

BIOINVASION

ENVIS Newsletter on Biological Invasion

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Argemone mexicana
(Mexican poppy)



Domain : Eukaryota
Kingdom : Plantae
Phylum : Spermatophyta
Subphylum : Angiospermae
Class : Dicotyledonae
Order : Ranunculales
Family : Papaveraceae
Genus : *Argemone*
Species : *Mexicana*



Widespread noxious annual weed

Native: Central America (Mexico)

Invasive in Argentina, India, Mascarene Islands, South Africa, Australia

Characteristics:

Extremely hardy pioneer plant

Tolerant of drought and poor soil

Has bright yellow latex

Poisonous to grazing animals

Extremely low nutrient requirement

Habitat:

Can colonize and persist in severely disturbed areas, wastelands, cropland

Compete and eventually displace indigenous species

Control: Biological control is most suitable

Natural enemies: Aspergillus niger, Helicoverpa assulta, Rotylenchulus reniformis

Epidemic dropsy is caused by consumption of mustard oil contaminated with argemone oil.

Source: The Invasive Species Compendium, CAB

ABOUT ENVIS

Ministry of Environment, forest and Climate Change's (MoEFCC) Environmental Information System (ENVIS) resource partner at Amrita Vishwa Vidyapeetham is established to disseminate scientific, technical, and semi-technical information on various issues related to biological invasion/Invasive Alien Species and conduct related research and extension activities.

Some of the objectives of the ENVIS Centre are:

1. To promote, implement, and coordinate Green Skill Development Programme (GSDP), an initiative to skill youth in environment, forest, and wildlife sectors and enable them to be self-employed. E.g., lantana craft and furniture making, herbal kitchen gardening of native species.
2. To implement and coordinate National Environment Survey (NES) a Grid-based Resource Information and Decision Support System (GRIDSS) for sustainable management of natural resources to fill in data gaps with respect to various environmental parameters such as emission inventory and pollution; forest and wildlife flora and fauna; wetlands; rivers and other water bodies; public health, etc.
3. To implement and coordinate a community driven Environmentally Sustainable Village Programme (CESVP) with the objective of mobilizing communities on environmental issues, creating decentralized models of development to empower local communities and build an awareness driven atmosphere in villages to adopt environmentally sustainable practices at community level.
4. To build a repository and dissemination centre in Environmental Science, Information and Management (ESIM).
5. To support and promote research, development and innovation in ESIM.
6. To promote national cooperation and liaise with agencies concerned for exchange of environment and biological invasion related information.

Dr. Maya Mahajan

THE ENVIS TEAM

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Content



1	Study on Pistia stratiotes an Alien Invasive Aquatic plants in Tiruchirappalli district	5
2	Lantana Craft training under Green Skill Development Programme at Sengeuttaiur Tribal Village	8
3	The mile-a-minute weed Mikania micranta: liability to asset	12
4	Webinar on the Occasion of World Wetland Day	15
5	Celebration of World Wildlife Day, 2022 and World Wildlife week, 2021	16
6	“Ecosystem health and biodiversity” The Complete circle	18
7	Invasive Alien Plant Species: Their Impact on Ecosystem Service and Human Health	20
8	News highlights on invasive species	25

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Pistia stratiotes L. is a free-floating aquatic plant species. While the native range of the species is uncertain, either South America or pantropical (Renner and Zhang, 2004; Neuenschwander et al., 2009; Brundu et al., 2012), the species has been introduced into



Europe and subsequently spread into 14 European countries. Climate modelling demonstrated the potential future distribution of *P. stratiotes* in southern Europe, where the species has already been reported as invasive (Brundu, 2012; EPPO, 2016) and under control through manual removal (Brundu et al., 2012; EPPO, 2016). *P. stratiotes* has established in naturally thermally heated waters in Germany,

Russia and Slovenia (Sajna et al., 2007). The floating plants are sensitive to frost, and emerged floating leaves die when exposed to freezing air temperatures, but the small flat winter forms can persist air frost however they will die when enclosed in ice (Hussner et al., 2014). Viable seed production has been documented and the seeds are viable even after exposure to freezing temperatures. *P. stratiotes* spreads simply via daughter plants with the water flow (Heidbüchel et al., 2016) and dispersal by seeds via waterbirds seems likely (Green, 2016).

The ornamental trade is the major pathway for the introduction of invasive alien aquatic plants (IAAPs) into continents and countries (Kay and Hoyle, 2001; Maki and Galatowitch, 2004;). Prevention of further introductions of a species is cheaper and easier to achieve than the management of invasive alien aquatic plant species. Trading bans and codes of conduct are valuable tools to stop the future introduction of invasive alien aquatic plant species (Verbrugge et al., 2014; Hussner et al., 2017). *P. stratiotes* is frequently imported (Brunel, 2009) and sold in shops (Hussner et al., 2014b) in European countries, and every single plant poses a potential risk for secondary intended or unintended releases into freshwater habitats from aquarium and garden pond cultures of *P. stratiotes*. However, accidental escapes from cultivated *P. stratiotes* populations (for wastewater treatments and experiments) may occur, and thus measures to prevent this unintended spread must be taken (Brundu et al., 2012).

