



Valorization of groundnut haulms in the feeding of small ruminants in the Sudanian area of Benin

Gbênagnon Serge Ahounou^{*1}, Aristide Mahoutin Agbokounou⁴,
 Mahamadou Dahouda², Jonas André Djenontin³, Victor Moutouama¹,
 Guy Apollinaire Mensah⁵, Benoît Koutinhoun¹, Jean-Luc Hornick⁶,
 Issaka Youssao Abdou Karim¹

¹Department of Animal Production and Health, Polytechnic School of Abomey-Calavi, University of Abomey-Calavi, Abomey-Calavi, Republic of Benin

²Department of Animal Production, Faculty of Agronomic Sciences, University of Abomey-Calavi, Abomey-Calavi, Republic of Benin

³Department of Animal Production, Faculty of Agronomy, University of Parakou, Parakou, Republic of Benin

⁴Direction of Monitoring and Evaluation of Projects and Programs, Beninese Centre for Scientific and Technical Research, Cotonou, Republic of Benin

⁵Research Center of Agonkanmey, National Institute for Agricultural Research, Abomey-Calavi, Republic of Benin

⁶Tropical Veterinary Institute, Department of Animal Production, Faculty of Medicine Veterinary, University of Liège, Liège, Belgium

Key words: *Arachishypogaeae*, Breeders, Benin, North, Sheep

<http://dx.doi.org/10.12692/ijb/10.3.35-45>

Article published on March 12, 2017

Abstract

Groundnut haulms are highly used in the feed of ruminants in Benin. This study was conducted to characterize practices related to the incorporation of groundnut haulms in the feed of small ruminants in the Sudanian area of Benin. A total of 113 small ruminants keepers were interviewed in Borgou and Alibori Departments of the country. The study revealed that interviewed famers belong to diverse ethnic groups mainly Bariba (52.2%), Dendi (12.4%) and Gando (5.31%). The proportions of the other ethnic groups (Fon, Ottamari, Lokpa, Mokole, Nago, Peulh, Ubiore, Djerma and Yom) were very low and varied from 3.54% to 1.77%. The use of groundnut haulms in the feed of small ruminants is mostly practised by male farmers (83.2%). About 92.8% of respondents were married. Most of those who use groundnut haulms harvest them from their own farms (65.5%), while others (31.0%) receive them as gifts, and some (27.4%) purchase them from producers. The majority of breeders (98.2%) use groundnut haulms to feed sheep. Many respondents (77.0%) reported that groundnut haulms are used in the dry season, whereas 29.4% use it whenever it's available. The present study indicates the need for improving practices of groundnut haulms use in the feeds of small ruminants among breeders.

* Corresponding Author: Gbênagnon Serge Ahounou ✉ agserge@yahoo.fr

Introduction

Proteins of animal origin have a paramount nutritional importance in the food of many populations (Toukourou *et al.*, 2016). Due to poor management of available local food resources, populations of sub-Saharan African countries are not able to cover their nutritional needs. Such deficiency has resulted in the decrease of the consumption of animal husbandry products per inhabitants that declined from 14.4 kg/ihbt/yr in 1980 to 13.3 kg/ihbt/yr in 2005 (FAO, 2009). It is therefore necessary to increase the local agricultural production in order to assure food security in sub-Saharan Africa. Apart from the satisfaction of nutritional needs, the growth of agricultural production particularly animal production may induce economic growth in these countries.

In many developing countries, animals endure starvation in dry seasons. This period is characterized by poor quality and insufficient fodders (Nyako, 2015) with subsequent unavailability of substitution feed. The use of artificial pasture is limited and inaccessible to small size herds (Koralagama *et al.*, 2008), whereas natural grazing is essentially composed of perennial gramineous plants in which the fibre content is very high with low total nitrogen content (Pamo *et al.*, 2007).

For a sustainable production system, efforts must be directed towards the use of local resources. Nevertheless, the use of these resources must be based on the nutritional needs of the concerned animals because harvest residues are not able alone to cover the nutritional needs of ruminants (Ibrahim and Yashim, 2014). The most common plant residues used in the feed of livestock to improve their productivity are cereal and legume residues (Abdou *et al.*, 2011). Studies conducted in Western Niger reported excellent growth performances in sheep fed with bean haulms as basic feed and cereal grains as supplement (Osakwe and Drochner, 2006; Anele *et al.*, 2010). With their availability and low cost, the use of leguminous plants' haulms as basic feed for ruminants has become a common practice among farmers (Nyako, 2015).

Groundnut is one of the most cultivated leguminous crops in tropical and subtropical regions (Shiyam, 2010) with high nutritional and economic importance (Noba *et al.*, 2014). The valorisation of groundnut and its by-products in livestock feed comes as a great alternative to animals' starvation during dry seasons. Dried groundnut haulms are more recyclable than the straws especially when they are treated with urea and constitute an interesting basic diet for ruminants in fleshing (Arbouche *et al.*, 2008).

