Original Research Article

Phytosociological study of fodder formations in the PlateauRegion of Togo

ABSTRACT

Objectives: Livestock production systems in Togo are still dependent on the availability of natural vegetation formations for livestock feed. The present study aims at characterizing the grazed formations of the Plateau Region. More specifically, the aim is to inventory forage species and analyze their diversity.

Methodology: In order to characterize the grazed plant formations of the zone, phytosociological surveys were carried out at six sites, namely: Nyidové and Djamakondji (Agou), Dalia (Haho), Tchella (Ogou), Onè (Amou) and Mempeassem (Danyi). A total of 140 plots (10mx10m), twenty per site, were installed and investigated using the Braun-Blanquet stigmatization method. Ecological parameters (bush fires, grazing, biomass removal, etc.) are the main factors responsible for the loss of forage diversity and degradation of plant cover on the sites. A total of 87 species were inventoried, mainly in the families Asteraceae, Poaceae, Fabaceae, Euphorbiaceae and Rubiaceae. Among the species identified, the most palatable are *Panicum maximum* (Poaceae), *Centrosemapubescens* (Fabaceae), *Sporobolus pyramidalis* (Poaceae) and *Tridaxprocubens* (Asteraceae).

Conclusion: The results of this study will be used for pastoral management work in the area.

Key words: botanical identification, fodder species, association, forages, phytosociology.

ABREVIATIONS

GDP: Gross Domestic Product

RM: Average Recovery

GPS : Global Positioning System

ITRA : TogoleaseInstitutof Agronomic Research

INTRODUCTION

Livestock is a sector of activity that contributes significantly to the fight for food security and to national GDP in tropical Africa. In the context of climate change, access to pastoral resources faces several constraints and the management of fodder resources is a priority that should be understood in its entirety because of natural hazards, the plurality of users, the diversity of spaces and the land implications, which themselves vary.

In West Africa, the supply of fodder for livestock remains dependent on the plant resources of grazing areas. Vegetation formations remain the main basis of food for local and transhumant livestock. In view of this situation, the characterization of pastoral landscapes is becoming a concern at the national level.

Like the countries of the West African sub-region, ruminant livestock in Togo remains dependent mainly on the availability of fodder from natural pastures[1][2][3][4]. However, in the face of ever-increasing demographics, grazing areas are decreasing face of advancing of agricultural front. This leads to an overcrowding of grazed rangelands, drastically influencing the phytosociological composition of available forage formations [5]. Several other factors, including rainfall, human activities, etc., are driving forces of degradation and loss of forage diversity in the floristic composition

of grazed plant formations[6]. It is with the aim of contributing to the sustainable management of grazed flora in Togo that the present study was undertaken in the Plateaux region. The objective of our study is to characterize the natural grazing areas of the target environments. More specifically, it is to inventory the diversity of grazed plant formations in the area and to analyze the impact of ecological factors on the floristic composition of the plant cover.

MATERIAL AND METHODS

The methodological approach adopted in this study is based on surveys of grazed vegetation within 100 m^2 plots installed at each site (Nyidové and Djamakondji in Agou Prefecture, Dalia in Haho, Tchella in Ogou, Onè in Amou and Mempeassem in Danyi Prefecture) (Figure 1). Within each plot, species were recorded in presence/absence following the Braun-Blanquet method.