The identification of *P. stratiotes* is relatively easy in comparison to most submerged invasive alien aquatic plants, but still species identification knowledge of the responsible

authorities controlling the import of plants is required (Hussner et al., 2017). This will increase the success of trading bans and codes of conduct, but the success is still hard to quantify and depends on various parameters, e.g., on correct labelling of plant material and contamination by seeds (Hussner et al., 2014; 2017). Among 55 species of alien aquatic plants in India, 10 species are invasive, such as *Eichhornia crassipes*, *Alternanthera philoxeroides*, and *Pistia stratiotes*. Most of these invaders were intentionally introduced and dispersed across the country but are now widely distributed and invasive. Under climate warming, many species have expanded their distributions to areas where it was originally too cold for their survival. These species are beneficial plants in aquaculture and for the restoration of aquatic ecosystems (for water purification) across larger areas. However, for



potential invasive species, climate warming is increasing their invasion risk in more areas. In addition, nitrogen deposition and phosphorus inputs may also alter the status of some alien species.

Presence of *Eichhornia*, *Pistia* and *Ipomoea* indicated a clear sign of invasion of alien species in the lake. Narayana and Somashekar (2002) concluded that the physico-chemical characteristics of lake influence the growth of species, distribution, indicator



group and pollution tolerant species. Presence of *Eichhornia*, *Pistia* and *Ipomoea* indicated a clear sign of invasion of alien species in the lake.

The presence of *P. stratiotes* indicated a clear sign of invasion of alien species in lake. The Santhapettai area of Lalgudi ($10^{\circ} 52' 37.7868''$, $E 78^{\circ} 48' 50.0184''$) is one of the biggest freshwater lakes in Lalgudi in Tiruchirappalli district, Tamil Nadu, India. The plants have been identified from fresh water. It is found that the higher macrophytes diversity was observed in mesotrophic to slightly eutrophic lakes. Inhabitants around the lake are unaware about the importance of flora and fauna. Qualitative and quantitative floristic survey, constant monitoring and protection of lentic and lotic ecosystems are the need of the hour in order to save the native biota, to maintain the quality of drinking water, and disqualify the efforts of alien species to invade.

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India has become one of the world's fastest growing knowledge-based economies due to immensely abundant human capital. However, given the changing demands resulting from labour force shifts from primary to secondary and tertiary sectors, there is still a need to further develop the country's existing low skill levels, which pose a challenge to the country's growth and global competitiveness. In response, the Government of India has been striving to initiate and achieve formal/informal skill development of the indigenous population via education and skill training learning methods.

In this background, Ministry of Environment, Forest and Climate Change has proposed Green Skill Development Program (GSDP) under Environmental Information System (ENVIS) to meet the challenge of expansion of training

capacity with speed, high quality standards and sustainability of indigenous community. It is aimed at upgrading the skills of the tribal people which would enable them to gain suitable employment or enable them to become self-employed.

The 45 days long lantana furniture and craft course titled "**Value addition and marketing of NTFPs (Plant Origin): Lantana Furniture and Crafts Advance course**" held at Sengeuttaiyur village, Coimbatore is a key component of the Amrira Vishwa Vidyapeedham ENVIS RP project, Coimbatore, which is part of the GSDP course. The novel approach was to encourage tribals living in the forests to use the plentifully available weed as a source of employment and livelihood. This novel initiative has also contributed to the management of the profusely growing invasive weed Lantana, which





is otherwise appearing as a threat to the indigenous biodiversity.

Sengeuttaiyur hamlet is in the Anaikatti Reserve Forest hill region (11°09'02.4"N, 76°46'36.6"E)



in North Taluk of Coimbatore district in Tamil Nadu. The places cover a large area of thick forest vegetation which habitats wild animals.

The reserve forest covers dry deciduous forests, thorn forests and scrub vegetation in which lantana (*Lantana camara*), a garden ornamental has spread extensively in the village. Lantana grows at a ferocious rate and removing it has its own challenges. Forest departments spend significant effort and money to remove these invasive species.

Most of the settlements in the area consist of forest dwelling communities such as Irula. There are 90 Irula residences in the community, with a total population of over 300 people. Irula tribes in Sengeuttaiyur village traditionally depend on forest for their livelihood. Land holding is small and most of the land parcels are covered with reserve forest area. As a result, most of the community members depend on temporary jobs in nearby private concern for their





livelihood. There have been only limited agricultural activities. Based on this background Amrita ENVIS under GSDP programme started the Lantana craft making training programme on 8th January 2022 at in Sengeuttaiyur village with 20 participants. They were trained to make craft and furniture using plentifully available exotic invasive plant 'Lantana camara'. Dr. Maya Mahajan, coordinator of ENVIS RP, Amrita Vishwa Vidyapeetham, launched the training programme along with other ENVIS employees

Dr. R Alexander, Program Officer, Dr. Brindha, Information Officer, and Royal Tata, IT officer. The training programme was led by a master trainer from the Siruvani tribal hamlet. The trainees were provided stipend and food allowance. The participants were first trained on small, handcrafted product such as stools, basket, trays and later they were trained for making large furniture items such as sofas, chairs, and racks. Other essentials required for the furniture making process was provided by the



center. The training programme went successfully with very active participation and involvement of the participants.

On successful completion of the training programme titled "Value addition and marketing of NTFPs (Plant Origin): Lantana Furniture and Crafts Advance course, valedictory function was held at Sengeuttaiyur village on April 6th, 2022. The Chief Guest of the function was Shri. Prema Rangachary, Founder, Vidya Vanam school and a famous activist and the Registrar, Amrita Vishwa Vidyapeetham Dr.K



Shankaran graced the function as Guest of Honour.

