

Importance of woody fodder resources in agropastoral lands of the sub-prefecture of Koundoul, Province of Chari Baguirmi (Chad)

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1. ABSTRACT

The aim of the study is to identify fodder ligneous plants and their exploitation and management methods, to understand their current dynamics. The methods used consisted in gathering the knowledge of agropastoralists on the management and conservation of fodder woody plants. Survey forms were drawn up and submitted to a sample of 135 agropastoralists with livestock from August 15 to September 15, 2017, in 9 villages. They enabled us to identify 21 fodder woody species belonging to 17 genera distributed in 13 families in the village terroirs of the Koundoul Sub-Prefecture. The results revealed that Dicotyledons accounted for 95% of the forage woody species identified, and Monocotyledons for 5%, represented by the Arecaceae family. The other families belong to the Dicotyledons. Of all the species identified, *Faidherbia albida* Del. and *Ziziphus mauritiana* Lam. are the most widely used, with 17.20% and 16.90% respectively. They are followed by *Vachellia nilotica* (L.) Willd. ex Del. (12.30%) and *Balanites aegyptiaca* (L.) Del. (11.50). All these species are uncommon (38%) and used mainly for cattle fodder (37%). There are several reasons for their destruction, the main one being abusive cutting for charcoal, even though legal provisions exist to improve management.

2. INTRODUCTION

In the Sahel, rural communities rely heavily on the exploitation of renewable natural resources to meet their needs and survival (Elhadji-Seybou *et al.*, 2016). This vast semi-arid African zone has been suffering for several decades from the deterioration of climatic conditions (Akpo *et al.*, 1996) and anthropogenic actions (Jalut *et al.*, 2000). These adverse effects of the climate, combined with human pressure, contribute to further degradation of these natural resources. For livestock, feeding fodder during the dry season or in a year of low rainfall is difficult with annual plants and in this case woody grazing

becomes an important element (Bakhoun *et al.*, 2020). Forage species play a major role in the forage balances of extensive livestock systems. They provide protein inputs that are essential for the dietary balance of livestock on natural pasture during the dry season (Bechir and Kabore-Zoungrana, 2012). Their contribution to livestock feed is essential during the dry season, thus conditioning the mobility of livestock (Le Houerou, 1980 ; Ngwa *et al.*, 2000). However, humans, through their local land use practices, are causing a transformation of ecosystems that is increasing at the rate of population growth

(Ouédraogo *et al.*, 2012). Nowadays, there is a lot of pressure on woody forage resources, eliminating or limiting their availability in real time. In this context, the need to update knowledge on forage plants contributes to improved management. The objective of this study is to evaluate the management of woody

fodder resources in the village areas of the Koundoul sub-prefecture. Specifically, it will be a question of identifying woody forage species, understanding how they are harvested and benefits for local communities and the means of legal protection.

3. MATERIALS AND METHODS

3.1 Study area: The sub-prefecture of Koundoul is located 20 km south of the city of N'Djamena. This area has a Sahelian climate characterized by a dry season from October to May and a rainy season that begins in June and ends in September. Rainfall is abundant between July and August. The average annual precipitation is 368.3 mm, the average annual temperature is about 29.3°C. Temperature peaks occur from April to May with an optimum of 45.3°C and a minimum of 13.9°C observed in December. Two main classes of soils (steppe and hydromorphosis) characterize the wooded savannah of *Senegalia senegal* (L.) Britton. and *Vachellia scorpioides* (L.) W. Wight and the shrub

savannah of *Bauhinia reticulata* Lam. and *Balanites aegyptiaca* (L.) Del., *Vachellia seyal* Del, *Kigelia africana* (Lam.) Benth. share the perimeter of Koundoul (Mbaisbe *et al.*, 2025). Administratively, the sub-prefecture of Koundoul in the Madiago canton depends on the Madiago canton which is headed by a canton commonly called "sultan". According to current data, the sub-prefecture of Koundoul in the Madiago canton includes 65 villages (Dama, 2017). Given its geographical position beneficial to all, several ethnic groups have settled there to hunt, fish, trade, agriculture or livestock. After the kotoko come the Bornou, whose main activity is trade.