In Benin, the subsector of animal production is regarded as one of the boosters of economic growth. For that matter, a number of programs were initiated to improve animals' performances in the country. Among all concerned species, small ruminants occupy a place of choice. The national size of small ruminants was estimated at 2.576.000 heads including 860.000 sheep and 1.716.000 goats against 2.166.000 heads of cattle (DE, 2014). Despite these numbers, there is a serious supply deficiency in small ruminants in Benin. This is the reason why people from Benin usually purchase sheep and goats from neighbouring countries (Niger and Burkina-Faso), especially during religious feasts when the demand is high (Youssao *et al.*, 2008). The increase of the productivity of small ruminants is therefore necessary for the satisfaction of nutritional needs of populations in animal protein but also for food security and poverty alleviation. These small ruminants represent for the poor rural populations an important source to improve the availability of food of animal origin (Toukourou *et al.*, 2016). The improvement of animals' feed is the best way to achieve, in real time a significant growth of productivity in the herds because growth performances are enhanced in favourable seasons when there is sufficient feed (Gbangboché *et al.*, 2005).

For the improvement of the performances of small ruminants, the valorisation of groundnut haulms in their feed seems to be an interesting possibility. The objective of the present study was to characterize practices related to the incorporation of groundnut haulms in the feed of small ruminants in the Sudanian area of Benin

Material and methods

Study area

This study was conducted in Parakou and Tchaourou municipalities in the Department of Borgou and

Kandi, Banikoara and Gogounou municipals in the Department of Alibori (Fig. 1).

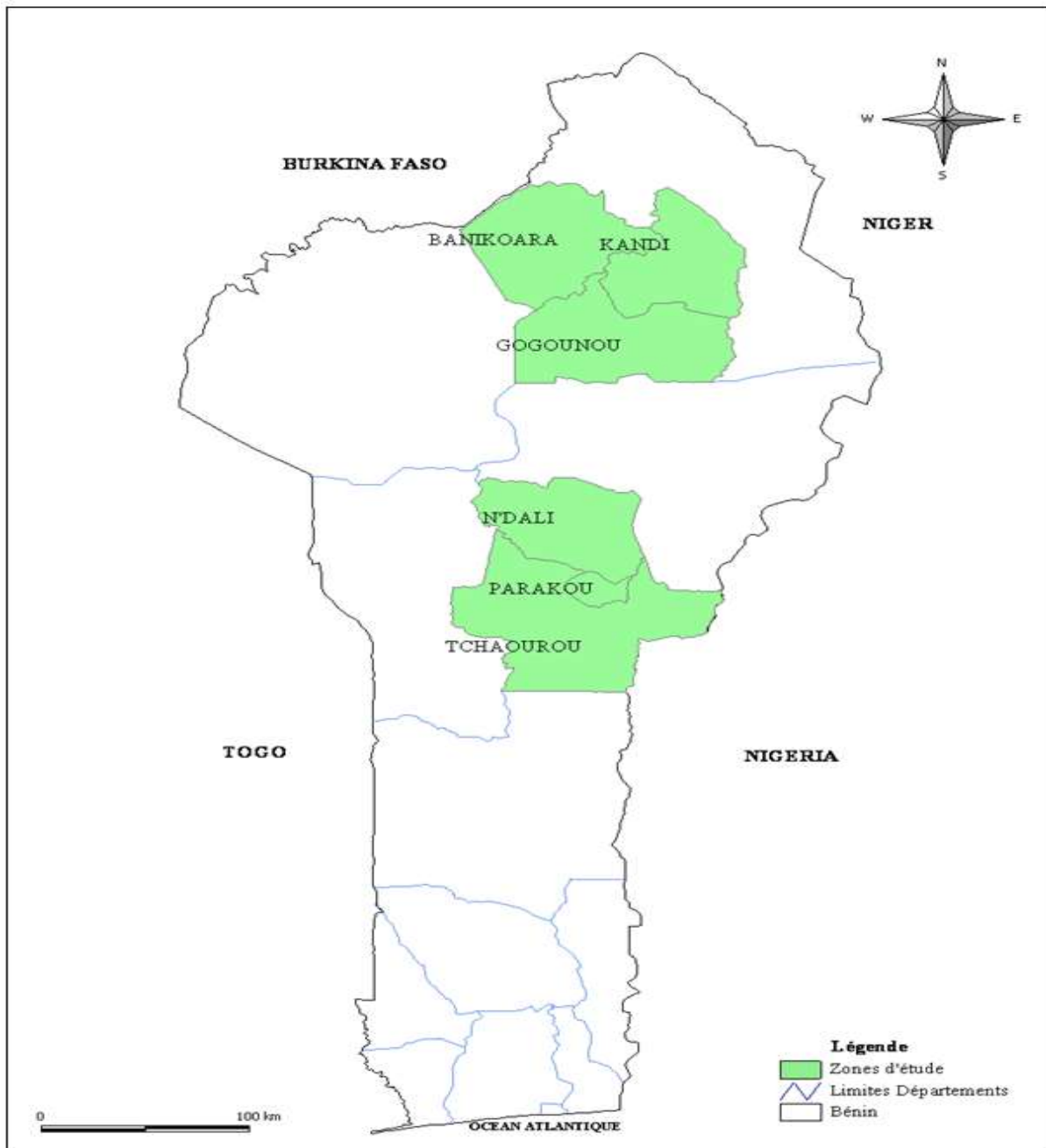


Fig. 1. Study area.