Dr. Maya Mahajan, coordinator of ENVIS RP and Associate Professor, Amrita Vishwa Vidyapeetham, who launched the training



of the training program were conferred with certificates. Lantana furniture is marketed as inexpensive, long-lasting, and resistant to termites and bed bugs. Considering these features, as well as the convenience of maintenance and the visual appeal, demand for such furniture is expected to increase in near future. However, in order to reach the

programme gave the brief highlight of the overall project. Dignitaries from FICCI FLO that work towards entrepreneurship and skill

market, such indigenous goods developed by



indigenous community that also solve the issue of invasive weed management would need appropriate marketing and promotion.

development programs for women, Ms Ritisha Niveda, Dr Kamini Surendran, ENVIS staff Dr. Sampri Katak (Program Officer) and Dr. Brindha (Information officer), administrative officials and media persons also attended the event. Participants



Dr. Sampri Katak
Programme officer, ENVIS, Amrita

Mikania micrantha is a branched, perennial, slender-stemmed vine with herbaceous to semi-woody stems. It is one of the world's most destructive and economically



damaging invasive species. This fast-growing vine is native to Central and South America. Once introduced the crop can grow profusely eradicating other vegetation or decreasing their yield and biodiversity. It was intentionally introduced into a number of countries and has since become a major weed in entire Southeast Asia and the Pacific and is still expanding its coverage. With a vast quantity of seeds, runners and suckers, and the ability to grow from stem pieces, this species is difficult to control. Many countries have initiated biological programme aimed at this species. Mikania, often known as "Mile-a-minute Weed," as it spreads swiftly in the spring and summer. This is how micrantha increases its photosynthetic capacity and achieves a very fast growth: It takes in CO₂ at night to help with carbon fixation during the day, and its stems are more efficient at photosynthesis. The metabolites of *M. micrantha* can also make more nitrogen available by boosting the number of microbes

that play a role in nitrogen cycling. (Liu et al., 2020).

Reported traditional uses

The broad uses of the plant include as animal feed, fodder, forage, for landscape improvement, soil improvement, as green manure, for pharmaceutical applications. In India, Malaysia, and Fiji, it has also been used as a livestock feed. It has also been used as a cover crop, for soil improvement or to prevent soil erosion. As a green manure, *M. micrantha* has been shown to increase the growth and yield of rice in India. However, because of its high-water content and faster degradation, it is not ideal for mulching or composting. The antibacterial and antimicrobial characteristics of *M. micrantha* have also been employed as a therapeutic herb in many nations. For snake, bug, and scorpion bites, some Indian tribal people utilize the gum from the leaves. Medicinal uses of *M. micrantha* include treating wounds and nausea. Bee and ant bites may be alleviated with the application of ointment made from the leaves. It is also used as rat poison.



Source: FAO.org

Some traditional control measures

Plantations in the Asia-Pacific area are suffering major productivity and profitability losses due to Mikania. The control measures are often non sustainable or viable. There are several ways to manage mikania, including manual/mechanical methods and the use of herbicides, however many of these approaches have severe limitations. Clearing Mikania with physical means is currently the most usual practice for its eradication globally. However, there may be regrowth from the bases and repeated removal at regular interval should be applied as and when necessary. Manually pulling out the plants allows removal of roots but the process could be often labour intensive.



(Photo: Carol Ellison, CABI BioScience, Source: <http://www.iucngisd.org/>)

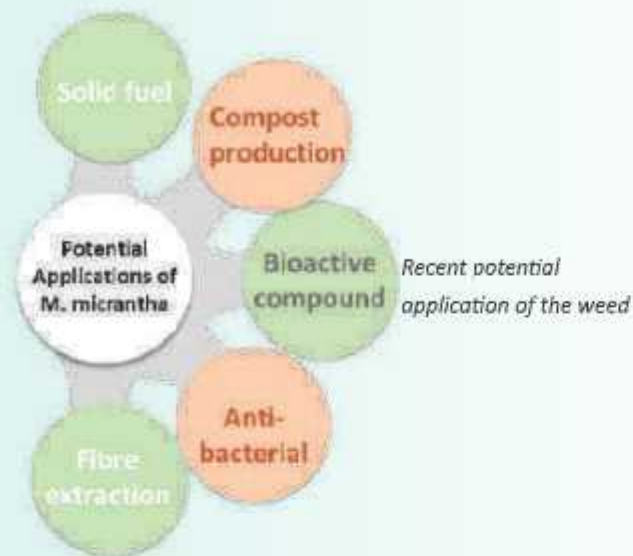
Chemical control of Mikania includes use of herbicides such as glyphosate and sulfometuron-methyl. However, application of herbicide should be used with safety precautionary measures. There are initiatives on mikania control through habitat management. Mikania's germination and growth rates are reduced in shady environments, thus clearing Mikania from affected areas and planting trees

and shrubs might potentially offer the shaded habitat necessary to prevent the weed from returning. Surveys in India have found that there are no native natural enemies that could be used to control Mikania. Ellison, 2005 has shown that India's Mikania problem can be solved by introducing exotic fungal pathogens, which is a long-term and sustainable way to deal with it. This technology could be appropriate for resource poor farmers, since it requires no financial or time inputs.

