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Research Paper

Assessment of fodder food needs and their availability of livestock in the pastures of South Kivu

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ABSTRACT
The study on the assessment of fodder food needs and their availability of livestock took place in the pastures of South Kivu. The aim is to determine the carrying capacity of the different selected pastures and the bromatological value of species depending on the seasons in South Kivu. This work was carried out by a survey, phytosociological survey method of Braun Blanquet (1934) and the UBT load was calculated using the conversion indices proposed by Shigeo (2001). Most farmers only use fodder as a staple feed for cattle in addition to crop waste and agri-food by-products. 169 species are available in agroecological zones during the year. They are distributed in 38 botanical families. The most predominant are Poaceae (19.48%), Fabaceae (19.22%), Asteraceae (18.42%), Malvaceae (8.95%), Acanthaceae (4.86%), Rubiaceae (4.37%), Lamiaceae (3.86%), Apiaceae (3.06%) and Verbenaceae (2.28%). The other families including Apocynaceae, Convolvulaceae and Cyperaceae are in low proportions. The dry biomass yield was higher in the rainy season (8.49 t/ha) than in the dry season (2.08 t/ha). The dry matter content varied greatly ($p<0.05$) according to the different agroecological zones following the seasons. It was higher in the dry season (61%) than in the rainy season (18%). During the rainy season, the dry matter yield of fodder is high in the agro-ecological zone of Kabare (9.426t/ha) making it support 1.19 TLU/ha, where Walungu (1.10 TLU/ha) ha) and the Ruzizi Plain (0.92 TLU/ha) would support less TLU/ha. During the dry season, all the agroecological zones surveyed including Kabare (0.58 TLU/ha), Walungu (0.57 TLU/ha) and the Ruzizi Plain (0.52 TLU/ha) support the same number of cattle. Given the nutritional value and the carrying capacity of pastures, pasture improvement works must be considered. The establishment of a regulatory system for grazing of ruminants is suggested in the study area based on the conclusions reached in this study. Livestock intensification in this study area can be based on reliable feeding techniques.

Keywords: *Cattle, agroecological zones, fodder food, pasture, livestock*

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I. INTRODUCTION

Livestock farming represents nearly 40% of global agricultural production (Michel, 2014). It ensures the livelihoods and food security of more than 45 million livestock keepers in developed countries and nearly 1.5 billion populations in developing countries (Hosri et al., 2016; Mounier, 2020). It is a socio-economic activity of major importance in sub-Saharan Africa and particularly in the Democratic Republic of Congo (DRC), where it ensures both macroeconomic and environmental functions (Novak et al., 2012).

Cesar et al. (2004) report that attempts to introduce cultivated fodder plants have long been made in many tropical African countries. Extension poses problems and there are few villages where we can observe fodder crops in place and in good condition. In addition, natural tropical forages are deficient in nitrogen. Thus, the nitrogen value of grasses in particular, whether spontaneous or cultivated, declines rapidly with the age of regrowth. The difficulties in establishing forage crops are technical, human and economic. According to Arab et al. (2009), several factors are involved and largely responsible for deficiency situations such as: livestock intensification, climate instability, fertilization, soil characteristics which influence the bioavailability of these nutrients. However, these constraints precarious access to pastoral resources and further compromise livestock mobility (Donou et al., 2008; Kiema et al., 2012).

Indeed, the increase in population has led, through overexploitation, to the degradation and then regression of the grassland producing area. It must therefore be restored and made more productive (Cesar et al., 2014; Kperou et al., 2020).

In the DRC, cattle breeding play an important role because it constitutes a form of capitalization. Thus, the sale of products such as meat, milk, wool and often skin allows the regular recovery of monetary income (Kalume, 2012). In South Kivu, cattle are raised for a diverse range of renewable (milk and manure) as well as non-renewable products such as meat and hide (Shrestha and Fahmy, 2007; Monau et al., 2017).

On the other hand, despite the high potential of ruminants and the intensification of livestock breeding in South Kivu, bovine milk production has declined significantly in recent decades, making it difficult to record 4 liters of milk per day (Nguluma et al. , 2020). Furthermore, the quality of nutrition being one of the key factors on which the success of each breeding depends. Several authors Dewa et al. (2018), Sib et al. (2018) and Ghêliho et al. (2019) report that the production and reproduction performance of ruminants would therefore depend on it. However, the floristic inventory and nutritional value of forage species existing in eastern DRC have not been documented for more than five decades. This does not open up avenues for the pasture improvement program to increase productivity. In this context, the objective of this study is therefore to determine the carrying capacity of the different selected pastures and the bromatological value of species depending on the seasons in South Kivu.

II. MATERIALS AND METHODS

Study area

This study took place in the province of South Kivu, east of the Democratic Republic of Congo. The spatial delimitation of this study (Figure 1) is such that the region concerned by this study extends only over 3 agro-ecological zones chosen ad hoc according to altitude, but also for their large spaces developed for the purposes of animal breeding. Looking at Figure 1, it can be seen that depending on the agroecological zones, the agroecological zones selected for study were: (1) the high altitude with the Walungu zone, (2) the medium altitude Kabare and (3)) the low altitude covering the Ruzizi plain in Uvira territory. The temporal boundary goes from January 2021 to January 2022. The present study was carried out throughout the year, both in the rainy season as well as in the dry season. The goal is to capture the deep variabilities commonly observed, reinforced by altitude. There are also particularities for each of the agroecological zones retained in this study, notably their location (Longitude, Latitude and Altitude), climatic data as well as the type of soil and the nature of the vegetation encountered in each zone. The territory of Kabare extends between 28°45' and 28°55' East Longitude, 2°30' and 2°50' South Latitude, raised to an altitude between 1460 and 3000 m above sea level It covers an area of 1960 km^2 . Average annual temperatures vary between 18° and 20°C (Clérisse et al., 2016; Amani et al., 2016). Average precipitation would be estimated between 1300 and 1800 mm of rainwater (Kijana et al. , 2017). The humid tropical and mountain climate is the one that predominates there. It belongs to the Aw4 type according to the classification developed by Köppen (Mangambu et al., 2018). The rainy season lasts 9 months (mid-September to the end of May). The dry season covers the remaining 3 months of the year, from June to early September (Mondo et al., 2019). The vegetation of Kabare is mainly made up of savannah naturally composed of wild grasses. The soil is predominantly loamy, generally eroded and volcanic in nature (Jean-Pierre et al., 2019). Being located in Uvira territory, the Ruzizi plain extends between 2°42' and 3°24' South latitude and 29°00' and 29°22' East longitude. It is raised to approximately 800 m above sea level. It covers 80,000 ha of which 35,000 ha are occupied by pastures (Byavu et al., 2000). The semi-arid climate belonging to the Aw4 type according to the Köppen classification is observed there ((Bagula et al., 2013). The average annual precipitation recorded in this region varies between 600 to 900 mm, distributed over 120 to 140 days of the year (Ilunga, 2007). The monthly averages of daily maximum temperatures increase at the end of the dry season, going from 30.5° to 32.5°C in September. The monthly averages of daily minimum temperatures are the lowest during half of the dry season going from 17° to 14.5°C in July (Byavu et al., 2000; Bagula et al., 2013). The predominant soil texture in the Ruzizi plain is sandy -clay-loamy to sandy-clayey, thus being able to accommodate crops of rice, corn, peanuts, beans, soya, tomatoes and a good variety of market garden crops, roots and tubers. , Bagula et al (2013) indicate that in these types of soil, very small areas of allochthonous alluvial soil can be distinctly observed on different sites. The territory of Walungu covers an area of 1800 km². It is located in a grassy savannah zone reaching an altitude of 1776 m and where a humid tropical climate (Aw4 type) reigns (Jefwa et al., 2014). It extends between 28°40’ and 29°00’ East longitude and between 2°35’ and

