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Most consumed ligneous forages in ruminant breeding on natural pasture in north of Benin

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ABSTRACT

There are rainfall dependent and rainfall less dependent forages. The present study, conducted in districts of Nikki, Kalalé, Ségbana and Gogounou located in north-east of Benin republic, deals with less dependent on rainfall ligneous' forage which are important forages resources available and accessible throughout the year. The methodological approaches used are: participatory diagnosis. The useful timbers which leaves are used in ruminant feeding are *Pterocarpus erinaceus*, *Azelia africana* and *Khaya senegalensis*. Facing the regression of those palatable species due to climate change and overexploitation, twenty-six other woody species previously without any interest to bovine nutrition are increasingly used in drought. However, the contribution of those 26 species in ruminants' feeding could be limited by the availability, accessibility and palatability.

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1. Introduction

In republic of Benin, livestock is second to crop production in terms of natural resources potentially exploitable and convertible into foreign currencies (Awouhouédji et al. 2013). Rural ruminant production contributes significantly to the subsistence, economic and social livelihood of the majority of rural families and it

has resulted to national consensus on the need to focus more attention on its long-term sustainability (Dossa et al. 2007). Thus, it's necessary to make a diagnosis of the feeding system in the North East of the country, which has 66.7% of the national herd, rural breeders' strategies in the context of climate variability's. Indeed, in those rural areas, ruminants' feeding system has had two important changes. First of all, breeders used to go into safeguard forests; secondly they have changed their transhumance cycle and have learnt to new species to feed their animals. Among those new species, ligneous forage are very important, because during drought trees produce tenders leaves, flowers and fruits and they account traditionally for 70 % of cattle's diet (Neya, 2006) during this period. Thus, they constitute a potential food resource available throughout the year for ruminants and they are overexploited. Indeed, the most ligneous forage used for cattle's feeding in the north-east of Benin republic namely *Afzelia africana*, *Pterocarpus erinaceus* and *Khaya senegalensis* are all overexploited by various socio-economic actors and are vulnerable species due to habitat loss and environmental degradation (Neya, 2006). Therefore, other woody species formerly without major interest to ruminants' nutrition are increasingly used in dry season. This study aims to make a participatory diagnosis on ruminants feeding system with ligneous forages in the context of usual forages' extinction due to overexploitation.

1.1. Hypothesis

Ruminants' breeders in north-east of republic of Benin used more than 3 novel tree species to fed their animals.

2. Materials and methods

2.1. Study Area

The present study was carried out in the districts of Nikki, Kalalé, Ségbana and Gogounou located in the north east of Benin. Those districts had 66.7% of national herd on a surface which was only 14.72% of country surface. 16.6 km². Nikki and Kalalé municipalities were located in the department of Borgou while those of Ségbana and Gogounou were in the department of Alibori. The study area is located between latitudes 9°39' and 12°23' north latitude and between the meridians 15°2' and 3°15' east longitude. The study area had 14.72% of Benin surface.

2.2. Sampling

The survey method used was developed by the Institut d'Elevage et de MédecineVétérinaire des pays Tropicaux (IEMVT). It was used for the typology of cattle farming systems in many tropical countries, especially in Guadeloupe (Salas et al. 1986), Mexico (Cervantes et al. 1986), Burkina Faso (Bourzat 1986), Guinea (Lhoste et al. 1993), Reunion (Tache, 2001), the Philippines (Duval, 2001), Brazil (Lau et al. 2001), Morocco (Sraïri, 2004) and Benin (Alkoiret et al. 2009).

The herds were identified and recorded at the vaccination centers which helped their size by district. After that, each district of the east north of Benin had been classified under two criteria which are:

1. Herd size;
2. Ligneous forage supply

The result of this classification had shown that the districts which had more than 20% of country's cattle size and 75% of protected forest (Three Rivers forest, Higher forest of Alibori and Sotta's forest) are Nikki, Kalalé, Ségbana and Gogounou. Indeed, the forests are used as pastoral land. In rural regions, breeders used forest as pastoral land. So, in dry season in those four districts, breeders had a lot of resources of tree's leaves to give to their livestock as food.

The number of herds is 1436, 620, 664 and 378 respectively for Kalalé, Nikki, Gogounou and Ségbana districts. Those herds were 39% of national total herds. A random sampling had been done by cluster. Two hundred and forty (240) farms totalizing of 21,700 heads of bovine had been chosen.

Exploratory investigation and survey pre-test had been done before any data collection (Table 1). The real survey had been done from July 2012 to December 2012. Semi-structured interview technique combined with focus group was used for the real survey.