The Department of Borgou covers a total surface of 25 856 km² and is situated in the Nord-East Benin between the latitudes 8°55' and 10°53'N, and the longitudes 2° and 3°50' E. It is characterized by a Sudanian type of climate with one dry season (November to May) and one rainy season (June to October).

The annual rainfall is 1,200 mm (Zakari *et al.*, 2012). The Department of Alibori, is located in the extreme North of Benin between 10° 49' and 11.86° 0' of North latitude and 2° 25' and 3°41' of longitude. Its surface is of 26242 km² and the climate is of Sudano-sahelian type.

The rainy season lasts from May to September and the dry season from November to April. The average annual rainfall varies between 700 and 1,000 mm (DDPD/B-A, 2007).

These two Departments are situated in Northern Benin. Benin is bordered in the North by Niger River that separates it from the Republic of Niger, in the North-West by Burkina-Faso, the west by Togo, the East by Nigeria and the South by Atlantic Ocean, with a total surface of 114.763 km².

Methodology

Structured pretested questionnaire was used to collect quantitative and qualitative data from animal keepers of the study area. Information was collected on sociological characteristics of breeders, the source of groundnut haulms used and the modes of utilisation of these haulms in animals feed.

The study employed retrospective techniques based on face-to-face interview with farmers. All farmers practising animal husbandry were first included in the study. However, during the survey, the accessibility and availability of farmers to provide the needed information was an important selection criterion. A total of 113 breeders were enrolled. After the interview, the filled-in questionnaires were stripped and the collected data were encoded and recorded in a database conceived with Microsoft Excel software.

Statistical analyses

The collected data were analysed with SAS software (Statistical Analysis System, 2006). Means were calculated with the procedure *Proc means* and proportions by the procedure *Proc freq*. Comparisons between the relative frequencies were performed by the bilateral Z test. For every relative frequency, a confidence interval (CI) at 95% was calculated according to the formula below

$$ICP = 1,96\sqrt{\frac{[P(1-P)]}{N}}$$

P is the relative frequency and N the total sample size. A factorial analysis of correspondences (AFC) was performed using the collected data. Then a hierarchical ascending classification based on the characteristics of the users of groundnut haulms was carried out on the most significant components of the AFC. Unfortunately, many groups of groundnut haulm users could not be determined. Consequently, only one type of users was found and the results are presented as proportions and confidence interval or means and standard deviations.

Results

Table 1 shows the characteristics of breeders that use groundnut haulms in the feed of sheep in the sudanian area of Benin. It revealed a wide diversity of ethnic groups among these breeders (Fig. 2). The predominant ethnic group was Bariba (52.21%), followed by Dendi (12.39%) and Gando (5.31%).

Table 1. Characteristics of farmers who use groundnut haulms to feed their sheep.

Variables		Number	Percentage	Confidence interval
Sex	Feminine	113	16.81b	6.9
	Masculine	113	83.19a	6.9
Matrimonial situation	Married	111	92.79a	4.81
	Divorced	111	4.50b	3.86
	Widowed	111	1.80b	2.47
	Bachelor	111	0.90b	1.76
Religion	Muslim	111	73.87a	8.17
	Christian	111	23.42b	7.88
	Animist	111	2.70c	3.02
Level of education	Illiterate	111	73.87a	8.17
	Primary	111	10.81b	5.78
	Secondary	111	10.81b	5.78
	University	111	4.50b	3.86

Intra-class proportions of the same column without common letters do differ significantly at 5%.

The proportions of the other ethnic groups (Fon, Ottamari, Lokpa, Mokole, Nago, Peulh, Ubiore, Djerma and Yom) were low and varied from 3.54% to 1.77%. Most of the farmers were Muslim (73.87%) while Christian farmers were only 23.42% and animists were 2.70%. Male farmers were the dominant users of groundnut haulms (83.19%). The majority of respondents (92.79%) were married,

whereas only 4.5% were divorced. Widowed farmers represented 1.80% of the respondents and bachelors were 0.9%. Almost three quarters (73.87%) of breeders are illiterate. Those that have primary and secondary education levels were similar and equal to 10.81%. Only 2.7% of the respondents had university education.

Table 2. Source of the used groundnut haulms.

