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Ethnobotanical knowledge and traditional management of *Prosopis africana* (Guill. & Perr.) Taub. in the West Coast Region of The Gambia: implications for species restoration and sustainable conservation

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ABSTRACT

In many West African countries, a decoction of the trunk bark of *Prosopis africana* is used to heal wounds and fight against cancer. Leaves are also used to treat headaches and toothaches, as well as several other ailments. This was a cross-sectional study in which questionnaires were administered to 633 indigenous residents of 10 villages located in the Western Region of The Gambia. This study aims to identify ethnobotanical knowledge on the utilizations, threats, risks, and local management methods of *Prosopis africana* to provide data for its sustainable domestication. The relative frequency of citation was used to investigate ethnobotanical data. Descriptive statistics were also used to determine local perceptions of the species' status, risk factors, and tactics used for its conservation. Chi-square and generalized linear models were applied to check the dependence between ethnic groups and variables. Three organs, namely leaves, stems, and roots are widely used for many purposes. In total, 4 main use forms were reported by local people for all organs, with the stem having a higher index value of useful organs (91%). The results of the generalized linear model performed on the perception of the status of *Prosopis africana* showed that there was a significant relationship between the Mandinkas' (CL = -0.296–1.907 and p = 0.007) and the Jolas' (CL = -0.032–1.656 and p =0.042). Local strategies for the species conservation of *Prosopis africana* in protected areas among the ethnic groups show that those living in Kombo South (X^2 = 3.802, p = 0.010) and those from Kombo Central (X2 = 27.511, p = <0.001) were the only variables that significantly influenced the respondent's knowledge on where the species should be grown. This study reveals the importance of *Prosopis africana* while also highlighting essential aspects to consider to successfully engage in its sustainable conservation.

Keywords: Conservation strategy, Ethnic groups, Local knowledge**,** *Prosopis africana,* Risk factor.

1. INTRODUCTION

Local populations in Africa are exceedingly dependent on forest products such as games, medicine and food products, fungi, larvae, honey, and spices for their alimentation (Houètchégnon et al., 2015). As such, they always have deep ethnobotanical knowledge thanks to the cultural and ecological diversity of their living environment (Assogbadjo et al., 2010). Local communities understand wild species as key components for their alimentation and their rituals (Assogbadjo et al., 2010).

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The genus *Prosopis* is characterized by about 44 species of trees (Akaaimo and Raji, 2006; Sciammaro et al., 2016), and they are widely distributed in the Sahelian, Sudanese, and Guinean savannas. *Prosopis africana* (*P. africana*) is 10–20 m high, can reach 0.4–0.8m in diameter, and has light green foliage. It is commonly known all over the world as mesquite (Akaaimo and Raji, 2006). It is one of the 44 species of *Prosopis* genus widely found in many African countries. Almost all parts of this tree are used in traditional medicine (Yanda et al., 2022). It is known as Kembo in Mandinka, Hurr in Wollof and Rohi in Fula (Kargbo, 2023). In many West African countries, a decoction of the trunk and bark of *P. africana* is used to heal wounds and fight cancer. The leaves are also used to treat headaches and toothache as well as several other ailments. Its leaves and bark are combined to treat rheumatism, remedies for skin diseases, caries, and fevers. The roots are diuretics and are used to treat gonorrhoea, toothache, stomachache, dysentery, and bronchitis (Weber et al., 2008; Yanda et al., 2022). Aqueous extracts of *P. africana* leaves and stem barks are effective sources of anti-biofilm, anti-quorum, anti-inflammatory and antioxidant phytomolecules (Bance et al., 2021). The seeds of *P. africana* have been reported in Nigeria to be good sources of carbohydrates, fibre, protein, potassium, magnesium and substantial quantities of most of the indispensable amino acids for livestock (Ausol and Mukhtar, 2011; Jiwuba et al., 2020; Akande and Alabi, 2021). Even though, *P. africana's* status worldwide is of least concern (IUCN, 2019), it is classified as a species of high national priority in terms of threats facing it in The Gambia (Danso, 2001). This indicates the need for research on its ethnobotanical significance to establish conservation plans for its long-term use.

