Ecology and Evolutionary Biology
2024; 9(1): 1-8
http://www.sciencepublishinggroup.com/j/eeb
doi: 10.11648/j.eeb.20240901.11
ISSN: 2575-3789 (Print); ISSN: 2575-3762 (Online)

Major Dominant Invasive Alien Plant Species, Land Uses Types and Their Management Practice in Dedessa, Bedelle and Chora Districts, Buno Bedelle Zone, Southwest Ethiopia

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To cite this article:
Derebe Terefe Gemechu, Tadele Weldebirhan, Dawit Bekele Gudina. (2024). Assessments of Major Dominant Invasive Alien Plant Species, Land Uses Types and Their Management Practice in Dedessa, Bedelle and Chora Districts, Buno Bedelle Zone, Southwest Ethiopia. *Ecology and Evolutionary Biology*, *9*(1), 1-8. https://doi.org/10.11648/j.eeb.20240901.11

Received: November 6, 2023; **Accepted**: December 7, 2023; **Published**: January 11, 2024

Abstract: Invasive alien species have affected every ecosystem type on the planet and are considered as the second greatest global threat to biodiversity, following habitat destruction. Therefore, the objective of this study was to identify the major dominant species, awareness creation local to community, invaded land uses types and management procedure taken to control and reduce invading species in Buno Bedelle zone, Southwest Ethiopia. As stated by, an assessment was accomplished in Buno Bedelle zone, Dedessa, Dedelle and Chora districts, in 41 randomly selected households in twelve distnict Kebeles (the smallest administrative unit in Ethiopia). According to the interview and field observation, the level of invasive alien plant species invasion was very high and the plant was the most dominant on cultivated lands, grazing lands, roadside and non-cultivated land in the study areas. Invasive alien plant species were appear to the study area during road construction cooperatively with sand, stones and agricultural inputs and materials. The great threat and problem were loss of biodiversity and crop production due to high outspread rate, prolific seed production and high rejuvenate capacity of invasive alien plants. The implication of the study candidates regarding the finest method that the local people should use to manage the spread of IAPS, 94% of them indicated that the control of the spread in the future went further research by stakeholder and most of them believed the government, communities and non-governmental organizations should work together in order to control the spread of Invasive alien plant species. Researchers overwhelming need to distinguish and measure the socioeconomic effects and devise proper strategies for cost effective and time efficient management options of invasive alien species.

Keywords: Argemone Ochroleuca, Caesalpinia Decapetala, Cuscuta Campestris, Lantana Camara, Parthenium Hystophorus, Senna Didymobtrya, Invasive alien Plant Species

1. Introduction

Invasive species (IS) are either indigenous or nonindigenous species that can heavily colonize a particular habitat [4], but invasive alien species (IAS) are nonnative species that are introduced deliberately or unintentionally in areas outside their natural habitats, where they become established, proliferate, and spread, causing damage to the environment [6]. They are widely distributed in all kinds of ecosystems throughout the World due to the potential to emerge themselves, invade, out-compete natives, and control the new environment [6]. As well as this, invasive species have now affected every ecosystem type on the planet and are taking into account as the second greatest global threat to biodiversity, following habitat destruction [11, 14]. Similarly, invasion by alien species causes extensive impact on the habitats they invade, which include impact on indigenous species diversity, soil nutrient composition, affecting forest fire cycles and loss of productivity of invading ecosystems. It also becomes a threat to endangered or threatened plant species around the world [13]. Invasive species are causes for the uniformity of floras that causes a significant threat to biodiversity and ecological integrity of native landscape and

ecosystems [8]. Invasive species may disturbances in environmental services, such as flood control and water supply, water assimilation, nutrient recycling, conservation and regeneration of soils [10].

Biological invasions are fascinating far-reaching focus from ecologists because of their significant ecological impacts and economic costs. Particularly, biological invasions are highly remarkable as a noticeable conundrum for the conservation of biological diversity. Invasive Aliens Species (IASs) are of great concern in Ethiopia, posing specific problems on biodiversity of the country with great economic and ecological impacts. The extraordinary rise in the movement of wild species that goes parallel to the globalization of the economy has produced an enhancement of the rate of introduction of new alien species everywhere, with its harmful consequences on native biological diversity [12, 15].

