



Spatial distribution of goat breeds bred in Benin

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ABSTRACT

Characterization of local goat breeds is an important step for the development of its breeding. This characterization cannot be done without knowing the size and the spatial distribution of the existing breeds. Thus, this work was carried out to study the spatial distribution of goat breeds bred in Benin. To achieve this, 498 breeders spread across the three climate zone of Benin were subjected to semi-structured individual interviews. The data collected were the socio-demographic characteristics of breeders, the number of breeds bred and the size of the herd per breed. Descriptive statistics, and the generalized linear model of Poisson family were used for data analysis. Results showed that breeders were mainly male (54.02%), married (88.15%) with a high rate of non-education (65.26%). The number of breeds bred by breeders in Guinean zone was 3 (West African Dwarf (WAD), Sahelian and Maradi goat) but 4 Soudanian and Soudano-Guinean zone (WAD, Sahelian, Maradi goat and Saanen). Despite the diversity of this breeds in the climate zone, only WAD breed was bred by more than 80% of breeders with a livestock size of 6133.

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INTRODUCTION

In tropical countries, domestic goat (*Capra hircus*) is a valuable genetic resource due to its ability to survive in all type of environment, in different production system and its tolerance to a range of diseases (Kosgey and Okeyo, 2007; Pamo et al., 2007; Abdul-Aziz, 2010; Fantahun et al., 2013). In developing countries, goats are more abundant in terms of size around the tropics and dry

zones, especially in Asia and Africa (Devendra, 2010). In Benin, estimates indicate that about 1 955 811 head of goats are reared in 2019 (FAOSTAT, 2021) and the goat population growth rate increased about 29.51% during the last decade. This makes of goats the third important animal species produced in Benin after poultry and cattle. Goat production play an important socio-economic role by improving livelihoods of owners, reducing

poverty and attaining sustainable agriculture and universal food security (Kosgey and Okeyo, 2007; Abdul-Aziz, 2010; Assen and Aklilu, 2012). However, despite their roles in improving the livelihoods of smallholders, goats are an under-used and poorly understood animal resource as compared to cattle, sheep and poultry (Abdul-Aziz, 2010). In Benin, little attention was paid to goat production promotion in various animal production development programs.

Goats raised by producers in Benin are of local breeds characterized by low performances and high mortality resulting in low productivity. According to Houndonougbo (2017) the local breeds low productivity is linked to genetic, environmental and health factors. Scarcity of reliable genetic database and ignorance of the genetic potential of local breeds leads to practices of introducing exotic breeds for productivity improvement purposes. This promotes untimely crossbreeding between local and introduced breeds leading to genetic erosion (Rege and Gigson, 2003; FAO, 2008). Genetic diversity and integrity preservation on one hand, and genetic improvement on the other hand for the development of goat farming requires the characterization of the existing breeds. The characterization must first and foremost involve, an inventory of breeds bred, as well as their spatial distribution. Therefore, this study came up with the spatial distribution of goats breeds bred in Benin.

MATERIALS AND METHODS

Study area

This study was carried out in 16 districts distributed in the three climate zones of Benin (Figure 1). Bohicon, Klouekanmey, Lalo and Zogbodomey were covered in the Guinean zone while the Soudano-Guinean zone covered Bante, Djidja, Glazoue Parakou and Save. However, the Soudanian zone covered Gogounou, Kandi, Kerou, Kouande, Pehunco, Malanville and N'Dali. The Guinean zone is characterized by 2 rainy seasons and 2 dry seasons with an annual mean rainfall ranging between 950 and 1500 mm (Hounkponou and IDID Benin, 2015). In the Soudano-Guinean

zone, the annual mean rainfall varies between 1000 and 1200 mm. Concerning the Soudanian zone, it is characterized by a succession of rainy season and dry season with an annual mean rainfall ranging between 700 and 1200 mm (Hounkponou and IDID Benin, 2015).