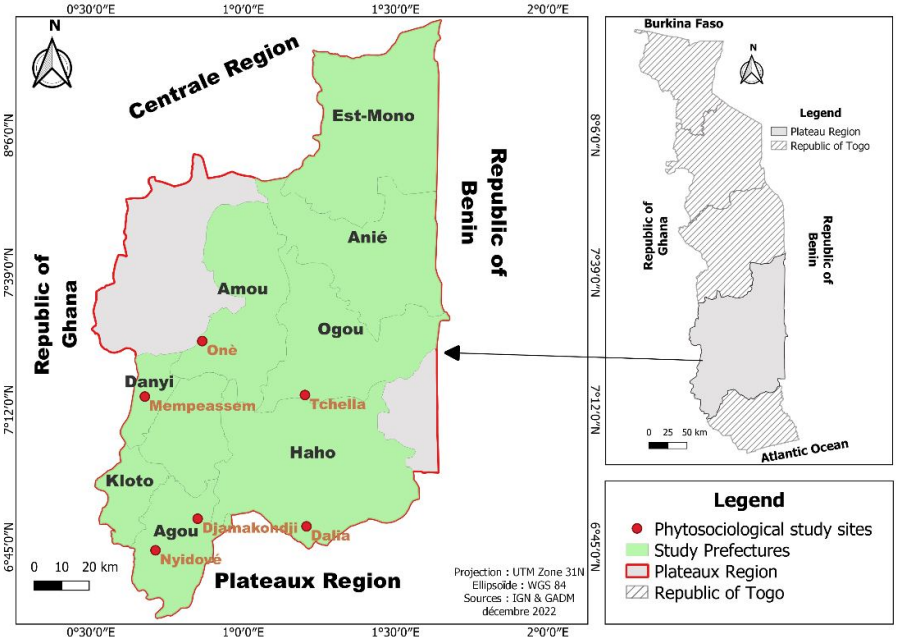


Figure 1: Phytosociological study sites in the Plateaux Region

Phytosociological surveys were carried out on the six (6) sites following the quadrat point method of Braun Blanquet[7]. For each site, the geographical coordinates were recorded with a GARMIN GPS. Depending on the vegetation facies present on each site, 15 to 25 square plots (10m square) were installed. In total, one hundred and forty (140) plots were surveyed for plant species. The unidentified species were collected in a herbarium and sent for identification to the Laboratory of Botany and Plant Ecology of the Université de Lomé via the flora of Togo (1954-1972) [8], Keay& Hepper (1954-1972) [9], and Benin[10].

The main information collected on each plot includes: species present and their abundance and dominance coefficients, typology of plant formations grazed, mean cover (MC) etc. In addition to this information, ecological factors such as: soil type and soil texture, human activity indices, etc. were also collected.

The data were entered into the Excel table and subjected to various statistical treatments to bring out the relative frequencies, curves and graphs. The appetence indices were assigned to each species for an analysis of the bromatological value of the studied plant formations. The indices of palatability or specific quality [IS] ($0 < IS \leq 5$) denote their bromatological value. The palatability indices (IS) used in this study are those defined for the flora of African tropical regions[11] complemented by those of the work of Amégnaglo[4]. For each plant species surveyed, an index is assigned that shows whether or not this species is palatable to animals.These indices are defined as follows:

- miscellaneous non-fodder or refusal (DNF): IS = 0,
- miscellaneous forages (DF): IS > 0,
- poor grasses (GME): (IS = 1),

- average grasses (GMO): (IS = 2),
- good grasses (BG): 3 ≤ IS ≤ 4,
- very good grasses (VG): IS = 5
- poor legumes (LME): (IS = 1),
- medium legumes (LMO): (IS = 2),
- good pulses: 3 ≤ IS ≤ 4, and
- very good legumes (VLL): IS = 5.

RESULTS AND DISCUSSIONS

1. Diversity of grazed plant formations

1.1. Frequency of species

A total of 87 species were recorded in the study area. The most frequent species are *Chromolaena odorata* (92.85%), *Imperata cylindrica* (78.57%), *Tridax procumbens* (64.28%) present a relative frequency of more than 50%, hence the dominance of these species in all sites. Eleven (11) species have a relative frequency ≥ 40%. These are: *Ageratum conyzoides* (50%), *Commelinaerecta* (50%), *Annona senegalensis* (42.85%), *Calopogoniummucunoides* (42.85%), *Centrosemapubescens* (42.85%), *Conyza aegyptiaca* (42, 85%), *Danielliaoliveri* (42.85%), *Flueggeavirosa* (42.85%), *Hyptissuaveolens* (42.85%), *Mucuna poggei* (42.85), *Sida acuta* (42.85), *Triumfetta cordifolia* (42.85%). Forty-four (44) species have a relative frequency between 14-35%. These are *Acanthospermumhispidium* , *Rourea coccinea*, *Sporobolus pyramidalis*, *Triumfettarhomboidea*, *Aspiliahelianthoides*, *Eriosemapsoraleoides*, *Mimosa invisa*, *Panicum maximum*, *Vernonia galamensis*, *Amaranthus dubius*, *Andropogon gayanus*, *Andropogon tectorum*, *Azadirachta indica*, *Cajanus cajan*, Cyperus pectinatus, *Gmelina arborea*, *Gomphrena celosoides*, *Justicia flava*, *Phyllanthus amarus*, *Sarcocephaluslatifolius*,*Schwenckia americana*, *Sida acuta*, *Strychnos spinosa*, *Vitellaria paradoxa*, *Ampelocissusbombicyna*, *Chamaecrista rotundifolia*, *Crotalaria retusa*, *Cynodondactylon*, *Diodiasarmentosa*, *Dissotissp*, *Eragrostisirvingiana*, *Eulesine indica*, *Euphorbia hirta*, *Hygrophilapobeguinii*, *Lippia multiflora*, *Mitragynainermis*, *Momordica charantia*, *Paspalum scrobiculatum*, *Pennisetum pedicellatum*, *Pupalialappacea*, *Sterculia tragacantha*, *Syzygiumguineense*, *Vernonia cinerea*, *Waltheria indica*. Finally, 27 species have relative frequencies ≤ 7%.

