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Forage Diversity and Ecosystem Services in Grazed Areas of the Badenou Classified Forest (FCB)

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Abstract **Original Research Article**

A study was carried out on the forage diversity and ecosystem services of the grazed areas of the Badénou Forest Reserve (FCB). The aim of the study was to assess the forage production potential and identify the ecosystem services of the Badénou Forest. The data collection method was based on an ethnobotanical survey of herders and farmers in the villages surrounding the Forest, followed by a floristic inventory carried out in the areas grazed by the animals. The floristic inventory identified a total of 252 species divided into 196 genera and 63 families. The most common families were, in order of importance, Fabaceae (20.32% or 51 species), Rubiaceae (7.57% or 19 species) and Malvaceae (4.78% or 12 species). Of the total number of species recorded, 62 were identified as fodder species in the grazing areas of the Badenou Forest. They are grouped into 43 genera and 14 families. The most representative families of this forage flora are, according to the degree of importance, the Poaceae (32.26%) with the species Perotis indica (L.) Kuntze which alone has a cover rate of 76.667%, and the Fabaceae (19.35%) with the species Piliostigma thonningii (Schum.) Miln-Redh which has a cover rate of 58.333% of the inventoried area. The species Sida linifolia and Perotis indica, with Csi of 6.28% and 5% respectively, are considered to be very productive species. Overall, the livestock feeding method most commonly used by farmers is natural pasture feeding in the BCF, with a proportion of 87.14%, and the supply service is the most important ecosystem service provided by the BCF, with the response rate (100%) and the consensus value (2.01) given by the respondents. This suggests that the Badenou Forest is an important resource for meeting the vital needs of the surrounding population.

Keywords: Forage diversity, Ecosystem services, Grazed areas, Fodder species, Badenou Forest Reserve.

INTRODUCTION

Natural environments, in this case forests, savannahs and grasslands, have always been the main places providing goods and services to mankind (Sala and Paruelo, 1997; MEA, 2005). Indeed, these ecosystems often abound in fodder species favourable to livestock farming. These forage species make up the bulk of livestock feed in countries where livestock farming is practised (Sala *et al.*, 2017). According to FAO (2000), livestock production accounts for 2% of the world total. In Brazil, for example, it contributes 30.4% of the agricultural gross domestic product (FAO, 2011) and 80% in Mongolia (Enkhbayar, 2002). In Africa, however, this revenue is estimated at 10% of Gross Domestic Product (Ahmat, 2008). In West Africa, 119 million hectares are used by 250 million head of ruminants (FAO, 2012), and livestock farming contributes 44% of agricultural GDP to the livelihoods of around 170 million people living in rural areas (Diop, 2013). However, in Côte d'Ivoire, livestock farming is a secondary activity for most people (Kouamé, 1992; Kouassi *et al*., 2013). This is a traditional activity that needs to be encouraged, as it contributes around 4.5% to GDP (Tra Bi Tra, 2009). Several towns in the country are home to occasional or traditional livestock farming, whether for profit or not. The north and centre of Côte d'Ivoire still have significant resources, estimated at 11 million hectares of rangeland, compared with 40,000 ha

of improved pasture out of a total of 28051000 ha of land that is suitable for livestock farming (MIRAH, 2013; PSDEPA, 2014). The ruminant farming system (cattle and small ruminants), more than 95% of which is traditional and of the extensive sedentary or semi-transhumant type, remains heavily dependent on natural rangelands. Transhumant herds from the Sahel (Mali, Burkina Faso, Niger) migrate towards the coast (Côte d'Ivoire) in search of water, pasture and markets (RPCA, 2009 and 2010; Guibert *et al*., 2009; Corniaux, 2012). Unfortunately, the invasion of grazing land generates socio-ecological constraints due to the non-respect of transhumance corridors, which is often a source of degradation of the vegetation in protected areas. The Badénou classified forest, which is located in the north of Côte d'Ivoire, is an area of intense pastoral activity and is not immune to these constraints. Thus, in a context of sustainable management, there is an urgent need for decision-making tools to ensure the long-term survival of these pastures. To achieve this, a better understanding of the forage flora and the ecosystem services provided by this area is essential. This study was initiated to assess the forage production potential and identify the ecosystem services of the Badénou Classified Forest. More specifically, the first aim is to inventory the current forage flora and identify the various uses provided by the forest.

MATERIEL AND METHODS

Description of the Study Sites

The Badénou classified forest (260980 ha) is located in the north of Côte d'Ivoire between 5° 32' 06‘and 5° 49' 67’ W and 9° 41' 63‘ and 9° 51' 63 ’N, in the town of Korhogo (Figure 1). It belongs to the Sub-Sudanian phytogeographical zone. The vegetation consists of patches of dense dry forest, open forest, gallery forest, wooded savannah, shrub savannah and grassy savannah (Kassé *et al*., 2006, Yaokokoré-Béibro, 2010). The climate is Sudano-Guinean with two seasons. Most of the rain falls between July and September, with an average annual rainfall of 1,200mm. Monthly temperatures vary between 24°C and 29°C (Gboze *et al*., 2020). The population living alongside the Badenou classified forest is predominantly farming, and is made up mainly of Sénoufos and Malinkés. There are also non-natives (Attié, Baoulé, Bété, Lobi) and non-natives from neighbouring countries (Mali, Burkina Faso, Guinea) (Yaokokoré-Béibro, 1995).