Survey

The data collection was preceded by a focus group between goat breeders, butchers, transhumance management community members, goat's merchant and rural development agents. The focus group was realized in each of the climate zone and assisted in knowing the race breeds in each climate zone. It was followed by a survey where 498 breeders were interviewed using a questionnaire digitized on smartphone via KoboCollect. Data collected through this questionnaire were socio-demographic characteristics of breeders, the number of race breeds and the livestock size per race. The number of breeders surveyed was determined per district. An exploratory survey was carried out with 50 randomly selected breeders to determine the proportion p of breeders raising goat. The number n of respondents was computed as follows (Dagnelie, 1998):

$$n = \frac{U_{0.975}^2 * p(1 - p)}{d^2}$$

Where n is the number of respondents per district, p the proportion of the district raising goat, $U_{0.975} \approx 1.96$ is a quantile of a standard normal distribution for a probability of 0.05 and d the marginal error fixed at 8%.

Statistical analysis

Descriptive statistics (mean, standard error, frequency and citation frequency) was used to analyze socio-demographic and breeds data. The generalized linear model of binomial and Poisson families helped to test respectively the significance of citation frequencies and access the variability of goat breeds size according to climate zone. Data were analyzed using R4.1. (R Core Team, 2021). ArcGis10.1 software helped to realize the map of the study area and the distribution of breeds inventoried.

