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## Assessments impact of an invasive alien weed species on indigenous species and its management practices in eastern Hararghe, Ethiopia

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### Abstract

Invasive alien species are non-indigenous species that adversely affect, economically, environmentally or ecologically habitats. An assessment was conducted to identify Impact of an Invasive Alien weed Species on Indigenous Species and its management practices in eastern Hararghe, Ethiopia and community's perception on their socioeconomic and ecological impacts. The survey area was randomly selected and the total numbers of respondents were 80. The major threat and challenge were loss of biodiversity and crop production due to high spread rate, prolific seed production and high regeneration capacity of invasive alien plants. Respondents noted that invasion of both disturbed and undisturbed areas in the study districts was adversely affected fertility status of soils, suppresses growth of grasses, other herbaceous plants, bush lands and economically important crops, human and livestock health. To prevent the entry of invasive plants utilization of invasive alien plant species as firewood, construction, fence, feed and erosion control were major tackle of their management. Adoption of an integrated management program is mandatory in instead of depending on any single option. Researchers urgently need to characterize and quantify the socioeconomic impacts and devised proper strategies for cost effective and time efficient management options of invasive alien species.

**Keywords:** *Parthenium hystophorus*, *Prosopis juliflora* striga, *Plectranthus barbatus*, *Argemone ochroleuca* and invasive alien species

### 1. Introduction

Invasive Alien Species' refers to a species subspecies or lower taxon, introduced outside its natural past or present distributions which are widely distributed in all kinds of ecosystems throughout the world including all categories of living organisms (IBC, 2009; Genovesi and Shine C, 2004) [15, 10]. Invasive Alien Species refer to plants, animals or microorganisms that are not native to specific ecosystem and whose introduction threatens food security, biodiversity, health or economic development (McNeely *et al.*, 2001). According to Raghubanshi *et al.* (2005) [25], invasive alien species have unique characteristics over the native ones. They do not need special environmental requirement for seed germination, have rapid seedling growth and produce seeds for longer period of time as long as environmental condition permit, they are also highly tolerant to climatic and edaphic variations and have an ability to compete and drive off other species from their habitat. It is found in a wide range of environments. However; it is most common in semi-arid, sub-tropical and warmer temperate regions (Huma Q *et al.*; 2014; Jarosik *et al.*; 2011; Sanaa, A. and Moussa, I. 2012) [14, 17].

Invasive alien species are introduced deliberately or unintentionally outside their natural habitat, where they have the ability to establish themselves, invade, out-compete natives and take over the new environment (CBD, 2005) [7]. Invasive species are of concern because of their capability of spreading fast, their high competitiveness and ability to colonize new areas within short periods. The nature and severity of the impacts of these species on society, economic life, health and national heritage are of global concern (McNeely *et al.*, 2001). Invasive species have significant social, ecological and economic impacts. They reduce agricultural yields, irrigated crop lands, grazing areas, water availabilities, and contribute to spread of vector borne diseases (Essa *et al.*, 2006) [8].

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Moreover, they can reproduce sexually and asexually. It reproduces by producing a large number of seed which may fall naturally to the ground (Rajvaidhya, S *et al*; 2012, Rawson, J. E, Bath. S. J, 1980) [26, 27]. The majority of seeds are dispersed by floodwaters. It is also possible for the whole plant to break off at the base which can be blown by the wind in to new areas. It can grow and persist in disturbed areas and farmland where it can compete and potentially displace native biodiversity (Huma Q *et al*; 2014, Rajvaidhya, S *et al*; 2012; Reddy, C. S. and Pattanaik, C (2007) [14, 26, 29]. The formation of dense stands, as seeds fall locally, also affects wildlife and decreases biodiversity which is commonly found as a weed of road sides, mining dumps, rabbit warrens, recently cultivated paddocks, waste places, and overgrazed pastures (Karlsson, L *et al*; 2003; Patel, P. K. 2013; Rawson, J. E, Bath. S. J 1980; Reddy, C. S. and Pattanaik, C 2007) [19, 27, 29, 24].

Ethiopia is rich in biodiversity and is one of the 12 Vavilovian centers of origin (UNEP, 2003) [32].

