

INVASIVE SPECIES OF FEDERAL CAPITAL AREA ISLAMABAD, PAKISTAN

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Abstract

Islamabad has a well-developed flora rich in abundance and variety. Due to high-quality city planning, the native flora is not much affected by the population. It has further been enriched by the introduction of a great number and variety of ornamentals, particularly trees. The tree plantation by CDA has reached the 11 million mark in 1982. Previously the invasion of new species in capital area was not noticed but when the harmful effects of some of these non native species occurred then the experts took it seriously and then much research work was carried out to find out the harmful effects of these species. This project deals with such exotic species of Islamabad capital area, which produced serious problems in various ways, while some plant species which are invaded through seed import or through seed disposal by air, water, animals from the nearby areas or other cities and countries. In the present work 9 species viz., *Broussonetia papyrifera*, *Parthenium hysterophorus*, *Cannabis sativa*, *Lantana camara*, *Xanthium strumarium*, *Alternanthera pungens*, *Trianthema portulacastrum*, *Pistia stratiotes* and *Phragmites australis* are dealt with which are the most aggressive weeds of the study area. These are examples of alien invasive plant species which not only reduce land value and cause great loss to agricultural communities but were detected as a source of allergy as well. Based on the indigenous botanical knowledge obtained from local communities a project is aimed to find out the list of invasive plant species, their impact on ecosystem and possible arrangement.

Introduction

The present research addresses the effect of non native plants on the local flora of Federal Capital, Islamabad. Including the introduced exotic plants dicotyledons in this area include 103 families. The number of genera described has reached the figure of 466. A total of 793 species has been reported of which 439 are wild and 354 are cultivated (Stewart, 1972). Present research work comprises to find out the harmful effect of the non-native plants on the local flora as well as on biodiversity. The research includes finding out the non-native plants, its specimen collection, field photography where its invasion occurs. Statistical analysis for quantitative approach and discussion with the local people, biodiversity expert authorities of related fields. The project is aimed to find out the list of invasive plant species their impact on ecosystem and possible arrangement, in capital area Islamabad. The term alien exotic refer to species which are non-native species of the area but they arrived in an area outside their natural range (Thompson *et al.*, 1995). They established themselves in an area, exponentially increasing their population, thus out competing the native species of that area and usually bringing change in ecosystems functions. A large part of the problem comes in declaring what qualifies a plant as an invasive species. No universal definition has been established. However, some general characteristics have been considered by researchers.

Human induced disturbances include the removal of native vegetation for activities such as farming, forestry and mining. These provide an open niche for alien invasiveness due to lack of competition and altered soil structure, availability of moisture and nutrients (Randall & Marinelli, 1996). *Parthenium hysterophorus* Linn., (Asteraceae), an alien invasive species, commonly known as parthenium weed is an annual or short-lived ephemeral herb of neo-tropical origin that now has a pan-tropical distribution. In Pakistan, this weed is spreading aggressively in wastelands, degraded areas, rocky crevices, along water channels, roadsides and railway tracks. It has recently also been reported in cultivated lands. This noxious weed can affect crop production, animal husbandry, human health and biodiversity (Shabbir, & Bajwa, 2007). The impact of the alien invasive species on local environment includes disturbance of habitat biodiversity loss, economic loss and ecological imbalance due to frequency and magnitude of their introduction creates by their tremendous ability to grow and proliferate.

Materials and Methods

Ethnobotanical approach, using indigenous knowledge of the local communities was employed in study of invasive weeds. For this purpose, survey methodology was used to determine the extent of invasive weeds. Survey was conducted in the capital area of Islamabad sector wise. During the survey residential and cultivated areas of G, F and H sectors were analyzed. The equipment used during the research work included notebooks, maps, pencils, markers, plants presser, drying papers (old news papers and blotting papers), polyethene bags for collecting plants, knife, trowel, two cameras, colour films etc., whereas methodology included two stages; field visits and documentation of the findings/records. In field visits we collected area details, plant collection, preservation, questionnaire filling by the interviews of taxonomist, biodiversity experts, medical specialists, agriculturists and people of local community.

Results

Most successful control mechanism included pulling weeds by hand, the most ancient weed removal technique, works best with smaller annual and biennial plants before seed dispersal especially when the soil is damp. Many seeds need light to germinate and become established. Mulching is the process in which we cover the soil with non living material (hay, straw, grass clippings, wood chips, plastic film), to stop light to seed.

Rainfall: Average (Annual) 1143 mm.

Temperature:

	Minimum (average)	Maximum (average)
Winter (Oct- Mar)	3.4°C	16.5°C
Summer (Apr-Sep)	24.4°C	32.2°C
Annual	14.4°C	28.9°C

Based on indigenous knowledge collected from the local community of Islamabad capital territory, 35 problematic weeds in total are identified. These weeds are creating problems in various patches of the area. Out of 44 available weeds, 14 were associated with wheat, 11 with maize, 10 with wasteland and roadside and 9 with vegetables. Some

of these weeds can be found simultaneously in more than one crop. The important crops for this area were wheat, maize, potato, garlic, onion and fruit orchards.

