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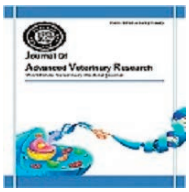

Phenotypic Characterization and Temporal Evolution of Cattle Breed Diversity in Djidja, Benin

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ABSTRACT

The duration of the drought in northern Benin favours the transhumance of cattle to central and southern Benin, resulting in the sedentarization of some transhumant pastoralists. The objective of the study was to characterize the different bovine breeds phenotypically and to evaluate the evolution of the diversity of these breeds in Djidja, between 1996 and 2016. A survey was performed on 58 farmers from the 5th of January to the 22nd of February, 2017. The reared breeds and the introduced breeds have been identified and described. It appeared from this study that all breeders used zebus and zebus-taurine crossbred animals. The zebus used were the Yakana (96.5%), Goudali (32.8%), M'Bororo (5.2%) and Djeli (3.4%). The taurines used by some breeders were Borgou (8.6%) and Lagune (5.2%). The breeds that existed 20 years ago were Lagune, Yakana, Borgou, Goudali, Djeli and M'Bororo. The most widely used breeds at that time were the Lagune and Yakana breeds and the least used were the Borgou, Djeli, Goudali and M'Bororo breeds. The breeds most introduced into the herds in the last 20 years were the Goudali breed, the Yakana breed and the M'Bororo breed, then the less introduced breed is the Djeli breed. These breeds were introduced to improve the milk and meat performance of animals. The Goudali, Yakana and M'Bororo breeds have been introduced from Nigeria and Niger. As for Djeli, the breeders imported it from Niger (91.3%) and Burkina (8.7%). The disappeared breed is mainly the Lagune breed and it is necessary to implement conservation strategies for this breed in the farms.

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Introduction

Cattle breeding is practiced throughout the national territory and provides about 57% of the meat produced in Benin. It is the country's main source of animal protein (FAOSTAT, 2019) and animals are reared in two systems: improved system and traditional or extensive system (Houessou *et al.*, 2019a; Sanni Worogo *et al.*, 2019). Improved livestock farming is less practiced and involves state farms and some private farms (Youssao, 2015). In this type of farming, animals are well monitored for health (vaccination, disease treatment, external and internal deworming, etc.) and feed (artificial fodder, supplementation) (Youssao *et al.*, 2009; Kassa *et al.*, 2016a). As for the traditional livestock system practiced by most livestock farmers, it is characterized by the use of natural pastures, crop residues and ligneous trees (Totin Vodounon *et al.*, 2016; Honvou *et al.*, 2018; Houessou *et al.*, 2019a), a lack of appropriate attention and does not facilitate the expression of animals' potential. This livestock system provides almost all the beef produced and consumed in Benin. This meat is produced by taurines, zebus and crossbred (Katé *et al.*, 2015; Lesse *et al.*, 2015; Kassa *et al.*, 2019). Taurines are reared in the Southern part of the country for their trypano-tolerance and zebus are mainly reared in the North for their resistance to heat stress. The northern region is characterized by a long dry season (6 to 9 months per year) and during this period, water and feed become very scarce while these resources are available in the southern part of the country during this period (Lesse *et al.*, 2015). As a result, a movement of animals from North to South (Lesse *et al.*, 2015; Diogo *et al.*, 2017; Tamou *et al.*, 2018). Taurines and zebus coexist during this period and sometimes herds are mixed on pasture with the possibility of mating between breeds. When they arrive, zebus were also used by local cattle farmers to improve the zootechnical performance of their animals. These improvements are not controlled and the risk of extinction of taurines is high. For better management of animal genetic resources, it is necessary to make a state of evolution of the racial structure of cattle in Central and Southern Benin. The main objective of the study was to contribute to the conservation and management of animal genetic resources in Benin. Specifically, it aimed to characterize the different cattle breeds phenotypically and to evaluate the evolution of the diversity of these breeds in the Commune of Djidja, between 1996 and 2016. The Commune of Djidja was

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chosen because of the abundance of fodder for a long period of year (about 8 months), which makes it the northern transhumant reception area (Diogo *et al.*, 2017; Azalou *et al.*, 2019). The 20-year duration was chosen for a better appreciation of the evolution of animal genetic resource diversity with time.

