

## Effect and Control of Invasive Plant Species on Biodiversity

<sup>1</sup>Nazir M. Bodinga, <sup>1</sup>Ibrahim Suleiman, <sup>1</sup>Ibrahim Malami, <sup>2</sup>Usman S. Dinawa <sup>2</sup>Abdul'aziz Shehu

<sup>1</sup>Department of Agricultural Technology,  
College of Agriculture and Animals Science Wurno, Sokoto.

<sup>2</sup>Department of Forestry,  
College of Agriculture and Animals Science Wurno, Sokoto.

### ABSTRACT

A natural aggressive plant may be invasive when it is introduced to a new habitat and has the ability to thrive and spread aggressively outside its natural range. The examples of the invasive plants include **Prosopis glandulosa**, **Chromolaena odorata** and **Lantana camara**. Biological invasions are considered as a key threat to biodiversity. Invasion by alien species causes extensive damage to the habitats they invade, which includes impact on indigenous species diversity and soil nutrient composition, altering forest fire cycles and loss of productivity of invading ecosystems. It also becomes a threat to endangered or threatened plant species around the world. Invasive species may also affect native species by introducing pathogens or parasites that cause disease or kill native species and may cause changes in environmental services, such as flood control and water supply, nutrient recycling, conservation and regeneration of soils. There are three (3) methods of control of invasive plants; these are mechanical control, chemical control and biological control. Mechanical control options are the physical uprooting or removal of plants from the site using slashes, axes, bulldozers, etc. and often in combination with burning. In chemical control, herbicides can be applied to prevent sprouting of cut stumps, or to kill seedlings after felling or burning. Biological control is the use of living organisms to control weed species. Once the invasive species made entry into a region or country, it often becomes difficult to eradicate and it appears that they have come to stay. Worse still, their adverse effects on the native biodiversity are enormous and they are considered ecologically harmful, agricultural and economic losses.

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### INTRODUCTION

Invasive plants have the ability to thrive and spread aggressively outside its natural range, a natural aggressive plant may be invasive when it is introduced to a new habitat, an invasive plant colonizes a new area may gain an ecological edge since the insects, diseases and foraging animals that naturally keep its growth are not present in its new habitat.

Invasive alien plants are characterized by the following features as follows:-

1. Rapid growth rates,
2. Ability to colonize new habitat,
3. Produces large number of individual plants each season,
4. Extensive dispersal capabilities,
5. Large and rapid reproductive output and
6. Broad environmental tolerance (Geesing *et al.*, 2000).

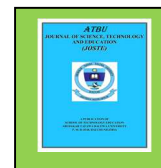
It is estimated that as many as 50% of invasive species in general can be classified as

Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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ecologically harmful, based on their actual impacts (Richardson *et al.*, 2000).

Invasive species are found in all taxonomic groups and they include introduced viruses, fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem type, in all regions (Lowe *et al.*, 2000).

The examples of the invasive plant species are as follows;

***Prosopis glandulosa*** (honey mesquite tree) is the most common example of such invasive plant which is a native to southwestern America and Mexico which has been introduced in to a lot of countries especially African countries. The IUNC consider it as one of the world's worst invasive species outside its native habitat range, this type plant is found in Gwadabawa LEA of Sokoto State (northern part Nigeria).

The honey mesquite tree is a tall shrub or tree of 3-9 m; deciduous foliage; spines axillary, uninodal, 1-4.5 cm long, mostly solitary, sometimes very few, germinate alternately on different nodes of the same twig and have the following characteristics;

1. The plant has a rounded big and floppy, dropping branches with feathery foliage and straight, paired spines on twigs.
2. May reach up to 6-9m but can grow as tall as 15m.
3. It has a rapid growth rate.
4. A single-trunked that is cut down will soon be replaced by a multiple trunked.
5. The plant flowers from March to November with pale, yellow, elongated spikes and bears straight, yellow seedpods.
6. The plant is also characterized by evergreen leaves.
7. It is a plant with a very deep root system (up to 18.3 m).

***Chromolaena odorata*** is a shrub plant candidate for one of the top 100 worst weeds in the world that are found in some countries such as USA, India and African countries and have the following characteristics the plant forms dense

tangled bushes 1.5-2 m in height (some branches can grow up trees to 20 m) (Singh, S.P. 2008).

