Characterization and Typology Analysis of Cattle Breeding Practices on Rural Farms in Northern Côte d'Ivoire

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ABSTRACT

A comprehensive understanding of agricultural production variables is essential for developing effective agricultural strategies. To identify the key factors shaping cattle farming practices in Côte d'Ivoire, a study was conducted to characterize the diversity of livestock farming practices and identify the different typologies of livestock production systems in the northern (Poro, Tchologo, and Bagoué) and north-eastern (Bounkani) regions. The methodology involved a structured survey targeting livestock farmers. Participants were selected based on two main criteria: the accessibility of their farms and their willingness to share information. Data collection was carried out using a standardized questionnaire designed to gather information on socio-economic characteristics, herd composition, farming practices, and constraints. Of the 105 livestock farmers initially identified, only 53 satisfied the inclusion criteria and were included in the survey. The results revealed that cattle farming is predominantly managed by Peulh ethnic groups originating from neighbouring countries (Mali and Burkina Faso) to the north. Herds are largely composed of Méré and Zebu cattle breeds. Through data analysis, three distinct livestock production systems were identified: (i) sedentary native farmers engaged in livestock rearing as a secondary activity alongside trade, (ii) semi-transhumant Fulani pastoralists for whom livestock is the primary livelihood, and (iii) agro-pastoralists integrating crop and livestock farming. The main challenges reported by farmers include feed shortages and animal diseases, with additional constraints related to land-use conflicts and limited access to agricultural services. Farmers expressed the need for designated grazing areas, affordable feed supplements, and improved access to veterinary care. This typology provides a clear view of livestock systems in Côte d'Ivoire. It serves as an effective foundation for an integrated strategy to improve Ivorian livestock production.

Keywords: cattle; Côte d'Ivoire; northern region; production system

INTRODUCTION

In Africa, livestock farming holds significant importance in terms of food security, economic development, and environmental sustainability (Baizina *et al*., 2023). It contributes significantly to food security by diversifying farmers' income sources and serving as a buffer against crop failure. In Côte d'Ivoire, livestock farming is a secondary economic activity, contributing only 4.5% to the agricultural GDP and 2% to the total GDP (Kouamé *et al*., 2024b). This limited contribution reflects a sector that is underdeveloped despite its potential to meet rising domestic demand for animal protein.

To address this challenge, the Ivorian government has made significant investments and structural reforms in the sector (PNIA2, 2017; Ducroquet

et al., 2017). These programs aim to enhance the productivity and competitiveness of animal production systems while strengthening livestock value chains. Nonetheless, national production still falls short of covering domestic needs. For instance, only 48% of the national meat demand is met locally, with per capita meat consumption standing at 11.6 kg/year, and fish production covers merely 16% of demand, with a consumption of 25.6 kg/year (MIRAH, 2022; Kouamé *et al*., 2024a). This dependence on imports underscores the need for systemic transformation within the sector.

Recent studies have emphasized the importance of typological approaches in understanding farming systems, as they enable the classification of farms into homogeneous groups for targeted interventions (Alvarez *et al*., 2018; Sarker *et al*., 2021). While typology

research is well-established in agriculture, few studies have focused specifically on livestock production systems in West Africa, and even fewer have been conducted in Côte d'Ivoire. Existing typologies often focus on mixed crop-livestock systems or are limited to specific agroecological zones, which may not reflect the full diversity of livestock farming practices in the country (Koutou *et al*., 2016; Sossou *et al*., 2021).

This study offers a novel contribution by developing a comprehensive typology of livestock farming systems in Côte d'Ivoire, taking into account local realities and the diversity of practices in different regions. By identifying and characterizing farm types, this research aims to inform more tailored and effective development strategies for the livestock sector. Specifically, the objectives are to: (i) characterize the diversity of livestock farming practices, and (ii) identify the different typologies of livestock production systems to support decision-making in the formulation of policy and development programs. In doing so, the study provides an evidence-based foundation for enhancing the sector's contribution to national food sovereignty and economic resilience.

METHODS

Survey Area

The study was conducted from January to August 2024 in four regions of northern and northeastern Côte d'Ivoire (Figure 1). These include three regions from the Savanes district (Poro, Tchologo, and Bagoué) in the north and one region from the Zanzan district (Bounkani) in the northeast. These northern and northeastern regions represent the traditional cattle-breeding areas of Côte d'Ivoire, housing 80% of the country's total cattle herd (Kouamé *et al*., 2024a). They are also convergence areas for transhumant herds from neighboring northern countries, which are now showing a tendency toward sedentarization (Soro, 2021).

The northern region is a savanna area characterized by a Sudanian-Guinean climate, with a wet season from

June to September and a dry season extending from November to early March. Rainfall varies between 900 and 1,200 mm, reaching its peak between July and August. Agriculture is the main economic activity in this region, with cotton, cashew, and mango being the dominant cash crops. In addition to these cash crops, rice, maize, yam, groundnut, and market gardening are cultivated for local consumption. Livestock farming, particularly cattle rearing, is also a major source of income for the local population (Kouamé *et al*., 2024a).

