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The Environmental Impact of Alien Invasive Plant Species in Bangladesh

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***Abstract*— Invasive alien species colonize the environment and are aggressively a mediator of change and threaten native biodiversity of Bangladesh. The spread of invasive alien plants is due to their opportunistic exploitation of anthropogenic disturbances; the absence of natural enemies; and frequently their allopathic competitive strategies. Invasive non-indigenous species can have a significant impact on development, affecting sustainability of livelihood, natural habitats, food security and rapidly changing the native character of indispensable natural or semi-natural ecosystem services and dynamics. The study entails the impact of these alien invasive plant species on the perspective of Bangladesh.**

Keywords: *Alien plant, Invasive plant, Ecosystem, Biodiversity, Bangladesh.*

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 [1]. Plants are assets in the urban and rural landscape. The geographical condition and climate of Bangladesh is quite conducive to the growth of different plant species.

Introduction of plants from one place to another may be natural or planned manner. But in recent years invasive alien species have gained considerable notoriety as being major threats to native species and ecosystem of Bangladesh [2]. Some of the species have luxuriant growth and suppress the growth of other native species. This results in a loss of native floral diversity of the country. These alien invasive plants are becoming a major concern, during past two decades, among conservationists, ecologists, foresters, policy makers and scientists for their severe biological, ecological and socio-economic impacts worldwide. It has been identified as one of the greatest intimidation to native ecosystems, species habitats and biodiversity [3]. 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 [4]. This study attempts to evaluate the environmental impact of alien invasive plant species in the Bangladesh context.

BANGLADESH CONTEXT

Bangladesh is basically formed by the fertile soil brought down by the mighty rivers. Due to the favourable geo-climatic context, it is exceptionally rich in biodiversity [5]. The country's flora and fauna has the characteristics of high growth rate, high economic value, high market demand etc. [6]. According to Forest Department and some other sources Bangladesh forest cover is nearly about 2.53 million ha representing approximately 17.5% of the country's total surface area, but according to FRA- 2005 it is only about 0.871 million ha [7], however, only 6% of the forest resources is well stocked. The annual deforestation rate in the country is 3.3% which is highest among the south-east Asian countries [8]. The causes of deforestation in Bangladesh are due to heavy demands for forest products and fuel wood, besides conversion of forest land to other uses such as urbanization, cultivation, industrial, infrastructures, transportation, energy production and so on.

The environmental effects of deforestation are soil degradation, flooding, erosion and above all the danger of contributing towards climate change [3]. The massive deforestation has been creating enormous degradation of native biodiversity and ecosystem of the country. Major reasons behind biodiversity depletion in Bangladesh are high population density, extreme poverty and unemployment, habitat loss, degradation and fragmentation of land, illegal poaching, environmental pollution and degradation, lack of people's awareness, lack of political commitments and unwillingness towards addressing the burning issues, absence of proper institutional arrangements, global climate change and sea level rise and introduction of invasive alien species etc. [9].

A. History of Invasion

A large number of exotic (non-native) plants have been introduced into Bangladesh for agriculture, horticulture, forestry, animal husbandry and fisheries. Introduction of alien invasive species of flora and fauna were in most cases deliberate in Bangladesh, to increase productivity and to support the needs of 140 million people in an area of only 147,000 sq. km. Introduction of alien species has a long history in Bangladesh [6]. The plantation of alien invasive species dates back to colonial period, but these have expanded alarmingly in recent years. Most of the herbs and shrubs were introduced during the British colonial period for their aesthetic value and most of the timber species were introduced in Bangladesh from the late 1880s to early 1890s to meet the country's rapidly growing demand for timber [3]. The British mostly contributed to the introduction of some economically important forest plants from almost all the continents in the 19th century, e.g. *Tectona grandis*, *Paraserianthes falcataria*, *Albizia saman*, *Xylia dolabriformis*, and *Swietenia macrophylla* etc.