Variables		Number	Percentage	Confidence interval
Awareness of the origin of groundnut haulms used in the feed of small ruminants		76	50.00	11.24
Source of the groundnut haulms	Self-production	113	65.49a	8.77
	Purchase from market	113	0.88c	1.72
	Gift	113	30.97b	8.53
	Purchase from producers	113	27.43b	8.23

Intra-class proportions of the same column without similar letters do not differ significantly at 5%.

Only 112 farmers gave their age, while 103 responded to the question of number of dependents. The mean age of breeders was 43 ± 1.6 years and every breeder has 9.34 ± 0.61 dependents. The average number of sheep per herd was about 16 heads. The amount of groundnut haulms given to the animals was 1.82 kg.

The investigated sheep keepers practice other activities as shown in Fig. 3. The integration of animal and crop production is practised by most of the respondents (61.26%). The proportion of merchants among respondents was 14.41% and close to ($p > 0.05$) that of civil servants (18.92%). The proportion of agriculturists was low and similar to the one of exclusive breeders (2.70%).

Nearly all respondents (98.23%) keep sheep. Furthermore, the two third of interviewed farmers keep goats and poultry and more than half of them (55.75%) have cattle. However, pig production is least developed in the study population (7.08%) (Fig. 4).

Most of the groundnut haulms (65.49%) used to feed small ruminants in the study population originates from the fields of the breeders. A considerable proportion (30.97%) is from gifts. About 27.43% of respondents purchase groundnut haulms from the producers.

However, groundnut haulms are not commonly purchased from the market (0.88%) (Table 2). Close to half of interviewed farmers did not declare the origin of the groundnut haulms that they use.

The modes of utilisation of groundnut haulms vary according to breeders (Table 3). The majority (98.23%) use groundnut haulms to feed sheep with incorporation rates that vary with the season ($P < 0.05$). About 77.98% of farmers use groundnut haulms in the dry season, while 29.36% use them whenever they have it in store.

Many farmers (88.18%) distribute groundnut haulms to groups of animals, whereas 11.82% practice individual distribution. Groundnut haulms are used as feed supplement by 84.55% of interviewed breeders.

However, 14.55% of them use exclusively groundnut haulms to feed their animals. Grazing and residues of harvest are the main feed supply of sheep. Most breeders use grazing than the other types of feed. Grazing on herbaceous pasture is mostly practiced by farmers to feed their animals (81.91%). The use of residues of harvest is based on rice straws (56.38%), maize bran (52.13%) and bean haulms (41.49%).

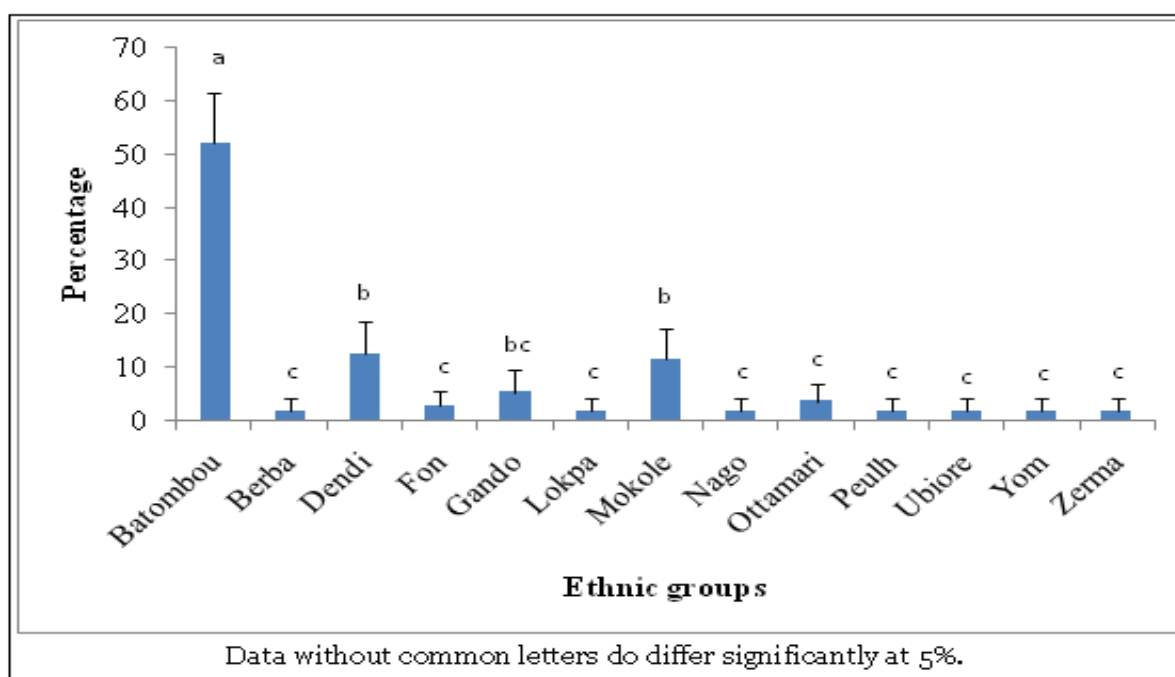
Table 3. Modes of utilisation of groundnut haulms in the feed of sheep.