1. Leaves extend from stem in opposite pairs, light green with velvety hairs, triangular shape, leaf edges can have large serrations (teeth) or they can be smooth (without teeth);
2. Leaves have a distinctive 3-vein "pitchfork" pattern;
3. Stems have short, soft hairs (older stems woody);
4. Flowers in small round clusters, white to mauve color, 4-5 mm long; individual flower shape is a slender trumpet; long, whispy structure (called the "style") extends beyond flower petals, see photos, left;
5. Seeds are dark, 3-4 mm long, with a 5 mm long fluffy structure
6. This is the first record of this weed in the Hawaiian Islands;
7. Tolerates a wide range of soil conditions and severe drought;
8. Prefers full sun to partial shade (does not tolerate heavy shade);
9. Rapidly forms dense thickets in disturbed/cleared areas;
10. Creates a fire hazard;
11. Allelopathic (prevents other plants from growing nearby);
12. Allergen/toxic to humans (causes skin problems and asthma in allergy-prone people);
13. Can be toxic to animals, causing diarrhea and death in extreme cases;
14. Host for recognized pests and pathogens;
15. Can grow and spread from cut stems;
16. Can mature in a year and begin producing seed;
17. Produces many wind-dispersed seeds (up to 800,000 per plant) persisting more than a year in soil; (Akinluyi TO, Odeyemi O. 1989).

***Lantana camara*** is a weed of National Significance. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and

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Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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environmental impacts. Lantana forms dense, impenetrable thickets that take over native bush land and pastures on the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock. Lantana is a serious threat to biodiversity in several World Heritage-listed areas including the Wet Tropics of northern Queensland, Fraser Island and the Greater Blue Mountains. Numerous plant and animal species of conservation significance are threatened. It is listed as the most significant environmental weed by the South-East Queensland Environmental Weeds Management Group. It is a problem in gardens because it can cross-pollinate with weedy varieties to create new, more resilient forms.

*Lantana* is a form of vegetative reproduction where stems send roots into the soil, allowing it to quickly form very dense stands and spread short distances. *Lantana* can grow in high-rainfall areas with tropical, subtropical and temperate climates. It does not tolerate salty or dry soils, water logging or low temperatures (<5°C). It thrives on rich, organic soils but also grows on well-drained clay and basalt soils.

*Lantana* flowers whenever the soil is moist and the air is warm and humid. For much of its range along the Queensland and New South Wales coasts, this results in almost, continuous flowering and fruiting. Further inland, peak flowering occurs several weeks after soaking rain (25 mm or more) and is usually accompanied by good fruit set ([EnvironmentACT@act.gov.au](mailto:EnvironmentACT@act.gov.au)).

## LITERATURE REVIEW

The impacts of invasive species on ecosystem services have attracted worldwide attention. Despite the overwhelming evidence of these impacts and a growing appreciation for ecosystem services, however, researchers and policymakers rarely directly address the connection between invasions and ecosystem services, various attempts have been made to address the ecosystem processes that are affected by invasive species (Levine *et al.*, 2003; Dukes and Mooney *et al.*, 2004), but the links

between these mechanisms and ecosystem services are largely lacking in the literature. Assessments of the economic impacts of invasive species cover costs beyond those associated with ecosystem services (e.g., control costs), and generally do not differentiate by ecosystem service type. Additionally, while advances have been made in quantifying non-market-based ecosystem services, their loss or alteration by invasive species are often overlooked or underappreciated.

Ecosystem services are the benefits provided to human society by natural ecosystems, or more broadly put, the ecosystem processes by which human life is maintained. The concept of ecosystem services is not new, and there have been multiple attempts to list and categorize these services, especially as the existence of additional services has been recognized (e.g., Daily 1997; NRC 2005). For the purposes of this chapter, the address ecosystem services in the framework put forward by the Millennium Ecosystem Assessment (2005).