This study aims to identify and characterize ethnobotanical knowledge, utilization, threats, risks, and local management methods of *P. africana* to provide early data for its sustainable domestication. To reach this goal, the following assumptions were formulated: (i) ethnobotanical knowledge of *P. africana* is constant within local populations in the West Coast Region of The Gambia, (ii) ethnobotanical importance of *P. africana* organs vary according to the population's ethnicity and (iii) local methods of *P. africana* management differ from one sociocultural area to another.

2. METHODOLOGY

2.1. Study Area

The study was done in Western Gambia, where the species are extensively found. The West Coast Region has nine districts and only five districts (Kombo Central, kombo South, Kombo East, Foni Brefet and Foni Kansala) districts were randomly chosen for this study. This region

occupies a total area of 1764 km^2 or 16% of the total area of The Gambia 11300 km^2 (Mappr 2024). Each district is made up of several villages but on two villages were chosen from each district namely Kombo South (Sanyang and Gunjur), Kombo Central (Kassa Kunda and Darsilami), Kombo East (Basori and and Faraba), Foni Brefet (Bulock and Sutusinjang) and Foni Kansala (Bwiam and Sangajor) (Fig 1). The Gambia has a tropical sub-humid eco-climatic zone with a rainfall range between 800 and 1200 mm yearly. The climate is characterized by two seasons, namely a wet season (between June and October) and a dry season (November to April). The dry season runs for 6-7 months and is dominated by dry and dust-laden winds blowing from the Sahara Desert in the northeast (Jaiteh and Sarr, 2011). The western region of The Gambia is characterized by a vegetation mosaic of forests, gallery forests and savannas (Jaiteh and Sarr, 2011). The population of the study area was estimated at 730,895 inhabitants representing 38% of The Gambia's population of 1,922,950 (GBOS, 2017). Ten villages in the western region of The Gambia were used for the investigation. These villages were categorised as either peri-urban settlements (Gunjur, Kassa kunda, Darsilami, Bassori and Sanyang) or rural settlements (Faraba, Giboro, Bulok, Bwiam, Sutinsijang and Sangajor). The two biggest settlements (Gunjur and Sanyang) alone have a population in 15000 of the study regions and less than 5000 people living within other towns and villages (GBOS, 2017).

