



# **Environment and Sustainable Development**

Problems, Prospects and Mitigation

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## Invasive Alien Species in Indian Biodiversity

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### ABSTRACT

An alien species is a non-native species that spread from their origin to invade the new habitat and alter it negatively. These invasive species can be found in a wide variety of environments around the world, and they affect many types of living things. Invasive alien species in terrestrial ecosystems are most commonly seen in plants, animals, and insects. Biological invasions now function on a global scale and will grow rapidly in this century. Invasive exotics also bring new disease risks to many native animals that have no natural defenses. These diseases may also pose a health risk. The establishment of invasive exotics can result in a loss of species diversity and pose a threat to the native flora and fauna but also human health, social and economic values. Identifying invasive species early and responding quickly is often more effective than trying to control a wide infestation.

*Some mechanisms were introduced by NISIC such as biological, chemical, mechanical, and physical methods for controlling the invasive species. The government presently takes action against a few of the many imported species that have already been established and spread. Trade is the largest contributor to this entry of alien species in our country.*

**Keywords:** Alien species, Native flora, Native fauna, Environmental changes, Invasion

## 1. INTRODUCTION

Biodiversity losses are the world's current rapid rates of species extinction, which are mostly attributed to human activities. Ecologists have warned that if current extinction trends continue, over half of all species on the planet would be extinct within the next century. Invasive species lead to the extinction of native species, as well as changes in hydrology and ecosystem function. Changes in soil structure, profile, decomposition, nutrient content of the soil, moisture availability, and other factors may result from differences in native and exotic plant species requirements and techniques of resource acquisition and consumption. Invasive species are thus a substantial impediment to biodiversity conservation and sustainable use, with significant negative consequences for ecosystem products and services. Biological invasions now function on a global scale and will grow rapidly in this century as a result of interactions with other changes such as market globalization, global trade, travel, and tourism (Singh, 2005).

### 1.1 Alien species

An alien species is a non-native species that spread from a point of introduction to invade the new habitat and alter it negatively. They're normally introduced for good reasons, yet they can cause environmental, ecological, and economic harm. Many alien species play an important role in our agricultural and forestry systems. However, some alien species become invasive when they are transferred outside of their normal habitats, either purposefully or accidentally, into new places where they demonstrate the potential to establish, invade, and outcompete native species. Alien Invasive Species is defined by the International Union for Conservation of Nature and Natural Resources (IUCN) as an alien species that become established in natural or semi-natural ecosystems or habitat, is a change agent, and poses a threat to native biological diversity.

## 2. INVASION OF ALIEN SPECIES

When alien species are introduced, whether intentionally or unintentionally, for any reason, some of them become invasive and cause the decline or extinction of indigenous species. These invasive species can be found in a wide variety of environments around the world, and they affect many types of living things. Invasive alien species in terrestrial ecosystems are most commonly seen in plants, animals, and insects. Invasive alien plants comprise 173 species in 117 genera, accounting for 1% of the Indian flora. Exotic pests are posing a threat to India's agricultural industry. In India, there are 116 foreign insect species, the majority of which are Coleoptera and Lepidoptera (Fatik, 2011). Invasive species are thus a serious challenge to biodiversity conservation and sustainable use, with significant negative consequences for ecosystem products and services. Invasive species are thus a substantial impediment to biodiversity conservation and sustainable use, with significant negative consequences for ecosystem products and services.

## 3. CAUSES OF INVASIVE SPECIES

These invasive species can be found in a wide range of environments around the world, and they encompass all types of living beings (Sreedhar *et al.*, 2020). Some exotic species can spread unrestricted throughout the country. Their natural predators and competitors are absent so their population became high. They can also compete for food with our native animals, which can cause threaten their existence. When native species cannot defend themselves against exotics, the invasive exotics the habitats of native species take over the habitat of native species.

Invasive exotics also bring new disease risks with them to which many native animals have no natural defenses. These diseases may also pose a health risk. The establishment of invasive exotics can result in a loss of species diversity and pose a threat to the native flora and fauna but also human health, social and economic values. Invasive species lead to the extinction of native species, as well as changes in hydrology and ecosystem function. Changes in soil structure, profile, decomposition, nutrient content of the soil, moisture availability, and other factors may result from differences in native and exotic plant species requirements and techniques of resource acquisition and consumption (Singh, 2005). Invasive species are thus a substantial impediment to biodiversity conservation and sustainable use, with significant negative consequences for ecosystem products and services.

