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Socio-Economic and Technical Characteristics of Beef Cattle Breeding in Ndé Division, West Region of Cameroon

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Abstract

Insight is here provided into the socio-economic and technical characteristics of cattle production in the Ndé Division (West Cameroon region). Using a semi-structured questionnaire, information on the activity was assessed following onsite visits and interviewing breeders. Through a random sampling scheme, 110 breeders in the four subdivisions of the Ndé Division were shadowed. The majority (98.18%) of breeders were men aged 20 to 40 and married (91.82%). They belong to the Mbororo ethnic group, having cumulated more than 10 years in the activity. Most respondents (50.91%) did not attend school and earn their living mainly from livestock (78.18%). Cattle were raised for sale and to feed the breeder's family (77.27%). The main mode of acquisition of animals was through inheritance (81.82%). The cattle breeds were mostly made up of white Fulani (70%), living in private farms using a combination of stake and barbed wires (67.27%) as fences. The combination of natural fodder and cooking salt was used by most breeders (59.09%) as a daily ration. Reproduction was by natural mating (97.07%). Parasites (internal and external) and foot-and-mouth disease were the main diseases reported by the majority of farmers. Self-treatment (50%) was the main prophylactic measure taken by farmers in case of disease symptoms. Cattle herders faced several challenges, such as insufficient pasture (67.27%), agro-pastoral conflicts (76.36%) and diseases (90.91%). Cattle breeding was rather a widespread activity with no particular restriction.

1. Introduction

The world population is increasing at an alarming rate, with a projection of a 30% increase by the year 2050 [1]. This continued growth has been explained by several factors, including high fertility, low mortality, and economic and technological development [2] [3]. The constantly increasing world population is to face adequate provision of food and water. African countries are scoring the highest percentage of growth per year (2.5% to 3%) and about 239.1 million people located in Sub-Saharan countries are subject to inadequate protein supply and more specifically, animal proteins [4]. Dietary protein intake, mainly meat and milk, is estimated at 1 to 1.6 g per kg body weight for people with limited to high physical activity [5]. Livestock and agriculture represent major assets in maintaining food security around. Although Africa possesses 16.7% of the worldwide cattle herd, the production there remains low, with a milking potential that hardly reaches 5% of worldwide burdens [6] [7]. This setting remains fragile mainly because of the ongoing world food crisis exacerbated by ongoing wars. Armed conflicts, such as the one involving Russia and Ukraine, have the potential to reduce the capacity of nations, households and individuals to feed themselves appropriately [8].

In Cameroon, livestock production remains an important part of the economy, contributing about 125 billion XAF to the Gross Domestic Product [9]. Cameroon is home to important animal genetic resources composed of cattle (9,857,361 heads), small ruminants (10,895,621 heads), poultry (53,630,641 subjects), pigs (3,936,636 subjects), etc. [10]. Among these speculations, cattle (particularly Zebus of the Goudali and M'bororo breeds) are the main providers of animal products, particularly milk and meat. Due to its many advantages (source of animal protein, source of income, etc.), cattle breeding is, therefore, an important means of rapidly increasing meat production in Cameroon [11]. Cattle contribute 54% of all meat products produced locally and consumed by the population. Cattle breeding provides annually 110,000 tons of meat and 174,000 tons of milk entirely consumed locally [11]: in 2015, the Cameroonian Ministry in Charge of Livestock and Animal Husbandry (MINEPIA) reported that the annual demand for milk in Cameroon was estimated at 297,000 tons. This demand is still to be met because of low productivity (both from meat and milk) from local breeds compared to exotic breeds [12] [13]. To improve meat/milk production and consumption, there are several factors influencing productivity to be checked. These factors are mainly social, economic, zootechnical, sanitary, climatic and nutritional [14] [15]. To improve cattle herd productivity in Came-

roon, studies have focused on the socio-economic and technical characterization of cattle breeding in some Cameroonian Divisions [16] [17] [18] [19]. However, such information is still missing from several hotspots of production. More quantitative data on the socio-economic surrounding cattle breeding is still lagging in enabling planning for effective management of this resource.

In this study, the profile of herders involved in the daily follow-up of cattle herds is presented in the Ndé Division, known as a hotspot of production in the West Region. The socioeconomic background of people involved in the cattle breeding activity is assessed, including the constraints associated with this activity.