Reported potential uses

There are some recent reports that explored some novel potential application of this weed. Li et al., 2013 demonstrated existence of broad range of antimicrobial properties of *M. micrantha* indicating that it might be useful as a broad-spectrum antimicrobial. The study showed efficacy of antimicrobial compounds from its leaves against plant pathogenic fungi such as *Exserohilum turcicum*, *Colletotrichum lagenarium*, *Fusarium solani*, and plant pathogenic bacteria such as *Xanthomonas oryzae*, *Xanthomonas campestris*, *Xanthomonas campestris*, *Staphylococcus aureus*, *Bacillus subtilis* etc. Some novel compounds viz. deoxymikanolide, scandenolide, mikanolide, dihydromikanolide, have been isolated from leaves of Mikania. The bioactive chemicals have been found to have promising therapeutic value in a wide range of pathological conditions, such as pathogen-infected diseases, malignancies, diabetes, tissue inflammation, and severe wounds, as well as in a wide range of other conditions (Sheam, 2020). However, more research is needed to learn more about the molecular mechanisms behind their biological actions, which are important for

functional drug development.



Invasive plants can grow quickly and spread quickly with significant biomass production which can be advantageous for value added product extraction. Lim et al., 2018 showed the potential of lignocellulosic fiber extraction from its leaf by mercerization process. Further, the dried biomass of the plant has the potential for briquette or solid fuel production as shown by the study of Sing and Poudel, 2013, which can be another option for its utilization. Various physical and fuel characteristics of the briquette fuels and combustion tests showed it as a potential source of alternative energy.

Studies by Ishak et al., 2018 showed that ethyl acetate extract of micrantha contained significant total phenolic content and flavonoid content. These findings suggested the stems extract of *M. micrantha* using ethyl acetate can be a potential source of natural antioxidant.

Because of the non-toxic qualities of the compost made from the weed, as well as its different levels of toxicity, the weed could also be used to prepare organic manure (compost) for farming. The use of compost made from *M.*

micrantha were found to have a positive effect on the yield of different vegetables.

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Environmental Information system (ENVIS) Resource Partner, Amrita Vishwa Vidyapeetham organized a webinar on “Fish Invasion in Western Ghats and its impact on Exotic Aquatic Fauna” on 2nd February, 2022 on the occasion of “World Wetland Day”. The objective of this webinar was to deliberate a

The poster features the following text and graphics:

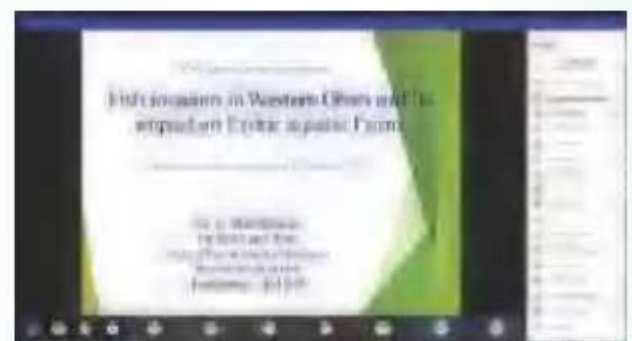
- Hosts:** Dr. Manimekalan and Amrita Vishwa Vidyapeetham (Coimbatore).
- Occasion:** On the Occasion of World Wetland Day 2022, Amrita Vishwa Vidyapeetham, ENVIS RP Coimbatore is organizing a Webinar on (the topic).
- Title:** FISH INVASION IN WESTERN GHATS AND ITS IMPACT ON EXOTIC AQUATIC FAUNA
- Date/Time:** Join us on 02 February 2022, 4:00 to 5:00 pm
- Speaker:** Dr. A. MANIMEKALAN, Professor & Head, Department of Environmental Sciences, Bharathiar University, Coimbatore.
- Moderator:** Dr. MAYA MAHAJAN, Professor and Associate Professor, Amrita Vishwa Vidyapeetham, Coimbatore.
- Visuals:** Five circular images showing various aquatic environments and fish species.
- Footer:** Includes the website www.amrita.edu.

spectrum of exciting and benefiting themes that discuss the aspects of invasions of fish species in Western Ghats and its impact on native aquatic ecosystems. Dr. A. Manimekalan, Professor and Head, Department of Environmental Sciences, Bharathiar University was the guest keynote speaker. He has been associated with numerous national projects like DST-SERB, UGC, Airport Authority of India, Coimbatore, Southern Weser

Ghats projects, Kerela Forest Department, UGC XII plan and Minenviorn System Pvt Ltd, Nagpur and Rio Tinto Australia with core subject area as Fish biodiversity.

The webinar began with a welcome address from Dr. B. Brindha, Information Officer at ENVIS. Dr. Maya Mahajan, ENVIS Coordinator and Associate Professor at Amrita Vishwa Vidyapeetham emphasized the importance of the session on the theme of fish invasion and she emphasized the importance of conservation of lakes and wetlands.

