

Invasive Alien Species - Threats to Nature, Economies, Food Security and Human Health

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Abstract:

The ecosystem's functions and human welfare are intrinsically related to biodiversity. Food production and nutritional security are known to be facilitated by biodiversity worldwide. In order to accomplish the sustainable development goals, biodiversity has several beneficial effects. Accordingly, the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) of the United Nations (UN) estimated that biotic invaders pose a threat to around one fifth of the Earth's surface, including the global biodiversity hotspots. Threats to the environment and public health may arise from the emergence of new invasion alien species in unfamiliar habitats. Invasion alien species tends to inhibit forest diversity and function as weeds, which lowers worldwide agricultural yield. In addition, the management of invasive alien species in the future needs to take public acceptability and economics into account. It is quite expensive to manage the invasive alien species through their removal.

Introduction

Invasive alien species - plants, animals or microorganisms that are introduced intentionally or unintentionally into areas where they are not native, remain one of the most striking symptoms of the adverse effect of human activities on our natural world. They influence entire ecosystems, economies and food security to human health, wellbeing and livelihoods. They also pose an increasingly serious risk to progress on the global goals.

We first became aware of invasive species through the publication of a book by Charles Elton in 1958. Even after that, it was only in the 1980s, after the SCOPE workshops, that invasive species were widely accepted as a cause of environmental concern. Thus, the concern over invasive species has only grown since the 1980s.



The severe global threat posed by invasive alien species is frequently ignored, undervalued, and misunderstood. New report released on December 4, 2023, by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) states that more than 37,000 alien species have been introduced by many human activities to regions and biomes around the world. Now, this estimate is rising at unprecedented rates. More than 3,500 of them are harmful invasive alien species that seriously threaten nature and the good quality of life. Invasive alien species pose a significant challenge to humans in all regions and countries.

According to the Assessment Report on Invasive Alien Species and Their Control, the worldwide economic cost of invasive alien species exceeded \$423 billion in 2019, and expenditures have increased every decade since 1970.

In 2019, IPBES's Global Assessment Report identified invasive alien species as one of the top five drivers of biodiversity decline – along with land- and maritime land-use change, direct species exploitation, climate change, and pollution. According to this report about 6% of alien plants; 22% of alien invertebrates; 14% of alien vertebrates; and 11% of alien microbes are known to be invasive, pose serious threats to the natural world and humans.

Indigenous Peoples and local communities are identified as the most directly affected by invasive alien species, with more than 2,300 species found on indigenous peoples' land – affecting their livelihoods and cultural identity.

Over 1,200 local extinctions are believed to be caused by at least 218 invasive alien species. Comparably, 85% of recorded impacts have a negative effect on people's quality of life. Examples of these impacts include health effects, such as diseases like West Nile fever, Zika, and malaria that are spread by invasive alien mosquito species like *Aedes albopictus* and *Aedes aegyptii*. Invasive alien species also harm livelihoods, for example, in Lake Victoria, where fisheries have declined due to depletion of tilapia due to the spread of water hyacinth (*Pontederia crassipes*), the world's most widespread invasive alien species. Lantana (*Lantana camara*), a flowering shrub, and the black rat (*Rattus rattus*) are the second and third largest widespread invasive alien species in the world and adversely effects on nature and people's quality of life.

According to the report, 34% of the effects of biological invasions reported from America followed by Europe and Central Asia (31%), Asia and the Pacific (25%), and Africa

(about 7%). About 75% of negative effects are documented on land, particularly in forests, woodlands and agricultural areas. Freshwater (14%) and marine (10%) environments have significantly fewer negative effects.

Indian scenario

India is a mega-diversified nation that is home to 45,000 wild plant species and around 90,000 animal species in less than 50% of the geographic area. According to Journal of Applied Ecology (2023) study, based on the largest wildlife survey conducted worldwide, 66 percent of India's natural systems are at risk from invasive plant species. India is one of the greatest population densities in the world. As a result, the demand for food, energy and infrastructure increases, potentially increasing the already epidemic attacks.

