

ANALYSIS OF LIVESTOCK PRODUCTION SYSTEMS IN THE VILLAGES OF GOMBÈLEDougou AND KOUMBIA IN THE SUDANESE REGION OF BURKINA FASO.

Abstract:

In Burkina Faso, livestock systems in the Sudanese agropastoral zone face climatic, economic, and demographic pressures. This study analyzes the diversity of livestock systems and their production constraints. A survey was conducted among 128 farms in the villages of Gombèledougou and Koumbia in western part of Burkina Faso. The data were analyzed using the chi-square test for qualitative variables and analysis of variance (ANOVA) for quantitative variables at a 5% significance level. The results reveal significant differences between the two villages regarding the number of goats ($p = 0.004$), chickens ($p = 0.04$), guinea fowl ($p = 0.007$), grazing distance ($p = 0.002$), and the number of feed sheds ($p = 0.024$). Free-range grazing (95.5% in Gombèledougou versus 76.2% in Koumbia, $p = 0.023$) and the use of fields during the rainy season (77.3% in Gombèledougou versus 40.5% in Koumbia, $p < 0.001$) are more prevalent in Gombèledougou than in Koumbia. Stabling (22.6% in Koumbia versus 4.5%, $p = 0.023$), the use of plains during the rainy season (57.1% in Koumbia versus 25%, $p = 0.001$), lowlands (42.90% in Koumbia versus 13.60%, $p = 0.002$), and the use of plains during the dry season (46.40% in Koumbia versus 22.70% in Gombèledougou, $p = 0.015$). Watering difficulties during the rainy season are significantly more common in Koumbia (36.9%) than in Gombèledougou (4.5%) ($p < 0.001$). In contrast, participation in the management of water infrastructure is significantly higher in Koumbia (89.3% vs. 59.1%; $p < 0.001$). Livestock farmers in Gombèledougou face greater difficulties with access to water ($p = 0.001$), animal care ($p < 0.001$), animal transport ($p < 0.001$), and marketing ($p < 0.001$) than those in Koumbia. These results support the need for differentiated and targeted interventions in development policies.

Key words:-

Characteristics, Livestock, Management, Feeding Practices, Health Practices

Introduction

Livestock farming is one of the most strategic economic activities in sub-Saharan Africa, contributing significantly to food security, rural incomes, and natural resource management (Thornton, 2010). Agropastoral systems, which combine agriculture and livestock raising within the same territory, are the dominant production system in the Sudanese and Sudano-Sahelian regions of West Africa, providing a livelihood for tens of millions of people (Ayantunde *et al.*, 2023). With an estimated cattle population of more than 9 million head, Burkina Faso ranks among the leading livestock-raising countries in the subregion (FAO, 2022). In Burkina Faso, livestock farming involves more than 80% of rural households and accounts for 10 to 20% of the gross national product, making it the second-largest contributor to agricultural value added after cotton (MRAH, 2018). Livestock products account for 26% of export revenue and are a vital source of animal protein for the population (Ouédraogo *et al.*, 2023). The dairy cattle sector is also experiencing significant growth in the western part of the country, with the emergence of market-oriented agro-pastoral systems (Vall *et al.*, 2021). Despite this major economic contribution, livestock systems in Burkina Faso's Sudanese agropastoral zone are facing a multidimensional structural crisis that jeopardizes their sustainability and productive capacity. Indeed, once considered the country's agropastoral breadbasket, the Sudanese zone is experiencing a drastic reduction in its pastures due to the combined effects of the expansion of cotton farmland and ecological degradation. (Vall *et al.*, 2021; Bullock *et al.*, 2023). The seasonal forage shortage now affects all agroclimatic zones, forcing livestock farmers to purchase feed during the dry season to compensate for the lack of natural pastures (Amole *et al.*, 2023). The national forage supply for the 2022–2023 crop year covered only 74% of estimated needs, with more than half of the provinces facing a shortage (FAO/FEWS NET, 2023). This pressure on forage resources is driving herders to increasingly remote and ecologically fragile areas, including protected forests, thereby exacerbating conflicts between farmers and herders and deforestation (Bullock *et al.*, 2023). Furthermore, the high cost of veterinary supplies, limited access to agricultural credit, the

