

THE STATUS OF HIGHLY ALIEN INVASIVE PLANTS IN PAKISTAN AND THEIR IMPACT ON THE ECOSYSTEM: A REVIEW

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ABSTRACT

Invasive alien species colonize the environment and are aggressively a mediator of change and threaten native biodiversity of Pakistan. Invasive species are the species that has been accidentally or intentionally introduced to a different habitat which may be any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. The introduction of these species likely to cause economic or environmental harm or harm to human health. One day consultative workshop was held at NARC, Islamabad in Pakistan on 17 September 1999, to identify, evaluate, and rank non-native plants that threaten the ecological integrity of wildlands and cropping systems. The focus was on species that are already established in areas that support native ecosystems, such as parks, reserves, wildlife areas, national forests, and rangelands. Fourteen plant species have been identified through a one-day consultative workshop on Alien Invasive Species. These plant species include trees and shrubs mainly as well as aquatic plant species.

Keywords: Invasive, alien species, polen.

INTRODUCTION

Plants are the basis of life on earth and are central to people's livelihoods. They provide natural conservation, ecological balance and benefits, as well as contribute towards the aesthetic values of the environment. People are closely allied to their ecosystem and live in harmony with nature (RAP, 2008). Many wetland plants fit the definition of "invasive plants" as species or strains that rapidly increase their spatial distribution by expanding into native plant communities (Richardson *et al.*, 2000). The success of invasive plants in a non native range is due to their massive capability of adaptation such as producing large numbers of new plants each season, tolerating different soil types and weather conditions, spreading easily and efficiently, usually by wind, water, or animals, growing rapidly and allowing to compete and displace slower growing plants and spreading rampantly when they are free of the natural checks and balances found in their native range. Pakistan has remarkably rich biodiversity. Geographically, the country possess varying landscapes from plains to deserts, forests, hills, and plateaus from the Southern coastal areas of Arian sea to the mountains of the Karakorum range in the north. Land managers and others need objective information on which non-native plants pose a threat to the viability of native ecosystems. The undisturbed natural forests are resistant to alien invasions while the degraded and secondary forest areas and wastelands are susceptible to aggressively invading invasive alien species (Das, S.,1982).

It has almost all the major types of native flora and fauna with the characteristics features. Hence, it would be more discreet if the concerned authorities could try to improve and popularize these indigenous species instead of indiscriminately introducing alien invasive species. Due to not-well-thought-out government policies, weak legislation, enforcement of existing safeguards, lack of proper quarantine departments and lack of popular awareness alien invasive species are taking over natural habitats and rapidly changing the native character of the ecosystem. IUCN, the World Conservation Union, states that the impacts of alien invasive species are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats. Hundreds of extinctions have been caused by invasive alien species. The ecological cost is the irretrievable loss of native species and ecosystems. We confine our review to flowering plants. We exclude submersed and floating plants of aquatic (deepwater) habitats not because deeper water

wetlands are less threatened by invasives, but to limit the scope of our review. Thus, we consider emergent species that occupy permanent standing water, plants that occur in wet soils and soils with intermittent drying, and vegetation in transitions from wetland to upland.

In Pakistan, many plants species have been accidentally arrived or brought for different purposes like beautification of the area and horticultural purposes etc. According to Ameen (1999), alteration of ecological communities caused by alien invasive plant and animal species influence the functioning and overall health of the affected ecosystems. Fourteen plant species have been identified through a one-day consultative workshop on Alien Invasive Species in Pakistan, 17 September 1999, NARC, Islamabad. These plant species include trees and shrubs mainly as well as aquatic plant species.

MATERIALS AND METHODS

Invasive species are the species that has been unintentionally or purposely introduced to a different territory which may be any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. A Technical one day workshop was held at National Agricultural Research Centre, Islamabad (17 September 1999) to identify and to investigate the status of alien invasive plants in Pakistan. There were various sessions and presentations from various intellectuals aimed at highlighting the severity and issues of alien plants. At the end of the concluding session different plants were identified and discussed on their origin and their impact in that particular area. These plant species include trees and shrubs mainly as well as aquatic plant species (Table 1).

RESULTS AND DISCUSSION

Following plants were identified as alien invasive and their levels were discussed as under.

