International Journal of Food Science and Biotechnology
2026, Vol. 11, No. 4, pp. 140–150
https://doi.org/10.11648/j.ijfsb.20261104.12

Research Article

Assessment of *Prosopisjuliflora* Effect on Environment and Animal Health in KebriDehar, Somali Regional State, Ethiopia

Isaak Sheik Mohamed[1, *], Kebede Tilahun[2], Noor Ahmed Hassan[3], Abnet Shewafera Mekonnen[1]

[1]College of Veterinary Medicine, Kebridahar University, Kebridahar, Ethiopia

[2]Department of Animal Production and Technology, Kebridahar University, Kabridahar, Ethiopia

[3]Department of Plant Science, Kebridahar University, Kebridahar, Ethiopia

Abstract

Prosopisjuliflora is one of the most invasive plant species in the arid areas of the Somali region and has encroached upon Kebridahar District. The invasion of *Prosopisjuliflora* has increased recently in the last two decades at an alarming rate, destroying forage, pasture, and biodiversity, thereby threatening the environment, which ultimately affects both the lives of animals and the pastoral community. *Prosopisjuliflora* has gone out of control, deteriorating and reducing the diversity of forage and pasture species in the region, causing animals to starve. This study focuses on assessing pastoralists' perceptions of the effect of this plant on the environment and animal health. It specifically examines the awareness of the people towards this invasive species in the area and identifies its major effects. Semi-structured questionnaires and group discussions were conducted with pastoralists in the area. Four kebeles, namely Mara'ato, Farjano, Melka-Afweyn, and Tukaley, were selected possessively. A total of 118 households were selected randomly for interview purposes. The data were analyzed using SPSS Version 20.0, and the results were presented using both inferential and descriptive statistics. Impact on environmental encroachment, water shortage, poisoning, and the death of both animals and humans are among some elder-narrated findings. Floods, winds, and animal dung are significant spreading methods as shown in the results. Donkeys and cattle were significantly more affected than other species when animal species susceptibility to *Prosopisjuliflora* was measured.

Keywords

Prosopis, KebriDehar, Effect, Environment, Animal

[*]Correspondence: Isaak Sheik Mohamed (yacquub2017@gmail.com)

Received: 9 October 2026; **Accepted:** 21 October 2026; **Published:** 11 November 2026

Copyright: © The Author(s), 2026. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

1. Introduction

1.1. Background

Prosopisjuliflora is an evergreen, rapidly growing mimosa shrub and one of the world's worst invasive plant species, native to South America, the Caribbean, and Mexico. The plant at maturity reaches a height of 11.9 meters with a trunk diameter of 1.3 meters and forms impenetrable thickets with spines [1]. It was introduced to many places in the world (Africa, Asia, and Australia) during the last 100-150 years [2]. However, *Prosopis* becomes a serious invasive weed when introduced into non-native areas without proper management, even though it has natural beauty and greenness [3]. Currently, *Prosopis* has become the worst weed and woody species in both agro-pastoral and pastoral communities in East Africa [4].

Previous evidence indicates that *Prosopis* was introduced to Ethiopia in the early 1980s intentionally to tackle the challenge of desertification in overgrazed lowland areas of Eastern Ethiopia by some multi-national development agencies [5]. In terms of land occupation, there are moderately damaged parts in some drylands of Central Ethiopia, and the most harmfully destructed region by this plant species includes the Somali Regional State, the area around Dire Dawa city, and Afar [6].

The fast spread of *P. juliflora* is regarded as a great danger because of its invasive nature, especially for livestock keepers since their livelihood depends on the normal environment. It can conquer grass, cultivated lands, and irrigation canals; finally, the result becomes an irreparable dislocation of natural pasture, crops, and land original vegetation [7]. Its harmful consequences include hindering both the biological and physical environment and the interaction between them, and replacing important native plant species; encroachment onto homes, villages, paths/roads, water points, farm- and rangelands; also wounds caused by piercing of thorns affect both animal and human health, certainly causing some human and animal deaths [4]. Fodder production and grassland severe decline may take place because of the coverage of *Prosopis*. Soil degradation and decreased livestock productivity have been the outcome, leading to less quantity and quality rangeland remaining for pastoralists [8]. Most importantly, the dangerous thing is its adverse acts on the biotic environment, such as creating impenetrable shrubby thickets, lowering the water table, invading water courses, and thus limiting nutrients and moisture of other plant species, forming what is called 'desert land,' entirely lacking life, which might result in either animals starving or becoming diseased [9].

