-most) having forest jurisdiction in the district
Member Secretary	Senior-most District Forest Officer / Wildlife Warden / Deputy Director having forest jurisdiction in the district

Functioning of the District committee: The Nodal Agency will develop rules for functioning, including frequency of meetings, quorum, formulation of agenda and minutes, website etc.

Mandate of the District committee: The committee shall look into the following areas

a) Implement the Invasive Removal and Restoration Protocol (IRRP)

b) Evaluate the outcome of implementation and express course correction

c) Ensure documentation of the implementation in the long-term scale

d) Identify field challenges and apprise the state- level committee

e) Implement the mandates imposed by the state-level committee and the Nodal Agency

f) Adopt eco-friendly approach in implementation with ecological restoration

g) Coordinate local institutions and agencies

h) Constitute local implementation committees if required for different areas within the District

i) Develop field methodologies and strategies with findings to take it to the state-level committee for standardization

BIENNIAL ESTIMATION

The invasive nature of a plant species is expressed immediately or even after several years of its introduction. Identifying the species, its life history, including growth, development, means of reproduction and dispersal, spread potential, preferred habitat and climatic tolerance, its native distribution and current world distribution and many other parameters play a significant role in expression of the species as invasive.

It is essential to assess the expression of the species in the ecosystem in terms of its distribution, abundance, and impacts.

A biennial estimation of the spread of invasive plant species is to be planned and the Nodal Agency will coordinate the state-wide estimation within forest areas. Methods of estimation will be defined and standardized by the Nodal Agency. Once the procedure is standardised this exercise shall be dovetailed with regular field monitoring programmes such as state wide wildlife census etc. in order to minimize associated financial expenses involved in undertaking this exercise separately. The Nodal Agency shall aim to involve or utilise scientific institutions, NGOs, citizen-science, and digital tools to support the biennial estimation.

FINANCIAL MANDATE

Accomplishing the policy objectives depends critically on the financial mandate and support for the required tasks and activities and institutional and infrastructural arrangements. The funds created through the financial mandate and made available to the stakeholders will enable the institutional arrangements and mechanisms to become operative. The government shall explore ways and means to allocate funds to implement the policy and support its sustained implementation. Many prescriptions of this policy shall be implementable by a committed and assured funding mechanism that covers all required aspects including:

1. Technological interventions including invasive alien plant species mapping
2. Weed risk assessments
3. Environmental Impact Assessments
4. Incentives to land owners and other stakeholders in non-forest areas
5. Capacity building and support for Nodal Agency and state-level and district-level committees
6. Biennial estimation of invasive alien plant species in forest areas
7. Implementation of Invasive Removal and Restoration Protocol (IRRP)
8. Stakeholder and institutional collaborations
9. Research partnerships and grants
10. Operationalisation of the institutions proposed in the policy
11. Digital resources including web-enabled and open access data base
12. Publications
13. Outreach Programmes
14. Trainings, Symposiums, Workshops
15. Any prescription interpreted from the policy

POLICY LIMITATIONS

Management of invasive alien plant species is a complex subject that needs a focused and dynamic approach based on previous studies and field experiences. The phenological and ecological character of the alien species in a new territory are subject to modification, both temporally and spatially and hence information updates from field managers and researchers, and synthesis of relevant literature are most essential. An understanding of changes in spatial and temporal distribution and abundance of invasive alien plant species is also crucial. The present policy has tried to incorporate current scientific understanding, available literature, and field experiences, but as comprehensive scientific information and practical experience on all the above aspects are as yet limited, this forms a limitation of the present document as well. The formulation of a policy for the prevention, control and containment of invasive alien plant species necessitates deep understanding of the invasive problem, collaboration with various stakeholders both governmental and non-governmental, a reading of global literature and experiences, and a broad understanding of various scientific concepts in addition to the substantial investment in time and finance.

This pioneering policy on invasive alien plant species of Tamil Nadu addresses the terrestrial alien invasive species of flora alone, leaving aside the faunal part as well as the marine invasive problem for which a separate effort is required.

This document has tried to take into account the existing modalities and monitoring protocols in the field of invasive species management in the forest landscape of Tamil Nadu. While proposing management of invasive alien plant species due care has been taken to formulate management actions that have least detrimental effect on the wilderness character and local livelihoods. Although identification of best practices / SoP falls part of objectives herein, the species wise portfolio is not included here. Instead the broader policy aspects are discussed and the species wise intervention can better be taken up as a separate exercise.

Whereas satisfactory control strategies for several existing problematic species are yet to be established, the policy also takes into account the nascent stage of research on several new invasive plants as well as on bio-control methods for the target species and therefore, a need may arise for periodic course correction and revision of this policy.

In short, this policy document is conceived to provide direction for identifying and applying appropriate management interventions for invasive species management including prevention, eradication, control, containment and restoration.

RECOMMENDATIONS AND WAY FORWARD

The following key recommendations are proposed under the Policy:

1. The policy proposes Tamil Nadu Biodiversity Board to be designated or established as the Nodal Agency which will look at the policy implementation. The Nodal Agency shall be empowered as an authority to develop, manage and implement aspects of this policy which includes listing and delisting of species, issuing notification and developing protocols and guide lines for invasive alien species of Tamil Nadu, provide information and technical advice to the state government and mainstreaming international and national obligations into state and district policies, programmes and action plans.

2. Integration of invasive alien species management is required in multiple government working plans and schemes including:

a. Management and Working Plans: Invasives management plans need to be integrated within Tiger Conservation Plans (TCP) of Tiger Reserves, Management Plans of Wildlife Sanctuaries and National Parks, and Divisional Working plans of the Tamil Nadu Forest Department. To ensure this, local restoration experts or members of the invasive management committee can be made part of the TCP, and management or working plan development teams.

b. Human Wildlife Conflict Mitigation Schemes: Invasive species management needs to be made an integral part of Human Wildlife Conflict mitigation schemes / measures since colonization of wildlife habitats by Invasive species displaces wildlife and are regarded key drivers to the conflicts. As part of habitat improvement measures, control and management of invasive species can be taken up resorting to funds available for addressing the Human Wildlife Conflict.

c. Watershed and River Rejuvenation plans: Invasive alien plant species, especially in the upper catchments of river basins, can have substantial hydrological impacts and therefore river rejuvenation and watershed development programs need to incorporate attention to invasive alien species removal and ecological restoration. This can be important for key rivers and river rejuvenation projects like Nadanthai Vazhi Cauvery Scheme, and the Noyyal and Vaigai rejuvenation projects.

d. Wetlands Management Plans: Under the National Wetlands Rules, 2017, Tamil Nadu is pursuing the identification, notification, and development of integrated management plans for 100 wetlands in Tamil Nadu. Aquatic invasive alien species management should be integrated within these integrated management plans. Local experts on invasive alien species and restoration may be included within the state and district wetland management committees to enable their better integration with this invasive policy.

e. MGNREGA Scheme: Invasive alien plant species management and ecological restoration activities can be included under Mahatma Gandhi National Rural Employment Guarantee Act and scheme (MGNREGA). This will boost availability of funds and manual labour available for the work, besides providing livelihood opportunities and creating local assets such as native plant nurseries, watershed protection and revival.

f. CR/ CFR Plans under FRA: Invasive alien species also affect forest-dwelling communities, since they influence grazing lands, fuel and fodder needs, and non-timber forest produce (NTFP) availability. Where Community Rights (CR) and Community Forest Rights (CFR) have been settled under The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA, 2006), communities can be encouraged to take up invasive alien plant species management as part of their CR/ CFR management plans.

g. CAMPA Activities: Funds under the Compensatory Afforestation Management and Planning Act (CAMPA) can also be leveraged for invasive alien plant species management, including plans for implementation and monitoring, periodic plan of operations, weeding and site maintenance in the long-term.

3. A unified and stringent quarantine protocol for the state for regulation of introduction of all non-native species.

4. Sensitisation of the implementing agencies and stakeholders on the regulatory framework with due thrust on inter agency cooperation and interstate coordination.

5. Capacity building and refresher training of agencies involved in regulation and quarantine in state borders, airports, sea ports etc., to fortify and prevent any unauthorised or ignorant admission of any invasive species of flora and fauna and their propagules.

6. Preparation of manuals for field identification and management protocols for invasive alien plant species of Tamil Nadu.

7. A comprehensive and credible open access database on invasive alien plant species and their pathways accessible to the implementing agencies for prompt, pro-active early response and swift action.

8. Prohibition of cultivation, stocking, or planting of invasive alien plant species in government (including Forest Department) nurseries and private nurseries, botanical gardens, and campuses of Government and educational institutions, and in industrial sites and campuses, and the safe removal and disposal of existing stock of these species in the state.