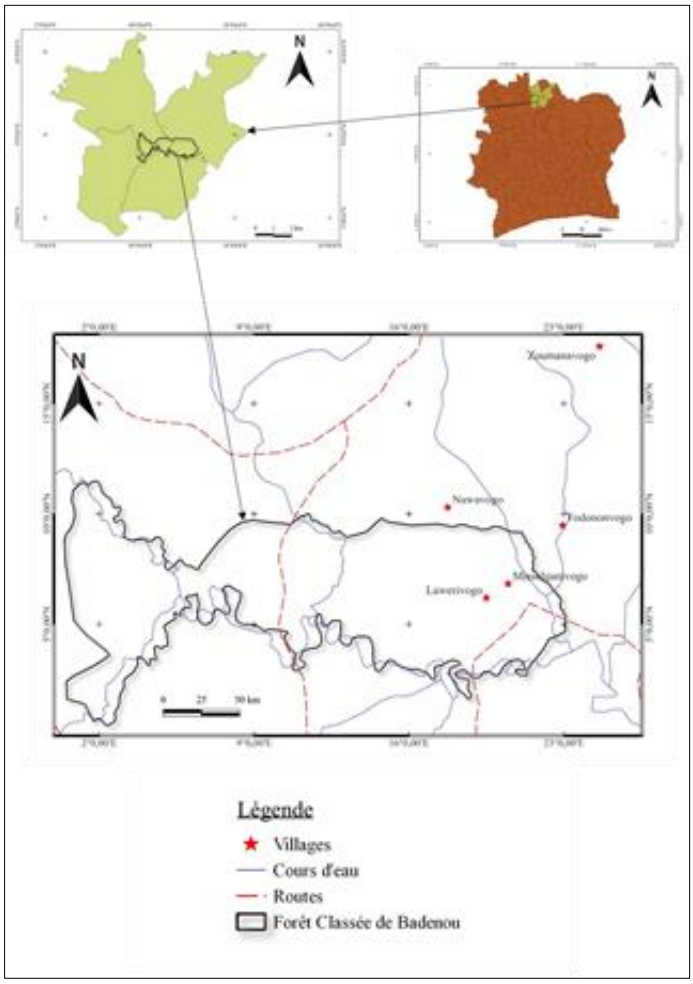

Figure 1: Geographical location of the Badenou classified forest

Data Collection

In this study, the roving survey method was adopted for data collection (AKE ASSI, 1984). This consisted of walking the landscaped university area in all directions, noting all the ornamental plant species encountered. The species encountered were identified and listed. Fertile samples were collected in order to build up a herbarium for verifying direct determinations. These verifications were made using the work of Aké-Assi (2002), Porter *et al*., (2004), Aké-Assi *et al*., (2010) and Aké-Assi E. (2015) and by comparison with specimens in the Herbarium of the Centre National de Floristique (CNF). The nomenclature used in this study is that of the phylogenetic classification of the Angiosperm Phylogeny Group (APG) in its latest version known as (APG IV 2016).

Analysis of the Data

Data were collected by means of an ethnobotanical survey followed by a floristic inventory (Kouassi *et al*., 2010; Atakpama *et al*., 2015). The ethnobotanical survey was carried out among herders and farmers in the villages surrounding the Badenou classified forest.

Five villages identified after a pre-survey were visited. These were Missôlgamvogo, Lawérivogo, Nawavogo, Fodononvogo and Zoumanavogo. A semi-structured questionnaire was submitted to the respondents during the interviews. Its purpose was to identify the grazing areas within the classified Badenou forest and the forage species consumed by the livestock. Respondents were also asked about the various benefits derived from the use of Badenou classified forest resources. A floristic inventory was then carried out on the grazing sites mentioned by the respondents. Two inventory methods were used. These were the roving inventory method and the surface survey method. These inventories were carried out in areas grazed by animals in different biotopes (Gbozé *et al*., 2020), such as open forests, old fallows, young fallows, semi-deciduous forests, etc.). The surface survey was carried out using the classic method of (Braun-Blanquet, 1932). This consists of making an inventory of all the plant species encountered within a 25m x 25m plot, obtained from the minimum area. A total of 60 plots measuring 25 m x 25 m and spaced 200 m apart were set up. For each survey, the following information was recorded: location, nature of substrate, date and harvest number of species present, abundance-dominance indices. These surveys only took into account the herbaceous plants and shrubs present in the biotopes and also throughout the study area (Kouassi *et al*., 2014). The surveys made it possible to draw up a floristic list of all the forage species inventoried. The itinerant inventory carried out between two plots consisted of recording all species not found in the plots (Jongking *et al*., 1999; Aké-Assi L *et al*., 2005; Malan *et al*., 2007, Kouassi *et al*., 2010). Species identification is consistent with the various floras of Africa and Côte d'Ivoire (Hutchinson and Dalziel, 1954-1972; Aké-Assi, 1984; 2001 and 2002). Species not identified in the field were collected and identified by comparison with the National Reference Herbarium of the Centre National Floristique. The nomenclature adopted in this study is that of APG IV (2016).

Data Analysis

Floristic Richness and Composition

The data were analysed to establish the number of species, genera and families, as well as forage types and phytogeographical distributions. The forage types were established on the basis of the different morphological types (Aké-Assi L., 1984). Phytogeographical distribution was based on the work of White (1986). We adopted the APG IV (2016) phylogenetic classification for naming the species listed.

The rank-abundance curve or Whittaker diagram (1965) used in this study revealed the dominance-rarety patterns of the species in the biotopes inventoried. The curve is presented in the form of a graph showing abundance rank (x-axis) and relative abundance (y-axis). Species richness is the number of species ranked, while species evenness is the slope of the line corresponding to the curve (Saeedghalati, M. 2017). This visualisation not only helps to identify dominant and rare species, but also to compare patterns of diversity between different communities or environments (Wilson, 1991).

Frequency and Specific Contribution

The specific frequency of each species (FSi) is obtained by summing the presence of each species in each survey; it is an absolute value (Kouassi *et al*., 2014). It is expressed according to the following formula:

FSi= ni/N * 100

« N » is the total number of plots surveyed, « ni » the number of plots where species « i » is present.

The specific contribution of each species (Csi) based on the formula defined by Daget and Poissonet (1990) is :

Csi = Fsi/ ∑Fsi * 100

With CSi: specific contribution and FSi: specific frequency of species i.

The specific contributions of each species were grouped according to forage type.

Subsequently, the forage species identified were classified as high-producer, low-producer and non-producer species based on the value of their specific contribution (Csi) according to the criteria defined by Daget and Poissonnet (1971) and taken up by Kouassi *et al*., (2014). These authors define:

- highly productive species with CSi > 4 ±1;
- lowly productive species with 1 < CSi < 4;
- non-productive species with Csi< 1.

The classification adopted in this study makes it possible to identify the fodder plant species known as producers (Kouassi *et al*., 2014) and to assess the

contribution of fodder species to biomass production (Kouadja *et al*., 2022).