In Ethiopia, several invasive alien plant species are posing negative impacts on native biodiversity, agricultural lands, rangelands, national parks, waterways, lakes, rivers, etc. [9]. Currently, in Ethiopia, [15] also reported the presence of 35 alien plant species, the top-20 such as : *Prosopis juliflora, Parthenium hysterophorus, Eichhornia crassipes, Lantana camara, Opuntia ficus-indica, Opuntia stricta, Argemone mexicana, Ageratum conyzoides, Senna occidentalis, Datura stramonium, Mimosa diplotricha, Mimosa pigra, Cryptostegia grandiflora, Acacia saligna, Nicotiana glauca Graham, Xanthium strumarium, Caesalpinia decapetala, Pistia stratiotes, Cirsium vulgare, and Xanthium spinosum* [3]. These IAS pose a serious threat to agriculture (crop and livestock), livelihoods and human health at various levels [7]. The Environmental Policy of Ethiopia, the Forest Resource Strategy and the National Biodiversity Strategy and Action Plan, identify invasive plant species to be growing threats to the biodiversity of the country and socioeconomic well-being of the people [2].

Buno Bedelle zone had been invaded by invasive alien plant species, but their socioeconomic and ecological impacts were not assessed so far. In addition to this, brief policies or strategies have yet not been set as a nationally in general and study area too in particular so, assessing the overall impact of alien plants would be quite crucial to measure, communicate and make scientific decisions about the likelihood of socioeconomic and ecological damage in the area. Thus, quantification of effects of invasive alien plant species on invading species, communities and ecosystems was important in providing cogent information and prioritizing management options to the public and policy makers. Early detection of invasive plants, enhanced through mapping efforts, is critical for fast response and effective monitoring strategies. For this reason, this study expected to undertake on dominant invasive alien species, disturbed land uses type and their management practice regarding the effect on the biodiversity in districts of selected kebeles. Specifically, this reconnaissance survey was used to address the following pertinent objectives:

1) To identify the type of major dominant invasive species found in study site
2) To assess the awareness of the local community about invasive plant species.
3) To identify major invaded land uses types by invasive alien plant species.
4) To pin out management practice taken to control and eradicate invading species

2. Materials and Methods

2.1. Description of Study Areas

This study was conducted during 2023 under autumn season conditions in Buno Bedelle zone, Oromia National Regional State of Southwest Ethiopia. Buno Bedelle zone was one of the 21 zones found in Oromia National Regional State with Bedelle City as its capital, which is located 480 km away from Addis Ababa. Located in western Oromia and bordered on the south by Southern Nations, Nationalities, and Peoples Region, on the West by the Illubabor zone, on the North by the East Wollega zone and West Wollega zone and on the East by Jimma zone. Buno Bedelle was created by 9 districts, namely Bedelle, Chora, Dedessa, Gechi, Dega, Meko, Cheweka, Dabo Hana, Borecha and Bedelle town in March 2016. Accordingly, three study sites from Buno Bedelle zones (Bedelle, Dedessa and Chora) were selected for investigation based on the recommendation from the zone Environment, Forest and Climate Change Authority office experts and the researcher's own observation. The zone has a latitude and longitude of 8° 27' 21.60" N 36° 21' 10.87" E and an elevation between 2,012–2,162 meters (6,601–7,093 ft) above sea level. The Zone covers 5,856.5030 square kilometers of which 1,126.64 square kilometers are covered by forests.

According to the central statistical agency's population projection, the population of the Buno Bedelle zone was projected to be 707, 223 by 2017, of whom 354,168 men and 353,055 women [5]. Teff, maize, wheat, sorghum, barley, millet, groundnut, sesame, and Arabica coffee are among some of the major agricultural crops cultivated in this region. Vegetables and fruits are also cultivated in this region. Besides vegetables and fruits cultivation, indigenous and local breeds of livestock rearing is also practiced in the study area.