Materials and methods

Study area

The data were collected from cattle farms in Djidja. The Commune of Djidja covers an area of 131 km², or 2.50% of Zou department area (Fig. 1) and has a population of 123,542 inhabitants (INSAE, 2015). It has a sub-equatorial climate tending towards Sudano-Guinean in the northern parts. The relief is constituted by plateaus with depressions, but also granitic outcrops (Lô, Lalo) reaching an altitude of 100 m. In terms of hydrography, the commune is drained by 145 km of watercourses, including two rivers, namely Zou and Couffo. The other rivers are seasonal rivers that flow into either river. The natural vegetation is composed of islets of forest giving the appearance of tree or shrub vegetation.

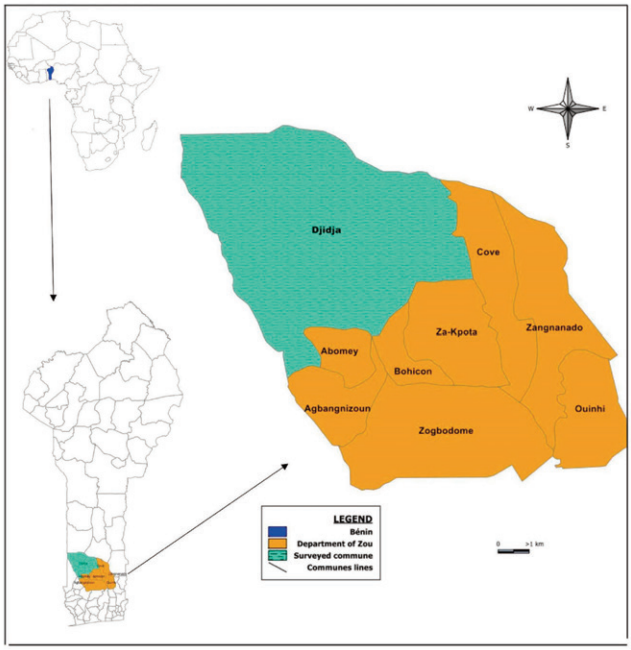

Fig. 1. Study area

Animal material and rearing methods

The study was performed on cattle reared in Djidja. Data were collected from the 5th of January to the 22nd of February 2017 on zebus and taurines reared by farmers. The animals were from 58 extensive farms. Animal feed is provided by natural grazing, crop and harvest residues (groundnut hay, cowpea hay, rice straw, corn cob, etc.). The animals go to pasture each morning and return to the park in evening. The mating is free and births are registered in the herds all year round. The animals are watered by river water. They drank once a day. The sanitary monitoring consists of park cleaning, vaccinations against pasteurellosis and PPCB organized by the livestock services and external and internal deworming.

Evolution of bovine breed diversity

The evolution of cattle breed diversity in Djidja was assessed through a retrospective survey by interview with farmers. This survey made it possible to identify the breeds reared, the breeds introduced, the objectives of the breeds' introduction and the breeds threatened with extinction. The cattle farmers were chosen according to accessibility criteria, experience (at least 20 years) and their availability to provide information. A multiple-choice survey form was used. The questions were closed and focused on: the identity and education level of farmers (out of school, primary, secondary and university levels), genetic type (taurine, zebus, improved), animal use, provenance of animals, breeds that existed 20 years ago and those introduced in the last 20 years (1996 to 2016).

Phenotyping

The different breeds were identified by interview with the cattle farmers. Male and female (non-pregnant) reproducers were then described. This description was made by ourselves. For the description, a collect sheet was used. This collect sheet included information on: colour and design of the coat, muzzle and eyelids colour, hooves colour, presence or absence of horns, horns colour, horns shape, ear shape, size and shape of hump, facial profile, dewlap size, rump profile, size of umbilical fold and sheath size.