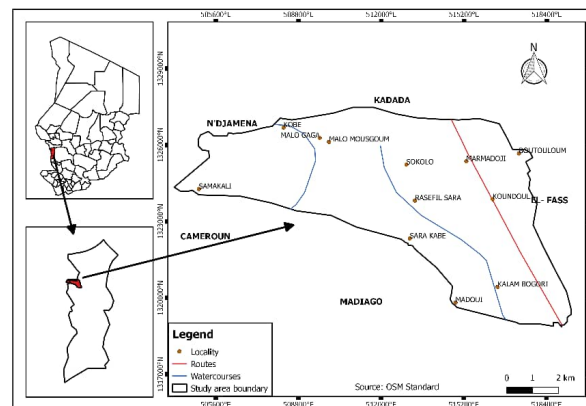


Figure 1 : Location of the study area

The fieldwork took place from August 15 to September 15, 2017 in 9 randomly selected villages in the sub-prefecture of Koundoul. Focus group discussions were conducted in each village to capture the overall perception of the problem, and individual surveys were conducted to obtain quantitative data using random sampling.

3.2 Data collection: The data were collected through surveys using semi-structured interviews based on a quiz on the knowledge of forage species in agropastoral lands, their benefits for local communities, the method of harvesting and conservation, the causes of their destruction, the means and regulatory provisions of protection in force. The naming of forage species was carried out on the basis of the flora

of Senegal (Berhaut, 1967 ; Bakhoun *et al.*, 2020). A total of 135 agropastoralists of both sexes were subjected to semi-structured individual interviews. It was mainly a survey in which every agropastoralist keeping domestic animals is interviewed. The sampling method is of the simple random type. In each village, 15 people of both sexes and aged between 20 and 70 years were randomly interviewed. Gender and age were taken into account.

3.3 Data analysis and processing: The Sphinx Plus² software version 4.5. was used for the design of the survey questionnaire, the collection of coded responses, and the processing and statistical analysis of the data.

4. RESULTS

The results obtained from this study are grouped as follows: the forage species identified, the benefits for local communities, the method of removal, the availability of forage species in the land, causes of destruction, the means of combating destruction and the means of legal protection.

4.1 Woody fodder trees identified: Table 1 shows the list of woody fodder trees identified in the agropastoral rangelands of the various villages surveyed. Each woody tree is defined by its presence in the pasture area and fields. A total

The flat or cross-sorting method of the data made it possible to determine the variations in the frequency of the variable studied. The calculated citation frequency expressed as a percentage (%) is obtained by the following ratio :

$$F = \frac{n}{N} \times 100$$

where *n* expresses the number of citations of the agropastoralist in relation to a given variable and *N* the total number of citations followed (101). The results obtained are expressed as a percentage. Pearson's Chi-square test is used for the comparison of the observed frequencies between two variables.

of 21 woody forage species belong to 17 genera and are divided into 13 families (Table 1). Analysis of the table reveals that Dicots accounted for 95% of the woody plants identified and monocots 5%. The Monocots are represented by the family Arecaceae. The other families belong to the Dicotyledons. Of all the species identified, *Faidherbia albida* Del. and *Ziziphus mauritiana* Lam. are the best used with 17.20% and 16.90% respectively. They are followed by *Vachellia nilotica* (L.) Willd. ex Del. (12.30%) and *Balanites aegyptiaca* (L.) Del. (11.50%).