In lowland regions of Ethiopia, *Prosopisjuliflora* is an exotic species that is widely distributed. Since recent years, the invasive nature of *Prosopisjuliflora* has been expressed obviously in the pastoral areas, threatening the lives of the pastoral community and spreading at an increasing rate in the region [10]. The invasiveness habit of the species appears to have been further aggravated by overgrazing/browsing of rangelands and deforestation of native tree species [11]. In terms of land occupation, the most affected areas nationally include the Somali region and around Dire Dawa city in the southeast of the country [6].

The invasion of *P. juliflora* has affected the livelihood of the pastoral and agro-pastoral community in many ways, such as declining pasture availability; shortage of grazing land; invasion of residential areas; poisonous thorns for people and livestock; and causing health hazards on livestock due to pod consumption. These effects were found to be intermingled with one another and became complex, magnifying the negatives of *P. juliflora* invasion against pastoral livelihoods [12]. Thorn damage causes eye and hoof inflammation in camels and cattle, and the injury does not heal unless intensive medical treatment is provided; then, by poisoning, it eventually leads to death. In general, this is a matter of serious problem for the lives of pastoralists as their livelihood depends on livestock, and they suffer from the death of livestock [13].

Several studies have shown that the losses of biodiversity due to the invasion of *Prosopis* are immense all around the globe [14]. Despite its harmful effect on the environment and animal health, the invasiveness and expansion control of *Prosopisjuliflora* were poorly revealed and understood in the Somali region. Since nothing has been done to assess and evaluate the effects of this species on the pastoral community in the region, this study aims at generating information regarding its impact on the environment, animal health, and controlling methods of its expansion in KebriDehar District.

1.2. Objectives of the Study

1.2.1. General Objective

To assess the pastoralist perception of *Prosopisjuliflora* effect on the environment and animal health.

1.2.2. Specific Objectives

To know the knowledge of the people towards this invasive species in the area.

To identify the major adverse effects of *Prosopisjuliflora* on animal health.

1.2.3. Significance of the Study

This study will serve as a reference for other researchers who have an interest in conducting research related to the effect of *Prosopisjuliflora* on the environment and animal health. It may enable the zone agriculture/livestock health center to know more about and get enough information concerning environmental and animal problems caused by *Prosopisjuliflora* and to make their effective plans to increase and deal more with the control strategy of this invasive plant species.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in KebriDehar District, which is the headquarters of Korahey Zone and is situated at about 405 km and 1015 km from the capital city of the Somali region, Jigjiga, and that of Ethiopia, Addis Ababa, respectively. The town has a latitude and longitude of 6°44′ N 44°16′ E or 6.733° N 44.267 °E. The altitude is 493 m a.s.l., with a few foothills of higher altitude. The mean annual rainfall is about 300 mm. Pastoral and agro-pastoral systems of production exist in the area. There are 10 kebeles in KebriDehar District. Among those kebeles in the district, four (4) kebelesMera'ato, Farjano, Bunddada (Melka-Afweyn), and Tukaleywere selected purposively based on the invasion and distribution of *Prosopisjuliflora*.

2.2. Sampling System and Sample Size Determination

Study sites in KebriDehar District were chosen based on the abundance and invasion of *Prosopisjuliflora* in the area. Before the actual data collection, a rapid reconnaissance field survey was made in order to maintain an impression of the distribution of *Prosopisjuliflora*. Discussion was held with district land management staff. This helped to identify the distribution and very concentrated areas of the invasive species. A semi-structured questionnaire was designed to capture information on the threat that the invasive species *Prosopisjuliflora* poses to the environment and animal health. Based on the information obtained from the field survey and group discussion with local pastoralist elders, a total of 4 kebeles were selected purposively. Out of the selected four kebeles, a total of 118 households were selected randomly for interview. For group discussion, key informants were selected based on the information and recommendation obtained from the elders. The discussion was held with 5 informants in each kebele.

Yamane (1967: 886) gives a simplified formula to calculate sample sizes. This formula helped to calculate the sample size. A 95% confidence level and P = 0.5, e = 0.09 precision. Where N = the total population of the study area.

$$n = N / (1 + N(e)^2)$$

The total sampled 118 from total population for this study (Table 1).