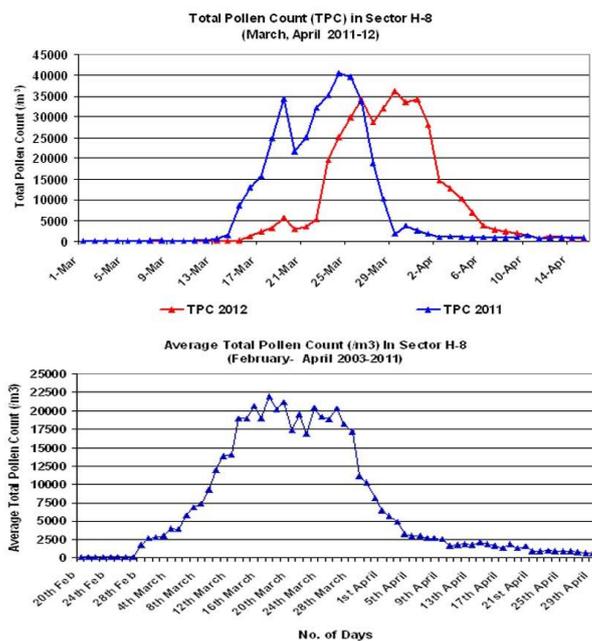
Invasive Tree

Broussonetia papyrifera commonly called Paper mulberry is native to East Asia. It was introduced (seed dispersal thorough aerial mode) to Pakistan in 1960's for greening Islamabad and controlling soil erosion. According to estimation 60-70 percent of the trees in Islamabad are of Paper mulberry.

In less than 30 years it has been declared as Highly Invasive plant due to its aggressive growth, replacement of native flora and above all main culprit of causing Pollen allergies to the local community. During the months of February until April proximity to this tree can contribute to severe pollen allergy. In Islamabad, Pakistan the pollen count goes as high as 55000 per m^3 causing severe problems for residents (PMD, 2012). Capital development Authority is using Mechanical input to control this specie but because of its regeneration ability and wide spread. The expenses on the mechanical removal of Paper mulberry plants in Islamabad alone run in several millions of rupees each year, but not fully succeeded. The paper mulberry pollen count, which continues to increase steadily, is estimated to cross the 55,000 mark. When the Pakistan Meteorological Department reports the pollen count, it reports the average over a 24-hour period, and this has crossed 40,000. Hourly monitoring of pollen reveals the highest counts after 'Fajr,' and again between 'Asr' till night. However, the suspended amount of pollen in the atmosphere has been causing severe agony for pollen allergy patients. Severe persistent coughing with difficulty in breathing and wheezing have been the cardinal features of pollen allergy this year because the sudden exponential rise in pollens did not allow much time for the early symptoms of sneezing, itching in the eyes and skin, and blocked nose. The World Conservation union lists paper mulberry as one of the six worst plant invaders in Pakistan (IUCN Website). Recent studies have shown that it is also one of the top alien invasives in Pampa grasslands in Argentina, (Ghersa et al. 2002).

Prosopis juliflora (Mesquite, Kikar) is a native to West Indies and Mexico. It was introduced in 1878 in Sindh and is now widespread in Balochistan, Punjab, Sindh and KPK (Khatoon and Ali, 1999). The plant has well established in Pakistan from mountains to seacoast. It is now growing naturally in the Pabbi Hills, the Salt Range, the piedmont area, the mining wastes, plains, riparian forests, waste agricultural lands, saline and waterlogged areas, desert Suleiman Range and anywhere expected. It is found on almost all the linear land strips like highways, canals and railway tracks. Sizeable areas of Makran coast of Balochistan are home to mesquite. The poor rural masses enjoy its free harvest for their domestic energy needs, as it is considered as a weed. Like many other invasive this plant contains toxic metabolites which deter local herbivores and also prevent the growth of indigenous plant species in the vicinity (Khatoon and Ali, 1999). It has also become a serious pest in many sensitive areas in Sindh, especially in Southern Kirthar National Park where it has replaced many native plant species of *Tamarix*, *Acacia* and other shrubs (Akhter, 2012).

Paper Mulburry



Invasive Shrub

Lantana camara (Punch Phuli) is native plant of United States of America and is one of the ten worst weed of the world. All the control measures have been not able to fully control this specie. This alien species is widely distributed in Pakistan. It is most common in north Punjab and also found in KPK. It has invaded hilly areas of Islamabad, Margalla National Park, Rawal Lake and along Murree Road towards Bharako (Khan et al., 2010).

It is mainly a weed of plantation crops. In Pakistan it is recognized as a pest of forested areas and sizeable areas have been taken over by this weed. The seeds are carried by birds and where it establishes, it quickly covers open areas and forms dense thorny thickets. It is threatening native biodiversity and is detrimental to local plants. It has taken over much of natural grazing ground. *L. camara* thickets are potential breeding places for rats, wild pigs, and insects (mainly a host of cotton white fly, *Bemisia tabaci*), etc. The leaves and seeds are toxic to many animals. Photosensitivity, gastrointestinal disturbances and deaths have followed the ingestion of the plant parts by sheep and calves (Observations of participants of workshop on Alien Invasive Species, 17 September 1999, NARC, Islamabad).