Statistical analysis

The data collected in the field were recorded in a database designed on Excel software and analyzed with SAS software. For quantitative variables, an analysis of variance with one classification criterion was performed by the SAS Proc glm procedure and breed was the classification factor considered. For qualitative variables, the frequencies were calculated by the Proc freq procedure of SAS (2013) and compared two by two by the bilateral Z test. For each relative frequency, a 95% confidence interval (CI) was calculated according to the formula:

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

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

Results

Characteristics of the surveyed farms

The breeders surveyed were all married men, the majority of whom were Muslim (98.28%) and from Fulani tribe (98.28%). The majority of them are out of school (86.21%). Those who have been at school (13.79%) have primary (6.9%), secondary (5.17%) and university (1.72%) education. The proportion of out-of-school breeders was significantly higher ($p<0.05$) than that of educated breeders (Table 1). These breeders carry out as their major activity the livestock trade (50%), breeding (44.83%) and other activities (crafts, agriculture). They all use zebus and Zebus-Taurine crossbred animals. However, some of them (8.62%) used taurine. The zebus reared were Yakana, Goudali, M'Bororo and Djeli. Yakana (96.55%) was more used ($p<0.05$) by farmers than Goudali (32.76%), which was also more used ($p<0.05$) than M'Bororo (5.17%) and Djeli (3.45%). The taurine breeds used by the surveyed farmers were Borgou (8.62%) and Lagune (5.17%). These animals were used for meat and milk production. The method of herd formation was diversified. The breeders who use Borgou, Lagune and Djeli breeds have inherited them from their parents and those who used M' Bororo have purchased them. As for the Yakana or Goudali, they were inherited or purchased. These animals were more purchased ($p<0.05$) than inherited (Table 2). They were bought in the same commune by breeders. Most often the herds are composed of several breeds. Zebus and especially males are found in all of

Taurine's herds. Table 3 presents the structure of herds by genetic type. The number of Yakana cows was significantly higher ($p<0.05$) than those of taurine cows. In other categories, no significant differences were observed in mean numbers, but the number of zebus present in herds by category was higher than that of taurine (Table 3).

Existed and introduced breeds

The breeds that existed 20 years ago were Lagune, Yakana, Borgou, Goudali, Djeli, M'Bororo and Somba. The most reared breeds at this moment were Lagune and Yakana and the least reared were Borgou, Djeli, Goudali, M'Bororo and Somba (Fig. 2). Thus, 98.28% of the surveyed farmers had the Lagune and 29.31% the Yakana compared to 8.62% for Borgou, 3.45% for Goudali and M' bororo and 5.17% for Djeli. The breeds introduced in the last 20 years into the herds were Djeli, Goudali, M'Bororo and Yakana. The most introduced breeds into herds were Goudali (77.59%), Yakana (72.42%) and M'Bororo (54.17%) and the less introduced breed was Djeli (17.25%). These breeds have been introduced to improve milk and meat production in all farms. No taurine breeds have been introduced in the last 20 years. The Goudali and M'Bororo introduced were imported from Nigeria and the Yakana from Nigeria (50%) and Niger (50%). As for Djeli, the herders brought it from Burkina Faso (8.70%) and Niger (91.30%). The breeds that were extinct in the herds surveyed were Lagune (96.55%), Somba (3.45%), Yakana (1.72%) and Djeli (1.72%) (Table 4). According to the persons surveyed, these same breeds are threatened of extinction (Table 4).

Table 1. Profile of surveyed cattle farmers

Variables		Number of breeders	Frequency (%)	Confidence interval
Religion	Catholic	58	1.72b	3.35
	Muslim	58	98.28a	3.35
Tribe	Fon	58	1.72b	3.35
	Fulani	58	98.28a	3.35
Gender	Male	58	100	0
Marital status	Married	58	100	0
Level of study	Primary school	58	6.90b	6,52
	Secondary school	58	5.17b	5,70
	Academic	58	1.72b	3,35
	Not in school	58	86.21a	8,87
Activity	Breeder	58	44.83a	12.8
	Trader	58	50a	12.87
	Other Other	58	5.17b	5.7

Intra-class percentages followed by different letters differ significantly at the 5% threshold