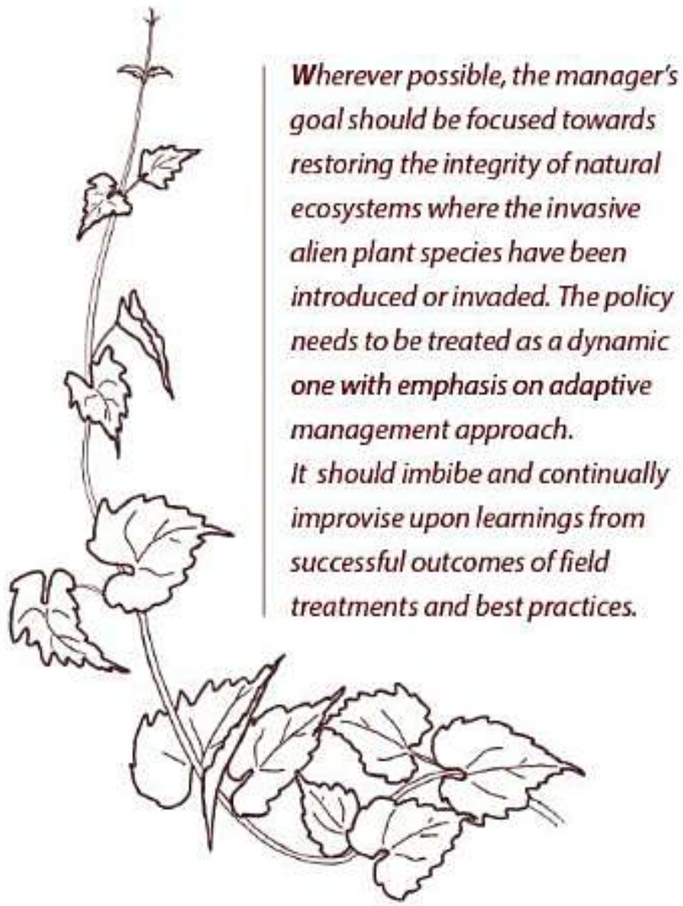
9. Protocols for forest surveillance for alien species on a periodic basis need to be developed by the Forest Department.

10. Simplified and streamlined mechanisms to accept funds from Corporate Social Responsibility need to be developed apart from other innovative funding mechanisms.

11. Spreading awareness on the ill effects and impacts of invasive species among private individuals, traders, other agencies, farmers, public thereby coordinating them for managing invasives in their lands and other sources to have focus on non-forest lands especially those abutting forests. Specific legal procedures shall be developed to bind such groups to eradicate the invasive species from their premises. Land owners may also be incentivized to cultivate earmarked indigenous species.

12. Regulation of e-commerce and other trade needs to be focused to prevent introduction and transit of invasive species through these means.

13. Wherever necessary, legal impediments hurdling strategies to invasive species management need to be amended for enforcing regulation smoothly.



Wherever possible, the manager's goal should be focused towards restoring the integrity of natural ecosystems where the invasive alien plant species have been introduced or invaded. The policy needs to be treated as a dynamic one with emphasis on adaptive management approach.
It should imbibe and continually improvise upon learnings from successful outcomes of field treatments and best practices.

REFERENCES

Adhikari, D.,Tiwary, R. & Barik, S.K. (2015). Modelling Hotspots for Invasive Alien Plants in India. PLOSONE, 10 (7), e0134665. https://doi.org/10.1371/journal.pone.0134665

Arigela,R.K., Singh,R.K., Kabeer, K.a.A., Murthy, G.V.S., & Robin, V.V.(2019). Phyto diversity Inventorisation and Mapping of Shola Grasslands of Kodaikanal Wildlife Sanctuary, Western Ghats, India. Indian Forester, 145(3), 214–226. https://doi.org/10.36808/if/2019/v145i3/14445

Gann, G. D., McDonald, T., Walder, B., Aronson, J., Nelson, C. R., Jonson, J., Hallett, J. G., Eisenberg, C., Guariguata, M. R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N.,Decleer, K., & Dixon, K. W. (2019). International principles and standards for the practice ofecological restoration. Secondedition. Restoration Ecology,27(S1), S1–S46. https://doi.org/10.1111/rec.13035

ICFRE. (2020). Important invasive alien species in forests of India: Status and management. Indian Council of Forestry Research and Education.

Inderjit, Pergl, J.,vanKleunen, M.,Hejda, M.,Babu, C.R,Majumdar, S.,Singh, P.,Singh, S.P.,Salamma, S., Rao, B. R. P., & Pyšek, P. (2018). Naturalized alien flora of the Indian states: Biogeographic patterns, taxonomic structure and drivers of species richness. Biological Invasions, 20 (6), 1625– 1638. https://doi.org/10.1007/s10530-017-1622-y

Joshi, A.A., Mudappa, D.,& Raman, T.R.S.(2009). Brewing trouble: Coffee invasion in relation to edges and forest structure in tropical rain forest fragments of the Western Ghats, India. Biological Invasions, 11(10),2387–2400. https://doi.org/10.1007/s10530-009-9423-6

Joshi, A. A., Mudappa, D., & Raman, T. R. S. (2015). Invasive alien species in relation to edges and forest structure in tropical rainforest fragments of the Western Ghats. Tropical Ecology, 56(2), 233–244.

Khuroo, A. A., Reshi, Z. A., Malik, A. H., Weber, E., Rashid, I., & Dar, G. H. (2012). Alien flora of India: Taxonomic composition, invasion status and bio geographic affiliations. Biological Invasions, 14(1), 99–113. https://doi.org/10.1007/s10530-011-9981-2

Kohli, R.K.,Batish, D.R.,Singh,J.S., Singh,H.P., & Bhatt, J.R.(2012). Plant invasion in India: An overview. In J. R. Bhatt, J. S. Singh, S. P. Singh, R. S. Tripathi, & R. K. Kohli (Eds.), Invasive alien plants: An ecological appraisal for the Indian subcontinent (pp. 1–9). CABI, Walling ford. https://doi.org/10.1079/9781845939076.0001

Lenzner, C., B.,Pergl,J.,Pouteau,R.,Pyšek,P.,Winter,M.,Ebel,A.L.,Fuentes,N.,Glehl,E.L.H., Kartesz, J., ... van Kleunen, M. (2021). The global loss of floristic uniqueness. Nature Communications, 12(1), 7290. https://doi.org/10.1038/s41467-021-27603-y

Love, A., Babu, S., & Babu, C. (2009). Management of Lantana, an invasive alien weed, in forest ecosystems of India.Current Science, 97,1421-1429

Martens, C., Deacon, G., Ferreira, D., Auret, W., Dorse, C., Stuart, H., Impson, F., Barnes, G., &Molteno, C. (2021).A practical guide to managing invasive alien plants: A concise handbook for landusers in the Cape Floral Region.WWFSouth Africa.

Mudappa, D., & Raman, T. R. S. (2010).Rainforest Restoration: A Guide to Principles and Practice.Nature Conservation Foundation, Mysore.

Narasimhan, D., Arisdason, W., Sheeba, J. I., & Gnanasekaran, G. (2009). Invasive alien plantspecies of Tamil NaduIn Proceedings of the National Seminar on Invasive Alien Species (pp.29–38).ENVIS Centre, DepartmentofEnvironment, GovernmentofTamilNadu.

Narasimhan, D., & Irwin, S. J. (2021).Flowering plants of Tamil Nadu: A compendium. Care Earth Trust,Chennai.

Olson,D.M., Dinerstein,E.,Wikramanayake,E.D.,Burgess,N.D.,Powell,G.V.N.,Underwood, C., D'amico, J. A., Itoua, I., Strand, H. E., Morrison, J. C., Loucks, C. J., Allnutt, T. F., Ricketts, T. H., Kura, Y., Lamoreux, J. F., Wettengel, W. W., Hedao, P., & Kassem, K. R.(2001). Terrestrial

Ecoregions of the World: A New Map of Life on Earth: A new global map of terrestrial ecoregionsprovides an innovative tool for conserving biodiversity. BioScience, 51(11), 933–938.https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Pant,V.,Patwardhan,C.,Patil, K.,Bhowmick,A.R.,Mukherjee,A.,&Banerjee,A.K.(2021). ILORA: A database of alien vascular flora of India. Ecological Solutions and Evidence, 2(4), e312105. https://doi.org/10.1002/2688-8319.12105

Parthasarathy,N.,Pragasan,L.A.,&Muthumperumal, C.(2012).Invasive alien plants in tropical forests of the South-eastern Ghats, India: Ecology and management. In J. R. Bhatt, J. S.Singh,S. P. Singh, R.

S. Tripathi, & R. K. Kohli (Eds.), Invasive alien plants: An ecological appraisal for the Indian subcontinent (pp. 162–173). CABI, Wallingford. https://doi.org/10.1079/9781845939076.0162

Pyšek, P., Richardson, D. M., Rejmánek, M., Webster, G. L., Williamson, M., & Kirschner, J.(2004). Alien plants in checklists and floras: Towards better communication between taxonomists and ecologists. Taxon, 53(1),131–143.https://doi.org/10.2307/4135498

Rao, R. R., & Sagar, K. (2012). Invasive alien weeds of the Western Ghats: Taxonomy and distribution. In J.

R. Bhatt, J. S. Singh, S. P. Singh, R. S. Tripathi, & R. K. Kohli (Eds.), Invasive alien plants: An ecological appraisal for the Indian subcontinent (pp. 139–161). CABI.https://doi.org/10.1079/9781845939076.0139

Sankaran, K. V., & Suresh, T. A. (2013).Invasive alien plants in the forests of Asian and the Pacific.Food and Agriculture Organisation, Bangkok.