Study Methodology

Study design, Distribution of Surveyed Farms, and data collection. The study was conducted in two phases and involved direct engagement with livestock farmers or farm owners. The first phase, known as the pre-survey, aimed to identify target farms, define study parameters, and develop a semi-structured questionnaire. This questionnaire focused on key aspects such as the socio-economic profile of the farmer, types of animals raised, feeding practices, livestock health monitoring, and the management of natural resources used for animal husbandry. This preliminary stage was crucial for refining and validating the data collection tool. It also helped to overcome language barriers by involving interpreters to ensure that information provided by respondents, mainly Malinké speakers, with a few Peulh speakers, was accurately understood and recorded.

In the second phase, the finalized questionnaire was administered to the selected farms. The farms were chosen based on three main criteria: ease of access, the farmers' willingness to share information, and the size of the cattle herd. The survey covered seven departments across four regions in northern Côte d'Ivoire. These regions were selected due to their dynamic agropastoral activities, and the specific localities were identified with the support of the regional or departmental offices of the Ministry of Animal and Fisheries Resources (MIRAH). In the northeast, the Bounkani region included the departments of Bouna and Téhini.
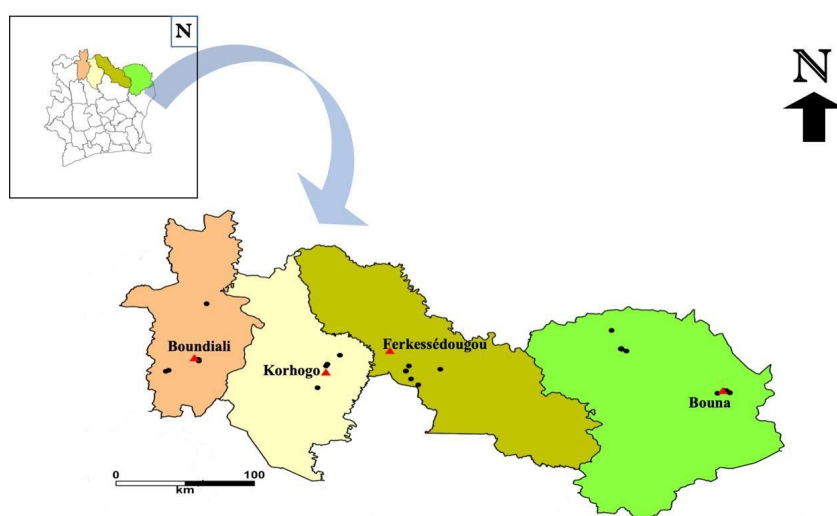

Figure 1. Distribution of farms in the study area in four regions of northern and northeastern Côte d'Ivoire. ▲, regional capital; ●, visited location.

In the north, the Bagoué region included Kouto and Boundiali, while the Poro region comprised Korhogo and Dikodougou. Lastly, the Ferkessédougou department in the Tchologo region was also surveyed.

In total, 53 farms were surveyed, distributed as follows: 17 in the Bounkani region, 14 in Bagoué, 14 in Poro, and 8 in the Ferkessédougou department. This geographic and demographic spread allowed the study to capture a diverse range of farming practices and conditions across major livestock-producing zones in Côte d'Ivoire.

Study's limitation. Despite its valuable contributions, this study presents several limitations that should be acknowledged. First, the relatively small sample size (53 farms) may limit the generalizability of the findings to all livestock farming systems in Côte d'Ivoire, particularly in regions outside the northern and northeastern zones. Second, the study primarily relied on self-reported data, which may be subject to recall bias or social desirability bias, especially concerning herd sizes, management practices, and the use of veterinary inputs. Third, while interpreters were used to mitigate language barriers, subtle nuances in local dialects or cultural contexts may have affected the accuracy of data interpretation. Additionally, the cross-sectional nature of the study does not capture seasonal variations or changes over time in livestock management practices and herd dynamics. Finally, the analysis focused mainly on cattle farming, which may overlook important variations within other types of livestock production systems, such as small ruminants or poultry, which also play a critical role in rural livelihoods.

Statistical analysis. The collected data, structured in a question-and-answer format, were first defined and coded into explanatory variables with different categories before being subjected to statistical analysis. To describe the socio-economic structure and the representativeness of the various studied parameters, the data underwent basic descriptive analysis (frequency, categories, mean, and standard deviation). This analysis helped characterize the socio-economic profile of the respondents and the characteristics of the studied farms.

To identify the most influential parameters in differentiating the surveyed farms, the data were analyzed using Multiple Correspondence Analysis (MCA). Based on the most discriminating variables, livestock farming types were then classified using the hierarchical cluster analysis (HCA) method. All these analyses were performed using XLSTAT software, version 2019.