Table 1. *Number of total sample.*

Kebeles	Popu-lations	Sample size based on the proportion of population in the kebeles
Mara'ato	800	33
Farjano	660	28
Mel-ka-Afweyn	950	40
Tukaley	400	17
Total	2,810	118

2.3. Method of Data Analysis

Data collected through the questionnaire were entered into the Statistical Package for Social Sciences (SPSS version 20.0 for Windows 2013). Inferential statistical analysis was adopted to assess the major findings of the study. Quantitative data were analyzed using inferential statistics such as percentages and correlation through p-value (SPSS version 20.0). Qualitative data were presented in the form of narration or actual words, and sometimes they were put into boxes.

3. Results and Discussions

3.1. General Characteristics of Respondents in the Study Area

The general characteristics of respondents in the area of study are presented in Table 2. This survey revealed that the majority of the respondents (88.1%) were males, and the remaining were females. This is due to the fact that females are busy with extra work, and the chance to meet them is rare. The educational backgrounds of respondents were varied, and the majority of them (50.8%) were able to read and write but did not attend formal school. They had learned from religious institutions and other informal sources. The others (39.8%) were illiterate and

unable to read and write. They did not attend formal school as well as informal education. Only small proportions (5.1%) and (2.5%) attended elementary and high school, respectively. The remaining small proportions (0.9%) attended preparatory and (0.9%) above preparatory. High illiteracy and uneducated populations might be due to the area being pastoral and agro-pastoral; there were no schools and educational centers able to provide schooling for the populations. In the past, educational centers were very far apart from the rural community and concentrated in towns and cities; in addition to this, most of the respondents were elderly people. The age groups of the respondents also varied. The majority of respondents (28.8%) were found in the age group of 41-50, and (28%) were found in the age group of >60 years. The majority of the sampled populations (72.9%) were pastoral, and the remaining proportions (27.1%) were agro-pastoral; they cultivate crops and rear livestock. Currently, the number of agro-pastoralists is reduced due to the fact that cropland around their home is invaded and covered by *Prosopisjuliflora*. In this area, about half of the respondents (49.2%) were unemployed. Among those employed, only (12.7%) were employed in government institutions such as kebele administration and extension workers. Thus, (37.3%) were employed privately; they participate in different activities such as farming, camel and goat rearing.

Table 2. *General characteristics of respondents in the study area.*

Characters	N	Percentage (%)
Sex		
Male	104	88.1
Female	14	11.9
Educational status		
Illiterate	47	39.8
Read and write	60	50.8
Elementary school	6	5.1
High school	3	2.5
Preparatory	1	0.9
Above	1	0.9
Age		
20-30	4	3.4
31-40	16	13.6
41-50	34	28.8
51-60	31	26.2
>60	33	28
Occupation		
Pastoral	86	72.9
Agro pastoral	32	27.1
Employment		
Employed	60	50.8
Unemployed	58	49.2
Form of employment		
Private	44	37.3
Government	15	12.7

N = number of respondents.

3.2. Effects of Prosopisjuliflora on Environment

The impacts of the species on the environment are discussed in Table 3. There was no significant association between kebeles and impacts of *Prosopisjuliflora* on the environment ($p > 0.05$). However, there was a significant difference ($p < 0.05$) between kebeles and the next loss that *Prosopisjuliflora* might cause on animals and humans after the loss of the environment; this might be due to the fact that pastoralists have good knowledge about the bad effect of the invasive species on the environment and expect worse outcomes for humans. It has a negative impact on the environment. Most of the respondents in the study (29, 40, 25, and 15) in Melka-Afweyn, Marato, Farjano, and Tukale, respectively, responded that *Prosopisjuliflora* has a harmful consequence on the environment. Since this invasive plant invades the environment, it can eradicate other plant species from the land, and this is similar to the study of Pimentel et al. [15], which reported that the invasion by alien species resulted in unexpected damage to the habitats it invaded, which include the effect on nutrient composition of soil, indigenous species diversity, changing forest fire cycles, and loss of ecosystem productivity after invading. It also endangered or threatened the existence of world plant species. Farmland coverage is also one of the dangerous events that faced the community and affected the farmland. *Prosopis* has the ability to absorb groundwater and compete with other plant species, resulting in loss of groundwater. Groundwater is the main source of water for the community in this place for different purposes, such as fetching for livestock and growing different plants around their backyards. Since *P. juliflora* invaded the area, it can absorb and reduce groundwater, and cropping is hardly possible. Most crop and grazing land areas are also covered with this alien species, and it is difficult for ploughing, digging, and planting as well as for rearing livestock. Due to this, the communities suffered from a shortage of crop and grazing land areas.