Survey of Invasive species in the capital area sector wise: Preliminary study was conducted during the fieldwork in following sectors of Islamabad F, G, and H sectors. With the cooperation and guideline of experts of related field it is observed that there are 4 plant species of different taxonomic group such as *Broussonetia papyrifera*, *Cannabis sativa*, *Lantana camara* and *Parthenium hysterophorus* are found to be more aggressive in the urban area of Islamabad. It is documented sector wise

Sector F-6, F-7: More aggressive plant is *Broussonetia papyrifera* *Parthenium hysterophorus*, while *Lantana camara* and *Cannabis sativa* are not found in excess

Sector F-8, F-9: These sub sectors are now adays dominated by *Broussonetia papyrifera*, *Parthenium hysterophorus* and in some places patches of *Lantana camara* while in the past *Cannabis sativa* was more aggressive plant of the area.

Sector F-10: The F10 sector having plain areas is very short but the small streams are passing so the plant communities are present in large numbers. *Broussonetia papyrifera*, *Parthenium hysperophorus* and *Cannabis sativa* are dominant species.

Sector F-11: The F11 sector is the newly constructed sector and like G11 construction is in progress. The F11 sector is nearby Golra Sharif and in that area some cultivated fields are also present, which are not disturbed by construction. During the field survey it is observed that the cultivated as well as the constructed areas are badly affected by *Parthenium hysterophrus* and *Cannabis sativa*, while *Broussonetia papyrefera* is very rare.

Sector G-6: The G6 area is mostly official area and in this sector, the vegetation is present only along the sides of the houses and around the playgrounds. Among the trees along with other ornamentals and shady trees, the most abundant is *Broussonetia papyrifera* and in some places, another shady tree *Dalbergia sissoo* is also present. However, the playgrounds are badly covered with the new invader *Parthenium hysterophorus*. The already present grass families are slowly and gradually being replaced by this non-native species.

Sector G-7: Due to same environment and localities, the plant communities present in G7 area are nearly the same. However, due to the presence of low populated area, vegetation is slightly dense and again *Broussonetia papyrifera* is the dominant plant species here. Besides this *Parthenium hystrophorus* is also present in abundance.

Sector G-8: The road side of the G8 sector is densely populated by *Parthenium hysterophorus* and the blank area are thickly covered with *Broussonetia papyrifera*. *Cannabis stiva* and *Lantana camara* are rarely found.

Sector G-9: The G9 sector, on the vacant spaces, is populated by variety of plant communities having the various types of shady trees, herbs and shrubs. The tree population consists of *Dalbergia sissoo*, *Morus* species etc., but the most invasive species

is again *Broussonetia papyrifera*. Among the herbs and shrubs the invasive species is *Parthenium hysterophorus* but the graveyard of the G9 consists of other native species but gradually it will also be replaced by *Parthenium hysterophorus* due to high vegetation range.

Sector G-10: The G10 sector is also badly affected by the three types of invasive species, especially *Cannabis sativa*, *Broussonetia papyrifera* and new invader *Parthenium hysterophorus*. *Cannabis sativa* is more aggressive during the past several years, but due to the all allelopathic effect of *Parthenium hysterophorus* on *Cannabis* vegetation it is replaced by *Parthenium*. *Parthenium hysterophorus* grows in mix form with other grasses in the fields and it is the cause of bitter milk disease. However, the villagers do not know about *Parthenium*'s nature in this regard. They avoid this species as a wild weed and is new for them.

Sector G-11: A newly constructed sector and the cultivated area is still present, the agricultural lands are badly covered by *Parthenium hysterophorus* and *Cannabis sativa*.

Sector G-12, G-13, G-14: These are the cultivated areas although acquired by CDA but still in village form, more aggressive, but *Parthenium hysterophorus* and *Lantana camara* are also found to be invasive near Golra more (Toll plaza).

Sector H-8, H-9, H-10, H-11: The H-8 and H-9 sector are residential areas so thick vegetation is rare. In trees *Broussonetia papyrifera* is the dominant tree while besides exotic ornamental *Dalbergia sissoo* is also common. In herbs and shrubs *Parthenium hysterophorus* and *Lantana camara* are common while sector H-10 and H-11 consist of agricultural land where *Parthenium hysterophorus* is problematic.

Discussion

The spread of the species of plants, animals and micro-organisms from one part of the world to other through intentional or not deliberate human effort is now recognized as one of the most serious threats to Earth's Biodiversity and ecosystems. It is variously termed as "Bioinvasion" or "Biopollution". Some scientists consider it as more disastrous than the chemical pollution, because organisms can evolve and proliferate while chemicals cannot.