Evaluation of the Ecosystem Services Provided by the CBF

The ecosystem services cited by the respondents were classified into three categories based on the Millennium Ecosystem Assessment (2005, 2003). These are provisioning services (which concern the products derived from ecosystems, such as food, wood, fibre, etc.); regulating services (which are the benefits derived from the regulation of ecosystem processes) and cultural services (which concern the intangible benefits derived from ecosystems, such as spiritual and religious benefits, heritage and recreation).

The response rate (Tr) for respondents by ecosystem service category was calculated using the following formula (Seastrom, 2001):

$$Tr = ns/N \times 100$$

Tr: response rate at respondent level (%); ns: number of respondents who provided a response for an ecosystem service; N: number of respondents in this category. Tr varies between 0 and 100%. Values close to 0 indicate that many respondents have very limited knowledge of an ecosystem service. On the other hand, values close to 100 indicate that many respondents have a good knowledge of an ecosystem service (Sabi Lolo Ilou *et al*., 2017).

The consensus value of the choice of ecosystem services (UCs) was used to measure the degree of concordance of the choice of ecosystem services made by the respondents. It is obtained from the following expression (Byg & Balslev, 2001):

$$UCs = 2ns/n-1$$

ns is the number of respondents who chose the ecosystem service and n is the total number of respondents. UCs varies between 0 and 4. Values close to 0 indicate that very few respondents agree on the choice of an ecosystem service. On the other hand, values close to 4 indicate that the majority of respondents agree on the choice of an ecosystem service (Sabi Lolo Ilou *et al*., 2017).

RESULTS

Floristic Diversity of Pastures in the Badénou Forest

The floristic inventory carried out on the grazed areas of the FCB identified a total of 252 species divided into 196 genera and 63 families. The most common families were, in order of importance, Fabaceae (20.32% or 51 species), Rubiaceae (7.57% or 19 species) and Malvaceae (4.78% or 12 species). Of the total number of species recorded, 62 make up the forage flora of the grazing areas of the Badenou Forest. They are grouped into 43 genera and 14 families. The most representative families of this forage flora are, according to degree of importance, Poaceae (20 species or 32.26 %), Fabaceae (12 species or 19.35 %), Cyperaceae and Malvaceae (5 species or 8.06 %) and Phyllantaceae (4 species or 6.45 %). The other families (5) are the least represented, each with one species or 1.61% (Figure 2). Analysis of the biological types shows that the forage flora of the FCB is mainly composed of therophytes (24.19%), hemicryptophytes (20.96%), nanophanerophytes (19.35%) and microphanerophytes (14.51%). Epiphytes and megaphanerophytes are the least represented, with a relative frequency of 1.61% each (Figure 3). In terms of phytogeographical distribution, species from the transition zone (GC-SZ) are strongly present in the study area, with a proportion of 65% (Figure 4). They are followed by Guineo-Congolian (GC) species, with 25%, and Sudano-Zambézian (SZ) species with 8%. Introduced species (i) are poorly represented.

