RESEARCH ARTICLE

CHARACTERISTICS OF AFRICAN DWARF SHEEP REARING SYSTEMS USED IN THE NORTH AND SOUTH OF BENIN

Adjibode G[1]., Tougan U.P[2]., Daouda I-H[2]., Zannou M.S.[2]., Mensah G.A[3]., Youssao A.K.I[1]., Hanzen Ch[4]., Thewis A[5] and Koutinhouin G. B[1]

[1]Department of Animal Production and Health, Polytechnic School of Abomey-Calavi, 01 BP 2009, Cotonou, Republic of Benin, Benin
[2]National High School of Agro-Pastoralism (ENSAP), University of Parakou, Republic of Benin
[3]Agricultural Research Center of Agonkanmey, National Institute of Agricultural Research of Benin, 01 BP 884, Cotonou 01, Republic of Benin
[4]Service de Thériogénologie, Département clinique des animaux de production, Faculté de Médecine Vétérinaire, Université de Liège
[5]Animal Sciences Unit, Gembloux Agro-Bio Tech, University of Liege, Passage des Déportés, 2, 5030 Gembloux, Belgium

A R T I C L E   I N F O

A B S T R A C T

The study aims to compare the rearing system characteristics of Djallonke sheep in the North and South of Benin. Data were collected on 133 sheep breeders in the North and 154 farms in the South of Benin from September to November 2015. It comes out from the survey that the sheep breeders were predominantly a man (p <0.001). Fulani represent the more important ethnic group of shepherds in the North while in the South zone, Fon ethnic group predominate. The sheep owners of the two zones are married. The rate of non-schooled farmers is more important in the North (79.70%) than in the South (38.96%; p <0.001). Their main activity was essentially livestock breeding in the North region (63.91%) to agriculture (46.75%) in the South. The majority of farmers in the North (75.94%) and South (59.74%) raise the animals as savings (p <0.001). The sale and consumption constitute the main production goals (45.86% and 69.93%, respectively in the North and South; p <0.001). Animal feeds in both areas are provided by fodder, crop residues, and kitchen residues. Only a few farmers (26.62% - 29.32%) store some feeds for the dry season. Herd size is highest in the North than in the South (31.51 vs 17.67 heads; p <0.001). 69.17% of surveyed farms in the North have no habitat while 66.23% of the surveyed farms south have traditional shelters. The grazing time is longer in North than in south (7.92 *vs* 7.09 hours, p <0.001). The management of the farms are based on the owner or itfamily financing support with a predominance in the North (p. <0.001). Several species including poultry, goats and cattle were associated to the sheep rearing. The diversity of these systems of production must be taken into account for purposes of Djallonke sheep development.

INTRODUCTION

West African Dwarf sheep production plays a very vital role in the livelihood of rural populations in sub-Saharan Africa as sales of the animals and their products help to stabilize household income. The tropical environment, with its characteristic harsh weather conditions, adversely affect meat and reproductive performance of animals (El-Hassan *et al*., 2009).

Djallonke sheep is the most reared sheep breed in Benin (Gbangboche *et al*., 2004) because of its perfect adaptation to the local climatic conditions and its resistance (Mawuena 1987; Gbangboché *et al*., 2005a, Gbangboché at al., 2005b). This West African Dwarf sheep is a hairy sheep breed found all over West and Central Africa south of 14° latitude, and widely distributed throughout 12 the savannah and humid zones. The characteristics of WAD sheep have been described

by several authors (Rombaut et Van Vlaenderen, 1976; Pagot, 1985; Larrat, 1989; Fournier, 2006; Gbangboché *et al*., 2005). It is a compact breed with a small mature size and short horizontal lop ears. Coat colour varies from spotted black and white to solid black or white. Some have tan or brown coat colour and black bellies. Rams are horned and females usually polled. WAD sheep are capable of limiting parasite multiplication and remain productive in tsetse-infested areas where other breeds can't survive without treatment (Ayuk *et al*., 2014). However, West African dwarf sheep have low productivity (Yapi, 1994) and weak reproduction and growth performance (Adjibodè, 2012) varying with latitude from north to the south of Benin (Gbangboché *et al*., 2005b; Youssao *et al*., 2008).

Few studies (Gbangboché *et al*., 2004; Akouedegni *et al*., 2013; Awohouedji *et al*., 2013) are carried on the characterization of Djallonke sheep reared in Benin.

Furtheremore, these studies are conducted in station where farming is of semi-modern type (Gbangboché *et al*., 2004; Akouedegni *et al*., 2013; Awohouedji *et al*., 2013). Moreover, the differences among the production systems used for the rearing of this local sheep breed in the North and the South of Benin are not documented. According to Adjibode *et al*. (2016), differences among rearing systems could lead on great variability in the reproductive and growth performances in sheep. The development of programs to improve the breed of sheep inevitably requires the control of technical elements related to farming practices (pasture management, policies made reproduction), sociology breeders, their education, economic activities, their financial and social constraints (Soro *et al*, 2015).

The aim of the current survey is to investigate deeply on the characteristics of the Djallonke sheep rearing systems used in the North and the South of Benin.

Specifically, it is to:

- Identify the profile of Djallonke sheep producers;
- Compare the characteristics and the management of this livestock production in the North and the South of Benin.