Table 1. *Selected specific site in the district (kebeles).*

No.	Zone	Districts	Selected specific site in the areas (kebeles)
1	Buno Bedelle	Bedelle	Ambalta
2		Dedessa	Kuchie
3			Bumba
4			Gela
5			Dembara
6			Geshe
7		Chora	Siso
8			Gichila
9			Koda
10			Korbo
11			Abdibori
12			Sucha

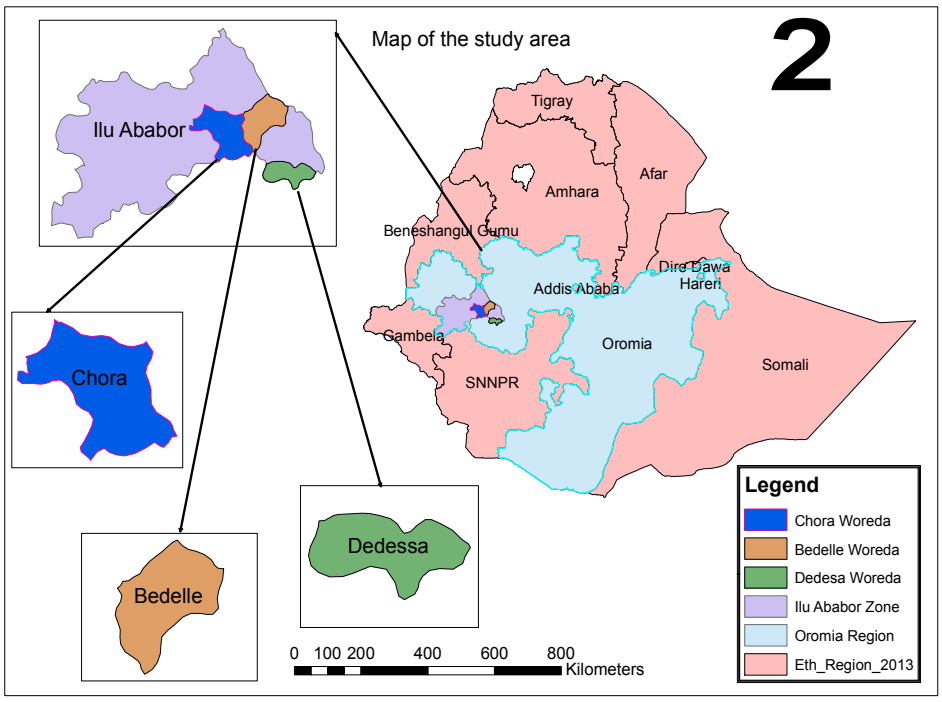

Figure 1. *Map of the study area.*

2.2. Data Collection

Field study on the impacts, trends, mode of entry, spread, status, distribution and management practices of invasive alien plant species in Buno Bedelle zone, Dedessa, Bedelle, and Chora districts, Oromia National Regional state was conducted. The study districts were identified on the basis of the level of invasive alien plant species with the help of information obtained from the Buno Bedelle zone Environment, Forest and Climate Change Authority office. According to the above selection criteria from the three districts, the study was conducted only on twelve representative kebeles. From each district two Kebeles (the smallest administrative unit in Ethiopia) were selected based on the invasion of invasive alien plant species according to the information obtained from the district Environment, Forest and Climate Change Authority office. Accordingly, Ambalta, Kuchie, Bumba, Gela, Dembara, Geshe, Siso, Gichila, Koda, Korbo, Abdibor and Sucha were selected to conduct this research. From each kebele households were selected randomly bringing the total number of sampled households to 41. Data was gathered from primary sources. The primary data was collected through Semi-Structured interview, preference ranking and field observation. Secondary sources of data were obtained from the Environment, Forest and Climate Change Authority office of the districts, from different books, journals and research articles.

2.3. Data Analysis

The collected data was analyzed by using SPSS (statistical package for social sciences). MS-Excel was also used for drawing bar graphs and charts. The results were presented by tables and figures.