Table 1 : the woody fodder trees identified and the most used

Woody fodder trees	Family	Frequency (%)
<i>Acacia dudgeoni</i> Craib. ex Holl.	Fabaceae	1,40
<i>Vachellia nilotica</i> (L.) Willd. ex Del.		12,30
<i>Senegalia senegal</i> (L.) Britton.		5,70
<i>Vachellia seyal</i> Del.		5,50
<i>Vachellia siberiana</i> DC.		5,20
<i>Faidherbia albida</i> Del.		17,20
<i>Bauhinia rufescens</i> Lam.		1,10
<i>Parkinsonia aculata</i> L.		1,60
<i>Tamarindus indica</i> L.		1,90
<i>Azadirachta indica</i> A. Juss.	Meliceae	2,20
<i>Khaya senegalensis</i> (Desv.) A. Juss.	Meliaceae	1,60
<i>Balanites aegyptiaca</i> (L.) Del.	Zygophyllaceae	11,50
<i>Leptadenia hastata</i> (Pers.) Decne	Asclepiadaceae	0,50
<i>Combretum glutinosum</i> Perr. ex DC.	Combretaceae	0,50
<i>Diospyros mespiliformis</i> Hochst. ex A. DC.	Ebenaceae	1,60

<i>Ficus gnaphalocarpa</i>	Moraceae	3,80
<i>Guiera senegalensis</i> J.F. Gmel.	Combretaceae	0,80
<i>Hyphaene thebaica</i> (L.) Mart.	Arecaceae	0,80
<i>Kigelia africana</i> (Lam.) Benth.	Bignoniaceae	3,60
<i>Mitragyna inermis</i> (Willd.) O. Ktze.	Rubiaceae	3,80
<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	16,90

4.2 Benefits for local communities: An examination of Figure 1 shows that the woody trees identified are mainly used by local populations as fodder (37%). They are also used

for food (20%), construction (18%) and shade (10%). They are a good source of traditional pharmacopoeia and energy wood. Under certain conditions, they are used as a dead hedge (1%).

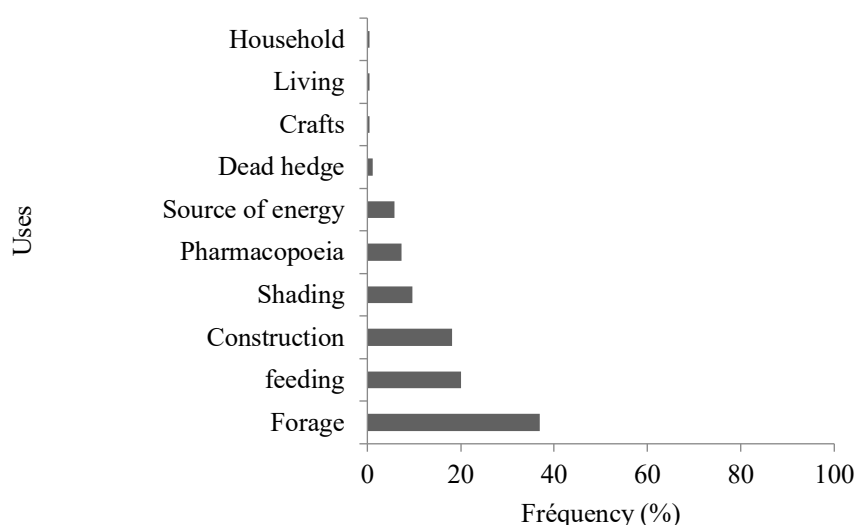


Figure 2 : local and common use of woody fodder

4.3 Method of harvesting woody fodder: The most cited method of sampling remains pruning with 89% as shown in figure 3. Woody trees are also subject to grazing (65%). Debarking and

slaughter were mentioned with low proportions of 16% and 13% respectively as other methods of harvesting woody plants.