However, there are about 35 invasive alien species threat the biodiversity of the country (McGinley, 2007). Foremost among these are *Parthenium hysterophorus* L., *Eichhornia crassipes* (Mart.) Solms, *Prosopis juliflora* (Sw.) DC., *Lantana camara* L., *Argemoneochroleuca* Sweet, *Xanthium strumarium* L., *Ageratum conyzoides* L., *Senna occidentalis* (L.) Link, *Datura stramonium* L., *Nicotianaglauca* Graham and *Sennadidymobotrya* (Fresen.) Irwin and Barneby (Boy and Witt, 2013) [6]. These IAS pose a serious threat to agriculture (crop and livestock), livelihoods and human health at various levels (Haysom and Murphy, 2003) [12]. The Environmental Policy of Ethiopia, the Forest Resource Strategy and the National Biodiversity Strategy and Action Plan, recognize invasive plant species to be growing threats to the biodiversity of the country and socioeconomic well-being of the people (Anagae, A *et al*; 2004) [3].

Eastern Hararghe has been invaded by invasive alien plant species, but their socioeconomic and ecological impacts were not assessed so far. In addition to this, clear policies or strategies have yet not set as a nationally in general and study area too in particular so, assessing the overall impact of alien plants will be quite crucial to measure, communicate and made scientific decisions about the likelihood of socioeconomic and ecological damage in the area. Thus, quantification of impacts invasive alien plant species on invading species, communities and ecosystems is important in providing cogent information and prioritizing management options to the public and policy makers. Early detection of invasive plants, facilitated through mapping efforts, is critical for rapid response and effective monitoring strategies. Therefore, this research was plan to attain with general objective of assessing the impacts, distribution pattern, trend, management practices and status of Invasive alien plant species in districts of selected kebeles. Specifically, this reconnaissance survey was tried to address the following pertinent objectives:

- ✓ To identify the type of invasive species found in the selected woredas.
- ✓ To assess the perception of local resident about the control of invasive species.

## 2. Materials and Methods

### 2.1. Description of study area

This study was conducted during 2021 under rain fed conditions in Eastern Hararghe Zone, Oromia Regional State of Eastern Ethiopia. The Zone is bordered on the southwest by the Shebelle River which separates it from Bale, on the west by West

Hararghe, on the north by Dire Dawa and on the north and east by the Somali Region. The Zone comprises of 18 districts, namely Babille, Bedeno, Chinaksen, Deder, Fadis, Girawa, Gola Oda, Goro Gutu, Gursum, Haramaya, Jarso, Kersa, Kombolcha, Kurfa Chele, Malka Balo, Meyumuluke, Midega Tola and Goro Muti. Accordingly, four study sites from Eastern Hararghe zones (Babile, Fadis, Kersa and Meta) will selected for investigation based on the recommendation from the Zone agricultural office experts and the researcher own observation. This Zone has a total population of 2,723,850 of whom 1,383,198 are men and 1,340,652 women; with an area of 17,935.40 square kilometers and has a population density of 151.87. A total of 580,735 households were counted in this Zone, which results in an average of 4.69 persons to a household, and 560,223 housing units. The two largest ethnic groups reported were the Oromo (96.43%) and the Amhara (2.26%); all other ethnic groups made up 1.31% of the population. Afan Oromo is spoken as a first language by 94.6%, Somali is spoken by 2.92% and Amharic by 2.06%; the remaining 0.42% speak all other primary languages reported. The majority of the inhabitants are Muslims (96.51%), while 3.12% of the populations professed Christianity (CSA, 2007).

### 2.2 Data Collection

Field study on the impacts, trends, mode of entry, spread, status, distribution and management practices of *Invasive alien plant species (IAPS)* in Eastern Hararghe zone (Fadis, Babile and Kersa) of Oromia region will conducted. The study districts and kebeles will be selected purposively on the basis of the level of *IAPS* invasion with the help of information obtained from Agricultural office of Eastern Hararghe zone. The socioeconomic data will be collected to assess the perception and awareness of the local people towards the invasive species, and data will be collected from primary sources. Primary data through semi-structured questionnaires and participatory rural appraisal (PRA) interview will be collected. Secondary source of data was obtained from the agricultural office of the districts, from different books, journal and research article. The study will conducted on six representative *kebeles*. From each district two *kebeles* will selected based on the level of invasion of *IAPS* according to the information obtained from districts agricultural office. From each *Kebeles* 10 households will selected randomly and bring the total number of respondents to 60.

### 2.3 Data Analysis

Descriptive statistics will be used for data presentation and analysis. MS-Excel will be used for drawing bar graph and charts. SPSS version 20 was used to correlate the familiarity of informants with age and observations about invasive species.