Different grasslands disappeared due to the coverage of *Prosopisjuliflora* plants. *Prosopis* can cover all grassland, bush, and herbaceous plants. It can cover open grassland, roadside, enclosure area, and residential area, as the majority of respondents in the area (19, 32, 18, and 11) in Melka-Afweyn, Marato, Farjano, and Tukale, respectively, reported that

Prosopis can cover all types of land.

Table 3. *Impacts of Prosopisjuliflora on environment.*

Impacts	Kebeles				P value
	Melkafweyn	Marato	Farjano	Tukaley	
Is there any impact on environment	N	N	N	N	
Yes	29	40	25	15	0.169
No	4	0	3	2	
List of impacts					
Eradication of other plant	15	24	21	10	0.139
Loss of ground water	18	16	7	7	
Do grass disappeared					
Yes	33	40	28	17	-
No	0	0	0	0	
Prosopis is more common					
Open grass land	6	2	5	2	0.689
Road side	3	2	3	2	
Enclosure land	4	2	2	2	
Resident area	1	2	0	0	
All type of land	19	32	18	11	
After loss of environment next loss will be					
Human	8	13	15	2	0.034
Animal	3	2	4	3	
Both	22	25	9	12	

3.3. Spreading Methods of Prosopisjuliflora

Prosopisjuliflora has the potential to spread from one area to another was indicated in Table 4. There was a significant difference ($p < 0.05$) between kebeles and spreading methods; this is because the species has a fast and potential spreading act. KebriDehar District is highly invaded by this alien species. It can spread into different areas of the district as well as into different other areas by different ways such as wind, flooding, and by animal dung after the animals eat its pod. In this area, most of the respondents (26, 26, 25, and 2) in Melka-Afweyn, Merato, Farjano, and Tukale, respectively, replied that among different methods of spreading, it is highly transmitted by animal dung after eating its pod (seed). A similar result was reported by Geesing et al. [16], which indicated that the presence of animals is usually important for long-distance dispersion of *P. juliflora* and for germination. Since the animals available in the *Prosopis*-invaded area can travel into non-*Prosopis*-invaded areas to search for feed and water, as well as by means of selling. In the area, pastoralists move from the dry area to the area in which animal feeds are available. Due to this, the animals that ate *Prosopis* can transmit it into new areas.

As there were different spreading methods, there were different controlling methods to minimize its spreading, and there was a significant difference ($p < 0.05$) between kebeles and controlling methods. Most of the respondents in the study area replied that it is possible to reduce its spreading and spatial coverage. Cutting is one of the recognized controlling methods and is possible for the community in the district. Most of the respondents (23, 23, 22, and 15) in Melka-Afweyn, Merato, Farjano, and Tukale replied that cutting is the only controlling method that pastoralists can do. Burning and hand pulling are used by some of the community to control and minimize the spreading of *Prosopisjuliflora*. Hand pulling is not

as equitable a method since it needs enough force, and the thorns of *Prosopis* are highly poisonous, and also the root is penetrated deep into the ground. It is difficult to pull out large amounts and big plants. The problem facing the community while trying to control the spread of *Prosopisjuliflora* by "cutting" is that the plant has the ability to regrow more branches after cutting, as reported by Shiferaw [3], until trees are cut below ground level.

Table 4. *Spreading methods of Prosopisjuliflora.*

Character	Kebels				Test
	Melka-afweyn	Marato	Farjano	Tukaley	P value
	N	N	N	N	
Spreading methods					
Floods	7	3	0	12	0.000
Wind	0	11	0	3	
Animal dung	26	26	25	2	
All methods	0	0	3	0	
Is there any controlling mechanism					
Yes	27	24	22	13	0.154
No	6	16	6	4	
Controlling mechanisms					
Cutting	23	23	22	15	0.009
Burning	5	16	4	0	
Hand pulling	5	1	2	2	
Is there any help from government					
Yes	10	7	5	1	0.202
No	23	33	23	16	