MATERIAL AND METHODS

Study Area

The study was thus conducted conjointly at the North and the South of Benin respectively in the departments Atlantic and Borgou. Situated between the latitudes of 6°20' and 12°30' north and between the longitudes of 1°30' and 3°45 East, the republic of Benin covers an area of 113440 km2 with a population of 10448647 inhabitants (INSAE, 2015) and a density of 60 hab./km2.

The department Atlantic exhibits climatic conditions of sub-equatorial type, characterized by two rainy seasons with an uneven spatial and temporal distribution of rainfall: major (from April to July) and minor (from September to November). These two seasons are separated by a dry season. Average rainfall is close to 1200 mm per year. The monthly average temperatures vary between 27 and 31°C and the relative air humidity fluctuates between 65%, from January to March, and 97%, from June to July.

The department Borgou exhibits climatic conditions of Sudan type, characterized by only one rainy season (from April to October) and one dry season (November to March). Average rainfall varies between 900 and 1300 mm per year while the average annual temperature is 26°C with a maximum of 32°C in March and a minimum of 23°C from December to January. The relative humidity varies between 30 and 70%. Vegetation of Borgou department is a diversified savannah where tree density decreases towards the North.

Data collection

A representative sample of 287 sheep farms of both different areas was chosen. Data were collected from November 2014 to December 2015 on a total of 287 producers of West African dwarf sheep. The materials used for data collection includedsurvey forms, pens, a digital camera and a laptop. The survey form carries the following information:

- profile of the sheep producer;

- origin of the herd;
- mode of herd renewal ;
- habitat characteristics;
- herd size and structure;
- diseases and animal health follow-up;
- use of animals and their products;
- funding.

The methodology used in the study is that of the retrospective survey by interview with the breeder.

Statistical analysis

The recount was an operation in which data collected during the survey were reviewed, coded and stored in a database designed using the software Excel 2010.

The data collected were analyzed using SAS 9.2 (Statistical Analysis System, 2013) software. The means and variances were calculated using the GLM procedure and frequencies were calculated using the procedure *Procfreq*of SAS. Frequencies were compared using the Chi square test and bilateral test of Z.

For each frequency P, a confidence range (ICP) at 95% was calculated using the formula:

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

Where:
P is the relative frequency and N is the sample size.

RESULTS

Profile of sheep breeders

Table 1 shows the profile of Djallonkesheep producersin the North and the South of Benin. In both areas, farmers were mostly male, married with a dominance in the North (97.71% vs. 83.77%, p <0.001). Sheep ranchers in the North were mainly of the ethnic groups Peul (55.64%), Bariba (25.56%) and Gando (10.53%) practicing Islam (96.24%) as religion, while in the South, farmers were predominantly of the ethnic group Fon (48.05%), Aizo (26.6%) and Yoruba (7.06%) with as religion Christianity (51.63%) and animism (31.37%). The proportion of different ethnicities and beliefs encountered in these two areas differed significantly (p <0.001). Most breeders met in the two areas were non schooled with a predominance in the North (p <0.001). No breeder interviewed in the North had the university level while 7.14% of sheep breeders in the South have reached this level.

The average age and social dependents of sheep breeders varied significantly depending on the area (table 2). In the North, the average age of sheep breeders was of 42.75 years with 13.37 dependents per breeder whereas in the South, the average age of the surveyed sheep producers was of 46.87 years with 8.01 dependents per breeder on average.

As for the main and secondary activities of breeders (table 3), North breeders had as main activity livestock production (63.91) and agriculture (19.55%) while in the South, agriculture was the dominant main activity (46.75%) followed by crafts (16.23%).

Table 1 Profile of sheep breeders

Variables		North (N=133)		South (N= 154)		Test of significance
		%	CR	%	CR	
Sex	Female	2.29a	0.03	16.23b	0.06	***
	Male	97.71a	0.03	83.77b	0.06	
Ethnic group	Goun	0a	0	3.90b	0.03	***
	Fon	0a	0	48.05b	0.08	
	Aïzo	0a	0	26.62b	0.07	
	Mina	0a	0	3.90b	0.03	
	Mahi	0a	0	0.65a	0.01	
	Xuéda	0a	0	1.30b	0.02	
	Haoussa	0a	0	3.25b	0.03	
	Adja	0a	0	1.95b	0.02	
	Kotafon	0a	0	2.6a	0.03	
	Dendi	3.76a	0.03	0b	0	
	Bariba	25.56a	0.07	0b	0	
	Peulh	55.64a	0.08	0b	0	
	Gando	10.53a	0.05	0b	0	
	Boo	2.26a	0.03	0a	0	
	Idaaatcha	0.75a	0.02	0a	0	
	Kotokoli	0.75a	0.02	0a	0	
	Yorouba	0.75a	0.02	7.79b	0.04	
Religion	Christian	3.76a	0.03	51.63b	0.08	***
	Muslim	96.24a	0.03	9.15b	0.05	
	Vodoun	0a	0	31.37b	0.07	
	No religion	0a	0	7.84b	0.04	
Matrimonial status	Maried	98.50	0.02	92.86	0.04	NS
	Divorce	0	0	0.65	0.01	
	Widow	0.75	0.02	2.60	0.03	
	Non maried (single)	0.75	0.02	3.90	0.03	
Education level	Non schooled	79.70a	0.07	38.96b	0.08	***
	Primarylevel	13.53a	0.06	22.73b	0.07	
	Secondairylevel	6.77a	0.04	31.77b	0.07	
	Universitylevel	0a	0	7.14b	0.04	