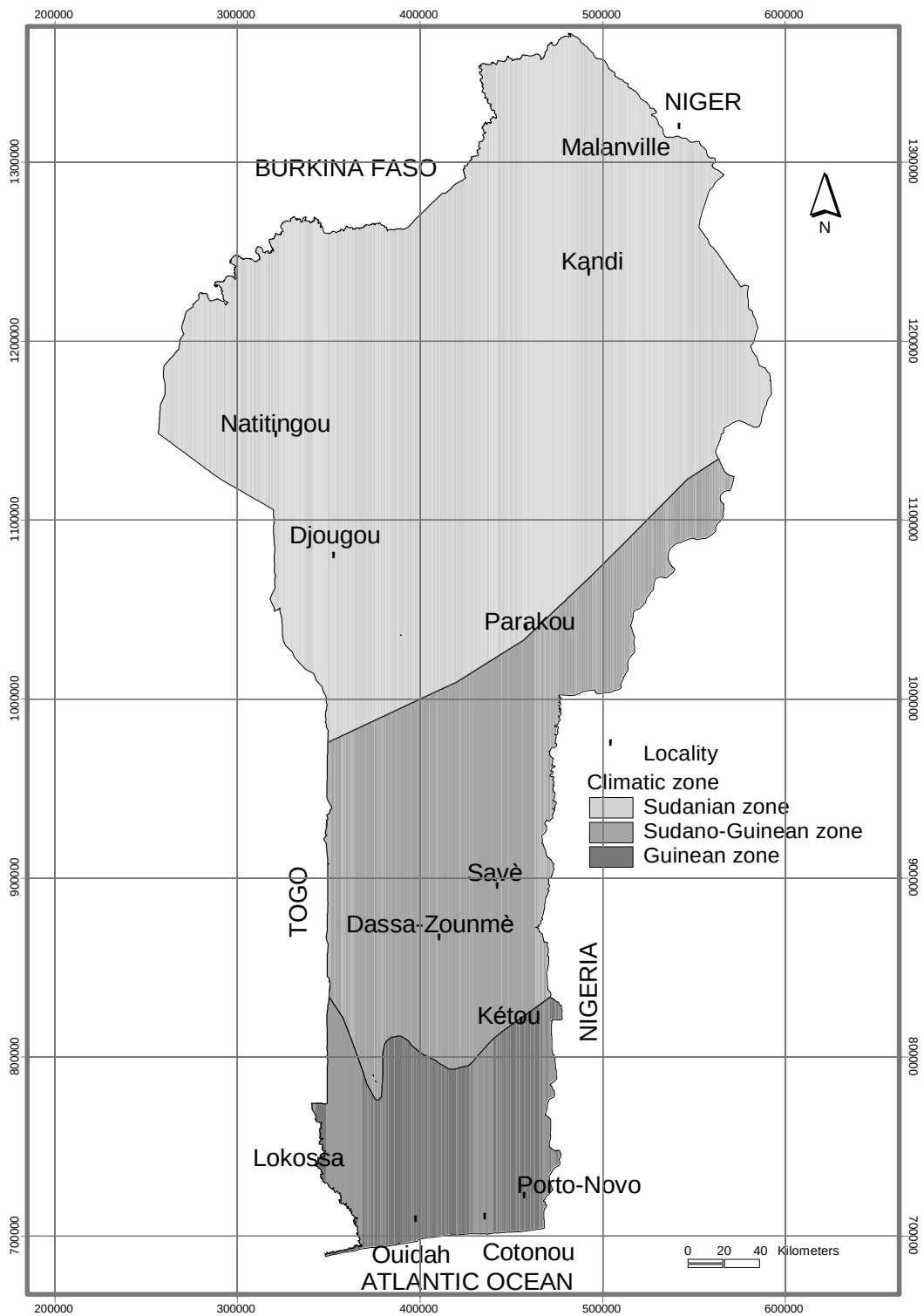


Figure 1: Study area.

RESULTS

Socio-demographic characteristics of breeders

Globally, most of breeders (Table 1) were men (54.02%) with a high proportion in Guinean and Soudanian zone (54.46%) compared to Soudano-Guinean zone (51.09%). The ethnic group Peulh was dominant in Soudanian zone (50.99%) while Yoruba (54.35%) was dominant in Soudano-Guinean zone. However, in the Guinean zone Fon and Adja were popular (56.25 and 42.86% respectively). Most of respondents were muslim in the Soudanian zone (84.19%) but catholic in Soudano-Guinean zone (76.09%). In the Guinean area, 41.07% of breeders practiced native religion while 58.04% were catholic. Globally, there were illiterate (65.26%). This rate was higher in the Soudanian zone (82.18%) than that observed in the Guinean and Soudano-Guinean zone (57.14 and 51.63% respectively). The proportion of married respondents was lower in the Guinean zone (78.57%) than the Soudano-Guinean and Soudanian zone (91.30 and 90.59% respectively). Knowledge acquisition through training was low (8.43%) globally. This rate was less in the Soudanian zone (4.95%) than that registered in the Guinean (13.39%) and Soudano-Guinean (9.24%) zone. About the age, breeders were older in Guinean zone (47 years old) than the others zone (45 years old for Soudano-Guinean and Soudanian zone). Concerning the household size, it was lower in the Guinean zone (7 people) than that observed in the Soudano-Guinean zone (8 people) and the Soudanian zone (9 people). Farmer was the dominant activity (Figure 2) whatever the area (60.64%). It was followed by traders (13.45%), others activities (13.05%) and breeders (12.85%).

Breeds reared and their spatial distribution

The breeds inventoried by the survey were West African Dwarf, Sahelian, Maradi goat and Saanen (Figure 3). The number of breed bred by breeders vary from a climate zone to another. Saanen was absent in the Guinean zone while West African Dwarf, Sahelian and Maradi goat were observed in the three climate zones. The breeds inventoried for

the survey in the different areas were the same mentioned by breeders during the focus group discussion.

A part from Maradi and Saanen goat, the citation frequencies of the other breeds varied significantly ($p < 0.05$) from a climate zone to another (Table 2). West African Dwarf breed citation frequency (Figure 3) was significantly higher in Guinean (95.15%) and Soudano-Guinean zone (92.44%) than Soudanian zone (89.99%). The citation frequency of this breed was more important than that of the others. Sahelian breed was more reported in Soudanian zone (10.20%) but rarely reported in Guinean and Soudano-Guinean zone (4.85 and 5.36% respectively). Maradi goats were absent in the Guinean zone. For this breed, the citation frequencies were 2.45 and 3.19% respectively for Soudano-Guinean and Soudanian zone. Concerning Saanen breed, there had the lowest citation frequency compared to the others breeds. Only 0.63 and 0.43% of respondents mentioned this breed in their livestock.