This distribution of specific frequencies indicates that the sampled stands are more or less floristically homogeneous with variants related to the ecological site conditions. The distribution curve of specific frequencies showing a decreasing trend well fitted to a logarithmic function illustrates this result (Figure 2). This indicates a high representativeness of some plant species compared to others. The high frequency of species such as *Chromolaena odorata*, *Imperata cylindrica* is a sign of degradation and loss of forage diversity of the sites investigated in this study.

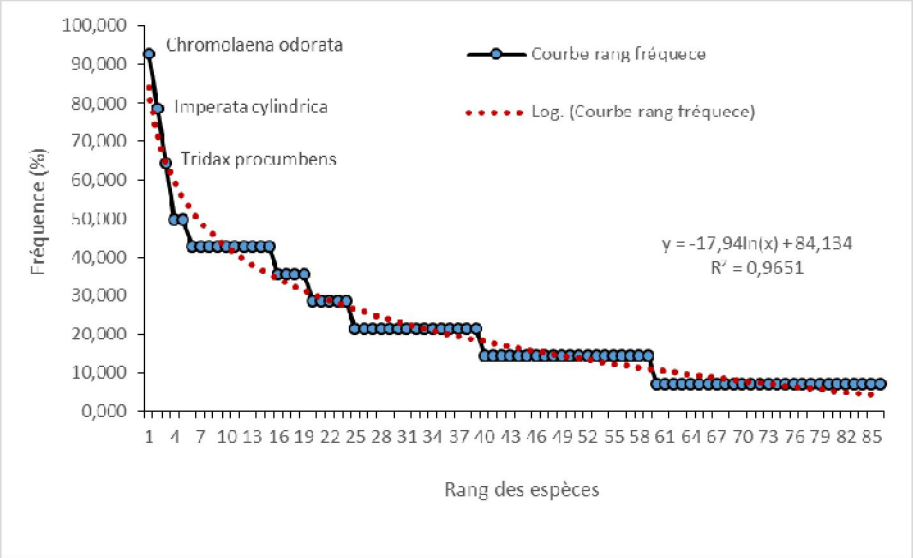


Figure 2: Frequency of forage species

1.2. Botanical families of the forage formations in the study area

Figure 3 below shows the botanical families' composition of the six (6) study sites. Thus, the botanical investigations carried out within Nyidové stand allowed for the identification of 38 species grouped into 29 genera and 16 families. The three (3) most represented families are: Poaceae (6 species), Asteraceae (5 species), and Euphorbiaceae (5 species). In Djamakondji, 31 species were recordedin 23 genera and 8 families. Three (3) families are the most represented. These are Fabaceae (9 species), Poaceae (8 species), Commelinaceae (5 species). As for the site of Dalia, it is noted 41 species distributed in 34 genera and 12 families whose three (3) most represented are: Asteraceae (11 species), Poaceae (9 species) and Caesalpiniaceae (5 species). In Tchella, botanical explorations carried out within the settlement of this site have allowed us to identify 40 species assembled into 31 genera and 11 families. Three (3) families are the most represented namely: Asteraceae (13 species), Amaranthaceae (6 species), Euphorbiaceae (5 species). Botanical research carried out within the Onè settlement led to the identification of 58 species divided into 48 genera and 14 families of which two (2) are the most represented: Asteraceae (19 species) and Poaceae (8 species). Regarding the Mempeassem site, botanical investigations conducted within the settlement of this site resulted in the identification of 47 species gathered in 33 genera and 15 families. As shown in Figure 3, two (2) families are the most represented. These are Fabaceae (12 species) and Asteraceae (6 species). The diversity of botanical families on the sites with an under-representation of Fabaceae shows a low representativeness of forage species on the whole area.