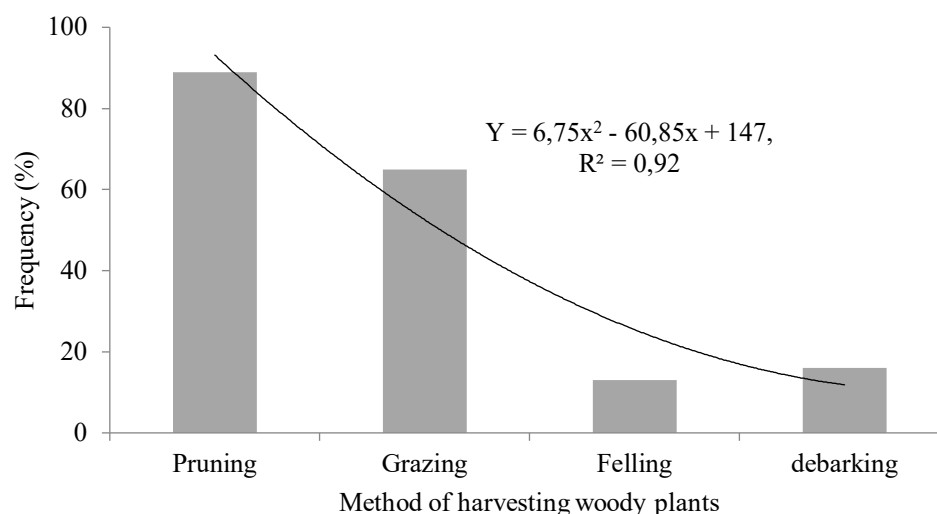


Figure 3 : method of collecting the parts used from woody forage species

4.4 Availability of forage species in terroirs: The ethnic groups encountered had different perceptions of the availability of woody plants (figure 4). For the Massa, woody fodder is frequent (14%) and uncommon (20%) in village

areas. They represent 9% for the Arabs. For Sara, availability is frequent with 6% and uncommon with 8%. This feeling is shared among the Ngambaye with 3% and 7% respectively.

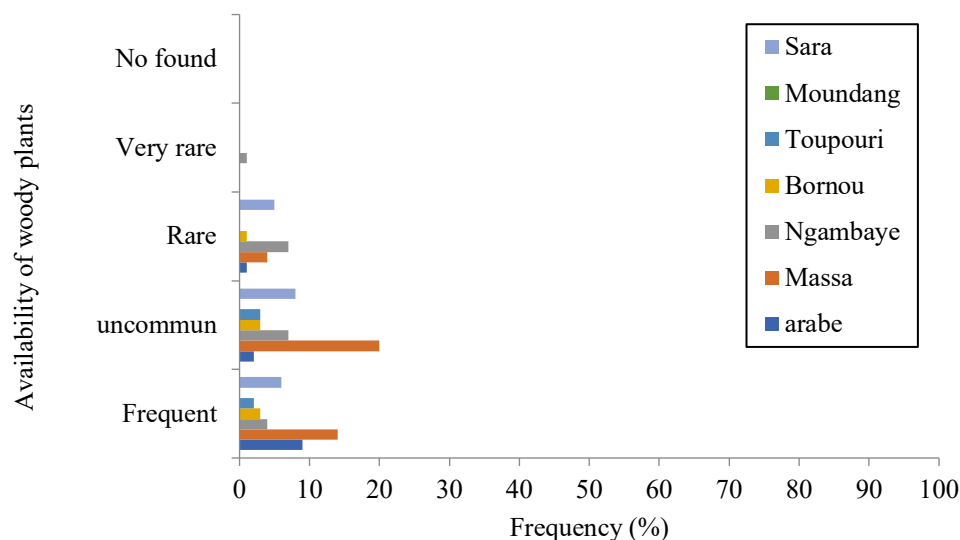


Figure 4 : availability of woody fodder in agropastoral lands according to ethnic groups.

4.5 Causes of the destruction of forage species: Several causes of the destruction of woody plants have been mentioned, as shown in figure 5. Of these, cutting for charcoal is the main cause with 30%, followed by abusive cutting of trees with 18% and the use of fodder trees as a source of energy (16%). The three

causes are considered to be the main causes. Besides these, there are other causes considered secondary in the figure. These are demographic pressure (10%), the irregularity of rainfall and the sale of green wood with 8% in both cases. In addition to the main and secondary causes, there are three other causes

that are rarely cited. The low proportions range from 2 to 5%. These are the clearing of crop

fields (5%), fire-based clearing (5%) and overgrazing (2%).