About 40% of India's plant species are alien, of which 25% are invasive. According to a recent survey, India has 1599 alien plant species belonging to 841 genera of 161 families and thus alien flora constitutes 8.5% of the total vascular flora of India.

According to reports, savannas are the most vulnerable to invasions about 87 per cent, followed by moist grasslands and dry deciduous forests each at 72 per cent. Evergreen forests were found to be least suitable for invasive species at 42 percent susceptibility. However, the suitability of individual alien plants and its drivers varied for each species.

Lantana camara covering 50% of natural area and spread across 574,186 square kilometres. The Nilgiri Biosphere Reserve in the Western Ghats was one of the most affected hotspots due to invasion dominated by *Lantana camara*, *Prosopis juliflora* and *Chromolaena odorata*.

Water hyacinth (*Eichhornia crassipes*) (Mart.) belongs to family Pontederiaceae is a native of South America. It is considered to be one of the most harmful aquatic weeds on the planet. It is also one of the most common aquatic weeds in India. Water hyacinth was introduced into the country in 1896 as a decorative plant in the botanical garden of Bengal, India. In the majority of the nation's water bodies, this plant is now a threat to the environment and to society. Most of the country's Ramsar sites have been proliferated by the species. Ramsar sites of *Eichhornia crassipes* in India includes Bhitarkanika Mangroves, Harike Lake, Pong Dam Lake Ashtamudi Wetland, Sasthamkotta Lake and Vembanad-Kol Wetland.

Ramsar Sites

Any wetland site which has been listed under the Ramsar convention that aims to conserve it and promote sustainable use of its natural resources is called Ramsar site. Ramsar convention is known as the convention of wetlands. It was established in 1971 by UNESCO and came into force in 1975. India became a signatory to the Ramsar Convention on February 1, 1982. Over the years, the number of Ramsar Sites in India has steadily increased. There were 26 recognized sites between 1982 and 2013. But there was a significant uptick from 2014 to 2022, when 49 more wetlands were designated as Ramsar sites. India established 28 new sites in 2022 alone. Among the Indian states, Tamil Nadu leads with 16 Ramsar Sites, followed closely by Uttar Pradesh with 10. There are 80 Ramsar sites in India. Sundarbans is the largest Ramsar site and Renuka wetland in Himachal Pradesh is the smallest wetland of India.

In 2012-13, the National Wetlands Conservation Programme (NWCP) was launched to protect and manage the identified wetlands including the Ramsar sites across India. The National Wetlands Conservation Plan was later integrated with the National Lake Conservation Plan and National Plan for Conservation of Aquatic Ecosystem to form a comprehensive conservation plan for lakes and wetlands.

India has added 27 wetlands to the Ramsar List thus far, ranging from the high-altitude wetlands of the Himalayas (Tso-moriri and Chandertal), lakes and marshes (Wular, Renuka, Keoladeo, Loktak, Deepor, Rudrasagar, Nalsarovar and Sasthamkotta), river stretches (Upper Ganga River stretch and Kanjili), salinas (Sambhar), mangrove swamps (Sunderbans, Bhitarkanika and Point Calimere) and lagoons and estuaries (Chilika, Ashtamudi and Vembanad-Kol). The Government of India has also included water storage places (Pong, Bhoj Wetlands, and Surinsar-Mansar) and collections of sewage-fed fish farms (East Calcutta Wetlands) to the List.