3.4. *Prosopisjuliflora Effect on Animals*

Prosopisjuliflora, locally known as "Garanwaa," is well known and understood by the community of the area. Effects of *Prosopisjuliflora* are presented in Table 5. All of the sampled respondents reported that they had knowledge of this invasive species and its effect on animals, the environment, and other plant species. From the respondents' perception, it is observed that *Prosopisjuliflora* is a non-native plant that has the ability to eradicate all other native species. There was a significant difference ($p < 0.05$) among kebeles and the animals that feed on this invasive plant; this might be due to the fact that pastoralists have close contact with their animals and the feeding system. All respondents in Farjano and Tukale reported that their livestock were reared in an area where *Prosopis* plants occupied and used as a feed source. Whereas some respondents in Melka-Afweyn and Mara'ato reported that their animals were not reared on this plant due to the fact that they suffered from the death of animals after eating this invasive plant. Different problems were encountered in the area due to *Prosopisjuliflora* after being eaten by livestock species. In Farjano and Tukalekebeles, it was observed that there was a high effect caused by this plant, since all respondents stated that there were different problems encountered in the case of livestock production. This is the same as the report of Admasu [17], which indicated that the invasion of *Prosopis* has brought a tangible decrease in livestock production and productivity due to the loss of dry season grazing areas. Pleasant native pasture species have all been reduced. *Prosopisjuliflora* also resulted in different diseases that kill all animal species in sudden cases. When animals consume its leaf or pod, different clinical signs might appear that are simply observed by local pastoralists. Bloating was the main clinical sign indicated that the animal was in a difficult situation, and it leads to sudden death. This finding agrees with the study of Ayanu et al. [18], which reported that there are negative relationships

between the invasion rate of *Prosopis* and livestock production. Here, most of the respondents in the kebeles (24, 31, 18, and 11) in Melka-Afweyn, Marato, Farjano, and Tukale, respectively, reported that bloating and sudden death are the main signs observed in animals that ate this invasive species. Whereas foamy salivation and binding neck were also reported as the signs of *Prosopisjuliflora*-affected animals. This finding is similar to that of Tabosa et al. [19].

Table 5. *Prosopisjuliflora effect on animals.*

	Kebels	Test			
Character	**Melkaafweyn**	**Mar'ato**	**Farjano**	**Tukale**	**P value**
Do you have knowledge about Prosopis	N	N	N	N	
Yes	33	40	28	17	_
No	0	0	0	0	
Do your animal eat Prosopis					
Yes	26	37	28	17	0.011
No	7	3	0	0	
Any disease caused					
Yes	28	37	28	17	0.073
No	5	3	0	0	
Clinical sign					
Bloat, sudden death	24	31	18	11	0.612

3.5. Animal Species Susceptibility to *Prosopisjuliflora*

The effects of *Prosopisjuliflora* on animal species are presented in Table 6. It had different impacts on animal species. It affects production and productivity in many ways. This result is in line with the report of Niguse and Amare [20], which reported that *Prosopis* can affect production due to encroachments on grassland and lead to scarcity of feed. *Prosopis* can kill any animal species at any stage of growth and leads to economic problems for livestock keepers in pastoral areas. It decreased the number of livestock due to death caused by starvation and disease. Senayit et al. [21] reported that the invasion of this invasive plant brought limited grazing lands for livestock, which consequently resulted in a severe reduction in livestock number and also products. There was a significant difference between kebeles and animal species affected ($P < 0.05$). However, there were variations in susceptibility between livestock species. Some species were highly affected, and the others were sustained and coped up to some extent. As per respondent perception across the study area, donkeys and cattle were highly affected than other species. Most of the respondents (27, 33, 17, and 10) in Melka-Afweyn, Mara'ato, Farjano, and Tukale, respectively, reported that donkeys were the most affected animals. Next to donkeys, cattle, sheep, and goats were affected by *Prosopis* pods and leaves. Camels were the least affected animals compared to others. This result agrees with that of Silva et al. [22], which says that feeding on *P. juliflora* pods leads to neurological problems and their secondary effects in cattle. From group discussion, respondents reacted that there were negative impacts on market values after animals were diseased by *Prosopis*.

Table 6. *Animal species susceptibility to Prosopis.*

Character	**Kebeles**	**Test**			
Susceptible species	**Melka - afwayn**	**Mara'ato**	**Far-jano**	**Tukale**	**P-value**
	N	N	N	N	0.04
Donkey	17	21	14	9	
Cattle	12	19	10	4	
Sheep	3	0	1	3	
Goat	1	0	3	0	
Camel	0	0	0	1	

3.6. Milk and Weight Reduction Caused by *Prosopisjuliflora*

Animals were affected in different ways by the alien species *Prosopisjuliflora*. Milk reduction in dairy cattle, goats, and camels and weight reduction in all animals were apparently observed. Also, the other mostly observed by pastoralists was physical injury in different animal species (Table 7).

There was no significant association observed between milk reduction, weight reduction, and physical injury with respect to kebeles ($P > 0.05$). This might be due to the fact that pastoralists do not use any parameter to note the exact milk or weight reduction. Most of the respondents in all study areas reported that there were high milk reductions after the animals consumed this invasive species. Milk production is the main food source for pastoralists in the study areas. However, due to the effect of *Prosopis*, pastoralists reported that they suffered from milk shortage and quality, and this agrees with the results of Rogers et al. [23].