## 3. Result and Discussion

### 3.1 Respondents socio-demographic status

In the present study, the marital status from total of 80 respondents were interviewed from the four districts (20 from each) of which the majority were male respondents 58 (70%) and the rest 22 (30%) were female respondents (Figure 1). From this survey study most of the respondents were male in compared to females because in Hararghe females do more on selling and buying chat. This makes males cover more agricultural activities. In line with present result, Amare *et al.* (2016) [2] was reported in that the prevailed male number of respondents was occurred by accident when households were randomly selected, but females were not systematically ignored for this research. In addition to this traditionally males are

considered as household heads while females are house wives. From the recruited 80 respondents, highest age group between 16-35 (35 %) of the respondent was in Kersa district followed by 36-50 (30%) in Babile, Metta and Fadis (Figure 2). The age group between 36-50 (30%) were recorded in Kersa district where as the remaining districts records the same number second (% 25) followed by age above 50. Fadis accounts is highest percentage of age in between 0-15 (25%) followed by Babile (20%) and Meta and Kersa accounts no significant difference

which is 15%. This shows that dependent on their family for surviving. With regard to educational status 21.3% of them were uneducated, 30.0% of them studied informal education while 45.0% of them studied primary education and 3.8% them were educated up to Secondary High School (9-10) (figure 3). The educational status of the households' heads was from uneducated households' heads up to Secondary high School (9-10).