Sundararaju, V. (2018).A weed and a tale. Down to Earth, 16 May. https://www.downtoearth.org.in/blog/forests/a-weed-and-a-tale-60559

Udhayavani, C., & Ramachandran, V. S. (2017). Montanoa hibiscifolia (Asteraceae): A new record for India from the Nilgiris, Western Ghats of Tamil Nadu, India. Webbia, 72(1), 121–125.https://doi.org/10.1080/00837792.2016.1251083

van Kleunen, M., Pyšek, P., Dawson, W., Essl, F., Kreft, H., Pergl, J., Weigelt, P., Stein, A., Dullinger, S., König, C., Lenzner, B., Maurel, N., Moser, D., Seebens, H., Kartesz, J.,Nishino, M., Aleksanyan, A., Ansong, M., Antonova, L. A., ... Winter, M. (2019). The Global Naturalized Alien Flora (GloNAF) database. Ecology, 100(1), e02542.https://doi.org/10.1002/ecy.2542

Wilk, K.J. (Ed.).(2017).State of the World's plants 2017. Royal Botanic Gardens.

Yang, Q., Weigelt, P., Fristoe, T. S., Zhang, Z., Kreft, H., Stein, A., Seebens, H., Dawson, W., Essl, F.,König,

GLOSSARY OF KEY TERMS

Baseline: A baseline in the context of ecological restoration refers to what the site condition is like in a degraded site prior to initiation of interventions such as invasive species removal or ecological restoration.

Original ecosystem: This refers to the original natural ecosystem of a site prior to degradation. Such information on prior condition may be available or obtained from historical sources (working plans, floras), maps of potential natural vegetation, or indigenous people based on their traditional knowledge.

Benchmark site: Also known as a Reference Site or reference ecosystem, this is the relatively undisturbed target ecosystem selected to guide the ecological restoration of a degraded site. In other words, this is a template site to emulate or aspire for that one aims to recover on the site.

Phytosanitary measures: Any legislation, regulation or official procedure having the purpose to prevent the introduction and/ or spread of invasive plants.

Plant introduction: The purposeful or unintentional movement by humans of plant species propagules outside its natural range and dispersal potential. This movement can be either within a country, or between countries. Such introduction should not be construed as applying only to initial introductions but applies also to any purposeful or unintentional movement of said propagules.

Precautionary measures: Considerations and activities to be undertaken when dealing with a plant species suspected to be potentially invasive. This may include consultation of experts and databases on invasive species, review of information on species behaviour elsewhere, risk assessment, and contained screening and scientific field testing and evaluation.

Recovery: In ecological restoration theory and practice, recovery refers to the extent to which, in relation to the chosen ecosystem baselines and benchmark sites, the restoration has brought back the original native biological diversity, habitat structure, ecosystem function, or other measurable target attributes or indicators chosen for assessment.

Risk assessment: Considerations and activities undertaken to assessing the risk of entry, establishment and spread of alien and potentially invasive species and includes multiple aspects such as prioritisation, analysing pathways of entry, threats to or impacts on ecosystems, available information, or carrying out assessment studies. Risk assessments will need to take into account legal and infrastructural frameworks and management constraints.

APPENDIX 1

List of Invasive Alien Plant Species in Tamil Nadu

This list of 196 species has been compiled from multiple sources, mainly Narasimhan et al. (2009), Kohli *et al.* (2012), Narasimhan and Irwin (2021), and Pant *et al.* 2021 and a few recent studies (see Chapter on *Alien and Invasive Alien Plant Species of Tamil Nadu*). Scientific names were verified and updated with reference to the Plants of the World Online (Kew, https://powo.science.kew.org/). The species are arranged in alphabetical order of Family and Scientific Name.

Note: The 23 Priority Invasive Plant Species are marked in bold.

S.No	Scientific Name	English Name	Tamil Name	Habit	Region of origin
	ACANTHACEAE				
1	*Ruellia tuberosa*	Bluebell, cracker plant, Popping pod	Silandhi nayagam	Herb	Tropical America
	ALISMATACEAE				
2	*Limnocharis flava*	Velvet leaf, Yellow bur-head.	Nagappola	Aquatic herb	Tropical America
	AMARANTHACEAE				
3	*Alternanthera bettzickiana*	Calico plant, Parrot leaf	Line keerai, Sivappu Ponnanganni	Herb	South America
4	*Alternanthera brasiliana*	Joy Weed, Ruby Leaf	Sivappu Ponnanganni	Herb	Tropical America
5	*Alternanthera ficoidea*	Baptist Plant, Joseph's Coat	Seemai Ponnanganni	Herb	Tropical America
6	*Alternanthera paronychioides*	Alligator weed	Seemai Ponnangani	Herb	Tropical America
7	*Alternanthera philoxeroides*	Pig weed, Alligator weed	Ponnanganni, Seemai Ponnanganni	Herb	South America
8	*Alternanthera pungens*	Creeping chaff-weed, Khaki weed	Mul Ponnanganni	Herb	Tropical America
9	*Amaranthus spinosus*	Needle burr, Prickly amaranth, Spiny amaranth, Thorny pig weed	Mullu keerai	Herb	Tropical America
10	*Celosia argentea*	Cock's Comb, Crested Cock's Comb, Quail Grass, Red Fox, Red-Spinach, Wool Flower	karthigai poo, Kozhikkondai, Pannai Keerai, Pannai poondu	Herb	Tropical America

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
11	*Chenopodium album*	Common's Lamb Quarter, Fat Hen, Goose Foot, Late Flowering Goose Foot, Wild Spinach	Chakravarthi Keerai, Paruppu Keerai	Herb	Europe
12	*Dysphania ambrosioides*	American Worm seed, Hedge Mustard, Jerusalem Parsley, Jerusalem Tea	Puzhukolli keerai	Herb	Tropical America
13	*Gomphrena celosioides*	Cock's Comb Gomphrena	Tharai Vaadamalli	Herb	Pan tropical
14	*Gomphrena serrata*	Coastal Globe Amaranth	Padar Vaadamalli	Herb	Tropical America
	ANNONACEAE				
15	*Annona glabra*	Alligator Apple, Monkey Apple, Pond Apple	Periya Paanchipazham	Tree	Tropical America
	APOCYNACEAE				
16	*Asclepias curassavica*	Bastard Ipecac, Blood flower, Milk weed, False Ipecac, Scarlet Milk weed	----------	Herb	Tropical America
17	*Cryptostegia grandiflora*	Indian Rubber Vine, Lilac funnel swallow cotton	Palai, Garudappalai	Climbing Shrub	Madagascar
	ARACEAE				
18	*Caladium bicolor*	Heart of Jesus	----------	Herb	Tropical America
19	*Pistia stratiotes*	Nile cabbage, shellflower, water cabbage, water lettuce	Kodi thamarai, Agaasa thamarai, kuzhi thamarai	Floating herb	South America
	ASTERACEAE				
20	*Acanthospermum hispidum*	Bristly Starbur, Goat's Head, Hispid	Kombu Mullu	Herb	South America
21	*Ageratina adenophora*	Cat Weed, Crofton Weed, Hemp-Agrimony, Mexican Devil, Sticky Snakeroot	Congress Pachai, Aeroplane Poondu	Herb / Under shrub	Mexico
22	*Ageratum conyzoides*	Billy Goat Weed, Goat Weed, Tropical White Weed,	Poom Pillu, Naara Chedi	Herb	Mexico

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
23	*Ageratumhous tonianum*	Ageratum, Blue Billy Goat Weed, Blue Mink, Floss Flower	----------	Herb	Guatemala, Honduras, Mexico
24	*Ambrosiaarte misiifolia*	Annual ragweed, Common ragweed	----------	Straggling herb	North America
25	*Bidens biternata*	Beggar Ticks, Yellow Flowered Black Jack, Spanish Needles	----------	Herb	Africa, South & South East Asia
26	*Bidens pilosa*	Beggar Sticks, Black Fellows, Black Jack, Cobblers Pegs	Mookuthi Poo	Herb	Tropical America
27	*Calyptocarpus vialis*	Creeping Cinderella - weed		Herb	Tropical America
28	*Centratherum punctatum*	Lark Daisy	Kaattu Seeragam, Kesavardhini	Herb	South America
29	***Chromolaena odorata***	**Baby Tea, Bitter Bush, Butterfly Weed, Eupatorium,**	----------	**Shrub**	**Tropical America**
30	*Cirsium arvense*	Creeping Thistle, CanadaThistle, Field Thistle	----------	Herb	Eurasia, Africa
31	*Crasso cephalum crepidioides*	Red flower, Rag leaf	----------	Herb	Madagascar, Tropical Africa, Yemen
32	*Eclipta prostrata*	Eclipta, False Daisy	Kaarisalai, Vellai Karisalankanni	Herb	Tropical America
33	*Erigeron bonariensis*	Argentine Fleabane, Asthma Weed, Flax leaved Fleabane, Hairy Fleabane	----------	Herb	South America
34	*Erigeron karvinskianus*	Dancing Daisy, Mexican Daisy, Santa Barbara Daisy, Seaside Daisy	----------	Herb	Mexico, South America
	ASTERACEAE				
35	*Galinsoga parviflora*	Gallant Soldier, Lesser Quick Weed, Little Flower Quick Weed, Smooth Peruvian Daisy	----------	Herb	Tropical America

