

ASSESSMENT OF INVASIVE ALIEN PLANT SPECIES, *Cryptostegia grandiflora*, IN EAST SHEWA ZONE, OROMIA REGIONAL STATE, ETHIOPIA

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ABSTRACT

Invasive alien species are getting more and more problematic in many African countries including Ethiopia. The introduction and spread of Invasive Alien Plants (IAPS) threatens the biodiversity, the economy and the society at large. *Cryptostegia grandiflora* is one of the IAPS worldwide. In Ethiopia its distribution is increasing from time to time. Therefore, the objectives of this study was to assess the impacts, spreading mechanisms, trends, status, distribution and management practices of *Cryptostegia grandiflora* in selected districts of East Shewa Zone, Oromia Regional State, Ethiopia. Accordingly, an assessment was carried out in two selected districts of East Shewa Zone (Fentale and Boset) in 78 randomly selected households from six different *Kebeles* (the smallest administrative unit in Ethiopia). All respondents (100%) agreed that they were aware of about the horrible invasiveness and the negative impacts of *Cryptostegia grandiflora*. Based on the interview and field observation, the level of *Cryptostegia grandiflora* invasion was very high and it was the most dominant IAPS on flooding areas, roadside, forest areas, around fence and hill side and Awash River basins in the study areas. Almost all of the respondents reported that the level of damaging impact of *Cryptostegia grandiflora* on native biodiversity increased in the past and most of them (91 %) worried about its negative impacts on biodiversity in the future. Regarding the main route of introduction of *Cryptostegia grandiflora* in the study districts, majority (62.8%) of respondents did n't know how it was introduced. Besides this, some of the respondents claimed that it was introduced either by flood or wind and a few them reported as it was occurred instantly. Most of the respondents recommended that to control the spread of *Cryptostegia grandiflora* in the future further investigation is needed by concerned body. Therefore, Governmental and Nongovernmental Organizations should find a mechanism to control and eliminate this IAPS and save the range land and forests of the study areas before becoming out of control.

KEYWORDS: *Cryptostegia grandiflora*, Invasive Alien Plants (IAPS), biodiversity, impacts, status, distribution and management practices

INTRODUCTION

An invasive species is defined as a plant, fungus, bacteria or animal species that is not native to a specific location, and which has a tendency to spread to degree believed to cause damage to the environment, human health or economy. Invasive alien species seriously affect many sectors of the economy; especially they are noted for being an important cause of global biodiversity loss. The impact of alien invasive species on biodiversity has been described as immense, insidious and usually irreversible. Their fast growth, rapid reproduction, high dispersal ability and phenotypic plasticity accounts for their impact. Invasive species have many vectors to inter into the new environment, including biological vectors, but most invasions are associated with human activity (McNeely, 2001).

Cryptostegia grandiflora (Rubber vine) is an invasive plant species in the family Apocynaceae. It is one of the worst invasive alien plant species in the world because of its invasiveness, potential for spread, and negative impacts on biodiversity, economic and environment. It has also negative impact on the pasture, toxic to livestock and dense infestations replace productive species, rendering grazing country less productive or even unusable (Klackenberg, 2001, Luizza et al., 2016).

Cryptostegia grandiflora is an aggressive woody climbing shrub which is capable of growing over trees up to 30m high. It kills native trees by growing up into their canopy, blocking their access to the sun and "choking them," in addition to inhibiting the establishment of grasses when growing in shrub form. Cultivation of

rubber vine as an ornamental plant makes the problem much worse (Paman, 2008). It invades and disrupts indigenous forest system. *Cryptostegia grandiflora* can be introduced to an area by animals or humans. Livestock can carry seeds long distances through agricultural fields. Contaminated vehicles and machinery transport seeds from one worksite to another (GISD, 2015, PIER, 2003).

Moreover, about 95% of seed produced by rubber vine is viable. It is scattered short distances from the parent plant by wind that catches the tufts on the seed ends, or longer distances by floating on floodwaters. Most seed remains viable even after the pods have floated on fresh or salt water for over a month, potentially leading to spread between catchments. Seeds can also be potentially spread by birds, or in mud attached to vehicles, machinery and animals. With each seedpod producing between 340 and 840 seeds, a hectare of rubber vine can produce millions of seeds every year (Luizza et al. 2016).