In the 20th century this trend continued, and some Australian species (*Eucalyptus camaldulensis*, *Acacia mangium*, and *Acacia auriculiformis*) were getting preferences in the plantation programs [3]. Perhaps the first widely introduced alien invasive plant species in Bangladesh is Water Hyacinth *(Eichhornia crassipes)*. At

that time, nobody realized how vigorously this species could turn into an aquatic weed. Now it has invaded almost all the wetlands of Bangladesh [10]. Among the Australian alien plant species, the *Acacia auriculiformis* is dominating in all the plantation programmes and growing well in all sorts of degraded land. But its pollen is thought to be allergic to many people [3]. In fact, these alien species are introduced in Bangladesh for their rapid growth, increasing food production, utilization of a vacant niche in the native ecosystem, efficient dispersal capabilities, control of undesirable species considered as pest, pestilence, weed, etc. as a tool for biological control, large reproductive output and tolerance to a broad range of environmental conditions etc. However, some of them were introduced for decorative or ornamental purposes in Bangladesh [6].

B. The Invasive Plants in Bangladesh

Many of the exotic plants are of economic benefit and some have severe negative impacts through invasion on the native biodiversity of the country [4]. Some of alien plant species in terrestrial zones that have been introduced to Bangladesh for many years for their high economic importance are concurrently creating severe negative impacts to the ecosystem including that of break of local food-web and food-chain, thus contributing towards the breakdown of the local ecosystem [11]. Some of the examples are as Akashmoni *(Acacia auriculaeformis); Eucalyptus (Eucalyptus brassiana); Eucalyptus (Eucalyptus camaldulensis)*; *Eucalyptus* (*Eucalyptus tereticornis);* Telekadam (*Leucaena leucocephala),* Pine *(Pinus oocarpa);* Caribaea pine *(Pinus caribaea); etc.* [12]. During the British colonial period the first widely introduced alien invasive aquatic plant species in Bangladesh as stated earlier was Water Hyacinth *(Eichhornia crassipes)* (weedy in nature) that was brought from Brazil. Besides there are Alligator weed *(Alternanthera philoxeroides), (Ipomoea aquatic Forsk*) and Water lettuce or Tupapana *(Pistia stratiotes L)* etc. [3].

More than 300 exotic species are supposed to be either wildly growing or cultivated as an economic crop in Bangladesh. Among all invasive non-native plants species, most potential invasive alien plants is *Acacia* and *Eucalyptus* that created several controversies and problems. All the species of these two genera are proven to be rivals to the endemic flora and found to be environmentally unfriendly to Bangladesh [10]. *Acacia and Eucalyptus* trees produce leaves that are not easily degradable resulting in less fertile soil and the threatening of thousands of humus-dependent species including herbs and earthworms. These trees absorb large amount of water and hence even the indigenous trees cannot grow properly around them. These plants do not support any wildlife since these do not produce edible fruit or nectar for them [10]. *Eucalyptus* trees release allelochemicals into the soils that lower the nutrient content of soil and effect the growth of native crops and plants species very severely [13]. Among alien aquatic plant (weed) species *Eichhornia crassipes*, water hyacinth is most likely to cause problems in Bangladesh. It is an aggressive invader of dams and slow flowing of rivers [3][5] creating high sedimentation. There are several factors that contribute to the fast growth and spread of invasive alien plant species. Records reveal that more than 130 exotic tree species so far have been tried in the plantation programs of Bangladesh but only a few of them adapted well for growth in the large scale plantation programs.

C. Factors Contributing Towards the Growth of Invasive Plants

There are different factors that influence species invasions and contribute to the massive growth and spread of invasive alien plant species in Bangladesh. Most invasive non-indigenous plant in the country produces huge amount of long lived seeds that is transferred to different regions by wind and birds. Reproductive strategies also help to spread of these alien species in Bangladesh. The geo-climatic condition and availability of nutrient are favourable for the rapid growth rates of most alien plants species in Bangladesh. Most invasive alien plant species have the ability to colonize new habitats in Bangladesh. Human activities are also facilitator to trans-locate the plants in the new areas due to their lack of awareness on invasive impact of alien species in Bangladesh. Due to increasing level of tourism and import, the entry of invasive non- indigenous species have increased in Bangladesh. On the other hand, alien species have been introduced through flood water from India [3][11]. Most of the alien agricultural species require extra care, fertilizers, insecticides and controlled watering thus resulting in the loss of soil fertility and contributing towards soil and water pollution. In short, the threat of invasive alien plants to biodiversity is second only to habitat loss and even more than pollution that have severe impacts on air; water; soil; food web and natural chains in the ecosystem.