3. Results and Discussions

3.1. Households Characteristics

From the total respondents, 36% of the household heads were aged between 40 and 48, while a little below half of the household heads (27%) were aged between 31 and 39, 17% of the households were aged between 22 and 30. Most of the respondents were males (78%) and only a few of them were females (22%). In line with, [1] was reported that the prevailing male number of respondents occurred by accident when households were randomly selected, but females were not systematically ignored for this research. The major factor for the large number of male headed households was due to the overall truth that manifests in Ethiopia where males are take into account as the head of the household or the owner of the land while females mostly participate/work at home.

According to the educational status of the households, 17% of the respondents were uneducated(illiterate), while 24% of the participants studied primary (first cycle, 1–4 grade) education, 46%, 7% and 5% of the household heads were educated up to primary level(Second cycle, 5–8 grade), secondary high school (9–12 grade) and degree households respectively. The educational level of the households was from uneducated households up to Degree households. Assessment in the marital status showed that 90% of households were married, 5%, 2% and 2% of households were single, widowed and divorced respectively. The job classification of the respondents implies that all of the respondents were found to be farmers. Different perceptions of informants were evaluated to know their attribute and aspect towards main sources of income. Regarding their main sources of household income majority of 37% were

permanent/salaried agricultural related, 32% were cash crop farming, 17% were short term agricultural wage labor (< 3 months) and 10%, 2%, 2% and 2% subsistence farming, short term non - agricultural wage labor (< 3 months), business and remittances respectively. Regarding number of years lived by the respondents in the study kebeles, 63% of the respondents lived in the study kebeles for 12-42 years, while 27% and 10% of them lived for 43-55 and 56-63 years respectively.

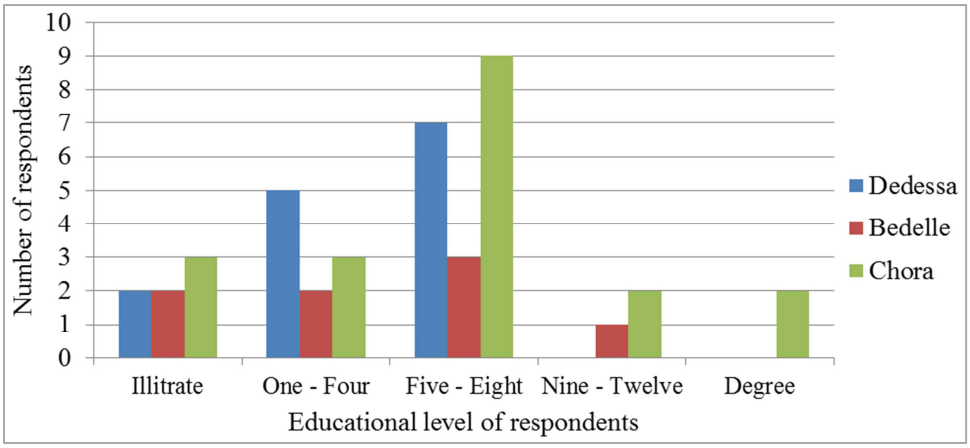

Figure 2. *Educational status of recruited respondents in the study areas.*

3.2. Floristic Classification of Dominant Invasive Species

The Finding of the study implies that ten most frequently dominant invasive alien plant species (IAPS) that heavily invade large areas of different land use types and belong to six families were identified from 12 specifically selected kebeles in the three districts (Table 1).