Cryptostegia grandiflora is also regarded as one of the worst invasive alien plant in Ethiopia. It is widely distributed in East Shewa and Afar regions, Ethiopia. However, less attention is given to the studies of this Invasive Alien Plant Species in Ethiopia and little investigation has been undertaken since then. Hence, no

adequate recent information exists about the impact, distribution pattern, status, trend, spreading and controlling mechanisms of *Cryptostegia grandiflora*. Therefore, this study aimed at assessing the impact, distribution pattern, status, trends, spreading and controlling mechanisms of the Invasive Alien Plant Species, *Cryptostegia grandiflora*, in Fentale and Boset districts of East Shewa Zone, Oromia Regional State, Ethiopia.

1. MATERIALS AND METHODS

1.1. Description of the study area

East shewa East Shewa (Amharic: Misraq Shewa; Afaan Oromo: Shawaa Bahaa) is one of the Zones of the Oromia Region of Ethiopian. This zone is bordered on the south by the West Arsi Zone, on the southwest by the Southern Nations, Nationalities and Peoples Region, on the west by South west Shewa and Oromia Special Zone Surrounding Finfinne, on the northwest by North Shewa, on the north by the Amhara Region, on the northeast by the Afar Region, and on the southeast by Arsi; its westernmost reach is defined by the course of the Bilate River. Currently, East Shewa Zone undertakes its administrative duties and responsibility in 10 districts (Fantale, Boset, Adama, Lume, Bora, Dugda, Adami Tullu Jido Kombolcha, Ade'a, Liben and Gimbichu).

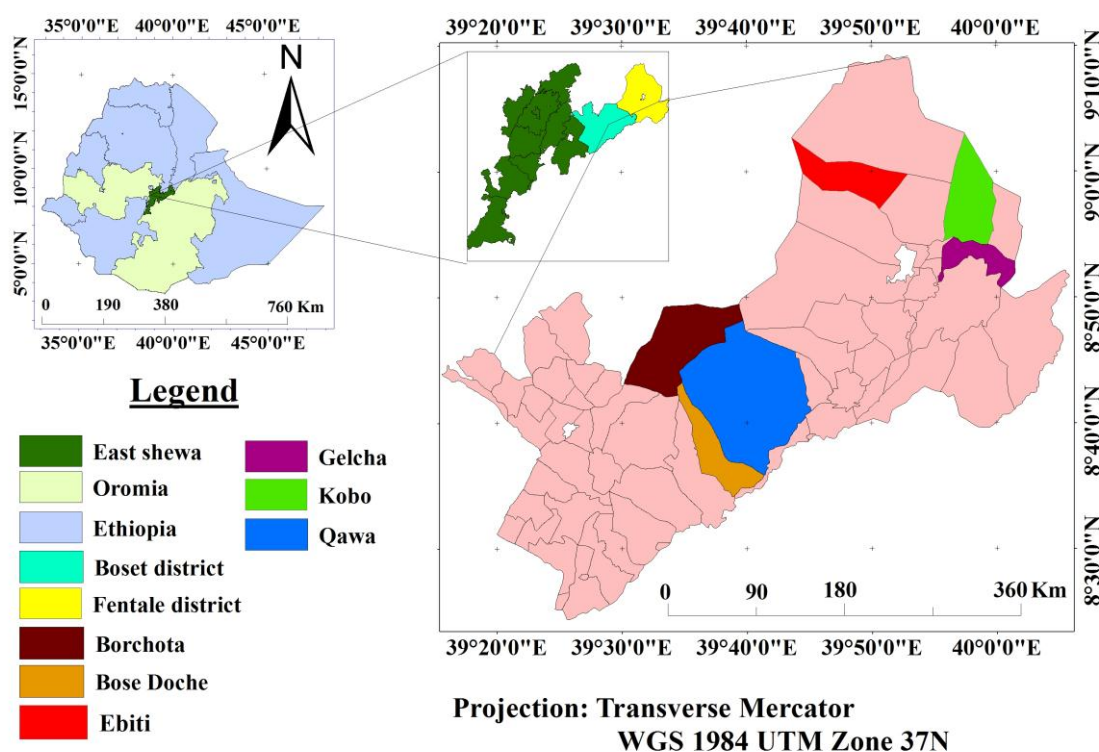


Fig. 1: Administrative Map of the study area.