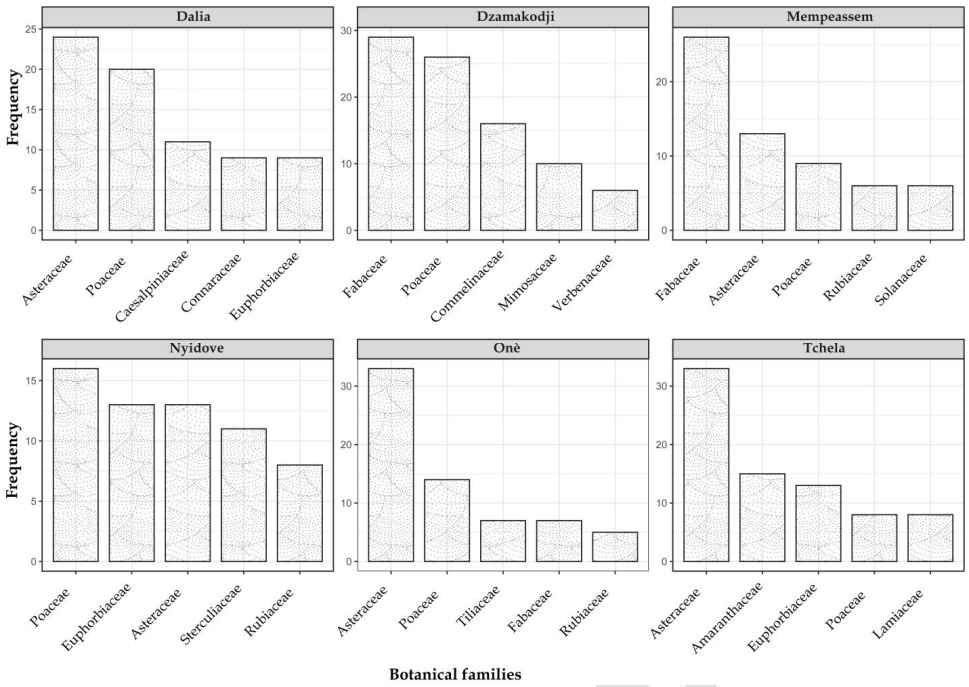
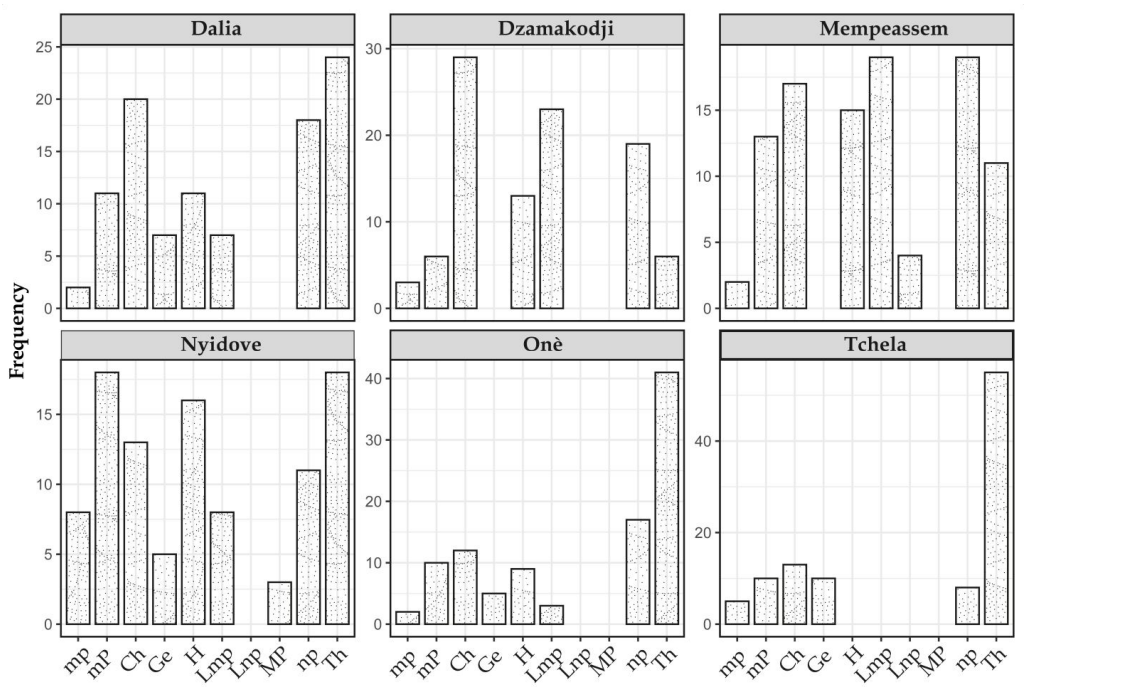