2. Methodology

2.1. Study Site

This study was conducted between January and June 2022 in the Ndé Division in Cameroon (Figure 1). Ndé is located between 10˚21' and 10˚51' East longitude and 4˚52' and 5˚16' North latitude with a population of more than 200,000 inhabitants 19. It covers an area of approximately 1524 km^2 with a tropical climate of type. The average annual temperature is 20.4˚C and rainfall of about 1950 mm per year [20]. The Municipality of Bangangté concentrates more than half of the population of the Division and extends over an area of approximately 800 km^2. The Ndé Division has a total of four subdivisions (Bangangté, Bazou, Tonga and Bassamba) [21].
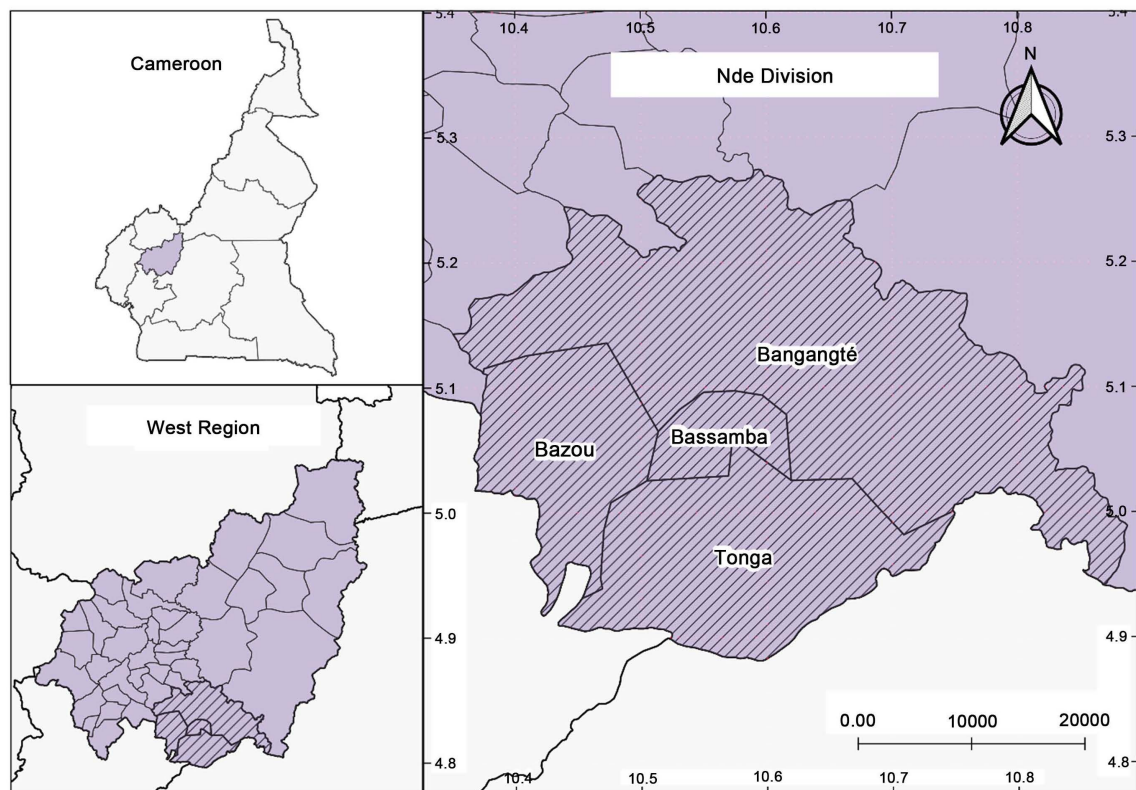

Figure 1. Geographical location of the study area.

2.2. Data Collection

Data collection was done through a semi-structured questionnaire. The questionnaire was mounted in French and was administered in French and/or local language with the help of an interpreter whenever necessary. Topics covered in the questionnaire included relevant information on socio-economic information of respondents, associated farming techniques and constraints.

Respondents were reached through representative following an introductory meeting involving local authorities as divisional delegate and the district delegates of Livestock, Fisheries and Animal Industries of the study area. The identification of breeding areas and access to herder communities were approved by their representative following presentation of research credentials. Seventeen farmers randomly selected within the study division tested the clarity, reliability and validity of the questionnaire. Farmers were briefed on the main objective of the work and their consents obtained before administration of the questionnaire. A total of 110 farmers in four districts of the Division representing 70% of the number of cattle breeders in this locality were surveyed based on the random number generation technique selected from a list of breeders obtained at the Delegations of Livestock, Fisheries and Animal Industries (DREPIA) of Ndé division and completed by private field farmers.

2.3. Data Processing and Statistical Analysis

Following the survey, each questionnaire was assigned a unique code then entered into a database using the KoboCollect tool. The data base was subjected to descriptive statistics to describe the socioeconomic characteristics of the breeders, the technical characteristics of the farms and the constraints of breeding. The Chi-square test was used to test the independence between the qualitative variables at the 5% threshold. Multiple Correspondence Analysis was run to establish the typology of breeders and cattle farms. Statistical analysis was performed using the statistical program R v. 4.1.3 [22].