The services lists are primarily those enumerated in the Millennium Ecosystem Assessment (2005), with minimal variation in wording, and inclusion of several additional services not explicitly stated in this assessment. This framework places services into four categories (in italics). Provisioning services are products obtained from ecosystems, and include food (crops, livestock, fisheries, etc.), freshwater, fiber (timber, cotton, silk, etc.), fuel, genetic resources, biochemical's/pharmaceuticals/natural medicines, and ornamental resources. Regulating services are obtained from the regulation of ecosystem Ecological Studies (Nentwig *et al* 2003).

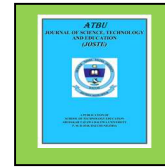
According to (Springer-Verlag Berlin Heidelberg 2007) the Biological Invasions processes include air quality regulation, climate regulation, water regulation (timing and extent of flooding, runoff, etc.), water purification, waste treatment, disease regulation, natural pest control, pollination, erosion control, and coastal storm protection. Cultural services are non-material benefits, and include aesthetic values, recreation/tourism, spiritual/religious values,

Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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educational/scientific values, cultural heritage values, inspiration, and sense of place.

Supporting services are overarching, indirect, and occur on large temporal scales, but are necessary for the maintenance of other services. They include photosynthesis, primary production, nutrient cycling, water cycling, soil formation and maintenance of fertility, as well as atmospheric composition. This review includes both goods, which have direct market values, and services that in turn maintain the production of goods and biodiversity, and directly or indirectly benefit humans (Nentwig *et al* 2003).

### Valuing Ecosystem Services

In order to understand how invasive species affect ecosystem services, one must first understand how ecosystem services are valued, and how these values relate to the costs of invasive species. Economic valuation of ecosystem services and goods typically involves several components. All goods and services are categorized within a framework of total economic value, and subsequently assigned monetary value (Costanza *et al.* 1997).

The review initially differentiates between use and non-use values. Use values further divide into direct and indirect use values. Direct use values involve human interaction with nature, and include both consumptive and non-consumptive uses. Consumptive use refers to products consumed locally or sold in markets, whereas non-consumptive use typically refers to cultural services such as recreation and tourism. Indirect use values encompass species that humans rely on indirectly through trophic and other interactions (e.g., natural pest control), and services that are closely tied to ecosystem processes. Examples are productive inputs such as soil fertility, pollination, water purification, and flood control, all of which are extremely important in agriculture. Non-use values, while less tangible, are critical to a comprehensive assessment of economic valuation. They derive from the continued existence and intrinsic value of a service, good, species, habitat, etc., and include existence, option and bequest values (Born *et al.* 2005).

These three values are succinctly explained by an example taken from (Daily 1997), where non-use values for a hypothetical freshwater site include the value of knowing the site exists, irrespective of whether or not an individual visits the site (existence value); the value of preserving the option of enjoying the site in the future (option or future use value); and the value of ensuring that one's descendants will be able to enjoy the site (bequest value). While the literature on ecological economics includes several variations of this framework, all versions include the same basic principles (Born *et al.* 2005).

Although the invasive plant are of negative effect, however some of the plants are of importance and can be useful such as *Prosopis juliflorac*an be used in the Lake Chad region where the tree is becoming invasive, affecting fishing on the Lake, *Lantana camara*as alternative to bamboo for making baskets and brooms to local people, some of the plant is used by the farmers to cover their farmland and also for firewood and making charcoal, as well as quality wood pulp in paper making. Some invasive plant can yields alcohol even more than other crops, *Tithonia diversifolia* leaves are boiled and drunk to treat malaria. *Chromolaena odorata*have been reported to be very effective in the production of biogas and also for carbon storage (sink), in addition to the fact that it is also processed to treat malaria and wound disinfection in Southwest Nigeria (Singh *et al.*, 2008).

### Effect of Invasive Plant on Biodiversity

Invasive alien species, once they made entry into a region or country, often become difficult to eradicate and it appears that they have come to stay. Worse still, their adverse effects on the native biodiversity are enormous and they are considered ecologically harmful. Agricultural and economic losses to invasive species are comparatively high. Mechanical control is expensive and difficult in some terrains; chemical control is also expensive, requires constant application and has its environmental

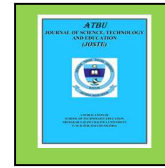
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Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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implications, while biological control is mired with mixed failures and successes.