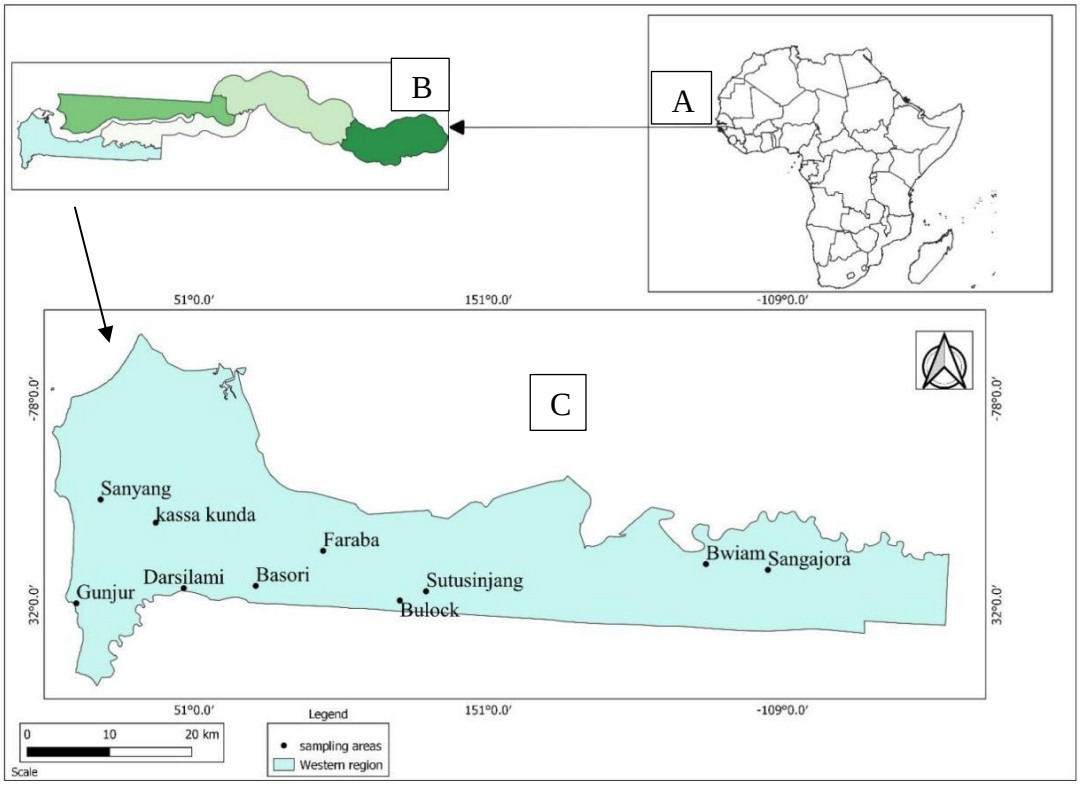

Figure 1. Map of the Western Region of The Gambia showing the study area of the 10 sampled villages. Map of Africa (A), Map of The Gambia (B) and Map of the western part Gambia (C).

2.2. Sampling Design

2.2.1. Data Collection

A pilot study was conducted with 60 randomly chosen respondents (Dagnelie, 1998). Pictures of the whole plant and its leaves (Fig 2) were kept and shown to each informant.

Figure 2. P. africana growing at Mansa Colley Bojang primary School, Jalambang village of The Gambia (A) whole P. africana plant (B) branches showing their leaves

The number of respondents who know and or have used *P. africana* was calculated as P = 50/100, P ≈ 0.5. With this P value, the sampled size was calculated using the formula (Dagnelie, 1998): $n = U21\text{-}\alpha/2[P(1\text{-}P)/d2]$.

Where, n = (317,787) the total number of informants within a locality; U1-α/2 = 1.96 for α = 0.05;
P = the estimated proportion of the interviewed respondents in the preliminary survey; and
d = the expected error margin of any parameter to be estimated from the interviews (d = 5%).

A minimum of 384 sample sizes was attained. In total, 633 individuals were purposely recruited for this study. Table 1 presents the size of people chosen per locality, ethnic group, gender, and age group. Using a questionnaire, a semi-structured interview was conducted with the sampled people. The questions asked were related to (i)- the part used, (ii)- the use forms of the species, (iii)- the perception of the species' status, and (iv)- the strategies for the conservation. In addition, questions related to areas of abundance, threat factors, and conservation solutions for *P. africana* were listed.

Table 1. Proportion of the total respondents in each region.

District	***Sample***	***Ethnic Group***		***Sex***		***Age***			***Education***				
		Tribe	***Total***	***M***	***F***	***18-25***	***26-35***	***>36***	***T***	***Sec***	***Pri***	***Mad***	***Non***
Kombo East	120	Mandinka	36	20	16	3	18	15	3	12	4	14	3
		Fula	27	16	11	3	12	12	1	9	1	15	1
		Jola	46	26	20	9	4	33	5	11	4	12	14
		Wolof	4	2	2	0	3	1	3	0	0	0	1
		Manjago	2	2	0	0	1	1	0	0	1	0	1
		Others	5	2	3	0	1	4	0	3	0	1	1
Kombo South	203	Mandinka	106	86	20	5	31	70	20	21	8	53	4
		Fula	28	22	6	0	4	24	3	0	5	20	0
		Jola	43	37	6	4	10	29	15	9	8	10	1
		Wolof	5	3	2	0	1	4	0	0	0	5	0
		Manjago	15	12	3	0	5	10	5	5	2	0	3
		Others	6	2	4	0	0	6	2	0	0	4	0
Foni Brefet	61	Mandinka	17	13	4	0	3	14	0	3	1	10	3
		Fula	16	6	10	0	4	12	0	2	1	8	5
		Jola	21	14	7	0	1	20	4	4	4	3	6
		Wolof	0	0	0	0	0	0	0	0	2	0	3
		Manjago	5	3	2	0	0	5	0	0	1	0	1
		Others	2	2	0	0	0	2	0	3	1	10	3
Foni Kansala	61	Mandinka	12	6	6	0	1	11	2	0	2	4	4
		Fula	11	6	5	0	0	11	1	0	0	7	3
		Jola	34	21	13	0	0	34	7	2	3	3	19
		Wolof	4	4	0	0	0	4	0	0	0	3	1
		Manjago	0	0	0	0	0	0	0	0	0	0	0
		Others	0	0	0	0	0	0	0	0	0	0	0
Kombo central	188	Mandinka	62	43	19	11	17	34	5	24	6	17	10
		Fula	58	32	25	8	19	31	8	7	1	22	20
		Jola	39	25	14	0	5	34	5	10	7	11	6
		Wolof	22	13	9	0	1	6	2	3	3	10	4
		Manjago	5	1	4	0	4	1	1	4	0	0	0
		Others	2	2	0	2	0	0	0	0	0	0	2