Variables		Number	Percentage	Confidence interval
Proportion of breeders that use groundnut haulms to feed sheep		113	98.23	2.43
Period of distribution of groundnut haulms	Dry season	109	77.98a	7.78
	When available	109	29.36b	8.55
Proportion of breeders that use groundnut haulms to feed all animals		109	92.00	5.09
Category of animals that receive groundnut haulms	Animals on Fattening	109	5.50	4.28
	Sick animals	109	0.92	1.79
Distribution of groundnut haulms	Individually	110	11.82	6.03
	In group	110	88.18	6.03
Utilisation of groundnut haulms	Exclusive	110	14.55b	6.59
	As supplement	110	84.55a	6.75
Feed supplements given to sheep fed with groundnut haulms	Herbaceous grazing	94	81.91a	7.78
	Aerial grazing	94	13.83c	6.98
	Bean haulms	94	41.49b	9.96
	Rice straw	94	56.38b	10.03
	Sorghum stem	94	12.77c	6.75
	Millet stem	94	7.45cd	5.31
	Cassava peelings	94	2.13d	2.92
	Maize bran	94	52.13b	10.10
	Maize tips	94	9.57c	5.95
	Yam peelings	94	1.06d	2.07
Number of distribution of groundnut haulms per day	Once	110	20.91b	7.60
	2times	110	48.18a	9.34
	3times	110	30.91b	8.64
Period of distribution of groundnut haulms in the day	Morning	110	90.91a	5.37
	Afternoon	110	40.00c	9.16
	Evening	110	79.09b	7.60

Intra-class proportions of the same column without common letters do differ significantly at 5%.

Almost half of the interviewed farmers (48.18%) serve groundnut haulms to their animals twice per day. Those that serve once or thrice represent 20.91% and 30.91% respectively. The distribution of groundnut

haulms is basically done in the mornings (90.91%) and evenings (79.09%). Less than half of farmers serve groundnut haulms in the afternoon (40%).

**Fig. 2.** Ethnic groups of farmers who use groundnut haulms to feed their sheep.

Discussion

The present study revealed that the incorporation of groundnut haulms in the feed of small ruminants was practised by various ethnic groups in the sudanian area of Benin; however, Baribabreeders were the predominant users. This result is related to the demography of the study area (Departments of

Borgou and Alibori) which is dominated by Bariba tribes (DDPD-BA, 2007). The majority of the breeders were men with a mean age of 43 years. They are mostly married, illiterate and Muslims with about 9 dependents per household. Similar results were reported by Didagbe*et al.* (2015) in the same area among groundnut producers.

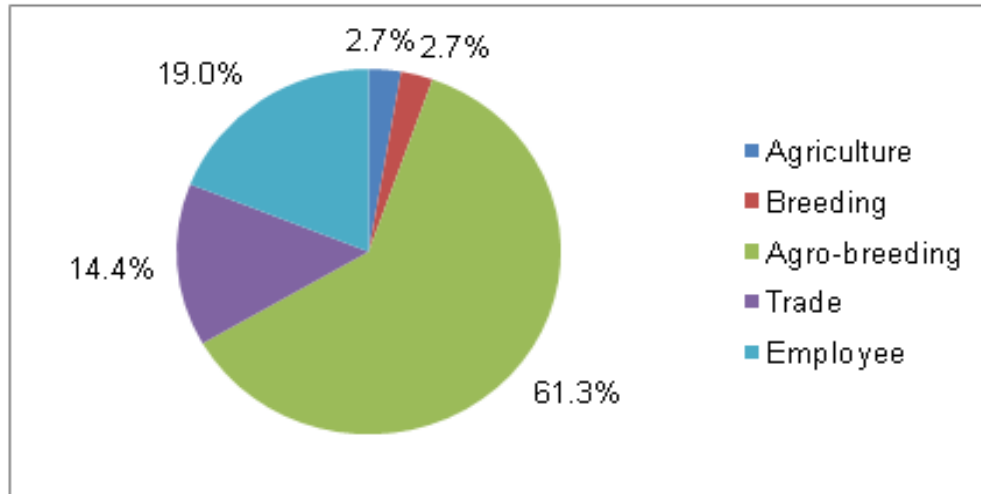


Fig. 3. Main activities of groundnut haulms users.

This indicates that the socio-demographic characteristics of breeders reported in this study are the ones of the study area as a whole. These results differ from those obtained by other authors in other countries on the importance of women in small ruminants keeping. According to Tamini*et al.* (2014), household sheep fleshing is mainly practised by women in Burkina Faso. In southern Mali, Nantoumé *et al.* (2014) reported no significant difference between proportions of men and women involved in sheep rearing. However, Tendonkeng *et al.* (2013) found in Cameroon similar situations to the ones of the current study that describes men as the main sheep keepers. Nevertheless, Tendonkeng *et al.* (2013) reported a high level of education among their study population where Christianity was the dominant religion. This discrepancy can be explained by the specific distribution of populations in each African country. In many African countries, the northern parts are often populated by Muslims and the southern part by Christians. The literacy rate is also usually low in the northern parts as compared to the South.