The ten (10) best stockbreeders and the 10 best pastoralists were selected in each village according to Ministry of Agriculture data for the focus group. Two (02) focus groups were been done in each village in the goal

to collect endogenous knowledge on ligneous forage. Concerning semi-structured interview, 240 were been made in the four districts (Table 1).

In the goal to identify ligneous forage exploited for bovine, interviewers had followed stockbreeders on rangeland and had sampled all trees' leaves which had been collected in each farm selected for the survey.

2.3. Statistical Analysis

All species cited by stockbreeders and pastoralists had been identified at the National Herbal Institute of the University of Abomey-Calavi. Descriptive statistics was applied on survey and focus group data with R software (R Core team, 2015). Relative frequency of each tree species which leaves or fruits or flowers or shrub were used as forage in dry season was calculated. When relative frequency of specie was higher or equal to 20%, it's considered as novel species used to feed ruminants.

Table 1
Distribution of villages sampled by town

Departments	Districts	Villages	Ethnic	Focus group	Semi-structured interviews
Borgou	Nikki	Sakabanssi	Gando	2	15
		Sérékalé	Gando	2	15
	Kalalé	Dérassi	Peulh	2	15
		Gandopeul	Gando	2	15
Alibori	Ségbana	Sokotindji	Gando	2	15
		Poela	Peulh	2	15
	Gogounou	Zougou	Bariba	2	60
		Ouèrè	Peulh	2	15
		Sori	Bariba	2	60
		Gounarou	Peulh	2	15

3. Results

3.1. Demographic and sociological characteristics of breeders

They were several classes of breeders (figure 1) and all of them (100 %) were men (Table 2). All of them were bovine breeders. According to all focus groups' information's, in breeders societies in the north's of Republic of Benin, women had no decision unless milk processing and selling. A lot of breeders (96.67 %) were 30 years old and 3.33 % were between 15 and 30 years. As they were Muslim (86.7 %), there were 71.67 % of breeders who were polygamous, 25.07 % who were monogamous and 3.33 % who were single. The breeders were hardly scholarized (45 % had never been to school). In despite of those charteristics, nearly all the breeders (88.3 %) had started breeding from childhood.

Table 2
Surveyed breeders

Critères	Sex		Age (years)		Marital status			School level		
	M	F	0 - 30	30 & +	M(p)	M(m)	S	N	Pr	Se
Nikki	60	0	0	60	48	12	0	32	12	4
Kalalé	60	0	6	54	45	9	6	40	8	12
Ségbana	60	0	2	58	35	23	2	16	40	4
Gogounou	60	0	0	60	44	16	0	20	32	12
Total(%)	100	0	3,33	96,67	71,6	25	3,33	45	43,3	11,7

M : male ; F : female ; N : None ; Pr : Primary ; Se : Secondary ; S : single ; M(m) : Married monogamous ; M(p) : Married polygamous

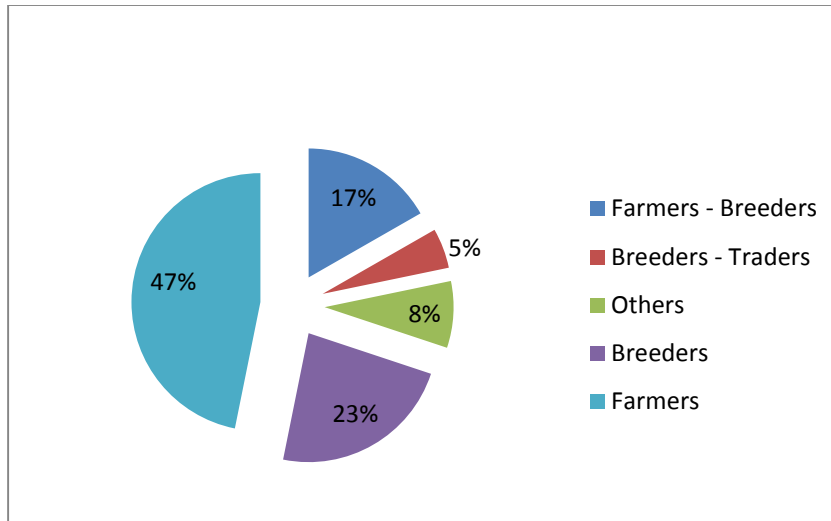


Fig. 1. Principals activities.