*% : percentage ; CR : Confidance Range; NS: P>0.05; ***: P 1‰ ; N : Amount.*
The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Table2 Age of sheep breeders and number of dependents kept

Variables	North (N=133)		South (N=154)		ANOVA
	Mean	Standard Error	Mean	Standard Error	
Age of sheep breeder	42.75	1.82	46.87	1.47	**
Number of dependents	13.37	1.12	8.01	0.90	***

**:P 1%; ***:P 1‰;N:Amount.

Table3 Activities of sheep breeders

Variables		North (N=133)		South (N=154)		Test of Chi²
		%	CR	%	CR	
Dominant activity	Crop production	19.55a	0.07	46.75b	0.08	***
	Animal production	63.91a	0.08	13.64b	0.05	
	Commerce	7.52a	0.04	7.79a	0.04	
	Craft	7.52a	0.04	16.23b	0.06	
	Fonctionary	0.75a	0.01	11.04b	0.05	
	Other	0.75a	0.01	4.55b	0.03	
Secondairy activity	Crop production	53.38a	0.08	15.58b	0.06	***
	Animal production	36.09a	0.08	79.87b	0.06	
	Commerce	7.52a	0.04	3.25a	0.03	
	Craft	2.26a	0.03	0.65a	0.01	
	Fonctionary	0.75a	0.02	0.65a	0.01	

*% : percentage ; CR : Confidance Range; ***: P 1‰ ; N : Amount.*
The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Distribution of water and stored foods

The frequency of water distribution and stored foods to the animal depends on the region (table 4). All surveyed sheep breeders of the South (100%) supply some water to their animals to only 58.65% of sheep breeders in the North (p <0.001). Stored foods were distributed mainly during the dry season by all farmers in the North zone (100%) to 72.34% in the South (p <0.001).

Table4 Watering and distribution of stored feedstuffs

Variables		North (N=133)		South (N=154)		Test of Chi²
		%	CR	%	CR	
Watering	No	41.35a	0.08	0b	0	***
	Yes	58.65a	0.08	100b	0	
Distribution frequency of water	1	64.56a	0.11	46.10b	0.08	
	2	30.38a	0.10	53.90b	0.08	
	3	5.06a	0.05	0b	0	***
Storage	No	70.68	0.08	73.38	0.07	NS
	Yes	29.32	0.08	26.62	0.07	
Distribution moment of stored feedstuffs	Dry season	100a	0	72.34b	0.13	
	Dry and rainyseason	0a	0	27.66b	0.13	***
Distributionfrequency	1	74.36a	0.14	96.10b	0.04	***
	2	25.64a	0.14	3.90b	0.04	

*% : percentage ; CR : Confidance Range; NS : P>5% ; ***: P 1‰ ; N : Amount.*
The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Herd structure

The structure of the sheep herds depends on the region (table 5). The average size of the surveyed sheep herds in the North was of 31.51 animals to 17.67 animals in the South. Similarly, the amounts of ewes, rams and lambs of the surveyed sheep herds in the North were significantly higher than the values observed in the herds of the South of Benin(p <0.001). The amount of pregnant ewes was of 9.48 per herds in the North to 5.39 per herd in the South. Moreover, the sheep herds of the North count on average 5.42 milking ewes to 2.67 in the South (p <0.001).

Table 5 Sheepherd structure

Variables	North(N=133)		South (N=154)		ANOVA
	Mean	Standard Error	Mean	Standard Error	
Rams	2.83	0.39	1.53	0.32	***
Ewes	15.05	1.43	9.14	1.16	***
Lambs	8.01	1.06	4.92	8.86	**
Yearling lambs	5.13	0.61	2.11	0.49	***
Pregnantewes	9.48	0.98	5.39	0.79	***
Non Pregnantewes	5.59	0.53	3.30	0.43	***
Milkingewes	5.42	0.56	2.67	0.46	***
Total herdamount	31.51	2.95	17.67	2.60	***

ANOVA: Analysis of variances;N:Amount;**: P 0.01; ***: P 0.001.

Purchase or sale price of sheep

The sale price of varied according to the region and depends on the age and the sex (table 6). The sale price of ram in the North is less expensive than in the South (32931.29 FCFA *vs* 44011.90 FCFA). Nevertheless, the sale price of yearling ewe in the North is more expensive than in the South (14778.6 FCFA *vs* 12911.48 FCFA). However, the prices of yearling ram and ewe were not affected by the region.

Production aims and criterion of animal sales

The aims of creation of West African Dwarf sheep ranching varied according to the area (table 7). Most farmers in the North region (75.94%) rear the animals in order to make savings. On the other hand, South sheep breeders rear animals not only for savings (59.74%) but also for meat production

(35.06%). The use made of the animals and their products varies according to the area. However, the main uses of animals and their products in both regions are the sale and the consumption, with a predominance of consumption in the South (69.93 % *vs*45.86 %, p <0.001). The animal sales criteria in the North are mainly based on the animal body maturity and development, the occurrence of ceremony of festive occasions or when animals are ill, whereas in the South, the sheep are sold only when their reach their body maturity and development (adult age) or during festive occasions.