The total size of the livestock of breeders interviewed in the study area was 6,474 goat heads (Figure 4). West African Dwarf breed had the greatest size whatever the climate zone (6,133 heads) representing 94.73% of the total livestock. It was followed by Sahelian breed which represented only 3.77% of the total livestock. The total size of this breed (244 heads) was less than that of West African Dwarf. The size of each breed significantly ($p < 0.05$) varied among climate zone (Table 3). West African Dwarf breed had a higher size in Soudanian and Soudano-Guinean zone (2,454 and 2261 heads respectively) than that registered in Guinean zone (1,418 heads). However, the number of Sahelian goats recorded in Soudanian zone (135 heads) was greater than those of Guinean zone (62 heads) and Soudano-Guinean zone (47 heads). The greatest size of Maradi goat was registered in Soudanian zone (34 heads) while the lowest size was recorded that of in the Soudano-Guinean zone (20 heads). However, for Saanen breed, the size was greater in the Soudano-Guinean zone (28 heads) than the one in the Soudanian zone (15 heads).

Table 1: Socio-demographic characteristics.

Variables		GZ	SGZ	SZ	Global
Gender (%)	Female	45.54	48.91	43.56	45.98
	Male	54.46	51.09	56.44	54.02
Ethnic group (%)	Adja	42.86	0.54	0.00	9.84
	Bariba	0.00	7.61	36.14	17.47
	Fon	56.25	26.09	0.99	22.69
	Peulh	0.00	7.07	50.99	23.29
	Yoruba	0.89	54.35	3.47	21.69
	Others*	0.00	4.35	8.42	5.02
	Catholic	58.04	76.09	17.82	48.39
	Muslim	0.89	19.02	81.19	40.16
Religion (%)	Endogenous	41.07	4.89	0.99	11.45
	Literate	3.57	3.80	4.46	4.02
	Illiterate	57.14	51.63	82.18	65.26
	Primary	15.18	16.30	3.96	11.04
	Secondary	23.21	26.09	8.42	18.27
	University	0.89	2.17	0.99	1.41
	Single	1.79	2.72	3.47	2.81
	Married	78.57	91.30	90.59	88.15
Marital status (%)	Widow	19.64	5.98	5.94	9.04
	No	86.61	90.76	95.05	91.57
Training (%)	Yes	13.39	9.24	4.95	8.43
Age	Mean±SE	47.00±1.31	45.00±0.93	45.00±0.95	46.00±0.59
Household size	Mean±SE	7.00±0.42	8.00±0.50	9.00±0.54	8.00±0.30