Table 2. Breeds used by farmers

Variables			Number of breeders	Frequency (%)	Confidence interval
Genetic types		Taurines	58	8.62b	7.22
		Zebus	58	100a	0
		Improved	58	100a	0
Taurines		Borgou	58	8.62a	7.22
		Lagune cattle	58	5.17a	5.7
Zebus		Yakana	58	96.55a	4.7
		Goudali	58	32.76b	12.08
		Djeli	58	3.45c	4.7
		M'Bororo	58	5.17c	5.7
Taurines used	Borgou	Milk and meat	5	100a	0
	Somba	Meat	1	100a	0
	Lagune	Meat	2	100a	0
Zebus used	Yakana	Milk and meat	56	100a	0
	Goudali	Milk and meat	19	100a	0
	Djeli	Milk and meat	2	100a	0
	M'Bororo	Milk and meat	3	100a	0
Acknowledgement mode	Borgou	Inheritance	5	100a	0
	Lagune	Inheritance	2	100a	0
	Yakana	Inheritance	55	32.69b	12.4
		Purchase	55	67.92a	12.34
		Donation	55	3.77c	5.03
	Goudali	Inheritance	14	28.57b	23.66
		Purchase	14	71.43a	23.66
	Djeli	Inheritance	2	100	0
	M'Bororo	Purchase	3	100	0
Place of purchase	Yakana	Bohicon	36	11.11b	10.27
		Djidja	36	88.89a	10.27
	Goudali	Djidja	15	100	0

Intra-class percentages followed by different letters differ significantly at the 5% threshold

Phenotypic characterization of the main introduced breeds

The most introduced breeds were Djeli, Goudali, Yakana and M'Bororo. The Djeli breed has not been described because it has not existed as a pure breed in the surveyed farms.

Goudali

The Goudali is a larger animal with an ashen or white coat (91.67%). These coats were mostly uniform (83,33). Piebald (8.33%) and speckled (8.33%) coats were also encountered. The Goudali have mostly (91.67%) unpigmented hooves, eyelids and a muzzle. The majority of facial profile was rectilinear (94.74%) and the minority was convexilinear (5.26%). In the majority (58.33%), the horns were absent and even if they were present, they were small in size, fixed or floating (Table 5). These horns were black (80%) or brown (20%). The horns were oriented downwards (80%) or forwards (20%). The ears were erect (91.67%) or lateral (8.33%) with a rounded edge (100%). The humps were mostly large in size (66.67%) and fall to the side (50%) or back (16.67%). Medium and erect humps (33.33%) have also been described. Dewlap were large (58.33%) and medium (41.67%). The dorsal line is straight. The rump was inclined (100%) and the tail was long (91.67%) (under the shank) or medium (8.33) (at the shank). The umbilical fold was of medium size (80%) and small size (20%). It is