Table 2. *Major dominant invasive alien plant species in Dedessa, Bedelle and Chora districts.*

No.	Scientific name	Family name	Local name	Habit
1	Parthenium hysterophorus	Asteraceae	Farramsiisa	Herb
2	Senna didymobtrya	Fabaceae	Seenaamakkii	Shrub
3	Cuscuta campestris	Convolvulaceae	Injirree/biqilballeessi	Herb
4	Mimosa diplotricha	Fabaceae	Naqabinaa	Shrub
5	Lantana camara	Verbenaceae	Lantana	Shrub
6	Caesalpinia decapetala	Fabaceae	Arangamaa	Shrub
7	Argemone ochroleuca	Papaveraceae	Qooraatii	Herb
8	Senna occidentalis	Fabaceae	Seenaamakkii	Shrub
9	Xanthium strumarium	Asteraceae	Xanthium	Herb
10	Nicotiana glauca	Solanaceae	Abaaboo	Shrub

According to the life form or habit of invasive alien plant species, invasive plants of shrubs' habits are highly distributed and dominant, account higher number 60% and the smallest percentages (40%) were dominated by herb species (Figure 3).

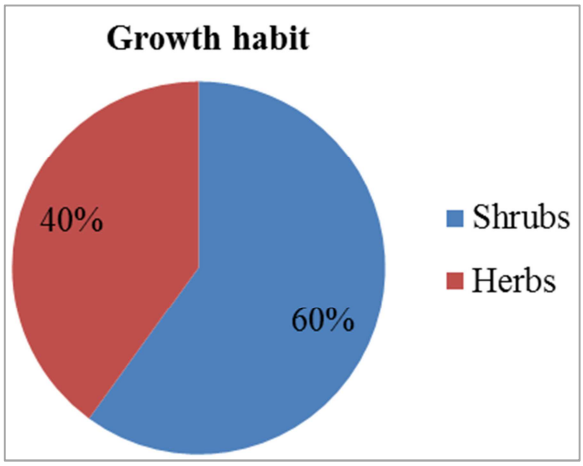

Figure 3. *Dominant invasive species Life form in the districts.*

3.3. Distribution and Invaded Land Use Types

Distribution and land invaded by Invasive alien plant species were varies across the specific site and accordingly differ across the districts. *Parthenium* weed was a dominant invasive species in the districts and has been rapidly invading grazing land, cultivated areas, roadsides, recreation areas, and good plains in the districts. It was also known to defectively distress crop production, biodiversity, animal husbandry, human health and even ecosystem integrity. Although the invasion of this weed was not new to the local community, the status of its invasion was not controlled as required. Frequently available and dominating species across all kebeles but highly invading in ambalta, kuchie, Bumba, gela, abdibori, sucha, and dembara (Table 3). Similarly, [9] reported that the *Parthenium hysterophorus* was observed on 13 waypoints (19%) which were at/near the towns of the Districts that is, Chora, Metu, Yayu, Ale, Bure, Dedesa, Gechi, Bedelle, Hurumu, Halu and Chawaqa.

Senna didymobtrya was one of major dominant invasive succeeding *Parthenium* weed found in all kebeles but highly dominating in ambalta, geshe, korbo, dembara, gela, kuchie around abdibori kebeles including many part of the city and highly covering grazing land, roadside, forest areas. In contrast, [9] reported that the distribution of *Senna didymobotra* was localized spreading from town to rangeland following roadsides in all districts except in Bedele, Chora, Yayu and Hurumu districts where high infestation on rangeland was observed. People in the districts intentionally, cultivating and propagating those species in their home garden and in their farming area for decoration (*Nicotiana glauca*), fencing and for good protection (*Lantana camara*). *Cuscuta campestris* is also dominant invasive plants found in all kebeles and their distribution is differ and heavily invading in koda, korbo, gichila, siso, geshe, dembara, gela and kuchie kebeles and infested on farm site of all kebeles especially after crop sowing and till harvesting season. Forest area, agricultural land, non- cultivated land, degraded land, rural village, urban open areas including home garden for decoration, recreation site, botanical garden and grazing land were the invaded land use types dominated by invasive alien plant species in the study site (Table 3).