*: Dendi, Otamari, Yao-Lokpa, Kabyè; %: Percentage, SE: Standard Error

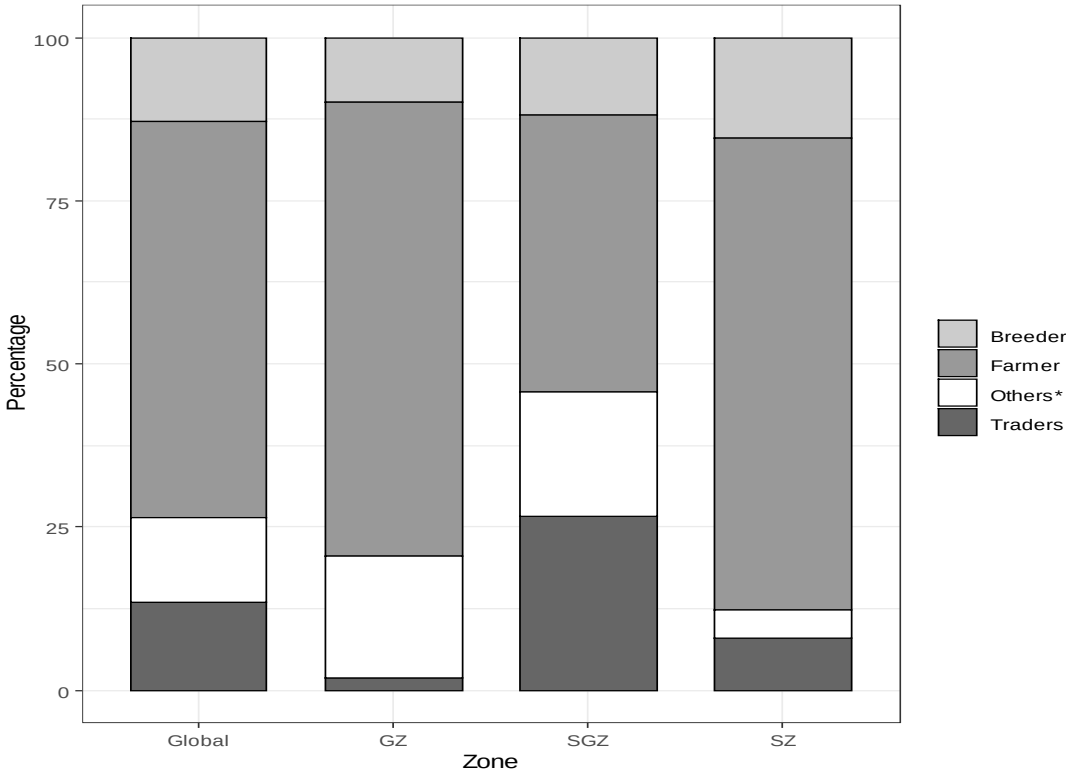


Figure 2: Respondents activities.

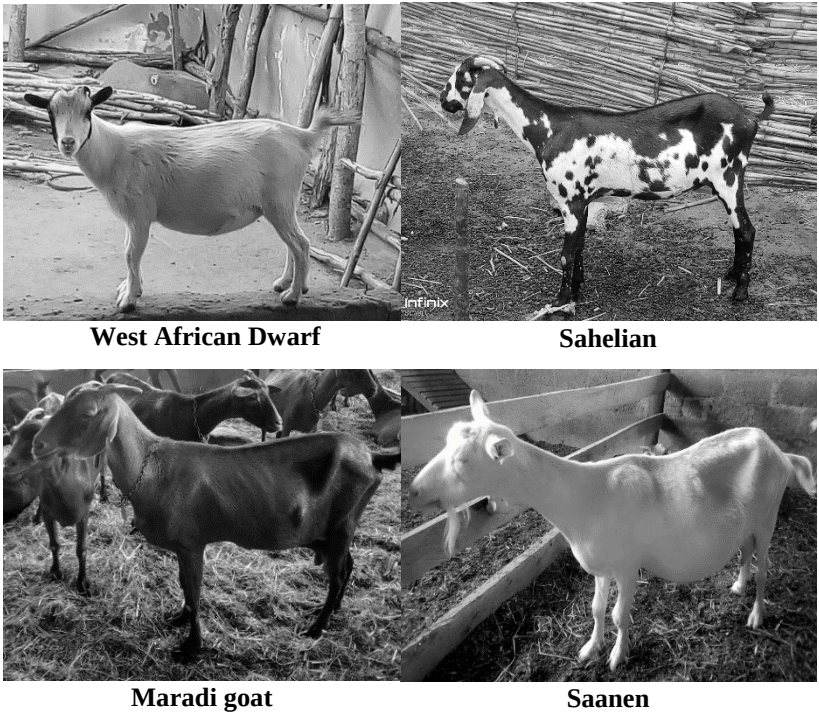


Figure 3: Goats breeds.

Table 2: Effect of pole on the citation frequency of breeds inventoried.

	Chisq	Df	p-value
WAD	7.37	2	0.025
Sahelian	50.13	2	0.000
Maradi goat	5.09	2	0.166
Saanen	3.56	2	0.311