3. Results and Discussion

3.1. Social Characteristics of Breeders

Localities surveyed contributed unequally to the collection of data (Table 1). The highest proportion (92.73%) of breeders came from the locality of Banganté, followed by the localities of Bazou and Tonga with 2.73% of breeders and finally the locality of Bassamba which contributed 1.82% of breeders ($\chi^2 =$ 269.13; p < 0.001). The high number of breeders present in this district would be due to a large area and the fodder routes favorable to cattle breeding compared to the other districts. Cattle breeding was mainly practiced by men (98.18%; χ^2 =102.15; p < 0.001), whose ages ranged between 20 and 40 years old. The male gender and the Mbororo ethnic group appeared to be the categories of people most involved in cattle breeding. These results are similar to those of [16] where the majority of breeders surveyed in the Noun division were men (98.1%) and

Table 1. Social characteristics of cattle breeders (n = 110) in the Ndé Division, West Cameroon region.

Variables	Social Characteristics of Cattle Breeders			
	Modalities	Frequencies	Percentages	p-value
Subdivisions	Bangangte	102	92.73	p < 0.001
	Bassamba	2	1.82	
	Bazou	3	2.73	
	Tonga	3	2.73	
Sex	Males	108	98.18	p < 0.001
	Females	2	1.82	
Ages	20 - 40	57	51.81	p < 0.001
	41 - 60	43	39.09	
	60+	10	9.09	
Ethnic	Mbororo	75	68.18	p < 0.001
	Foulbé	27	24.55	
	Haoussa	3	2.73	
	Bamoun	2	1.82	
	Bamiléké	2	1.82	
	Kapiski	1	0.91	
Marital Status	Married	101	91.82	p < 0.001
	Single	5	4.55	
	Widow	4	3.64	
Level of Education	None	56	50.91	p < 0.001
	Koranic	32	29.09	
	Primary	9	8.18	
	Secondary	9	8.18	
	Higher	4	3.64	
Religion	Muslim	102	92.73	p< 0.001
	Christian	8	7.27	
Years of Experience	4 - 6 Years	1	0.91	p < 0.001
	7 - 9 Years	1	0.91	
	10+	108	98.18	
Principal Activity	Breeder	86	78.18	p < 0.001
	Agro-Breeder	13	11.82	
	Businessman	8	7.27	
	Civil Servant	3	2.73	

Note: p < 0.001 = highly significant.

that most (69.8%) of the breeders were Mbororos. Indeed, the dominance of men in cattle herding are mainly because they are breadwinners in these communities and take responsibility for managing the herds to meet the subsistence needs of the family [18]. The 20 to 40-year-old group presented a representative weight, suggesting that breeding is carried out by adults, but the practice is diluted at older ages (60 years and over). The influence of the age pyramid is another element of explanation. A similar observation was made by [23] in North Cameroon where 60% of herders were under 35 years old.

The largest number of herders (68.18%) was the Mbororos followed by Foulbés (24.55%), Haoussa (2.73%), Bamoun (1.82%), Bamilékés (1.82%) and Kapiski (0.91%) (χ^2 = 290.51; p < 0.001). The breeders were mostly married (91.82%; χ^2 = 169.33: p < 0.001), reflecting the frequent practice of this activity by adults. Most of the breeders (50.91%) had no educational level, followed by those who had completed vocational studies (29.09%), then by those with a primary and secondary level (8.18%) and finally those with a higher degree (3.64%). This high rate of illiteracy could be explained by the constant movement associated with most livestock herders even during the schooling period of the year. The Koranic literacy rate of 29.09% testifies that a large part of cattle breeders are Muslims (92.73%) and learn Koranic reading from an early age while giving little importance to Western schooling. According to the study carried out by [24] on cattle breeders in Menoua, the proportion of illiterate breeders was 81.2%. On the other hand, those carried out by [11] in the North-West and by [16] in Noun observed that the proportion of literate herders was 71.2% and 81.2% respectively. The majority of cattle breeders carry out this breeding as their main activity. They assume that this livestock sector could be a fairly profitable activity for breeders to the point that they no longer need to resort to other activities in parallel. The dominance of paid labor would be due to cattle farming requiring a lot of space and time to drive the animals. Breeders may need paid labor in the event of other occupations or old age. Thus, a survey carried out in the municipality of Kalalé in Benin revealed that the majority of breeders sought foreign labor in order to better manage their herds [25]. A large number of breeders surveyed obtained their animals by inheritance. This result can be explained by cattle breeding being a traditional profession among breeders and the animals are transmitted from father to son.

3.2. Economic Characteristics of Breeders

This study shows that 77.27% of respondents raised cattle for self-consumption and sale (χ^2 = 102.78; p < 0.001) (Table 2). With regards to labor, 50% of livestock keepers had paid labor, 25% of them had paid family labor while the remaining 25% had exclusively family workers. (χ^2 = 13.5; p < 0.001). The study revealed that the majority of breeders (93.63%; χ^2 = 276.55; p < 0.001) used their own funds as a source of finance. Animals were mostly sold from the farm (62.72% χ^2 = 131.55; p < 0.001) and merchants (butchers) were the main customers (46.36%).