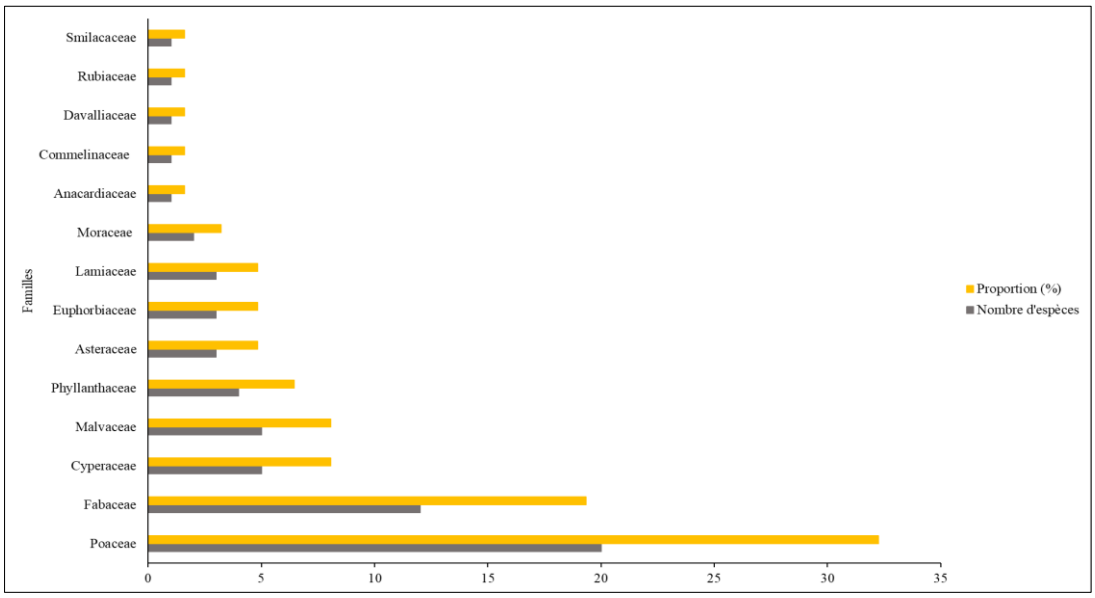

Figure 2: Proportion of forage species families listed in the FCB

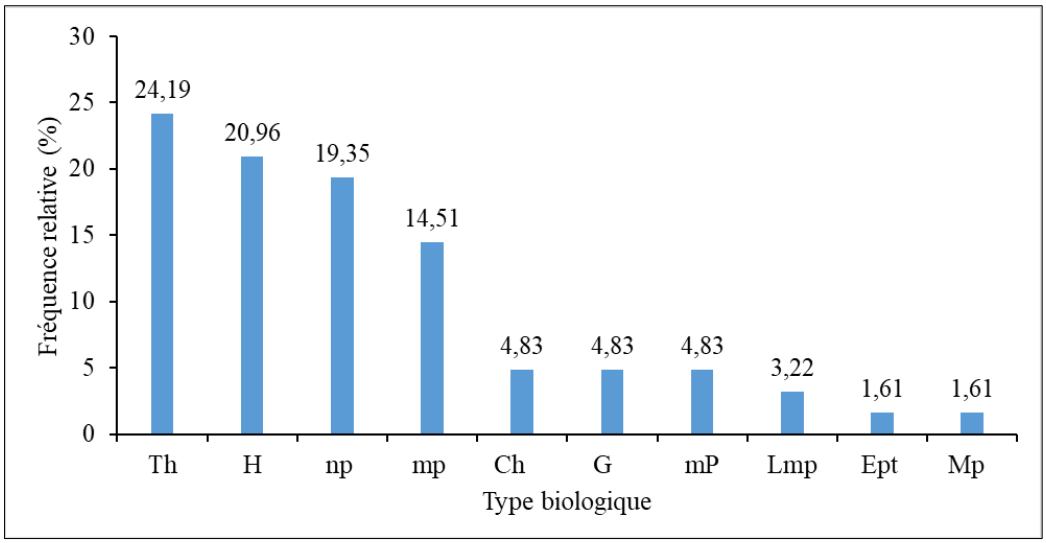

Figure 3: Distribution of FCB forage species according to biological type

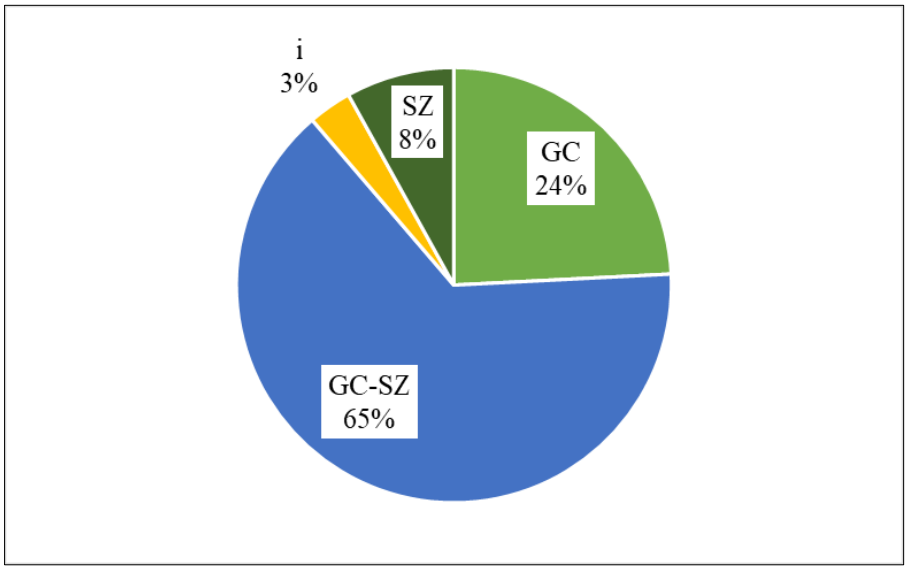

Figure 4: Spectrum of phytogeographic distribution of forage species of the FCB

Forage Importance of FCB Grazed Areas

Of the total forage species recorded in the grazed areas of the Badenou Classified Forest, the species abundance rank diagram shows the notable predominance of Perotis indica (L.) Kuntze and Paspalum conjugatum P. J. Bergius. These two species constitute respectively 26 (6.73%) and 19 (4.92%) of the total individuals sampled (Figure 5).

The abundance of species was also distributed using the abundance ranks of species according to the different pasture areas of the Badenou classified forest. In the open forest, we observe that Paspalum conjugatum P. J. Bergius and Pentodron pentandrus (Schumach. & Thonn.) Vatke dominate with six (10.52%) of all the individuals encountered. These two species are followed by Perotis indica (L.) Kuntze and Sorghum bicolor (Linn.) Moench with the same order of importance of five individuals (8.77%). Regarding the semi-deciduous forest, Andropogon gayanus Kunth and Euphorbia heterophylla Linn are the most abundant fodder plants present with two individuals (5.8%) reported. In the fallow, Panicum afzelii Sw., Panicum maximum Jacq and Perotis indica (L.) Kuntze are co-dominant with four (7.14%) of all the individuals observed (Figure 6).