1.2. Method of Data Collection

This study was conducted in East Shewa Zone, Oromia regional State, Ethiopia. The study districts were selected

purposively on the basis of the level of *Cryptostegia grandiflora* invasion with the help of information obtained from Agricultural office of East Shewa Zone.

Based on the above selection criteria, from this zone two districts, from each three representative *Kebeles*, a total of 6 (Kobo, Gelcha, Debit, Borcheta, Bose-deche and Qawa) were selected. Hence, from each *Kebele* 13 households was selected purposively taking the total number of sampled households to 78 to study the impact, status, trend, distribution pattern and management practices of *Cryptostegia grandiflora*.

Generally, data was collected from primary and secondary sources. The primary data was collected through Semi-structured interview and field observation. Secondary source of data was obtained from the agricultural office of the districts, from different books, journal and research article. Both quantitative and qualitative data were collected.

1.3. Method of Data Analysis

The collected data was analyzed by using SPSS (statistical package for social sciences). A descriptive statistical method was employed to analyze and summarize the data and to calculate percentages, frequency and mean.

3. RESULTS AND DISCUSSIONS

3.1. Households Characteristics

A total of 78 respondents, 64[82.1%] males and 14[17.9%] females, were interviewed. The age of respondents varied between 19 years old (the minimum age) and 78 years old (the maximum age) with mean age of 40.9±12.153years, range 59 years and mode 40 years. Majority of the respondents (96.2%) were married and 3.8% of them were unmarried. Regarding to their education status, 55(70.5%) were uneducated, while 1(1.3%) had informal education, 16(20.5%) had attended primary school, 4(5.1%) secondary school education and insignificant number of the respondents 2(2.6%) had attended higher education.

3.2. Level and status of *Cryptostegia grandiflora*

All respondents agreed that they were aware of about the horrible invasiveness and the negative impacts of *Cryptostegia grandiflora*. This is also confirmed by personal observation during the study. Of the total respondents, 76.9% agreed that the level of infestation of *Cryptostegia grandiflora* was either high or very high in the study area and 23.1% claimed that the level was medium in their local area(Table 1).

Table 1: Respondents statement about the level of *Cryptostegia grandiflora* in their locality.

	Frequency	Percent	Cumulative Percent
Medium	18	23.1	23.1
High	32	41.0	64.1
Very high	28	35.9	100.0
Total	78	100.0	

All the respondents (100%) agreed that the level of *cryptostegia grandiflora* invasion has been increasing from time to time (Table 2).

Table 2: Respondents' statement on previous and current spread of *cryptostegia grandiflora*.

	Frequency	Percent	Cumulative Percent
Increases	40	51.3	51.3
Highly increases	38	48.7	100.0
Total	78	100.0	

Majority of the respondents (56.4%) reported that *Parthenium hysterophores*, *Xanthium strumarium*, *Cryptostegia grandiflora*, *Prosopis juliflora* *Senna didymobrya*, *Lantana camara*, *Calotropis procera*, *Senna occidentalis* and *Argemone ochroleuca* were the most dominant Invasive Alien Plant species in the study areas, while 24.4% of them reported that *Cryptostegia grandiflora*, *Argemone ochroleuca*, *Parthenium hysterophores*, *Prosopis juliflora*, *Alternanthera nodiflora*, *Xanthium strumarium*, *Opuntia stricta* and *Lantana camara* were the most dominant IAPS. On the other hand 14.1% them replied that *Prosopis juliflora*, *Calotropis procera*, *Lantana camara*, *Parthenium hysterophores*, *Argemone ochroleuca* and *Cryptostegia*

grandiflora were most commonly found in the study areas.

Moreover, insignificant number of the respondents (5.2%) responded that *Cryptostegia grandiflora*, *Parthenium hysterophores*, *Senna didymobrya*, *Senna occidentalis*, *Opuntia stricta* and other unidentified species were commonly found in the study areas. From field observation and the respondents report the most dominant invasive alien plant species in the study area were *Parthenium hysterophores* and *Cryptostegia grandiflora* which occurred in almost all respondents land followed *Prosopis juliflora*, *Argemone ochroleuca*, *Lantana camara*, *Xanthium strumarium* and *Calotropis procera* respectively (Table 3).