Table 6 Selling price of sheep per age and sex

Variables	North(N=133)		South(N=154)		ANOVA
	Mean	Standard Error	Mean	Standard Error	
Rams	32931.29	4125.19	44011.90	3218.31	**
Ewes	26455.22	1494.39	27711.51	1195.99	NS
Male Yearling lambs	18242.25	1356.57	16844.89	1069.66	NS
Female Yearling lambs	14778.62	909.02	12911.48	679.83	*
Male Lambs	-		12327.07	1539.48	-
FemaleLambs	-		10884.06	1033.54	-

*ANOVA: Analysis of variances; N: Amount; NS: P>5%; *: P 5%; **:P 0.01.*

Feeding

The West African Dwarf sheep breeders of the North and the South of Benin feed their animal feed with fodder, crop residues and kitchen residues (Table 8). In the North Zone, 57.89% of the sheep breeders use only the fodder in the feeding of their herds and 33.83% associate crop residues to the fodders in the feeding, while in the South, the animals fed mainly fodders associated with crop residues and other conventional feeds or concentrate in 86.37%. The average duration of grazing was significantly higher in the North (7.92hours/day) than in the South area (7.09 hours/day) (p <0.001; Table 9).

Animal health management

The illnesses were reported by almost all of the surveyed farmers as the main cause of animal death in their herds (Table 10). The clinical signs reported by sheep breeders are various and differ according to the area (p <0.001). The main symptoms mentioned by farmers were weight loss, diarrhea, injury, weariness, cold, rheum, cough and abscess with a highest frequencies found in the North (p <0.001).

Table7 Production aims and selling criterion

Variables		North (N=133)		South(N=154)		Test of Chi^2
		%	CR	%	CR	
Aims of sheep production	Meat production	6.02a	0.04	35.06b	0.08	
	Prestige and passion	0a	0	2.60a	0.03	
	Savings	75.94a	0.07	59.74b	0.08	***
	Meat production and savings	12.78a	0.06	0.65b	0.01	
	Meat production, passion and savings	5.26a	0.04	1.95a	0.02	
Use modes of rearedanimals	Selling	3.76a	0.03	0b	0	
	Selling and consumption	45.86a	0.08	69.93b	0.07	
	Selling, gift and consumption	36.09a	0.08	25.49a	0.07	
	gift and consumption	12.78a	0.06	1.96b	0.02	***
	Selling and gift	0.75a	0.01	0a	0	
	Consumption	0.75a	0.01	2.61a	0.03	
Sellingnorms or criterions	Financial need, live weight and party	0a	0	83.66b	0.06	
	Financial need, live weight, party and disease	82.68a	0.07	13.07b	0.05	
	Financial need, live weight, party and Age	1.57	0.02	1.96	0.02	
	Financial need, maturity, party and disease	0a	0	0.65a	0.01	***
	Financial need, live weight, party, age and disease	10.24a	0.05	0.65b	0.01	
	Financial need, live weight, party, maturity, and disease	3.94a	0.03	0b	0	
	Financial need, live weight, party, maturity, age and disease	1.57a	0.02	0a	0	

***:P 0.001.The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Table8 Feeding mode

Variables		North (N=133)		South (N=154)		Test of Chi^2
		%	CR	%	CR	
Type of feeds	Forage	57.89a	0.08	9.09b	0.05	
	Forage and kitchenresidues	3.01a	0.03	0b	0	
	Forage and cropresidues	33.83a	0.08	41.56b	0.08	
	Forage and kitchen + crop residues	2.26a	0.03	4.55a	0.03	***
	Forage, kitchen + crop residues and concentrate feeds	1.50a	0.02	0a	0	
	Forage, crop residues and concentrate feeds	1.50a	0.02	44.81b	0.08	
Source of forage	Unnaturalgrazingonly	0	0	0	0	
	Natural grazingonly	98.50	0.02	99.35	0.01	NS
	Both Natural and unnatural grazing	1.5	0.02	0.65	0.01	
Type of cropresidues	Bran of grains	21.05a	0.09	40.54b	0.08	
	Bean and groundnut residues	13.16a	0.08	0b	0	
	Peelings of cassava	5.26a	0.05	0.68b	0.01	
	Bran of grains and Bean and groundnut residues	9.21a	007	0b	0	
	Brans and cassavateguments,	0a	0	1.35a	0.02	
	Grain brans and Peelings	22.37a	0.09	49.32b	0.08	***
	Brans, peelings and bean and groundnut residues	26.32a	0.10	2.03b	0.02	
	Peelings and bean and groundnut residues	2.63a	0.04	0b	0	
	Peelings, Brans, cassava teguments, bean and groundnut residues	0a	0	4.73b	0.03	
Sourceof mineral	Salt (NaCl)	86.67	0.09	90.40	0.05	
	Minerallick	13.33	0.09	5.60	0.04	NS
	Salt ans minerallick	0	0	4.00	0.03	

CR: Confidence Range; N: Amount; NS: P>5%; ***:P 0.001. The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Table 9 Grazing time

Variables	North(N=133)		South(N=154)		Test of Chi²
	Mean	**Standard error**	**Mean**	**Standard error**	
Duration of grazing per day	7.92	0.26	7.09	0.21	***

***:P 1‰;N:Amount.

Almost all breeders use curative treatments for their animals. Veterinary products used by farmers differ according to the area (table 11). The main products used were oxytetracycline, alfamec, trypamidium, deworming (Albendazole and ivermectin) and pharmacopeia products. A proportion of 41.18% of farmers surveyed in the South vaccinates systematically their animals to 24.81% in the North (p <0.01).

of constitution of the herds were identified. The cash purchase (44.36%), gift and inheritance (38.5%) were the main modes of livestock constitution in the North while in the South, only the cash purchase (88.96%) was the main mode of acquisition of animals. External support is very scarce, farming activities were funded by the farmers and / or their family (Table 12).