Table 2. Economic characteristics of cattle breeders (n = 110) in the Ndé Division, West Cameroon region.

Variables	Economic Characteristics of Cattle Breeder			
	Modalities	Frequencies	Percentages	p-value
Objective for Keeping Animals	Commercialization	24	21.82	
	Auto Consumption/ Commercialization	85	77.27	p < 0.001
	Leisure	1	0.91	
Laborers	Paid	54	50	
	Paid and Family	27	25	p < 0.001
	Family	27	25	
Mode of Acquisition of Animals	Bought	55	50	
	Inheritance	90	81.82	p < 0.001
	Gift	5	4.55	
Source of Funding	Personal Funds	103	93.63	
	Personal Funds, Credit	1	0.90	
	Personal Funds, Subvention	4	3.63	p < 0.001
	Subvention	2	1.81	
Animal Sell Site	Market	18	16.36	
	Farm	69	62.72	
	Market and Farm	9	8.18	
	Market and at the Client's House	2	1.81	p < 0.001
	Farm and at the Client's Home	12	10.90	
Nature of Client	Business Person	51	46.36	
	Business Person Establishment (Restaurant, Hotel)	1	0.9	
	Individuals	1	0.9	
	Individuals + Business person	34	30.90	p < 0.001
	Individuals and Establishment (Restaurant, Hotel			
	Breeder with Individual and Business Persons	22	20	

Note: p < 0.001 = highly significant.

3.3. Zootechnical Characteristics of Cattle Breeders

Genetic Materials

Cattle breeds reared were White Fulani (70%), Goudali (44.55%), Hybrids (34.55%),

Red Fulani (11.82%) (Table 3), Holstein (1.82%) and Montbéliard (0.91%) (χ^2 = 269.09; p < 0.001) while respondents often reported the use of more than a single breed. The average number of farms was 46 cattle. The lowest number was 20 heads while the highest number was 700 heads. The majority of respondents had a herd of fewer than 75 heads (76.63%; χ^2 = 30.36; p < 0.001). The herds were mainly made of white Fulani. This breed is much appreciated by the breeders of this locality as it is a hardy, very good walker and much more resistant to disease than other breeds 23. In addition, some breeders individually had several herds (2 to 4) while others had common or collective herds. The existence of collective herds would make their management difficult because decision-making does not depend only on the group leader but on all the members.

3.4. Housing and Farming Mode

Clay was the material used in most instances (70%) for the enclosure floor while 23.63% used concrete and 0.9% used plywood (χ^2 = 96.36; p < 0.001) (Table 4). The different types of enclosures were made of stake and barbed wire (67.27%), plank associated to barbed wire (30%), plank (1.81%) and concrete (0.9%) (χ^2 = 128.91; p < 0.001). Cattle breeders are increasingly sedentary in the Ndé (51.81%) while some still practice transhumance. Reasons set forth for transhumance are mainly scarcity of water and agro-pastoral conflicts (χ^2 = 39.21; p < 0.001). These are associated to investment in time, finance or energy making more breeders to be reluctant to embrace this practice. Although those engaging in this practice often evoke the lack of fodder, lack of water and agro-pastoral conflicts, in some other divisions (Noun and Mbam and Inoubou) transhumance is still well practiced [16] [18]. Sedentary could also be explained by the breeders getting themselves increasingly involved in developing personal fodder plot of *Pennisetum clandestinum, Brachiarria ruziziensis* and *Trypsacum laxum* while those depending solely on natural pastures are still verse in transhumance.

3.5. Feeding and Access to Water

Natural fodder combined with cooking salt were mainly used to feed herd (59.09%), 40% of farmers added concentrate to feed (χ^2 = 4.04; p = 0.044) (Table 5). A greater proportion of these breeders (70.90%; χ^2 = 19.23; p < 0.001) had personal fodder plot of *Pennisetum clandestinum, Brachiarria ruziziensis, Trypsacum laxum*. The sources of water supply for their animals were boreholes, backwaters and rivers (Table 4). The majority of breeders took their herds to the backwater for drinking (78.18%; χ^2 = 239.12; p < 0.001).

4. Constraints of Cattle Farming

4.1. Socio-Economic Constraints

The main social constraint observed was the lack of technical training related to cattle breeding (Table 6). This situation implies a transmission of knowledge related to cattle breeding from father to son and consequently, the breeders devote

Table 3. Main breeds and number of cattle obtained from the different cattle breeders (n = 110) of Ndé Division, West Cameroon region.

Variables	Main Breeds			
	Modalities	Frequencies	Percentages	p-value
Breed	White Fulani	77	70	
	Goudali	49	44.55	
	Hybrids	38	34.55	p < 0.001
	Red Fulani	13	11.82	
	Holstein	2	1.82	
	Montbéliard	1	0.91	
Herds	Less than 75 Cattle	82	76.63	p < 0.001
	More than 75 Cattle	25	23.36	

Note: p < 0.001 = highly significant.