An evidence of low literacy rate was described by Alkoiret*et al.* (2009) among cattle keepers in Gogounou municipality of Benin (North). The low literacy rate among breeders resulted in the lack of data on the amount of groundnut haulms served to animals. Only 10% of respondents were able to give the amount of groundnut haulms they serve to their animals.

The study also indicated that investigated farmers are involved in many other activities mainly the integration of animal and crop production. This association of animal production and crop production was previously reported by Didagbe*et al.* (2015) and Ahounou *et al.* (2016).

Most of the farmers use groundnut haulms to feed sheep. This choice is related to the necessity of improving production performances of these animals since animal production in tropical areas is confronted to sustainability challenges (Dedieu *et al.*, 2011). Furthermore, the study demonstrated that the period of groundnut haulms utilisation varies among breeders whereby the majority (2/3) use them in dry season while the other 1/3 use them whenever available.

This is in contradiction with the observations of Alexander *et al.* (2012) who reported that farmers in tropical regions manage the feed of their herds based on the available resources rather than the nutritional needs of the animals. For Dicko *et al.* (2006),

the supplementation that becomes systematic in dry seasons seems to continue throughout the year. Also, recommendations should be made to convince breeders to make efficient use of available local resources such as fodders or non-conventional feed resources (Alexander *et al.*, 2012).

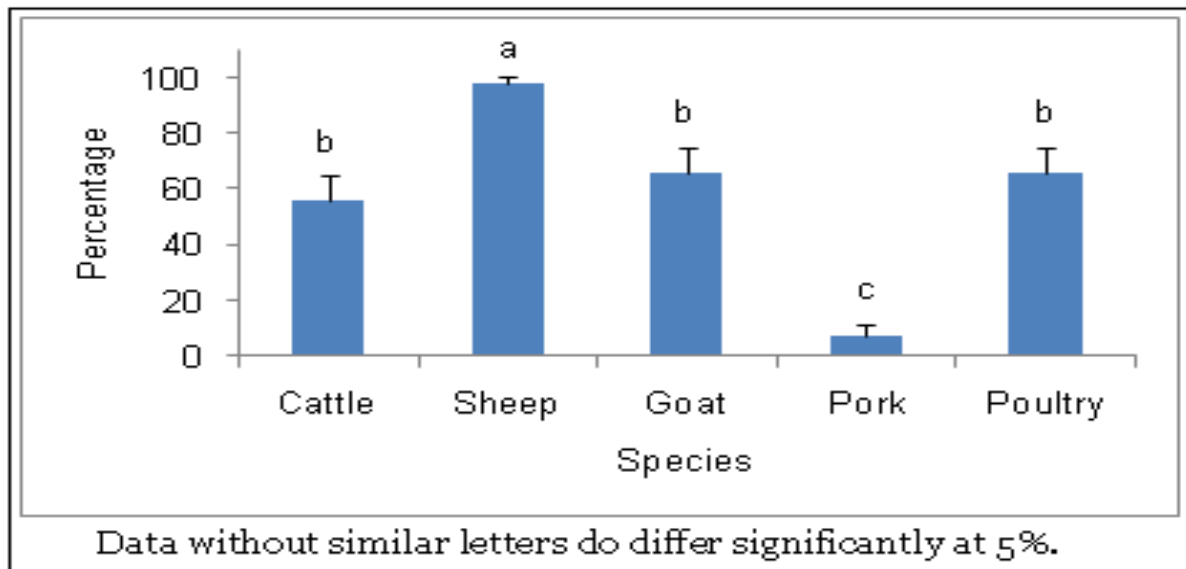


Fig. 4. Animal species reared by farmers who use groundnut haulms.

The majority of interviewed farmers keep sheep, and this is attributable to their religious conviction. With a high proportion of Muslims in the study area, the demand of sheep gets high during religious feasts. According to Ayantunde *et al.* (2008), sheep production is a growing business in West Africa especially during Islamic feasts. However, apart from sheep these farmers also keep goats and poultry. But pig production is not common in the area because of their Islamic belief. More than half of the breeders use groundnut haulms from their own farms to feed their animals. This result can be explained by the fact that most of the breeders are involved in animal and crop production and they have the possibility to harvest and store groundnut haulms from their own farms to feed their animals. These results are in accordance with the observations of Didagbe *et al.* (2015) who reported that in Northern Benin, groundnut producers tend to keep the haulms to feed their animals. Groundnut haulms obtained as gifts or purchased were also reported in this study. This is because not all breeders practice both crop and animal production.