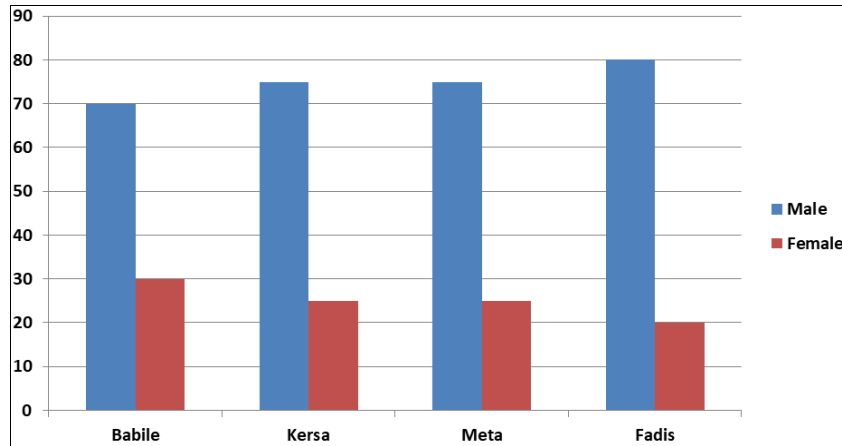


Fig 1: Marital status of Respondents in the study area

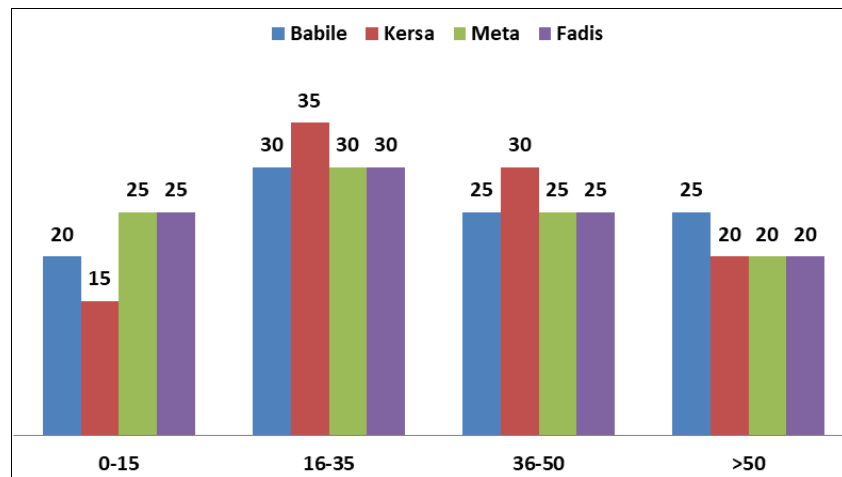


Fig 2: Respondents age of Respondents in the study area

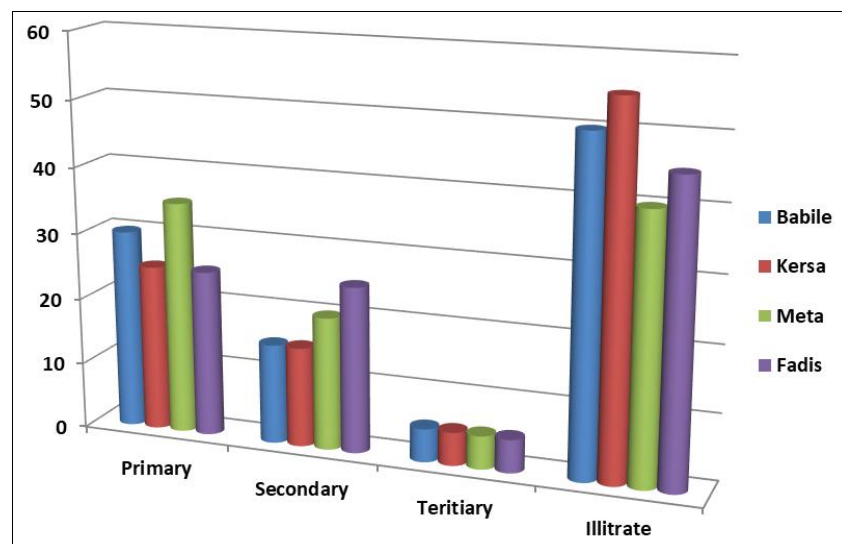


Fig 3: Educational status of recruited respondents in the study area

### 3.2. Invasive alien weed species and Invaded land use

Survey study showed that 6 invasive alien species were identified and recorded. They were categorized into woody, non woody/herbaceous and broad leaves. Invasive species most dominantly invaded in the eastern Hararghe zone of Oromia region were *Striga*, *Plectranthus barbatus* and *Argemone ochroleuca* identified from Meta and Kersa woredas. Whereas, *parthenium hystophorus* and *Prosopis juliflora* were dominantly occur in Fadis and Babile ditricts. Field survey showed that forest area, agricultural land, and grazing land were the invaded land use by the aforementioned dominant invasive species.

A very abundant (87.5-100%) *Parthenium* and *lantana camara* infestation were observed in habitation areas during the field survey while it is found rarely (1.25-11.25%) on wastelands at Fadis and Babile. In line with present findings Teye *et al.*, (2010) [18] have also observed *Parthenium* infestations along road sides, habitation areas such as towns, waterways and crop lands. Similar findings were reported elsewhere in different parts of the country (Berhanu *et al.* 2015; Jemal and Teye 2015; Amare *et al.* 2017; Reda and Tewelde, 2018) [5, 1, 18, 28]. Our results are also in line with Mcconnachie *et al.* (2011) [22] who reported the suitability of disturbed habitats such as roadsides, railway tracks, building areas and agricultural areas for *Parthenium* establishment because of lack of competition. The infestation status of *parthenium hystophorus* and *Lantana camara* were high at Fadis and Babile in area of grazing land, roadsides and other cultivated area during this conducting the survey. In agreement with this result, Zimmermann HG, *et al.* (2004) reported that *Parthenium hystrophorus* and *Lantana camara* has been rapidly invaded roadsides, grazing land, recreation areas, railway tracks as well as wastelands and cultivated areas. In concord with present findings, among all weeds species, *Parthenium hystrophorus* was highly dominant species in Gamo Gofa, Ethiopia (Gebrehiwot N, *et al.*; 2015) [9]. Despite its importance, the local people observed major problems including decrease crop production, animal health, quality of honey bee and biodiversity because they were used its flower for honey bee sucking. Several characteristics, such as wide adaptability, drought tolerance, strong competition and allelopathy, high seed production ability, small and light seeds capable of long-distance travel through, water, wind. In line with present result, Getachew S, *et al.* (2012) [11] and Ayanu YZ *et al.* (2015) [4], *Prosopis juliflora* is now considered the most horrible invasive species in Afar and one of the most damaging invasive plants in Ethiopia, having numerous direct and indirect economic, ecological, and local livelihood impacts.

### 3.3. Impact of Invasive Alien Plants on Indigenous species, agricultural production, Human Health, Socioeconomic and Environment

According to assessment conducted, type and number of invasive species found in the study area 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 4).