Table 4. Farmhouse used by cattle breeders (n = 107) of Ndé Division, West Cameroon region.

Variables	Farmhouse Used by Cattle Breeders			
	Modalities	Frequencies	Percentages	p-value
Nature of the Floor	Concrete	26	23.63	
	Plywood	1	0.9	p < 0.001
	Mud	83	75.45	
Nature of Enclosure	Barb Wire + Stick	74	67.27	
	Plank + Barb Wire	33	30	
	Concrete	1	0.9	p < 0.001
	Plank	2	1.81	
Farming Mode	Sedentary	57	51.81	
	Transhumant	51	43.36	p < 0.001
	Sedentary + Transhumant	2	1.81	
Transhumance Reasons	Forage	4	3.63	
	Forage + Watering	25	22.72	
	Forage + Watering + Agro-pastoral Conflict	27	24.54	p < 0.001
	Forage + Agro-pastoral Conflict	1	0.9	

Note: p< 0.001 = highly significant.

Table 5. Feeding and watering practices of cattle breeders (n = 110) of Ndé division, West Cameroon region.

Variables	Feeding and Watering Practices of Cattle Breeders			
	Modalities	Frequencies	Percentages	p-value
Food Utilized	Natural Fodder + Cooking Salt	65	59.09	p = 0.044
	Concentrated Feed + Natural Fodder + Cooking Salt	44	40	
Personal Fodder Plot?	Yes	78	70.90	p < 0.001
	No	32	29.09	
Source of Water Supply	Borehole	3	2.72	p < 0.001
	Backwater + Borehole	6	5.45	
	Backwater	86	78.18	
	River + Backwater	2	1.81	
	River	12	10.90	

Note: p < 0.001 = highly significant; p > 0.001 = significant.

Table 6. Socio-economic constraints of cattle raring (n = 110) in Ndé Division, West Cameroon region.

Variables	Socio-Economic Constraints Of Cattle Raring			
	Modalities	Frequencies	Percentages	p-value
Social Constraint				
Level of Technical Training	Untrained	107	97.27	p < 0.001
	Trained at IRAD	3	2.72	
Economic Constraints				
Access to Funding?	Yes	16	14.54	p < 0.001
	No	94	85.45	
Easy Selling of Animals?	Yes	38	34.54	p = 0.001
	No	72	65.45	

Note: p < 0.001 = highly significant; p = 0.001 = significant.

themselves little to new pastoral techniques which constitute a brake for the development of this activity. Formal education is not commonly practiced in communities with the skills transmitted from parents to offspring (mostly fathers to son). Indeed, the majority of respondents had no technical training (97.27%; χ^2 = 98.33; p < 0.001). Similar observations were previously reported in other localities in Cameroon [24] [26]. Additionally, several parents will start initiating the offspring at the early ages sending them with the animals to supervise grazing. Regarding economic constraints, a large part of the breeders did not have access

to financing (85.45%; χ^2 = 55.30; p < 0.001). The sale of animals remains challenging in this locality (65.5%; χ^2 = 10.50; p = 0.001). In the Ndé division, there is no livestock market. Breeders mainly rely on butchers as main customers and get all their money after the product has been sold by the latter.

4.2. Zootechnical Constraints

Almost all of the breeders reported that their cattle came from the same herd (99.09%; χ^2 = 106.04; p < 0.001) (Table 7), most of the respondents also had cattle of other species on their farms (66.36% χ^2 = 11.78; p < 0.001). The agro-pastoral conflict seemed to be the main limiting factor related to housing in this locality. Indeed, 76.36% of breeders face this problem. Herds generally have a narrow path while moving to a new site to graze. This augments the chances of animals deviating to nearby farmlands and feed on crops.

The insufficiency of fodder around was the major problem related to food encountered by cattle breeders (67.27%; χ^2 = 13.12; p < 0.05). Ongoing human development characterized by the building of infrastructures and intensive agriculture are reducing rangeland for cattle. Access to drinking water also remains a challenge to herds and runoff from nearby farmland could eventually transport pesticides downside to the few remaining accessible drinking points. Findings here are similar to previous studies showing that agro pastoral conflicts are widely spread in the community [16] [18]. Access to quality fodder remains challenging throughout the year. This is exacerbated in the dry season, contributing to the practice of fodder cultivation by the majority of breeders. Similar observations were made by Awa *et al.* (2004) in the cotton areas of Cameroon, the Central African Republic and Chad.

The majority of breeders (65.45%) did not have a prophylaxis program (χ^2 = 12; p < 0.05). Actually, 90.09% of breeders admitted having previously encountered pathologies in their herd. In the event of symptoms, the means of treatment were self-treatment (50%), self-treatment associated to slaughtering (26.36%), veterinary assistance with self-treatment (10.90%), veterinary assistance associated to self-treatment and slaughtering (9.09%) and veterinary assistance only (3.63%) (χ^2 = 77.54; p < 0.001). Cattle breeders usually provide treatment themselves for their sick animals. This is controversy as most of them lack the necessary knowledge and skills to diagnose and/or manage diseases through appropriate medication or practices.