D. Environmental Impact of Invasive Plant Species

Some of the alien invasive plants which have the ability to endure very high air pollution, temperatures and draught are *Ipil-Ipil, Acacia* and *Eucalyptus*. Some plants species also have a major impact on catchment hydrology; it does alter hydrological flows; condition and patterns; reduce stream flow; reduce water yield from watersheds; reduce surface water runoff etc. It can also disrupt stock watering, irrigation, tourism and recreational use of resources and heritages [2]. Some alien invasive weed species rapidly invade lake, water ways and wetlands, create floods in water ways and reduce oxygen level of water for phytoplankton growth. Aggressive alien invaders reduce the amount of nutrients and water that is available to native species, alter soil chemistry, moisture-holding capacity, and erode ability, increase soil erosion along stream banks, shorelines and roadsides, change characteristics of the soil structure, increased nitrogen (N) (ex. as *Ipil-Ipil* and *Acacia)* deposition in soil. Some types of flora introduced in Bangladesh which exercises adverse effects on soil fertility. The allelochemicals released into the soils of some invasive alien plants (ex. as *Eucalyptus)* lowered nutrient content in comparison to native forest ecosystems and inhibited the growth of native species [14]. These chemicals also reduced crop output when planted adjacent to crops [13]. Long-term exposure to allelochemicals may cause soil erosion by reducing vegetative cover [15].

The invasion of plant species in the new environments is triggered by land and forest degradation; land use and land cover changes; disrupt fire regime; displace native plant and animal species; man-induced habitat fragmentation; human health; many diseases affecting humans, plants and animals; and interrupt food webs and food chain etc. [3]. Among all these impacts of IAS, food webs and food chain plays a severe effect on the environment. Non-native invasive plant species are one of the major causes of habitat loss.

Among different invasive non-indigenous plant species, some of them have strength and much utility on the environment of the country. Some of these alien plants are fast growing, can be planted in any kind of soil, have the ability to withstand in degraded areas and unfavourable conditions, can grow in unfavourable climatic conditions, and can help raise people's economy by being planted in afforestation programs. It help in erosion control, have the ability to filter different air pollutants, use for compost materials, providing different building materials (use in bridges, buildings, railway, aircrafts etc.), produce farm timbers, fuel wood (e.g. *Acacia* , *Ipil Ipil* and *Eucalyptus*), stick, paper pulp (e.g. *Acacia*, *Ipil Ipil* and *Eucalyptus*), wood coal (e.g. *Acacia and Ipil Ipil*), oil (e.g. *Eucalyptus*), ply wood (e.g. *Ipil Ipil*), use as shade trees in native crops plantation program etc. These plants if at all introduced should be strictly in a controlled manner only for a particular desired effect [11].

Control Of Invasive Alien Species

A variety of well-known methods can be used as measures to control alien invasive species and their spread. These vary from administrative (national and international cooperation and coordination, database management, legislation regarding quarantine and so on), to mechanical (including digging up root systems, slashing and chopping), to chemical (utilizing acceptable and tested herbicides) and to biological (making use of plant specific insects or pathogens to damage and control aliens). These options are generally incorporated into integrated control program.

Conclusion

The alien invasive plant species have been acknowledged as a stern threat to the native biodiversity of Bangladesh. These species are extremely susceptible to the ecosystems of the country that threatening the endurance of local counterparts. These plant species remain a pressing concern for authorities responsible for environmental conservation and other economic sectors. There are scores of gaps in the current management approach against invasive species in the country. Undeniably there are innumerable areas that need to be strengthened to effectively administer the problem. To prevail over further detrimental effects on agricultural and natural ecosystems, the policy makers of Bangladesh must put management of these alien invasive plant species lofty on their list of national resource management priorities. Besides, of the many alien species in the country, their impact on local ecosystems have yet to be identified should be studied.

Acknowledgment

The paper is based on un published M.Arch term paper by the author A (Sonya Afrin) under the supervision of author C (Prof. Dr. Qazi Azizul Mowla) in Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

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