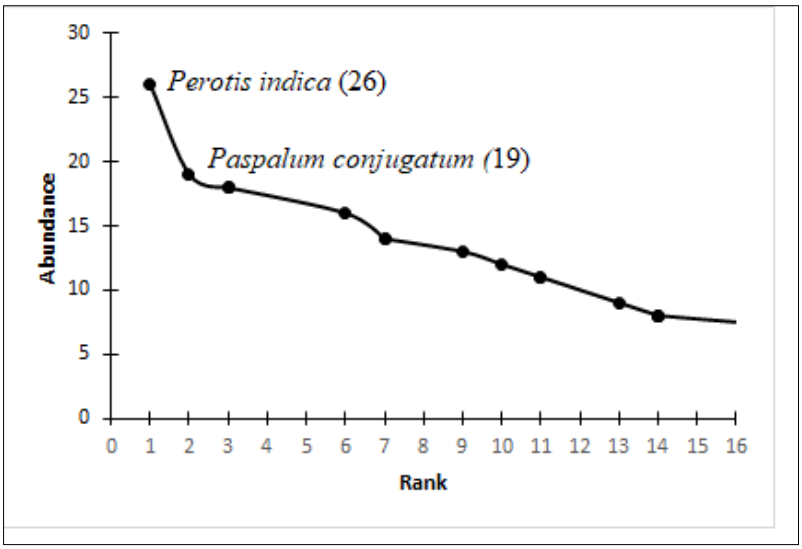

Figure 5: Total abundance rank curve of FCB species

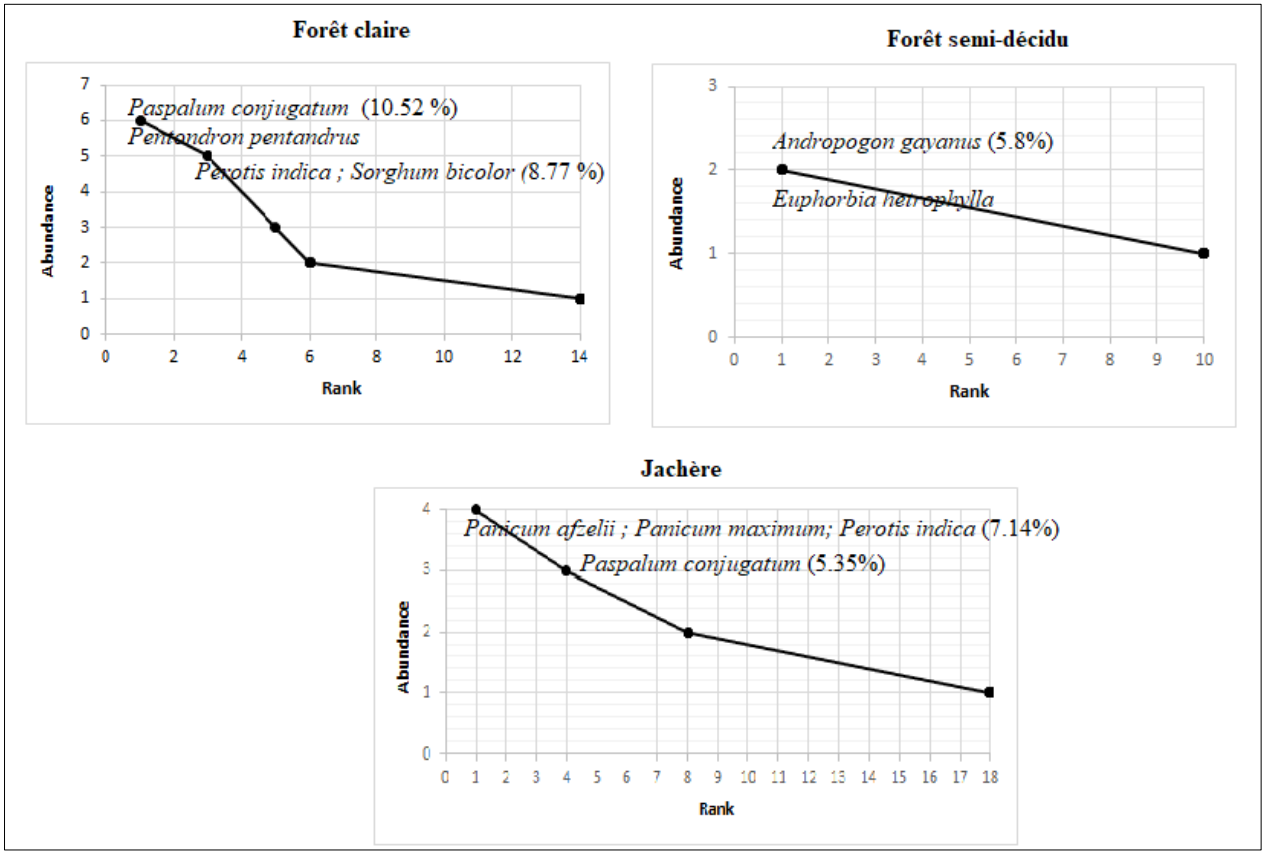

Figure 6: Species abundance rank curves in FCB habitats

Specific Richness of Forage Species Recorded in the FCB

The specific recovery is generally low for the majority of species encountered (less than 50%) in all surveys. According to the specific recovery rate, the species can be classified into two groups. The first group includes species with a recovery rate greater than 50% but represents only 7% of the fodder species recorded. These are Perotis indica (L.) Kuntze (76.667%), Piliostigma thonningii (Schum.) Miln.-Redh. (58.333%), Paspalum conjugatum P. J. Bergius (51.667%) and Ficus exasperata Vahl (51.667%).

The second group includes species with a cover of less than 50%, which includes the largest number of fodder species recorded. Among these species, some have cover rates of more than 40%, these are: Andropogon tectorum Schum. & Thonn., Sporobolus pyramidalis P. Beauv, Sorghum bicolor (Linn.) Moench, Rottboellia cochinchinensis (Lour.) Clayton, Senna occidentalis (L.) Link, Pentodron pentandrus

(Schumach. & Thonn.) Vatke, Paspalum scrobiculatum L. var. scrobiculatum, Panicum maximum Jacq, Panicum repens L., Cynodon dactylon (Linn.) Pers.

Overall, the analysis of Figure 7 shows that species belonging to the other forages category have a greater relative specific contribution (46.28%) than forage Poaceae (43.97%) and forage Legumes (15.08%).

The fodder species found in the grazed areas of the FCB have a specific contribution (Csi) that varies from 6.28 to 0.52 (Table 2). Two species, representing 3.22% of the fodder species, have their specific contribution greater than 4%; they are said to be highly productive species. These are Sida linifolia Juss. ex Cav and Perotis indica (L.) Kuntze with respective Csi of 6.28% and 5%. The low-productivity species represent 64.51% (40 species) of all species. Among these, Piliostigma thonningii (Schum.) Miln.-Redh is the most important with a Csi of 3.66% followed by Ficus exasperata Vahl (3.25%), Paspalum conjugatum P. J. (3.25%) and Panicum maximum Jacq. (3.03%). The remaining 20 forage species, i.e. 32.25%, with a CSi index of less than 1 are classified as non-productive species (Figure 8).

