Review Article

Invasive Plant Species in Ghana: Route of Spread, Socio-Economic and Environmental Implications.

ABSTRACT

Globally, there has been a rapid increase in biodiversity loss, these losses have been attributed to habitat loss and invasive flora and fauna species. Extensive work has been done on the losses brought about by invasive fauna species, however, the impact of invasive flora species has less been explored in Ghana. This review focused on the various alien plant species found in Ghana and the factors that support their spread, establishment, and colonization. Findings indicate that the common invasive plants in Ghana are *Chromolaema odorata, Calopogonium mucunoides, Cedrella ordorata, Leucaena leucocephala, Broussonetia papyrifera and Prosopis glasdulosa, Azardiracta indica, Echinochloa colona, and Leucaena leucocephala.* The economic losses and environmental impact of these plant species were also reviewed. This review revealed that there is an urgent need to initiate interventions to control the rapid spread of invasive plant species, those measures should be cost-effective and eco-friendly.

KEYWORDS: invasive plant species, route of spread, Ghana

INTRODUCTION

Species have migrated and colonized new areas since the dawn of time. Migrating species in some cases were unable to establish sustainable populations in new habitats and died out quickly [1]. However, other species were integrated into the structure of the ecosystem or were attributed to altering the native food chain by out-competing native competitors or decimating native prey [2]. The Ghanaian ecosystem has never been an exception to this principle.

Ghana is one of the ecological regions within the sub-Sahara region with diverse plant and animal species. The abundance of native plant and animal species has contributed to the sustenance of Ghana's ecosystem as well as its economic development [3]. The interaction between humans in the areas of international commerce i.e., flora and fauna trading and natural migration have introduced non-native species into the Ghanaian ecosystem [4]. Non-native or invasive species are plants and animal species that have gained dominance in modifying and or disrupting the ecosystem they colonize [5]. The negative impact of non-native species on the Ghanaian ecosystem and economy keeps increasing at an alarming rate. In this regard, this paper seeks to highlight the various invasive species in Ghana, the causes of invasion, factors that support their spread, and the ecological and economic effect of invasive species on the Ghanaian ecosystem and economy [6].

Materials and Methods

A literature search was carried out on databases such as Google Scholar, Research Gate, Elsevier, Science Direct, Springer, and other scientific electronic libraries using the keywords "invasive," "non-native," "alien," and "exotic." Nuisance plant species associated with the Boolean operator "AND."

Two reviewers independently extracted the data, and by scrutinizing the publications' titles and abstracts, duplicate data was eliminated. The remaining articles were reviewed to make sure they complied with the requirements for inclusion. A critical review of the papers resulted in the selection of 27 articles.

The literature search turned up 50 relevant publications. Out of those publications, 18 were discarded since they had nothing to do with the keywords used in the literature search. The search was limited to studies conducted solely on 'invasive plant species, original publications written in English with their abstracts available were included. Before the complete papers were retrieved for in-depth reading from the remaining

32 articles, one duplicate article and four-chapter articles were eliminated. In total, 27 papers were chosen for further evaluation and data extraction to be included in this review. Figure 1.0 displays a flowchart of the exclusion selection process.

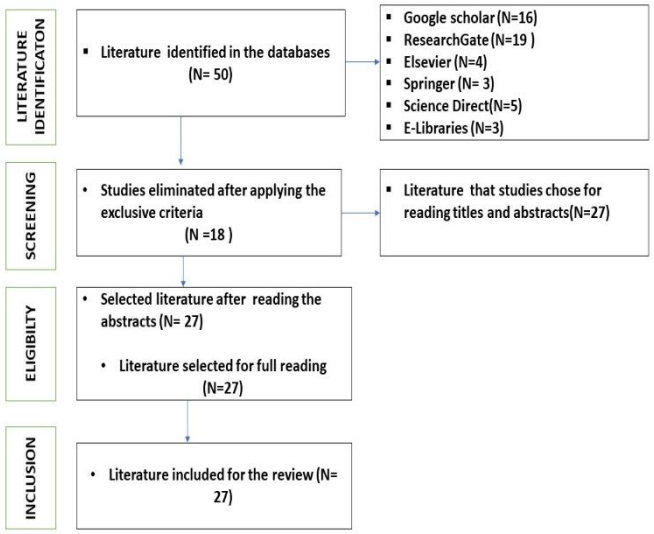

Figure 1 PRISMA Flow chart. Source: Survey data, 2023.