3°00' South latitude. Average annual precipitation varies between 1500 and 1800 mm. Average temperatures vary according to altitude between 16 and 20.6 degrees centigrade (Bisimwa et al., 2018). The predominantly clay-sandy soils found there come from the alteration of basalt rocks resulting from volcanic eruptions (Masamba et al., 2019).

Figure 1: Study area (Lab GIS UEA, 2021)

Methods

Sampling

A survey was initiated among 693 farmers distributed randomly and proportionally in the three agroecological zones selected (Walungu in high altitude, Kabare in medium altitude and Ruzizi plain in low altitude). These breeders were chosen on the basis of certain criteria in particular: (1) belonging to the study area, (1) breeding ruminants as an example of cattle, (3) location of this herd in the area study, (4) acceptance to freely provide information without compensation or negotiations. The questions during this survey focused on (i) livestock management (species raised, breeding system, feeding method, types and mode of exploitation of pastures, as well as strategies to deal with drought), (ii) the numerical composition of herds (cattle, goats and sheep) and (iii) the food resources used to feed cattle in the study areas (fodder species and their availability, crop residues and by-products). agro-industrial products).

Inventories of fodder resources in pastures used by ruminants

Field surveys were carried out in the rainy season (in January 2021) and in the dry season (in August 2021) to inventory the different forage species grazed by ruminants, predominantly cattle, in the different agroecological zones. A total of 15 collective and natural pastures were chosen in the three agroecological zones, including five (5) pastures per zone. The pastures were selected based on the following criteria: (1) Presence of species attractive to the animals, (2) accessibility on the pasture and (3) security on the pasture. Furthermore, the phytosociological survey method of Braun Blanquet (1934) was applied to determine the forage floristic wealth available on each pasture as widely used by Camcnisch and Géhua (1993), Mirkin and Naumova (2009), Pott (2011). , Mirkin et al. (2015), Sieben et al. (2016), Ighbareyeh et al. (2017), Dengler et al. (2018).

In each pasture, a minimum area of 10 m x 20 m measured by a measuring tape was determined each season following the homogeneity of the forage species on the pasture and in which two surveys were carried out using the quadrant method (1m x1m). In total, 60 phytosociological surveys were studied in the three agroecological zones during the two seasons, including 30 surveys per season. Forage species found in the quadrant were identified in situ. On the other hand, unidentified species were sampled, codified and placed in a herbarium for subsequent identification at the CRSN/Lwiro herbarium. Furthermore, the identified forage species were grouped according to their systematic families.

Biomass production and nutritional value of fodder resources

In order to capture the variability's due to seasonality, the evaluation of the fresh and dry biomass of fodder was carried out during every two seasons experienced by the study environment. The basic principle was to evaluate the quantity of aerial plant dry matter produced per unit area. Indeed, this evaluation concerns the fresh plant biomass or herbaceous phytomass, more precisely the aerial fraction actively sought and appetized by livestock. The estimation of the fresh phytomass produced during the observation period was carried out by the method of clear cutting of the biomass using pruning shears or a knife over an area of one square meter for each season as widely used by Gauns and al., (2015). The samples obtained were packaged in paper envelopes, weighed to have the fresh weight and pre-dried in the open air then dried in a Titanox A3-213-400 brand oven at a temperature of 105 °C for 24 hours in the soil laboratory of the Faculty of Agricultural and Environmental Sciences of the Evangelical University in Africa (UEA). After drying in the oven, the samples were reweighed with the precision balance to obtain the dry weight.

The Dry Matter (DM) was determined by the method proposed by Mbow et al. (2013), Lesse et al. (2016), Alhassane et al. (2018). It consisted of taking the total water content (100%) and subtracting the moisture content obtained after the fodder drying session in the oven. The production of dry matter collected per square meter (m2) in each pasture in each agroecological zone during each season was reported per hectare. The results on dry matter production were used to determine the productivity of forage species listed during the floristic inventory (Idrissa et al., 2020). In addition, dry matter data were served to determine the carrying capacity (CC) of pastures (Ngom et al., 2012; Yameogo et al., 2014; Idrissa et al., 2020). The determination of the bromatological values of each composite sample was made at the soil laboratory of the Faculty of Agricultural and Environmental Sciences of the Evangelical University of Africa (UEA). This session of chemical analysis of fodder involved the evaluation of the parameters below: (i) the moisture content of the fodder, their organic matter, their mineral matter (calcium and phosphorus), (ii) the total nitrogenous matter that they contain, (iii) their fat content (fatty acids or lipids), (iv) their energy content (raw and digestible), and finally (v) their rate of digestibility of organic matter (dMO) indicating the share of organic matter being released in the feces produced by cattle fed by the species for which the estimates were made.

The moisture of the forage was determined by the difference observed between the fresh weight and the dry weight of the samples as proposed by Diatta et al. (2020); Sanon et al., (2014); Lesse et al., (2016). The procedure consisted of weighing the fresh forage sample (P1) placed on a heavy aluminum cylinder (P0). After drying in an oven at 105°C for 24 hours, the capsule containing the sample is brought to be cooled in the desiccator before being weighed (P3) then the weight of the dry sample is deducted (P2). The difference of these two weights (P1 – P2) allows us to deduce the water content.