RESULTS

Characterization and Diversity of Livestock Farming Practices

Socio-economic characteristics and livestock management practices of cattle farmers in northern Côte d'Ivoire. The socio-economic profile of cattle farmers surveyed in northern Côte d'Ivoire reveals that the sector is overwhelmingly dominated by married

men (100%), most of whom (69.81%) are between 40 and 60 years old. A smaller proportion (16.98%) was under the age of 40. The majority of farmers (64.15%) belong to the Peulh ethnic group, originating mainly from neighboring countries such as Burkina Faso (47.17%) and Mali (18.87%). However, a notable number of Ivorian farmers also engage in cattle farming, primarily among the Sénoufo (16.98%) and Malinké (13.21%) ethnic groups (Table 1).

Regarding education levels, 44.52% of the farmers had no formal schooling. Among those who received an education, 14.38% completed primary school, 5.56% reached the secondary level, and only 2.78% had pursued higher education. Additionally, 36.92% of the participants reported receiving instruction in Quranic schools. Interestingly, only 13.21% of the surveyed farmers considered livestock farming as their primary occupation. The majority (86.79%) practiced it as a secondary activity, with 52.83% also involved in crop farming, 28.3% in trade, and 5.66% in various other professions (Table 1).

A large proportion of farmers (86.79%) reared multiple animal species in addition to cattle. Specifically, 73.59% raised both small ruminants and poultry, 9.43% raised only small ruminants, and 3.77% raised only poultry. This diversification likely supports household food security and income stability. Farm ownership was mostly individual-based, with 92.89% of the cattle farmers being the legal owners of their farms. Farms were acquired primarily through inheritance (37.42%), purchase (30.88%), or donation (24.76%). Among the owners, 45.91% inherited their herds, while 36.76% and 10.21% acquired theirs through purchase and donation, respectively (Figure 2).

In terms of experience, the number of years in cattle farming ranged from 2 to 40 years, with an average of 23.32 ± 10.04 years. In the Savanes district, experience averaged 21.42 ± 10.64 years (range: 2–39 years), whereas in the Zanzan district, it averaged 27.35 ± 7.36 years (range: 17–40 years). Herd sizes varied as well: the average number of cattle per farm was 43.30 ± 20.80. In the Savanes district, herd sizes ranged from 11 to 83 heads (average: 41.31 ± 19.29), while in the Zanzan district, they ranged from 14 to 90 heads (average: 47.53 ± 23.75).

The study identified five main cattle types across the farms: the taurine breeds (N'Dama and Baoulé), the Zebu, and two types of crossbreeds. These include the Méré (a local hybrid of N'Dama, Baoulé, and Zebu) and exotic hybrids (crosses between local and improved
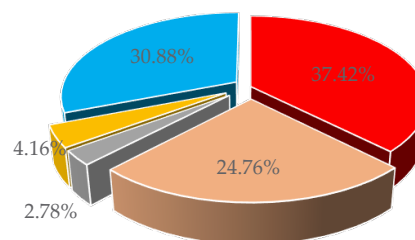

Figure 2. Distribution of farmers (%) depending on the mode of acquisition of the cattle farm. ■, Inheritance; ■, Donation; ■, Lease; ■, Entrusts; ■, Purchase.

Table 1. Distribution of farmers (%) according to the social characteristics of breeders

Characteristics	Variables	Distribution of farmers (number of respondents)		
		Savannah (N=36)	Zanzan (N=17)	Overall (N=53)
Sex	Men	100 (36)	100 (17)	100 (53)
	Women	0 (0)	0 (0)	0 (0)
Age groups (years)	<40	19.44 (7)	11.76 (2)	16.98 (9)
	40-60	69.44 (25)	70.59 (12)	69.81 (37)
	>60	11.11 (4)	17.65 (3)	13.21 (7)
Origin of breeders	Côte d'Ivoire	41.67 (14)	25.53 (4)	33.96 (18)
	Burkina Faso	33.33 (13)	70.59 (12)	47.17 (25)
	Mali	25 (9)	5.88 (1)	18.87 (10)
Ethnic group	Malinké	13.89 (5)	11.76 (2)	13.21 (7)
	Sénoufo	25 (9)	0 (0)	16.98 (9)
	Peulh	58.33 (21)	76.47 (13)	64.15 (34)
	Lobi	0 (0)	11.76 (2)	3.77 (2)
	Mossi	2.78 (1)	0 (0)	1.89 (1)
Marital status	Monogamous	30.56 (11)	70.59 (12)	43.40 (23)
	Polygamous	69.44 (25)	29.41 (5)	56.60 (30)
Education level	None	36.11 (13)	52.94 (9)	41.51 (22)
	Primary school	11.11 (4)	17.65 (3)	13.21 (7)
	Secondary school	5.56 (2)	0 (0)	3.77 (2)
	Undergrade	2.78 (1)	0 (0)	1.89 (1)
	Koranic school	44.44 (16)	29.41 (5)	39.62 (21)
Second activity	None	16.67 (6)	5.88 (1)	13.21 (7)
	Agriculture	44.44 (16)	70.59 (12)	52.83 (28)
	Commerce	30.56 (11)	23.53 (4)	28.30 (15)
	Other	8.33 (3)	0 (0)	5.66 (3)
Other types of animals in the herd	Small ruminant	11.11 (4)	5.88 (1)	9.43 (5)
	Small ruminant and poultry	63.88 (23)	94.12 (16)	73.59 (39)
	Poultry	5.56 (2)	0 (0)	3.77 (2)
	None	19.44 (7)	0 (0)	13.21 (7)

Note: N= Number of farmers surveyed.