#### 4. EXOTIC FISH SPECIES

In India, alien species have been used for fisheries and aquaculture diversification since the mid-nineteenth century (Singh and Lakra 2006; Lakra *et al.*, 2008). Knowingly or unknowingly, alien fish species have been imported into India for some purposes of aquaculture, aquarium commerce, therapeutic value, research, biological control, and among other things (Singh and lakara, 2006). Many of the exotic fish had been illegally introduced, and their historical information was not available. Hundreds of exotic ornamental species are traded in India's aquarium trade (Lakra *et al.*, 2008). Many alien fish species have been imported into India illegally by private aquaculturists, entrepreneurs, and aqua-industrialists for instant profit over the last two decades. Unauthorized operations like these are promoting indiscriminate alien species spread, which could have harmful environmental implications (Singh and Lakra 2006; Lakra *et al.*, 2008). Many exotic species have been imported into India and are being cultivated, such as *Clarias gariepinus*, *Pangasianodon hypophthalmus*, *Aistichthys nobilis*, *Oreochromis niloticus*, and *Piaractus brachypomus*. In aquaculture and the aquarium trade, these unauthorized introductions have come to prominence (Singh and lakara, 2011). Bighead carp, a prominent aquaculture species in India, could have been imported from Bangladesh in 1987. It quickly spread, and this alien species can be found in most areas of freshwater aquaculture. The African catfish (*C. gariepinus*) was probably introduced clandestinely into the state of West Bengal in 1994 and quickly expanded throughout the country, including into cold regions and coastal areas. West Bengal and Andhra Pradesh are the states where it is primarily practiced. Seed production, on the other hand, is primarily conducted in the state of West Bengal. These fish have become popular among aquaculturists in the country, even though their cultivation is illegal. (Singh and lakara, 2011).

##### 4.1 Risk assessment of alien fish species

Today, alien fish risk assessment is one of the most important aspects of safeguarding fish biodiversity and food safety. For the ecological roles in which alien fish species are enmeshed, the advantages and hazards of alien fish species in India have been analyzed. The 'Invasiveness Screening Test' is a science-based simple risk assessment protocol (Singh and lakra, 2011) that includes a screening of potential biological features like growth, culture level, history of the establishment, wild breeding, phenotypic plasticity, ability to live off a variety of food types, competition with local

species, diseases, and dispersal ability (Kolar and Lodge 2001, 2002) (Ricciardi and Kipp, 2008). The key predictor of aquatic alien species establishment was propagule pressure, which was defined as the number or frequency of alien species discharged (Fausch *et al.*, 2009) and was influenced by a human interest in any foreign species. As a result, unlicensed alien species culture by public aquaculturists has exploded in recent years. Once established, alien species can quickly spread due to environmental conditions such as temperature and salt (Moyle and Light 1996; Bomford *et al.*, 2010).

### 5.0 Invasive plant species

The richest families in terms of invasive species are 27 species from Asteraceae, 20 species from Fabaceae, and 12 species from Solanaceae (Khuroo *et al.*, 2021). The genus of North American shrubs, *Parthenium hysterophorus* is belonging to the sunflower tribe and subfamily Asteroideae of the daisy family. It is a subtropical American native that has been quickly invading the North-Western Indian Himalaya (Himachal Pradesh) in recent decades. It is also known as Asteraceae and congress grass is one of India's most problematic and toxic weeds. The average height of *P. hysterophorus* plants was  $2.09 \pm 0.27$  m, with its root system reaching a depth of  $17.32 \pm 4.03$  cm below ground level. It produced a large number of seeds, which will aid in its spread over a variety of ecosystems. During one season, a single Parthenium plant produced more than  $7397 \pm 81.42$  seeds, according to research. The seeds were smaller, with a length of  $2.31 \pm 0.02$  mm and a width of  $1.03 \pm 0.01$  mm. *P. hysterophorus* did various life cycles in one year in the NW (northwest) Himalaya, from March to June and July to November (Dogra., *et al.*, 2011). Apart from easily invading areas and replacing native plants, it has been linked to several human health issues, including skin allergies, asthma, and eye irritation in nearby inhabitants. In addition to being unpleasant and harmful to livestock, it also causes a lack of fodder (Kohli., *et al.*, 2006). It infected habitats up to 2000 meters above mean sea level, wreaking havoc on local plant resources in the infected areas. In the NW Himalaya, the density and dominance of *P. heterophoria* were higher in the summer and were almost non-existent during the winter (Dogra., *et al.*, 2011). It has become the most important invasive weed in the country, with a distribution that reaches practically the whole country. It has become a severe weed of pastures, wastelands, roadsides, railways, watercourses, and crops in Australia, Western Africa, Asia, and the Caribbean countries. Parthenium infestations have been reported to decrease grain and forage yields by 40%–90% (Tanveer., *et al.*, 2015).

