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Contemporary prosopis dilemma: Perception of inhabitants of Sabian Kebele (Goro) towards invasive tree *Prosopis juliflora,* Eastern Ethiopia

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The study was conducted in Sabian Kebele specifically Goro locality of Dire Dawa administration, Eastern Ethiopia. The study was aimed at assessing the perception of inhabitants of Sabian Kebele (Goro) towards the exceedingly invasive *Prosopis juliflora* species. The surveys were conducted between October 2014 and February 2015. The study population was selected based on their settling in *P. juliflora* infested locality of Dire Dawa city administration, Eastern Ethiopia. Consequently, Sabian Kebele (Goro) was considered for the survey. Fifty informants living in the *P. juliflora* infested areas of the Kebele were selected purposively for the interview. Primary data were collected using interview. Thus, semi-structure questionnaire was prepared to access information concerning when and how the area were occupied by the plant, perception of the local people on the invasive plant, positive and negative aspects, evaluation based on use criteria, dispersal and control mechanism of *P. juliflora.* The study showed that, 68% of the respondents agreed that, *P juliflora* occupied the study area 20 years ago. The inhabitants of the Kebele have both negative and positive perception towards the invasive *P. juliflora*. They reported useful aspects of *P. juliflora* as fire wood, wind break, forage and medicinal applications. The overall use value evaluation indicated that, the wide usage of *Prosopis* for different purposes, though many complaints about its negative impacts outweigh the uses. Besides, the finding of the study has also indicated that, ecosystem degradation, loss of native plants and having problematic thorn for human and animals are the harmful aspects of the plant. Flooding, cattle and browsers are the most significant dispersal agents. Generally, the local inhabitants in Kebele suggested possible ways to eradicate the invasive species in addition cutting as the use of biological control, burning the stump and use of chemicals.

Key words: Biodiversity, Goro, invasive tree, *Prosopis juliflora*, thorn.

INTRODUCTION

Prosopis juliflora is an ever green tree native to South America, Central America and the Caribbean which was first introduced to many tropical areas in the 1970s and 1980s as a response to global concerns of deforestation and fuel wood shortages (Zimmerman et al., 2006). This plant has been extensively planted for its supply of fuel and fodder even in drier climates of the tropics (Pasiecznik et al., 2004). However, the spread has gone

out of control in many countries (Matthews and Brand, 2004).

The plant has occupied millions of hectares of land which were under different land use systems in Africa, Asia, South America and Australia (Pasiecznik, 1999; Mwangi and Swallow, 2005). In Africa alone, *Prosopis* is believed to have invaded over 4 million hectares, threatening crop and rangeland production, desiccating water resources and displacing native flora and fauna (Zimmerman et al., 2006; Witt, 2010). Furthermore, it is still highly expanding in the Eastern and Southern Africa, tropical Asia and Australia (Matthews and Brand, 2004). For instance, in Ethiopia, *P. juliflora* has covered an area of several million hectares and more than 12,000 hectares in Dire Dawa city administration (Zeray, 2008). It has now expanded to the south eastern and south western parts of the country reducing the farm land, chocking out local plant species and drastically reducing the grazing land and considered now as the national number one invasive plant (EARO and HDRA, 2005).

The tree was found to have both positive and negative effects on the livelihoods of the invaded community and the environment (Abiyot and Getachew, 2006; Zeray, 2008). As a positive side, the tree products are used for fire wood, charcoal, timber, posts and poles. Negative effects include reduced crop fields and grazing lands, invasion into wetlands. People's perception about the costs and benefits of *P. juliflora* depends on their livelihoods strategy. For example, in India and other countries where *P. juliflora* is native, it is referred as a poor man's tree or a valuable tree from which considerable peoples in the dry land make their living (Pasiecznik et al., 2001).

In Africa and Asia, however, it remains underutilized and is often regarded as an invasive weed and called a devil tree. Studies in these regions of the world show that, the possible benefits of the plant have been dramatically outweighed by the multiple negative impacts associated with its invasion, purpose and its eradication through possible means. This may be related to the fact that the indigenous knowledge surrounding its management and use was not introduced along with the tree and lack of appropriate technologies that reduce its spread by increasing its utilization.

In Ethiopia, the spread of invasive plant species in national parks, around lakes, rivers, dams and urban green spaces is a growing concern and it is causing huge economic and ecological losses (Hailu et al., 2004; Senayit et al., 2004; Kassahun et al., 2005). Nationally, *P. juliflora* has been ranked as the most problematic plant invader in Ethiopia (Taye, 2007). Moreover, the plant has potentially deleterious effects in rangelands of Ethiopia (Hailu, 2003). In line with the aforementioned studies, *P. juliflora* has a huge impact on the pastoralists of Dire Dawa Administration (Zeray, 2008).

