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Floristic Composition of Grass Species in the Parklands of the Commune of Aguié and Mayahi, Niger West Africa

Ado Adamou Matalabi[1], Moussa Soulé[2*], Ibrahima Djibo Bassirou[3] and Saadou Mahamane[1]

[1]Département de Biologie, Faculté des Sciences et Techniques, Université Dan Dicko Dankoulodo de Maradi, BP 465, Maradi, Niger
[2]Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana
3University of Ibadan, Ibadan, Nigeria
**Corresponding author*

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A B S T R A C T

Floristic studies play an important role in assessing of plant biodiversity, conservation and sustainable management of ecosystem resources. Therefore, this study tried to determine the floristic composition and socio-economic importance of the *Poaceae*flora in the commune of Aguié and Mayahi. We used plot method based on systematic random sampling technique to inventory gramineae species within the parklands in August and September 2012. The grass flora of the two communes is composed of 45 species, divided into 27 genera and 8 tribes in 106 relevés. The grass flora of the commune of Aguié is composed of 41 species distributed in 25 genera and 8 tribes, while The Commune of Mayahi comprises 6 tribes, 21 genera and 38 species. The ethnobotanical survey realized on a sample of 52 persons that revealed that the grass flora provides a myriad of benefits to the people of the two communes. The grass species contribute a lot in the livelihoods the populations. The study revealed the main uses that the populations make of these species are pastoral, agricultural, socio-economic, ecological etc. This study recommends further research that examines the impact of human activities on the grass flora of the two communes.

Introduction

The Gramineae or *Poaceae* provide humanity throughout the world, from very remote times, with high-value foods as well as the food of its herds and raw materials of great importance (Jacques Felix, 1962). They are found all over the world in all forms of climate (Jacques-Félix, 1962). In the Sahel, they occupy the largest area of the herbaceous stratum (Descoings, 1975a, Tracol, 2004). Poaceae is the first largest botanical families in flora of the Commune of Aguié and Mayahi (Soulé *et al*. 2016a and 2016b). Moreover, they constitute the basic elements of the resilience of an ecosystem disrupted by their capacity to settle in the first year after fallowing (Achard *et al*. 2001). In Niger, there are at least 260 species of Poaceae that play an important economic and ecological role (Saadou, 2006a). They are used in many fields such as construction, pasture, livestock feeding, etc. However, the recurrent droughts of recent years, crossed with anthropogenic

actions, lead to their reduction, especially in the case of perennial grasses. Before the 1970s, for instance, the excess rainfall period, Penning and Djetèye (1982, in Tracol 2004) mention the greater presence of perennial grasses in the Sahel, but the pressure of droughts in recent years Make them disappear in favor of annual species (Achard *et al*.2001). Added to the grass species are under threat due to unsustainable agricultural practices such as the use of fire, inappropriate use of chemicals, and over grazing in Niger. Such pressure may lead to the reduction of the grass flora.

Niger is a country of pastoralism. Grass species are of great importance to the pasture. This study aims at providing grass floristic information for their sustainable management. In Niger, several studies have been conducted, including the work of Garba (1984), Saadou (1984), Saadou (1990), Mahamane (1997), Mahamane (2005), and Morou (2010). These studies have all been carried out on vegetation in general. The work of Saadou (2006) on the anatomy of certain species of Poaceae and those of Poilecot (1999) on "The Poaceae of Niger" also constitute a reference for the knowledge of this family. Nevertheless, in this context of climate change coupled with land degradation due human activities, it is necessary to know the species located in different localities in order to control their distribution well and to draw up the definitive list for Niger. This study aims at providing the list of grass species in the agroforestry systems of the commune of Aguié and Mayahi in Niger. Furthermore, the overall objective of this study is to contribute to the knowledge of the Poaceae family and to understand its importance in the socio-economic activities of the population of Aguié and Mayahi communes with a view to sustainable management. The study area is located in the southern belt of the country, which accounts for ¾ of the agricultural and agro-pastoral population (CNEDD, 2009).