Dr. A. Manimekalan highlighted basics of fish invasions, difference between the exotic and alien species, how biological invasion appears as one of the greatest threats to global biodiversity with multiple impacts on species, livelihood, and ecosystem services. He underlined the distribution of major aquatic alien species in the Western Ghats Biodiversity Hotspot, their origin and impact on native ecosystems using spatial data. A total of 28 alien species such as *Claria gariepinus*, *Cyprinus carpio*, *Gambusia affinis*, *Oreochromis mossambicus*, *Oreochromis niloticus* and *Poecilia reticulata* were recorded in the Western Ghats. It was emphasized that most significant pathways for the establishment



of most alien species in Western Ghats are through aquarium trade and aquaculture. The session concluded with discussion and questions related to laws, legal compliance, monitoring framework to control the trade of these exotic species



5 Celebration of World Wildlife Day, 2022 and World Wildlife week

Keyur Panchal
(2nd Winner of photography competition)
World Wildlife week

ENVIS Amrita Vishwa Vidyapeetham celebrated Wildlife week, 2021 (2-8th October, 2021) and World Wildlife Day, 2022. On the first occasion a photography competition has been organized on the theme "Wildlife in natural habitats in India". On the World Wildlife Day day two events were organized a photography contest and essay writing competition to raise awareness among students and research community. The theme of photography contest was "Rare, endangered and Endemic species in Western Ghats". The



essay writing competition was held on the theme "Ecosystem health and biodiversity" We received responses from good number of participants who shared some outstanding photographic moments from wild and shared

their views about the themes. The winners were decided through internal assessment by ENVIS staff and external wildlife experts. The prize-winning entries were published in the ENVIS newsletter 'Bioinvasion' and e certificates were provided to winners.



Abhishek Govekar
(3rd Winner of photography competition)
World Wildlife week



Varadharajan Krishnan
(2nd Winner of photography competition),
World wildlife Day



Abhijith_s
(3rd Winner of photography competition)
World wildlife Day

Palak Gour
Institute - Government Meera Girls
College, Udaipur, Rajasthan

Presently in 2070,

"Attention citizens of the Underground living. It is an official announcement from the surface living. Please come forward and take your food supplies, The Macronutrient Injections. I repeat, take your nutrient injection supplies. We don't think that next year the supplies will be delivered, the population is increasing at a large scale. so please take your nutrient injection supplies to an optimum amount. Thank you very much." "Why were you making such an announcement Mummy? Do the Underground citizens do not have access to food?", asked Shivam.

"Shiv, the world is not what it used to be, now it is divided by wars, natural resources requirements, overpopulation and environmental crisis into two parts: the surface and the Underground. We are the surface people who can afford buying oxygen masks, air purifiers, and water purifier facilities for our sustainable living but the Underground people cannot so they live in the Underground section of the country funded by the government, where they depend on supplies from the government and make their survival through this." Kavita said.

"But Mummy, don't we have any solution to this difficulty?"

"We had a solution by following sustainable

development, rising awareness, being self-reliant and responsible but we never did anything about this. Also, now the government cannot do anything about it because long ago they didn't understand that a journey of thousands of miles begins with a single step and they never took one." presently 2022,

We have always heard the famous quotation that "health is wealth", but it took a whole pandemic to make us understand the importance of it. When we talk about health, we mention the condition of being sound in body, mind, and spirit. The three elements combined just like the three elements of our planet earth, air, water and land which go together hand in hand.

In India Ayurveda, a natural system of medicine, originated more than 3,000 years ago which means ayur (life) and veda (science or knowledge). Thus, Ayurveda translates to knowledge of life. Based on the idea that disease is due to an imbalance or stress in a person's consciousness, Ayurveda encourages certain lifestyle interventions and natural therapies to regain a balance between the body, mind, spirit, and the environment. Our Ayurveda has already taught us about how medicinal plants and herbs help us cure diseases like cancer, and many of our physical ailments but this is not all. In one early study, Yoshifumi Miyazaki, a forest-therapy expert and researcher at Chiba University in Japan, found that people who spent 40 minutes

walking in a cedar forest had lower levels of the stress hormone cortisol, which is involved in blood pressure and immune-system function, compared with when they spent 40 minutes walking in a lab.

Another researcher, Dr. Qing Li, a professor at the Nippon Medical School in Tokyo, found that trees and plants emit aromatic compounds called phytoncides that, when inhaled, can spur healthy biological changes in a manner similar to aromatherapy, which has also been studied for its therapeutic benefits. In his studies it is shown that when people walk through or even stay overnight in forests, they often exhibit changes in the blood that are associated with protection against cancer. This is the power of our ecosystem and environment. Also, specifically people who keep pets in their house help them to relax, improve their relationship and also improves their fitness.

We human beings think of ourselves as the most adaptable species on planet earth, basically we consider us as the most powerful of all living organisms present today but I ponder that we should think twice. Fukushima is a place where a massive earthquake and tsunami triggered the world's second worst nuclear accident. Interestingly researchers have found Japanese macaques, raccoon dogs and wild boars in areas where humans are not allowed.

Although many neighbourhoods remain empty today, wild animals like snow monkeys, and red foxes seem to be thriving, even in the presence of lingering radiation. For a new study published in the journal *Frontiers in Ecology and the Environment*, researchers observed more than 20 species on camera over the course of 120 days from May 2016 to February 2017.

Similarly, in 1986, a reactor at the Chernobyl nuclear power plant in Pripyat, Ukraine exploded during a botched test. Regardless of this, multiple lines of evidence support the idea that there are abundant populations of mid- to large sized mammals like elk, roe deer, red deer, and wild boar increasing, as well as the presence of radio trophic fungus in the Chernobyl exclusion zone. Researchers found population densities of animals like elk, roe deer, red deer and wild boar were similar to those counted in four uncontaminated natural reserves in Belarus.