Mineral Material (MM) or Raw Ash (CB): It was estimated by calcination of the dry sample in a muffle furnace for 4 to 5 hours, at 550°C, until white ash was obtained. These were cooled in a desiccator and then weighed. Mathematically, the expression of the results of the mineral matter, resulting from the analyzes took into account the ratio below:

$\mathrm{MM}(\%) = \frac{\mathrm{P2}}{\mathrm{P1}} \mathrm{x}100$ With P1: the weight of the forage sample before calcination, P2: the weight of the forage sample after calcination, and MM (%): the content of raw ash in the dry matter.

Organic Matter (OM): Its content was obtained by the simple difference between the dry matter content and the raw ash content as applied by Berge et al. (1991) and Babayemi and Adebayo, (2020).

Total Nitrogen Material (TAM): total nitrogen was measured using the colometric method. The organic nitrogen of the fodder is mineralized by hot sulfuric acid in the presence of an appropriate catalyst; the ammoniacal nitrogen formed is displaced by a strong base and measured in a titrated boric acid solution. After resting for 2 hours, the absorbances were read with a spectrophotometer at a wavelength of 650 nm. However, the total nitrogen content in the forage sample was deduced using the following formula: $\mathrm{MAT}\% = \frac{(\mathrm{a}-\mathrm{b}).\mathrm{v}}{\mathrm{W.al.10000}}$) With a: concentration of total nitrogen in the forage sample solution, b = concentration of total nitrogen in the blank reagent solution, v: total volume at the end of the analysis operation (i.e. 0.2 mL + 10 mL = 10.2 mL), w: dry weight of the sample used (i.e. 0.5g), al: aliquot of the solution taken (c .i.e. 0.2 mL).

The crude protein content is determined by the following formula PB (%) = MAT X 6.25. The gross energy (BE) of forages is estimated from their chemical composition using the equation from Richard et al. (1990): EB = 4516 + 1.646 MAT + 70 With EB: Gross energy expressed in Kcal/Kg of DM and MAT: Total nitrogenous materials or total crude proteins (PBT) expressed in %DM or%.

The digestibility of organic matter (dMO) was estimated sequentially using the equation of Guerin et al., (1989) below: $\text{dMO} = 900\frac{(\text{MAT})^2}{(\text{MO})^2} + 45{,}1$ With dMO: Digestibility of organic matter expressed in %MO (i.e. percentage of organic matter), MAT: Total nitrogenous matter or total crude protein (PBT) expressed in %MS (i.e. the percentage of dry matter) and OM: Organic matter expressed in %MS.
Digestible energy (DE) was estimated sequentially using the Vermorel equation (Vermorel and Martin-Rosset ,1988) as follows: ED=EBx dE With ED: Digestible energy expressed in Kcal/Kg of DM and dE: Digestibility of gross energy expressed in % and is given by the equation of Richard et al. (1990) below: dE = 1.055dMO - 6.833 with dMO being the digestibility of organic matter expressed in%.

Estimation of pasture carrying capacity
The formula applied in this study is that widely used by Sanon et al. (2014), Djibo et al. (2018), Saidou et al. (2019); Tabopda and Fotsing (2019):
$CC\left({}^{UBT}/_{ha}\right) = \frac{K_i\ X\ BT}{6{,}25\ Kg^{MS}/_{UBT}/_{J}\ X\ PU}$ fodder productivity expressed in Kg of dry matter per hectare, Ki corresponds to the pasture utilization coefficient, the value 6.25 expressed in kg DM/day represents the daily ration of a TLU of 250 kg, PU returns to the period of use of the pasture (number of days).
Data analysis
The data collected were encoded using MS. Excel 2013. For the data collected on the inventory of forage species, a descriptive analysis was carried out on the basis of all the species grouped according to their botanical families for which the frequencies for each family were revealed. Additionally, analysis of variance (ANOVA) was applied on bromatological value data and animal performances. The separation of means was carried out using the Fisher LSD test when a significant effect was observed at the 5% significance level. Furthermore, the data on carrying capacity were analyzed based on grazing study principles on the basis of which an analysis of variance was carried out. All these analyze were carried out with the R 4.0 software (RStudio 3.6.3 extension) and XL-Stat 2014. The UBT load was calculated using the conversion indices proposed by Shigeo (2001).

III. RESULTS AND DISCUSSION

Results
Table 1 summarizes the different forage species grazed and used as staple foods in the diet of ruminants in South Kivu.

Table 1: Fodder species inventoried on pastures surveyed in South Kivu

Botanical families	Forage species	Effective	Frequency (%)	
			Species	Family
Acanthaceae	*Asystasia gangetica*	5	1,28	4,86
	Dyschoriste radicans	6	1,53	
	Hygrophyla auriculata	2	0,51	
	Justicia flava	3	0,77	
	Rungia grandis	3	0,77	
Amaranthaceae	*Achyranthes aspera L.*	1	0,26	0,52
	Cyathula uncinulata	1	0,26	
Anacardiaceae	*Mangifera indica L.*	1	0,26	0,26
Apiaceae	*Centella asiatica*	8	2,04	3,06
	Hydrocotyle manni	4	1,02	
Apocynaceae	*Tevettia nerifolia Juss*	1	0,26	0,26
Asparagaceae	*Agave sisalana Perrine*	1	0,26	0,78
	Asparagus flagellaris	1	0,26	
	Dracaena sp.	1	0,26	
Aspleniaceae	*Asplenium sp.*	1	0,26	0,26
Asteraceae	*Acanthospermum sp.*	3	0,77	18,42
	Ageratum conyzoides L.	6	1,53	
	Bidens pilosa L.	5	1,28	
	Blumea axillaris	5	1,28	
	Bothriocline longipes	6	1,53	
	Conyza aegyptiaca	2	0,51	
	Conyza neglecta	3	0,77	
	Conyza schimperi	2	0,51	
	Conyza sumatrensis	9	2,3	
	Crassocephalum montuosum	1	0,26	
	Crassocephalum vitellinum	7	1,79	
	Guizotia scabra	1	0,26	
	Helichrysum cyamosus	4	1,02	
	Helichrysum luteo-album	2	0,51	