Even though, the aforementioned studies and others showed that, the plant had serious effects, its positive and negative impacts in other regions are unknown (Abiyot and Getachew, 2006). Nevertheless, no study was done to assess the perception of local inhabitants in Goro (Sabian Kebele) to add up the impact of the plant on the dwellers in positive or negative aspects. Thus, the study has been initiated to assess the dilemma and perceived value by the inhabitants towards the exceedingly *P. juliflora* infested locality of Dire Dawa administration in Sabian Kebele (Goro), Eastern Ethiopia.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Sabian Kebele (Goro) which is found in Dire Dawa city administration. The study area is located in the Eastern part of Ethiopia between 9°.7 and 9°.49 north latitude and between 41°.38 and 42°.19 east latitude. The climate of Dire Dawa city is characterized by relatively high temperature throughout the year with minor seasonal variation. The mean annual temperature is about 24.8°C and the average maximum temperature is about 31.4°C, whereas the average minimum temperature is about 18.2°C. The rainfall in Dire Dawa is very low and highly variable in both amount and space. The main annual rain fall in Dire Dawa and the surrounding area ranges from about 1000 mm on the south to about 500 to 600 mm in the north low land. Almost all of the administration (about 97%) receives less than 900 mm of rainfall (Figure 1).

Experimental

The surveys were conducted between October 2014 and February 2015. The study population was selected based on in the presence of *P. juliflora* in Dire Dawa city administration, Eastern Ethiopia. Therefore, Sabian Kebele (Goro) was selected for the administration of the survey. Fifty informants living in the Kebele were selected purposively for the interview. Primary data was collected using interview. Thus, a semi-structured questionnaire was prepared to access information concerning when and how the area were occupied by the plant, perception of the local people on the invasive plant, positive and negative aspects, evaluation based on use criteria, dispersal and control mechanism of *P. juliflora.* The enumerators interviewed the respondents. Personal observation was also included in the study to strengthen the quality of the data. Descriptive statistical method such as frequency distribution table was employed to analyze and summarize the data on the reported negative and positive effect of the plants and associated Knowledge.

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Figure 1. Map of the study area.

RESULTS

Perception of the respondents towards *P. juliflora*

Most of the respondents (68%) agreed that, *P. juliflora* occupied the study area 20 years ago. According to the informants, the plant had both negative and positive impact on the inhabitants of the study area (Table 1).

Uses (positive sides) of *P. juliflora* to inhabitants of the locality

According to the informants of the locality, the plant is a problem for having positive and negative impacts on the dwellers. The outcome of the used values showed that, *Prosopis* is largely used for firewood, fencing, windbreaks and forage (Table 2).

Harmful aspects of *P. juliflora* in the locality

The overall evaluation indicated that, the wide usage of *Prosopis* for different purposes; though many people still complaint about its negative impacts outweighing the uses (Table 3). The local inhabitants perceived that, the plant had several harmful effects to the locality in various forms (Table 4). *Prosopis* has become a problematic species expanding at an alarming rate in the study area. In Table 4, most of the respondents (54%) said that, the plant is threatening local plants (Biodiversity) due to invasive nature, 24% degrading ecosystem, 14% problematic thorn that affects both human and animal and 8% kill goats and camels.

Dispersal mechanisms of *P. juliflora* in the locality

According Table 5, most of the respondents (40%) reported that, the plant is dispersed by flooding, 34% by cattle and browsers, and 26% by wind in the locality.

Controlling mechanisms of *P. juliflora* in the locality

As mentioned by most of the respondents in the Table 6, majority of the respondents (56%) said that, the invasive plant controlling mechanisms are biological methods (Introduction of an insect to feed on the prospis pod), (26%) burning, and (18%) Physical controlling method in

Table 1. Perception of the respondents towards *P. juliflora*.

Perception	No. of respondents	%
Useful	21	42
Harmful	5	10
Both (useful and harmful)	24	48
Total	50	100

Table 2. The positive uses of *P juliflora* in the study area.

Uses	No. of respondents	%
Firewood	11	22
Fencing wind break	7	14
Forage	4	8
Medicine	3	6
All	25	50
Total	50	100

Table 3. Evaluation of *Prosopis* on use criteria.

Criteria	R10	R2	R3	R4	R5	Total
Firewood	4	4	4	4	4	20
Wind break	2	2	1	3	2	10
Charcoal	2	2	3	1	1	9
Forage	3	1	1	1	1	7
Fencing	1	1	1	1	1	5
Medicine	1	1	1	0	1	4

4=Best; 3=Very good; 2=Good; 1=Fair; 0=Least. Note that the mean use value is the mean value given by ten key informants.

the study area.