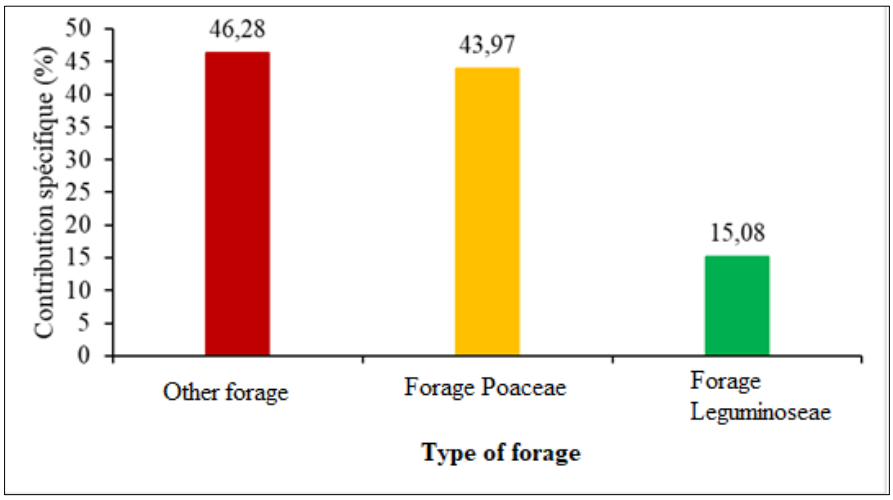

Figure 7: Specific contribution of FCB forage types

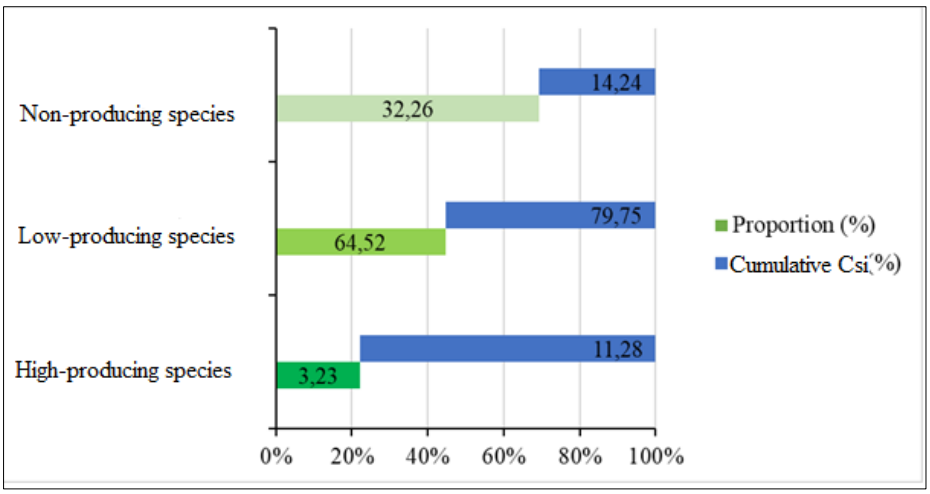

Figure 8: Forage qualities of the species recorded

Ecosystem Services Provided by the Badenou Classified Forest

Sociodemographic Profile of Respondents

The respondents are men with an age ranging from 18 years to over 60 years. Respondents whose age is between 18 and 40 years are the most numerous with a proportion of 65.67%. They are followed by those aged 40 to 60 years with a proportion of 32.83% and those over 60 years with a proportion of 1.49%. The majority of respondents are married (98.5%) and belong to the Senoufo ethnic group (91.04%). Regarding the activities they carry out, 64.67% are farmers, 32.83% are both farmers and livestock breeders, 1.99% practice only livestock breeding and 0.49% agriculture and mechanics (Table 1).

Table 1: Summary of the sociodemographic profile of FCB residents

	Profile variable	Number of citations	Proportion (%)
Sex	Male	201	100
Age	18-40 years	132	65,67
	40-60 years	66	32,83
	Over 60 years old	3	1,49
Marital status	Single	3	1,49
	Married	198	98,5
Ethnic groupe	Malinké	6	2,98
	Peuhl	11	5,47
	Senoufo	183	91,04
	Wolof	1	0,49
Activities	Farmer	130	64,67
	Farmer/Breeder	66	32,83
	Breeder	1	1,99
	Farmer/mechanical	4	0,49

Pastoral Practices

The livestock surrounding the FCB is composed of cattle, goats and sheep (Figure 9). The livestock consisting solely of cattle is the largest in the area with a population of 82.85%. It is followed by livestock composed of cattle/sheep with 32.85%, sheep/goats with 5.51% and sheep with 1.42%. Overall, the method of feeding livestock most practiced by breeders is feeding on natural pasture in the FCB with a proportion of 87.14%, (Figure 6)

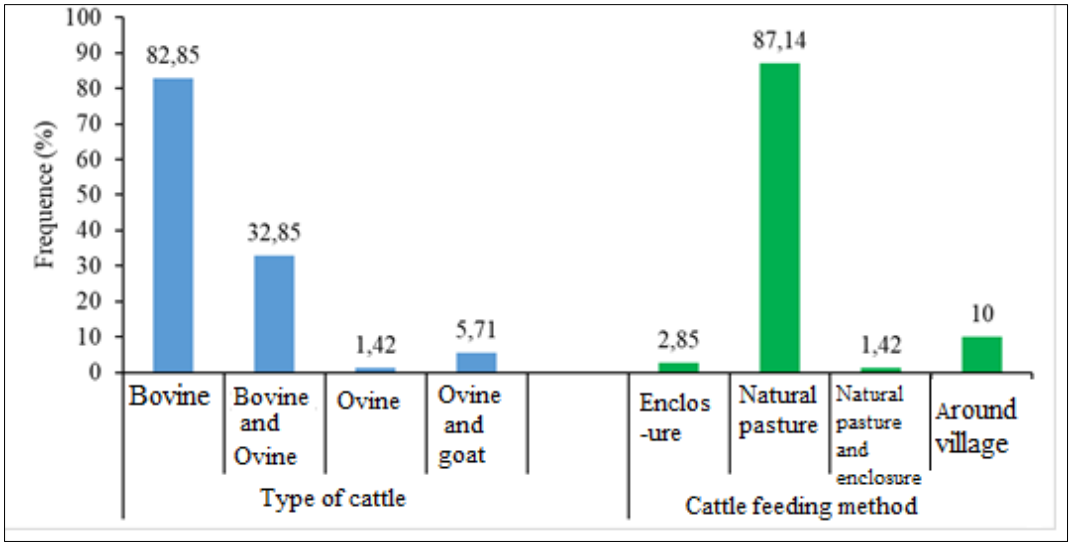

Figure 9: Type of livestock and pastoral practices encountered

Three ecosystem services were identified by residents living near the FCB. The most important service for the population around the FCB is the plant supply service with a response rate of 100%. This is followed by cultural and regulatory services with the same order of importance for the respondents, which is 29.35%. In addition, all the respondents agree that their supply service is essentially derived from the FCB with a consensus value of 2.01 (Table 5).

Table 5: Consensus values and response rates of ecosystem services

Ecosystem services	Number of respondents (ns)	Response rate (Tr)	Consensus value (Ucs)
Cultural service	59	29,35	0,59
Plant Supply Service	201	100	2,01
Regulation service	59	29,35	0,59

The analysis of Figure 10 made it possible to identify three herbal supply services cited by the respondents; These are traditional medicine (99.5%); food (30.85%) and fodder for livestock (22.9%). As for the cultural service provided by the FCB to local residents, it is limited to ritual and mystical sacrifice.