After animals eat *Prosopisjuliflora*, they become bloated, and there could be difficulty in eructation, and it leads to weight loss, and animals become tiny/poor in body condition. This will decline the livelihood and economy of pastoralists in many ways.

While livestock grazed in the areas covered by *Prosopis*, many physical injuries occurred on the external body parts. Physical injuries on the hooves of animals were mostly observed and protected the animals from long tracking. Injury around the eye area was the most serious harassment that the animals encounter and is difficult to treat. The thorns of *Prosopisjuliflora* were highly poisonous, and their effect is difficult to heal without veterinary service.

Table 7. *Production loss.*

Characters	Districts				Test
	Melka-afweyn	Marato	Farjano	Tukaley	P value
	N	N	N	N	
Is there milk reduction					
Yes	31	39	24	15	0.286
No	2	1	4	2	
Weight reduction					
Yes	31	40	17		0.155
No	2	0	0		
Physical injury					
Yes	33	40	28	17	-

3.7. Direct P. Juliflora Impacts on Humans

Prosopisjuliflora can affect the community and the country directly and indirectly, and there was a significant difference ($p < 0.05$) between kebeles and *Prosopis* direct impact on humans; this is because the life of humans is dependent on both the environment and animals, and what affects them will consequently affect human life (Table 8). Its thorns are poisonous and can affect the community during transport, wood collection, animal rearing, and farming, during its controlling activities. Thorn injury on the body parts of humans is a problem that the community suffered. From its poisonous injury, the affected people are difficult to heal and may die because of this injury. The death of humans and livestock can directly reduce the income of the community. Dubow [24] reported similar findings, which indicated that invasive plant species can cause gangrene, which lastly may result in limb amputation. *Prosopisjuliflora* blocked and covered different areas; due to this, it can affect the movement of humans and helped increase the mosquito population, then lead to malaria, and this totally agrees with the report of Muller et al. [25]. *Prosopisjuliflora* can absorb water and resulted in a scarcity of water. As the local people declared, the invasion of *Prosopis* has caused uncountable negative effects on their livelihoods, food security, and the region's natural environment, and this result agrees with the report of Dubale [25].

Table 8. Direct impact on humans.

Direct impact on human	Kebels				P value
	Melka-afweyn	Marato	Farjano	Tukaley	
	N	N	N	N	
Thorny injury	17	8	23	4	
Blockage of area	16	12	3	3	0.000
Economical problem	0	10	2	2	
Water scarcity	0	10	0	8	

4. Conclusions and Recommendations

4.1. Conclusion

Prosopisjuliflora is an aggressive weed with strong negative consequences. It has the potential of encroaching upon an immense space of Somali dry lands, undermining livelihood opportunities of the local people, mainly pastoralist communities, and adversely affecting local biodiversity. Pastoralism is a system that has been defined to effectively co-exist with local environments and to help the maintenance of areas abundant in range land and biodiversity.

The perceptions of Somali pastoralists in connection with the *Prosopisjuliflora* effect on the environment, animals, and its invasion provide a depth and breadth of hazards on many aspects of their existence. The biodiversity and the relationship between inflicts indicate the severity of a danger that affects every component of the pastoral production system, from the breeding stage and success of livestock to their capability of gaining feed and water, to the possibility with which livestock can be taken to market. Most importantly, livestock plays a great role in the pastoral economy, but unfortunately today it is increasingly broken by the existence of *Prosopisjuliflora* by coverage of the range lands. The invasion of *P. juliflora* species in the Somali Region is progressing at an alarming rate due to a lack of proper intervention, prevention, and management methods. The invasive species come up with huge losses of grass and browse biodiversity in the area and displacing pastoralists from their residence. It also causes loss of animal life while causing diseases and depriving feed. Furthermore, it threatens human life in different ways, such as loss of life after entering *Prosopisjuliflora*-covered areas, lameness from thorn injury, and economic problems after conquest of farm and range lands and loss of animal life on which the lives of pastoralists depend. It is advisable to set priority to the areas where pasture genetic and forage resources are under extinction, like KebriDehar District, due to invasive species that are prevailing all over the region. Since the effect of this exotic species, a great number of cattle, goats, sheep, and camels have been lost because of feed shortage and the poisoning of the plant that causes diseases. Therefore, possible attention must be given to this hazardous plant species to alleviate and mitigate the disastrous phenomenon of invasion and rehabilitate conservation of threatened species of forage and pasture biodiversity in order to save the lives of both animals and humans.