isolation of many production areas, and limited market opportunities reduce the profitability and competitiveness of the livestock sectors (Ouédraogo *et al.*, 2022). These constraints are exacerbated by the lack of effective producer organizations in many rural areas, leaving livestock farmers without a safety net against shocks. Livestock systems are highly diverse, ranging from nomadic pastoral systems to intensive sedentary systems, including mixed agro-pastoral systems, which dominate the Sudanese zone. (Eeswaran *et al.*, 2022). Previous studies have analyzed breeds and genetic breeding systems (Zoma-Traoré *et al.*, 2020), the integration of crop and livestock farming in the cotton-growing region through energy flows and agronomic practices (Vall *et al.*, 2021 ; Ouédraogo *et al.*, 2022). Despite these efforts to characterize livestock production systems at the national level, intra-zonal variability in practices and constraints remains insufficiently documented, particularly in the western Sudanese zone. This study aims to analyze the diversity of livestock production systems and production constraints in two contrasting villages in the Sudanese agropastoral zone of Burkina Faso.

Material and methods

Material

Presentation of the study site

The study was conducted in two villages, Gombèlédougou and Koumbia, in the Guiriko region. These villages are located in western part of Burkina Faso (Error! Reference source not found.). These two towns are located in Tuy Province, in the heart of Burkina Faso's cotton-growing region, about 40 km northeast of Bobo-Dioulasso, which is economic capital of Burkina Faso. Tuy Province lies between latitudes 11°N and 12°N and longitudes 3° and 4°, within the agroclimatic zone Southern Sudanese climate characterized by annual rainfall ranging from 900 to 1,100 mm. The rainy season lasts from May to October (5 to 6 months). The dry season, from November to April, is marked by the harmattan and a reduction in forage availability. Rain-fed agriculture is the main livelihood activity for households, while livestock raising plays an essential complementary role: savings, animal power, organic fertilizer, and a source of animal protein. The two villages have contrasting profiles in terms of infrastructure and accessibility, which justifies their selection for this comparative study. With an estimated area of 9,700 hectares, the village of Koumbia is located on National Highway 1, 34 km southwest of Houndé (the provincial capital) and 67 km east of Bobo-Dioulasso. The geographic coordinates of Koumbia are: latitude 12°42'207", longitude 4°24'010", and elevation 290 m. It is bordered to the east by Sébébougou, to the northeast by Dankari, to the west by Kongolikan, and to the south by Soa and Gombélédougou.

The number of family farms is estimated at 800 (Dabiré *et al.*, 2011). There are four main types of soil: stony, gravelly soils, or "sambia" in *Bwamu*; sandy-silt soils, or "tientien" in *Dioula* and "hamanifori" in *Bwamu*; sandy-clay soils, or "hamanabri" in *Bwamu*; and clay soils, or "manhon" in *Bwamu*. The municipality of Koumbia is characterized by high land-use pressure (42 inhabitants per km² and 45 livestock units per km²). The main crops grown are cotton and maize. The livestock population consists of approximately 2,710 head of cattle and 2,255 small ruminants. (Blanchard, 2014). Animal feed comes from pastures, often supplemented with agro-industrial products during the dry season. Fattening and dairy production during the dry season are developing slowly, relying primarily on cottonseed meal and very little legume green fodder or woody forage, which makes animal feed costs high.