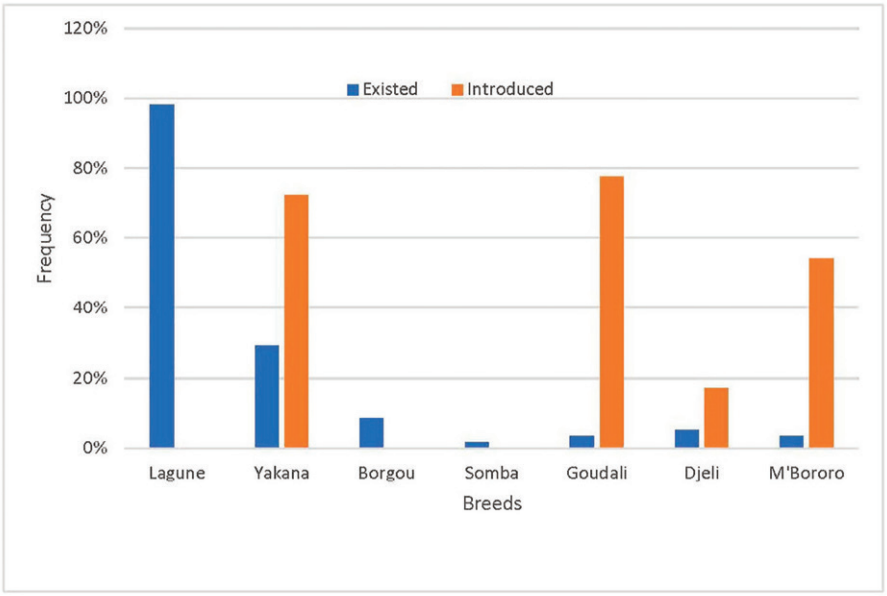

Fig. 2. Breeds existing 20 years ago and breeds introduced in the last 20 years

Table 3. Herd structures

Variable	Borgou (n=5)		Lagune (n=3)		M'Bororo (n=3)		Goudali (n=18)		Yakana (n=55)		Significance
	Average	DS	Average	DS	Average	DS	Average	DS	Average	DS	
Cow	8.60b	4.22	7.33b	2.08	15.33b	6.66	16.28b	11.15	30.02a	14.51	***
Bull	0.60a	0.55	1.00a	1	1.00a	1	1.72a	1.07	2.36a	1.87	NS
Veal/Calf	8.60a	1.14	5.00a	1	8.00a	3.46	9.17a	8.26	13.29a	7.71	NS
Young Bull	3.80a	0.84	5.33a	1.15	5.00a	1	5.94a	4.61	7.71a	4.8	NS
Heifer	2.60a	0.89	4.67a	0.58	6.33a	3.79	7.06a	6.09	8.69a	5.16	NS
Beef cattle	0.00a	0	0.00a	0	0.00a	0	0.94a	1.95	0.42a	1.29	NS

n: Number of farms; ***: p<0.001; DS: Standard Deviation. Mean at the same row followed by different letters differ significantly at the threshold of 5%.

Table 4. Introduced breeds and extinct and endangered breeds

Variables			Number of breeders	Frequency (%)	Confidence interval
Origin of introduced breeds	Yakana	Nigeria	2	50a	69.3
		Niger	2	50a	69.3
	Goudali	Nigeria	45	100	0
	M'Bororo	Nigeria	26	100	0
	Djeli	Burkina Faso	46	8.70b	8.14
		Niger	46	91.30a	8.14
Extinct breeds		Somba	58	3.45b	4.7
		Lagune	58	96.55a	4.7
		Yakana	58	1.72b	3.35
		Djeli	58	1.72b	3.35
Breeds at risk of extinction		Borgou	58	3.45b	4.7
		Lagune	58	96.55a	4.7
		Djeli	58	6.9b	6.52

Intra-class percentages followed by different letters differ significantly at the threshold of 5%

mainly used for meat production, but also for milk production.

M'Bororo

It is a large animal. The coat colour was red (100%), uniform (80%) and piebald (20%). The muzzle, hooves and eyelids are mostly unpigmented (Table 5). The facial profile was straight. It has a medium (80%) or small (20%) size and erected (100%) hump. The eyelids and hooves were pigmented or unpigmented. The horns were very developed, fixed (80%) and oriented facing forwards (40%) and backwards (40%) and in lyre (100%). These horns were brown (60%) and black (40%). The ears were erect and had straight edges. The M'Bororo cattle had a medium (80%) or small (20%) dewlap and a flat rump (100%). The sheath of males is also small (50%) or large (50%) in size. The umbilical folds were large (66.67%) or small (33.33%) and the tail is long (80%) or medium (20%).

Yakana

It is a larger animal with a white (77.50%) and uniform (80%) coat. Black (17.50%), piebald (12.50%) or black spotted