Table 3. *Distribution status of Invasive Plants Species on land use type in the districts/kebeles.*

No	Invasive Plants	Distribution on land use types		Distribution and dominance rank
		Land use type	Infestation status	
1	Parthenium hysterophorus	1,2,3,4	Very high	1
2	Senna didymobtrya	1,2,3,4,6	High	2
3	Cuscuta campestris	1,3,4	High	3
4	Mimosa diplotricha	1,2,3,4	Moderate	4
5	Lantana camara	1,2,3,4,6,8	Moderate	4
6	Caesalpinia decapetala	1,2,3,4	Moderate	5
7	Argemone ochroleuca	1,2,3	Moderate	5
8	Senna occidentalis	3,4	low	6
9	Xanthium strumarium	1	low	7
10	Nicotiana glauca	6	low	7

**1 = Cultivated land 2 = Road side 3 = Grazing areas 4 = Non-cultivated land 5 = Rural villages 6 = urban areas 7 = Riverside 8 = Forest areas

Major dominant species invade land use system at different rate and *Parthenium hysterophorus* account (20.28%) which is the highest infestation, *Senna didymobtrya* (18.84%), *Cuscuta campestris* (15.94%), *Mimosa diplotricha* and *Lantana camara* (11.95%), both *Caesalpinia decapetala* and *Argemone ochroleuca* (10.14%), and *Senna occidentalis*, *xanthium strumarium*, and *Nicotiana glauca* had all most similar infestation which was (1.45%) in percentage (Figure 3). In the field observation and survey, invasive alien plant species were differently infested on different land use types. From those land use type in the districts, cultivated land, roadside and grazing areas (including open area or waste land in the city) were the highly affected land use types in the districts (Table 3).

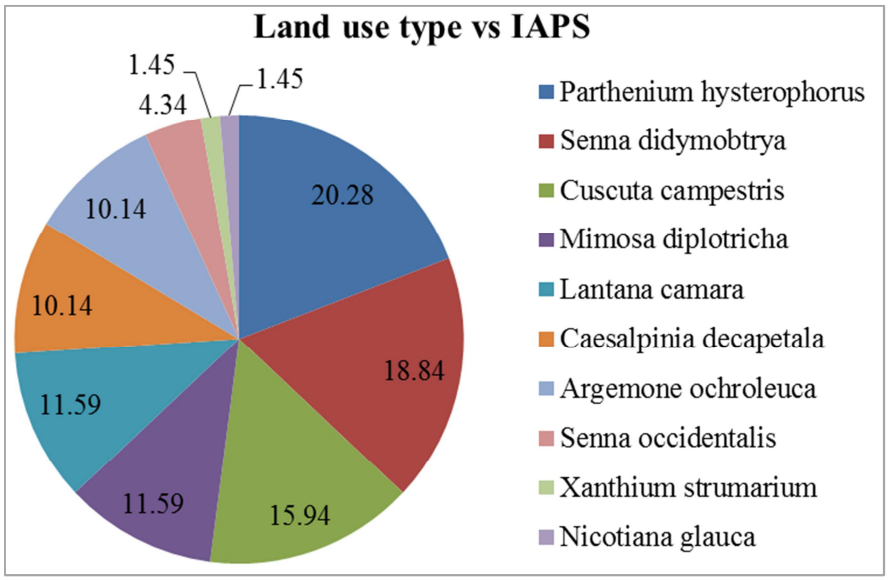

Figure 4. *Distribution and invaded land uses type by invasive species in the districts.*

Respondents Estimate on the Perceptional Status of IAPS

Most of the respondents (71%) reported the high level of invasive alien plant species and 16% and 13 % of them reported its level invasion as intermediate and lower level respectively (Figure 4). As field observation and from the respondents report, the level of invasion was very high in the

study area particularly around non-cultivated, grazing, non-cultivated land and roadside. From field observation and as the respondents reported the most dominant invasive alien species in the study areas were *Parthenium hysterophores*, *Senna didymobtrya* and *Cuscuta campestris*. Moreover, almost 100% of the respondents in the area were familiar with invasive species. Almost all of the respondents (100%) believe that there is currently a much more increase in the spread of invasive plant species in the study areas.