Considering economic constraints, access to finance remains a main challenge to cattle breeding. The lack of subsidy can be the cause of the low renewal of the herds by the breeders and mostly resulting to low veterinary care towards animals. In most instances, specimens used for breeding are coming from the same herd. This is potentially increasing inbreeding rate in the herd and the vulnerability of animals to disease and environmental challenges. Additionally, the presence of different breed observed in the many farms can favor the transmission of diseases from a breed to the other.

Table 7. Zootechnical constraints of cattle breeding (n = 110) in Ndé Division, West Cameroon region.

Variables	Zootechnical Constraints of Cattle Breeding			
	Modalities	Frequencies	Percentages	p-value
Constraints Link to Genetic Material				
Origin of Bull	Same Farm	109	99.09	p < 0.001
	Neighbouring Farm	1	0.9	
Do You Have Other Species of Animals?	Yes	73	66.36	p < 0.001
	No	37	33.63	
Constraints Link to Housing				
Do You Face Agro-pastoral Conflicts?	Yes	84	76.36	p< 0.001
	No	24	21.82	
Constraints Link to Feeding				
Availability of Fodder in the Locality?	Yes	36	32.72	p = 0.0003
	No	74	67.27	
Constraints Link to Animal Health				
Do You Follow a Prophylaxi Program?	Yes	36	32.72	p = 0.0005
	No	72	65.45	
Presence of Pathologies?	Yes	100	90.91	p < 0.001
	No	10	9.09	
What Do You Do in Case of Appearance of Symptoms?	Veterinary Assistance	4	3.63	p < 0.001
	Self-treatment	55	50	
	Self-treatment + Slaughter	29	26.36	
	Veterinary Assistance + Self-treatment	12	10.90	
	Veterinary Assistance + Self-treatment + Slaughter	10	9.09	

Note: p < 0.001 = highly significant; p > 0.001 = significant.

4.3. Diseases and Prophylaxis

Farmers usually reported several concurrent cause of mortality. In most instances, these constrains are reported at the same time by the same farmer. However, when taking each case alone, 86% of farmers complained of skin diseases, these are most often due to the nature of the floor, the atmosphere in the accommodation, the season and especially the practice of hygiene. Seventy-one percent did not know the nature of the disease, 54% complained of diarrhea, 45% spoke of foot-and-mouth disease which is characterized by hyperthermia and causes nasal, oral, foot and breast lesions which start with vesicles. Twenty-two percent

spoke of Contagious Bovine Pleuropneumonia known to be characterized on the anatomo-pathological level by an exudative inflammation of the lung and the pleura. Tuberculosis was mentioned by 20% of farms and brucellosis by 18%. This study also showed that animals could be sick at any time of the year (during the dry season as well as in the rainy season) because of no disease association with the seasons (χ^2 = 2.03; p = 0.363). The majority of breeders associated modern treatment with traditional treatment (tree barks, medicinal herbs, etc.) as the type of treatment administered by breeders in the event of symptoms (98.18%; χ^2 = 102.15; p < 0.001).

4.4. Functional Characteristics

Multiple Correspondence Analysis (MCA) was applied to 15 variables (Table A1) composed of 45 modalities contributing to the total inertia of the first 3 axes of 27.23%. The existing correlations between the variables studied and the first two axes are illustrated in Figure A1. Figure A2 shows the 5 groups of cattle breeders sampled in the department of Ndé.

As reported in Figure A1, Axis 1 represents 11.66% of the total inertia. It is correlated with main activity, schooling, provision of a prophylaxis program, experience, gender, provision of forage plot, the objective of exploitation, type of feed used, mode breeding, and labor. Axis 2 provides 8.1% total inertia. It is significantly correlated with School Enrolment, Main Activity, Purpose of Operation, Type of Labor, District, Experience, Type of Foods Used, Marital Status and Family and Provision of fodder plot. Axis 3 represents 7.47% of inertia and is significantly correlated to the variables Manpower, Purpose of Operation, Presence of Pathologies, Schooling, Age, Experience, Types of food used, Provision of a Prophylaxis program, Main activity, District, Marital status, Provision of fodder plot.