List of Ramsar sites in India

The table below contains the list of some of the Ramsar Sites in India, as well as their names and Location:

Sl.No.	Name of the Ramsar Sites in India	State – Location
1	Chilika Lake	Odisha
2	Keoladeo National Park	Bharatpur Rajasthan
3	Harike Wetland	Harike, Punjab

4	Loktak Lake	Bishnupur, Manipur
5	Sambhar Lake	Rajasthan
6	Wular Lake	Jammu and Kashmir
7	Kanjli Wetland	Kapurthala Punjab
8	Ropar Wetland	Ropar, Punjab
9	Ashtamudi Wetland	Kollam district, Kerala
10	Bhitarkanika Mangroves	Odisha India
11	Bhoj Wetland	Bhopal, Madhya Pradesh
12	Deepor Beel	Guwahati, Assam
13	East Kolkata Wetlands	Kolkata West Bengal
14	Kolleru Lake	Andhra Pradesh
15	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu
16	Pong Dam Lake	Kangra, Himachal Pradesh
17	Sasthamkotta Lake	Kollam, Kerala
18	Tsomoriri	Ladakh
19	Vembanad-Kol Wetland	Kerala
20	Chandra Taal	Lahul, Himachal Pradesh
21	Hokera Wetland	Zainakote, Jammu and Kashmir
22	Renuka Lake	Simaur, Himachal Pradesh
23	Rudrasagar Lake	Melaghar, Tripura, India
24	Surinsar-Mansar Lakes	Jammu and Kashmir
25	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh

Recently assigned Ramsar Locales in India

- Tampara Lake, located in Odisha.
- Hirakud Reservoir situated in Odisha.
- Ansupa Lake, found in Odisha.
- Yashwant Sagar, located in Odisha.
- Chitrangudi Bird Sanctuary, situated in Madhya Pradesh.
- Suchindram Theroor Wetland Complex, located in Tamil Nadu.
- Vaduvur Bird Sanctuary, found in Tamil Nadu.

- Kanjirankulam Bird Sanctuary, situated in Tamil Nadu.
- Thane Creek, located in Maharashtra.
- Hygam Wetland Conservation Reserve, found in Jammu and Kashmir.
- Shallbugh Wetland Conservation Reserve, situated in Jammu and Kashmir.

In January 2024, five new sites were added to the list of Ramsar Sites in India.

- Ankasamudra Bird Conservation Reserve – Karnataka
- Aghanashini Estuary – Karnataka
- Magadi Kere Conservation Reserve – Karnataka
- Karaivetti Bird Sanctuary – Tamil Nadu
- Longwood Shola Reserve Forest – Tamil Nadu

The Ramsar Sites in India contain a wide variety of wetland ecosystems, including mangroves, marshes, lakes, rivers, coastal areas, and more. They act as basic natural surroundings for various plant and creature species, including transitory birds that follow the Focal Asian Flyway. Additionally, these locations support traditional means of subsistence, such as farming and fishing, enhancing the socioeconomic well-being of the surrounding communities.

Furthermore, because the Ramsar sites in India are frequently connected to antiquated customs and religious rituals, they are significant cultural landmarks. They also present a wealth of opportunities for scientific study, providing insights into wetland ecology, climate change impacts, and sustainable management practices. They have a role in mitigating climate change by sequestering carbon, especially in peatland ecosystems.

Policy decisions

As anthropogenic components such as climate change give the ideal environment for alien species to multiply and spread, our decisions and actions must be rooted in a comprehensive understanding of this threat and its future implications.

The increase in harmful alien species and their negative impact is expected to be significantly higher. Invasive alien species are projected to increase as a result of intensified and expanded land - and sea-use change, accelerating global economy, as well as demographic changes. Already existing alien species will continue to grow in number and spread to new countries and regions even in the absence of introduction of new alien species.



As part of the new Kunming-Montreal Global Biodiversity Framework, the Governments of the world agreed, in December 2022 to decline the introduction and establishment of priority invasive alien species by at least 50% by 2030. This is a vital, but also very important commitment. In order to meet this need, combine the latest science, data, and new thinking to guide countries, and communities, to prevent, mitigate, and manage invasive alien species.

The IPBES experts draw attention to the inadequate steps taken to address these issues. Only 17% of nations have national laws or regulations specifically addressing managing these invasive alien species while 80% of countries have targets related to managing invasive alien species in their national biodiversity plans. It also increases the risk of harmful alien species in neighbouring countries. According to the report, 45 percent of all countries do not invest in managing biological invasions.