Habitat characteristics and livestock management

The majority of farmers surveyed in the north (69.17%; table 13) have no habitat for animals whereas the majority of surveyed farmers in the South have a traditional habitat (p <0.001). The majority of habitats are built using local materials. 69.17% of respondents in the North do not clean their animal habitats to 92.67% in South (p <0.001) who clean their animal shelters once per day.

Table 10 Manifestation of disease in the surveyed herds

	Variables	North(N=133)		South (N=154)		Test of Chi²
		%	**CR**	**%**	**CR**	
Disease	No	0a	0	3.25b	0.03	*
	Yes	100a	0	96.75b	0.03	
Clinicalsigns	Diarrhea, wound and cough	6.02a	0.04	0b	0	
	Diarrhea, wound cachexia and cough	7.52a	0.05	0b	0	
	Diarrhea, wound cachexia, cold and cough	26.32a	0.08	0b	0	
	Diarrhea, wound cachexia, abscess, asthenia cold and cough	21.05a	0.07	0b	0	
	Diarrhea, wound cachexia, and rheum	6.77a	0.04	0b	0	
	Diarrhea, wound cough and rheum	7.52a	0.05	0b	0	
	Diarrhea, wound cough, asthenia and rheum	24.81a	0.07	0b	0	
	Diarrhea, cachexia and cold	0a	0	14.29b	0.06	
	Diarrhea, wound and cachexia	0a	0	9.52b	0.05	
	Diarrhea, Scab, wound and cachexia	0a	0	11.90b	0.06	
	Diarrhea, Scab, cachexia, cough and rheum	0a	0	27.78b	0.08	
	Diarrhea, cachexia, wound and abscess	0a	0	16.67b	0.07	
	Diarrhea, cachexia and rheum	0a	0	12.70b	0.06	
	Diarrhea, Scab, cachexia, cough and asthenia	0a	0	7.14b	0.05	***

CR: Confidence Range; N: Amount; NS: P>5%; *: P 5%; ***:P 0.001.The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Table 11 Mode of treatment

	Variables	North (N=133)		South (N=154)		Test of Chi²
		%	**CR**	**%**	**CR**	
Treatment	No	2.26	0.03	3.29	0.03	NS
	Yes	97.74	0.03	96.71	0.03	
Veterinary Products	Oxytetracycline	3.91a	0.03	0	0	
	Pharmacopeia products	9.38a	0.05	19.23b	0.07	
	Oxytetracycline, alfamec, dexaphenylathritediminazene, and deworming	44.53	0.09	0b	0	
	Oxytetracycline, and deworming	21.88a	0.07	0b	0	
	Deworming	10.94a	0.05	0b	0	
	Oxytetracycline and Pharmacopeia	9.38a	0.05	0b	0	
	Oxytetracycline, alfamec, and deworming	0a	0	32.31b	0.08	
	Oxytetracycline, alfamec, Betadine, and deworming	0a	0	10b	0.05	
	Oxytetracycline, alfamec, dexaphenylathritediminazene, betadine and deworming	0a	0	10.77b	0.05	***
	Oxytetracycline, alfamec, dexaphenylathritediminazene, betadine, deworming and Pharmacopeia	0a	0	10.77b	0.05	
	Oxytetracycline, alfamec, Trypamidium and deworming	0a	0	16.92b	0.06	
Vaccination	No	75.19	0.07	58.82	0.08	**
	Yes	24.81	0.07	41.18	0.08	
Responsible of treatment	Veterinary	5.43a	0.05	60.54b	0.08	
	Herdowner	41.09a	0.09	27.21b	0.07	
	Otherperson	3.10a	0.03	0b	0	
	Veterinary and Herdowner	48.84a	0.09	12.24b	0.05	***
	Veterinary and other	1.55a	0.02	0a	0	

N: Amount; NS: P>5%; **:P 0.01; ***:P 0.001.The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Modes of constitution and financing of sheep ranching

The majority of sheep producers in the North (92.48%) and the South (67.53%) of Benin form or make the renewal of their herds from the sheep farms located in their municipality with a predominance in the North (p <0.001). Different modes

The method livestock management varied significantly depending on the area (p <0.001). 26 to 31% of the sheep herd owners are the shepherd in both regions. 51.13% of the child of the sheep herd owners are the shepherd in the South area to 0% in the North (p <0.001).