Note: *Others means (Aku, Serere, Sarahule,); Education (T=tertiary, Sec=secondary, Pri=primary, Mad=Madarasa and Non=(none).*

2.3. Data Analysis

The Relative Frequency of Citation (RFC) was used to investigate ethnobotanical data.

$$RFC = \frac{RF}{N} \text{ x } 100$$

Its values measure the local perceptions of the importance of the species or category studied based on the frequency of citation (RF), divided by the total number of respondents (N) in the study. The greater the value of the RFC, the higher the importance level of that parameter in that locality (Benlarbi et al., 2023). Descriptive statistics such as pie charts, bar charts and frequencies of local perceptions on the species' status, risk factors and tactics used for its conservation were computed (Benlarbi et al., 2023). Chi-square test was then applied to check the dependence between socio-demographical characteristics (district, ethnic groups, education, occupation, sex, and age) of the respondents and local perceptions and strategies. Finally, to determine the degree of agreement between the responses (regarding areas of presence and conservation solutions) of the different ethnic groups, a generalized linear model (Dabre et al., 2023) was used in SPSS V21.

3. RESULTS

3.1 Use and Ethnobotanical Knowledge of *Prosopis africana* in The Gambia

Our study showed that the local population has some knowledge of *P. africana (*Fig 5). Different local names were given to the species according to ethnic groups. *P. africana* is called "Kembo" meaning Charcoal by Mandinkas, "Hirr" by the Wollof and "Rohi" by the Fulas because its wood is as hard as stone (Table 2).

Table 2. Local names of P. africana at different sociocultural group levels in The Gambia.

Ethnic group	***Local name***	***Meaning of local name***
Mandinka	Kembo	Charcoal
Fula	Hirr	Stony tree
Wolof	Rohi	Stony tree
Jola	Budicap / bujekab	Stony tree
Aku	Ironwood	Iron wood

Locals indicated four primary cited parts of a plant were used in The Gambia, and these included the roots, leaves, bark, and trunk. Its trunk has the highest index value of useful organs (91%) (Fig 3). Medicinal uses of the plant such as the (leaves were reported to be used to treat fever, malaria, headaches, stomachaches, among others) was the most reported cited uses (67%) and cultural uses which includes making of crafty wood items was the second highly cited (63%) (Fig 4).