India has no exclusive legislation or policy to deal with and eradicate invasive alien species. However, regulation exists in the form of the Plant Quarantine (Regulation of Import into India) Order 2003 which requires that any import of plants or seeds into the country should be examined for the potential risk of pests. The order was issued under the Destructive Insects and Pests Act of 1914, which aims to prevent the spread of pests that are potentially harmful to crops.

The Government of India launched the National Biodiversity Action Plan in 2008 and set National Biodiversity Targets (NBT) by 2015, aligned with the Aichi Targets. Under Target 4 of NBTs, the goal was to develop invasive species management strategies and integrate them with existing protected areas and wetland management plants.

The Wildlife (Protection) Amendment (“WPA”) Bill 2021 (Bill No. 159/ 2021), in a first, introduces a regulatory framework for ‘invasive alien species’ (“IAS”) in the Indian environmental legislative regime. However, while this is a good initiative, the scope of this provision is still limited and not sufficient to address the threat posed by invasive species to the Indian ecosystem. The current definition of alien in the Bill does not include invasive native species. Compared to the definition in the Convention on Biological Diversity, the narrow scope of the proposed change becomes clear. While the CBD follows an ecological approach and defines "alien species" in the context of its natural habitat, the Bill's definition understands the term "alien" in a geopolitical context, that is, a species that is not native to India. As a result,

species that are native to India but are still invasive when introduced into a new habitat in the country are excluded from the regulation. For example, Katsagon (*Haplophragma adenophyllum*), although native to eastern India, was introduced to other states during afforestation campaigns, it has become invasive. Similarly, the NBA itself has acknowledged that the introduction of several protected native species, including the Asian elephant, barking deer and spotted deer from mainland India to the Andaman and Nicobar Islands, has threatened the local flora and fauna and is considered an invasive species on the island. According to IUCN (International Union for Conservation on Nature) red list in their native range, Asian Elephant is also classified as 'Endangered' but it is also considered invasive by the NBA. However, the Bill fails to acknowledge the impacts of such native invasive species. In order to take a significant step towards meeting the Aichi and National Biodiversity Targets, it is imperative that future legislation in this area is aligned with international standards and mindful of the regional ecological requirements.

Management

By using more integrated strategies and efficient management techniques, invasive alien species and their effects can be avoided. "Prevention is certainly the best and most cost-effective method – but eradication, containment and control are also effective in specific contexts. Ecosystems restoration can also strengthen the resistance of ecosystem to future invasive alien species. Indeed, controlling invasive alien species can help alleviate the negative impacts of other drivers of change.

In the Asia-Pacific region, the introduction of a rust fungus (*Puccinia spegazzinii*) to control bitter vine (*Mikania micrantha*) has proven to be an effective method of biological control for invasive alien plants and invertebrates, with over 60% of cases showing success. Consideration of consistent policies and codes of practice across sectors and scales; commitment and resources; public awareness and participation, such as citizen science campaigns; filling knowledge gaps as well as inclusive and fair governance are needed for their management.

Conclusion

It is controversial among invasion ecologists how alien species contribute to the loss of native species because they have an impact on native biodiversity and ecosystem services.



Biologic invasions are primarily caused by anthropogenic disruptions. Long-term continuation of these human-mediated perturbations may lead to the formation of new invasive alien species that are dangerous to the environment and public health. We can, however, manage the invasive alien species in a sustainable manner if we have a clear grasp of the numerous mechanisms underlying the introduction, propagation, and establishment of invasive alien species. The intricate interplay between emerging global challenges such as unsustainable agriculture, climate change, biodiversity loss, and environmental disruptions, and human health should be thoroughly examined. The effects of environmental stressors on the environment and ecosystem services, socioeconomic status (livelihood), and human health should thus be examined in future studies using a variety of environmental stressors.