3.2. Cattle breeding system

Cattle breeding system in the North East Benin was an extensive one. Benin native breeders didn't go in transhumance any more. Only breeders came from neighboring countries were transhumant. The presence of transhumant herds highly exacerbates the lack of forage resources in the dry season. So, ruminants' diets in dry season in the study area were based on crop residues (cotton, sorghum, millet ...) and ligneous forage. Even if cattle breeding system was an extensive one, 10% of breeders of our study area possessed cultivated forage plots (Figure 1).

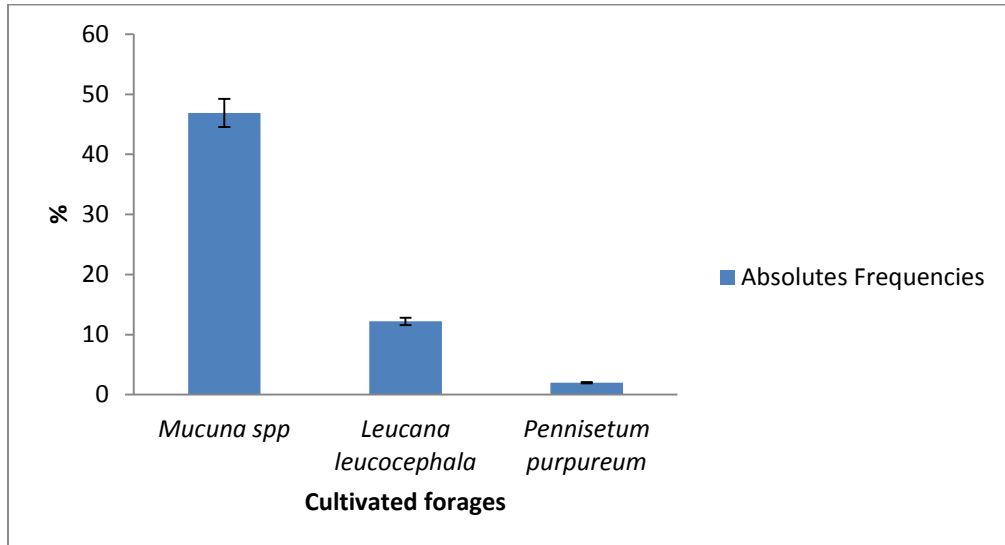


Fig. 2. Relative frequency histogram of cultivated forages for cattle feed.

3.3. Ligneous forage

The survey had revealed trees species (table 3) had been adapted by stockbreeders and pastoralists during drought for bovine feeding. Those trees were categorized with three criteria namely: accessibility, appetency and preservation.

Table 3

Tree species involved in bovine feeding in the North East Benin

Local name (Foufoude)	Scientific name	Family
Wayayi	<i>Azelia africana</i>	Cesalpiniaceae
Banouyi	<i>Pterocarpus erinaceus</i>	Fabaceae
Kahi	<i>Khaya senegalensis</i>	Meliaceae
Kalaayi	<i>Daniellia oliveri</i>	Cesalpiniaceae
Guiédanéyi	<i>Acacia sieberiana</i>	Mimosaceae
Baboussadji	<i>Lonchocarpus laxiflorus</i>	Fabaceae
Doukouli	<i>Annona senegalensis</i>	Annonaceae
Daniandani	<i>Xeroderris stuhlmannii</i>	Fabaceae
Alaayi	<i>Securidaca longepedunculata</i>	Polygalaceae
Kouli ou Kouroudji	<i>Bombax costatum</i>	Bombaceae
Tchamin	<i>Fluggeae virosa</i>	Euphorbiaceae
Gbèsonayi	<i>Monotes kerstingii</i>	Dipterocarpaceae
Bouhiliou bourdi	<i>Dichrostachys cineria</i>	Mimosaceae
Tchintchingouyi ou Kohidimi	<i>Prosopis africana</i>	Mimosaceae
Bagou	<i>Phyllanthus muellerianus</i>	Euphorbiaceae
Alaaitayi	<i>Hymenocardia acida</i>	Euphorbiaceae
Gorodjéidanéyi	<i>Maranthes polyandra</i>	Chrysobalanaceae
Kookobi	<i>Swartzia madagascariensis</i>	Cesalpiniaceae
Djilodjiloyi ou djilomayi	<i>Stereospermum kunthianum</i>	Bignoniaceae
Karéyi	<i>Vitellaria paradoxa</i>	Sapotaceae
Ibiyaki	<i>Ficus gnaphalocarpa</i>	Moraceae
Barikéyi	<i>Pilostigma thonningii</i>	Cesalpiniaceae
Bapamtalayi	<i>Strychnos spinosa</i>	Loganiaceae
Fhatrô	<i>Nauclea latifolia</i>	Rubiaceae
Katiam	<i>Gardenia erubescens</i>	Rubiaceae

Those species were from different botanical families and were involved in bovines' diet. But for each tree, different organs were eaten by animals (Table 4).