Fig. 2: Status of *Cryptostegia grandiflora* in the study areas.

Table 3: Lists of Invasive Plant Species recognized by the respondents (with Frequency and Percent).

No.	Prioritized list of IAPS by the respondents	Frequency	Percent
1.	 <i>Parthenium hysterophores</i> ,  <i>Xanthium strumarium</i> ,  <i>Cryptostegia grandiflora</i> ,  <i>Prosopis juliflora</i> ,  <i>Senna didymobtrya</i> ,  <i>Senna occidentalis</i> and  <i>Argemone ochroleuca</i>  <i>Lantana camara</i>  <i>Calotropis procera</i>	44	56.4
2.	 <i>Cryptostegia grandiflora</i> ,  <i>Parthenium hysterophores</i> ,  <i>Alternanthera nodiflora</i>  <i>Prosopis juliflora</i>  <i>Lantana camara</i>  <i>Argemone ochroleuca</i>  <i>Xanthium strumarium</i>	19	24.4
3.	 <i>Prosopis juliflora</i> ,  <i>Calotropis procera</i> and  <i>Cryptostegia grandiflora</i>  <i>Parthenium hysterophores</i>  <i>Lantana camara</i>  <i>Argemone ochroleuca</i>	11	14.1

4.	 	<i>Cryptostegia grandiflora</i> <i>Parthenium hysterophores</i>	2	2.6
5.	     	<i>Cryptostegia grandiflora</i> , <i>Senna didymobrya</i> , <i>Parthenium hysterophores</i> <i>Senna occidentalis</i> <i>Opuntia stricta</i> unidentified species	2	2.6
	Total		78	100.0

Regarding to the expansion of *Cryptostegia grandiflora* in the study area; 53.8% of the respondents reported that it got out of control and, 46.2% of the respondents suggested that *Cryptostegia grandiflora* did not get out of control.

3.3. Mode of Entry and spread of *Cryptostegia grandiflora*

Regarding the main route of introduction of *Cryptostegia grandiflora* in the study districts, majority (62.8%) of respondents argued that they didn't know how it was introduced. Besides this, 14.1% of the respondents claimed that it was introduced either by flood or wind. Despite these, 12.8% of the respondents in the study districts have informed that it has been occurred instantly and 6.4% of the respondents replied that *Cryptostegia grandiflora* appeared since the time of the construction of Methara sugar factory by Foreigner investors (Holland).

Regarding from where *Cryptostegia grandiflora* was introduced, 76.9% of the respondents replied that they didn't know how it was introduced to the area. However, 15.4% of the respondents replied that *Cryptostegia grandiflora* had been appeared by road dump soil during road construction and some of the respondents (7.7%) reported that *Cryptostegia grandiflora* came from Eretria.

Regarding to the mechanisms of spread, half of the respondents (50%) agreed that *Cryptostegia grandiflora* easily dispersed by flood, animals, wind and vehicles in view of the fact that it has many and light winged seeds. On the other hand, 44.9% of the respondents replied that the mechanism of spread of *Cryptostegia grandiflora* related to the presence of long dormancy period of the seeds, its resistances to drought, high coppicing abilities, many and light winged seeds and lack of awareness to control its spread. The remaining (5.1%) reported that the mechanisms of spread of *Cryptostegia grandiflora* related to only the presence of many and light winged seeds and high coppicing abilities. Klackenberg (2001) reported that each seed of *Cryptostegia grandiflora* has a tuft of long, white, silky hairs, which enable easy dispersal by wind and water.

Almost all of the respondents (96.2%) informed that flooding areas, roadside, forest areas, around fence and Hill side and Awash River basins were the main habitats which were mostly invaded by *Cryptostegia grandiflora*.

Of this, 60.3% informed that *Cryptostegia grandiflora* was mainly found on the flooding areas, roadside, forest areas, around fence and hill side, the remaining (35.9%) informed that it was found in Awash River basins and on communal land. Insignificant number of the respondents (3.8%) did not know the areas that invaded by *Cryptostegia grandiflora*.