	Helichrysum panduratum	2	0,51	
	Lactuca attenuata	2	0,51	
	Microglossa densiflora	1	0,26	
	Microglossa pyrifolia	3	0,77	
	Tagetes minuta L.	1	0,26	
	Vernonia amygdalina	1	0,26	
	Vernonia kirungae	4	1,02	
	Vernonia scaettae	2	0,51	
Bignoniaceae	*Jacaranda mimisifolia*	1	0,26	0,26
Boraginaceae	*Cynoglossum lanceolatum*	1	0,26	0,26
Celastraceae	*Maytenus arbutifolia*	1	0,26	0,52
	Maytenus sp.	1	0,26	
Clusiaceae	*Harungana madagascariensis*	3	0,77	0,77
Combretaceae	*Combretum sp.*	1	0,26	0,26
Commelinaceae	*Commelina diffusa*	2	0,51	0,51
Convolvulaceae	*Cuscuta kilimanjari*	1	0,26	1,29
	Dichondra micrantha	3	0,77	
	Ipomoea tenuirostris	1	0,26	
Cucurbitaceae	*Momordica foetida*	1	0,26	0,26
Cyperaceae	*Cyperus angolensis*	1	0,26	1,55
	Kyllinga bulbosa	2	0,51	
	Kyllinga pumila	1	0,26	
	Mariscus macrocarpus	1	0,26	
	Mariscus cylindristachyus	1	0,26	
Dennstaedtiaceae	*Pteridium aquilinum*	1	0,26	0,26
Fabaceae	*Acacia sp.*	3	0,77	19,22
	Piliostigma thonningii	2	0,51	
	Crotalaria incana L.	3	0,77	
	Crotalaria ononoides	1	0,26	
	Crotalaria spinosa	5	1,28	
	Desmodium adscendens	1	0,26	
	Desmodium repandum	2	0,51	
	Desmodium velutinum	2	0,51	
	Erythrina abyssinica	1	0,26	
	Glycine wightii	4	1,02	
	Indigofera ambelacensis	2	0,51	
	Indigofera arrecta	3	0,77	
	Indigofera volkensii	3	0,77	
	Leucaena diversifolia	1	0,26	
	Mimosa invisa	2	0,51	
	Mimosa pudica L.	4	1,02	
	Neonotonia wightii	1	0,26	
	Senna floribunda	1	0,26	
	Senna hirsuta L.	1	0,26	
	Senna mimosoides L.	3	0,77	
	Senna siamea Lam.	1	0,26	
	Stylosanthes spp.	3	0,77	
	Tephrosia purpurea	1	0,26	
	Tephrosia spp.	2	0,51	
	Tephrosia vogelii	2	0,51	
	Teramnus labialis	2	0,51	
	Trifolium pratense L.	4	1,02	
	Trifolium purseglovei	4	1,02	
	Tylosema spp.	3	0,77	
	Vigna schimperi	3	0,77	
	Vigna vexilata	2	0,51	
Juncaceae	*Juncus sp.*	1	0,26	0,26
Lamiaceae	*Clerodendon rutundifolium*	1	0,26	3,86
	Clerodendron johnstonii	1	0,26	
	Hoslundia opposita	2	0,51	
	Leonotis nepetifolia (L.)	1	0,26	
	Leucas deflexa Hook. f.	1	0,26	
	Ocimmum gratissimum L.	2	0,51	
	Platostoma montanum	3	0,77	
	Plectranthus assurgens	1	0,26	
	Plectranthus longipes	1	0,26	
	Solenestemon sp	2	0,51	
Malvaceae	*Aboutilon mauritianum*	2	0,51	8,95
	Hibiscus aponeurus	1	0,26	

	Hibiscus cannabinus L.	4	1,02	
	Hibiscus fuscus	1	0,26	
	Hibiscus noldae	1	0,26	
	Hibiscus sp.	2	0,51	
	Pavonia urens Cav.	2	0,51	
	Sida acuta Burm. f.	10	2,55	
	Sida rhombifolia L.	1	0,26	
	Triumfetta cordifolia	1	0,26	
	Triumfetta rhomboidea	6	1,53	
	Urena lobata L.	4	1,02	
Melastomataceae	*Dissotis irvingiana*	1	0,26	0,26
Menispermaceae	*Cissampelos mucronata*	1	0,26	0,26
Myrthaceae	*Eucalyptus globulus*	2	0,51	1,53
	Psidium guajava L.	4	1,02	
Onagraceae	*Ludwingia abyssinica*	1	0,26	0,26
Oxalidaceae	*Biophytum helenae*	1	0,26	0,26
Phyllanthaceae	*Bridelia bridelifolia*	1	0,26	1,03
	Phyllanthus niruri L.	2	0,51	
	Phyllanthus nummulariifolius	1	0,26	
Plantaginaceae	*Plantago palmata*	1	0,26	0,26
Poaceae	*Andropogon sp.*	1	0,26	19,48
	Axonopus sp.	3	0,77	
	Brachiaria brizantha	5	1,28	
	Brachiaria ruziziensis	1	0,26	
	Chloris pycnothrix	2	0,51	
	Cynodon dactylon (L.)	3	0,77	
	Digitaria abyssinica	12	3,06	
	Eleusine indica	1	0,26	
	Eragrostis blepharoglomis	4	1,02	
	Hyparrhenia confinis	2	0,51	
	Hyparrhenia rufa	5	1,28	
	Isachne kiyalaensis	1	0,26	
	Panicum maximum	1	0,26	
	Paspalum conjugatum	3	0,77	
	Paspalum dilatatum Poir.	3	0,77	
	Paspalum glumaceum	5	1,28	
	Paspalum notatum	5	1,28	
	Paspalum scrobiculatum L.	4	1,02	
	Pennisetum clandestinum	1	0,26	
	Pennisetum polystachyon	2	0,51	
	Rhychelictrum repens	1	0,26	
	Setaria barbata	1	0,26	
	Setaria viridis	1	0,26	
	Sporobolus molleri	1	0,26	
	Sporobolus pyramidalis	6	1,53	
	Sporobolus stapfianus	1	0,26	
	Themeda sp	1	0,26	
Proteaceae	*Grevillea robusta*	1	0,26	0,26
Rosaceae	*Rubus steudneri*	1	0,26	0,26
Rubiaceae	*Canthium sp.*	1	0,26	4,37
	Cinchona officinalis L.	2	0,51	
	Pentas longiflora Oliv.	1	0,26	
	Pentas zanzibarica	2	0,51	
	Rubia cordifolia L.	1	0,26	
	Morinda morindoides	1	0,26	
	Rubiaceae inconnue 2	1	0,26	
	Spermacoce dibrachiata	2	0,51	
	Spermacoce princeae	4	1,02	
	Spermacoce subvulgata	1	0,26	
	Virectaria major	1	0,26	
Scrophulariaceae	*Alectra senegalensis*	1	0,26	0,26
Solanaceae	*Lycopersicum esculentum*	1	0,26	1,55
	Solanum angustispinosum	3	0,77	
	Solanum mauritianum	1	0,26	
	Solanum sp.	1	0,26	
Theaceae	*Camellia sinensis*	1	0,26	0,26
Verbenaceae	*Lantana camara L.*	10	2,02	2,28
	Stachytarpheta indica	1	0,26	
Xanthorhoeaceae	*Aloe macrosiphon*	1	0,26	0,77
	Aloe vera	2	0,51	