Table 5. Comparison of phenotypic characteristics of high breeds

Variable		Goudali			M'Bororo			Yakana		
		n.	%	CI	n.	%	CI	n.	%	CI
Types of the coat	Uniform	12	83.33a	21.09	5	80a	35.06	40	80a	12.4
	Piebald	12	8.33a	15.64	5	20a	35.06	40	12.5a	10.25
	Speckled	12	8.33a	15.64	5	0a	0	40	5a	6.75
Colour of coat	Black	12	0a	0	5	0a	0	40	17.5a	11.78
	Red	12	8.33b	15.64	5	100a	0	40	0.00b	0
	White	12	91.67a	15.64	5	0.00b	0	40	77.5a	12.94
Color of muzzle	Pigmented	12	8.33a	15.64	5	0a	0	40	5a	6.75
	Unpigmented	12	91.67a	15.64	5	100a	0	40	95a	6.75
Eyelid color	Pigmented	12	8.33a	15.64	5	20a	35.06	40	2.50a	4.84
	Unpigmented	12	91.67a	15.64	5	80a	35.06	40	97.5a	4.84
Color of hooves	Pigmented	12	8.33a	15.64	5	20a	35.06	40	5a	6.75
	Unpigmented	12	91.67a	15.64	5	80a	35.06	40	95a	6.75
Presence of horns	Absent	12	58.33a	27.89	5	0b	0	40	0b	0
	Present	12	41.67b	27.89	5	100a	0	40	100a	0
Color of horns	Black	5	80ab	35.06	5	40b	42.94	40	82.50a	11.58
	Brown hair	5	20.00ab	35.06	5	60.00a	42.94	40	10.00b	9.3
	White	5	0.00a	0	5	0.00a	0	40	7.50a	8.16
Attachment of horns	Floating horns	5	60.00a	42.94	5	20ab	35.06	39	7.50b	8.27
	Fixed horns	5	40b	42.94	5	80ab	35.06	39	92.50a	8.27
Shape of the horn	Right	5	0a	0	5	0a	0	40	2.50a	4.84
	Curve	5	20a	35.06	5	0ab	0	40	0b	0
	Lyre	5	0b	0	5	100a	0	40	92.50a	8.16
	Floating	5	80a	35.06	5	0b	0	40	5.00b	6.75
Orientation of the horn	Laterally	5	0.00a	0	5	20a	35.06	40	25.0a	13.42
	Top	5	0.00b	0	5	40ab	42.94	40	60.0a	15.18
	Bottom	5	80a	35.06	5	0.00b	0	40	0.0b	0
	Facing forwards	5	20.00a	35.06	5	0.00a	0	40	10.0a	9.3
	Facing rearward	5	0ab	0	5	40a	42.94	40	5.0b	6.75
Ear shape	Straight edges	12	0.00b	0	5	100a	0	40	100a	0
	Rounded	12	100a	0	5	0.00b	0	40	0.00b	0
Hump size	Small	12	0.00a	0	5	20.00a	35.06	40	5.00a	0
	Medium	12	33.33b	26.67	5	80ab	35.06	40	77.50a	12.94
	Large	12	66.67a	26.67	5	0.00b	0	40	17.50b	11.78
Hump shape	Erected	12	33.33b	26.67	5	100a	0	40	97.50a	4.84
	Falling backwards	12	16.67a	21.09	5	0.00abab	0	40	0.00b	0
	Falling on the side	12	50a	28.29	5	0.00b	0	40	2.50b	4.84
Facial profile	Straight	10	94.74a	7.1	5	100a	0	40	100a	0
	Convex	10	5.26a	7.1	5	0.00a	0	40	0.00a	0
Dewlap size	Small	12	0.00abab	0	5	20a	35.06	40	0.00b	0
	Medium	12	41.67b	27.89	5	80a	35.06	40	95.00a	6.75
	Large	12	58.33a	27.89	5	0.00b	0	40	5.00b	6.75
Profile of the rump	Flat	12	0.00b	0	5	100a	0	40	100a	0
	Inclined	12	100a	0	5	0.00b	0	40	0.00b	0
Umbilical folds	Small	5	0.00a	0	3	33.33a	53.34	18	0.00a	0
	Medium	5	80b	35.06	3	66.67b	53.34	18	100a	0
	Large	5	20a	35.06	3	0ab	0	18	0b	0
Sheath size	Small	7	0b	0	2	50a	69.3	22	0b	0
	Medium	7	0c	0	2	50b	69.3	22	95.45a	8.71
	Large	7	100a	0	2	0b	0	22	4.55b	8.71

n: number of cattle; CI: Confidence interval; percentages of the same row followed by the same letters do not differ significantly at the threshold of 5%.