So far, conventional control methods such as burning, slashing and digging are applied for controlling this weed. Using herbicides for its control is contested for economic reasons as well as for detrimental implications to the environment.

Invasive herb

The native range of *Parthenium hysterophorus* is Mexico, Central and south America. It was accidentally introduced in many countries and after causing symptoms of bronchitis, acute dermatitis and eczema in India, it has now been witnessed in different localities of Islamabad and rapidly spreading in Punjab and KPK and has invaded many areas of Pakistan. This Mexican weed (*Parthenium hysterophorus*) is reported in Pakistan in 1980's. It has now invaded waste places and road sides, irrigation channels, field ditches etc. Its impact on the local vegetation is very clear. It has been spreaded in many areas of Punjab and KPK. Visual surveys revealed that almost every area in Punjab and KPK has been infested with this weed. Surprisingly, it is being used as an ornamental plant in bouquets. Population living in the villages around Rawalpindi, Islamabad, Lahore and Peshawar are using it as a fodder.

The visit to different allergy centers (National Institute of Health, Islamabad, and Allergy centre in Peshawar) and personnel communications with allergy specialists' revealed that people, even doctors are unaware of the *Parthenium* weed and its allergen impacts on humans. No species of the past or the present century can ever match with this. The reasons for its fast spread are: (1) High germination ability throughout the year, (2) Large seed production ability, (3) High survival rate, (4) Extreme adaptability in a wide range of habitats. (5) Easy dispersal of seeds.

Invasive aquatic plants

Native range of *Salvinia molesta* is southeastern Brazil and northern Argentina (Dye and Heinz Undated) while known introduced range since the 1940s has been dispersed by humans to various tropical and subtropical regions in Africa, Asia, the Australasia-Pacific region and, more recently, the USA (Pieterse et al 2003 and Rice 2002). In Pakistan, it has been severely damaging Kinjhar Lake, Haliji Lake and Chotiari wetland complex. It threatens crops and fouls irrigation systems and streams, and interferes with electric power production. The grids and irrigation systems become plugged. Fishing areas are blocked off or are destroyed by darkness and lack of oxygen or it may simply prohibit the setting and lifting of nets. It is a direct threat to many crops by interfering with distribution of irrigation water. It recently has become a threat to Lake Kinjhar's (Sindh) flora and fauna. The seasonal growth of *Salvinia molesta* Mitchell In the lake recorded was 19.0% per day, 25.7% per day and 16.6% per day, during the period March 1978 to April 1979 in floating quadrats established in Lake Moondarra, Australia (C. Max, 1984). The weed harbors snails and insects, which are vectors of human and animal diseases. Snails have been reported intermediate hosts of *Schistosoma haematobium* and *S. mansoni* the organisms responsible for sporadic outbreaks of urinary and intestinal schistosomiasis. The species is known as a plant providing shelter and breeding sites for mosquitoes (Holm et al, 1977).

Eichhornia crassipes (Water hyacinth) is a native of the Amazon basin. It is one of the worst aquatic weeds and widely distributed in Pakistan except in hilly areas. This plant spreads fast by producing vegetative offshoots and seeds. It is sold by various plant sellers by the name of purple money plant which is the one of the main cause of spread. It is choking water bodies in Sindh and Punjab. Flow of water is impeded in irrigation canals; drainage ditches are closed and great water loss occurs from the reservoirs and distribution systems. The weed clogs the irrigation pumps and interferes with hydroelectric schemes. Another impact on the water body is shading and causing lack of oxygen as the weed cover becomes denser destroys fishing grounds. Spawning areas are blocked causing resistance in reaching the fishing areas. It destroys water ecosystems by forming an impenetrable layer on water surfaces and competing with native biota for oxygen causing massive die-off from asphyxiation. Several insect vectors of human and animal diseases seek harbors in the mats of this weed.

Water hyacinth loses water rapidly through its leaves. This phenomenon has been studied on numerous occasions in various parts of the world and it has been estimated that the average loss of water due to evapotranspiration by water hyacinth is ca.3.5 times that from a free water surface (Timmer and Weldon, 1967; Gopal and Sharma, 1981). No studies on water losses due to this weed have been undertaken in Pakistan, but the impacts may reach the same magnitude as has been reported from elsewhere.