Materials and Methods

Study area

Our study areas were the commune of Aguié and Mayahi in the Maradi region (Figure 1). The two communes belong to the Sahelian compartment (B2) according to the national classification proposed by Saadou (1990). The commune of Aguié is situated between 07.56 ° and 07.85 ° East longitude and 13.23 ° and 13.74 ° North Latitude. While the Commune of Mayahi is located on 13 ° 57'48.2"N and 007 ° 40'19"E in the northeast of the region of Maradi, in the center of the department bearing the same name. The Commune of Aguié is on a relief little movement outside a few localities. It is generally characterized by a large sandy plateau with much larger planar surfaces and small depressions. The maximum altitude is 472 m (PDC Aguié, 2008). Whereas the relief of Mayahi is characterized by a succession of dune plateaus throughout the extent of the Commune and the depression of the Goulbi N'kaba valley. The climate of Aguié is south sahelian and the climate is of the northern Sahelian type (Saadou, 1990).Graph 1 shows the evolution of rainfall variances of the commune of Aguié over the last 13 years. The analysis of this curve shows a gradual decrease in rainfall. Indeed, since 2003, year of higher rainfall, the values decrease until 2012 where a positive gap is recorded, with a cumulative of 627.5mm. The mean value of these 13 years is 521.59 mm.

Graph2 shows the change in rainfall variability over the past nine (9) years of the commune of Mayahi. The wettest years are the years 2010, 2011 and 2012 and the less are 2009 and 2006. The mean rainfall for these 9 years is 382.23 mm. Values show

wide fluctuations, confirming the Sahelian character of the area, with a tendency to increase over the last three (3) years.*Pennisetum typhoides* and Sorghum *bicolor* are the main food crops grasses species in the two communes.

Data collection

The floristic survey took place in August and September 2012, which is the period of the maturity of herbaceous vegetation in Sahel (Saadou, 1990). We used a systematic random sampling approach to collect the vegetation data due to the homogeneity of the milieu. Plots of size 50 m x 50 m (2500 m^2) were used, one subplots of 100 m^2 (10 m x 10 m) were used, corresponding to the minimum areas for agroforestry and steppe vegetation (Mahamane and Saadou, 2008).Plots were laid systematically at every 500 m along transect lines, which were 500 m apart from each other. Ringing pole and GPS were used the fieldwork.

The plots were shown in Figure 1. We did firstlySystematic counting of all the herbaceous plant species in the subplot of 100m^2 and secondly in the large plot. The grass species outside the plots were counted. We used two approaches for specie identification. During of the survey, samples of all the species encountered are harvested and placed in a herbarium. Some of these samples were determined in the field and others at the laboratory level from the following floras:

- Illustrated flora of Senegal (Berhaut, 1967, 1975, 1976, 1979): Tomes II, III, IV and V;
- Flora of Senegal (Berhaut,1967);
- The Poaceae of Niger (Poilecot,1999);
- Adventrop (1995).

Ethnobotany is the study of the relations between man and the plant. Thus, in the study of the flora or vegetation of a given territory, it is essential to combine excursions on the ground with local knowledge in order to better appreciate their importance. Indeed, scientific knowledge is always the reflection or complement of traditional knowledge.We used also a questionnaire for ethnobotanical data.

Data analysis

We taped all the herbaceous vegetation data in Excel. After, the grass vegetation data were extracted from entire species inventoried in the two communes.

Results and Discussions

Grass floristic composition of the two communes

For this study, the grass flora of the two communes is composed of 8 tribes, 27 genera and 45 species (Table 1). The best-represented tribes are Paniceae, 17 species (37.78%), Eragrostideae, 9 species (20.00%), Andropogoneae, 6 species (13.33%) and Chlorideae, 6 species 33%). These four tribes represent the majority of the flora, totaling 84.44% of the species listed.

In terms of genera analysis, Eragrostis, Panicum, Aristida and Digitaria are the best represented. Nine (9) genera only contain at least two species whereas all 18 other species are monospecific (Table 2).

The grass flora of the two communes is composed of 45 species, divided into 27 genera and 8 tribes. This flora represents the 19.48% of the 231 species of *Poaceae* of Niger, according to Poilecot (1999). Saadou estimates this number at more than 260 species (2006). Analysis of the results shows that there is not a great difference in the floristic composition of the two communes.