Table 2. Distribution of farmers (%) depending on the type of cattle raised

Breeds	Distribution of farmers (number of respondents)		
	Savanes (N=36)	Zanzan (N=17)	Overall (N=53)
Baoulé	2.78(1)	47.06(8)	16.98(9)
N'Dama	36.11(13)	0 (0)	24.53(13)
Zébu	94.44(34)	76.47(13)	88.68(47)
Méré	97.22(35)	100(17)	98.11(52)
Exotic metis	36.11(13)	5.88(1)	26.41(14)

Note: N= Number of farmers surveyed.

exotic breeds). Among these, Méré (98.11%) and Zebu (88.68%) were the most commonly raised, found on nearly all farms. Taurine breeds were less frequent, with the Baoulé found exclusively in the Zanzan district, particularly in Bouna and Téhini (Table 2). Breeding practices were dominated by natural mating, used on 90.57% of the farms. Zebu and Méré males were preferred for this method. Artificial insemination was rare (9.43%) and mainly involved the use of semen from improved exotic breeds (Table 3).

Among all the farms surveyed, 69.81% rely on family labor, while 30.19% hire a shepherd-employee to manage their herds (Table 4). Semi-transhumance is the primary method of herd management. Natural pasture is the main source of feed for all farms. In addition to this natural food source, some farmers (60.04%) reported providing supplementary feed to their animals during the lean season (dry season).

This supplementation consists partly of agro-industrial by-products (cottonseed cake, maize bran, and rice bran) in 49.06% of cases, and partly of crop residues for 16.98% of respondents. All farmers stated that they provide mineral supplements, usually in salt licks or kitchen salt (Table 4). Water sources for livestock include dams/ponds (67.92%), rivers/streams (20.75%), and wells/boreholes (11.32%).

Health management, product valorization, and natural resource use among cattle farmers in northern Côte d'Ivoire. The study revealed that all surveyed cattle farms received technical support from the government, primarily through vaccination campaigns and occasional interventions by animal health agents during epidemics. Health management practices varied across farms and could be grouped into two main categories. A majority of farmers (58.49%) practiced self-medication,

Table 3. Distribution of farmers (%) depending on the race of male use as a reproductor and the fecundation type

Parameters	Modality	Distribution of farmers (number of respondents)		
		Savannah (N=36)	Zanzan (N=17)	Overall (N=53)
Race of the reproductive male	Zébu	77.78 (28)	52.94 (9)	69.81 (37)
	Méré	30.55 (11)	47.06 (8)	35.85 (19)
	Exotic metis	11.11 (4)	5.88 (1)	9.43 (5)
	Baoulé	0 (0)	11.76 (2)	3.77 (2)
Fecundation type	Free reproduction	100 (36)	100 (17)	90.57 (48)
	Artificial insemination	13.89 (5)	0 (0)	9.43 (5)

Note: N= Number of farmers surveyed.

Table 4. Distribution of farmers (%) based on animal feed system

Parameters	Modality	Distribution of farmers (number of respondents)		
		Savannah (N=36)	Zanzan (N=17)	Overall (N=53)
Alimentation	Natural pasture	100 (36)	100 (17)	100 (53)
Supplements	Agro-industrial by-products	63.89 (23)	17.65 (3)	49.06 (26)
	Crop residues	13.89 (4)	29.41 (5)	16.98 (9)
	None	25 (9)	52.94 (9)	33.96 (18)
Watering	Borehole/well	8.33 (3)	17.65 (3)	11.32 (6)
	Dam/Pond	72.22 (26)	58.82 (10)	67.92 (36)
	Watercourse	19.44 (7)	23.53 (4)	20.75 (11)
Animal surveillance	Family workforce	58.33 (22)	82.23 (15)	69.81 (37)
	Salaried workforce	41.67 (14)	17.65 (2)	30.19 (16)

Note: N= Number of farms surveyed.