The first two axes represent a cumulative total of 19.76%, which seems low and potentially represents that cattle breeding is rather widespread in the population of respondents without any particular restriction. The first group of cattle breeders (Cluster 1) was characterized by the Agro-Breeder modalities of the main activity, marketing as the objective of breeding, paid and family labor, education essentially centered on Koranic studies, fodder with cooking salt and concentrated food as types of food used, a transhumant breeding mode and an age group of 20 to 40 years. The second group of cattle breeders (Cluster 2) is represented by the fodder and cooking salt modalities of the types of feed used, the non-availability of a prophylaxis program, self-consumption + marketing of the objective of exploitation, the non-availability of fodder plots, family labor, stockbreeding as the main activity and transhumance of the farming method. The third group of cattle breeders (Cluster 3) is described by the following modalities of different variables: the 7 - 9-year duration of the experience and the Tonga locality for the district. The fourth group of cattle breeders (Cluster 4) stands out for the yes modality of the Provision of fodder plot, the yes modality of the Provision of a prophylaxis program, the sedentary modality of the Breed-

ing method, the Fodder with salt and food modality concentrates of the types of feed used, of the marketing modality of the breeding objective, modality of none level of schooling. The fifth group of cattle breeders (Cluster 5) is depicted by the modalities: a higher level of schooling, a civil servant of the main activity, not of the provision of a prophylaxis program, fodder associated with concentrating and cooking salt of the type of foods used, 4 - 6 years of the number of years of experience, leisure of the operating objective.

5. Conclusion

The study of the socio-economic and technical characteristics of cattle breeding in the Ndé division showed that this breeding was dominated by Muslim men, with the majority being married. There was mainly no formal education or professional training. Cattle were mainly raised for sale and self-consumption. White Fulani was the dominant breed chosen mainly for beef production and adaptation to harsh living conditions. Breeders mainly obtained their livestock by inheritance. Sedentary was the most practiced production system. Cattle herders relied in most instances on natural pastures for food and streams/rivers for watering. Pastures were often supplemented with salt and concentrate feed throughout the year. Self-treatment (vaccination and ticking) was the main preventive measure taken by breeders against diseases. Cattle farmers faced a series of challenges, including a lack of technical training related to cattle breeding, and reduced access to finance and difficult marketing of animals. Cattle herders also faced other difficulties, such as insufficient pasture, agro-pastoral conflicts and diseases.

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Authors' Contributions

Study design: DFW, FT, GCTT, BMTN; data collection: DFW, GCTT, BMTN; data analysis: GCTT, BMTN, DFW; writing: DFW, GCTT, BMTN, GFDT, ENN, ASN, MMFN, BHTF, FDKW, SGTK, KMT, KAE, FT. All authors read and approved the manuscript.

Consent to Participate

Participation in the interviews was entirely voluntary; respondents provided signed informed consent (see supplementary material).

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Data Availability

The dataset supporting the findings of this study is available from the corresponding authors upon reasonable request.

Conflicts of Interest

The authors declare no competing interests.

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Appendix

Table A1. List of variables used in the MCA.

Variables	Modalities	Codes
Localities	Bangangte	Loc 1
	Bassamba	Loc 2
	Bazou	Loc 3
	Tonga	Loc 4
Sex	Males	H
	Females	F
Ages	20 - 40	Age 1
	41 - 60	Age 2
	60+	Age 3
Marital Status	Married	SM 1
	Single	SM 2
	Widow	SM 3
Level of Education	None	Etud 1
	Koranic	Etud 2
	Primary	Etud 3
	Secondary	Etud 4
	Higher	Etud 5
Years of Experience	4 - 6 years	Exp 1
	7 - 9 years	Exp 2
	10+	Exp 3
Principal Activity	Breeder	prin 1
	Agro-Breeder	prin 2
	Businessman	prin 3
	Civil Servant	prin 4
Objective of Raring Cattle	Commercialization	Obj 1
	Self-consumption + Commercialization	Obj 2
	Leisure	Obj 3
Labour	Paid	Main 1
	Paid + Family	Main 2
	Family	Main 3
Exploitation Status	Stat 1	
	Stat 2	
Personal Fodder Plot	Par	
	No Par	