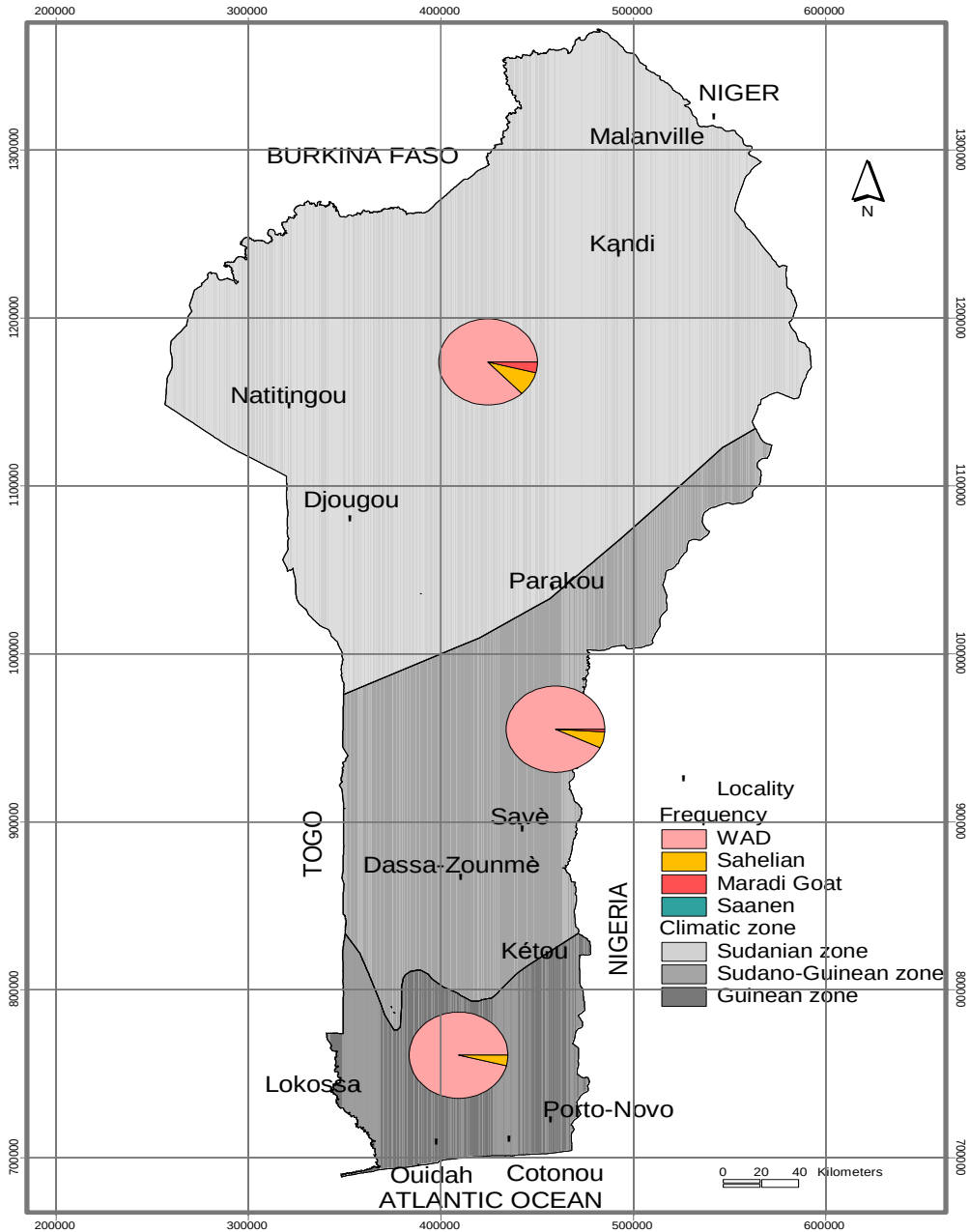


Figure 4: Citation frequencies of breeds.