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
36	*Galinsoga quadriradiata*	Fringed Quick-Weed, Gallant Soldier, Hairy Galinsoga, Pittsburgh Pest, Quik Weed, Shaggy Soldier	----------	Herb	South America
37	*Gnaphalium polycaulon*	Many Stem Cud Weed	----------	Herb	Australia, India, China, Japan, Myanmar, Nepal, Pakistan, Tropical Africa
38	*Lagascea mollis*	Acuate, Silk	----------	Herb	Tropical America
39	*Leucanthemum vulgare*	Ox-Eye Daisy, Dog Dasiy, Marguerite	----------	Herb	Europe, Russia
40	*Mikania cordata*	Cordate Hempweed	----------	Climber	West Africa, South Asia
41	*Mikania micrantha*	Climbing Hemp weed	----------	**Herb**	**Tropical America**
42	*Montanoa bipinnatifida*	Polymnia's Tree, Tree Daisy, Stephen's White Snow	----------		Mexico
43	***Montanoa hibiscifolia***	**Christmas Daisy, Joseph's Daisy, Tree Daisy**	----------		**Tropical America**
44	***Parthenium hysterophorus***	**Bitter Weed, Carrot Grass, Congress Grass, False Rag Weed, Fever Few, Parthenium, White Top Weed**	**Congress Pachai, Aeroplane Poondu, Mookuthi Poondu**	**Herb**	**Shrub**
45	*Sonchus oleraceus*	Anual Sow Thistle, Common Sow Thistle, Hare's Lettuce, Smooth Sow Thistle, Sow thistle	----------	Herb	Shrub
46	***Sphagneticola trilobata***	**Singapore Daisy, Creeping Oxeye, Trailing Daisy, Yellow Dots**	**Seemai Manjal Karisalankanni**	**Herb**	**Tropical America**

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
47	*Synedrella nodiflora*	Cerbatana, Node Weed, Synedrella	Mookuthi Poondu	Herb	Tropical America
48	*Tagetes minuta*	Aztec Marigold, Dwarf marigold, Khaki bush, Marigold, Mexican marigold	Chinna Sevvandhi	Herb	Argentina, Bolivia, Chile, Ecuador, Paraguay, Uruguay
49	*Tithonia diversifolia*	Mexican Sunflower, Tree Mari gold	Mara Sooriyakanthi	Herb	Tropical America
50	*Tridax procumbens*	Cadillo Chisaca, Coat Buttons, Tridax, Tridax Daisy	Vettuekkaaya Thazhai,Thalai vetti Poondu	Herb	Tropical America
51	*Verbesina encelioides*	American Dog Weed, Butter Daisy, Cow Pen Daisy, South African Daisy	----------	Herb	North America
52	*Xanthium strumarium*	Clothbur, Common cocklebur, Donkey Burr	Ottra Kaai	Herb	Tropical America
	BIGNONIACEAE				
53	*Dolichandra unguis-cati*	Cat's Claw Creeper, Yellow Trumpte Creeper	Poonai Nagak Kodi	Climber	Caribbean, Mexico, South America
54	*Tecoma stans*	Yellow Bells,Yellow Elder	Naga shenbagam, Sornapatti	Shrub	Tropical America
	BIXACEAE				
55	*Bixa orellana*	Annatto Tree, Butter SeedTree, Cheese Dye Tree, Lipstick Tree, Monkey Turmeric, Saffron Tree	Jabra, Sindhoora Maram	Small Tree	Tropical America
	BORAGINACEAE				
56	*Heliotropium indicum*	Indian Heliotrope, Indian Turnsole	Theyl Kodukku	Herb	Tropical America
	BRASSICACEAE				
57	*Lepidium didymum*	Swine Cress	----------	Prostrate herb	South America
	CACTACEAE				
58	*Cylindropuntia ramosissima*	Diamond Cholla	Uruttai Chapathikkalli	Shrub	North America
59	***Opuntia dillenii***	**Coastal Prickly , Sweet Prickly Pear**	**Chapathikkalli**	**Shrub**	**Jamaica, Mexico**
60	*Opuntia elatior*	Prickly pear	Pattanattukalli	Shrub	Colombia, Costa Rica, Panama, Venezuela

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
	CALCEOLARIACEAE				
61	*Calceolaria mexicana*	Rediculo, Lady' spurse, Slipper Flower	----------	Herb	Mexico, Bolivia
	CANNABACEAE				
62	*Cannabis sativa*	Gallow Grass, Hemp, Indian Hemp, Marijuana, Wild Hemp	Ganja Chedi	Herb	Afghanistan, Iran, Kazakhstan, Kyrgyzstan, Pakistan
	CARYOPHYLLACEAE				
63	*Spergula arvensis*	Corn Spurry, Starwort, Stickwort	----------	Herb	Europe
	CASUARINACEAE				
64	*Casuarina equisetifolia*	Australian Beef wood, Australian Pine, Common Casuarina, Whip tree, Whistling Pine	Savukku	Tree	Australia, South & South East Asia
	CLEOMACEAE				
65	*Cleome rutidosperma*	One-Leaved Mustard, Spindle Pod	Africa Naikadugu	Herb	Tropical Africa
	CONVOLVULACEAE				
66	*Evolvulus nummularius*	Coin-leaf White Bind weed		Herb	Tropical America
67	***Ipomoea carnea***	**Himalayan Fleabane, Badoh Negro, Bush Morning Glory, Siver Morning Glory**	**Kadal Palai**	**Herb**	**Tropical America**
68	*Ipomoea hederifolia*	Common Wall Flower	Kanavalikkodi	Herb	Tropical America
69	*Ipomoea indica*	Cloven Gum Box, Aquamarine Morning Glory, Blue Morning Glory, Blue Dawn Flower, Island Morning Glory	----------	Shrub	Tropical America
70	*Ipomoea purpurea*	California Poppy, Golden Poppy, Common Morniing Glory, Convolvulus Major, Purple Morning Glory, Tall Morning Glory	----------	Erect or Diffuse Herb	Tropical America

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
71	*Ipomoea quamoclit*	American Bell Flower, Barbados Sweet Williams, Red Jasmine, Star - Glory, Sweet Willy	Mayil Manikam	Twiner	Mexico, Central & South America
	EUPHORBIACEAE				
72	*Croton bonplandianus*	Wild Croton	Rail Poondu, Milagaai Poondu, Kerosine Poondu	Herb	Argentina, Bolivia, Brazil, Paraguay
73	*Euphorbia cyathophora*	Hypocrite Poinsettia, Mexican Fire plant, Milk weed, Painted Euphorbia, Wild Poinsettia	Paala Chedi	Herb	Tropical America
74	*Euphorbia hirta*	Pillpod Sandmat Spurge	Amman pacharisi	Herb	Tropical America
75	*Jatropha gossypiifolia*	Black Physic Nut, Bronze Leaved Physic Nut, Cotton Leaved Jatropha	Kastaamanakku	Shrub	Tropical America
76	*Ricinus communis*	Castor Bean, Jonah's Gourd, Lamp OilPlant, Palma Christi, Pearl Seed	Amanakku, Chaitthamanaku, Muthu Kottai, Plant, Wonder Tree	Shrub / small tree	Ethiopia, Somalia
77	*Triadica sebifera*	Chinese Tallow Tree, Poplar Leaved Croton, Water Long Pepper	----------	Tree	China, Japan, Korea, Taiwan
	FABACEAE				
78	***Acacia auriculiformis***	**Australian Babul, Ear Pod Wattle, Northern Black Wattle**	**Kathi Savukku**	**Tree**	**Australia, Indonesia, Papua New Guinea**
79	***Acacia dealbata***	**Silver Wattle, Sydney Black Wattle, White Wattle**	**Wattle Maram, Vellivaelam**	**Tree**	**Australia, Tasmania**
80	***Acacia decurrens***	**Black Wattle, Common Wattle, Green Wattle**	**Semai Velampattai, Karuppu Wattle Maram**	**Tree**	**Australia**
81	***Acacia farnesiana***	**Prickly Mimosa Bush, Sweet Acacia, Thorny Acacia, Mimosa Wattle, Needle Bush**	**Kasturivael, Veddayala**	**Shrub / small tree**	**Tropical America**

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
82	***Acacia mearnsii***	**Black Wattle**	**Suvukku**	**Tree**	**Australia, Tasmania, Papua New Guinea**
83	***Acacia melanoxylon***	**Australian Black Wood, Black Wattle, Black Wood Acacia**	**Ther chavukku, Malai Savukku**	**Tree**	**Australia, Tasmania**
84	*Aeschynomene americana*	American Joint Vetch, American Sensitive Plant, Thorn less Mimosa	Attrunetti, Sadai, Thakkai	Herb	Tropical America
85	***Calopogonium mucunoides***	**Tangled Green Carpet**	**Seemai Kolunji**	**Climber**	**Tropical America**
86	*Chamaecytisus albus*	Tree Lucerne	Kothagiri Maaru	Shrub	Central Europe, Ukraine
87	***Cytisus scoparius***	**Common Broom, Scotch Broom, Yellow Broom**	**Kothagiri Maaru**	**Shrub**	**Europe**
88	*Desmanthus virgatus*	Ground Tamarind, Slender Mimosa, Wild Tantan, Wild Koa, Petit Acacia	----------	Shrub	Tropical America
89	***Leucaena leucocephala***	**Lead Tree, Leucaena, West Indian Bead Tree, Wild Tamarind**	**Soundil, Joundil**	**Tree**	**Belize, Mexico**
90	*Lysiloma latisiliquum*	False Tamarind, Wild Tamarind	----------	Tree	Florida, Mexico, Cuba, Belize, Bahamas
91	*Macroptilium atropurpureum*	Purple Bean	Pudhur Avarai	Herb	Tropical America
92	*Macroptilium lathyroides*	Phasey Bean, Shrubby Bean,Wild Bean, Wild Bush Bean	Kaattu Avarai	Herb	Mexico, Nicargua, Panama
93	*Mimosa diplotricha*	Creeping Sensitive Weed, Giant Sensitive Weed	Kaatu Seekai	Straggler	Tropical America
94	*Mimosa pudica*	Touch-Me-Not, Hamble Plant, Sensitive Plant, Shame Lady	Thotal vadi, Thotaal Suringi	Herb	Tropical America
95	***Mucuna bracteata***	**Mucuna**	----------	**Climber**	**China, North-East India**
96	*Neustanthus phaseoloides*	Tropical Kudzu	----------	Climbing Herb	South & South East Asia