Table 5. Distribution of farmers (%) based on pathologies, health monitoring, and prevention methods

Parameters	Modality	Distribution of farmers (number of respondents)		
		Savanes (N=36)	Zanzan (N=17)	Overall (N=53)
Pathologies	Trypanosomiasis[1]	100 (36)	88.23 (15)	96.23 (51)
	CBPP[2]	91.67 (33)	70.59 (12)	84.90 (45)
	Foot-and-mouth disease[3]	83.33 (30)	76.47 (13)	81.13 (43)
	Dermatoses	11.11 (4)	11.76 (2)	11.32 (6)
	Diarrhea	13.89 (5)	0 (0)	9.43 (5)
Health monitoring	Veterinary	36.11 (13)	52.94 (9)	41.51 (22)
	Self-treatment	63.89 (23)	47.06 (8)	58.49 (31)
Prevention methods	Vaccination	94.44 (34)	94.41 (16)	94.34 (50)
	Deworming	100 (36)	88.23 (15)	96.23 (51)
	Spraying	97.22 (35)	94.41 (16)	96.23 (51)

Note: N= Number of farms surveyed; [1] parasite; [2] bacterial; [3] viral.

using readily available synthetic drugs alongside traditional knowledge to treat sick animals, often without consulting a veterinarian or animal health professional. In contrast, 41.51% of farmers reported receiving technical assistance from veterinarians or certified animal health agents. This self-medication trend was more prevalent in the Savanes district (63.89%) compared to the Zanzan district (47.06%) (Table 5).

Several recurring animal diseases were identified, including trypanosomiasis (96.23%), contagious bovine pleuropneumonia (CBPP) (84.90%), and foot-and-mouth disease (81.13%). To manage these diseases, farmers implemented preventive measures such as vaccinations against CBPP and brucellosis, as well as both internal and external deworming. Internal deworming was carried out using tablets or injectable treatments like ivermectin and oxytetracycline, while external deworming targeted ectoparasites, particularly ticks, through the application of synthetic acaricides such as alphacypermethrin and amitraz (Table 5).

Livestock products played a critical role in meeting the economic, nutritional, and cultural needs of the farming communities. Animals were mainly sold live and served as a key source of additional income. However, the market value of these animals varied according to genetic type. Across all surveyed localities, the Méré crossbreed was the most frequently sold (98.11%), followed by Zebu (75.47%). Taurine breeds and exotic crossbreeds were sold less often, representing only 13.21% and 9.43% of sales, respectively (Table 6). Milk production also contributed significantly to household livelihoods, as it was both consumed and sold by farm managers. Beyond their economic importance, livestock and their products held ceremonial and cultural significance, especially during traditional events.

The study also highlighted critical issues related to access and management of natural resources, particularly water and grazing land. Across all localities, farmers expressed a lack of awareness about the official

regulations governing the use of these resources. A large majority (96.22%) reported difficulties accessing water sources and grazing areas. These resources, especially dam water and communal pastures, were shared by farmers and livestock herders, often leading to competition and disputes. Reported conflicts were more frequent in the Zanzan district (41.17%) than in the Savanes district (30.56%) (Table 7). Most tensions arose from interactions between livestock keepers and crop farmers, particularly over the overlapping use of land and water.

Identification of The Different Typologies of Livestock Production Systems

Discriminant farm variables. The multiple correspondence analysis (MCA) reveals that the first two factorial dimensions explain 63.27% of the total variability among livestock farms (Figure 3). The first axis contributes 50.09% to this variability and is

influenced by variables such as ethnicity (17.14), the farmer's secondary activity (12.30), the cattle breeds raised (15.06), the type of labor used (16.21), and the provision of supplementary feed (11.12). The second axis, which accounts for 13.18% of the variability, is mainly determined by the farmer's level of education (27.89), the mode of livestock acquisition (28.96), and the farm's years of experience (21.30). The contributions of each variable to the factorial plane are recorded in Table 8.

Description of different typologies of farms. The hierarchical ascending classification, based on the first two factorial axes of the MCA, identified three different types of livestock farming (Figure 4).

Type 1 farms. These farms represented 11 farms, or 21% of the surveyed farms. They belong to Ivorian nationals and are primarily acquired through purchase. They are mostly owned by traders, with some retirees and

Table 6. Distribution of farmers (%) according to the production characteristics

Parameters	Modality	Distribution of farmers (number of respondents)		
		Savanes (N=36)	Zanzan (N=17)	Overall (N=53)
Breeds sold	N'Dama	8.33 (3)	0 (0)	5.66 (3)
	Baoulé	0 (0)	23.53 (4)	7.55 (4)
	Zébu	80.56 (29)	64.71 (11)	75.47 (40)
	Méré	97.22 (35)	100 (17)	98.11 (52)
	Métis exotiques	11.11 (4)	5.88 (1)	9.43 (5)
Product type sold	Live animal	19.44 (7)	64.71 (11)	33.96 (18)
	Live animal and milk	80.56 (29)	35.29 (6)	66.04 (35)

Note: N= Number of farms surveyed.