The few species absent in the Commune of Mayahi (Table 3) have all been harvested in particular areas such as the SajaManja pond and the Bakabé forest, south of Aguié Commune. All authors who worked on the flora of Niger, except Garba (1984), confirmed the dominance of *Poaceae*. Apart from this dominance, the proportion of this family in the flora of an area is also important to demonstrate. Indeed, the comparison with other studies shows a quasi-constant percentage relative to the whole of the flora, being between 15 and 20% (Table 4). For the tribes, this study shows that *Paniceae* are the most dominant (37.78%), followed by *Eragrostideae* (20.4%), *Andropogoneae* and *Chlorideae* (13.33% each).

In Niger, there have been no detailed studies of the tribes, with the exception of the Poilecot (1999) work on the *Poaceae* of Niger. Thus, of the fifteen tribes reported by the latter, eight (8) were found in this study, about 53.33% of the whole, which explains the richness of the grassy flora of the area. Moreover, the order of importance at the level of the first four tribes is the same as that found by this author.

A permutation then took place for the fifth and sixth tribes. Indeed, for him, the Aristideae come after the *Sporoboleae* whereas for this study it is the *Sporoboleae* that come after the *Aristideae*. This can be explained by the diversity of environments explored by this author, and therefore this study, having been conducted on a small scale, does not allow to systematically reflecting the order.

The proportions of these different tribes are given in Table 4 for both studies. For genera, we noted a dominance of the genus *Eragrostis*, *Panicum*, *Aristida* and *Digitaria*. For Poilecot, after *Eragrostis* and *Panicum*, the genera *Sporobolus* and *Brachiaria* come.

Socio-economic-importance of grass species in the two communes

Grass food species

Apart from food crops (*Pennisetum typhoides, Sorghum bicolor, Zea mays*), there are not many wild grass food species in the study area. Nevertheless, *Dactyloctenium aegyptium* and *Cenchrus biflorus* were once consumed during the great famines that were raging in the area according to the respondents.

Grass forage species

Analysis of the data questionnaire show that the most cited forage species are *Eragrostis tremula* with 34.88% citation frequency, followed by *Cenchrus biflorus* (17.83%), *Dactyloctenium aegyptium* (13.18%), *Andropogon gayanus* (9.30%). Figure 33 shows the proportion of the ten most cited grass species as pastoral species by the 52 interviewed persons. For sale, the unit varies according to the period. Thus, during the rainy season, the species *Eragrostis tremula*is weeded by the children and sold in bags. The price varies from 100 to 250 CFA depending on the size of the bags. When mature, it is mowed and tied in small units called "koullâssa" in Hausa, then gathered in boots (Photo 1). The price of a boot varies according to the season: At the time of harvest, it is sold between 150 to 250 CFA, whereas at the end of the dry season and at the beginning of the rainy season, the same boot can be sold at 750 CFA and Sometimes up to 1000F.

Grass species used in the roof of huts

The analysis of the figure 5 shows that the most cited grass species used in the roof of huts are *Ctenium elegans* (46.43%), *Eragrostis tremula* (23.21%), *Andropogon gayanus* (12.50%) and *Pennisetum*

pedicellatum (8.93%). As for the price, the unit of sale is the boot. The price varies according to the season and the species. Several criteria are also taken into account including the beauty of the roof, protection against rain and especially the lifetime of the roof. Table 5 gives the average boot price of the different species used for roofing. Analysis of this table5 shows that the most expensive species is *Ctenium elegans*, followed by *Andropogon gayanus*,*Pennisetum pedicellatum* and *Eragrostis tremula* in last position. Indeed, *Ctenium elegans* is cultivated in association with crops in the fields for commercialization. Its choice on other species is justified by the fact that it lasts long in a roof and is recyclable. The minimum duration of a well-made roof made of Ctenium elegans is 10 years and can be recycled two to three times, with a reduction in the age of each cycle. Thus, in several villages such as Guidan Tanko, Guidan Nahantchi, Bakabé (Aguié) and Koran Habjia, Kotaré (Mayahi), the specie is strongly cultivated in association with millet or even in monoculture, for those who have enough land.