DISCUSSION

Nearly, 68% of the respondents in the study area Kebele, knew *P. juliflora* invasion 20 years ago, whereas 20% were only aware of it in the last five to ten years. Twelve percent of the informants alleged that, *Prosopis* appeared 15 years ago. However, the inhabitants of the Kebele have both negative and positive attitudes towards the plant. Around 10% of the respondents felt that the *P. juliflora* was an undesirable species, while 42% considered it as beneficial and the rest 48% stated it as both beneficial and harmful. In line with this, a study reported by Abiyot and Getachew (2006) and Zeray, (2008) indicated that, informants in Afar region and pastoralists in Dire Dawa administration have similar perceptions, respectively.

As shown in Table 2, the respondents reported that, the plant had multiple uses in the study area. These include firewood (22%), wind break (14%), forage (8%), medicine (6%), and (50%) mentioned they used the plant in all the four uses. Similar study conducted in Afar regional state indicated that, the plant is giving multiple purposes (Mwangi and Brent, 2005). As to the positive effects, *P. juliflora* is a multipurpose tree/shrub whose wood is used for firewood, charcoal, posts, poles, and a sawn timber; its pods can be used as a livestock feed and for making human food; and environmental services provided by nitrogen fixation, shade, shelter, live and dead fencing, erosion control, soil improvement and reclamation are remarkable (Pasiecznik et al., 2001).

According to the informants, *P. juliflora* has several harmful effects to the inhabitants of the study area (Table 4). Around 54% of the respondents replied that, the plant is threatening local plants (biodiversity) whereas 24% of the informants perceived the plant to degrading the ecosystem. The rest of the respondents (14%), mentioned the plant has problematic thorns that cause problems to

Table 4. Harmful effects of *P juliflora* in the locality.

Harmful aspects	No. of respondents	%
Threatening local plants (Biodiversity)	27	54
Degrade ecosystem	12	24
Problematic thorn (towards human and animal)	7	14
Kill Goats and Camels	4	8

Table 5. Dispersal mechanisms of *P juliflora* in the locality.

Dispersal mechanism	No. of respondents	%
Flooding	20	40
Cattle and browsers	17	34
Wind	13	26

Table 6. Possible controlling mechanisms of *P. juliflora* in the locality.

Controlling mechanism	No. of respondents	%
Biological control methods	28	56
Burning	13	26
Physical methods	9	18

both humans and animals and others 8% agreed that, excess accumulation of the pods (seeds) after feed causes death to goats and camels. *Prosopis* is one the major threat to Ethiopian grassland ecosystems and it is diminishing the biodiversity (Taye, 2007). Furthermore, the study reported by Shitae (2007), the plant has also similar harmful impacts on pastoralists of Afar region. It is fast growing, drought resistant, and with a remarkable coppicing capabilities.

Such unique adaptive traits of the species have contributed to the negative impacts for local biodiversity and ecosystems (Shiferaw et al., 2004; Abiyot and Getachew, 2006).

Around 40% of the local inhabitant responded that, *P. juliflora* disperses by flooding, 34% by cattle and browsers, while 26% by wind action in the study area (Table 5). In line with our study pastoralists in Afar region agreed that, cattle and browsers are major dispersal agents of *Prosopis* (Zeray, 2008). Moreover, invasion of *P. julliflora* in Afar region of Ethiopia is aggravated by the aid of different dispersal agents, such as cattle, camels and goats (Abiyot and Getachew, 2006).

Most of the respondents (56%) agreed that, biological control (Introducing an insect to feed on the prospis pods) is a possible controlling mechanisms for *P. juliflora.* On the other hand, 28% of the informants perceived that, burning is the best mechanism to eradicate *P. juliflora*. Whereas 8% of the informants reported that, mechanical cutting should be used to minimize *Prosopis* (Table 6). In consistent with our study, pastoralists in Afar regional state uses the aforementioned controlling mechanisms to their rangelands (Abiyot and Getachew, 2006). Similar studies has also reported burning (Archer et al., 1995; Van, 2000) and having population of large browsers in invaded areas (Archer, 1995) can be used to reduce bush encroachment.

Conclusion

The present study showed that, *P. juliflora* is a problem to the inhabitants study area. As the study indicated that the, dwellers of the study area Kebele perceived that, the plant has useful and harmful effects. As the informants mentioned firewood, wind break, forage and medicinal applications are some of the useful aspects of *Prosopis*. Besides, the study indicated that, ecosystem degradation, loss in native plants and having thorns that causes problems for human and animals are the harmful aspects of this plant. As per the study, flooding, cattle and browsers are the most significant dispersal agents. The dwellers in the Kebele suggested that, biological, burning and using chemical methods in addition to cutting the trees are possible ways to eradicate this invasive species.

Proper management and control of *Prosopis* is urgent

using the control methods suggested earlier in co-operation with experts and the local people. Otherwise, threats of the local biodiversity would be aggravated. The impact of this would be far-reaching that ranges from deterioration of local ecosystems to total habitat alteration.

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Conflict of Interests

The authors have not declared any conflict of interests.

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