Total	**392**	**100**	**100**

169 species were inventoried in the three agroecological zones selected. They were grouped into 38 botanical families whose representative frequencies in the phytosociological surveys were Poaceae (19.58%), Fabaceae (19.22%), Asteraceae (18.42%), Malvaceae (8.95). %), Acanthaceae (4.86%), Rubiaceae (4.37%), Lamiaceae (3.86%), Apiaceae (3.06%), Verbenaceae (2.28%). Then come the other families in small proportions including Apocynaceae, Convolvulaceae and Cyperaceae. The same results show that the forage species *Digitaria abyssinica* and *Sporobolus pyramidalis* are the most represented in the Poaceae family, respectively with frequencies of 3.06% and 1.53%. In the Fabaceae family, the most common species are: *Crotalaria spinosa* (1.28%), *Glycine wightii*, *Mimosa pudica L*, *Trifolium pratense* and *Trifolum purseglovei*. These results show that the most dominant species in the Asteraceae family are *Conyza sumatrensis* (2.5%), *Crassocephalum vitellimum* (1.79%), *Agerantumum conyzoides* (1.53%). For the Malvaceae family, the species *Sida acuta* Burm.f and Triumfetta rhomboidea are the most common, with frequencies of 2.55% and 1.53%. The species *Spermacoce princeae* is the most frequent in the Rubiaceae family while the *Dyschoriste radicans* species presented a high frequency in the Acanthaceae family. The species *Platostoma montanum* (0.77%) and *Hoslundia opposita* (0.51%) showed high frequencies in the Lamiaceae family. This table shows that the *Centella asiatica* species presented a high frequency (2.04%) in the Apiaceae family while the *Lantana camara* species is more frequent (2.02%) in the Verbenaceae family. The other families in low proportions including Apocynaceae, Convolvulaceae and Cyperaceae presented species with almost equal frequencies.
The seasonal variation in the bromatological value of the species inventoried in the study area is presented in Table 2.

Table 2: Bromatological value of species depending on the seasons

Parameters	***Season***	**Agroecological zones**			**General average**	***P-Value***
		Kabare	**Plaine de la Ruzizi**	**Walungu**		
Yield(Ton DMS/ha)	*Rainy season*	*9,43 ± 0,63*	*7,30 ± 3,47*	*8,73 ± 2,80*	*8,49 ± 2,58*	*0,848 ns*
	Dry season	*2,16 ± 0,35*	*2,55 ± 1,15*	*2,14 ± 0,75*	*2,08 ± 0,52*	
Dry matter (%)	*Rainy season*	*24,24 ± 15,06aA*	*16,68 ± 6,5bB*	*13,89 ± 3,47bB*	*18,54 ± 10,82bB*	*0,0001 ****
	Dry season	*57,2 ± 13,84cB*	*68,44 ± 10,86aA*	*60,02 ± 13,28bA*	*61,69 ± 13,43bA*	
Organic matter (%)	*Rainy season*	*63,18 ± 11,62*	*61,01 ± 8,57*	*63,8 ± 9,33*	*62,67 ± 9,95*	*0,8321ns*
	Dry season	*63,36 ± 15,03*	*62,15 ± 13,68*	*61,01 ± 16,03*	*62,19 ± 14,73*	
Digestibility M.O (%)	*Rainy season*	*58,76 ± 6,71*	*58,3 ± 8,23*	*58,9 ± 8,37*	*58,65 ± 7,67*	*0,2707 ns*
	Dry season	*52,08 ± 5,66*	*54,65 ± 6,37*	*51,93 ± 5,01*	*52,84 ± 5,72*	
Protein (%)	*Rainy season*	*7,53 ± 1,94*	*6,79 ± 2,39*	*7,25 ± 2,09*	*7,2 ± 2,14*	*0,1146 ns*
	Dry season	*4,87 ± 0,95*	*5,84 ± 1,36*	*4,69 ± 0,89*	*5,11 ± 1,17*	
Raw ash (%)	*Rainy season*	*36,82 ± 11,62*	*38,99 ± 8,57*	*36,2 ± 9,33*	*37,33 ± 9,95*	*0,8321 ns*
	Dry season	*36,65 ± 15,03*	*37,85 ± 13,68*	*38,99 ± 16,03*	*37,81 ± 14,73*	
Phosphorus (ppm)	*Rainy season*	*12,35 ± 1,41*	*11,96 ± 1,76*	*12 ± 1,26*	*12,11 ± 1,48*	*0,1398 ns*
	Dry season	*11,68 ± 1,91*	*10,74 ± 1,37*	*11,2 ± 1,53*	*11,22 ± 1,65*	
Carbon (%)	*Rainy season*	*3,37 ± 0,47*	*3,23 ± 0,35*	*3,51 ± 0,46*	*3,37 ± 0,44*	*0,2075 ns*
	Dry season	*2,95 ± 0,31*	*3,38 ± 0,4*	*2,55 ± 0,18*	*2,95 ± 0,45*	
Calcium (meq/100g)	*Rainy season*	*194,67 ± 40,22*	*179,85 ± 62,51*	*186,15 ± 56,67*	*187,18 ± 53,19*	*0,4091 ns*
	Dry season	*193,8 ± 52,99*	*180,89 ± 58,17*	*208,84 ± 46,35*	*194,74 ± 52,92*	
Magnesium (meq/100g)	*Rainy season*	*315,2 ± 111,15abA*	*321,48 ± 122,84aA*	*304,68 ± 86,25bA*	*313,95 ± 107,09abA*	*0,02535*
	Dry season	*301,24 ± 90,36aB*	*264,27 ± 75,12bB*	*264,42 ± 84,71bB*	*277,29 ± 84,29bB*	
Gross energy	*Rainy season*	*4598,39 ± 3,2*	*4597,17 ± 3,93*	*4597,94 ± 3,44*	*4597,85 ± 3,52*	*0,119ns*
	Dry season	*4594,01 ± 1,56*	*4595,62 ± 2,23*	*4593,71 ± 1,47*	*4594,42 ± 1,93*	
Digestible energy (Kcal/Kg DM)	*Rainy season*	*2536,60 ± 326,95aA*	*2513,82 ± 401,02bA*	*2543,00 ± 407,74abA*	*2531,19 ± 373,68abA*	*0,0001 ****
	Dry season	*2210,39 ± 274,81bB*	*2335,86 ± 309,69aB*	*2202,63 ± 243,00bB*	*2247,43 ± 278,21abB*	

Means with the same letters are statistically equal to the significance level of α = 0.05. The capital letters (A, B, C) define the comparison of averages between agroecological zones (in columns). The lowercase letters (a, b, c) refer to the comparison of averages between seasons (in lines). Means that do not have the same letters are equal between rows and between columns.