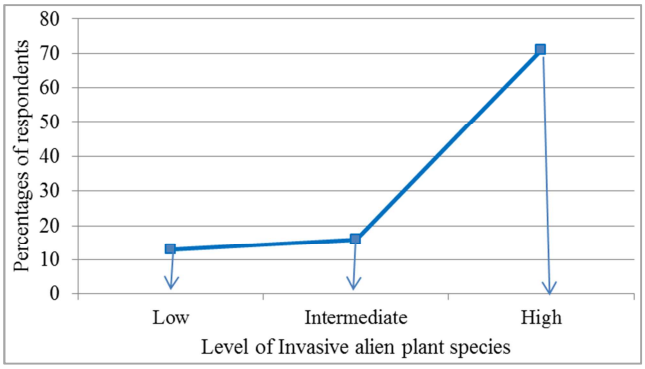

Figure 5. *Level of Invasive alien plant species in the study areas.*

3.4. Respondents Estimate on Entry of IAPS in the Districts

As shown on figure 5, the majority of respondents (43%) informed the time of entry it was 20 years ago and introduced it in their locality with construction, birds and seeds but 24% of informants confirmed the time of entry was 5 years ago. 17% informed the time of entry was 10 years ago but believe as it entered with agricultural inputs such seeds, chemical fertilizers and machinery equipment. Small respondents of 15% mentioned the time of entry was 15 years ago with expansion of rural road construction.

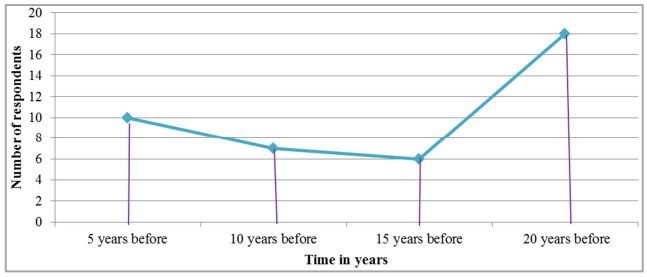

Figure 6. *Respondents paired in a number of years of Invasive alien plant species introduction into the study areas.*

3.5. Negative Impact of IAPS on Biodiversity and Future Impact Assessment in the Study Areas

As summarized on below figure 6, regarding their impact on biodiversity, most of the respondents 91% of informants were well informed as IAPS having an inclusive impact on biodiversity, as having low impact on biodiversity (6%) and 3% of respondents have no idea. From the summarized graph below, on the future impacts assessment of IAPS, majority of the respondents (76%) reported that IAPS will cause high impact in the future, 10% reported moderate impact and 14% reported that the impact of invasive in the future to be low.

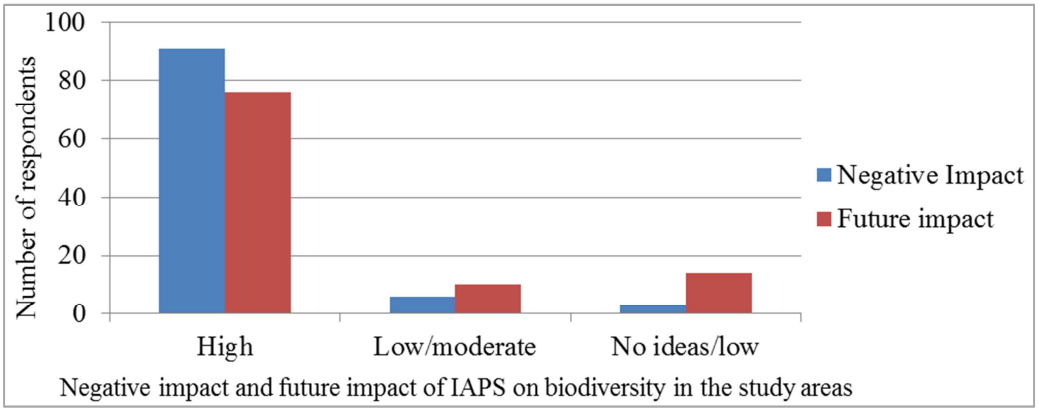

Figure 7. *Negative impact and future impact assessment of IAPS on biodiversity in the study areas.*

3.6. Impact of Invasive Alien Plants on Indigenous Species, Agricultural Production, Human Health, Socioeconomic and Environment

According to assessments conducted, type and number of invasive species found in the study areas and respondents' perception on socioeconomic and environmental (ecological) impacts were recorded and identified. Respondents were asked to mention the observed adverse effect of invasive alien plants found in the study areas and their perception was summarized in (Figure 7).