Table 7. Distribution of farmers (%) according to the difficulties of their business

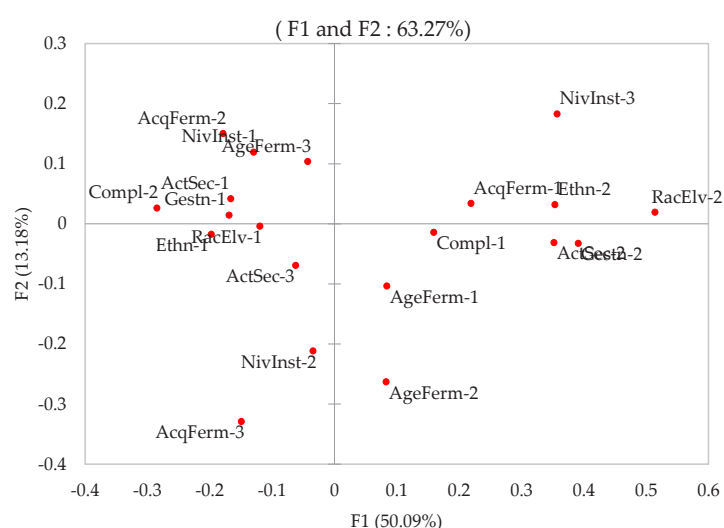| Parameters	Distribution of farmers (number of respondents)		
	Savanes (N=36)	Zanzan (N=17)	Overall (N=53)
Nutritional requirements	97.22 (35)	94.12 (16)	96.22 (51)
Animal diseases	94.44 (34)	94.12 (16)	94.34 (50)
Farmer-breeder conflicts	30.56 (11)	41.17 (7)	33.96 (18)
Access to veterinary services	27.78 (10)	11.76 (2)	22.64 (12)

Note: N= Number of farms surveyed.

Figure 3. Projection of the most contributory production variables into the factorial plane of the multiple correspondence analysis (MCA)

Table 8. Contributions of variable modalities to the first two factors of the multiple correspondence analysis (MCA)

Code	Variables	Modality	Factor 1 (50.09)	Factor 2 (13.18)
Ethn	Ethnic group	1= Peulh	6.143	0.187
		2= Autochtone	10.993	0.336
		Total	17.135	0.523
NivInst	Education level	1= None	1.708	5.481
		2= Koranic	0.114	16.546
		3= Formal	5.899	5.867
		Total	7.722	27.894
ActSec	Secondary activity	1= Agriculture	3.587	0.850
		2= Commerce	8.599	0.259
		3= Other	0.178	0.846
		Total	12.365	1.955
AcqFerm	Acquisition of farm	1= Purchase	5.097	0.458
		2= Inheritance	2.801	7.514
		3= Other	1.134	20.984
		Total	9.032	28.955
RacElv	Breeds reared	1= Méré and Zebu	2.842	0.015
		2= Méré. Zebu and Crossbreeds	12.221	0.063
		Total	15.063	0.078
Taur	Presence of taurine	1= Presence	0.911	2.980
		2= None	0.647	2.115
		Total	1.558	5.095
AutrEsp	Other animal species	1= Small ruminants and poultry	0.193	1.547
		2= None	0.942	7.562
		Total	1.134	9.109
Gest	Animal surveillance	1= Family	4.894	0.130
		2= Salary	11.318	0.300
		Total	16.212	0.430
Compl	Complementary feed	1= Yes	3.986	0.126
		2= None	7.132	0.225
		Total	11.118	0.350
Traitmnt	Health monitoring	1= Self-treatment	0.172	0.048
		2= Veterinary	0.242	0.068
		Total	0.414	0.117
Mont	Type of monte	1= Free	0.158	0.291
		2= Artificial insemination	1.935	3.563
		Total	2.093	3.854
Vent	Marketing	1= Animal live	0.464	0.095
		2= Animal live and milk	0.151	0.031
		Total	0.615	0.126
AgeFerm	Farm experience	1= less than 10 years old	0.229	1.320
		2= between 10 and 20 years old	0.350	13.397
		3= Over 20 years old	0.298	6.584
		Total	0.877	21.301
TailTroup	Herd size	1= Less than 30 cattle	3.015	0.150
		2= between 30 and 60 cattle	0.274	0.054
		3= Over 60 cattle	1.372	0.008
		Total	4.661	0.212

Note: Values in bold correspond to the highest contributions

informal sector workers who entrust the management of their farms to an employee. The owners have received formal education (are schooled) and consider livestock farming a secondary activity. These farms have been in existence for over 20 years. The herd size in these farms ranges from 11 to 63 cattle, with an average of 29 ± 19 animals. The livestock mainly consists of Méré and Zebu cattle. In addition to these breeds, exotic crossbreeds and other animal species such as sheep, goats, and poultry are also found on these farms.

The animals often receive supplementary feed in the form of agro-industrial by-products (maize cake, cotton seeds, and rice bran). Natural mating is the most common breeding method in these farms. However, some farmers have experimented with artificial insemination.