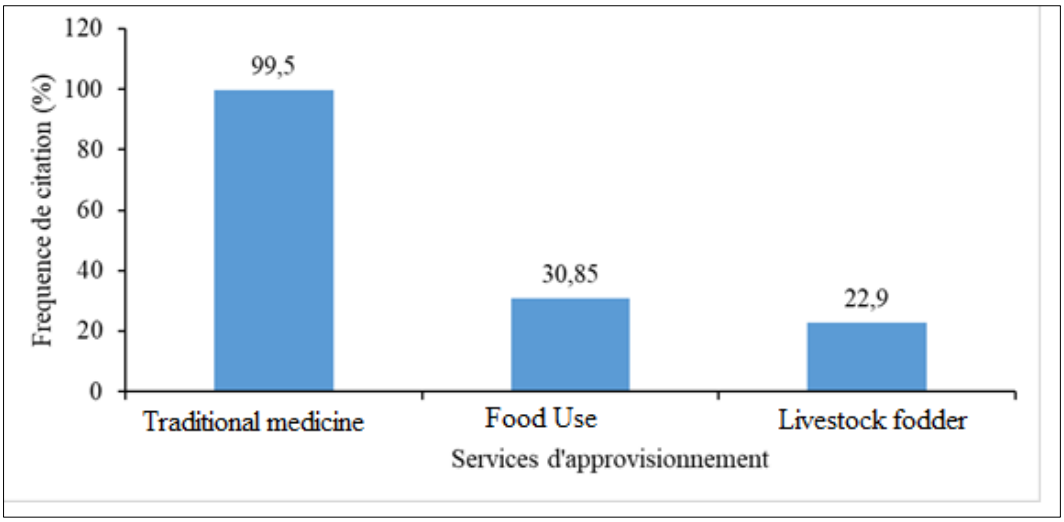

Figure 10: different types of supply services provided by the Badénou classified forest to local populations.

Surveys conducted among the riverside populations of the FCB revealed that 06 species distributed among 6 genera and 4 families are cultivated. The species with the highest frequency of citation are Zea mais (95.04%) and Gossypium hirsutum (87.62%). The least cultivated species are Anacardium occidentalis (1.48%) and Glycine max (0.49%), (Table 2).

Table 2: main species cultivated within the FCB

Number	Species	Common name	Families	Citation frequency (%)
01	*Zea mais*	corn	Poaceae	95,04
02	*Gossypium hirsutum*	cotton	Malvaceae	87,62
03	*Oryza sativa*	rice	Poaceae	72,77
04	*Arachis hypogaea*	peanut	Fabaceae	4,45
05	*Anacardium occidentalis*	Cashew	Anacardiaceae	1,48
06	*Glycine max*	soybean	Fabaceae	0,49

Appendix 1

Species	Family	TB	TC	Fa	R (%)	Cs
Ageratum conizoides L.	Asteraceae	Th	GC-SZ	7	11,667	0,73
Albizia ferruginea (Guill. & Perr.) Benth.	Fabaceae	mP	GC-SZ	13	21,667	1,36
Andropogon gayanus Kunth	Poaceae	H	GC-SZ	16	26,667	1,68
Andropogon tectorum Schum. & Thonn.	Poaceae	H	GC-SZ	25	41,667	2,62
Antiaris toxicaria Leschen.	Moraceae	mP	GC-SZ	19	31,667	1,99
Axonopus compressus (Sw.) P. Beauv.	Poaceae	H	GC	24	40	2,51
Bridelia atroviridis Müll. Arg.	Phyllanthaceae	mp	GC	22	36,667	2,3
Bridelia ferruginea Benth.	Phyllanthaceae	mp	GC-SZ	9	15	0,94
Centrosema pubescens Benth.	Fabaceae	Lmp	GC	13	21,667	1,36
Commelina benghalensis L.	Commelinaceae	Ch	GC-SZ	10	16,667	1,05
Corchorus olitorius L.	Malvaceae	np	GC-SZ	10	16,667	1,05
Croton hirtus L'Hérit.	Euphorbiaceae	np	GC	21	35	2,2
Cynodon dactylon (Linn.) Pers.	Poaceae	H	GC-SZ	25	41,667	2,62
Cyperus sphacelatus Rottb.	Cyperaceae	H	GC-SZ	16	26,667	1,68
Desmodium adscendens (Sw.) DC. var. adscendens	Fabaceae	Ch	GC	10	16,667	1,05
Desmodium ramosissimum G. Don	Fabaceae	np	GC-SZ	6	10	0,63
Desmodium salicifolium (Poir.) DC.	Fabaceae	np	GC-SZ	6	10	0,63
Desmodium velutinum (Willd.) DC.	Fabaceae	np	GC-SZ	6	10	0,63
Dichrostachys cinerea (L.) Wight & Arn.	Fabaceae	mp	GC-SZ	5	8,3333	0,52
Digitaria horizontalis Willd.	Poaceae	Th	GC-SZ	8	13,333	0,84
Euphorbia heterophylla Linn.	Euphorbiaceae	Th	GC	24	40	2,51
Ficus exasperata Vahl	Moraceae	Mp	GC-SZ	31	51,667	3,25
Fimbristylis ferruginea (L.) Vahl.	Cyperaceae	H	SZ	24	40	2,51
Fimbristylis litttoralis Gaud.	Cyperaceae	Th	GC	19	31,667	1,99