3.4. Impact of *Cryptostegia grandiflora*

Almost all of the respondents (96.2%) informed that *Cryptostegia grandiflora* had no use at all. Majority of the respondents (95.6%) reported that *Cryptostegia grandiflora* has been causing different damage to the community such as poison and kill livestock (especially camel and goat), minimize the growth of other plants, expand and compete around agricultural and communal land and poison and kill human. On the other hand most of the respondents believed that in addition to the different damage of *Cryptostegia grandiflora*, the controlling and eradication of this invasive plant species take time.

Cryptostegia grandiflora is an adaptive species that is stress tolerant and highly competitive in arid environments with limited water (Grice 1996, Brown et al., 1998).

Regarding the negative impact of *Cryptostegia grandiflora* on biodiversity, majority of the respondents (91%) reported that it computed all plants and finally destroyed them and poison and kill all livestock. Insignificant numbers of the respondents (9%) replied that *Cryptostegia grandiflora* mostly poison and kill livestock. Rodríguez-Estrella et al., (2010) reported that *Cryptostegia grandiflora* has been described as the biggest threat to biodiversity of the world. It is capable of covering trees up to 40 m high and destroying the upper storey vegetation, an important habitat for native birds and other endemic animals and a number of rare birds. As to the economic impact of *Cryptostegia grandiflora*, majority of the respondents (57.7%) replied that they lost between 15,000_100,000 Ethiopian Birr while 16.7% reported that they lost between 101,000_200,000 Birr. The remaining respondents (25.6%) reported that the lose was between 201, 000_700,000) (Fig.4).

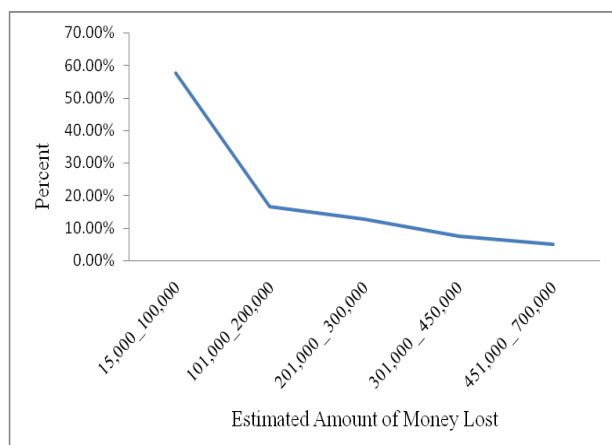


Fig. 3: Respondents Statement about the estimated amount of money lost due to the damage by *Cryptostegia grandiflora*.

Based on the respondents report, the level of the negative impact *Cryptostegia grandiflora* on biodiversity in the past times has been evaluated. Therefore, from the total respondents 67.9% replied that, its negative impact had increased sharply. The rest (32.1%) believed it had increased slightly (Table 4).

Table 4: Respondents' statement about the level of the negative impact of *Cryptostegia grandiflora* on the biodiversity in the past.

		Frequency	Percent	Cumulative Percent
Valid	Increase slightly	25	32.1	32.1
	Increase sharply	53	67.9	100.0
	Total	78	100.0	

The coverage of the negative impact of *Cryptostegia grandiflora* on biodiversity can be localized, scattered, widespread or throughout. Based on the evidence

obtained; majority of the respondents (69.2%) said the coverage is throughout; 21.8% widespread and 1.3% localized (Table 5).

Table 5: Respondents statement about the coverage of the negative impact of *Cryptostegia grandiflora* on biodiversity in the past.

		Frequency	Percent	Cumulative Percent
Valid	Localized	1	1.3	1.3
	Scattered	6	7.7	9.0
	Widespread	17	21.8	30.8
	Throughout	54	69.2	100.0
	Total	78	100.0	

Based on respondents report and personal observation in the study areas, *Cryptostegia grandiflora* will cause intensive impact on biodiversity in the future. Regarding to the future impact, 70.5% of the respondents reported

that the impact will be very high, 20.5% of the respondents replied it will be high and 9.0% of them reported that its impacts will be moderate (Table 6).