4.2. Recommendations

Areas invaded by invasive species and areas at risk from further invasion need to be identified and mapped. Alternative uses of the invaded lands and restoration plans need to be developed based on the importance and potential of those lands in specific locations. Local people in the invaded areas should be well advised and supported to carry out sustainable management of the lands to prevent invasion. In areas where the species has attained its invasive phase, it is now impossible for the local people alone to bring its expansion under control, and hence the need for outside help is absolutely required. Having declared *Prosopis* as a noxious weed, the government should now develop a comprehensive *Prosopis* control and/or eradication program.

Alternative control intervention methods such as biological methods or combinations of biological and mechanical methods, as well as different utilization options, should be researched and demonstrated to government partners and local people to prevent further invasion of new areas and to restore invaded areas in ways that benefit local communities. Technical and management capacities of communities as well as government institutions need to be enhanced to carry out research and facilitate management of invasive species. An enabling policy environment, including an appropriate legal framework, needs to be in place for the eradication, control, and management of invasive species at state and federal levels. It is also important to develop economic and environmental impact models to help predict future scenarios.

Abbreviations

P. juliflora	Prosopis Juliflora
SPSS	Statistical Package for Social Sciences
a.s.l.	Above Sea Level
N	Number (Total Population/Respondents)
n	Sample Size
e	Precision
P	Proportion

Author Contributions

Isaak Sheik Mohamed: Data curation, Formal Analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

Kebede Tilahun: Investigation, Methodology, Software, Validation, Visualization, Writing – original draft

Noor Ahmed Hassan: Formal Analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing

Abnet Shewafera Mekonnen: Formal Analysis, Writing – original draft, Writing – review & editing

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Berhanu, A., Tesfaye, G. The Prosopisjuliflora Dilemma, impacts on dryland biodiversity and some controlling methods. Journal of Drylands. 2006, 1(2), 158-164.

[2] Pasiecznik, N. M., Felker, P., Harris, P. J. C., Harsh, L. N., Cruz, G., Tewari, J. C., Cadoret, K., Maldonado, L. J. The Prosopisjuliflora - Prosopis pallida Complex: A Monograph. Coventry, United Kingdom: HDRA; 2001, 162 pp. (ISBN: 0-905343-30-1).

[3] Shiferaw, H., Teketay, D., Nemomissa, S., Assefa, F. Some biological characteristics that foster the invasion of Prosopisjuliflora (Sw.) DC. at Middle Awash Rift Valley Area, northeastern Ethiopia. Journal of Arid Environments. 2004, 58(2), 135-154. https://doi.org/10.1016/j.jaridenv.2003.08.011

[4] Mwangi, E., Swallow, B. Prosopisjuliflora Invasion and Rural Livelihoods in the Lake Baringo Area of Kenya. Conservation and Society. 2008, 6(2), 130-140. https://doi.org/10.4103/0972-4923.49207

[5] Rettberg, S., Müller-Mahn, D. Human-Environment Interactions: The invasion of Prosopisjuliflora in the Drylands of Northeast Ethiopia. In: Mol, L., Sternberg, T., editors. Changing Deserts Integrating People and their Environments. Cambridge: Whitehorse Press; 2012, pp. 297-316.

[6] Steele, P., Breithaupt, J., Labrada, R., editors. Increased Food Security: Control and Management of Prosopis. Proceedings of an Expert Consultation, 4, Awash, Ethiopia, 15-19 October 2007. Rome: FAO; 2009, 132 pp. (ISBN: 978-92-5-106229-6).

[7] Kassahun, Z., Yohannes, L., Olani, N. Prosopisjuliflora: Potentials and Problems. Arem. 2005, 6, 1-9.

[8] Wakie, T., Evangelista, P., Laituri, M. Utilization Assessment of Prosopisjuliflora in Afar Region, Ethiopia. US Forest Service / USAID Pastoral Livelihoods Initiative II Project; 2012.

[9] Patnaik, P., Abbasi, T., Abbasi, S. A. Prosopis (Prosopisjuliflora): Blessing and Bane. Tropical Ecology. 2017, 58(3), 455-483. (SSN 0564-3295).