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
97	*Pithecellobium dulce*	Manila Tamarind, Madras Thorn, Camachile	Kodukkapulli, Kodukkai	Tree	Tropical America
98	***Prosopis juliflora***	**Iron Wood Tree, Prosopis, Texas Algaroba**	**Veli kkaathaan, Seemai Mullu,Vaeli karuvai, Seemai Karuvai**	**Tree**	**Tropical America**
99	*Robinia pseudoacacia*	False Acacia, Black Locust, Acacia Blanc, Robinier	----------	Tree	North America
100	*Senna alata*	Candle Bush, Candle Stick, Roman Candle Tree, Seven Golden Candle Sticks	Seemai Agathi	Large Shrub	Tropical America, Central America
101	*Senna hirsuta*	American Hairy Senna, Hairy Sickle Pod, Woolly Senna	Malaiyavaram	Under shrub	Tropical & Sub tropical America
102	*Senna obtusifolia*	American Sickle pod, Sickle pod, Chinese Senna	Oosi Thagarai, Siru Thagarai	Herb	Tropical & Sub tropical America
103	*Senna occidentalis*	Coffee weed, Coffee senna, Septic weed,	Periyavarai Thagarai	Under shrub	Colombia
104	***Senna spectabilis***	**Golden Shower, White bark Senna**	**Seemai Kondrai**	**Tree**	**Tropical America**
105	*Senna tora*	Sickle senna, sickle pod	Oosi Thagarai	Herb	Central America
106	*Senna uniflora*	Solo Senna	Thagarai	Herb	Tropical America
107	*Stylosanthes hamata*	Caribbean Stylo	----------	Shrub	Mexico, Venezuela, Caribbean
108	***Ulex europaeus***	**Common Gorse, Whin**	----------	**Shrub**	**Western Europe**
	LAMIACEAE				
109	*Leonotis nepetifolia*	Annual Lion's Ear, Bald Head, Bird's Honey, Cat's Ear, Christmas, Candle stick	----------	Herb	Africa
110	*Mesosphaerum suaveolens*	Cattle Weed, Wild Spikenard	Seemai Thulasi	Shrub	Tropical America
	LAURACEAE				
111	*Cinnamomum camphora*	Camphor Cinnomon, Camphor Tree, Common Camphor, True Camphor	Indu, Karpuram, Soodam	Tree	Japan, Taiwan

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
	LINDERNIACEAE				
112	*Torenia fournieri*	Wish bone Flower	----------	Herb	Cambodia, India, Laos, Thailand Vietnam
	LOPHIOCARPACEAE				
113	*Corbichonia decumbens*	Prostrate Purslane	----------	Herb	Africa, West & South Asia
	MALVACEAE				
114	*Corchorus aestuans*	East Indian Mallow, West African Mallow	Pinaaku Poondu, Pinnaku Keerai	Herb	Pan tropical
115	*Malachra capitata*	Caribbean Mallow	----------	Herb	Caribbean Islands
116	*Malvastrum coromandelianum*	Broom weed, False Mallow, Prickly Malvastrum	----------	Herb	Caribbean Islands, United States, Venezuela
117	*Sida acuta*	Broom weed, Common Wire Weed, Spiny Head Sida, Wire Weed	Arival Mooku Poondu, Arival Manai Poondu, Malai Thangai	Under shrub	Bhutan, Cambodia, China, India, Laos, Nepal, Thailand, Vietnam
118	*Waltheria indica*	Heart Leaved Velvet Cinquefoil	Chembudu, Sengali Poondu	Under shrub	Tropical America
	MARTYNIACEAE				
119	*Martynia annua*	Ice Plant, Purple Claw, Tiger's Claw	Thael Kodukkiu	Herb	Tropical America
	MELASTOMATACEAE				
120	*Martynia annua*	Ice Plant, Purple Claw, Tiger's Claw	Thael Kodukkiu	Herb	Tropical America
	MENISPERMACEAE				
121	*Cissampelos pareira*	False Pareirabrava Plant	Appattu, Puttu Tiruppi, Vatta Tiruppi	Climber	Bangladesh, Bhutan, India, Indonasia, Thailand, Singapore, Sri Lanka
	MORACEAE				
122	*Broussonetia papyrifera*	Formosan Paper Tree, Paper Mulberry, Tapa-Cloth Tree, Thai Paper Mulberry	----------	Tree	South & South East Asia

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
	MUNTINGIACEAE				
123	*Muntingia calabura*	Calabur Tree, Capulin, Jamaica Cherry, Panama Berry, Strawberry Tree	Singapore Cherry	Small Tree	Caribbean Islands
	MYRTACEAE				
124	***Eucalyptus citriodora***	**Citron Scent Gum, Spotted Gum**	**Thaila Maram**	**Tree**	**Australia**
125	***Eucalyptus globulus***	**Tasmanian Blue Gum**	**Thaila Maram**	**Tree**	**Australia**
126	***Eucalyptus grandis***	**Flooded Gum, Rose Gum**	**Thaila Maram**	**Tree**	**Australia**
127	*Eucalyptus saligna*	Sydney Blue Gum, White Gum Of Paramatta	Thaila Maram	Tree	Australia
128	*Eugenia uniflora*	Barbadoes Cherry	Seemai Nelli	Shrub	Argentina, Brazil, Bolivia, Paraguay, Uruguay
129	*Psidium cattleianum*	Cattley Guava, Chinese Guava, Purple Guava, Strawberry Guava	Seemai Koyya	Shrub	Brazil, Uruguay
130	*Psidium guajava*	Apple guava, Guava, Round Guava, Tropical Guava	Koyya	Tree	Mexico, South America
	NYCTAGINACEAE				
131	*Boerhavia erecta*	Erect Spiderling, Erect Tar Vine	Seemai Mookarattai	Herb	Tropical America
132	*Mirabilis jalapa*	Beauty of the Night, Four O' Clock Plant, Garden Four O Clock	Badharatchi, Naalumani poo	Herb	Mexico
	ONAGRACEAE				
133	***Ludwigia peruviana***	**Pervian Primrose Bush, Water Primrose**	**Neer Kirambu**	**Shrub**	**Tropical America**
	OXALIDACEAE				
134	*Oxalis corniculata*	Creeping Lady's Sorrel, Creeping Oxalis, Creeping Wood Sorrel, Yellow Wood Sorrel	Puliyarai	Herb	Indonasia, MAlaysia, Myanmar, Philippines
135	*Oxalis debilis*	Lilac Oxalis	Puliyarai	Herb	Bolivia, Brazil, Ecuador, Brazil

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
136	*Oxalis latifolia*	Fishtail Oxalis, Garden Pink Sorrel, Pink Shamrock	Puliyarai	Herb	Tropical America
137	*Oxalis pescaprae*	Bermuda Buttercup, Buttercup Oxalis, English Weed, Sour Sob	Puliyarai	Herb	Namibia, South Africa
	PAPAVERACEAE				
138	*Argemone mexicana*	Mexican Poppy, Mexican Prickly Poppy	Mul-Naikadugu, Bhramanthandu	Herb	Tropical America
	PASSIFLORACEAE				
139	*Passiflora edulis*	Purple Granadilla, Passion Fruit	That boot, Thuraipadalai	Climber	Brazil, Argentina Paraguay
140	*Passiflora foetida*	Running Pop, Stinking Passion Flower, Wild Water Lemon	Siru poonaikkalai, Ponaipidukku, Mosukkatan	Climber	Caribbean, Mesoamerica, South America, United States
141	*Turnera subulata*	Golden SageRose, West Indian Holly		Herb	South America
142	*Turnera ulmifolia*	Sage Rose, West Indian Holly, Yellow Alder	Sage Rose, West Indian Holly, Yellow Alder	Herb	South America
	PEDALIACEAE				
143	*Sesamum alatum*	Wing seed Sesame		Herb	Africa
	PHYLLANTHACEAE				
144	*Phyllanthus tenellus*	Mascarene Island Leaf-Flower	----------	Herb	Angola, Madagascar, Mauritius, Mozambique, Reunion, Tanzania
	PIPERACEAE				
145	*Peperomia pellucida*	Manto Man, Shiny Peperomia, Vietnamese Crab Claw	----------	Herb	Tropical Africa And America
	PLANTAGINACEAE				
146	*Mecardonia procumbens*	Baby Jumpup, Small Baby Jumpup	----------	Herb	Tropical America
	PLANTAGINACEAE				
147	*Scoparia dulcis*	Licorice Weed, Sweet Broom	Sarakkotthini, Sarkaraj Vaembu	Under shrub	Tropical America