Grass species indicators of the soil fertility

The interview with the local population made it possible to identify 10 species mentioned with regard to soil fertility. For example, some species considered indicators of good soil fertility, for some people are indicators of impoverished soil. The different species cited for this purpose are:

Eragrostis tremula: 50% of those respondents consider it to be an indicator of good fertility, 35% recognize it as an indicator of poor fertility, while the 15% consider it to be a non-preference specie found in all environments.

• ***Dactyloctenium aegyptium***: 100 % of those respondents consider this specie to be indicator of good soil fertility.

• ***Cenchrus biflorus***: It is also recognized as indicators of good soil fertility. Some, moreover, explain the diminution of this specie due to the lack of fallows, considering it is a specie of fallow.

• **Pennisetum pedicellatum**: 66.66% of people consider this specie to be an indicator of good fertility, while for 33.33% it is an indicator of poor soil fertility.

• **Ctenium elegans**: Indicator of good fertility, this specie has even disappeared in the natural state because of the non-existence of the fallows, explained the respondents.

Table.1 Number of species and genera by tribe of Poaceae

Tribes	Genera	%	Species	%
Paniceae	7	25,93	17	37,78
Eragrostideae	5	18,52	9	20,00
Andropogoneae	6	22,22	6	13,33
Chlorideae	5	18,52	6	13,33
Aristideae	1	3,70	4	8,89
Sporoboleae	1	3,70	1	2,22
Oryzeae	1	3,70	1	2,22
Maydeae	1	3,70	1	2,22
Total	27	100,00	45	100,00

Table.2 Number of species per genus of the Poaceae family

Genera	Species	Percentage (%)
Eragrostis	5	11.11
Panicum	5	11.11
Aristida	4	8.89
Digitaria	3	6.67
Brachiaria	2	4.44
Cenchrus	2	4.44
Chloris	2	4.44
Echinochloa	2	4.44
Pennisetum	2	4.44
Andropogon	1	2.22
Anthephora	1	2.22
Ctenium	1	2.22
Cymbopogon	1	2.22
Cynodon	1	2.22
Dactyloctenium	1	2.22
Dinebra	1	2.22
Eleusine	1	2.22
Elionurus	1	2.22
Heckelochloa	1	2.22
Microchloa	1	2.22
Oryza	1	2.22
Schisachyrium	1	2.22
Schoenefeldia	1	2.22
Sorghum	1	2.22
Sporobolus	1	2.22
Tripogon	1	2.22
Zea	1	2.22
Total	45	100.00

Table.3 Proportion of Poaceae according to different studies

Authors	Total species recorded	Grass Species	Percentage (%)
Saadou (1990)	857	168	19.51
Mahamane (2005)	1068	218	20.4
Morou (2010)	224	34	15.2
Idrissa (2011)	252	49	19.44
Current Study	273	45	16.48

Table.4 Proportion of tribes according Poilecot findings (1999) and our findings

	Poilecot (1999)	Current study
Tribes	Percentage (%)	
Paniceae	30.7	37.78
Andropogoneae	25.5	20
Eragrostideae	12.1	13.33
Chlorideae	7.3	13.33
Aristideae	6.1	8.89
Sporoboleae	6.5	2.22
Oryzeae	2.5	2.22

Table.5 Average price per bunch of different forage species

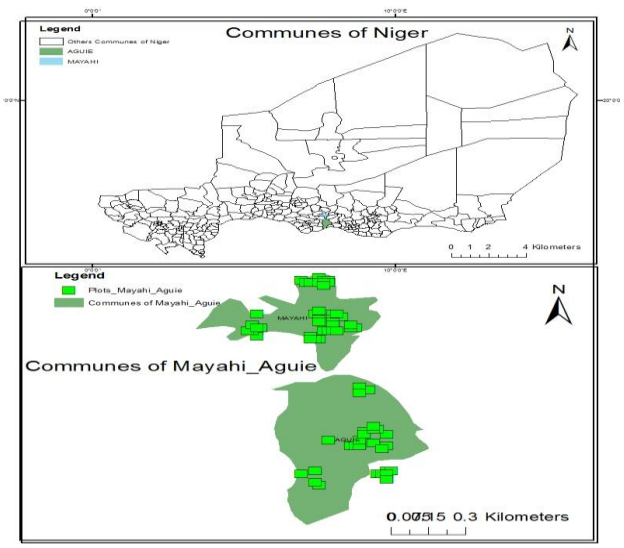
Grass Species	**Average price (±Standard deviation)**
Ctenium elegans	1377 (± 654.31)
Andropogon gayanus	1055.56 (± 766.79)
Pennisetum pedicellatum	861.11 (± 221.53)
Eragrostis tremula	419.70 (± 213.02)