Figure 3:Botanical families of the forage formations

1.3. Biological types of the forage formations of the study area.

Figure 4 below presents the biological types of the forage formations of the six (6) sites studied by the present work. Indeed, on the Nyidové site, the gross biological spectrum shows the predominance of mesophanerophytes (18.18%) followed by therophytes (18%), chaméphytes (15.15%), microphanerophytes (15.15%) and hemicryptophytes (12.12%). Geophytes, nanophanerophytes and lianas are poorly represented. In Djamakondji, the gross biological spectrum shows the predominance of champhytes (30.10%) and nanophanerophytes (21.03%). Hemicryptophytes, microphanerophyte lianas, climbing microphanerophyte lianas, microphanerophytes and therophytes are less represented. As shown in Figure 4, the gross biological spectrum at the Dalia site shows the predominance of therophytes (29.90%), champhytes (24.25%), mesophanerophytes (15%), nanophanerophytes (14.22%) and others are less represented. At Tchella, the gross biological spectrum shows the predominance of therophytes (60.10%), microphanerophytes and champhytes; geophytes are less represented. The crude biological spectrum in Onè, shows the predominance of therophytes (40.20%), champherophytes (15.10%), nanophanerophytes (15.10%) and the other biological types are less represented. As for the gross biological spectrum of Mempeassem, we note the predominance of champhytes (18.19%), hemicryptophytes (17%), microphanerophyte lianas (17%), nanophanerophytes (16.50%), mesophanerophytes (14.50%), therophytes (12%). The otherbiological types are lessrepresented.

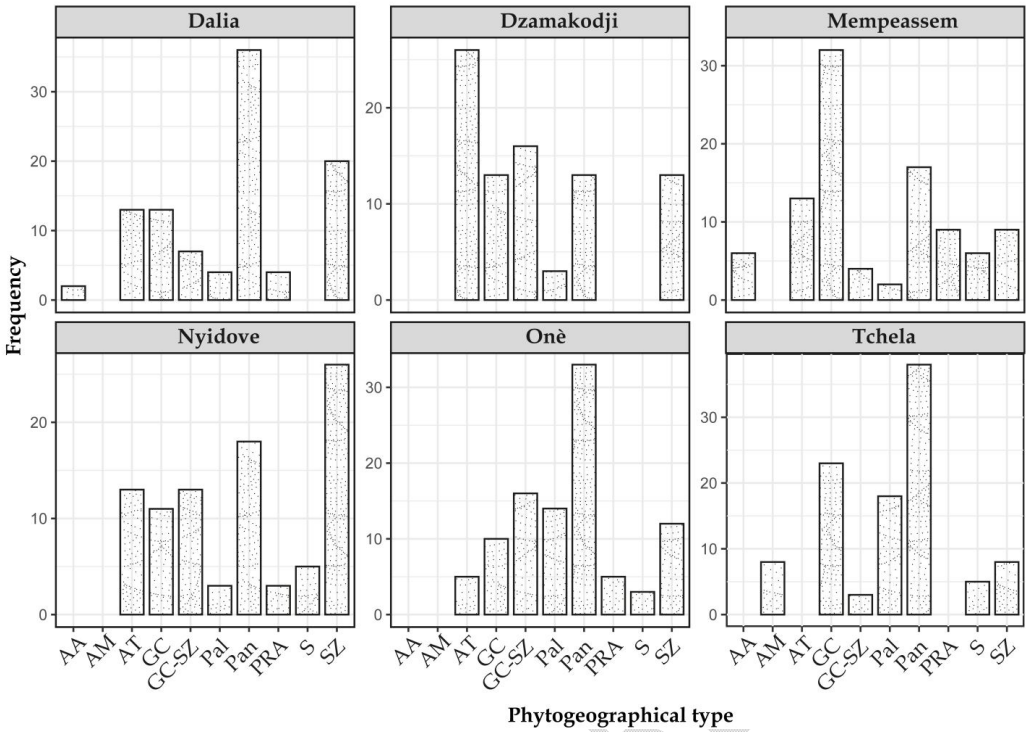


mp : microphanérophytes, mP : mésohanérophyte, Ch : chaméphytes, Ge : géophytes, H : hémicryptophytes, Lmp : Lianes microphanérophytes, Lnp : lianes nanophanérohytes, MP : mésophanérophyte , np : nanophanérophytes, Th : thérophyte.