Therefore, those who are not animal keepers have to get it out either as gifts or sale. The incorporation of groundnut haulms in the animals' feed is a common practice in the study population. However, the rates of incorporation vary with the season. Farmers serve groundnut haulms to their animals mainly during the dry season when there is not enough pasture to cover the nutritional needs of the animals. Similar situation was described by Obulbiga *et al.* (2015) in Burkina Faso regarding the low quantity and quality of pasture in dry seasons. Most farmers serve groundnut haulms to animals in groups. This practice of group service was described by Mouhous *et al.* (2015) around Tizi Ouzou Mountains in Algeria. Groundnut haulms were used as animal feed supplement by 4 farmers out of 5. This mode of feeding is related to the fact that in the study area, animals are basically fed on natural pastures. Similar observations related to the use of feed supplements were also reported around Tizi Ouzou Mountains (Mouhous *et al.*, 2015). Moreover, the main source of feed for sheep in the current study is natural grazing and harvest residues.

This is in accordance with reports of Kiema *et al.* (2008) in the Sahelian region of Burkina Faso. Most of the investigated farmers commonly serve groundnut haulms twice in the day: in the morning and in the evening. And this is probably because most of animals go for grazing during the day.

Conclusion

The incorporation of groundnut haulms in the feed of small ruminants is a very developed practice in the Sudanian area of Benin. Most of breeders who use groundnut haulms to feed their animals are men and belong to Bariba ethnic group. They are mostly married, Muslims and illiterate.

The majority of them keep sheep and commonly use groundnut haulms to feed their animals but do not keep pigs due to religious issues. More than half of the breeders use groundnut haulms from their own farms. However, the frequency of distribution of the haulms to animals varies according to the season of the year. Groundnut haulms are predominantly given to animals during dry seasons and used by 4 farmers out of 5 as feed supplement. The distribution of groundnut haulms to animals is commonly practised in the morning and the evening.

References

Abdou N, Nsahlai IV, Chimonyo M. 2011. Effect of groundnut haulm supplementation on millet stover intake digestibility and growth performance of lambs. *Animal Feed Science and Technology* **169**, 176-184. <http://dx.doi.org/10.1016/j.anifeedsci.2011.07.002>

Ahounou GS, Dahouda M, Djenontin JA, Agbokounou AM, Moutouama V, Mensah GA, Bénéoit Koutinhoun B, Hornick JL, Youssao AKI. 2016. Typology of groundnut pods and haulms producers in the sudanese zone of northern Benin. *International Journal of Advanced Research* **4**, 726-738.

Alexandre G, Arquet R, Fleury J, Troupé W, Boval M, Archimède H, Mathieu M, Mandonnet N. 2012. Système d'élevage caprins en zone tropicale: analyse des fonctions et des performances. *INRA Production Animale* **25**, 305-316.

Anele UY, Arigbede OM, Sudekum KH, Ike KA, Oni OA, Olanite JA, Amole GA, Dele PA, Jolaosho AO. 2010. Effects of processed cowpea (*Vigna unguiculata* L. Walp) haulms as a feed supplement on voluntary intake, utilization and blood profile of West African dwarf sheep fed a basal diet of Pennisetum purpureum in the dry season *Animal Feed Science and Technology* **159**, 10-17.

<http://dx.doi.org/10.1016/j.anifeedsci.2010.05.004>

Arbouche F, Arbouche R, Arbouche HS, Arbouche Y. 2008. Valeur nutritive d'un oléagineux local et de ses dérivés pour l'alimentation du bétail: cas de l'arachide «petite kaloise» Algérie **20**, Article #214. Récupéré le 8 décembre 2016, à partir de www.lrrd.org/lrrd20/12/arbo20214.htm.

Ayantunde, AA, Fernandez-Rivera S, Dan-Gomma A. 2008. Sheep fattening with groundnut haulms and millet bran in the West African Sahel *Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux* **61(3-4)**, 215-220.

Dedieu B, Aubin J, Duteurtre G, Alexandre G, Vayssières J, Bommel P, Faye B. 2011. Conception et évaluation de systèmes d'élevage durables en régions chaudes, à l'échelle de l'exploitation. In: Numéro spécial, Elevage en régions chaudes. Coulon J.B., Lecomte P., Boval M., Perez J.M. (Eds). *INRA Production Animale* **24**, 113-128.

Dicko MS, Djiteye MA, Sangaré M. 2006. Les systèmes de production animale au Sahel. *Sécheresse* **17**, 83-97.

Didagbe OY, Houngnandan P, Dedehouanou H, Sina H, Bello DO, Toukourou F, Baba-Moussa L. 2015. Characterization of the peanut production systems in their main agro-ecological regions in Benin, *European Scientific Journal* **11**, 242-261.

Direction Département de la Prospective et du Développement du Borgou et l'Alibori 2007. Tableau de bord social des départements du Borgou et de l'Alibori, 268 p.