Invasive species in Ghana

Over the past decade, Ghana has recorded an increasing number of biological invasive species. These species are introduced either deliberately or inadvertently [7]. According to literature, there are about seventy different species that have invaded Ghana. They range from pathogenic microbes (viruses, fungi, and bacteria), to plants, and animals that have the potency to affect humans and the ecosystem [8]. The prominent plant invasive species identified in Ghana include*; chromolaema odorata, Calopogonium mucunoides, Cedrella ordorata, Leucaena leucocephala, Broussonetia papyrifera and Prosopis glasdulosa* [8] *Azardiracta indica, Echinochloa colona, and Leucaena leucocephala* have also been identified by Ansong *et al., (2019)* as invasive plant species in Ghana [9]. The rapid establishment of invasive species in the Ghanaian ecosystem is still unclear, however, a study by Xu *et al*, (2020) suggests that invasive species grow faster than native plants causing a significant reduction in the species richness of native plants [10]. The invasive species then forms a monodominant strand which results in the suppression of the regeneration of native plant species.

Scientific Name	Family Name	Common Name	Akan Name
Chromolaena odorata	Asteraceae	Siam weed	Akitinkra
Calopogonium mucunoides	Fabaceae	Cupid's shaving brush	Owia
Cedrella odorata	Meliaceae	Spanish cedar	Bonsa
Leucaena leucocephala	Fabaceae	Leucaena, lead tree	-
Broussonetia papyrifera	Moraceae	Paper mulberry	Bo
Prosopis glandulosa	Fabaceae	Honey mesquite,	Nsia
Azadirachta indica	Meliaceae	Neem	Nim
Echinochloa colona	Poaceae	Jungle rice	Anokyekye
Leucaena leucocephala	Fabaceae	Leucaena, lead tree	-

Table 1 : List of invasive species

Factors that support the spread of invasive plant species in Ghana.

The wide spread of invasive species has been attributed to anthropogenic and environmental factors [11]. Humans moving plant parts, plant products, and wood from one ecosystem to another is considered an anthropogenic cause. Other agronomic activities, such as the movement of rootstock varieties and annuals used in reforestation and forest reclamation have also contributed to species invasion. Many invasive plant species have a unique adaptation that enhances their ability to be transported to new ecosystems, plumed and winded appendages of some seeds facilitate wind dispersal [12], seeds with bristlelike, hooked, sticky or barbed appendages can attach to humans, such structures enable them to adhere to garbs this facilitates the long-distance spread of invasive plant species. Some animals are also associated with the spread of invasive species, they feed on the fruit of plants and as a result, they disperse it through fecal matter [13]. On the other hand, nutrient resources, climate change, dispersal vectors, and interspecific, and intraspecific interactions are environmental factors that trigger invasive species' rapid spread in the areas they colonize. A study has indicated that such factors may either occur within the local environment resulting in rapid population expansions [11]. These factors have also been explained below;

Nutrient resources: Invasive species can disrupt an ecosystem's food web by destroying or replacing native nutrient sources [14]. They can also alter the abundance or diversity of native wildlife-friendly species. Destructive invasive species can swiftly replace a diverse ecosystem with a monoculture invasive species and cause changes in pre-existing ecosystem conditions,

such as changing the structure, chemical, or nutrient composition of the soil [5].

Climate change: The change in atmospheric weather and climatic conditions is having a greater impact on invasive species [15]. The exponential rise in abiotic factors such as temperature, rainfall, humidity, and drought have the potency to facilitate the rapid spread and colonization of new invasive species [16]

Dispersal Vectors: How invasive species spread within an ecosystem is dependent on vectors that carry them. Usually, the vectors are humans or inanimate objects such as a vehicle [17]. Spores or propagules of exotic plants can attach to vehicles and be transported to a new region, when favorable conditions prevail, they can spread and colonize the entire region [18]. Aside from vehicles, roads have proven to be the next dispersal vector interns of spreading terrestrial exotic plant species and plant diseases [19].