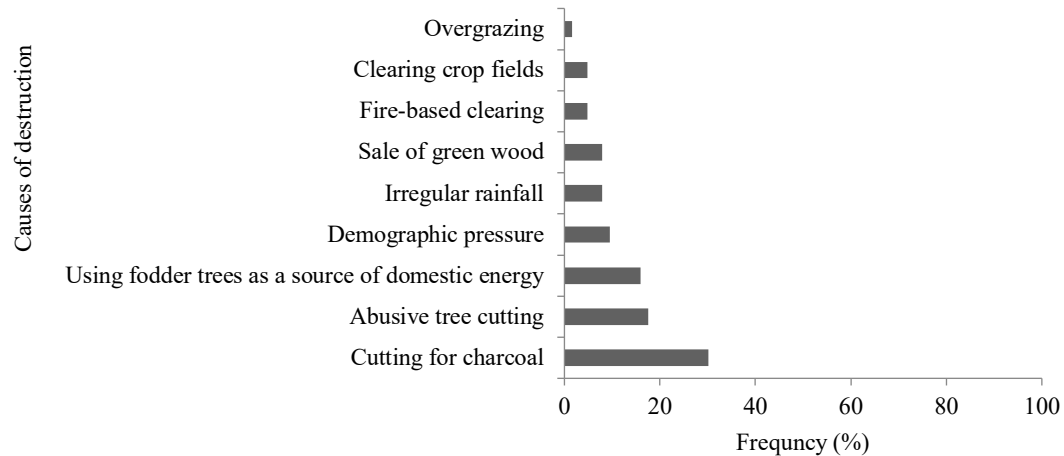
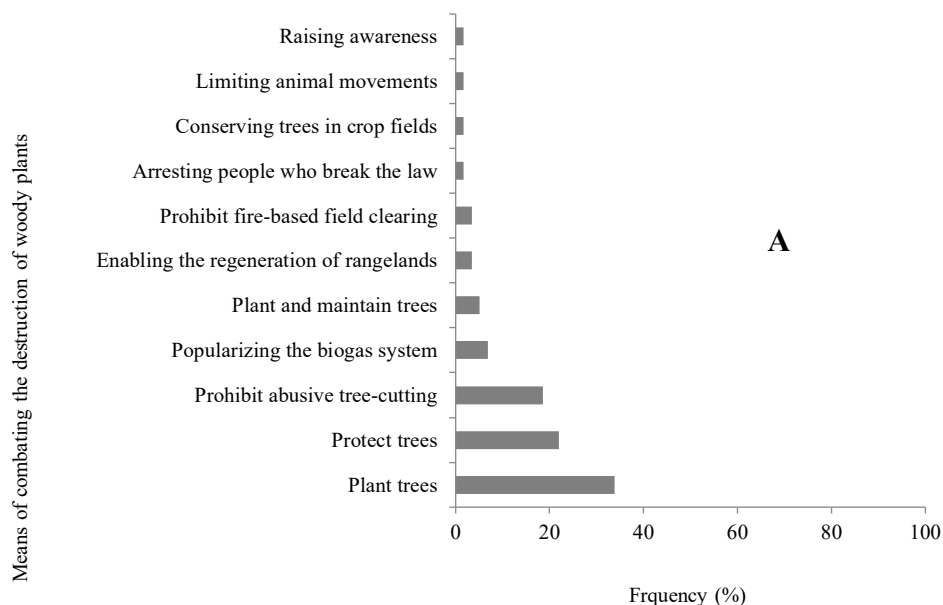