(5%) coats were also encountered. It has a medium hump size (77.50 %) in females and large in males. The hump was erected (97.50 %) in young and fallen to the side (2.50 %) in older animals. The facial profile was straight (100%) and the dewlap were of medium size (95 %). However, some animals have large dewlap (5 %). The ears were erect and had straight edges (Table 5). The dorsal line is straight (100%) and ends by a plane rump (100%). Females have a medium umbilical fold (100%) and males a medium (95.45%) and large (4.55%) sheath size. The tail was mostly long and fallen under the shank (97.50 %). Nevertheless, short tails have been described (2.50 %). They have black (82.50 %), brown (10 %) and white (7.50 %) horns. These horns are mostly fixed (92.50 %) and oriented facing forwards (60 %) and Lyre (92.5 %). Straight (2.5 %) and floating (5 %) horns were also encountered. Eyelids and muffles were mostly unpigmented (Table 5). The legs end also with unpigmented hooves. This animal is used by farmers for milk and meat production.

Comparisons between introduced breeds

The coat colour is red in M'Bororo cattle while it is white in Goudali and Yakana. All the M'bororo and the majority of Goudali and Yakana presented an unpigmented muzzle. The majority of the three breeds had unpigmented eyelids and hooves. The proportions of Yakana (100%) and M'Bororo (100%) with horns were significantly higher ($p<0,05$) than those of Goudali (41.67%.). The proportion of Yakana with black horns was significantly higher ($p<0,05$) than that of M'Bororo, while the proportion of M'Bororo with brown horns was significantly higher than that of Yakana. The horns were mainly floating in Goudali, fixed and lyre-shaped in M'Bororo and Yakana. The direction of the horns varies from one breed to another. They are more downwardly oriented for Goudali and upwardly oriented for Yakana and M'Bororo. The ears were erected and straight-edged in the case of M'Bororo and Yakana and rounded in Goudali. The hump is large in Goudali while it is medium in M'Bororo and Yakana (Table 5). These humps were erected in M' Bororo and in most of Yakana. In Goudali, they were erected or falling. The proportion of Goudali with an erected hump is significantly lower than that of M'Bororo and Yakana. The facial profile is straight for all M'Bororo and Yakana and 94.74% of Goudali. The rest (5.26%) of Goudali have a convex-line profile. Dewlap were large in the majority of Goudali, while they were medium in M' Bororo and Yakana. The proportions of M'Bororo and Yakana with medium dewlap size were significantly higher than those of Goudali and vice versa for large dewlap. No small dewlap was observed in Goudali and Yakana compared to 20% in M'Bororo. The rump was inclined in Goudali while it is flat in M'Bororo and Yakana. The umbilical fold of females was mainly of medium size in all three breeds, but the proportion of Yakana cows with a medium umbilical fold was significantly higher ($p<0.05$) than those of M'Bororo and Goudali. No Goudali and Yakana cows showed a small umbilical fold compared to 25% in M' Bororo. As for the bulls' sheath, it is large in all Goudali while it is medium in 95.45% of Yakana and 50% of M'Bororo. The other 50% of M' Bororo have a small sheath and the 4.55% of Yakana have a large sheath.

Discussion

The farmers surveyed were all married men and this is linked to the tribe of the respondents, most of whom were Fulani. In Fulani, heads of households were responsible for keeping animals and women were responsible for the milk produced (Corniaux *et al*., 2006; Chabi Toko *et al*., 2015). The tribe also explains the Islamic religion of the breeders surveyed and their lower level of education. These farmers surveyed used more zebus than taurines and this is due to the better zootechnical performance of these animals compared to taurines, especially in milk, which is a basic food for the Fulani population (Kassa *et al*., 2016b; ChabiToko *et al*., 2015; Tamou *et al*., 2018).

Most of this milk produced in a Fulani household is used for family consumption and the rest is sold raw or after it has been processed into cheese (Chabi Toko *et al*., 2015). Taurines have a daily production that varies between 0.36 and 2.5 liters and zebus give 1.52 to 6.7 liters of milk in West Africa (Kassa *et al*., 2016b; Tamou *et al*., 2018). In addition, the farmers' production objectives were milk and meat production and justified the presence of zebus used in crossbreeding in all herds. The zebu and taurine breeds recorded in this study have already been reported in Benin (Belemsaga *et al*., 2005; Katé *et al*., 2015; Houessou *et al*., 2019b), but zebu have been widely reported in the North. The only taurine reared in North (Donga and Atacora departments) is Somba (Dossa and Vanvanhossou, 2016). The presence of zebus in Djidja is due to the desire of improving production and the practice of transhumance because in dry season , breeders move with animals from North to South in search of water and feed resources (Azalou *et al*., 2019).