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
	POACEAE				
148	*Arundo donax*	Bamboo Reed, Giant Reed, Great Reed	Korukkai, Kouikkachi, Vaelam, Sothai Moongil	Herb	Mediterranean Region, Tropical Asia (Indian native, invasive in water bodies)
149	*Axonopus compressus*	Blanket grass, Broad leaf Carpet grass, Lawn grass	----------	Herb	Tropical America
150	*Brachiaria mutica*	Buffalo Grass, Para Grass	----------	Herb	Brazil
151	*Bromus catharticus*	Prairie Grass, Rescue Grass, Schrader's Brome Grass	----------	Herb	Tropical America
152	*Cenchrus clandestinus (=Pennisetum clandestinum)*	Kikuyu Grass	----------	Herb	Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, zaire
153	*Cenchrus purpureus (=Pennisetum purpureum)*	Elephant grass, Merker Grass	----------	Herb	Tropical Africa
154	*Cymbopogon citratus*	Lemon grass, Oil Grass, West Indian Lemon Grass	Elumicham Pullu, Karpura pullu, Narandam Pullu, Vasana Pullu	Herb	Brunei, Indonesia, Malaysia, Philippines
155	*Echinochloa colona*	Awnless Barnyard Grass, Corn Panic Grass, Decan Grass, Jungle	Gudhirai Valli Pullu, Karumpullu, Sauri, Sawa, Vaesanam Pullu Rice Grass, Millet Rice	Herb	Tropical Asia & Africa
156	*Festuca ovina*	Sheep Fescue	----------	Herb	North Africa, Europe, Temperate Asia
157	*Imperata cylindrica*	Alang-Alang, Blady Grass, Cogon Grass, Cotton Wool Grass, Japanese Blood Grass	Dharbai Pullu, Viswamithram	Herb	Africa, West Asia
158	*Megathyrsus maximus*	Green Panic Grass, Guinea Grass	Guinea Pullu	Herb	Madagascar Mauritius, Yemen

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
159	*Melinis repens*	Fairy Grass, Natal Grass, Natal Red top	----------	Herb	Oman, Saudi Arabia
160	*Paspalum vaginatum*	Biscuit Grass, Sea shore Paspalum, Silt Grass	----------	Herb	Tropical America
161	*Phalaris arundinacea*	Gardener's Garters, Reed Canary Grass, Ribbon Grass, Variegated Grass	----------	Herb	Global North Temperate Regions
162	*Setaria parviflora (=Pennisetum polystachion)*	Mission Grass	----------	Herb	South & North America
163	*Sporobolus africanus*	Parramatta Grass, Rat's Tail Grass, Tuft Grass	----------	Herb	Many parts of America
	POLYGONACEAE				
164	***Antigonon leptopus***	**American Mountain Rose, Chain of Love, Coral Vine**	**Kodi Rose, Railway creeper**	**Climbing shrub**	**Guatemala, Honduras, México**
	PONTEDERIACEAE				
165	*Monochoria vaginalis*	Pond Weed, Pickerel Weed	Kuvalai	Aquatic herb	Australia, South & South East Asia
166	***Pontederia crassipes***	**Common Water Hyacinth, Floating Water Hyacinth, Lechuguilla, Water Hyacinth**	**Vengaaya Thamarai**	**Floating Herb**	**Tropical America**
	PORTULACACEAE				
167	*Portulaca oleracea*	Common Purslane, Pigweed, Purslane, Pusky, Pusley, Wild Purslane	----------	Prostrate herb	Tropical Africa, Arabian Peninsula, Macaronesi, Mediterranean
	RHAMNACEAE				
168	***Maesopsis eminii***	**Umbrella Tree**	----------	**Tree**	**Central Africa**
	ROSACEAE				
169	*Prunus cersoides*	Indian Wild Cherry, Sour Cherry, Wild Himalayan Cherry	Patumukam, Pathumukam	Tree	Bhutan, China, Indian Himalaya, Laos, Myanmar, Nepal, Thailand, Vietnam

S.No	Scientific name	English Name	Tamil Name	Habit	Region of origin
	RUBIACEAE				
170	*Coffea canephora*	Robusta Coffee	----------	Shrub	West Africa
	SALVINIACEAE				
171	*Salvinia molesta*	Kariba weed	----------	Floating herb	South and South east Brazil to Argentina
	SOLANACEAE				
172	*Brugmansia suaveolens*	White Angel's Trumpet	----------	Shrub / small tree	Bolivia, Brazil, Peru
173	***Cestrum aurantiacum***	**Orange Cestrum, Orange Jessamine, Yellow Cestrum, Yellow Shrub, Jessamine**	----------	**Shrub**	**Costa Rica, Guatemala, Honduras, Mexico, Nicaragua**
174	*Datura ferox*	Angel's Trumpet, Thorn Apple	----------	Herb	Mexico
175	*Datura innoxia*	Angel's Trumpet, Desert Thorn Apple, Downy Thorn Apple	Oomatthai	Herb	Mexico
176	*Datura metel*	Downy Thorn Apple, Horn of Plenty, Purple Thorn Apple	Karu Oomatthai, Oomatthai	Under shrub	Tropical America
177	*Datura stramonium*	Common Thorn Apple, Europe Datura, Moon flower Thorn Apple	Seemai Oomatthai	Herb / Under shrub	Mexico
178	*Nicandra physalodes*	Apple of Peru, Shoo-Fly Plantsss	----------	Herb	Argentina, Bolivia, Chile, Peru
179	*Physalis angulata*	Cow Pops, Cut-Leaf Ground Cherry, Wild Tomato, Winter Cherry	Sodakku Thakkaali	Herb	Tropical America
180	*Physalis lagascae*	Pygmy Ground Cherry, Sun Berry	Sodakku Thakkaali	Herb	Tropical america
181	*Physalis peruviana*	Cape Goose Berry, Golden Berry, Horse Tomato, Jam Fruit, Peruvian Cherry	Pottipazham	Herb	Brazil
182	*Solanum americanum*	American Black Night shade, Apple of Sodden, Glossy Night shade, Purple Night shade	Manathakkali	Herb	Tropical America

S.No	Scientific name	English Name	Tamil Name	Habit	Region of oreigin
183	*Solanum mauritianum*	Ear-leaf Night shade, Flannel Weed, Kerosene Plant, Tobacco Weed, Tree Tobacco, Woolly Night shade	----------	Shrub	Argentina, brazil, Uruguay
184	*Solanum pseudocapsicum*	Capsicum Night shade, Jerusalem cherry	----------	Shrub	South America
185	*Solanum seaforthianum*	Blue Potato Creeper, Brazilian Night shade, Italian Jasmine, St Vincent-Lilac	----------	Shrub	Tropical America
186	*Solanum sisymbriifolium*	Bitter Apple, Thorned Bitter Apple, Sticky Nightshade, Wild Tomato	----------	Under shrub	South America
187	*Solanum torvum*	Green Fruited Pea, Pea Eggplant, Plate Brush, Prickly Solanum, Water Night shade	Chundai, Kothu Kathiri	Shrub	Tropical America
188	*Solanum viarum*	Tropical Soda Apple	----------	Under shrub	Argentina, Brazil, Paraguay, Uruguay
	TYPHACEAE				
189	*Typha angustifolia*	Elephant Grass, Small Bulrush of British, Pith Grass	Sambu, Jambu	Herb	Pan tropical
	URTICACEAE				
190	*Pilea microphylla*	Artillery Plant, Artillery Weed, Gun Powder Plant, Pistal Plant, Rock weed	----------	Herb	Tropical America
	VERBENACEAE				
191	*Citharexylum spinosum*	Fiddle Wood, Spiny Fiddle Wood		Tree	Tropical America
192	***Lantana camara***	**Common Lantana, WildSage**	**Unnichedi, Jimikki Malli**	**Shrub**	**Tropical America**
193	*Lippia alba*	Bushy Matgrass	----------	Shrub	Tropical America
194	*Stachytarpheta jamaicensis*	Blue Porter Weed, Brazilian Tea, Rooter Comb	Seemai Nayuruvi	Herb	Tropical America
195	*Stachytarpheta urticaefolia*	Deep Blue Bastard Vervein	----------	Herb	Tropical America
	ZYGOPHYLLACEAE				
196	*Tribulus terrestris*	Cats Head, Puncture Vine	Nerunji, Siru nerunji	Herb	Albania, Bulgaria, Croatia, Greece

APPENDIX 2

List of Casual Alien Plant Species (ILORA Database)

Important Note: This list includes only National Aliens reported from Tamil Nadu according to the ILORA database (Pant et al. 2021), but is a very incomplete list. The state of Tamil Nadu has 2,459 alien species of plants (Narasimhan and Irwin 2021), most of which are likely to be casual aliens or naturalised species (including cultivated species). The present list is therefore provided only as a starting point to evolve a more complete list.