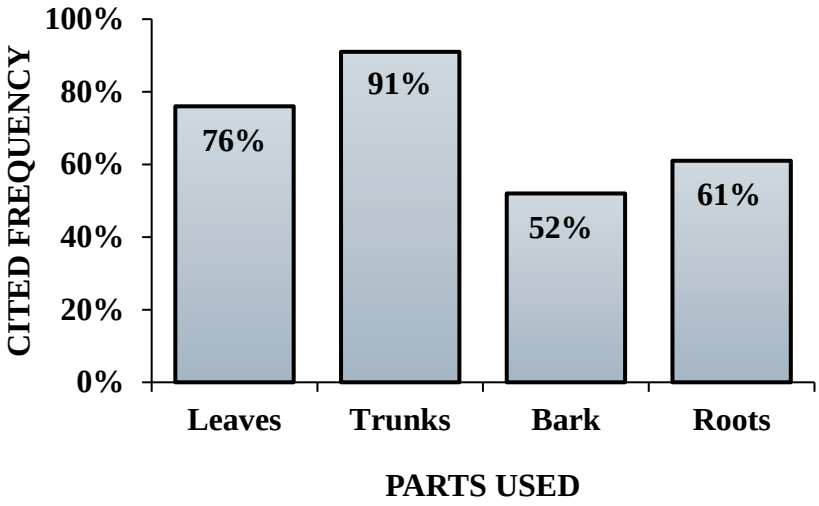

Figure 3. Perceived parts of P. africana used in The Gambia.

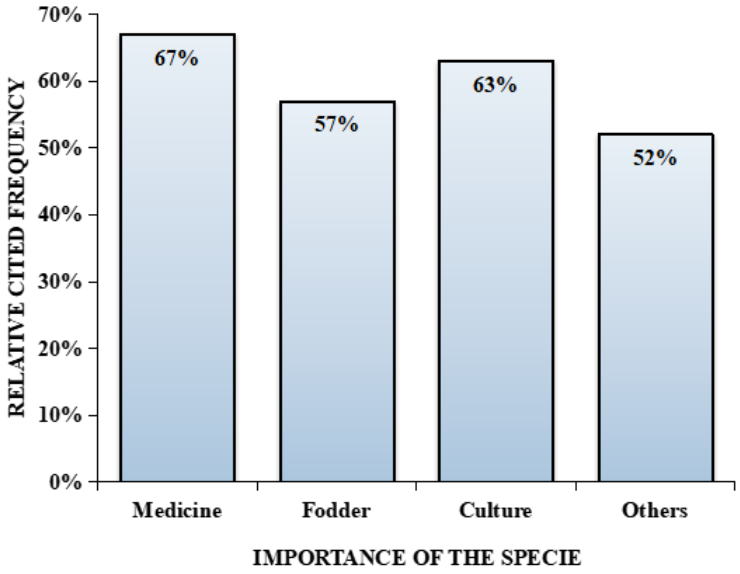

*Figure 4. Cited frequency of the importance of P. africana (**Note**: Others includes use of P. africana for firewood, fencing and roofing).*

3.2. Local perception Towards the Change and Decline in the *Prosopis africana* Population

About 54% of respondents stated that the population of *P. africana* has been decreasing in recent times both in abundance and distribution (Fig 5). While 18% of respondents cited that the species has rarely been seen in the wild in their communities, a small proportion of them think that its population is increasing (2%). The results of the Generalized linear model performed on the perception of the status of *P. africana* show that there was a significant relation among the Mandinka's (CL=-0.296-1.907, df=1 and p=0.007) and the Jola's (CL=--0.032-1.656, df=1 and p =0.042) (Table 3).