Table 6. Respondents statement about the negative impact of *Cryptostegia grandiflora* on biodiversity in the future.

		Frequency	Percent	Cumulative Percent
Valid	Moderate	7	9.0	9.0
	High	16	20.5	29.5
	Very high	55	70.5	100.0
	Total	78	100.0	

Regarding to the organisms that were highly harmed by *Cryptostegia grandiflora*, the majority of respondents (53.8%) responded that Camel, Acacia species and Grass were specifically affected by the *Cryptostegia grandiflora* in the study area. On the other hand, 20.5% of the respondents replied that *Cryptostegia grandiflora*

was harming Camel and all Plants and 17.9% of the respondents indicated that *Cryptostegia grandiflora* was seriously affecting all animals and plants. Insignificant number of them (7.7%) reported that *Cryptostegia grandiflora* was badly affecting Camels and Goats.

Concerning to the benefit of *Cryptostegia grandiflora*, 96.2% of respondents replied that it had no benefit and insignificant number of the respondents (3.8%) suggested that it had benefit. According to respondents report, *Cryptostegia grandiflora* had the following benefits. Some of the respondents replied that *Cryptostegia grandiflora* has been used by the local students to bind up the book (1.3%). This is because of the presence of sticky milky sap. In addition to this, some of the respondents (2.5%) replied that it has been used for fence and construction of house.

3.5. Management Practices

Based on the information obtained from the respondents and field observation, *Cryptostegia grandiflora* covers most of flooding and forest areas, Roadside, around fence, Awash River basin, on communal land and Hill side of the study areas. As to the technique or practice that the local community used to control the spread of *Cryptostegia grandiflora*, majority of the respondents (82.1%) reported that there was no attempt to control but insignificant number of the respondents (7.6%) reported that dig out and cutting at young stage and burn it were appropriate controlling methods. The remaining respondents (10.3%) had no information about the technique or practice that the local community used to control the spread of *Cryptostegia grandiflora*.

Concerning to the effective controlling methods of *Cryptostegia grandiflora*, 98.7% of the respondents informed that there was no effective controlling method due to intense infestations of the areas. As rubber vine spreads quickly, small infestations should be controlled first to prevent them from becoming major problem in the areas. Dense infestations are difficult and costly to treat. Follow-up treatment must be budgeted for within the overall control program. Techniques need to be integrated for successful rubber vine management (McFadyen & Harvey, 1991).

As to the possible best practice that will be applied by the local people to control the spread of *Cryptostegia grandiflora* in the future, 62.9% of the respondents believed that to control the spread of *Cryptostegia grandiflora* in the future, it needs further investigations and awareness creation program by concerned body, 20% of the respondents reported that dig out and burn it was appropriate to control the spread of *Cryptostegia grandiflora* in the future while 33.3% of them reported that eradicating through campaign by concerned body is needed to control the spread of *Cryptostegia grandiflora* in the future. The remaining insignificant number of respondents (3.8%) had no information about the controlling method of *Cryptostegia grandiflora*.

Regarding to the organization that has been working in the control of *Cryptostegia grandiflora*, all of the respondents (100%) informed that there was no organization that has been working in the control of *Cryptostegia grandiflora*. On the other hand, the

organization that will be involved in the control of *Cryptostegia grandiflora*, majority of the respondents (94.9%) believed that in the control of *Cryptostegia grandiflora*, the societies, the government and non-governmental organization should be better to work together. The remaining (5.1%) insignificant number of the respondents believed that the government should be better to design the control and regulation strategies of this species.

4. CONCLUSIONS AND RECOMMENDATIONS

Many IAPS are introduced intentionally or unintentionally for various purposes. *Cryptostegia grandiflora* is one of IAPS that invaded many ecosystems and communities in Ethiopia, in general disturbing ecosystem structure, function and reducing native biodiversity. Currently, it is invading the main field, disturbed land, range land, road side and near Awash river of East Shewa (Fentale and Boset districts), Oromia region, Ethiopia. This assessment study indicates the severity of the invasion in these areas. Therefore, the local Communities, Governmental and Nongovernmental organizations should find a mechanism to control and eliminate this invasive plant and save the forest and grazing lands before becoming uncontrolled.

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