Continued

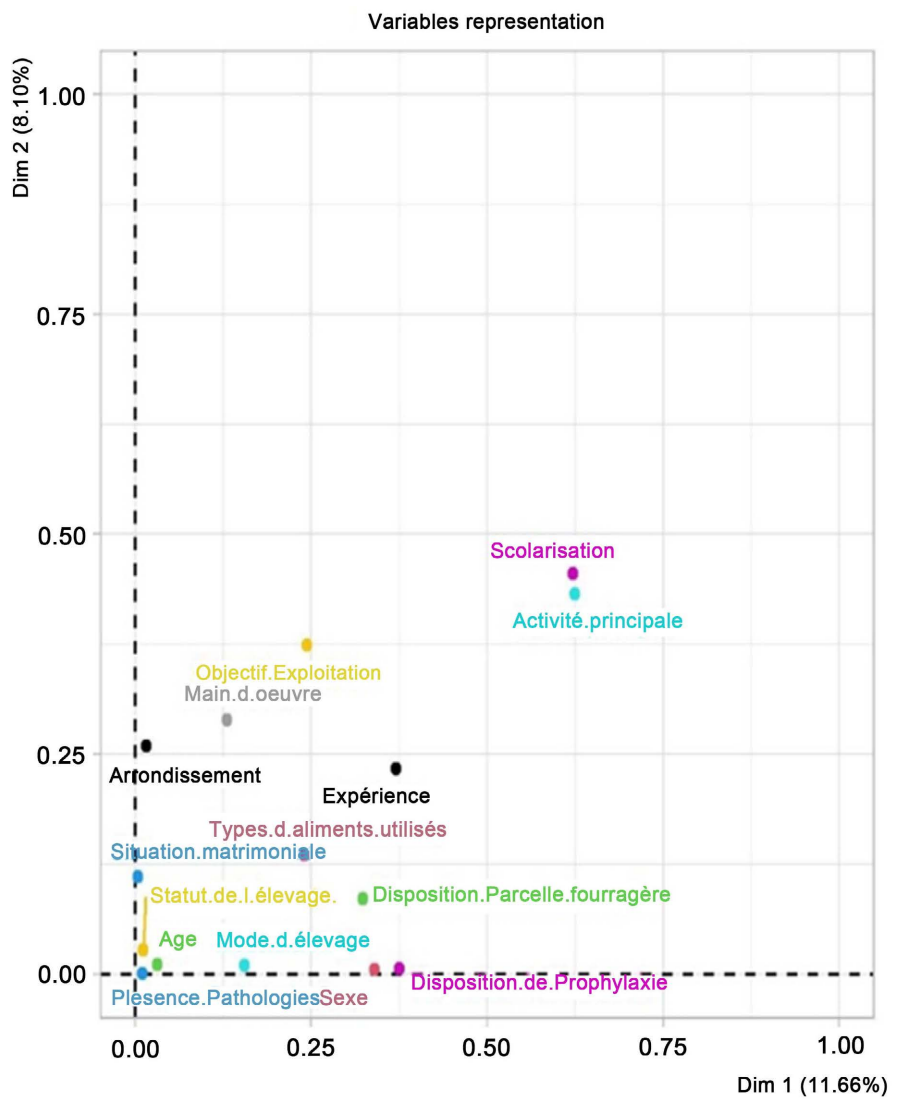|			
Number of Cattle per Herd	Eff 1		
	Eff 2		
Presence of Disease	Mal		
	No Mal		
Any Prophylaxis Program Followed?	Phy		
	No Phy		
Mode of Cattle Rearing	Mode1		
	Mode 2		
Food Used	Fodder and Cooking Salt	Alt 1	
	Fodder, Cooking Salt and Concentrated Feed	Alt 3	

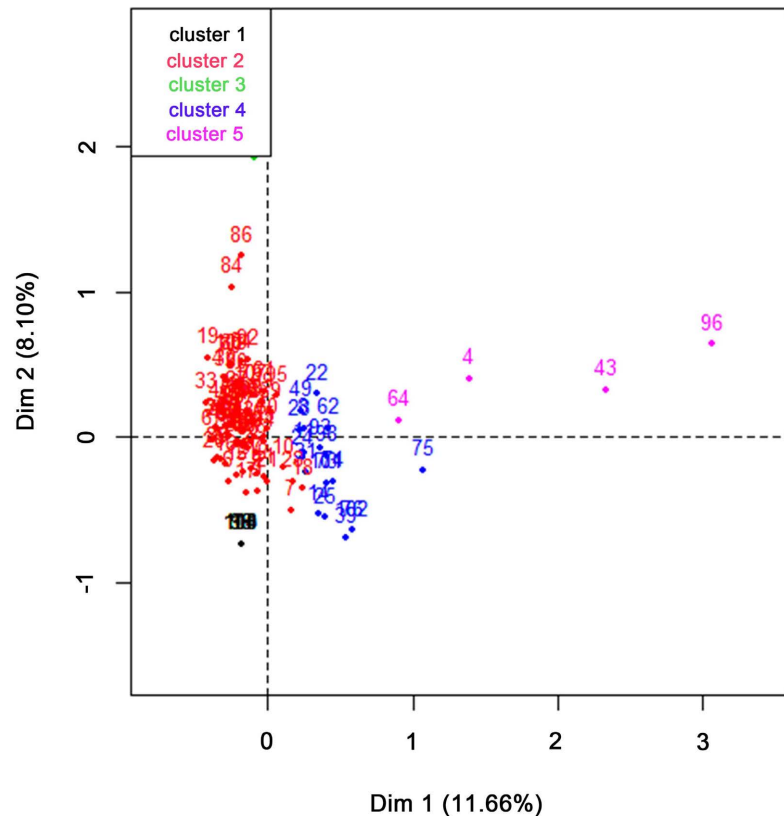**Figure A1.** Graphical representation of the different modalities on Axes 1 and 2.

Figure A2. Illustration of the Ascending Hierarchical Classification (AHC) with the different group descriptions.