The yield (in tons of DM/ha) is higher in the rainy season (8.49 ± 2.58) than in the dry season (2.08 ± 0.52). No significant difference is observed between the yields (in tons of DM/ha) obtained according to the agroecological zones (p>0.05). The results show that dry matter varied greatly (p<0.05) according to the different agroecological zones and differed according to the two seasons. A high dry matter content is obtained during the dry season (61.69 ± 13.43%) compared to 18.54 ± 10.82% recorded in the rainy season. Furthermore, Kabare recorded the best dry matter content in the rainy season (24.24%) while in the dry season, the Ruzizi Plain observed the best dry matter content (68.44%). The same results show that organic matter is similar during the two seasons and does not vary (p>0.05) following the agroecological zones. The organic matter content is such that in the rainy season, Walungu and the Ruzizi Plain have the same content (63%). In the dry season, Kabare maintains the same content (63%). For the digestibility of organic matter, in the rainy season, Walungu (58.89%), Kabare (58.76%) and the Ruzizi Plain (58.30%) have the same rate of digestibility of organic matter of fodder at the 5% significance level. In the dry season, the digestibility rate of organic matter in fodder seems high in the Ruzizi Plain (54.65%) than in Kabare (52.08%) and Walungu (51.92%). The results of the analysis of variance showed that the protein content varied significantly depending on the agroecological zones (p < 0.05). Kabare seems to have the high protein content in the rainy season (7.52%) while in the dry season, the high content is reported in the Ruzizi Plain (5.84%). The forages sampled in Kabare have the highest concentration of phosphorus both in the rainy season (12.34 ppm) as well as in the dry season (11.67 ppm). On the other hand, the carbon content evaluated in the rainy season is high in Walungu (3.51%) while it is high in the Ruzizi Plain in the dry season (3.38%). During the dry season, Walungu records a good calcium concentration of fodder (208.84 meq/100g) while Kabare records the highest concentration in the rainy season (194.66 meq/100g). However, the analysis of variance applied unfortunately did not reveal significant differences either according to seasons or even according to territories. The gross energy content is the same in both seasons (p>0.05) while it is more digestible in the rainy season (2531.19 kcal/kg DM) than in the dry season (2247.43 kcal/ kg DM) at the 5% significance level.

The estimates of the carrying capacity of pastures surveyed in the agro-ecological zones during the two seasons (dry and rainy season) are shown in Table 3.

Table 3: Carrying capacity of pastures according to seasons

Season	Agroecological zones	Yield (Kg DM/ha)	Loading capacity (UBT/ha)
Rainy season	Kabare	9 426,60 ± 626,25	1,19 ± 0,08
	Ruzizi Plain	7 299,60 ± 3 474,40	0,92 ± 0,44
	Walungu	8 729,00 ± 2 804,36	1,10 ± 0,35
	Average Rainy season	**8 485,07 ± 2 578,33**	**1,07 ± 0,33**
Dry season	Kabare	2 161,85 ± 348,08	0,58 ± 0,09
	Ruzizi Plain	1 948,53 ± 485,17	0,52 ± 0,13
	Walungu	2 137,20 ± 749,78	0,57 ± 0,20
	Average Dry season	**2 082,53 ± 521,75**	**0,56 ± 0,14**
Whole year	Kabare	5 794,23 ± 3 858,54	0,88 ± 0,33
	Ruzizi Plain	4 624,06 ± 3 663,82	0,72 ± 0,37
	Walungu	5 433,10 ± 3 976,82	0,84 ± 0,39
	Annual average	**5 283,80 ± 3 733,93**	**0,81 ± 0,36**
P-Value	Agroecological zones	0,848	0,794
	Season	3.49e-10 ***	4.6e-06 ***

The results of the analysis of variance showed that the yield in Kg DM/ha varied greatly (p<0.05) depending on the seasons. It appears from the table above that with a high dry matter yield in the rainy season (8485.07 ± 2,578.33 Kg DM/ha) than in the dry season (2082.53 ± 521.75 kg DM/ Ha). Pastures would support different numbers of cattle both in the rainy season (1.07 ± 0.33 TLU/ha) and in the dry season (0.56 ± 0.14 TLU/ha). In other words, the carrying capacity varied greatly depending on the seasons (p < 0.05), but no variation depending on the agroecological zones (p>0.05). It appears from these same results that in the rainy season, the Kabare pastures would support more animals (1.19 ± 0.08 TLU/ha), followed respectively by the Walungu pastures (1.10 ± 0.35 TLU/ ha) and those of the Ruzizi Plain (0.92 ± 0.44 TLU/ha). On the other hand, in the dry season all pastures presented similar carrying capacities. Furthermore, the results postulate that annually the Kabare pastures would support a lot of cattle (0.88 ± 0.33 TLU/ha), while the Walungu and Ruzizi Plain pastures would respectively support 0.84 ± 0.39 TLU/ha and 0.72 ± 0.37 TLU/ha per year.