Family	Scientific Name
Acanthaceae	*Justicia gendarussa*
	Thunbergia erecta
Alstroemeriaceae	*Alstroemeria aurea*
Amaranthaceae	*Amaranthus viridis*
Amaryllidaceae	*Agapanthus africanus*
	Hymenocallis littoralis
	Zephyranthes carinata
	Zephyranthes rosea
Apiaceae	*Coriandrum sativum*
	Daucus carota
Apocynaceae	*Plumeria pudica*
	Plumeria rubra
Araucariaceae	*Araucaria heterophylla*
Arecaceae	*Areca catechu*
	Cocos nucifera
	Dypsis lutescens
Asparagaceae	*Cordylin efruticosa*
	Furcraea foetida
Asphodelaceae	*Aloe vera*
Asteraceae	*Calendula officinalis*
	Chromolaena corymbosa
	Dahlia imperialis
	Dahlia pinnata
	Helianthus annuus
	Jacobaea maritima
	Tagetes erecta
	Tanacetum cinerariifolium
	Tanacetum parthenium
Basellaceae	*Anredera baselloides*

Family	Scientific Name
Bignoniaceae	*Handroanthus serratifolius*
Brassicaceae	*Brassica juncea*
	Brassica rapa
Cactaceae	*Pereskia bleo*
Capparaceae	*Cleoserrata speciosa*
Caryophyllaceae	*Drymaria cordata*
Convolvulaceae	*Ipomoea parasitica*
Cucurbitaceae	*Citrullus lanatus*
	Lagenaria siceraria
Cycadaceae	*Cycas revoluta*
	Cyperus hamulosus
Euphorbiaceae	*Euphorbia biocotiniifolia*
	Euphorbiapulcherrima
	Euphorbia serpens
Fabaceae	*Acacia longifolia*
	Cassia renigera
	Delonix regia
	Gliricidia sepium
	Psoraleap pinnata
	Senna didymobotrya
	Senna posiyphylia
	Senna sophera
	Tamarindus indica
	Trifolium repens
	Vachellia tortilis
	Virgilia oroboides
Gentianaceae	*Gentiana quadrifaria*
Heliconiaceae	*Heliconia rostrata*
Hydrangeaceae	*Hydrangea macrophylla*
Lamiaceae	*Clerodendrum chinense*
	Volkameria aculeate
Loganiaceae	*Spigelia anthelmia*
Lythraceae	*Cuphea hyssopifolia*
	Punica granatum
Malvaceae	*Sida spinosa*
Marsileaceae	*Marsilea quadrifolia*
Molluginaceae	*Glinus oppositifolius*
Myrtaceae	*Callistemon viminalis*
	Syzygium jambos
Nyctaginaceae	*Bougainvillea spectabilis*
Onagraceae	*Fuchsia boliviana*
Piperaceae	*Piper betle*
Plantaginaceae	*Veronica wyomingensis*
Poaceae	*Briza maxima*
	Hordeum vulgare

Family	Scientific Name
Poaceae	*Sorghum bicolor*
Potamogetonaceae	*Stuckenia pectinata*
Rosaceae	*Prunus avium*
Rubiaceae	*Oldenlandia corymbosa*
Sapindaceae	*Cardiospermum halicacabum*
Scrophulariaceae	*Leucophyllum frutescens*
Solanaceae	*Cestrum diurnum*
	Cestrum nocturnum
	Nicotiana tabacum
	Physalis philadelphica
	Solanum aureitomentosum
	Solanum erianthum
Theaceae	*Camellia sinensis*
Verbenaceae	*Verbena bonariensis*
Viburnaceae	*Sambucus nigra*
Violaceae	*Viola tricolor*
Vitaceae	*Vitis vinifera*
Zamiaceae	*Zamia furfuracea*

TN PIPER 2022

APPENDIX 3

List of Naturalised Plant Species (ILORA Database)

Important Note: This list includes only National Aliens reported from Tamil Nadu according to the ILORA database (Pant et al. 2021), but is a very incomplete list. The state of Tamil Nadu has 2,459 alien species of plants (Narasimhan and Irwin 2021), most of which are likely to be casual aliens or naturalised species (including cultivated species). The present list is therefore provided only as astarting point to evolve a more complete list. Also, a few species known to be invasive aliens inTamil Nadu but categorised as naturalised in the ILORA database are not included here as they are already in Appendix 1 (*Leucaena leucocephala, Prosopis chilenis* (prob. *P. juliflora*), *Eucalyptus globulus* (invasive in Palni hills), *Imperata cylindrica, Solanum mauritianum,* and *Solanum pseudocapsicum.*

Family	Scientific Name
Acanthaceae	*Thunbergia alata*
Amaranthaceae	*Amaranthus caudatus*
	Gomphrena globosa
Anacardiaceae	*Anacardium occidentale*
Apocynaceae	*Catharanthus roseus*
	Gomphocarpus physocarpus
	Rauwolfia tetraphylla
	Vinca major
Asparagaceae	*Agave americana*
	Agave vivipara
Asteraceae	*Acmella uliginosa*
	Bellis perennis
	Calyptocarpus vialis
	Cosmos bipinnatus
	Cosmos sulphureus
Bignoniaceae	*Tecoma capensis*
Boraginaceae	*Heliotropium curassavicum*
	Capsella bursa-pastoris
Cactaceae	*Opuntia ficus-indica*
	Opuntia monacantha
	Opuntia stricta
Calceolariaceae	*Calceolaria tripartita*
Euphorbiaceae	*Euphorbia tripartita*
	Euphorbia heterophylla
	Euphorbia prostrata
	Euphorbia thymifolia
	Euphorbia tirucalli
	Euphorbia umbellata
	Jatropha curcas

Fabaceae	*Centrosema pubescens*
	Clitoria ternatea
	Crotalaria incana
	Crotalaria micans
	Desmodium tortuosum
	Genista monspessulana
	Parkinsonia aculeata
Malvaceae	*Herissantia crispa*
	Hibiscus cannabinus
Meliaceae	*Swietenia mahagoni*
Moraceae	*Ficus carica*
	Morus alba
Myrtaceae	*Corymbia citriodora*
	Psidium guajava
Onagraceae	*Ludwigia hyssopifolia*
Papaveraceae	*Papaver somniferum*
Passifloraceae	*Passiflora subpeltata*
Petiveriaceae	*Rivina humilis*
Plantaginaceae	*Cymbalaria muralis*
	Veronica persica
Poaceae	*Briza minor*
	Panicum maximum
	Paspalum distichum
	Polytrias indica
Portulacaceae	*Portulaca pilosa*
Rhamnaceae	*Ziziphus jujuba*
Rubiaceae	*Dentella repens*
	Mitracarpus hirtus
	Richardia scabra
Solanaceae	*Physalis peruviana*
	Solanum elaeagnifolium
	Solanum laxum
Talinaceae	*Talinum fruticosum*
Verbenaceae	*Verbena rigida*

APPENDIX 4

List of Cryptogenic Plant Species (ILORA Database)

Important Note: This list includes only National Aliens reported from Tamil Nadu according to the ILORA database (Pant et al. 2021), but is a very incomplete list. The state of Tamil Nadu has 2,459 alien species of plants (Narasimhan and Irwin 2021), most of which are likely to be casual aliens or naturalised species (including cultivated species). The present list is therefore provided only as a starting point to evolve a more complete list.

Family	Scientific Name
Poaceae	*Brachiaria villosa*
	Chloris barbata
	Echinochloa crus-galli

ABSTRACT

Forests – Announcement – Policy on ecological restoration of forest areas infested with invasive plant species in Tamil Nadu – Constitution of a Committee for formulating the Draft Policy – Orders issued.

Environment, Climate Change and Forest (FR.6) Department

G.O.(D).No.158 **Dated: 01.11.2021**
விலை ரூ.15/-
திருவள்ளுவர் ஆண்டு-2052

Read:

Announcements made by Government on the floor of Legislative Assembly on 03.09.2021 on Forest Demand.

ORDER:

Invasive alien species of plants, cause serious economical and environmental damage and can adversely impact the ecosystem health. Invasive plant species in particular, adversely impact biodiversity, leading to the decline or elimination of native species through competition, predation or transmission of pathogens and cause disruption of local ecosystems and ecosystem functions. The invasion of these species is regarded as one of the major threats to biodiversity.

2. The threat of invasive alien species can be direct or indirect. Indirectly the non-native species suppress native species by disrupting the food web in an ecosystem by restricting or replacing native food sources. Invasive species can also alter the abundance or diversity of species that are important habitat for native wildlife. The invasion by such species is known to cause significant changes in the structure and function of forests by obstructing potential succession processes, interfering with fire regimes and pollination services, and displacing native flora and fauna.

3. Most of the exotic tree species were introduced in forest areas of Tamil Nadu like Wattle, Pine and Eucalyptus to satisfy industrial/commercial needs. However, they have had adverse impact on the ecology of the area, particularly in terms of modifying/affecting hydrology, forest/grassland community, wildlife and can lead to intensified man-wildlife conflict.

4. In order to address the growing threat of invasive plant species in forest areas of Tamil Nadu, there exists a serious and pertinent need to prioritize problematic species and develop strategies to manage the proliferation of the invasive alien species. In the past, there have been efforts

(P.T.O)

to compile lists of invasive plant species in India and to study the impact of invasive species in different parts of the country. However, a comprehensive policy framework for invasive species management in forest areas of Tamil Nadu is much needed keeping in view the serious threat. The Policy to control and eliminate invasive alien species needs to be developed taking stock of the invasive species cover in forest areas (species and area wise) and ongoing weed management practices in the field thereby incorporating learnings from best practices elsewhere.