Type 2 farms. These farms represented 18 farms, or 34% of the surveyed farms. The second type includes farms managed by Peulh herders. Most of these herders were educated in Koranic schools. The herd size in these farms ranged from 17 to 83 cattle (50 ± 20 cattle) and had an average of 18 years of experience. Like Type 1 farms, the livestock in these farms consisted of Méré and
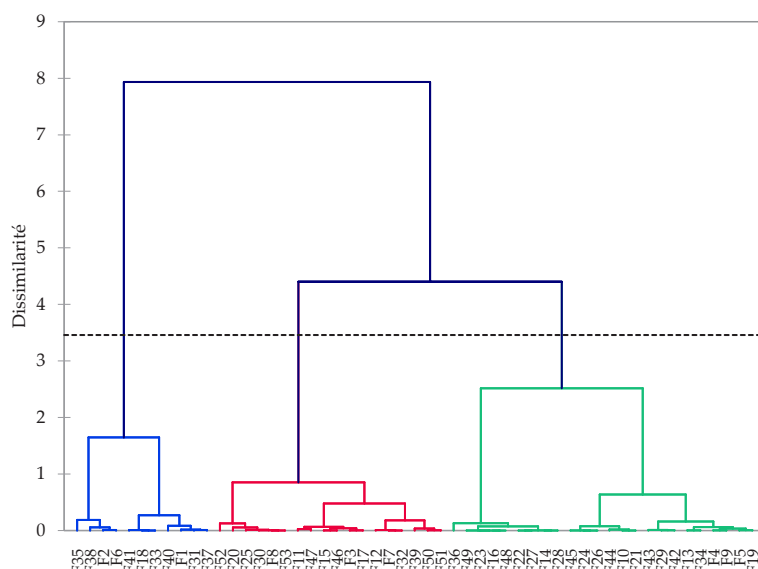
Figure 4. Dendrogram of the types of farms according to hierarchical ascending classification (HCA)

Zebu cattle, and the breeding method is natural mating. These farms are family-operated. The manager's family consumes the milk, which constitutes part of the Peulh herder's salary.

Type 3 farms. These farms represented 24 farms, or 45% of the farms surveyed. More than half (63%) of the herders in this group are Peulh herders who have become sedentary, while the others are indigenous people. All of them are non-literate agro-pastoralists. Most (67%) inherited their farms. These are the oldest farms, with an average age of 27 years. The herd size in these farms ranged from 14 to 90 cattle, consisting of Méré, Zebu, a few exotic crossbreeds, and taurine cattle. Family labor is used for both managing the livestock and performing agricultural tasks. In these farms, cattle breeding is combined with the breeding of sheep, goats, and poultry. Natural mating is the primary method of reproduction. However, 8% of the herders in this group also use artificial insemination.

DISCUSSION

The surveys conducted among livestock farmers in the northern region of Côte d'Ivoire revealed that cattle farming is predominantly a male activity. This male predominance is likely due to sociological factors (Tobada *et al.*, 2018). In rural African communities, economic support for the household is traditionally seen as the responsibility of men (Fall *et al.*, 2023), who tend to diversify their activities to increase their income. This male dominance is also linked to the physical demands of cattle farming, considering the size of the animals. Several authors, including Kouamé *et al.* (2024b) in Abidjan, Kanh *et al.* (2019) in Senegal, Soro *et al.* (2015) in the Lobi region in the northeast, and Sokouri *et al.* (2014) in central Côte d'Ivoire, have also noted these factors.

This study showed that with an average age of 48 ± 11 years, the herders who manage farms, which have been in existence for no more than 30 years, are mostly illiterate and non-national. These results suggest that cattle farming in northern Côte d'Ivoire does not appear to be a traditional activity, but rather an emerging one that is taken up relatively young, given the number of years the farms have existed and the average age of the herders. The observed age group of the herders is similar to the 45 years reported by Soro *et al.* (2015) in the localities of Bouna, Téhini, and Doropo. The high illiteracy rate (81.13%) among the herders, mostly non-Ivorian, was observed by authors such as Kouamé *et al.* (2024a) in Côte d'Ivoire, and by Baizina *et al.* (2023) in Tchad. The illiteracy rate is similar to those reported by Sokouri *et al.* (2014) in the central region of Côte d'Ivoire, and Soro *et al.* (2015) among Lobi herders, where the rates were 67% and 80.8%, respectively.

The farms studied are mostly family-run with small herds (43.30 ± 20.80 cattle), alongside the breeding of other species such as sheep, goats, and poultry, as well as other agricultural activities (crop production). These characteristics of farms in the Savanes and Zanzan districts depict livestock farming as a subsistence activity and a means of diversifying family income, as pointed out by Lawal *et al.* (2018) in Nigeria. The cattle herds of the surveyed farms are composed of five genetic types, including Méré crossbreeds, Zebu, N'Dama and Baoulé taurine breeds, and "exotic" crossbreeds. These five genetic types were identified by Sokouri *et al.* (2007) in Côte d'Ivoire, particularly in the central and northern regions. However, these authors indicated in their study that the "crossbreeds" referred to were hybrids, with unknown parental breeds. In the present study, the term Méré, as well as exotic crossbreeds, refers to crossbreeds between taurine and Zebu breeds, with at least one parent being of exotic origin. Among these five types, Méré (98.11%) is clearly dominant, followed by Zebu (88.68%). This predominance of Méré and Zebu cattle can be explained by the massive influx of Zebu cattle from transhumant herders from neighboring northern countries (Burkina Faso and Mali) and the northwest (Guinea), leading to a strong hybridization of local taurine breeds, estimated at 86% by Mopate (2015) in northern Côte d'Ivoire. These processes of mutation

and hybridization have resulted in a bottleneck for local taurine breeds and the introgression of Zebu blood into the Ivorian cattle population, which has led to a loss of adaptation to the Ivorian climate, where vector-borne diseases (such as tsetse flies and ticks) are prevalent. This explains the recurrence of trypanosomiasis and tick infestations reported by the interviewed herders in the present study. The prevalence of these vectors and the diseases they transmit to cattle have already been studied in the study area by several authors, including Ekra *et al.* (2023) and Kouassi *et al.* (2023).