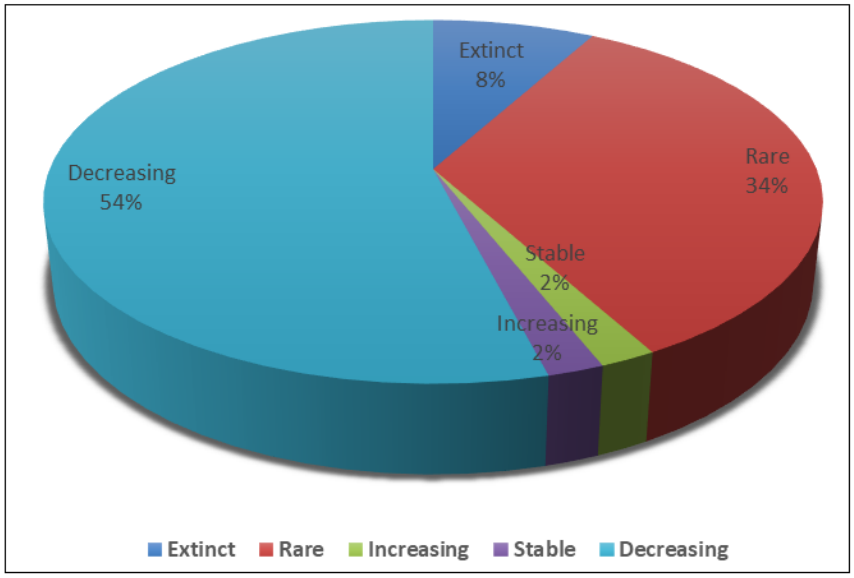

Figure 5. Status of P. africana in the West Coast Region of The Gambia.

Table 3. Factor influencing the perception on the status of P. africana in using Generalised Linear Model.

	B	***Std. Error***	***95% Wald Confidence Interval***		***Hypothesis Test***		
			Lower	***Upper***	***Wald Chi-Square***	***df***	***Sig.***
Mandinka	-1.102	0.4108	-1.907	-0.296	7.190	1	0.007*
Fula	-0.262	0.4190	-1.083	0.559	0.391	1	0.532
Jula	-0.844	0.4143	-1.656	-0.032	4.154	1	0.042*
Wolof	-0.648	0.4759	-1.580	0.285	1.852	1	0.174
Manjago	-2.303E-15	0.4966	-0.973	0.973	0.000	1	1.000
Others	Ref	.	.	.	.	.	.

***Note**: Others: Aku, Sarahule, Karonika, Serere.*

3.3. Local perception of the threats and risks to the survival of *Prosopis africana* in The Gambia

The key perceived threat factor contributing towards the deterioration and the disappearance of *P. africana* was deforestation 79%, timber logging 69% and more than half (57%) of the respondents reported others which includes charcoal, fencing, roofing, and wood production (Fig 6). Excessive cutting 87%, others (bush fire, firewood, and charcoal production) 53% and parasites 44% were the greatest risk factors facing *P. africana* (Fig 7). Figure 8 shows an example of a *P. africana* affected by a parasitic plant.

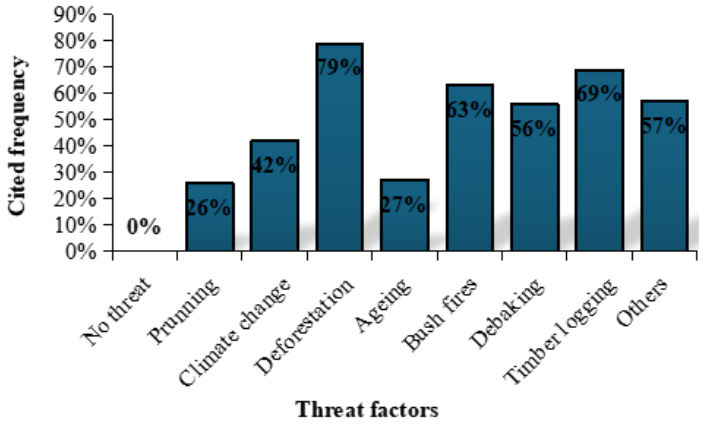

Figure 6. Threat factors on P. africana.

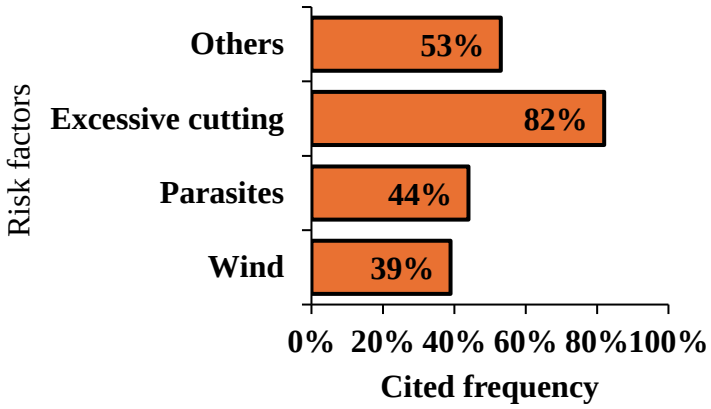

Figure 7. Risk factors affecting P. africana.