On the positive side, one of the world's endangered animals has found a haven in Chernobyl's exclusion zone. Przewalski's horse, the last remaining sub-species of wild horse, became extinct in the wild by the mid-1950s, and existing specimens lived only in captivity. As an experiment - from 1998 to 2004 - 36 horses were released in the Chernobyl exclusion zone after the accident. After 10 years, their numbers have nearly doubled to 65. You see the power of our biodiversity; large amounts of wildlife are capable of surviving in human abandonment areas. This is the strength of our flora and fauna, our ecosystem that surrounds us like a blanket.

We are living in an era where formation of 1050 bhp gravity jet suits is becoming an existence, a time where we can think of becoming an interplanetary species in reality. I believe if we are proving ourselves as a future generation with this level of advancement then why not prove by moving forward with our wildlife. The USA has introduced the concept of moving homes, home in the jungle which not only saves land but also our biodiversity. Dr. Rajagopalan who made roads in our Chennai through waste plastic. Canada has been successful in creating

underpasses and overpasses in areas where there is wildlife conflict thereby saving the lives of thousands of animals through road accidents. But are we progressing?

The answer could be a yes and a no, we are progressing but very slow. For illustration multinational companies like Starbucks agreed on a sustainable development approach and identified key areas in which it can make big impacts by 2030, including expanding plant-based and environmentally friendly menu options; shifting from single-use to reusable packaging; investing in innovative agricultural, water conservation and reforestation practices; looking for ways to better manage waste (including food waste) in stores and in communities; and developing more eco-friendly operations, from stores to supply chain to manufacturing.

This is the one step, but we require more such one step for example using GPS tracking and GIS

mapping software, we can identify hotspots where wildlife conflict is likely to occur. We can pinpoint these areas to increase manpower and funding. Health, Ecosystem and Biodiversity are the part of the same circle, together they complete each other. It is very important for us to shift our focus from wars, territories to real issues that matter and affect all our lives i.e., issues regarding our wildlife because we cannot survive alone without our wildlife. Earth is our home, and it is our responsibility to take care of it. Because W with an I, will always matter not W with an A. This means focus on WILDLIFE and not on WARS.

Homo sapiens focus on

W with an I

Not on W with an A

(This essay won the first prize in Essay competition organized on World wildlife day, 2022)

7

Invasive Alien Plant Species: Their Impact on Ecosystem Service and Human Health

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Introduction

Biodiversity and environmental services are intricately related to human well-being. Biodiversity is recognized to provide food and ensure nutritional security around the world. (Aerts et al., 2018, Stone et al., 2018, Jones, 2019). They play a critical function in preserving

the environment/ecosystem service as well as medicinal values in the treatment of ailments. These positive implications of biodiversity are essential for achieving the sustainable development goals (SDGs). However ecological perturbations caused by invasive alien plant species (IAPS) have been identified as a growing

threat to global sustainability for the past several decades. As result they have put the local biodiversity, ecosystem environmental quality and human health under jeopardy.

IAPS/alien invaders as major driver of biodiversity loss (IPBES, 2019). Researchers from different fields are working to build a framework for understanding how best to evaluate, quantify, and predict different kinds of