[10] Delessa, A. The Impact of Invasive Alien Species on Forage and Pasture Genetic Resource Diversity in Pastoral Area of Afar National Regional State, Northeastern of Ethiopia. International Journal of Environment, Agriculture and Biotechnology. 2018, 3(5), 1929-1934. https://doi.org/10.22161/ijeab/3.5.46

[11] Getu, E. Spatial and Temporal Analysis of Prosopisjuliflora (Swarz) DC Invasion in AmibaraWoreda of the Afar NRS. Master's thesis, Addis Ababa University; 2009.

[12] Selamnesh, T. Impact of Prosopisjuliflora L. (Fabaceae) on Plant Biodiversity at Alledeghi Wildlife Reserve and Surrounding Local Community, Ethiopia. Master's thesis, Addis Ababa University; 2015.

[13] Abdulahi, M. M., Ute, J. A., Regasa, T. Prosopisjuliflora L: Distribution, Impacts and Available Control Methods in Ethiopia. Tropical and Subtropical Agroecosystems. 2017, 20(1), 75-89. https://doi.org/10.56369/tsaes.2260

[14] Pimentel, D., Zuniga, R., Morrison, D. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics. 2005, 52(3), 273-288. https://doi.org/10.1016/j.ecolecon.2004.10.002

[15] Geesing, D., Al-Khawlani, M., Abba, M. L. Management of introduced Prosopis species: can economic exploitation control an invasive species? Unasylva. 2004, 55(217), 36-44.

[16] Admasu, D. Invasive Plants and Food Security: The Case of Prosopisjuliflora in the Afar Region of Ethiopia. FARM-Africa / IUCN; 2008, pp. 1-13.

[17] Ayanu, Y., Jentsch, A., Müller-Mahn, D., Rettberg, S., Romankiewicz, C., Koellner, T. Ecosystem engineer unleashed: Prosopisjuliflorathreatening ecosystem services? Regional Environmental Change. 2015, 15(1), 155-167. https://doi.org/10.1007/s10113-014-0616-x

[18] Tabosa, I. M., Souza, J. C., Graca, D. L., Barbosa-Filho, J. M., Almeida, R. N., Riet-Correa, F. Neuronal vacuolation of the trigeminal nuclei in goats caused by ingestion of Prosopisjuliflora pods (mesquite beans). Veterinary and Human Toxicology. 2000, 42(3), 155-158. PMID: 10839319.

[19] Niguse, H., Amare, F. Distribution and Socio-economic Impacts of Prosopisjuliflora in East Shewa and West Arsi Zones, Ethiopia. International Journal of African and Asian Studies. 2016, 24, 31-41.

[20] Senayit, R., Agajie, T., Taye, T., Adefires, W., Getu, E. Invasive Alien Plant Control and Prevention in Ethiopia. Pilot Surveys and Control Baseline Conditions. Report submitted to EARO, Ethiopia and CABI under the PDF B phase of the UNEP GEF Project. Addis Ababa: EARO; 2004.

[21] Silva, V. D. A., Pitanga, B. P., Nascimento, R. P., Souza, C. S., Coelho, P. L. C., Menezes-Filho, N., Silva, A. M. M., et al. Juliprosopine and Juliprosine from Prosopisjuliflora leaves induce mitochondrial damage and cytoplasmic vacuolation on cocultured glial cells and neurons. Chemical Research in Toxicology. 2013, 26(12), 1810-1820. https://doi.org/10.1021/tx400281b

[22] Rogers, P., N. Fiona, A. Abiy. Reimagining invasions: The social and cultural impacts of Prosopis on pastoralists in southern Afar, Ethiopia. Pastoralism: Research, Policy and Practice. 2017, 7, 22. https://doi.org/10.1186/s13570-017-0094-0

[23] Dubow, J. Still-Life, After-Life: W. G. Sebald and the Demands of Landscape. In: Daniels, S., DeLyser, D., Entrikin, J. N., Richardson, D., editors. Envisioning Landscapes, Making Worlds: Geography and the Humanities. London: Routledge; 2011.

[24] Muller, G. C., Junnila, A., Traore, M. M., Traore, S. F., Doumbia, S., Sissoko, F., Kravchenko, V. D. The invasive shrub Prosopisjuliflora enhances the malaria parasite transmission capacity of Anopheles mosquitoes: a habitat manipulation experiment. Malaria Journal. 2017, 16, 237. https://doi.org/10.1186/s12936-017-1878-9

[25] Dubale, A. Impacts of Prosopisjuliflora Invasion and Control Using Charcoal Production in Afar National Regional State, Ethiopia. MSc thesis (distinction), University of Wales, Bangor, UK; 2006.