Table.6 List of the Grass Species in the two communes

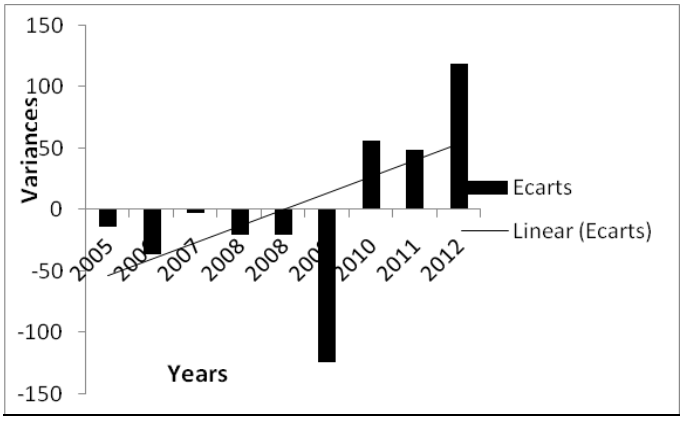
Tribes	**Genera**	**Grass Species**	**Aguié**	**Mayahi**
Andropogoneae	*Andropogon*	*Andropogon gayanus* Kunth. Var. gayanus	+	+
Andropogoneae	*Elionurus*	*Elionurus elegans* Kunth	+	
Andropogoneae	*Heckelochloa*	*Heckelochloa granularis* (L.) Kuntze	+	
Andropogoneae	*Schisachyrium*	*Schisachyrium exile* (Hochst.) Pilger	+	+
Andropogoneae	*Sorghum*	*Sorghum bicolor* (L.) Moench	+	+
Andropogoneae	*Cymbopogon*	*Cymbopogon schoenanthus* (L.) Spreng. Subsp. Proximus (A, Rich.) Maire et Weila	+	
Aristideae	*Aristida*	*Aristida mutabilis*Trin et Rupr.	+	+
Aristideae	*Aristida*	*Aristida adscensionis* L.	+	+
Aristideae	*Aristida*	*Aristida sieberiana*Trin.	+	+
Aristideae	*Aristida*	*Aristida stipoides* Lam.	+	+
Chlorideae	*Chloris*	*Chloris pilosa*Schumach	+	+
Chlorideae	*Chloris*	*Chloris prieurii*Kunth.	+	+
Chlorideae	*Ctenium*	*Ctenium elegans*Kunth	+	+
Chlorideae	*Schoenefeldia*	*Schoenefeldia gracilis*Kunth	+	+