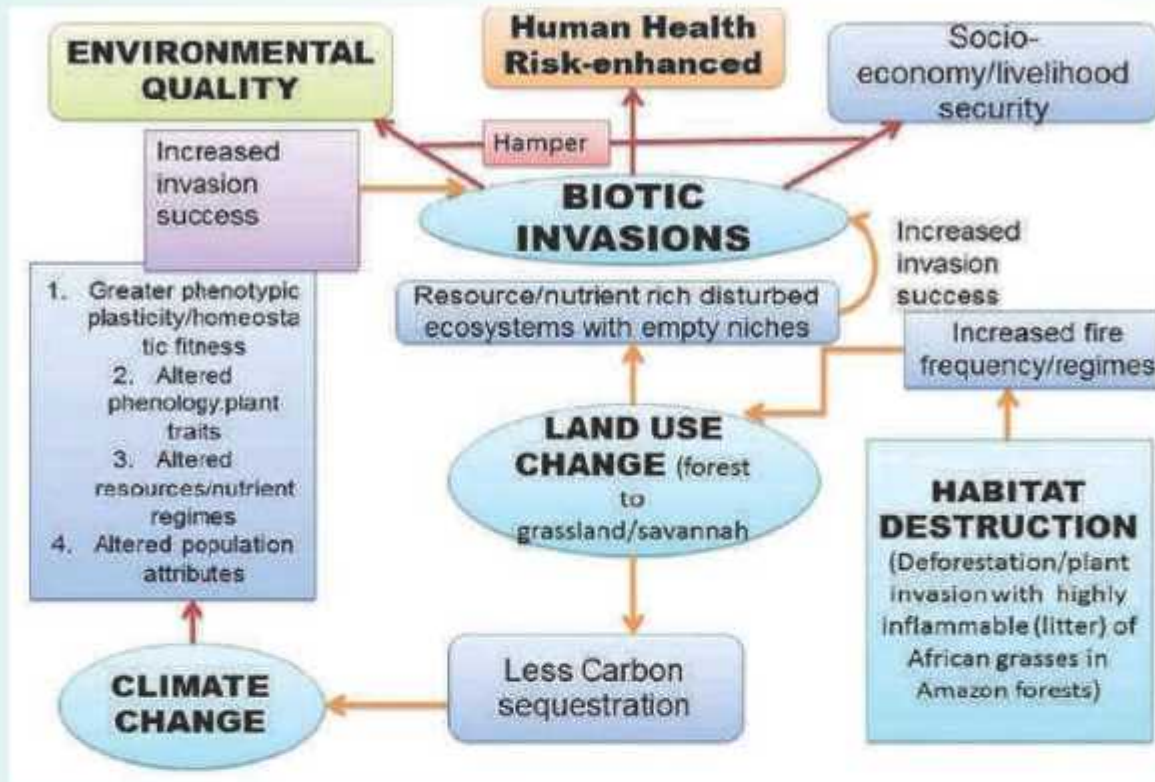


Figure 1.1 An interrelation framework, among anthropogenic factors/global environmental changes (biotic invasions, habitat destruction/fragmentation, land-use/climate change, environmental pollution), impacting socio-economy/livelihood and human health.

To this end, United Nation's (UN) Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) projected that about one fifth of the Earth's surface, including the global biodiversity hotspots, are at risk due to biotic invaders (IPBES,2019). It's worth noting that these rankings in terms of biodiversity threats/extinctions may differ by location. However, the most widely held belief among invasion ecologists is that anthropogenic perturbations are hastening the global problem of IAPS (Young and Larson, 2011). In this respect Global Assessment Report on Biodiversity and Ecosystem Services of UN recently declared the

impacts by non-indigenous species (NIS). Given their broad consequences on biodiversity, economics, and human health, invasive species are today a far-reaching, interdisciplinary topic that includes representatives from all taxonomic levels (e.g., viruses, bacteria, algae, plants, invertebrates, large mammals).

Notably, the IAPS not only linked invasive species impact with environment but also to the human well-being both in positive and negative manner. The major problem induced by invasion includes biodiversity loss, drastical changes in the meteorology/temperature and other climatic variables which indirectly cause

negative public health impacts (Jones, 2019). The ornamental and multi-purpose IAPS, which were deliberately or accidentally introduced subsequently spread to impose adverse effects on human and the ecosystem health. Invasion ecology is now increasingly being considered as trans-disciplinary subject, intimately linked with the global change biology, land-use change, health science, restoration and conservation biology (Pysěk and Richardson, 2010).

Adverse impacts of the IAPS on human health have been elucidated elsewhere (Pysěk and Richardson, 2010). Native plants can act as a sink for pollutants in the air and help to sequester carbon. Therefore, loss of native plant diversity through invasive plant pathogens may indirectly affect human health through perturbations in the environmental quality. The fast spread of vector-borne infections exacerbates the invasion's effects on human health. These environmental issues are global in nature and adversely affect public health (toxic chemicals, allergic, and the vectors of emerging diseases), that has led to the term 'planetary health' (Haines, 2016) (Fig. 1). IAPS from terrestrial and aquatic environment play critical role on human health by means of direct exposure, as pathogens, as vector, as toxins (chemical release/biological toxins), through contamination of edible foodstuffs, through their morphological/vegetation attributes, allergens and indirect implications.

Ecosystem service and human health

Biological invasions have many dramatic impacts, but also generate many subtle socio-economic consequences that are difficult to assess using traditional monetary approaches and market-based models. The ecosystem services approach attributes values to ecosystem processes as the basis for human

needs and distinguishes four categories: supporting (i.e., major ecosystem resources and energy cycles), provisioning (i.e., production of goods), regulating (i.e., maintenance of ecosystem processes), and cultural (i.e., nonmaterial benefits). The most documented worldwide IAPS, for example, eliminates CO₂ and so helps to mitigate climate change, but it also contributes to the emission of biogenic volatile organic compounds (BVOCs), which can cause health problems.

Impacts of Invasive species on Human Health

Invasive species negatively impact human health by infecting humans with new diseases, serving as vectors for existing diseases, or causing wounds through bites, stings, allergens, or other toxins (Mazza et al. 2013). Outbreaks of human diseases caused by novel pathogens, such as human immunodeficiency virus (HIV), monkey pox,

and severe acute respiratory syndrome (SARS), are analogous to the process of biological invasions. These pathogens cross the barriers that separate their natural reservoirs from human populations and ignite the epidemic spread of novel infectious diseases (Anita et al, 2003), resulting in huge economic costs.