Table 12 supplying, mode of herd constitution and funding mode and source

Variables		North (N=133)		South (N=154)		Test of Chi²
		%	CR	%	CR	
Source or zone of sheep supplying	In their township	92.48	0.05	67.53	0.07	***
	Out of their township	7.52	0.05	32.47	0.07	
Mode of herd constitution	Gift	38.35a	0.08	5.84b	0.04	***
	Cash payment	44.36a	0.08	88.96b	0.05	
	Installment plan	14.29a	0.06	3.25b	0.03	
	Cash payment and gift Entrust	0a	0	0.65a	0.01	
	Cash payment entrust and gift	0.75a	0.02	0a	0	
	Cash payment and entrust	1.50a	0.02	1.30a	0.02	
	Entrust and gift	0.75a	0.02	0a	0	
Funding	Family supports	33.83a	0.08	1.96b	0.02	***
	Herdowner	44.36a	0.08	90.85b	0.05	
	Family supports and Herd owner	17.29a	0.06	7.19b	0.04	
	Family and external supports and Herd owner	2.26a	0.03	0a	0	
	External supports and Herd owner	1.5a	0.02	0a	0	
	Family and external supports	0.75a	0.015	0a	0	
Source of external support	Non GovernmentalOrganizations	0a	0	50a	0.69	
	Church	0a	0	50a	0.69	
	Employer	28.57a	0.34	0a	0	
	Development program	71.43a	0.34	0b	0	*

*%:percentage;CR:Confidence Range; *: P 5%; ***: P 1‰;N: Amount.The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.*

Table 13 Habitats and herd management

Variables		North		South		Test of Chi²
		%	CR	%	CR	
Type of habitat	Traditional	20.30a	0.07	66.23b	0.08	***
	Semi-traditional	9.77a	0.05	8.44a	0.04	
	Modern	0.75a	0.02	4.55b	0.03	
	Houseless	69.17a	0.08	20.78b	0.06	
Materials used for habitat building	Local ressources	65.85	0.15	85.37	0.06	**
	Moderne	34.15	0.15	14.63	0.06	
Cleaning of the shelter	No	69.17	0.08	7.33	0.04	***
	Yes	30.83	0.08	92.67	0.04	
Frequency of cleaning per week	1	0a	0	4.32a	0.03	***
	2	2.44a	0.05	31.65b	0.08	
	3	24.39a	0.13	6.47b	0.04	
	4	4.88a	0.07	3.60a	0.03	
	7	60.98a	0.15	53.96a	0.08	
	14	7.32a	0.08	0b	0	
Shepherd identity	Herdowner	30.83a	0.08	26.62a	0.07	***
	Spouse	1.50a	0.02	0a	0	
	Child	51.13a	0.08	0b	0	
	Employee	1.50a	0.02	3.90a	0.03	
	Herdowner and child	6.77a	0.04	37.66b	0.08	
	Herdowner and spouse	3.01a	0.03	7.14a	0.04	
	Spouse and child	0.75a	0.01	14.94b	0.06	
	Herd owner, spouse and child	0a	0	4.55b	0.03	
	Herd owner, spouse, child and employee	0.75a	0.01	5.19b	0.04	
	Other	3.76a	0.03	0b	0	

*CR: Confidence Range; N: Amount; NS: P>5%; *: P 5%; **:P 0.01; ***:P 0.001. The proportions between the classes of the same column followed by different letters differ significantly at the threshold of 5%.*

Breeds of reared sheep and other animal species associated

Table 14 shows the breeds of sheep and other animal species associated to the rearing of Djallonke sheep. The majority of surveyed farmers in both zones used exclusively Djallonke sheep breedwith a predominance in the North (87.97% *vs* 73.20%; P <0.01). However, some farmers have associated to the Dwarf sheep of Djallonke breed, the Sahelian breed of sheep and / or their hybrid. The other animal species associated with the sheep rearing were mainly poultry, goats and pigs in the South zone, to cattle, poultry and goats in the North area.

DISCUSSION

Profile of Djallonke sheep breeders

The current study shows that women sheep breeders are a minority in the study area. The low involvement of women in animal rearing was also reported in Chad (Jalal *et al.*, 2008). The sheep producers identified in the town of Thies in Senegal are about 97% male (Ousseini, 2011). However, women are more represented (33%) in semi-intensive sheep fattening in Burkina Faso (Sanon and Traoré, 2014).

Table 14 Breed of reared sheep and other associated animal species

Variables		North (N=133)		South (N=153)		Test of Chi²
		%	CR	%	CR	
Breed	Djallonke	87.97a	0.05	73.20b	0.07	
	Djallonkeand Sahelian	3.76a	0.03	12.42b	0.05	
	Djallonkeandcrossbreeds	3.01a	0.03	11.11b	0.05	
	Djallonke, Sahelian and crossbreeds	5.26a	0.04	3.27a	0.03	**
Otherreared animal species	Poultry	56.39	8.43	88.89	4.98	***
	Rabbit	0	-	15.03	5.66	***
	Goat	44.36	8.44	74.51	6.90	***
	Cattle	60.90	8.29	3.27	2.82	***
	Pig	0.75	1.47	21.57	6.52	***
	Horse	0.75	1.47	0	-	NS
	Dog	0	-	7.19	4.09	*

%:percentage;CR:Confidence Range; NS: P>5%; *: P 5%; **:P 0.01; ***:P 0.001;N: Amount.The proportions between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

The social organization of the Fulani ethnic group assigns exclusively cattle breeding to men (Bierschenk and Forster, 2004). In addition, the traditional ruminant rearing system is mainly characterized by the practice of transhumance which remains dominated by men (Dehoux and Hounsou-Ve, 1993). Ranchers surveyed in the North are predominantly Fulani, Muslims, and married with an average amount of dependents of 13 people. These results are similar to those obtained by Alkoiret *et al.* (2009); and Youssao *et al.* (2013). Unlike farmers in the North area, those surveyed in the South area are mostly Fon and practice mainly Christianity and animism as religion. These results confirm the report of INSAE (2005) who show that the Atlantic department gathers mainly the sociocultural groupsAizo (32.6%) and Fons (28.9%) who practice mostly the religions as Catholicism (37.1%) and Voodoo (27.5%).