The table 4 showed that on the same tree, different organs could be eaten. The leaves which had the better appetency were for *Azelia africana*, *Pterocarpus erinaceus* and *Khaya senegalensis*. According to 80% of stockbreeders interviewed, *K. senegalensis's* leaves could not be given to calve because they tasted bitter. Also, according to these farmers, *A. africana's* leaves could enhance milk production, *P. erinaceus's* leaves could be used as diet supplement and *K. senegalensis's* leaves could be used to control gastric worms.

Six (06) trees (*Swartzia madagascariensis*, *Vitellaria paradoxa*, *Phyllanthus muellerianus*, *Monotes kerstingii*, *Hymenocardia acida* and *Strychnos spinosa*) had their leaves which had little appetency. Twelve (12) trees (*Acacia sieberiana*, *Lonchocarpus laxiflorus*, *Annona senegalensis*, *Xeroderris stuhlmannii*, *Securidaca longepedunculata*, *Bombax costatum*, *Fluggeae virosa*, *Dichrostachys cineria*, *Prosopis africana*, *Maranthes polyandra*, *Ficus sycomorus*, and *Gardenia erubescens*) had their leaves which had good appetency. Concerning the fruits, only five (05) trees (*Daniellia oliveri*, *Pilostigma thonningii*, *Sarcocephalus latifolius*, *Nauclea latifolia* and *Gardenia erubescens*) had theirs which were used in ruminants' feeding. Survey data showed that in ligneous forages, trees' leaves were more used than others organs.

3.4. Ligneous forage ranking

Ligneous forage ranking was used in the goal to identify the better species. Each species received a score that corresponded to how intensive it had been used by pastoralists (Table 5).

Species' ranks showed that stockbreeders were discovering new species for cattle's feeding in dry season as *Sarcocephalus latifolius*, *Dichrostachys cinera* and *Stereospermum kunthianum*.

Table 4

Organes consumed on the main woody species and palatability

Species (n = 26)	Family	Organ (s)	Appetency
<i>Afzelia africana</i>	Cesalpiniaceae	Le	+++
<i>Pterocarpus erinaceus</i>	Fabaceae	Le	+++
<i>Khaya senegalensis</i>	Meliaceae	Le	+++
<i>Daniellia oliveri</i>	Cesalpiniaceae	Le – Fl - Fr	+ (Fr)
<i>Acacia sieberiana</i>	Mimosaceae	Le	+
<i>Lonchocarpus laxiflorus</i>	Fabaceae	Le	+
<i>Annona senegalensis</i>	Annonaceae	Le	+
<i>Xeroderris stuhlmannii</i>	Fabaceae	Le	+
<i>Securidaca longepedunculata</i>	Polygalaceae	Le	+
<i>Bombax costatum</i>	Bombaceae	Le	+
<i>Fluggeae virosa</i>	Euphorbiaceae	Le	+
<i>Monotes kerstingii</i>	Dipterocarpaceae	Le	-
<i>Dichrostachys cineria</i>	Mimosaceae	Le – Fl	+ (Le)
<i>Prosopis africana</i>	Mimosaceae	Le – Fl	+ (Fl)
<i>Phyllanthus muellerianus</i>	Euphorbiaceae	Le	-
<i>Hymenocardia acida</i>	Hymenocardiaceae	Le	-
<i>Maranthes polyandra</i>	Chrysobalanaceae	Le – Fl	+ (Fl)
<i>Swartzia madagascariensis</i>	Cesalpiniaceae	Le	-
<i>Stereospermum kunthianum</i>	Bignoniaceae	Le	+
<i>Vitellaria paradoxa</i>	Sapotaceae	Le – Fl	-
<i>Ficus gnaphalocarpa</i>	Moraceae	Le – Fl	+
<i>Pilostigma thonningii</i>	Cesalpiniaceae	Fr	+
<i>Strychnos spinosa</i>	Loganiaceae	Le	-
<i>Sarcocephalus latifolius</i>	Rubiaceae	Fr	+
<i>Nauclea latifolia</i>	Myrtaceae	Fr	+
<i>Gardenia erubescens</i>	Rubiaceae	Fr	+

(-) Little appetency (+) appetency (++) good appetency (+++) very good appetency

Le: leaves; Fr: fruit; Fl: flowers.