5. The Policy will address highly invasive, habitat degrading plant species in the forest areas of Tamil Nadu for removal and management simultaneously. Principal focus has to be laid upon developing / elaborating strategies, methodologies and protocols for management of the most problematic weeds in forest areas viz., *Lantana camara L., Acacia mearnsii, Prosopis juliflora, Eupatorium perfoliatum, Parthenium hysterophorus L., Mucuna bracteatea, Eichhornia crassipes, Salvinia molesta, Ipomoea carnea, Leucaena leucocephala, Cuscuta Sp., Opuntia Sp., Celosia argentea, Ulex europaeus, Cytisus scoparius, Cestrum spp., Hypothenemus hampei etc., It is critical to pay an* immediate attention to restore the habitat health to support wildlife survival as well as to avoid straying out of wild animals.

6. Considering the importance and necessity, an announcement was made by the Government of Tamil Nadu on 3rd September, 2021 on the floor of Legislative Assembly that, a separate policy will be formulated on "Removal of alien species in forest areas of Tamil Nadu for eco restoration of forest areas infested with invasive weed species". In accordance with the announcement, the Government shall come out with a Policy on control and elimination of invasive alien species in Forest areas in Tamil Nadu.

7. Accordingly, the Government after careful examination, accord administrative sanction for framing a Policy on control and elimination of invasive alien plant species and eco restoration of forest areas already infested. Further, the Government constitutes an expert committee as below to formulate a Draft Policy on Removal of alien species in forest areas of Tamil Nadu for eco restoration of forest areas infested with invasive weed species:-

1. Thiru V.Naganathan. I.F.S.,
   Additional Principal Chief Conservator
   of Forests (Forest Conservation Act),
   Office of the Principal Chief Conservator
   of Forests (HoD), Chennai 15. ...Chairman

2. Thiru S.Anand. I.F.S.,
   Deputy Director,
   Srivilliputhur Megamalai Tiger Reserve,
   Theni. ...Member

..3...

TN PIPER 2022

3. Thiru. Vismiju Viswanathan. I.F.S.,
Deputy Conservator of Forests, (Project Formulation),
Office of the Principal Chief Conservator of Forests(HoD),
Chennai-15. ...Member

8. The Committee shall also consult and get inputs from experts in this area by outsourcing, co-opting them to prepare the Draft Policy. Funds required shall be met out from Tamil Nadu Compensatory Afforestation Fund Management Planning Authority (TN CAMPA).

9. The Committee shall include the following in the Draft Policy,

i) Identify, demarcate & assess the extent of area infested with invasive alien species in forest areas of Tamil Nadu,
ii) Formulate Standard Operating Procedure (SOP) for removal, disposal and eco-restoration of infested area.
iii) Suggest permanent measures to eliminate invasive alien species.

10. The Committee shall submit a detailed Draft Policy within three months from the date of issue of this order.

(BY ORDER OF THE GOVERNOR)

SUPRIYA SAHU
PRINCIPAL SECRETARY TO GOVERNMENT

To
The Principal Chief Conservator of Forests (Head of Department),
Chennai-15.
The Members of the Committee
(Through the Principal Chief Conservator of Forests
(Head of Department).
The Additional Principal Chief Conservator of Forests and
Chief Executive Officer, Tamil Nadu State Compensatory
Afforestation Fund Management Planning Authority,
Office of the Principal Chief Conservator of Forests
(Head of Department),
Chennai-15.
The Additional Principal Chief Conservator of Forests and Secretary,
Tamil Nadu Biodiversity Board,
Medavakkam, Chennai – 100.
The Accountant General, Chennai-18.
The Pay and Accounts Officer, Chennai-9.
The Resident Audit Officer,
Secretariat, Chennai-9.

(P.T.O)

Copy to:
The Finance (AHD&F) Department, Chennai-9.
The Private Secretary to Principal Secretary to Government,
Environment, Climate Change & Forests Department,
Chennai-9.
The Private Secretary to Special Secretary
(Environment, Climate Change)
Environment, Climate Change & Forests Department,
Chennai-9.
The Private Secretary to Special Secretary (Forests),
Environment, Climate Change & Forests Department,
Chennai-9.
SF/SC.

//FORWARDED BY ORDER//

ABSTRACT

Forests – Announcement made on the floor of the Assembly – Framing of Policy on 'Ecological restoration of forest areas infested with invasive plant species in Tamil Nadu' – Policy approved - Orders issued.

Environment, Climate Change and Forests (FR.6) Department

Govt. Order (Ms) No: 123 **Dated 13.07.2022**
பகிருது: ஆனி 29
திருவள்ளுவர் ஆண்டு – 2053

Read:

1. From Principal Chief Conservator of Forests, letter No: TS1/33964/2021, dated 04.10.2021.
2. Govt. Order (2D) No 158, Environment, Climate Change and Forests (FR 6) Department, dated 01.11.2021.
3. From Principal Chief Conservator of Forests, letter No WL4/33964/2021, dated 30.06.2022.

ORDER :

Exotic weeds, including *Prosopis juliflora*, *Lantana camera* etc., grow in large numbers in most of the forests of the State, affecting the natural forest environment and the richness of the forest habitat. This is the major challenge to forest management. The invasion of these species is regarded as one of the major threats to local biodiversity of forests. Knowing the importance, the Government have made following announcement on the floor of Legislative Assembly on 03.09.2021;

> *"The Government will formulate a separate policy on the removal of alien weeds found in the forests of Tamil Nadu and for the eco restoration of degraded forest"*

2) The necessity of the policy is narrated as below:

i) Invasive Species of plants, animals, pathogens causing economical or environmental harm or that adversely affect ecosystem health. In particular, they adversely affect biodiversity, including decline or elimination of native species through competition, predation or transmission of pathogens and cause disruption of local ecosystems and ecosystem functions.

TN PIPER 2022

ii) Invasive plants dominate the native ecosystems and are threat to ecosystem services. The invasion of non-indigenous species is regarded as one of the major threats to biodiversity. The invasive species have influence on community composition, abundance and species cover of native vegetation through complex interactions and combination of effects. They affect herbaceous vegetation through shading effect, exerting competition for utilizing available resources and moisture and hinder their growth by producing allele chemicals.

iii) The threats of invasive species may be direct like outcompeting native species for available resources or by indirect threats such as disrupting the food web in an ecosystem by restricting or replacing native food sources. Invasive species can also alter the abundance or **diversity of species** that are important habitat for native wildlife. The invasion by such species is known to cause significant changes in the structure and function of forests by obstructing potential succession processes, interfering with fire regimes and pollination services, and displacing native flora and fauna.

iv) Most of the exotic tree species introduced in forest areas of Tamil Nadu like wattle, pine and eucalyptus to satisfy industrial/ commercial needs however, had adverse impacts on the ecology of the area, particularly in terms of modifying/ affecting hydrology, forest/ grassland community, wildlife, and intensifying man-wildlife conflict.

v) In order to address the growing threat of invasive spread in forest areas of Tamil Nadu, there exists a serious and pertinent need to prioritize problematic species and develop strategies to manage the problematic invasive alien species. In the past, there have been efforts to compile lists of invasive plant species in India and to study the impacts of invasive species in different parts of the country. However, a comprehensive policy framework for invasive species management in forest areas of Tamil Nadu will be attempted, taking stock of the invasive species cover in forest areas (species and area wise) and ongoing weed management practices in the field and incorporating learning from best practices elsewhere.

3) The policy will address highly invasive, habitat degrading plant species in the forest areas of Tamil Nadu for removal and management simultaneously. Principal focus is laid upon developing/ elaborating strategies, methodologies and protocols for management of the most problematic weeds in forest areas to start with, on priority basis which needs immediate attention to restore the habitat health in the wildlife habitat to support wildlife survival as well as to avoid straying out of wild animals.

4) The Government have constituted a Committee for formulating the Draft Policy on "Ecological restoration of forest areas infested with invasive plant species in Tamil Nadu" with the following Terms of Reference:-

i) To identify, demarcate & assess the extent of area infested with invasive/alien species in forest areas of Tamil Nadu.

ii) To formulate Standard operating procedure (SOP) for removal, disposal and eco-restoration of infested area.

iii) To suggest permanent measures to eliminate the Invasive/alien species.

5) In his letter third read above, the Principal Chief Conservator of Forests (HoFF) has stated that based on the Committee's report, after detailed discussion and analyzing the various issues, in consultation with departments concerned, the Draft Policy was hosted in public domain for inviting public response and also been mailed to different scientific/ research organizations for eliciting suggestions / remarks. Further it has been stated by the Principal Chief Conservator of Forests (HoFF) that the final draft has been submitted by the Committee after necessary incorporations of valid inputs received from various quarters and relevant orders of the Hon'ble High Court of Madras.

6) After careful examination by taking into consideration of the recommendation of the Committee, the Government have decided to approve the policy on "Ecological restoration of forest areas infested with invasive plant species in Tamil Nadu" as appended to this Government Order and issue orders accordingly.

(BY ORDER OF THE GOVERNOR)

SUPRIYA SAHU
ADDITIONAL CHIEF SECRETARY TO GOVERNMENT

To
The Principal Chief Conservator of Forests (HoFF), Chennai-15.
The Principal Chief Conservator of Forests and Chief Wildlife Warden, Chennai-15.
The Principal Chief Conservator of Forests (Research and Education), Chennai-15

Copy to:-
Office of the Hon'ble Chief Minister,
Secretariat, Chennai-9.
The Senior Private Secretary to Hon'ble Minister (Forests),
Chennai-9.
The Senior Private Secretary to Addl. Chief Secretary to Government, Environment,
Climate Change and Forests Department, Chennai-9.
Stock File / Spare Copy.

// Forwarded By order //