IV. Discussion

Cattle food resources in South Kivu

The different plant formations listed on different pastures constitute the main source of food for the ruminant livestock across the study area. Floristic inventories carried out in the study area over a period of one year taking into account the dry season as well as the rainy season made it possible to identify a total of 169 forage species exclusively distributed in 38 botanical families. This includes the large plant formations constituting the main source of food for the ruminant livestock. A large dominance of herbaceous species (62.72%) over woody species (37.28%) was reported. The high proportion of herbaceous species at the expense of woody species would be supported by the hypothesis according to which the major disadvantage that woody plants can represent is that their exploitation, by animals, is not always easy (Garambois and Devienne, 2012). In addition, herbaceous species are experiencing rapid development with the imminent resumption of the first rains. However, Jayanegara et al. (2019) postulate that this development would be controlled by the small quantities of water available in the surface layers of the soil. Also, the availability of small quantities of mineral elements, for example nitrogen, would stimulate the vegetative growth of herbaceous plants more than that of woody plants. Our results match those found by Yameogo et al. (2014) having established the characteristics of the different herbaceous fodder resources of the natural pastures of the Vipalogo region in Burkina-Faso. The characteristic morphological type of pastures is covered by 72.78% of herbaceous plants compared to only 27.22% of woody plants, taking into account shrubs, sub-shrubs as well as suffrutexes. However, for the families of forage species inventoried, three botanical families were the most represented in the present study. These are the family Poaceae, Fabaceae and Asteraceae. Indeed, although with a few exceptions, our results converge with those of Amegnaglo et al. (2018) where Fabaceae, Poaceae, Cyperaceae and Asteraceae dominate the grazed plant formations of the Guinean zone of Togo. The low frequency of the Cyperaceae family in the present study would probably be due to the location of different pastures surveyed in the study area and/or even South Kivu, not crossing enough marshy or highly humid areas. Additionally, Sawadogo et al. (2020) argue that the low representation of sedge species is due to the fact that they are less palatable. However, parallelisms emerge by appending our results with those found by Amegnaglo et al. (2018) in the pastures of Togo and those of Yameogo et al. (2014) in Burkina Faso. Indeed, five types of grazed plant formations were described by each of them while we characterized three groups forming 4 types of pastures in the area covered by our study. In addition, certain forage species inventoried in our study area are also present or reported in Togo as well as in Burkina Faso, notably *Hyparrhenia rufa* and *Paspalum glumaceum*. This turns out to be a herbaceous formation increasingly affected to wetlands on predominantly sandy and loamy soil, more often hydromorphic. However, our results on the surveyed pastures do not corroborate with those established by Kimpolo et al. (2021) including the floristic inventory which made it possible to identify 309 trees divided into 79 species, 63 genera and 32 families. Indeed, the botanical family of Annonaceae (11.39%) was the most qualitatively represented in the different pastures identified while the botanical family of Olacaceae was quantitatively the most represented (11.65%) in the pastures identified in the Congolese Mayombe. This weak contrast would be due to the ecology of certain species different from others. In addition, the environments concerned do not have the same agro and pedoclimatic characteristics, thus conditioning the dispersion and disappearance of species on this or that other pasture as reported by Miderho et al. (2018).Moreover, our results are by far also different from those emerging from the investigations carried out by Ngom et al. (2012) in Senegal. They identified a total of 125 forage species divided into 38 families. The grass family was the most represented with 15 species, most of which are low in number. Legumes, which are considered a real indicator of rich pastures, are quite varied in species but dominant in number. These species are also divided into two large groups including the herbaceous species group and the woody species group. Finally, with regard to the specific richness of fodder inventoried on the pastures surveyed in the area e study, the diversity of forage species different from one pasture to another could be explained on the one hand, by seasonality, which would show good growth of herbaceous species when the rainy season is relatively long . Also, the overexploitation of pastures as observed in South Kivu would be taken as one of the factors in the disappearance of the genetic diversity of species, especially those which are the most palatable and do not have the good capacity to recover after trampling or same apprehension by livestock. On the other hand, the physicochemical properties of soils also have their contribution to explaining the diversity and/or specific richness of a given pasture. Thus, as reported by Lesse et al. (2016), the physicochemical properties of soils are the most determining factors in the distribution of species in phytogeographic sectors. However, Miderho et al. (2018); Sandjong et al. (2018) add that the floristic composition of a pasture is a function of all factors relating to climate and topography combined with soil characteristics. Furthermore, apart from the floristic richness of the species identified on the surveyed pastures, the availability of food resources identified in this study being conditioned by the conduct of cattle breeding in the area considered indicates that sweet potato harvest residues, corn and beans proliferate in all territories. This would be due to the fact that these crops, being considered food crops, are cultivated throughout the year.

Biomass production and nutritional value of fodder resources

Seeking to capture the effect of seasonality on the bromatological value of the species inventoried on pastures, the dry biomass yield was higher in the rainy season (8.49 t/ha) than in the dry season (2.08 t/ha). Ha). The results presented in this study show that the dry matter varied greatly ($p<0.05$) according to the different agroecological zones as well as the two seasons observed in the sense that a high dry matter content was observed in the dry season (61%) compared to 18% in the rainy season. All these trends are similar to the conclusions put forward by Delagarde et al. (2006); Kadi and Zirmi-Zembri (2016) have already shown that biomass production drops considerably in the dry season when animals do not find enough grass and those that are available do not contain enough nutrients. Therefore, independently of the agroecological zones investigated, the climatic factors governing the alternation of seasons (dry and rainy) would be best suited to justify and/or support the observed scenario of dry biomass yield in this study according to seasons. However, as reported by Amegnaglo et al. (2018); Adjonou et al. (2019), it is certain that climatic conditions (temperature, rainfall, light) influence the chemical composition of forage in pastures regardless of the agropastoral zones in which they are located. Furthermore, apart from climatic conditions, the quality of fodder inventoried on pastures would also depend on numerous factors including the botanical composition of the species, their development cycle and harvesting and storage conditions. Generally speaking, Maxin et al . (2013) postulate that light stimulates forage growth. It increases the contents of dry matter and soluble carbohydrates (glucose, fructose, sucrose), while reducing the proportion of cell wall constituents, notably crude fiber and lignin in plants.