Figure 4: Biological types of forage formations

1.4. Phytogeographical types of forage formation in the study area.

The various phytogeographic types found on the study sites through the available forage formations are illustrated in Figure 5 below. Thus, at Nyidové, the woody species in the forests are mainly represented by Sudano-Zambezian species (30%), followed by Pantropical (18.18%), Afro-Tropical (15.15%), Guineo-Congolian (9.09%) and Sudano-Guinean (9.09%) species. The Sudanese base element, the paleotropics and the African multiregionals are less represented. In Djamakondji, forest woody species are mainly represented by Afrotropical species (27.80%), followed respectively by Guinean-Congolese &Sudano-Zambezian species (17.5%) and introduced species (17.5%). Pantropical, Sudano-Zambezian, Guinean-Congolian and paleotropical species are less represented. In Dalia, forest trees are mainly represented by pantropical species (40%), followed by Sudano-Zambezian (25.60%) and Afrotropical (18.20%) species. The Guineo-Congolese, paleotropical and African multi-regional species are less represented. As for the Tchella site, forest ligneous species are mainly represented by pantropical species (49%), followed by paleotropical species (26.30%) and the others are less represented. As for the Onè site, the woody species of the forests are mainly represented by pantropical species (32%), followed respectively by Sudano-Zambezian (25.60%) and Afrotropical (19.15%) species, paleotropical (18.10%). The others are less represented. Through Figure 5, we observe that in Mempeassem, on the chorological level, the woody species of the forests are mainly represented by Guineo-Congolese species (29.30%) followed by pantropical species (19%), followed respectively by paleotropical species (26.30%) and the others less represented.



AA : afro-africaine, AM : afro-malgache, AT : afrotropicales, GC : guineo-congolaises, GC-SZ : guineo-congolaises et soudano-zambezien, Pal : Paléotropicales, Pan : Pantropicales, PRA : plurirégionales africaines, S : élément-base soudanien, SZ : soudano-zambezien.

Figure 5: Phytogeographical types of forage formations

1.5. Morphological types of forage formations in the study area

The morphological types of forage formations at the six (6) study sites are illustrated in Figure 6 below. In fact, at the Nyidové site, the available forage formations are dominated by herbaceous plants (38%) and woody plants (29%) at the expense of grasses (25%) and legumes (8%). In Djamakondji, on the other hand, legumes (41%) and grasses (26%) dominate the available forage in comparison to grasses (23%) and woody plants (10%). The fodder rangelands of Dalia show a dominance of herbaceous (33%) and woody (29%) species over grasses (20%) and legumes (18%). As for the Tchella site, there is a complete lack of legumes and a low representation of grasses (9%) in the available forage formations, which are dominated by grasses (64%) followed by woody plants (27%). At Onè, the available forage formations are dominated by grasses (50%) followed by woody plants (25%) at the expense of grasses (19%) and legumes (6%). On the Mempeassem site, there is a low representation of grasses (9%) compared to a preponderance of forbs (38%) and legumes (32%) followed by a relatively good representation of woody species (21%). Overall, grass biomass is less represented in the flora studied. This translates into a decrease in forage potential at the scale of the zone.