Figure 8. P. africana species affected by a parasitic plant.

3.4. Local strategies for the conservation of *Prosopis africana.*

Several strategies have been suggested by local communities for species conservation (Fig 9). The most used strategies cited were formulating proper land acquisition laws (80%) in the country to prevent deforestation by housing estate agencies and timber dealers. Encouraging

the planting of this species both in and ex-situ by seventy-eight percent (78%) of the respondents. Sixty-seven percent (67%) of the informants again reported the need to avoid bush burning and forming associations to create awareness to protect the plants in fields. Local strategies for the species conservation of *P. africana* in protected or unprotected areas among the ethnic groups show that those living in Kombo south (X^2 = 3.802, and p-value= 0.010) and those from the Kombo central (X^2=27.511 and p-value= 0.002) were the only variables that were significantly influencing the respondent's knowledge on where the specie should be grown (Table 4).

Table 4. Chi-square test showing respondents based on their ethnicity's suggestion of where to plant Prosopis africana in The Gambia.

District	***Ethnic group***	***Unprotect area***	***Protected area***	***Total***	***X^2***	***P value***
Kombo East					5.0630	0.344
	Mandinka	1	35	36		
	Fula	0	27	27		
	Jola	2	44	46		
	Wolof	0	4	4		
	Manjago	0	2	2		
	others	1	4	5		
Kombo South					3.602	0.010*
	Mandinka	2	104	106		
	Fula	0	28	28		
	Jola	6	37	43		
	Wolof	0	5	5		
	Manjago	0	15	15		
	others	0	6	6		
Foni Brefet					3802	0.891
	Mandinka	4	13	17		
	Fula	4	11	16		
	Jola	5	16	21		
	Wolof	1	4	5		
	Manjago	0	2	2		
	Others	0	0	0		
Foni kansala					2.506	0.474
	Mandinka	0	12	12		
	Fula	0	11	11		
	Jola	3	31	34		
	Wolof	0	4	4		
	Manjago	0	0	0		
	Others	0	0	0		
Kombo Central					27.511	0.002*
	Mandinka	0	62	62		
	Fula	2	56	58		
	Jola	2	37	39		
	Wolof	0	22	22		
	Manjago	2	3	5		
	others	0	2	2		

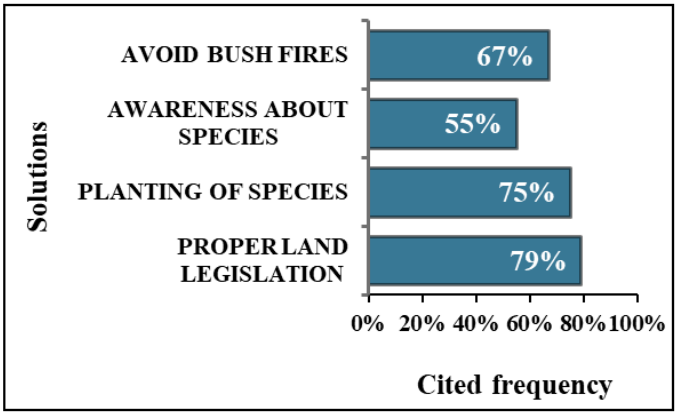

Figure 9. Respondents' perception of possible solutions towards protecting the decline of P. africana in The Gambia.