Chlorideae	*Cynodon*	*Cynodon dactylon* (L.) Pers		+
Chlorideae	*Microchloa*	*Microchloa indica* (L. f.) P. Beauv.	+	+
Eragrostideae	*Eragrostis*	*Eragrostis tremula*Steud.	+	+
Eragrostideae	*Eragrostis*	*Eragrostis atrovirens* (Desf.) Steud.	+	+
Eragrostideae	*Eragrostis*	*Eragrostis tenella* (L.) Roem. &Schult.	+	+
Eragrostideae	*Eragrostis*	*Eragrostis turgida* (Schumach.) De Wild.		+
Eragrostideae	*Eragrostis*	*Eragrostis ciliaris* (L.) R. Br.	+	
Eragrostideae	*Tripogon*	*Tripogon minimus* (A. Rich.) Steud.	+	
Eragrostideae	*Dactyloctenium*	*Dactyloctenium aegyptium* (L.) P. Beauv.	+	+
Eragrostideae	*Dinebra*	*Dinebra retroflexa* (Vahl.) Panzer	+	+
Eragrostideae	*Eleusine*	*Eleusine indica* (L.) Gaertn.	+	+
Maydeae	*Zea*	*Zea mays* L.	+	+
Oryzeae	*Oryza*	*Oryza barthii* A. Chev.	+	
Paniceae	*Panicum*	*Panicum nigerense* Hitch.	+	+
Paniceae	*Panicum*	*Panicum subalbidum*Kunth.	+	+
Paniceae	*Panicum*	*Panicum laetum*Kunth	+	+
Paniceae	*Panicum*	*Panicum turgidum*Forsk.	+	+
Paniceae	*Panicum*	*Panicum anabaptistum*Steud.	+	+
Paniceae	*Brachiaria*	*Brachiaria xantholeuca* (Hack. ex. Schinz) Stapf	+	+
Paniceae	*Brachiaria*	*Brachiaria ramosa* (L.) Stapf.	+	+
Paniceae	*Cenchrus*	*Cenchrus biflorus*Roxb.	+	+
Paniceae	*Cenchrus*	*Cenchrus ciliaris* L.	+	+
Paniceae	*Digitaria*	*Digitaria horizontalis*Willd.	+	+
Paniceae	*Digitaria*	*Digitaria gayana* (A.) Chev.	+	+
Paniceae	*Digitaria*	*Digitaria argillacea* Hitch. et Chase) Fern.	+	+
Paniceae	*Echinochloa*	*Echinochloa colona* (L.) Link	+	+
Paniceae	*Echinochloa*	*Echinochloa stagnina* (Petz.) P. Beauv.	+	
Paniceae	*Pennisetum*	*Pennisetum pedicellatum*Trin.	+	+
Paniceae	*Pennisetum*	*Pennisetum typhoides* (Burm.) Stapf& C. E. Hubb.	+	+
Paniceae	*Anthephora*	*Anthephora nigritana*Stapf. etHubb.		+
Sporoboleae	*Sporobolus*	*Sporobolus festivus*Hochst. ex A. Rich.	+	
Total	27	45	42	38

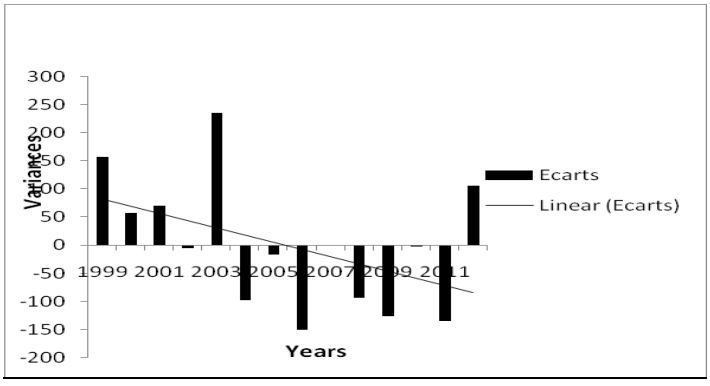
Figure.1 Commune of Aguié and Mayahi



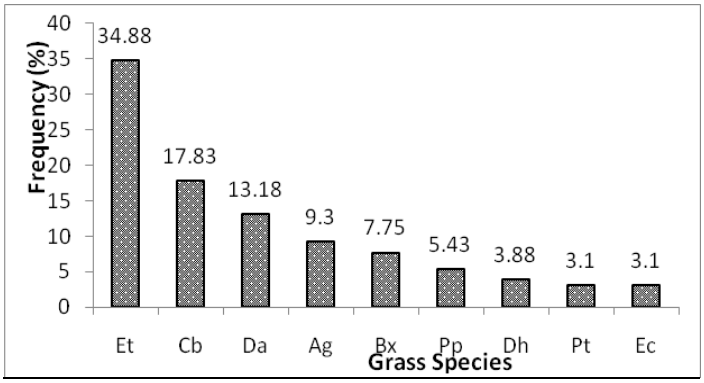
Graph.1 Evolution of the rainfall variances of the commune of Aguié