In the current study, the owners of flocks of sheep are relatively of young ages (40 to 45 years). Sanon and Traore (2014) reported similar results in Burkina Faso. More advanced ages in ruminant breeders were observed by Touré *et al.* (1995), Ali *et al.* (2003), Tchouamo *et al.* (2005); Jalal *et al.* (2008). However, according Tchouamo *et al.*, (2005), small ruminants are not only a predominantly male activity, but also an activity carried on by elderly men and married to more than one woman.

According to our study, the average number of dependents per breeder in the North is higher than the one of South breeders. This difference could be due to the fact that Peulh families consist of several households (Alkoiret *et al.*, 2009). In the current survey, 80% of farmers in the North of Benin were not schooled and none of schooled breeders has the university level. Similar finding was reported by Youssao *et al.* (2013) but differs from that of Tchouamo *et al.* (2005) who observed that the majority of small ruminant breeders of West Cameroun (76%) were schooled. The involvement of the whole family in the monitoring of animals is also reported by several authors (Hounkpèvi, 2005; Youssao *et al.*, 2013; Tchouamo *et al.*, 2005).

Carles (1983) and Doutresoulle (1947) reported that the Djallonke breed dominates sheep farms in subsaharan Africa and there was almost exclusively encountered. This result confirms our finding. It is there fore appropriate to set up a national program for genetic improvement of our local sheep breeds.

Breeders of the study area had also associated several species in their breeding including chickens and goats as found by Suttie (2004). These same observations were recorded by Jalal *et al.* (2008). However, the total absence of pig breeding in surveyed farms in the North could definitely be linked to religious customs (Islam) that prohibit the consumption of pork (Alkoiret *et al.*, 2009).

The sheep breeders met in theNorth spend more time for animal grazing than those of the Southarea in the current study. According to Dehoux and Hounsou-Ve (1993), the grazing time is longer in the North because shepherd led sheep grazing along with cattle. Pitala *et al.* (2012) reported in South Togo a grazing time lesser than six (6) hours per day.

The financing of sheep rearing activities in the survey area was undertaken by the sheep breeders. The external financial support mechanisms are scarce in both zones. So it is urgent to include these farmers in livestock sub-sector development programs and establish efficient mechanisms of support and funding to enable the farmer to improve their performance.

Profession of the surveyed breeders

Livestock production and agriculture are respectively the main dominant activity in the North and the South areas. The Fulani herders attach more importance to animal production while practicing subsistence agriculture (Bierschenk and Le Meur, 1997; De Haan, 1997). The association between livestock and agriculture, which has been highlighted by this study is similar to the finding of Alkoiret *et al.* (2009) and Youssao *et al.* (2013). Trade, public service and crafts are also the activities of farmers in the two study areas. This variety of dominant and secondary activities of sheep farmers testifies that sheep farming isn't often the sole livelihood of sheep breeder household (FAO, 2011; Youssao *et al.*, 2013.). In Senegal, the sheep farming is considered a secondary activity (Ousseini, 2011) practiced by individuals of various social and professional groups (Sanon and traoré, 2009).

Feeding

The water distribution frequency varies herein according to the region. Overall, watering was not considered essential by 41% of farmers in the North and 59% provided water on a more or less regular basis; while 100% of the sheep breeders of the South provided water to their animals. This finding corroborates the one of AdjouMoumouni (2006).

Storing food for animals is not systematic and is below 30% in the study areas. The major cause of non-food storage is the lack of conservation means and the mode of feeding based on the permanent use of natural pasture (Tchouamo *et al*., 2005; Alkoiret *et al*., 2009; Ousseini, 2011; Youssao *et al*., 2013). Farmers who store foods serve their animals mainly during the dry season when fodder becomes very scarce.

Herd structure

The different sheep flocks met in the current study are of extensive type. The average number of sheep per herd varies between 18 and 32 animals. In the wet Sahel in Tchad, the average number of sheep per sheep farm reported by Djalal *et al*. (2008) was of 27.40 ± 23.24 in the soudanese zone to 12.21 ± 9.30 heads in the dry Sahel.

Sheep Marketing

The average selling prices of sheep and yearlings are similar in the both study areas. However, the ram was more expensive in the South area (44011.90 CFAF) than in the North (32931.29 CFAF). These selling prices are more expensive than the value of average purchase price of 15000 FCFA for a sheep of 20 kilogram of live weight reported by DE (2012). This difference may be related to the current"market inflation" occurring in our country. Moreover, Gbangbotche *et al*. (2002) estimated that the heavy animals are increasingly in demand, as associated with many religious festivals like Eid El Kebir and the sacrifice required by indigenous religions. Ousseini (2011) reported average selling price varying from 271000 to 286000 FCFA for young Ladoumsheep in Senegal.