4. DISCUSSION

This work demonstrates that *P. africana* is a multipurpose plant. In The Gambia, ethnic groups have a name for African mesquite, which supposes the existence of a long history of use of these tree species. African mesquite trees are kept for their multiple functions: medicinal functions, fodder and cultural values when their timber is sold. The use of various parts of the plant for the treatment of various conditions contributes to the well-being of the local communities which includes to treat fever and malaria (Sharifi-Rad et al., 2019), headaches, stomachaches, and sexual weakness. Typically, a woman who has just had a birth is given the barks to help cleanse her body after they have soaked them in water. Findings of this study are similar to the findings of Houètchégnon et al. (2015), who also indicated that *P. africana* can be used to cure many diseases. Alkaloids, saponins, tannins, phlabatannins, flavonoids, anthraquinone and glycosides found in the aqueous extracts of *P. africana* stem, bark and leaves have shown pronounced effects and are classed as pharmacologically active (Trease and Evans, 1989; Abubakar and Oloyede, 2020). It has also been reported to have antibacterial properties (Ezike et al., 2010; Yanda et al., 2022), sore throat (Oguntoyinbo et al., 2007). Respondents in this study mentioned that they use *P. africana* species for various purposes including as a hedge plant, a source of firewood or charcoal, timber and fodder for livestock, mostly during the dry season when grass and other fodder are not available. This is in agreement with the findings of Agboola (2004), who also reported that, *Prosopis africana* has been used in many communities in Nigeria for firewood, charcoal and timber. The use of *Prosopis africana* as a fodder has also been reported in Nigeria by Akande and Alabi (2021).

Our findings revealed that the local community was aware of the decline of *P. africana* populations in The Gambia. This trend is consistent with the findings of previous

studies conducted on the same species in South Africa (Shackleton et al*.,* 2015). Despite *P. africana* being listed as a least concern species on the IUCN Red List (IUCN, 2019), the respondents in our study reported that the species are endangered in the West Coast Region of The Gambia. We also found significant ethnic variation in knowledge of the decline of *Prosopis africana*, as has been found for *Tamarindus indica* (Fandohan et al., 2010) and *Adansonia digitata* (Assogbadjo et al., 2008). Respondents' knowledge varied among the different ethnic groups, especially among the Mandinka's and Jolas living in the West Coast Region of The Gambia. The results confirm the significant differences in the ethnic groups' perception of the status of this plant species in their community as also shown by Koura et al. (2011). The respondents' observations such as human activities like deforestation, and other uses like making charcoal, fences, and firewood have had a major negative impact on the remaining *P. africana* trees in their community. In the same instance according to Dabré et al. (2023), bushfires, and forest loss may be the cause of the threat that *Celtis toka* face in Burkina Faso. Residents of The Gambia's Lower River Region have reported to Darboe et al. (2023) that the loss of tree species in the nation is caused by anthropogenic activities such as deforestation, timber logging, the demand for firewood, and the manufacturing of charcoal. Moreover, the installation of infrastructure, climatic unpredictability, and deforestation brought on by agricultural development affect spatial dynamics (Dabré et al. 2023). According to Dabré et al. (2023), excessive cutting may potentially be a factor in the absence of regeneration. Forty four percent (44%) of the residents thought that parasites including termites and fungi were the source of species scarcity (Graziosi et al., 2020). The impact of climate variability and change (40%) were also reported to be risk factors for the decline of *P. africana* in The Gambia. This finding concurs with Yaméogo and Yanogo, (2023) that climate change and its impact had negative effects on many tree plants in forest habitats.

The locals in the western Gambia are aware of the population shifts in *P. africana* brought on by persistent human pressure (Weber et al., 2008). The study's findings have brought attention to a pattern of dwindling species in the investigated area. It is generally acknowledged that management measures based on local knowledge could ensure that the species most useful to the local societies are the ones that are prioritized (Lokonon et al., 2021). Therefore, we recommend that any efforts to restore the species should consider the priorities of the local community (Eschen et al., 2023). This is because the local populations that actively participate in defining their well-being will be more successful in conservation efforts than those who just rely on outside influences (Lokonon et al., 2021).

5. CONCLUSION AND RECOMMENDATION

The study shows that people of the West Coast Region of The Gambia have gathered folk knowledge on the plant for many years. They could determine the various uses, threats and risk factors affecting *P. Africana*. They were also able to determine the possible solution to support the sustainable use of *P. africana*. Furthermore, the use of the plant for medicine, cultural artefacts, firewood and burning of charcoal exposes the plant to greater danger. It is very important to conserve existing natural populations using in situ and ex-situ methods in order to ensure its continuity and ecosystem services available for the nation.

6. CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

7. ACKNOWLEDGEMENTS

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