This increase in the levels of wall constituents significantly affects both the leaves and the stems. On the other hand, the effects of rainfall are such that a moderate water deficit slows down the growth and development of the plant as experienced and reported by Hamadou et al. (2017), Djibo et al. (2018), Delagarde et al. (2018). This would justify the low concentration of fresh weight of forage sampled in the dry season (239.47 grams) while it was higher in the rainy season (925.19 grams). On the other hand, water deficit generally leads to an increase in nitrogen content in most legumes, particularly in alfalfa (Evitayani et al., 2004; Detmann et al., 2014; Pal et al., 2015). Temperature is the climatic factor which induces the greatest variations in the soluble sugar content of forages in both grasses and legumes as reported by Dugué et al. (2018). Indeed, cool temperatures between 18 and 22°C and good sunshine make it possible to maximize the soluble sugar content in grasses and legumes (Ghêliho Zoffoun et al., 2019). This clearly explains the fact that the soluble sugar content is generally lower in the second cut than in the first. On the other hand, high temperatures (> 25°C) as observed during the dry season stimulate the lignification of supporting tissues. On the other hand, a given combination of the aforementioned factors would correspond to a habitat characterized by conditions of competition between species which generate the domination of certain species, the maintenance or even better the disappearance of other species following the effects due to seasonality. Also, forages that resist during the dry season have significantly reduced organic matter content under the influence of drought and heat (Dewa Kassa et al., 2018). It appears that during this period, additional feed would be necessary and very important for good and better productivity of the animals. Furthermore, no significant difference was observed in the average yields obtained according to agroecological zones ($p> 0.05$). This would be explained by the same distribution of rainfall during the year being almost the same in different agroecological zones surveyed. However, the Kabare agroecological zone recorded the best dry matter content in the rainy season (24%) while in the dry season, the Ruzizi Plain observed the best dry matter content (68.44%). The same results show that organic matter is similar during the two seasons and does not vary ($p>0.05$) following the agroecological zones. This makes sense to the extent that all the agroecological zones surveyed are in the tropical zone whose characteristics are the deficiency of nitrogen and phosphorus, total hydrolysis due to heavy rains, often unpredictable, leading to strong erosion of patches of land and/or a significant loss of the first surface layers of the soil on or in which the organic matter rests. The results obtained on the nutritional value indicated that all the parameters taken into account, except the organic matter content, the calcium concentration as well as the gross energy content in the evaluation of the nutritional value of fodder inventoried on the prospected pastures in the study area only vary significantly ($p<0.05$) depending on the season. The production of total biomass was 8.49 t/ha in the rainy season while it was only 2.8 t/ha in the dry season. On the other hand, the dry matter content of fodder is lower in the rainy season (18.54%) than in the dry season (61.69%). In view of the results obtained in the present study, we think that the Food value of the majority of forage species inventoried on the surveyed pastures would be appreciable. Such a fodder value of a pasture could probably cover the maintenance needs as well as the physiological needs of ruminants but not easily those of production (milk production and pregnancy) especially in the dry season to which would be added food supplements such as advanced by Enjalbert and Meynadier (2016). However, the few contributions of certain fodder resources that have been inventoried on pastures would be at the same level or even better than certain fodder resources cultivated and commonly provided as supplements to ruminants on livestock. This constant supports the hypothesis according to which cultivated species do not have the same characteristics even though they belong to the same botanical family.

They respond differently to environmental stimuli. However, despite the similarities observed in the different contents of parameters evaluated, Shiferaw et al. (2011) suggest that this analysis of the quality and/or nutritional value of fodder having been carried out, would still make it possible to assess the satisfaction or non-satisfaction of the nutritional needs of ruminants kept in South Kivu. However, this must be consistent with the characteristics of the different forages inventoried on pastures surveyed in the study area.

Pasture carrying capacity in the three agroecological zones of South Kivu

The results indicated that in the rainy season, pastures would support more cattle (1.07 TLU/ha) than in the dry season (0.56 TLU/ha). This, however, defines the order of magnitude of the number of animals likely to be fed, within the strict and reasonable limits of an operation that roughly protects future production. Thus, the difference recorded between the average UBT in the dry season and that in the rainy season turns out to be quite significant at the 5% significance level. This would be justified by the lower dry biomass yield in the dry season than in the rainy season even if it undergoes degradation as the dry season progresses when this dry biomass is measured at the end of the growing in the rains season. Also, following the scarcity of certain palatable species in the dry season due to the effects of climatic factors including excessively high increasing temperatures, a striking insolation which depreciates the quality of forage available on pastures (Idrissou et al., 2020). It also followed that during each season, the different agroecological zones surveyed did not record the same carrying capacity in the sense that during the rainy season, the Kabare pastures would support more animals (1.19 TLU/ha), in the same way with those of Walungu (1.10 TLU/ha) compared to those of the Ruzizi Plain for which the carrying capacity does not exceed 0.92 TLU/ Ha. On the other hand, during the dry season all the pastures surveyed have a similar carrying capacity, notably Kabare (0.58 TLU/ha), Ruzizi Plain (0.52 TLU/ha) and Walungu (0.57 TLU/ha). This finds its meaning in the distribution of seasons in all agroecological zones during the year (Ahouangan et al., 2010; Djibo et al., 2018; Idrissa et al., 2020). As a result, our results agree by default with those of Assan (2014) having obtained a carrying capacity of between 0.91 and 0.93 TLU/ha in several rangeland areas. However, they are in agreement with those of De Haan (2016), for whom the potential production depending on the type of soil in Guinean pastures varies from 2.5 to 3 tons of DM/ha to 13 tons of DM/ha, i.e. a carrying capacity of 145 UBT days to 690 UBT days of grazing. However, to maintain a sustainable level of exploitation of the study area, it would be important to respect the carrying capacity obtained and to put in place a system allowing the regulation of ruminant grazing in the study area. Furthermore, these results are by far those recorded in Ethiopia in the Awash valley (sub-desert environment) where with 700 to 3000 kg of DM/ha depending on the agroecological zones, the possible carrying capacity is between 4 and 12 ha/TLU .

V. CONCLUSION

Most farmers only use fodder as a staple feed for cattle in addition to crop waste and agri-food by-products. 169 species are available in agroecological zones during the year. They are distributed in 38 botanical families. The most predominant are Poaceae (19.48%), Fabaceae (19.22%), Asteraceae (18.42%), Malvaceae (8.95%), Acanthaceae (4.86%), Rubiaceae (4.37%), Lamiaceae (3.86%), Apiaceae (3.06%) and Verbenaceae (2.28%). The other families including Apocynaceae, Convolvulaceae and Cyperaceae are in low proportions. The dry biomass yield was higher in the rainy season (8.49 t/ha) than in the dry season (2.08 t/ha). The dry matter content varied greatly ($p<0.05$) according to the different agroecological zones following the seasons. It was higher in the dry season (61%) than in the rainy season (18%). During the rainy season, the dry matter yield of fodder is high in the agro-ecological zone of Kabare (9.426t/ha) making it support 1.19 TLU/ha, where Walungu (1.10 TLU/ha) ha) and the Ruzizi Plain (0.92 TLU/ha) would support less TLU/ha. During the dry season, all the agroecological zones surveyed including Kabare (0.58 TLU/ha), Walungu (0.57 TLU/ha) and the Ruzizi Plain (0.52 TLU/ha) support the same number of cattle. Given the nutritional value and the carrying capacity of pastures, pasture improvement works must be considered. The establishment of a regulatory system for grazing of ruminants is suggested in the study area based on the conclusions reached in this study. Livestock intensification in this study area can be based on reliable feeding techniques.

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