Biological invasions are considered as a key threat to biodiversity (Mooney and Hobbs 2000). Invasion by alien species cause extensive damage on the habitats they invade, which include impact on indigenous species diversity, soil nutrient composition, altering forest fire cycles and loss of productivity of invading ecosystem. It also becomes a threat to endangered or threatened plant species around the world (Pimentel *et al.*, 2005).

Invasive species are responsible for the homogenization of floras which causes a substantial threat to biodiversity and ecological integrity of native habitats and ecosystems (Hulme *et al.*, 2003). Invasive species may cause changes in environmental services, such as flood control and water supply, water assimilation, nutrient recycling, conservation and regeneration of soils (GISP *et al.*, 2004).

Invasive species may also affect native species by introducing pathogens or parasites that cause disease or kill native species (UNEP 2004). Agricultural losses to invasive species are enormous in all parts of the world. Example are the arrival and continuous spread of *C. odorata* in Nigeria has posed a serious threat to subsistent and commercial agriculture, where it is a major weed in young tree crop plantations (such as rubber, oil palm, cocoa and fruit trees), cassava, yam, banana, plantain and other important agricultural crops in southern and central parts of the country (Ivens 2004; Ogundola *et al.*, 2007).

#### **Some Method of Control of Invasive Plants**

There are three (3) method of control of invasive plants, these are

1. mechanical control
2. chemical control and
3. biological control

#### **Mechanical Control**

Mechanical control options include the physical felling or uprooting of plants, their removal from the site, often in combination with burning. The equipment used in mechanical control ranges from hand-held instruments (such

as saws, slashers and axes) to power-driven tools such as chainsaws and brush cutters, and even to bulldozers in some cases.

Mechanical control is labour-intensive and thus expensive to use in extensive and dense infestations, or in remote or rugged areas (Van Wilgen *et al.*, 2001).

#### **Chemical Control**

Herbicides can be applied to prevent sprouting of cut stumps, or to kill seedlings after felling or burning. Herbicides can target, for example, grasses or broad-leaved species, leaving other plants unharmed. However, there are legitimate concerns over the use of herbicides in terms of potential environmental impacts. Although newer herbicides tend to be less toxic, have shorter residence times, and are more specific, concerns over detrimental environmental impacts still remain. The use of chemical control is often governed by legislation, and the effective and safe use of herbicides requires a relatively high level of training; both of these factors can restrict the use of chemical control on a large scale (Van Wilgen *et al.* 2001).

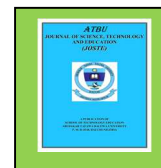
However, herbicide application in a large piece of land taken over by invasive species can be very expensive. Considering that thousands of hectares have been invaded by these and other weeds in Africa it is unlikely that (T. I. Borokini and F. D. Babalola 2012)

#### **Biological Control**

Biological control has been defined as the use of living organisms to control pest species (Waage and Greathead 2008; Watson 2001). Biological control, instead of eliminating the target organism, aims at establishing an equilibrium which maintains its population at a level of negligible harm (Bani 2002).

#### **CONCLUSION**

Once the invasive species made entry into a region or country, often become difficult to eradicate and it appears that they have come to stay. Worse still, their adverse effects on the native biodiversity are enormous and they are



considered ecologically harmful, agricultural and economic losses.

Unfortunately, all the existing control measures have their limited successes, with their corresponding huge cost of implementation, adverse environmental implications and in most cases, require continuous exercise, hence continuous financial expenses. Mechanical control is expensive and difficult in some terrains; chemical control is also expensive, requires constant application and has its environmental implications, while biological control is mired with mixed failures and successes.

### RECOMMENDATION

It is logical to recommend that the best way to control an invasive species is prevention from personal experiences, once an alien species is introduced into a new area and it establishes itself and reproduces rapidly, it is almost impossible to eradicate such a species.

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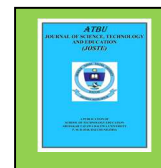
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Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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Corresponding author: Nazir, M. Bodinga

✉ [mbnazir01@gmail.com](mailto:mbnazir01@gmail.com)

Department of Agricultural Technology, College of Agriculture and Animal Sciences, Wurno, Sokoto State.

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