Production Targets

The aims of creation of West African Dwarf sheep ranching varied according to the area (table 6). Most farmers in the North region (75.94%) rear the animals in order to make savings. On the other hand, South sheep breeders rear animals not only for savings (59.74%) but also for meat production (35.06%). The use made of the animals and their products varies according to the area. However, the main uses of animals and their products in both regions are the sale and the consumption, with a predominance of consumption in the South (69.93 % *vs* 45.86 %, p <0.001). The animal sales criteria in the North are mainly based on the animal body maturity and development, the occurrence of ceremony of festive occasions or when animals are ill, whereas in the South, the sheep are sold only when their reach their body maturity and development (adult age) or during festive occasions.

The mobile that motivates the creation of a sheep farm in the both areas is primarily savings andsecondarilymeat production, consumption and donation. The animals are sold in case of money need. The role of similar alive financial reserve was reported in Guadeloupe (Salas *et al*., 1986), Burkina Faso (Bourzat, 1986), Guinea (Lhoste *et al*., 1993), Brazil (Lau *et al*., 2001) and among farmers of the Island of Mindanao in the Philippines (Duval, 2001). Our results confirm the fundamental socio-economic role played by sheep farming. Similar observations were made by Alkoiret *et al*., 2009 in the town of Gogounou on cattle.

Feeding

The feeding of sheep is provided mainly by natural pasture, table salt and secondarily by crop residues. The same observations were made by Hounkpèvi (2005) and Alkoiret *et al*. (2009). According to Hounkpèvi (2005), once the harvest is complete, the sheep feeding consists mainly of crop residues such as corn stalks, millet, sorghum and cotton.

Animal health management

The illnesses were reported in the current survey by almost all of the surveyed farmers as the main cause of animal death in their herds. The clinical signs reported by sheep breeders are various and differ according to the area and consisted of weight loss, diarrhea, injury, weariness, cold, rheum, cough and abscess. Dehoux and Hounsou-Ve (1993) also reported a variety of common diseases in cattle farms. Doko *et al*. (2009) mentioned trypanosomiasis in sheep but according Mawuena (1986), it is difficult to observe the clinical signs of trypanosome diseases in sheep. This variation of health status of the surveyed farms among regions can be due to the variability of the general conditions of Medicare, feeding and watering (Doko *et al*., 2009).

In the current study, the majority of farmers use veterinary treatment for their animals as found by Alkoiret *et al*.(2009) in cattle rearing systems. They treat their animals by modern medicine using veterinary products such as Trypamidium, Oxytetracycline, Alfamec, Diminazene, Dexa, Albendazol, Ivermectin and other (vitamins). These results differ from those of Ousseini (2011) in Senegal.

Moreover, the traditional medicine (Pharmacopoeia) was practiced by 9-19% of the surveyed sheep breeders.By the same way, the review carried out by Mapiye *et al*. (2008) on village chicken production constraints and opportunities in Zimbabwe revealed that the majority of smallholder farmers that treat their chickens use ethno-veterinary medicine (Muchadeyi *et al*., 2004; Mwale *et al*.,2005). The wide use of traditional medicine is due to its low cost, local availability, easiness of application and it does not require modern technologies such as refrigeration.

Mode of herd's constitution and habitat characteristics

It comes out from the current survey that the majority of sheep producers in the North and the South of Benin form or make the renewal of their herds from the sheep farms located in their municipality. Different modes of constitution of the herds were reported: cash purchase, gift and inheritance. Nevertheless, some farmers buy their reproductive outside the town and even in neighboring countries such as Niger, Burkina Faso and Mali. These usually come out of the town in search of the good gauge of animals and / or cheaper. Different modes of constitution of the herds had been identified. The cash purchase is the main mode of livestock renewal. However, there were also encountered in the North Zone herds of sheep inherited or assigned. These findings are comparable to the results found by Alkoiret *et al*. (2009) and Youssao *et al*. (2013b) on the typology of cattle rearing systems in the department of Borgou in Benin, and Youssao *et al*. (2013a) on indigenous poultry rearing systems in Benin. In the South region of study, habitats of the traditional type were built by the sheep breeders using local materials. Their cleaning up is done once a day, whereas the majority of surveyed farms in North had no habitat. The obtained result

corroborates that of Alkoiret *et al.* (2009) who report that farmers do not have stable and the animals are generally housed outdoors in parks around dwellings where they are usually tied to stakes.

CONCLUSION

The diversity of these systems of production must be taken into account for purposes of sheep development, in order to guarantee its sustainability. Specific measures need to be applied to each surveyed agro-ecological zone. Overall, the sheep rearing system in the North and the South of Benin are of extensive type characterized not only by the association of other animal species, exploitation of natural pasture and crop residues for animal feeding, utilization of family workforce, but also by the lack of suitable management resources, technical supports, funding and medicare. Therefore, the following suggestions are made to improve the performance of West African Dwarf sheep reared under traditional rearing system in Benin. It is to:

- educate local sheep farmers on good animal husbandry practices;
- Improve their abilities in the management of sheep breeding system and enable them to access easily to information on technical innovations;
- provide them some livestockinputs of best quality such as basic raw materials forfeeds and veterinary products by facilitating their supply and negotiate thetaxes discount on livestock inputs with thegovernment;
- facilitate the opening on the national markets to allow proper marketing of the breeding products.

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