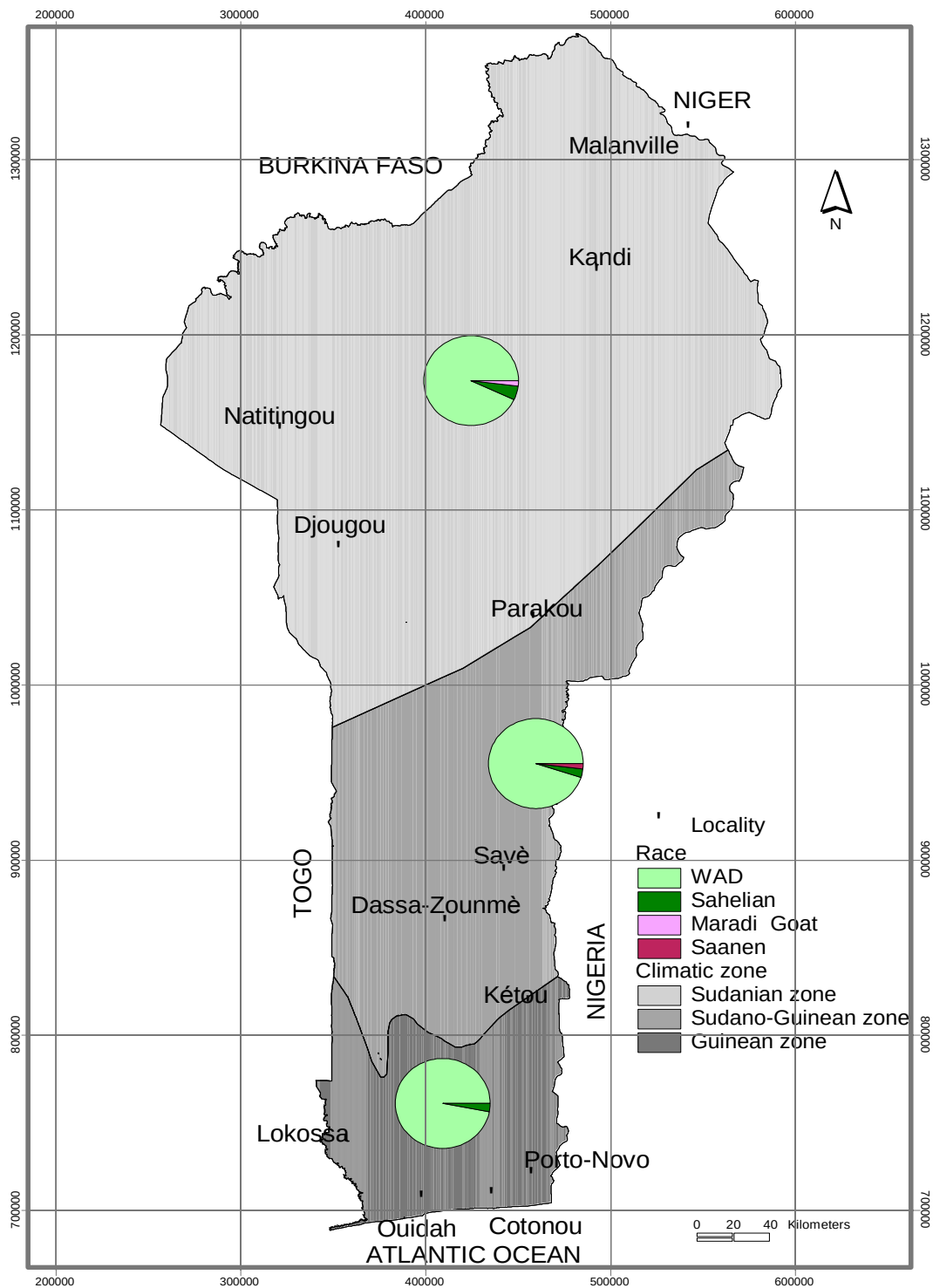


Figure 5: Breeds size.

Table 3: Effect of pole on the size of breeds inventoried.

	Chisq	Df	p-value
WAD	87.54	2	0.000
Sahelian	19.92	2	0.000
Maradi goat	31.55	2	0.000
Saanen	34.32	2	0.000

DISCUSSION

Socio-demographic characteristics of breeders

Goat breeding is an activity practiced by more men than women. Similar results were obtained by Guingouain (2017) in Togo, Louadi et al. (2018) in Algeria and Wasso et al. (2018) in Congo who found respectively 99.06; 69.19 and 82.27% of male breeders in their studies. The high rate of Peulh in Soudanian zone, Yoruba in Soudano-Guinean zone, Fon and Adja in Guinean zone can be explained by the dominance of these ethnic groups in the study area. These results confirm those of Sanni (2017). In fact, in his study Languages Spoken in the Household and Linguistic Assimilation in Benin, this author found a dominance of the Fon, Adja and Yoruba ethnic groups in Guinean zone, Fon and Yoruba in Soudano-Guinean zone, Peulh and Batonon in Soudanian zone. The rate of unschooled breeders in this study is higher than that of Guilherme et al. (2017) who obtained 16.10% of illiterate breeders in Brazil. This difference may be linked to the education system which is less developed in Benin. This low level of education confirms the work of Kouato et al. (2020), which obtained 40%. The activity of goat breeding is practiced by married people probably because it constitutes a source of income to the household. Similar results are reported by Wasso et al. (2018) in Congo (73.33%) and Kouato et al. (2020) in Benin (88%). The low rate of trained breeders in this study can be an obstacle for the application of basic rules of goat breeding. Indeed, these rules most of time are learned during training