Direction de l'élevage. 2014. Annuaire statistique 2013, 82 p.

FAO. 2009. Banque de données, FAOTSTAT. FAO. OGG : Agriculture. Adresse URL: <http://apps.fao.org/page/collection?suset=agriculture&e=fr>. Consulté le 27 juillet 2010.

Gbangboché AB, Hornick JL, Adamou-N'Diaye M, Etorh PA, Farnir F, Abiola AF, Leroy P. 2005. Caractérisation et maîtrise des paramètres de la reproduction et de la croissance des ovins Djallonkés. *Annale de Médecine Vétérinaire* **149**, 148-160.

Ibrahim TA, Yashim SM. 2014. Growth response, nutrient digestibility and haematological parameters of Red Sokoto Bucks fed lime treated maize cob supplemented with concentrate diet. *Nigeria Journal Animal Science* **16**, 264-271.

Kiema A, Nianogo AJ, Somda J, Ouédraogo T. 2008. Valorisation de *Cassia obtusifolia* L. dans l'alimentation des ovins d'embouche en région sahélienne du Burkina Faso. *Tropicultura* **26**, 98-103.

Koralagama KDN, Mould FL, Fernandez-Rivera S, Hanson J. 2008. The effect of supplementing maize stover with cowpea (*Vigna unguiculata*) haulms on the intake and growth performance of Ethiopian sheep. *Animals* **2**, 954-961. <https://doi.org/10.1017/S1751731108001912>

Mouhous A, Kadi SA, Brabez F. 2015. Analyse préliminaire des pratiques de production des élevages ovins en zone de montagne de Tizi-Ouzou (Algérie): cas de l'alimentation. *Livestock Research for Rural Development* **27**, Article 132. Récupéré le 8 Décembre, 2016, à partir www.lrrd.org/lrrd27/7/mouh27132.html

Nantoumé H, Traoré MS, Bonneville J. 2014. Enquête sur l'alimentation d'ovins villageois au Sud du Mali. *Livestock Research for Rural Development*. **26**, Article 16. Récupéré le 8 Décembre, 2016 www.lrrd.org/lrrd26/1/nant26016.html.

Noba K, Ngom A, Guèye M, Bassène C, Kane M, Diop I, Ndoye F, Mbaye MS, Kaner A, Tidiane Ba A. 2014. L'arachide au Sénégal: Etat des lieux, contrainte et perspectives pour la relance de la filière. *Oilseeds & fats Crops and Lipids* **21**, D205. <http://dx.doi.org/10.1051/ocf/2013039>

Nyako HD. 2015 Effect of feeding different supplements on the performance of Yankassa Rams offered a basal diet of groundnut haulms. *Global Journal of Animal Scientific Research* **3**, 576-582.

Obulbige MF, Bougouma V, Sanon HO. 2015. Amélioration de l'offre fourragère par l'association culturale céréale-légumineuse à double usage en zone nord soudanienne du Burkina Faso. *International Journal of Biological and Chemical Sciences*. **9(3)**, 1431-1439. <http://dx.doi.org/10.4314/ijbcs.v9i3.26>

Osakwe II, Drochner W. 2006. Nutritive value of *Morindalucida* and its fermentation parameters in West African dwarf sheep when fed as supplement to grass hay. *Small ruminant Research* **64(1-2)**, 107-115. <http://dx.doi.org/10.1016/j.smallrumres.2005.04.008>

Pamo TE, Boukila B, Fonteh FA, Tendonkeng F, Kana JR, Nanda AS. 2007. Nutritive values of some basic grasses and leguminous tree foliage of the Central region of Africa. *Animal Feed Science and Technology* **135**, 273-282. <http://dx.doi.org/10.1016/j.anifeedsci.2006.07.001>

Shiyam JO. 2010. Growth and yield response of groundnut (*Arachis hypogaea* L.) to plant densities and phosphorus on an Utilisol in Southeastern Nigeria. *Lybian Agriculture Research Center, Journal International* **1**, 211-214.

Tamini LD, Fadiga ML, Sorgho Z. 2014. Chaines de valeur des petits ruminants au Burkina Faso: Analyse de situation. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Toukourou Y, Abdoulaye M, Attakpa YE, Alkoiret IT. 2016. Croissance des agneaux Djallonkés nourris avec du lait de soja. *Tropicultura*, **34**, 150-157.

Youssao AKI, Farougou S, Koutinhouin BG, Bio Bagou G, Kora BD. 2008. Aptitudes maternelles de la brebis Djallonké en élevage traditionnel dans la Commune de Banikoara au Bénin, *Revue de Médecine Vétérinaire* **159**, 538-544.

Zakari S, Yabi I, Ogowalé E, Boko M. 2012. Analyse de quelques caractéristiques de la saison des pluies dans le Département du Borgou (Bénin, Afrique de l'Ouest). Actes du XXVème Colloque de l'AIC, Grenoble, France: 793-798.