Current Status

Introduction of *Broussonetia papyrifera* and other alien species into Pakistan developed several controversies and problems. All these species are proven to be competing and displacing the endemic flora and found to be environmentally unfriendly to Pakistan. Because of Paper mulberry aggressive growth, native flora becomes threatened. Moreover, the pollen produced by the flowers of these trees harm the respiratory tracts of human beings and lead to allergic diseases produce pollens that are allergic for many people of Islamabad. These trees absorb large amount of water and hence even the indigenous trees cannot properly grow around it. Currently, a

detailed list of alien species of plants introduced to Pakistan is not available. However, an abridged list of alien invasive species of plants introduced to Pakistan is given in Table below.

There is no legislation that deals specifically with IAS. The *Biodiversity Action Plan* (BAP) of Pakistan deals with this problem very superficially. Action 6.6 of the BAP reads: "Take measures to control IAS of fauna and flora, and to prevent further introductions." The Quarantine Department focuses only on any pests or pathogens while take no notice of the plant and animal species being imported accompanying them. There is no provision to check the possible ecological impact of imported species.

RECOMMENDATIONS/SUGGESTIONS

- Technical review of IAS occurrence in Pakistan.
- Enhance local expertise for managing IAS
- Develop legislation to discourage introduction of IAS, because there is at present no check on the introduction of such species.
- Strengthen and build capacity of the quarantine department for identification of IAS in the country. This is necessary because of increasing trade and travel.
- Facilitate close coordination and collaboration between quarantine and plant protection departments.
- The government through television and the print media should organize talks to discuss this issue.
- Initiate research projects to investigate the impacts of IAS on biodiversity, tourism, agriculture, livestock production, etc.
- Re-establish highly degraded and threatened native ecosystems, e.g. Islambad, Margalla hills, riparian forests in Sindh, Kenjhir Lake, Haleji Thatta, etc.
- Develop long term control actions of alien aquatic and terrestrial weeds.
- Educating and awareness rising is an important method in management of IAS.
- Initiate conservation projects aimed at conserving and restoring biodiversity, habitats and ecosystems that are threatened by IAS.
- Include prevention and management of IAS in forest and agriculture policies.

CONCLUSIONS

Research on the worldwide status of the plants species before introduction is a key to reduce the spread and Alien introduction. It is unfortunate that the long-term impacts, even short-term, adverse effects were not considered while introducing the alien invasive species to Pakistan. All over the world, the alien invasive species have been identified as an agent of the loss of native biodiversity. There is a need to focus on the negative impacts of biological invasions caused by Invasive alien species. Lack of awareness and proper initiatives is a major obstacle in combating IAS problem in Pakistan. Any further introduction of such species must be stopped. People should be made aware of the negative consequences of introducing alien species and should be motivated to cultivate indigenous species. Besides providing ecological balance the adverse impacts on native biodiversity can be reduced if introduction and spread of alien species is stopped. It is an urgent need that Pakistan should develop suitable methods and policies to deal with invasive alien species.

Table 1: List of Alien plants, their origin and rank of invasiveness

ALIEN PLANT SPECIES	RANK	ORIGIN
1) <i>Broussonetia papyrifera</i>	H	Japan and Taiwan
2) <i>Lantana camara</i>	H	Americas.

<i>bis sativa</i>	3)	Canna	M	Native of Central and Western Asia (Anon, 1969)
<i>pis juliflora</i>	4)	Proso	H	West Indies and Mexico
<i>enium hysterophorus</i>	5)	Parth	H	Mexico, Central America
<i>a carnea</i>	6)	Ipome	M	Tropical America
<i>ia molesta</i>	2. In water			
	1)	Salvin	H	South America
<i>ornia crassipes</i>	2)	Eichh	H	Native to South America. Introduced elsewhere.
<i>stratiotes</i>	3)	Pistia	M	Pantropical distribution (Holm et al, 1977)
<i>ris minor</i>	3. In cultivated agriculture			
	1)	Phala	M	Mexico and was introduced in Pakistan along with the seeds of wheat from Mexico in the 1960s (Ashiq et al, 1996).
<i>spinosa</i>	2)	Emex	M	Mediterranean region, Iraq, Iran (Rechinger, 1968)
<i>m aparine</i>	3)	Galiu	H	Europe
<i>ium strumarium</i>	4)	Xanth	M	Probably native to the New World, now a cosmopolitan weed" (Wagner et al, 1999).
<i>ena leucocephala</i>	5)	Leuca	M	Probably native to Central America or South America
<i>m temulentum</i>	6)	Loliu	M	Mediterranean region and South Africa.

H=highly invasive; M=Medium Invasive,

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