Interspecific, and intraspecific interactions;

Though other studies have suggested that the intensity of interspecific competition between native and invasive species may vastly exceed the impact of intraspecific competition within species due to limited resources, classical competition theory predicts that intraspecific competition should be greater than the interspecific competition because individuals within one species require similar resource conditions [20]. The ability to compete across species and within species is a key factor in the population dynamics and invasiveness of alien plants in newly introduced habitats [21]. Given that many invasive clonal plants form dense monospecific stands in the invaded range and those stoloniferous clonal plants grow in diameter rather than height, intraspecific competition within clonal plants is likely to be very strong [22].

Additionally, what scientists refer to as the "invasion meltdown" may result from the treacherous competition between invasive species and native flora for resources that control the function of the ecosystem [5], [14]. According to the invasion meltdown hypothesis, the emergence of one invasive species in a new environment facilitates the invasion of other non-native species [23].

Ecological and environmental impact of invasive plant species.

Biodiversity provides enormous benefits to the [24]. Global food and nutritional security have been attributed to the world’s biodiversity, and some potent drugs were also discovered from biodiversity [25]. Invasive plant species have diverse effects on the services that

biodiversity provides globally. The impact of invasion is mostly observed through socio-economic and human health assessments [26]. Studies have revealed that the havoc of invasive species occurs by three major mechanisms; reduction in the diversity of native plants and animals, notable variations in Physico-chemical characteristics of soils (mostly through allelopathy), and enhancement in ecosystems' response towards altered fire regimes [14]. These mechanisms have the propensity to contribute towards the extinction of certain vital plant species, this intern disrupts the food chain, and how nutrient cycles through the environment. Humans are highly affected as we virtually derive everything, we need to survive from plants from the air humans breathe, food, and medicine to clothes.

The economic impact of invasive plant species

In the quest to improve human welfare in the area of agricultural productivity some exotic breeds of plants are introduced to increase productivity, these species tend to create economic havoc [27]. Souza et al., (2018) have indicated some invasive species have a detrimental effect on the economy, environment, and native inhabitants through the alteration of water quality. The invasion of some plants in the aquatic habitat has reduced the fish population and ecotourism [28]. Millions of plants that are of benefit to man have been wiped off as a result of the invasion of non-native plant species. The economic impact of invasive species on livestock production includes disruption of grazing practices, reduction in forage yield and increased cost of managing and producing livestock, slowing animal weight gain, and reducing the quality of animal products [13]

The presence of invasive plant species does not only affect native plants but a greater effect is targeted on humans and the environment. Which tends to adversely affect the socio-economic status, especially for people living in low- and middle-income countries.

CONCLUSION AND RECOMMENDATION

Although aside from habitat destruction, invasive species are the second leading cause of depletion and extinction of biodiversity. Its effects on native species are adversely resulting in the interruption of ecosystem services. Nevertheless, the rapid spread of invasive species is attributed to anthropogenic and environmental factors. If such factors continue, the long-term implication will be the emergence of newer invasive plant species, which will harm humans, the environment, and ecosystems.

However, with the route of spread, establishment, and colonization of invasive plant species defined, we can sustainably control the mechanisms of spread when the appropriate measures are put in place. Ecologists and Environmental Scientists who specialize in studying invasive species should empathize with the chemical ecology of invasive and native plant species interactions and its contribution to the loss of biodiversity. In-depth studies should be made on how climate change and unsustainable agricultural activities are contributing to the widespread invasion. Also, given the diverse impact of invasive plant species, there is a timely need to formulate and prioritize cost-effective and ecologically friendly approaches to curb or manage invasive plant species. These practices should be integrated into both natural and Agroecosystems. There is also the need for the global scientific community to unite in devising a common effective approach to safeguard the biodiversity losses that are brought about as a result of invasive plant species.

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