Health problem was reported when peoples in infested areas were unknowingly utilized for sweeping after toilet and causing severe temporarily pains to them. Respondents also mentioned that dense growth habit of the plant enables to hold much moisture and serving as a suitable ground for mosquito reproduction.

Of the total respondents, 25% of them mentioned that *IAPS* had bad incidence with livestock/livelihood and 23.75 areas covering larger areas with infestation, whereas 21.25% of them also stated that it had the deleterious effect of biodiversity. Likewise, 20% of respondents were mentioned that that it was aggressively/fast spreads within a short period of time and covers larger areas, whereas 10% of them were noted that this invasive plant had the most dense growth habit (Figure 4).

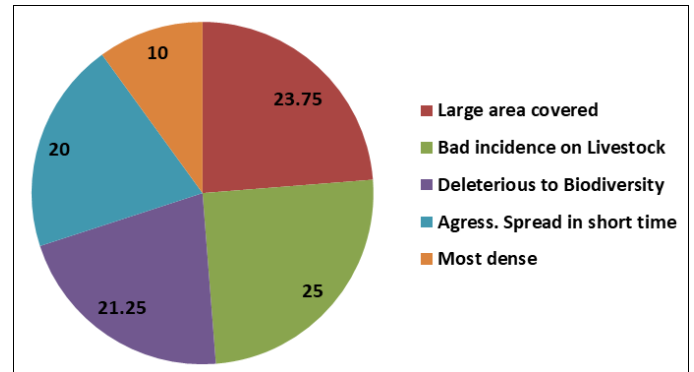


Fig 4: Respondent's perception of nature of Invasive alien plant species in the study area

Greater number of the respondents (32.25%) reported that *Invasive alien species* invades grazing land, 28.75% of them believed it has effect on agricultural production and 26.25% of them reacted that it has harmful effect on forest, 11.25% of the respondents reported it has negative impact on others like effect on biodiversity and rangelands and 1.25% of the remaining respondents agree with that its effect on wastelands (Figure 5). In line with current results, according to Holm, L; *et al.* (1977) it reduces the yield of many cereals such as wheat as its seed is an undesirable contaminant in stock sold food. Moreover, similar study by Karlsson, L *et al.* (2003) [19] reported that in eastern parts of Ethiopia *Argemone ochroleuca* occurs as awed with pulses, cereals, tobacco, tea, and sugarcane, tomatoes, cotton and potato causing reduction of their yield significantly. In agreement with current result, *Parthenium hystrophorus* weed was also known to defectively distress crop production, biodiversity, animal husbandry, human health and even ecosystem integrity (Kumari P, *et al.*, 2014).

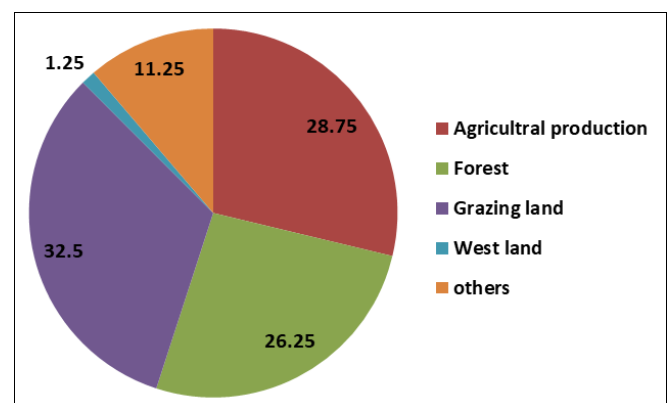


Fig 5: Respondent's perception on negative effect of Invasive alien plant species in the study area

### 3.4. Management practices of Invasive alien plant species and farmers Perception in the study area

Almost all respondents have common idea regarding to the practice that the local community used to control the spread of



*Invasive alien plant species* but they have different argument on way of controlling it. For instance, 25.0% of them reported the community used cutting at young stage and burn it to control the spread of it, while around half of them (48.3%) control its spread by digging out at young stage and burn it, 4.7% of them control its spread by cutting before fruiting and burn it, 17 % 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*, 92.5% 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. Conclusion and Recommendation

Invasive alien species are a major threat to 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, characterized, quantify the socioeconomic impacts and devised proper strategies for cost effective and time efficient management of invasive alien species. Thereby, 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:

- 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.
- Close monitoring and management of all natural and agro-ecosystems from disturbances to reduce the arrival and colonization of *IAPS*.
- Create awareness for stakeholders about *IAS* and impact on environment.

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