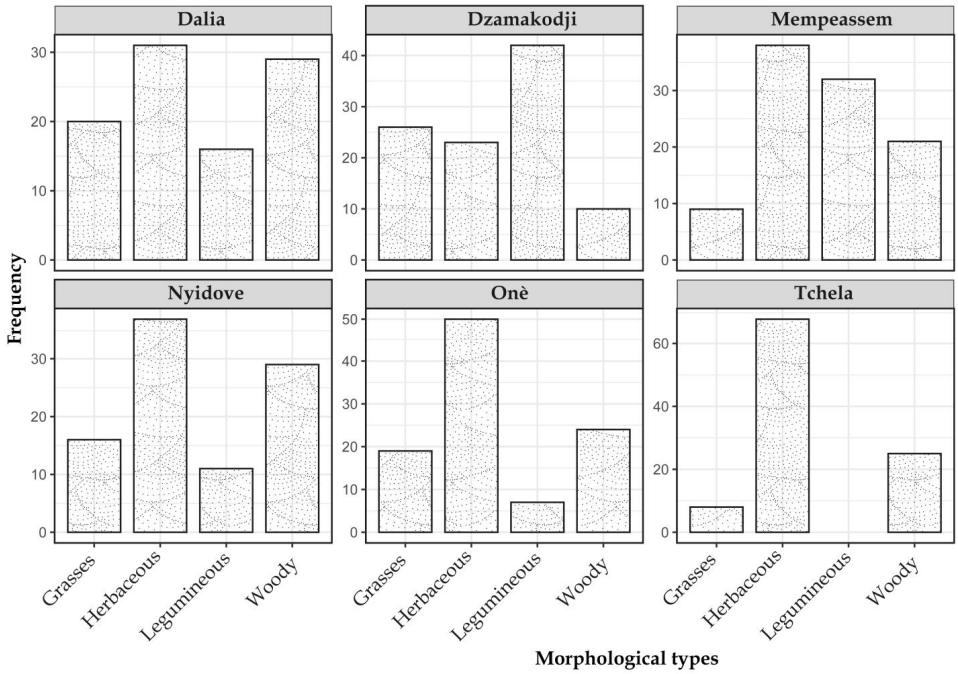


Figure 6: Morphological types of forage formations

2. Analysis of the bromatological value of the grazed plant formations

2.1. Palatability index of the forage formations in the study area

Figure 7 below illustrates the level of palatability of the forage formations available at each site involved in this study.

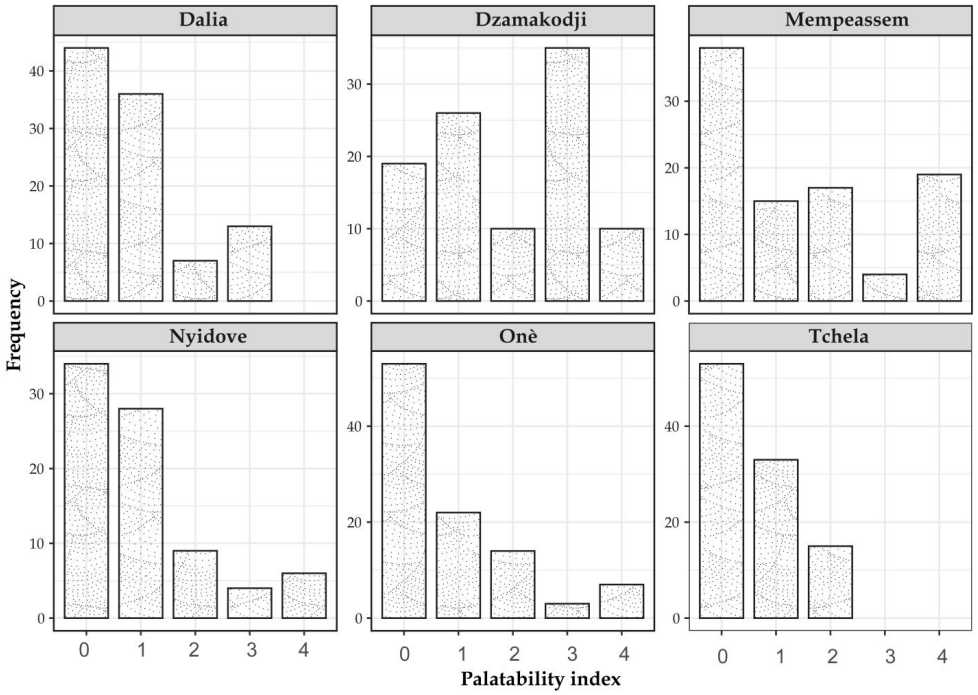


Figure 7: Palatabily index of the forage formations

Analysis of Figure 7 shows that the palatability of available forage varies from site to site. Thus, at the Dalia and Tchella sites, the available forage formations have a relatively low palatability (IS<4) and

contain neither good grasses nor good legumes. As for Nyidové and Onè sites, the available forage formations have average palatability (IS<5). There are species (grasses and legumes) of good and very good quality. At Djamakondji and Mempeassem, the forage formations available on the study sites have a fairly good palatability in terms of good quality forage species composition (IS<5).