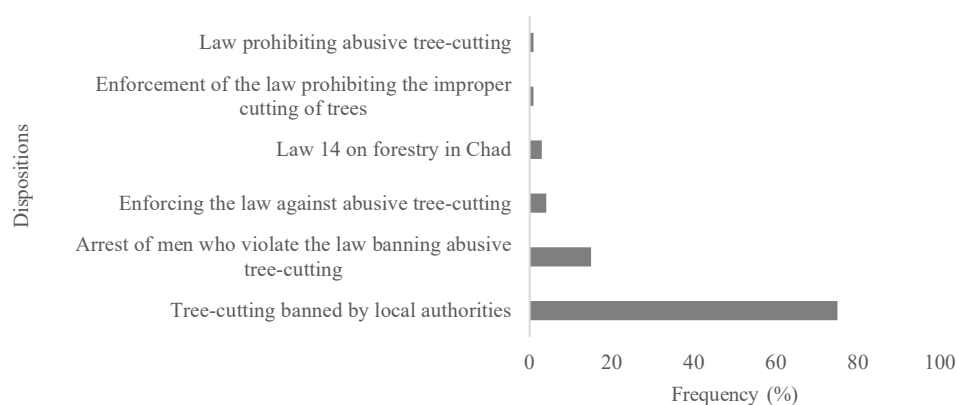
Figure 5 : causes of the disappearance of forage trees

4.6 Means of combating destruction and regulatory provisions:

Figure 6A shows that tree planting (34%), tree protection (22%) and prohibiting abusive tree cutting (19%) are the most frequently cited means of combating destruction. Alongside this, there are alternative solutions such as popularizing the biogas system (7%), planting and maintaining trees (5%), encouraging the regeneration of rangelands (3%) and banning fire-based clearing (3%). Some interviewers suggested arresting people who violate the law prohibiting abusive tree-cutting (2%), conserving trees in crop fields (2%), limiting animal movement (2%) and raising public awareness of environmental management (2%).

Figure 6B shows that the main provision is the prohibition of tree-cutting by local authorities (75%), followed by the arrest of people who violate the law prohibiting abusive tree-cutting (15%), the enforcement of the law prohibiting abusive tree-cutting (4%) and law 14 on forestry in Chad (3%).





B

Figure 6 : protective actions (A) and regulatory provisions for the protection of forage plants (B)

5. DISCUSSION

The present study revealed that the forage plants in the village terroirs of the Koundoul sub-prefecture are rich in 21 species often cited by agropastoralists and identified thanks to systematic botany classification works. They belong to 17 genera and 12 families, with a representation of dicotyledons estimated at 95% and monocotyledons at 5%. The Fabaceae family is best represented with 9 species. Compared to the results of Minda *et al.* (2015) who carried out their work on the characterization of woody populations along the route of the Great Green Wall in Chad, this area is specifically rich. This explains how important the village terroirs, where these species develop for fodder, are. These authors identified 18 species, 15 genera, and 9 families, with the Mimosaceae family being the most represented. Our results are close to those of Guihini *et al.* (2021) who inventoried 15 species, 11 genera, and 6 families at two sites along the path of the Great Green Wall in Chad. Among the forage species recorded, *Faidherbia albida* Del. and *Vachellia nilotica* (L.) Willd. ex Del. are the most represented woody species in the Fabaceae family, followed by *Ziziphus mauritiana* Lam. and *Balanites aegyptiaca* (L.) Del. from the Zygophyllaceae and Rhamnaceae families, respectively. This abundance of species belonging to the Fabaceae family was noted in