The other alien species is called the *Lantana camara* which is a blooming plant belonging to the verbena family that is endemic to the American tropics. It is a very adaptable species that can live in a wide range of settings; once introduced into a habitat, it quickly expands. It was first introduced to the United States in the 1690s. In the early 1800s, European colonial powers transported plants from Latin America to Europe and their colonial territories. *Lantana* species were first introduced to India in 1807, and colonial forces quickly spread the plant throughout the country (Kannan., *et al*, 2013). Sundaram *et al* in 2013 interviewed the open-ended question with Soliga people (An ethnic group of people in India) to gather knowledge and information about this biological invasion of *lantana* species. The Soliga attributed *lantana*'s spread to three factors as its prodigious fruit yield and broad seed distribution, changes in fire management, and past grass and bamboo harvest. The Soliga believe that the invasion of *lantana* has harmed the ecosystem and their way of life (Sundaram., *et al*, 2013). The new strategy involves the removing of this *lantana* such as using the cut rootstock method, weeding saplings from beneath trees used for perching by generalist birds that disperse seeds throughout their home range and from surface drainage channels originating from the area covered by such trees, and ecological restoration of weed-free landscapes, preferably grassland or forest communities (Love., *et al*, 2009).

In the late 1890s, *Acacia nilotica* was introduced to Queensland from India as an ornamental tree. *A. nilotica* has been extensively utilized as a shade tree and sheep feed in western Queensland since the mid-1920s (Dhileepan, 2009).

## 6. NON-NATIVE PEST STATUS

Invasive species are creatures that have adapted quickly to living in non-native environments, where they reproduce rapidly, and they must be harmful to property, the economy, medical and public health, and, in most cases, the ecology. While all invasive species are able of thriving in non-native environments, achieving just one of the above criteria characterizes a non-native species as "invasive." Naturally, not all non-native species are invasive, and some non-native insect pests aren't universally regarded as invasive. Non-native species can be utilized for financial advantage.

*Phenacoccus solenopsis*, also known as the cotton mealybug or solenopsis mealybug which belongs to the Pseudococcidae family which is considered an invasive species. One of the most prevalent groups of small sap-sucking insects is mealy bugs. They are

regarded as a major agricultural pest in several countries, producing significant issues in specific places (Miller *et al.*, 2002). In India, the first *P. solenopsis* infestations were discovered in Gujarat in 2005. After it was originally released, it quickly spread. *P. solenopsis* is a polyphagous insect pest that feeds on a variety of plant species (Prasad *et al.*, 2011).

The tomato leaf miner, *Tuta absoluta*, is a terrible pest of tomato which is also considered an invasive species from Latin America. During the 2014 rabi season, it was found for the first time on tomato at the Indian Institute of Horticultural Research (IIHR), Hesaraghatta, Bengaluru, Karnataka, India (Shylesha *et al.*, 2018). *T. absoluta* was identified on two hosts such as in tomato and potato, with the incidence of *T. absoluta* being higher on tomato than potato. *T. absolute* is the major host plant in tomatoes, but the bug has also been found on solanaceous weeds like *Solanum nigrum* and *Datura stramonium*. Eggplants, pepper, and potato have also been reported to be damaged. (Luna *et al.*, 2015).

## 7. PREVENTIVE MEASURES FOR INVASIVE SPECIES

The alien species could depend on the time of introduction, where species introduced early have a competitive advantage to dominate (Panda and Behera, 2019). According to National Invasive Species Information Center (NISIC), Prevention is the most expensive and safest method of controlling invasive species. Identifying invasive species early and responding quickly is often more effective than trying to control a wide infestation. Some mechanisms were introduced by NISIC such as biological, chemical, mechanical, and physical methods for controlling the invasive species. To manage invasive populations by biological method, animals, fungus, or illnesses native to the targeted species' home range are used. Pesticides, herbicides, fungicides, and insecticides are all examples of chemical control. Mowing, hoeing, tilling, girdling, cutting, and creating barriers with tools or machines are forms of mechanical control techniques. Hand-pulling, excavating, flooding, mulching, manual destruction or removal of nests, egg masses, or other life stages are forms of physical (or manual) control.

The most potent way to Regulate pest movement is through phytosanitary measures and ensuring that best agricultural practices being used to limit pest incidence to a low level are the most effective ways to avoid the international spread of pests through commerce and passenger movements (IPPC Secretariat, 2021). Phytosanitary import legislation is the first line of defense in any prevention of



international spread. A phytosanitary import regulatory system's goal is to prevent or limit the entrance of controlled pests into the country via imported commodities, other regulated products, and passengers. It will be even more vital for a phytosanitary import regulatory system to stay effective in the face of climate change to have good risk assessment capabilities and to use them to assess potential risk scenarios while considering climate change. It will also be critical to implement functional and well-organized surveillance and monitoring efforts (Carvajal-Yepes *et al.*, 2019), (Giovani *et al.*, 2020).

## 8. CONCLUSION

These invasive species can, therefore, play an important role in survival, population build up, and destruction and needs to be monitored. Any action that is undertaken often occurred when it is already too late Species has been established to eradicate them and cause more harm. The government presently takes action against a few of the many imported species that have already been established and spread. Trade is the largest contributor to this entry of alien species in our country.

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