The most widely raised breed 20 years ago was Lagune, and this is related to the proximity of the study area to the distribution area of this breed. Thus, Lagune cattle are found in southern Benin and especially in Ouémé Valley (Tobada *et al*., 2018; Ahozonlin *et al*., 2020). The introduced breeds in the last 20 years to improve animal productions were Djeli, Goudali, M'Bororo and Yakana. The introduced breeds are only zebus because of the objective of breeders in introducing these animals, which was to improve milk and meat production. Indeed, animals bred and adapted to the climatic conditions of West Africa are of two genetic types: taurines well resistant to diseases while zebus are less resistant to diseases than taurines, but more productive than taurines (Santoze and Gicheha, 2019). In the case of zebus in extensive breeding system in Benin, Goudali has a more satisfactory performance (Assani *et al*., 2015) than the others and explains its introduction in the majority of the surveyed farms.

The introduced zebus were imported from Niger, Burkina Faso and Nigeria and this finding is linked to the distribution of these breeds. Indeed, zebus were more reared in dry areas because they were more resistant to heat stress (Youssao, 2015). The main breed that was extinct and threatened to extinct in the last 20 years in investigated farms was the Lagune and this is linked to its poor performance. Thus, because of its low meat and milk productivity, national and international programs have for many years focused on improving tropical animal rearing performance by using more efficient imported animals, used either for crossbreeding or purebred breeding (UA-BIRA, 2016). Once introduced, these breeds are used uncontrolled in farms by breeders.

The Goudali described in this study is a large in size with a well-developed hump and dewlap, straight facial profile and short horns. These same characteristics were reported by Houessou *et al*. (2019b) and Meyer (2019). On the other hand, the ash white colour described is contrary to the red piebald colour described by Meyer (2019) and the rectilinear profile is contrary to the convexilinear profile described by Youssao (2015). This breed is used for meat and milk production according to the breeders and this would be due to the animal's performance. Thus, the meat yield of this breed is 50 to 52% (Youssao, 2015) and milk production varies from 4 to 6 litres (Assani *et al*., 2015; Kassa *et al*., 2016b). A 36-month weight of 310 kg has been reported by Harriet Ndofor *et al*. (2012) for Goudali cattle in Cameroon.

The phenotypic characteristics described for the M'bororo breed are in conformity with those described by Houessou *et al*. (2019a) and Meyer (2019), but Meyer (2019) also reported subconvex profiles for this breed. In addition, Assani (2013) reported an inclined rump that is contrary to the flat rump observed in this study.

The Yakana cattle described in this study is also known as White Bororo, Yakanaji, Bunaji, White Peul zebu, Akou etc. (Tamou *et al*., 2018; Meyer, 2019; Houessou *et al*., 2019a; 2019b). The main coat encountered for the Yakana is the white coat and is in harmony with the one reported for this breed by Houessou *et al*. (2019a) in Benin. According to ILRI (2009), there are individuals with black or red spotted on legs, flanks and ears and confirms the presence of individuals with a piebald or mottled black and red coat. The dewlap size and straight profile described for Yakana are in adequacy with those described by Tawah and Rege (1996) for this breed. Yakana cattle are used for milk and meat production. According to Kassa *et al*. (2016c) this breed produces an average of 1.45 liter milk a day without the quantity consumed by the calf. This production is influenced by calving parity and season (Kassa *et al*., 2016b). In general, the Yakana described is similar to the one described by Houessou *et al*. (2019b).

Conclusion

The study on the diversity of cattle breeds in Djidja municipality shows that the improvement of animal performance is obliging farmers to introduce zebus into their herds. The introduced breeds are Goudali, Yakana, M'Bororo and Djeli. These animals are imported from neighbouring countries such as Nigeria, Niger and Burkina Faso by farmers or transhumants. This introduction results in the extinction of taurine breeds such as the Lagune and Somba, which are often inherited from their parents.

Conflict of interest

The authors declare that they have no conflict of interest.

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