Table 5

Species ranks

Species	Family	Ranks
<i>Afzelia africana</i>	Cesalpiniaceae	1
<i>Pterocarpus erinaceus</i>	Fabaceae	1
<i>Khaya senegalensis</i>	Meliaceae	1
<i>Lonchocarpus laxiflorus</i>	Fabaceae	0.82
<i>Daniellia oliveri</i>	Cesalpiniaceae	0.65
<i>Prosopis africana</i>	Mimosaceae	0.60
<i>Acacia sieberiana</i>	Mimosaceae	0.53
<i>Ficus gnaphalocarpa</i>	Moraceae	0.47
<i>Piliostigma thonningii</i>	Cesalpiniaceae	0.47
<i>Sarcocephalus latifolius</i>	Rubiaceae	0.20
<i>Dichrostachys cineria</i>	Mimosaceae	0.05
<i>Stereospermum kunthianum</i>	Bignoniaceae	0.03

4. Discussion

Cattle's breeding in north east of Benin is an important economic activity. As said by Djènontin (2011) the breeding method is pastoralism. The number of ligneous forage species identified on the rangelands of Nikki Kalalé Ségbana and Gogounou's districts is twenty-six (26). This number is significantly higher than that found by Sinsin (1993). Indeed, Sinsin (1993) has found thirty trees and shrubs used for all domestic ruminants which only twelve (12) are specific to cattle in Nikki's and Kalalé's towns. It's important to underline that with a great pressure on natural pasture, breeders are obliged to give new tree species' leaves to cattle as feed. Babatoundé et al. (2011) has found in south of Benin 40 trees used in sheep feeding. Knowing that sheep could eat some forage which cattle cannot, it's normal to have more ligneous forages for sheep than bovine. In Nigeria, the number of tree species used in the feeding of bovine is forty six (46) (Miranda, 1989). At Burkina-Faso, in sahelian region, Singangar et Kaboré-Zoungrana (2001) has identified fifteen (15) ligneous forages. So, trees' leaves which could be used in cattle's feeding are many and vary with the area vegetation and the climate.

According to breeder the most used species in dry season as ligneous forage are *Azelia africana*, *Pterocarpus erinaceus* and *Khaya senegalensis*. In second position in appetite we have *Daniellia oliveri*, *Lonchocarpus laxiflorus*, *Prosopis africana*, *Acacia sieberiana*, *Ficus gnaphalocarpa*, *Piliostigma thonningii* and *Sarcocephalus latifolius*. This was the same in the natural pasture of "Monts Kouffé" forests (Djènontin, 2011). Only, after the three first species (*A. africana*, *P. erinaceus* and *K. senegalensis*) we have *Bombax costatum*, *Daniellia oliveri*, *Prosopis africana* and *Cordia sinensis*. Our survey shows that trees' organs which are used are leaves and fruits. In Burkina-Faso for example, the fruits and/or the pods of *A. praddiana* and *F. albida* have a great appetite for cattle (Singangar et Kaboré-Zoungrana, 2001). In the same moment only *B. egyptiaca*'s leaves are eaten by cattle (Singangar et Kaboré-Zoungrana, 2001) in the same country.

According to trees' leaves appetite, we have remarked that the most exploited species are disappearing: *Azelia africana*, *Pterocarpus erinaceus* and *Khaya senegalensis*. This may be explained by the ethnopharmacological use of those three species. Indeed, *A. africana* induces milk production, *P. erinaceus* increases weight gain and *K. senegalensis* ensures animal's health control (Awouhouéji et al. 2013). In consequences, Djènontin (2011) has classified *Azelia africana*, *Pterocarpus erinaceus* and *Khaya senegalensis* in the category of endangered species of IUCN. It's important to note that it's not only breeders' exploitation which affects the density of those three trees. Disappearance's causes are many and varied. Forestry development and climate variation have definitively stopped blossoming of those trees (Djènontin et al. 2004). In addition the development of agriculture has reduced rangeland superficies. Others woody species such as *Daniellia oliveri*, *Prosopis africana*, *Ficus gnaphalocarpa* and *Lonchocarpus laxiflorus* already require special attention.

5. Conclusion

Ligneous forage is used in ruminants' feeding in dry season. In the northeast of Benin, in Kalalé, Nikki and Gogounou's districts, our survey have shown 26 trees species which leaves or fruits are used as forage. In those 26 species, we have 3 which are disappearing and which have been classified in IUCN Red List. The 23 else also are endangered due to their habitat destruction, forest development, cultivated areas increasing and climate variation. A rangeland management strategy must be done in the goal to establish a sustainable breeding.

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