Hymenocardia acida Tul.	Phyllanthaceae	mp	GC-SZ	12	20	1,26
Hyparrhenia rufa (Nees) Stapf	Poaceae	H	GC-SZ	11	18,333	1,15
Hyptis lanceolata Poir.	Lamiaceae	np	GC-SZ	9	15	0,94
Hyptis specigera Lam.	Lamiaceae	Th	SZ	5	8,3333	0,52
Hyptis suavolensis (L.) Poit.	Lamiaceae	Th	GC-SZ	7	11,667	0,73
Imperata cylindrica (L.) Raeus.	Poaceae	G	GC-SZ	10	16,667	1,05
Kyllinga erecta Schuma. var. africana (Kük) H.	Cyperaceae	G	GC-SZ	11	18,333	1,15
Mangifera indica L.	Anacardiaceae	mP	i	8	13,333	0,84
Manihot esculenta Crantz	Euphorbiaceae	mp	i	12	20	1,26
Margaritaria discoïdea (Baill.) Webster	Phyllanthaceae	mp	GC-SZ	14	23,333	1,47
Mariscus flabelliformis Kunth var. flabelliformis	Cyperaceae	H	GC-SZ	7	11,667	0,73
Nephrolepis biserrata (Sw.) Schott	Davalliaceae	Ept	GC	6	10	0,63
Panicum afzelii Sw.	Poaceae	Th	SZ	17	28,333	1,78
Panicum maximum Jacq.	Poaceae	H	GC	29	48,333	3,04
Panicum repens L.	Poaceae	G	GC-SZ	25	41,667	2,62
Paspalum conjugatum P. J. Bergius	Poaceae	Sto	GC	31	51,667	3,25
Paspalum scrobiculatum L. var. scrobiculatum	Poaceae	H	GC-SZ	26	43,333	2,72
Pennisetum pedicellatum Trin.	Poaceae	Th	GC-SZ	10	16,667	1,05
Pennisetum polystachion (L.) Schult.	Poaceae	Th	GC-SZ	9	15	0,94
Pentodron pentandrus (Schumach. & Thonn.) Vatke	Rubiaceae	Ch	GC-SZ	22	36,667	2,3
Perotis indica (L.) Kuntze	Poaceae	Th	GC-SZ	46	76,667	4,82
Piliostigma thonningii (Schum.) Miln.-Redh.	Fabaceae	mp	GC-SZ	35	58,333	3,66
Rottboellia cochinchinensis (Lour.) Clayton	Poaceae	Th	GC-SZ	27	45	2,83
Senna occidentalis (L.) Link	Fabaceae	np	GC-SZ	25	41,667	2,62
Senna siamea (Lam.) H.S. Irwin & Barneby	Fabaceae	mp	GC-SZ	7	11,667	0,73
Senna tora (L.) Roxb.	Fabaceae	np	GC	6	10	0,63
Setaria barbata (Lam.) Kunth	Poaceae	Th	GC-SZ	19	31,667	1,99
Sida acuta Burm. f.	Malvaceae	np	GC	21	35	2,2
Sida garkena Pel.	Malvaceae	np	GC	10	16,667	1,05
Sida linifolia Juss. ex Cav.	Malvaceae	np	GC	9	15	6,28
Sida urens L.	Malvaceae	np	GC	5	8,3333	0,52
Smilax anceps Willd.	Smilacaceae	Lmp	GC-SZ	5	8,3333	0,52
Sorghum bicolor (Linn.) Moench	Poaceae	Th	SZ	26	43,333	2,72
Sporobolus pyramidalis P. Beauv.	Poaceae	H	GC-SZ	25	41,667	2,62
Vernonia colorata (Willd.) Drake	Asteraceae	mp	GC-SZ	8	13,333	0,84
Vernonia guineensis Benth.	Asteraceae	H	SZ	8	13,333	0,84
Zea mays Linn.	Poaceae	Th	GC-SZ	11	18,333	1,15
Zornia glochidiata Reichb. ex DC.	Fabaceae	Th	GC-SZ	12	20	1,26

DISCUSSION

The low number of fodder species recorded compared to the work of Kouassi *et al*., (2010; 2020) is explained by the difference in the environments inventoried. Indeed, the work of these authors took into account all the areas grazed by livestock biotopes encountered along the coastal strip of Port-Bouët and Grand-Bassam, unlike this study which essentially focused on the grazed areas of the FCB. However, compared to the number of forage species in the Alibi 1 community forest pasture series in Togo and that of the Kumbungu district in northern Ghana, we note that they are less numerous than ours with 51 and 59 forage species recorded respectively (Atakpama *et al*., 2022; Ziblim *et al*., 2015). This fact testifies to the floristic richness of the Ivorian plant formations. The high proportion of species from the Poaceae, Fabaceae and Cyperaceae families observed confirms the FCB's belonging to the sub-Sudanian phytogeographic zone characterized by islands of dense dry forests, open forests, gallery forests, wooded savannas, shrub savannas, and grassy savannas (Yaokokoré-Béibro, 2010). This is also reflected in the high representation of species from the Transition zone (65%) and species from the Guineo-Congolese zone (25%). These observations have already been reported by the work of YOKA *et al*., 2013, Kouassi *et al*., 2014 and Amegbenyuie *et al*., (2023) at the level of the composition of the forage flora. Furthermore, according to Amegnaglo *et al*., (2018) and Ibrahim-Naim *et al*., (2021), the dominance of Poaceae associated with Fabaceae in the floristic procession is a sign of quality and high forage potential of the grazed areas of the FCB. This justifies the exploitation of the FCB as a preferred area for livestock feeding by local residents. The relatively high proportion of therophytes (24.19%) followed by hemicryptophytes (20.96%) and nanophanerophytes (19.35%) reflect the beginning of degradation of the pastures found within the FCB (César, 1991). Degradation certainly due to overgrazing, the

advancement of the agricultural frontier and climate change (Amegbenyuie *et al*., 2023). Hence the need to implement a sustainable management plan for the FCB. Furthermore, for Durma *et al*., (2018), this degradation of anthropogenic and environmental origin is likely to have led to a modification of the structure and composition of the flora of the rangelands. This observation is reflected in the method of feeding livestock mainly practiced by breeders in the area, which is natural pasture feeding in the FCB. Nevertheless, the relatively high response rates for cultural (29.35%) and regulatory (29.35%) services indicate the level of knowledge of the populations regarding the different goods they can obtain from a forest. It can be deduced that the Badenou Classified Forest is an important resource in meeting the vital needs of the surrounding population.

CONCLUSION

Our work carried out has enabled us to inventory 252 species divided into 196 genera and 63 families. Of the total number of species recorded, 62 were identified as forage species in the grazing areas of the Badénou Classified Forest. They are grouped into 43 genera and 14 families. The most representative families of this forage flora are, according to the degree of importance, the Poaceae (32.26%) with the species Perotis indica (L.) Kuntze which alone has a coverage rate of 76.667%, and the Fabaceae (19.35%) with the species Piliostigma thonningii (Schum.) Miln.-Redh which has a coverage rate of 58.333% of the inventoried area. The species Sida linifolia and Perotis indica are considered highly productive species. Overall, the most common livestock feeding method used by livestock farmers is natural pasture feeding in the FCB, with a proportion of 87.14%, and the provisioning service is the most important ecosystem service provided by the FCB. The Badénou Classified Forest remains an important resource for the surrounding population.

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