The study showed that health monitoring in the farms of the Savanes and Zanzan districts follows two approaches: self-medication and veterinary supervision, in proportions of 58.49% and 41.51%, respectively. The predominance of self-medication observed in the studied farms can be attributed to the unavailability and high cost of veterinary products, as reported by the herders. Similarly, Sokouri *et al.* (2014) reported that livestock farmers in the Central region of Côte d'Ivoire choose not to seek veterinary assistance. The dominance of self-medication arises from the low coverage of services (such as the DSV and the decentralized offices of MIRAH in terms of availability of veterinary products and technical assistance limited to vaccination campaigns and interventions during declared epidemics). This low coverage leads to the uncontrolled entry of non-approved veterinary products, used without the advice of an animal health agent on farms. While health monitoring is a significant issue for livestock farming in the Savanes and Zanzan districts due to the low service coverage, access to natural resources for livestock is another challenge. Indeed, the respondents reported difficulties in accessing grazing lands. Although there are regulations governing access to and management of natural resources in Côte d'Ivoire (RCI, 2022, 2016), their implementation faces constraints. These include the occupation of grazing areas and pastures by urbanization and settlement, as well as the herders' lack of knowledge of these regulations due to language barriers and the insufficient awareness-raising among farmers about these texts. The consequences of these constraints are conflicts between herders and farmers, often arising from the destruction of cultivated plots by livestock (Sokouri *et al.*, 2014; Soro *et al.*, 2015).

The analysis of cattle farm typology, based on multiple correspondence analysis (MCA) and ascending hierarchical classification (AHC), identified three distinct types of production systems. These types differ based on the ethnicity and educational level of the farmer, the type of labor employed, and the production objectives. The results highlight the heterogeneity of cattle farming systems in northern Côte d'Ivoire. They also demonstrate that the typology of these farms depends both on the sociological profile of the farmer and on the production methods. This suggests a sociocultural influence on livestock management practices.

Type 1 farms, characterized by educated Ivorian traders or professionals who acquired their herds through purchase and employ salaried labor, represent an emerging form of semi-commercial livestock farming. These farms are generally more diversified, incorporate exotic crossbreeds, and sometimes use artificial insemination and supplemental feeding. Their multi-species structure and use of agro-industrial by-products reflect a semi-intensive model that responds to market opportunities. Additionally, the relatively small herd size facilitates feed management and health monitoring (Daburon *et al.*, 2014).

In contrast, Type 2 farms, managed by Fulani herders educated in Quranic schools, retain traditional systems based on family labor, milk production, and natural reproduction. This classical pastoral model remains dominant among transhumant herder societies (Guero *et al.*, 2024). Although these farms typically have moderately sized herds and some longevity, they are largely subsistence-oriented with minimal technological or commercial integration.

Finally, Type 3 farms, the most common, reflect long-standing agro-pastoral systems where livestock farming is passed down through inheritance. These are mainly managed by illiterate, semi-settled Peulh herders and rely exclusively on family labor and traditional methods. Their diversification, including both livestock and crop farming, promotes economic stability through multiple income sources (Dedieu *et al.*, 2011). Despite their longevity and livestock diversity, these farms remain poorly integrated into formal markets and veterinary innovations, underscoring the structural constraints affecting the most vulnerable producers.

The proposed typological framework offers valuable insights into how sociocultural factors, education level, farm acquisition modes, and labor structure influence production strategies and technology adoption. It underscores the importance of designing differentiated and context-adapted development policies to address the diverse needs of livestock farmers. Such policies could improve sector performance and, consequently, the living conditions of farmers (Gounou et Yabi, 2020).

CONCLUSION

The majority of cattle farms are managed by herders belonging to the Peulh sociocultural group. Five cattle types are raised, predominantly of Méré and Zebu. The typology analysis identified three types of herders: (i) semi-commercial farms owned by educated Ivorian investors, employing paid labor and partially using modern technologies; (ii) traditional pastoral farms managed by Peulh herders, relying on family labor and indigenous knowledge; and (iii) long-established agropastoral systems combining the rearing of multiple animal species with subsistence agriculture, with minimal integration of external inputs. These livestock systems vary according to ethnic affiliation and specific husbandry practices. By identifying the main constraints faced by herders, this study provides valuable insights to inform policymakers and development stakeholders in designing more inclusive and context-specific programs aimed at improving cattle farming in Côte d'Ivoire.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest with any financial or personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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