Graph.2 Evolution of the rainfall variances of the commune of Mayahi



Graph.3 Proportion of grass species in the most used in the forage



Graph.4 Proportion of grass Species used in the roof of Huts

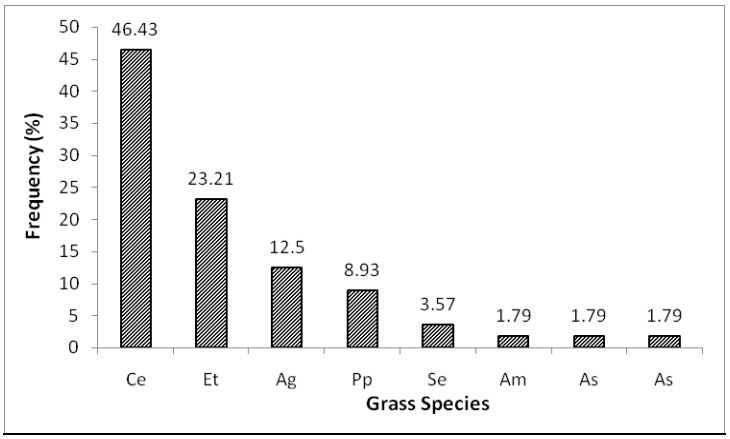


Photo.1 Boot of Eragrostis tremula

Photo.2 Ctenium elegans in association with millet

Photo.3 Andropogon gayanus Used in the cropland delineation

• **Digitaria horizontalis**: For 50 % of the respondents, it is indicator of good fertility, and bad for the other 50%. There are also few cited species that are indicators of good soil fertility such as *Microchloa indica, Andropogon gayanus, and Brachiaria xantholeuca.*

Grass species used for cropland delineation

Two species of *Poaceae* are used in the study area for farmlands delineation such as *Andropogon gayanus* and *Panicum anabaptistum*. However, *Andropogon gayanus* is the most cited specie. The process involves either the spreading of seeds during harvesting (crop debris is deposited at the edges of the fields) or the transplanting of young feet after a good rain.

Grass species used in the traditional pharmacopoeia

In Africa, few Gramineae enter into the various preparations of the traditional pharmacopoeia (Poilecot, 1999). However, in our study area, the respondents cited seven (7) species that are *Eragrostis tremula, Pennisetum pedicellatum, Diheteropogon hagerupii,Schisachyrium, Aristida sieberiana,*

Sporobolus festivus and *Heckelochloa granularis* are used the two communes for diverse treatments.

Grass species used in the manufacture of granaries

To make the granary, *Andropogon gayanus* is almost exclusively used grass specie in two communes according the respondents. In the absence of *Andropogon gayanus*, the stubble of *Pennisetum typhoides* is used for making the granary.

Grass species used for fencing the houses

For the production of fences, the most grass species used are *Andropogon gayanus, Aristida sieberiana, Panicum anabaptistum, and Pennisetum typhoides*according to the respondents.

Grass species used in the construction of huts

Andropogon gayanus and *Pennisetum typhoides* are the two species of *Poaceae* used for the construction of huts in the two communes.

Grass species used for bedding and mattress

The bed is made from the stubble of *Pennisetum typhoid*es and *Andropogon gayanus*, armed with the branches of *Combretum glutinosum, Combretum micranthum, and Guiera senegalensis*. For the manufacture of the mattress, five species of *Poaceae* were inventoried during the interview with the population: *Andropogon gayanus* (leaves and inflorescences eliminated during mowing), *Eragrostis tremula*, *Schisachyrium exile*, *Aristida mutabilis* and *Pennisetum pedicellatum.*

Grass species used for broom and lawn

The floral peduncles of *Schoenefeldia gracilis* and *Eragrostis tremula* are used for the manufacture of sweets whose price varies from 50F to 100F CFA depending on the size of the sweeper in the two communes. One grass specie (*Cynodon dactylon*) was used to beautify the lawn of some administrative areas in the commune of Mayahi.

Species used for the manufacture of hats

The floral peduncles of *Digitaria gayana* are used by the Fulani to make hats while driving animals to pasture in order to protect from the sunlight. On the other hand, the respondents announce its near total disappearance due to the lack of fallow land in the two areas.

In conclusions through this study, the species of *Poaceae* of the Communes of Aguié and Mayahi were inventoried. The different uses of populations of grass flora have also been determined. In the light of our results, the two communes are floristically rich in grass species (Table 6). Further, the grass species provides a myriad of benefits to the people of the two communes. The results constitutes floristical baseline data in terms of biodiversity management in which the floristic data are the key. This study recommends further study that will make a complete grass inventory and examine the anthropogenic pressure on the grass species in the two communes.

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