One of the most direct effects of invasive species on human health is the spread of pathogens. Epidemics, which have been well studied for over a century, are recognized as a particular case of biological invasions. Modeling approaches developed to study disease spread can be aptly applied to the spread of other invasive taxa. Direct effects of invasive species on human health and well-being occur when a species is a pathogen or is a vector for a native or exotic pathogen or it provokes changes in

Sl. No.	Invasive alien plant species (IAPS)	Mode/level of disease spread	Health impacts
1	Eichhornia crassipes (water hyacinth)	Both as vector and direct exposure	Management through physical removal of this top aquatic IAPS lead to abundance of arthropods and aquatic invertebrate larvae favourably inhabited by this macrophyte, which may lead to malaria outbreak. Also, act as host vector of snails carrying Schistosoma mansoni, causing parasites resulting in disease schistosomiasis.
2	Lantana camara (lantana/railway creeper)	As vector	Proved to be worst IAPS which provide favorable habitat for Clossine spp. (tse-tse fly), causing sleeping sickness
3	Parthenium hysterophorus (Parthenium/Congre grass)	Direct exposure	IAPS of severe threat to global landscapes, which affect human health through allergic responses e.g. contact dermatitis and asthma; Act as malarial vector, especially in South Africa
4	Sonchus oleraceus	Direct exposure	A noophyte in South Africa imposing serious human health risk due to toxic pyrrolizidine alkaloids group containing (mainly raietorina)
5	Allantia altissima	Direct exposure	Persistent long-term exposure to sap can cause myocarditis; Causes allergic response in the form of dermatitis
6	Fista Stratiotes, hydracotyle	As vector	Malaria outbreak through hosting Mansonia spp. And Malarial mosquitoes
7	Banunculoides, Myriophyllum Aquaticum, Egeria densa	As vector	Can transmit parasites to humans; resulting in schistosomiasis spread through water hyacinths; Can result in Malarial outbreak
8	Aquatic plants trade carrying Blomphalaria glabrata & straminea and B tanagophila and Anophila sp.	As vector	
9	Robinia pseudoacacia	Direct exposure	Continuous exposure can lead to gastroenteritis due to toxins lying flowers and seed
10	Prosopis juliflora, didymobolys and Trichostema	Semi Vector	Assist in outbreak of malaria by attracting the malarial parasites, at host. Prosopis juliflora demonstrated to accelerate the transmission potential of Anophelae
11	Datura spp., oriental; Castrom perqui, Lupinus polyphyllus.	Thuja Direct exposure	Ornamental / commercial plants toxic to health
12	Cartaeria seligana	Direct exposure	Injuries and wounds
13	Opuntia stricta	Direct exposure	Health implications in form of eye and skin irritation; possibly due to glochids on the fruit
14	Acacia dealbata	Direct exposure	Causes allergies/allergic responses
15	Schinus molle/trifolius.	Direct exposure	Allergic response resulting in (flu-like symptoms)
16	Lantana acida, Serjonia lupulina	Vector	Result in Malarial outbreak due to spread of female An. Gouluzi, a malarial parasite having affinity for nesters of these IAPS
17	Rhododendron auriculatum	Direct exposure	Cardiac problem due to contaminated honey with toxins (grayanotoxins) produced and transferred from this IAPS
18	Paragmites australis and Typha spp.	Habitat/reservoir vector (birds) pathogens	of Assist in spread of West Nile virus Hazardous to human health

Table 1.1 shows invasive alien plant species (IAPS) from terrestrial and aquatic environment, their mode of transmission and impacts on human health.

ecosystems that favor outbreak of native and exotic pathogens.

Effects of pathogenic invasive species on human health include well-known pandemics

and epidemics such as the Spanish flu caused by a strain of the influenza virus. The bubonic plague caused by the bacteria *Yersinia pestis*, swept across Asia, Europe and Africa via a flea vector on the invasive rat species *Rattus rattus*, causing immense fatalities; and the numerous outbreaks of cholera all over the world. Current

invasive species affecting human health include the spread of emerging diseases such as the virus causing severe acute respiratory syndrome (SARS) and the spread of introduced West Nile virus by mosquitoes in Europe and the United States. Further, a high-risk plant invader *Parthenium hysterophorus* is demonstrated to spread phytoplasmas a vegetable pathogen. *Lantana camara* is one of the top-ranking invaders, which provides a favorable habitat to tse-tse fly (*Glossina* spp.) which causes sleeping sickness (Leak,1999).

Conclusion

The Sustainable Development Goals (SDGs), which cover sustainable agriculture, water sanitation, food safety/security, poverty, human well-being/health, and other issues, are negatively impacted by the combined impact of present environmental disturbances associated to invasion biology. Further, the ecological indicator perspectives of IAPS and developing concrete risk assessment protocol need further studies. Indeed, the UN-IPBES- global indicators target i.e., 15.8 to achieve SDGs intensively deals with the need of effective prevention and management strategies to control the IAPS by 2020. Moreover, there is a paucity of the ecological models/indicators to establish interrelationship among global environmental changes, biodiversity and health, warranting future research. Invasive species have a negative impact on human health around the globe by

altering bio-physical system and cultural practices, that requires significant public and major governmental action. Understanding of the ecological and health consequences of biological invasions is improving, but better metrics for quantifying impacts must be developed and applied to allow for the objective prioritization of species to help in prioritizing action and to facilitate the transfer of information between regions.

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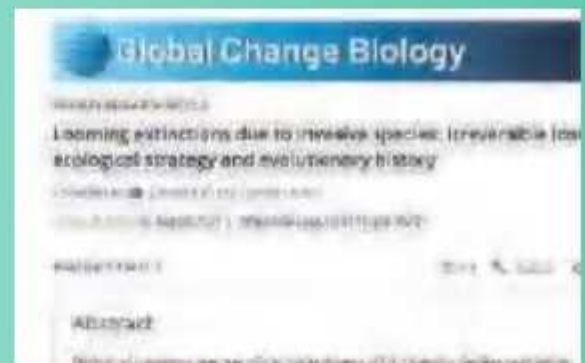
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