sections and their application could increase zootechnical and economic results of goat farms as reported by Silva et al. (2011). The trained breeders rate in this study is less than that observed by Carvalho et al. (2020) in Brazil on goat and sheep farmers (63.40 and 60% respectively). The average age of goat farmers in this study is 46 years old, indicating that young people are not interested in this activity or most of them left rural area for city. These results confirm those of Louadi et al. (2018) in Algeria (47 years old). Goat rearing is not the principal activity of goat farmers in this study but agriculture. The same results were obtained by Carvalho et al. (2020) who reveal that when considering the activities as a source of income, the majority of sheep and goat farmers do not consider this activity as their main source of income.

Breeds reared and their spatial distribution

High citation frequencies are recorded for West African Dwarf goats breed throughout the study area. It is the most breed bred by breeders probably because of the fact that it is a local breed, its ease to be raised and its rusticity. These results confirmed the work of Hounzangbe-Adode et al. (2010) and Direction de l'Elevage (2013) which say that West African Dwarf breed is met in all regions of Benin but also those of Houndjo et al. (2018) for whom most goats in Benin are of West African Dwarf breed. In the study area, Sahelian goats are bred by few breeders with little size, no doubt that it does not have the adaptive character and the tolerance to trypanosome like the West African Dwarf

breed. Hounzangbe-Adode et al. (2010) report that Sahelian are animals adapted to arid regions and do not support the pressure of tsetse fly which occurs in humid and hot zones of the South. This may explain its more pronounced presence in the Soudanian zone. The presence of Sahelian goats is in agreement with the work of Hounzangbe-Adode et al. (2010) and Houndjo et al. (2018). According to these authors, Sahelian goats are present in the north of the country and in peri-urban areas. However, the results contradict those of Missohou et al. (2016) who report that Sahelian goats are met in the Sahel strip from Tchad to Senegal. This presence of Sahelian goats in Benin can be explained by the transhumance which brings the herds through Niger, Burkina-Faso and Nigeria. Saanen and Maradi breeds are dairy goats, unlike West African Dwarf and Sahelian goats, which are beef breeds. The presence of these dairy goats in limited numbers in Soudaia and Soudano-Guinean area is probably explained by the difficulties to access these breeds. More, dairy goats inventoried in this study are less represented compared to West African Dwarf and Sahelian goat. Their low resistance, the lack of suitable infrastructure, the lack of knowledge in the management of dairy goat, the difficulty to master their feeding and appropriate health are probably the reasons why dairy goat are rarely met despite their qualities (Harouna-Boureima et al., 2021). These breeds have been met only on private farms producing goat milk. These results confirm those of Hounzangbe-Adode et al. (2010) who report the presence of Maradi goat in some private breeding even if its precise location has not been given. Kouato et al. (2020) also have mentioned the presence of Saanen and Maradi goat at N'Dali when doing the diagnostic of goat farming systems in this district which belongs to the Soudanian zone. The low size of Maradi goat in this study is not in agreement with the results of Abdou et al. (2017) who reported that Maradi goat is widely represented in Southern Niger. Apart from the dairy goat breeds listed in this study, the presence of Alpine goat was reported by Hounzangbe-Adode et al. (2010) in the district of Glo, Allada and Hinvi which belong to the

Guinean zone. Indeed, according to these authors, this breed from France was introduced to Benin in the 2000s in certain groups of breeders from. Its absence in this study can be explained by the fact that Glo, Allada and Hinvi were not take into account among the districts surveyed in the Guinean zone.

Conclusion

This study has inventoried four goat breeds in Benin. The most important is the West African Dwarf goat which is an endogenous breed. The low level of knowledge on the performances of local breeds associated to the desire of some breeders to improve its performances leads to the introduction of exotic breeds. Therefore, local goat breeds are threatened by extinction due to crossbreeding. Efforts have to be done for the sustainable use and conservation of such endangered breeds. But before this, there is a need of research on their production system, their typology and their characterization.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

MBB collected the data, analyze them and write the manuscript, AM produced the maps and contributed to the improvement of the quality of the manuscript with PVH, DOK, RLK and CAAMC.

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