It should be noted that the Djamakondji site is an ITRA station where the available forage is improved by the introduction of forage species, whereas at Mempeassem, the vegetation cover has not been sufficiently degraded as in other environments of the Plateaux Region.

2.2. Fodder potentialities

2.2.1. Plateau Region level

The distribution of biological forms in plant groups reflects the ecological conditions of the station in which they evolve[12]. Their analysis and monitoring over time give an idea of the dynamics of a plant community[13]. At the level of all the sites (Plateau Region), the synthesis of the specific spectrum of families, the frequency of families and the frequency of species listed give an idea of the forage potential of the grazing areas. Indeed, the state of a pasture depends on the proportion of grasses, the most productive species and the most consumed by livestock [14][15]. In our study area, the Poaceae (12 species) represent a relatively large proportion of about 14% of all species recorded (87 species). This proportion of Poaceae can be explained by the fact that they have a very high possibility of tillering and regrowth after grazing when the environmental conditions become favorable again[16]. The specific contributions of the miscellaneous herbaceous plants consumed are above 50%. This means that the proportion of herbaceous plants contributes to the diet of ruminants present in the study area. These results corroborate those obtained in Côte d'Ivoire[16].

We note the presence of species indicative of poor pastoral management, or even overgrazing. These are species classified as refusing, such as *Chromolaena odorata* (92.85%) and *Imperata cylindrica* (78.57%), which are present in all stations. These are species that multiply to the detriment of species of good forage value. They are considered indicators of overgrazing[15]. Indeed, a work in the Sahelian zone of Niger shows that in the case of heavy grazing in ecosystems grazed during the rainy season, the vegetation is dominated by one species or a small number of species that represent on average 50% of the specific contribution of the species recorded [17].

2.2.2. Particularities of the different sites

Among the six (06) sites studied, some present particularities in terms of forage availability. Although all of the sites are being progressively colonized by certain species, including *Chromolaena odorata*, some sites already have a high rate of coverage by this invasive non-fodder species. These are mainly the Dalia and Nyidové sites where the coverage is between 25 and 50% with a presence of between 20 and 40%. In addition, the Djamakondji site, which is a state station whose grazing areas are mostly installed in *Panicum maximum* (T1 and C1), is being progressively invaded by non-fodder Mimosaceae, namely *Mimosa invisa*. As for the site of Tchella, the non-fodder species *Hyptissuaveolens* is becoming more and more established in the grazing areas.

2.2.3. Guiding factors for degradation of grazing areas

The high frequency of unpalatable species such as *Chromolaena* and *Imperata* is a sign of advanced degradation of the grazing areas surveyed. Indeed, these species have the capacity to produce a lot of seeds (*Chromolaena*) and vegetative multiplication allowing them to compete with other species. This mechanism reduces the diversity of forage species on the site and induces frequent movements of livestock at the landscape scale. The same biological mechanisms in the degradation of natural pastures have been observed in the Mono plain[4]

The progressive predominance of certain unpalatable species (*Chromolaena odorata*, *Hyptissuaveolens*, *Mimosa invisa*, etc.) on grazing areas is mainly explained by exogenous factors such as: bush fires, overgrazing, misuse of herbicides, conversion of grazing areas to other purposes such as mechanized cultivation, exploitation of soil (laterite) or subsoil resources, hosting transhumant herds, etc.

The predominance of these non-fodder species is thus progressively reducing the real fodder availability of these areas, which used to be the preferred areas for livestock feeding.

CONCLUSION

A total of 87 species have been listed. Asteraceae, Poaceae, Fabaceae, EuphorbiaceaeRubiaceae are the most represented families. Among the species recorded, the most palatable are *Panicum maximum* (Poaceae), *Centrosemapubescens* (Fabaceae), *Sporobolus pyramidalis* (Poaceae) and *Tridaxprocubens* (Asteraceae). Significantly, the above species contribute to biomass production. Regardless of the threats to the study sites, the forage productivity of these sites allows them to cover the food needs of a significant number of livestock, given that the Plateaux region is one of the regions of the country that hosts a large number of transhumant herds (mostly from Sahelian countries) during periods of drought. This region therefore deserves special attention from the authorities and breeders in order to maintain and make the most of the fodder potential that it abounds. The ultimate goal is to achieve food security and optimize foreign exchange.

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