Health problems were reported when people in infested areas were unknowingly utilized for sweeping after toilets and causing severe temporary pains to them. Respondents also mentioned that dense growth habits of the plant enable it to hold much moisture and serve as a suitable ground for mosquito reproduction.

Of the total respondents, 22% of them mentioned that *IAPS* had bad incidence with livestock/livelihood and 27% covered larger areas with infestation, whereas 18% of them also stated that it had the deleterious effect of biodiversity. Likewise, 21% of respondents mentioned that it

aggressively/fast spreads within a short period of time and covers larger areas, whereas 12% of them noted that this invasive plant had the most dense growth habit (Figure 7).

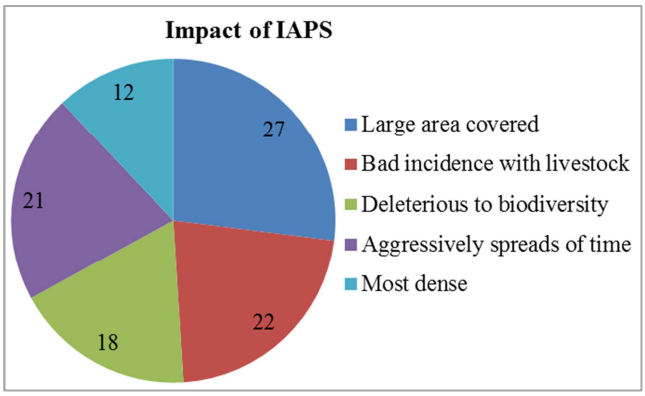

Figure 8. *Respondent's perception of nature of Invasive alien plant species in the study areas.*

3.7. Management Practices of Invasive Alien Plant Species and Farmers Perception in the Study Areas

Almost all respondents had common ideas regarding the practice that the local community used to control the spread of *invasive alien plant species* but they had different arguments on how to control it. For instance, 39% of them reported the community used cutting at young stage and burn it to control the spread of it, while around half of them (48%) control its spread by digging out at young stage and burn it, 3% of them control its spread by cutting before fruiting and burn it, 4% of them reported as using chemical, 5% of them reported the spread of it controlled by cutting and burn it, by digging out at young stage and burn it and using chemicals. The implication of the study participants about the best practices that the local people should use to control the spread of *IAPS*, 94% of them suggested that the control of the spread in the future needs further research by concerned body and majority of them believed the government, communities and non-governmental organizations should work together in order to control the spread of *Invasive alien plant species.*

4. Conclusions and Recommendation

Invasive alien species are a major threat to the natural ecosystem, human and animal health, and habitat. An organized plan of action is required in respective districts to enlighten hazardous effects of invasive alien species. Adoption of an integrated weed management program is mandatory in place of depending on any single management option. There is an urgent need for researchers to identify, characterize, quantify the socioeconomic impacts and devise proper strategies for cost effective and time efficient management of invasive alien species. There by, raising awareness to the general public and government agents.

The following recommendations are suggested to prevent, control the already invaded ecosystems in Ethiopia and elsewhere in the world:

1) Sustainable and multidisciplinary approach studies regarding history, properties of the invasiveness of the species and their impacts in relation to ecological impacts on ecosystems and socioeconomic consequences have to be conducted.
2) Close monitoring and management of all natural and agro ecosystems from disturbances to reduce the arrival and colonization of Invasive alien plant species.
3) Institutional mandate in managing invasive species should also be well specified and give priority for eradication.
4) Awareness creation, strong local support and commitment from the government and individuals will more likely facilitate the control, management and/or eradication of IAPS on private land.

Conflicts of Interest

The authors declare no conflicts of interest.

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