Bio-invasion is not a new phenomenon. The species keep on moving and colonizing new areas wherever they can find conducive environment. The animals are move from place to place because of their mobility in short time. Plants do not have limbs or feet but they do travel. This is through the dispersal of their seed, a capacity that determines their natural geographic range. Moving through natural means the species spread gradually and has to face all natural enemies and competitors, which maintain the ecological balance. On their own generally they cannot cross natural geographic barriers like oceans, mountains and large deserts. However, the human-assisted travel of the biota has crossed all the barriers. And this is a severe type of bio-pollution. The human-assisted arrival of exotic species is now about a million times greater than the natural rate in some instances, especially for the islands. The species so arrived in a region are termed as aliens or exotics, which now number several thousands world over. In some cases they almost equal or even out-number the native species such as New Zealand has 1570 alien vs 1790

native, Hawaii has 861 alien vs 956 native and Tristan da Cunha has 97 alien vs 70 native plant species (Randal & Marnelli, 1996; Simon, 1993). The alien species are now present in almost every part of the world and belong to all taxonomic groups like plants, animals, algae, fungi, microorganisms and viruses.

The deliberate introductions include the crop plants, farm animals, fish and shrimp for aquaculture, decorative plants, pets, biological control organisms etc., while accidental introductions may be as contamination with various trade commodities (Zimmermann, 1991) or passengers luggage, and most importantly through ship ballast which daily transfer millions of aquatic organisms throughout the world. In 1991 the outbreak of cholera in America, which killed about 10000 people, is believed to be due to the ballast water dumped into a Peruvian harbour. Historically, the human pathogens rapidly evolved and spread after the change in human lifestyle from nomadic to permanent settlement in the wake of agriculture about 12000 years back. And now it is globalisation, which is turning the world into a global village where the human pathogens and crop pests are exploring new dimensions of evolutions and spread (Thompson *et al.*, 1995).

Once on a new land, an alien species may either perish or flourish. In the latter case it generally exerts profound effects on the biodiversity and ecosystems of the land. The alien plant or animal species which establish themselves in the natural or semi natural ecosystems unusually out compete the native species, diminishing them or causing the extinction of more vulnerable and rarer ones. Such exotics are termed as invasive species or invaders. They usually proliferate exponentially depriving the native species of space, nutrients, moisture etc., thus modify the entire structure and functioning of the ecosystem (Simon, 1993). The modified structure of flora deprives the native animals of food and shelter, as well as the exotics may bring with them new pests and pathogens or allergens. In some cases they can hybridize with the native species and disturb their genetic integrity. The effects of the invasive species are, in most cases irreversible. All introduced species do not become invasive, but even the small proportion of invasive wreaks havoc on the ecology and economy of the region.

According to a recent review, just 79 invasive species in the USA have caused \$97 billion losses from 1906–1991 and another 15 potentially high impact species could cause \$134 billion loss in the future (Randal & Marnelli, 1996).

It is almost impossible to predict whether a new introduction would become invasive or not. An alien may take decades, even centuries, before becoming invasive. Generally it needs a long period of acclimatization. In 1984-85, *Passiflora ligularis* started invading forest gaps in Indonesia, although it existed there since 19th Century (Sherley, 2000).

The factors, which promote invasiveness, include the human-induced habitat disturbance, the magnitude and frequency of introduction, the inherent qualities of species for fast growth, profuse proliferation, efficient seed dispersal, etc. However, one factor is common to all aliens; they do not have natural predators and competitors in the new land; and the natives don't have the defense mechanism against the aliens because they did not evolve together in the same place. According to Gause (1934) competitive exclusion principle, the two species occupying the same niche in the ecosystem can not survive simultaneously for ever alongside this argument is well supported by various other ecological studies conducted in relation to the invasive species in various parts of the world (Qureshi 2009). The more aggressive one thrives and the poor competitor vanishes. In order for the two species to co-exist they have separate niche (Radosevich & Holt, 1984).

References

- Gause, G.F. 1934. *The struggle for existence*. Baltimore, MD: Williams & Wilkins.
- Qureshi, R.A., M.A. Ghafraam, S.A. Gilani, Z. Yousaf, G. Abbas and A. Batool. 2009. Indigenous medicinal plants used by local women in Southern Himalayan region of Pakistan. *Pak. J. Bot.*, 41(1): 19-25.
- Radosevich, S.R and J.S. Holt. 1984. *Weed Ecology. Implications for vegetation management*. pp 265. John Wiley & Sons, New York.
- Randall, J.M. and J. Marinelli. 1996. *Invasive Plants*. Brooklyn Botanic Garden, Inc.
- Shabbir, A. and R. Bajwa. 2007. *Parthenium* invasion in Pakistan-A. Threat still unrecognized. *Pak. J. Bot.*, 39(7): 2519-2526.
- Sherley, G. 2000. *Invasive species in Pacific: A technical review and draft Regional Strategy*. Published by South Pacific Regional Environment Program, pp. 1-197.
- Simon, N. 1993. *The Guinness Guide to Nature in Danger*. Guinness Publishing Ltd., Middlesex.
- Stewart, R.R. 1972. *Annotated Catalogue of Vascular plants of West Pakistan and Kashmir*. pp.1-1027. Karachi.
- Thompson, K., J.G. Hodgson and T.C.G. Rich. 1995. Native and alien invasive plants: More of the same. *Ecography*, 18(4): 390-402.
- Zimmermann, H.G. 1991 "Biological control of mesquite, *Prosopis* spp. (*Fabaceae*), in South Africa." *Agric. Ecosyst. Environ.* Vol. 37, No. 1-3, pp. 175-186.

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