the work of Zounon *et al.* (2022) on farmers' perceptions of the ecology of forage woody species. It represents 38% of the entire plant community in the studied area. The families are considered woody species that adapt better to difficult environmental conditions as previously reported by Moussa *et al.* (2019) and develop strategies that allow them to adapt and perpetuate their species (Mahamane and Saadou, 2009). These forage trees are frequently cited by agro-pastoralists for their role in livestock feeding. *Faidherbia albida* Del. and *Ziziphus mauritiana* Lam. are the most preferred by animals with citation rates of 17.20% and 16.90%, respectively. They are followed by *Vachellia nilotica* (L.) Willd. ex Del. (12.30%) and *Balanites aegyptiaca* (L.) Del. (11.50%). These results obtained in the village land of Koundoul regarding the palatability of *Faidherbia albida* Del. (17.20%) corroborate those obtained by several researchers (Sarr *et al.*, 2013 ; Salou, 2016 ; Tougiani *et al.*, 2021 ; Kebyeï *et al.*, 2022). Salou (2016) observed, through a floristic inventory in the pastoral zone, an abundant use of species such as *Faidherbia albida* Del. (10.7%) in the village territories of central-southern Niger. According to Tougiani *et al.* (2021), farmers estimated that an individual of *Faidherbia albida* Del. produces, depending on its age, an average of 90 kg of fruit pods without succulent branches annually.

Among the Sahelian forage species, Ickowicz *et al.* (2005) showed that the leaves of *Senegalia senegal* (L.) Britton have very good nutritional value with a high digestible nitrogen content and low tannin content ; making it a top-quality forage. Alongside their role as fodder (37%) in livestock feeding, the species recorded in the village areas of Koundoul have other uses for local communities. They are involved in construction and serve as a source of human food, shade, traditional medicine, fuelwood, and dead hedges for the local population. Their use in traditional medicine aligns with the findings of Bakhoum *et al.* (2020) on the uses of woody fodder in the rural community in Northern Senegal and Kebyeï *et al.* (2022) on the woody plants exploited in the wood energy supply basin of N'Djamena. According to the former authors, among the most used species was *Balanites aegyptiaca* (L.) Del. with a citation frequency of 60% for treating diseases such as hypotension, diabetes, colds, ulcers, hot flashes, and "supernatural" ailments. The most favored method of harvesting fodder species among agropastoralists remains pruning (89%) practiced during the dry season, followed by bark stripping and felling. The farmer strives through pruning to produce a sufficient quantity

of forage to feed the hungry herds (Petit and Maillet, 2001). Although prohibited in Senegal, some practices of pruning woody species persist in several communities and pose a lesser threat to them than clearing for the development of new fields or cutting for other purposes by loggers (Dione *et al.*, 2020). These various harvesting methods further contribute to the destruction of fodder trees in the Sahelian area, which is naturally subject to climatic fluctuations, particularly water shortages. Some respondents stated that fodder species are available or somewhat available. They justified this by the numerous causes of their disappearance, of which the cutting for charcoal alone accounted for 30%, along with cutting for other uses. This finding has been noted by other authors (Dione *et al.*, 2020 ; Baye-Niwah *et al.*, 2020 ; Kebyeï *et al.*, 2022) who highlighted other uses of fodder plants, such as their socioeconomic role. For the agro-pastoralists surveyed, reforestation, protection of trees, and banning excessive cutting of trees are the most encouraged means of combating the destruction of plants. Alongside awareness-raising, there are legal provisions for their protection. However, people blatantly violate the law prohibiting excessive cutting of trees (Dahai, 2017).

6. CONCLUSION

The present study carried out on the importance of forage plants in the village territories of the sub-prefecture of Koundoul has identified 21 species belonging to 17 genera and 12 families. Among them, species of the class of dicotyledons are the most numerous with a proportion of 95%. *Faidherbia albida* Del. and *Ziziphus mauritiana* Lam. are the most preferred by livestock. Some well-known species among agro-pastoralists serve not only for feeding livestock through various harvesting methods but are also exploited in different sectors of activity including human food, construction,

traditional pharmacopoeia, as a source of energy wood, and for dead hedges. One of the main causes of their destruction is the abusive cutting of trees. Regulatory measures must be put in place to prohibit the abusive cutting of trees by local authorities. It is interesting to extend the study to other agropastoral areas in order to identify other forage plants and understand how they are managed. The results obtained from this study can contribute to the improvement of the management and conservation of forage species in the Sahelian areas characterized by climate degradation.

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