The communal land set aside for grazing and livestock trails is increasingly being cultivated, creating tensions between farmers and herders. The arrival of migrants from the north in search of fertile land and pastures has increased pressure on resources. Land clearing has progressed rapidly with the adoption of animal-drawn machinery and herbicides, driven by cotton cultivation (20 to 30 % of cultivated land), causing a decline in forest-pastoral reserves. Fields are cultivated "continuously," with a predominance of cotton/maize rotation and the use of synthetic fertilizers and pesticides (Coulibaly *et al.*, 2012). The river system consists of several seasonal watercourses:

- The *Saramboué*, which marks the boundary between the village's territory and the Mou Protected Forest. It drains the southern part of the territory.
 - The *Djouanhonti* River, which drains the northeastern part of the village territory.
- Several small seasonal streams also facilitate the performance of traditional rituals and sacrifices, as well as small-scale fishing.
- The most common vegetation type is savanna. However, due to the ground and the presence of protected areas, other vegetation types can be found: a dense forest whose dominant species are *Cola cordifolia* and *Terminalia lasciiflora* ;
- an open forest dominated by perennial grasses and shrubs such as *Gardenia erubescens* and *Daniellia obovata*;
 - a dense wooded savanna dominated by *Cochlospermum planchonii* and *Cyanotis lanata*, *Entada africana*, *Acacia dudgeoni*, and *Piliostigma thonningii*, as well as *Maytenus senegalensis*, *Vitellaria paradoxa*, *Piliostigma thonningii*, *Sterculia setigera*, *Lannea acida*, and *Lannea microcarpa*;
 - a scrubby savanna consisting mainly of *Pennisetum pedicellatum*, *Andropogon chinensis*, *Andropogon gayanus*, *Gardenia erubescens* and *Vitellaria paradoxa*, *Lannea microcarpa*, *Lannea avelutina*, *Acacia dudgeoni*, *Parkia biglobosa* and *Anogeissus leiocarpa*;
 - a marshy shrub savanna consisting of: *Vetiveria zizanioides*, *Anadelphia afzeliana*, *Hygrophila auriculata*, *Mitragyna inermis*, *Acacia sieberiana*, *Nauclea latifolia*, *Terminalia macroptera*.

The village of Gombèlédougou is located at 12°21'66"N, 4°23'57"E and 18 km southeast of Koumbia. It is bordered to the north by the villages of Pê and Sébédougou, to the east by the villages of Man and Intiédougou, to the west by the village of Koumbia, and to the south by the Mou Protected Forest. The village's territory covers 9,516.5 hectares. It is crossed by four waterways: the *Biworoworo* to the east of the village; the *Popito* to the west; the *Lovokari* to the south; and the *Bilkari* to the north.

The vegetation of the Gombèlédougou region consists of three types:

The wooded savanna dominated by: *Burkea africana*, *Crossopteryx febrifuga*, and *Detarium microcarpa*.

The shrubby savanna consists of fallow lands undergoing regeneration with species such as: *Terminalia avicennoides*, *Combretum micranthum*, *Acacia machrostachya*, *Piliostigma thonningii*, *Pteleopsis suberosa*. The wooded savanna dominated by *Burkea africana*, *Detarium microcarpa*, *Crossopteryx febrifuga*, *Afromosia laxiflora*, *Entada africana*, *Pteleopsis suberosa*.

Economic activities in Gombèlédougou consist primarily of agriculture and livestock raising, and more recently, small-scale gold mining. The main crops grown are cotton and maize. There are approximately 400 family farms. The livestock population consists mainly of cattle, sheep, and goats. Farmers who, in the past, entrusted their cattle to Fulani herders no longer do so. They prefer to keep them themselves, not only to benefit from their labor and manure, but also to minimize losses. This village was once home to the pastoral zone now occupied by farmers. (Vall et Diallo, 2009). To compensate for the inadequacy of natural pasture, producers have learned, through research and research-and-development projects, techniques for forage production (storage of crop residues, cultivation of forage crops, harvesting, processing, and preservation of forage). Subsequently, this activity led to the emergence and development of the dairy and beef cattle sectors.

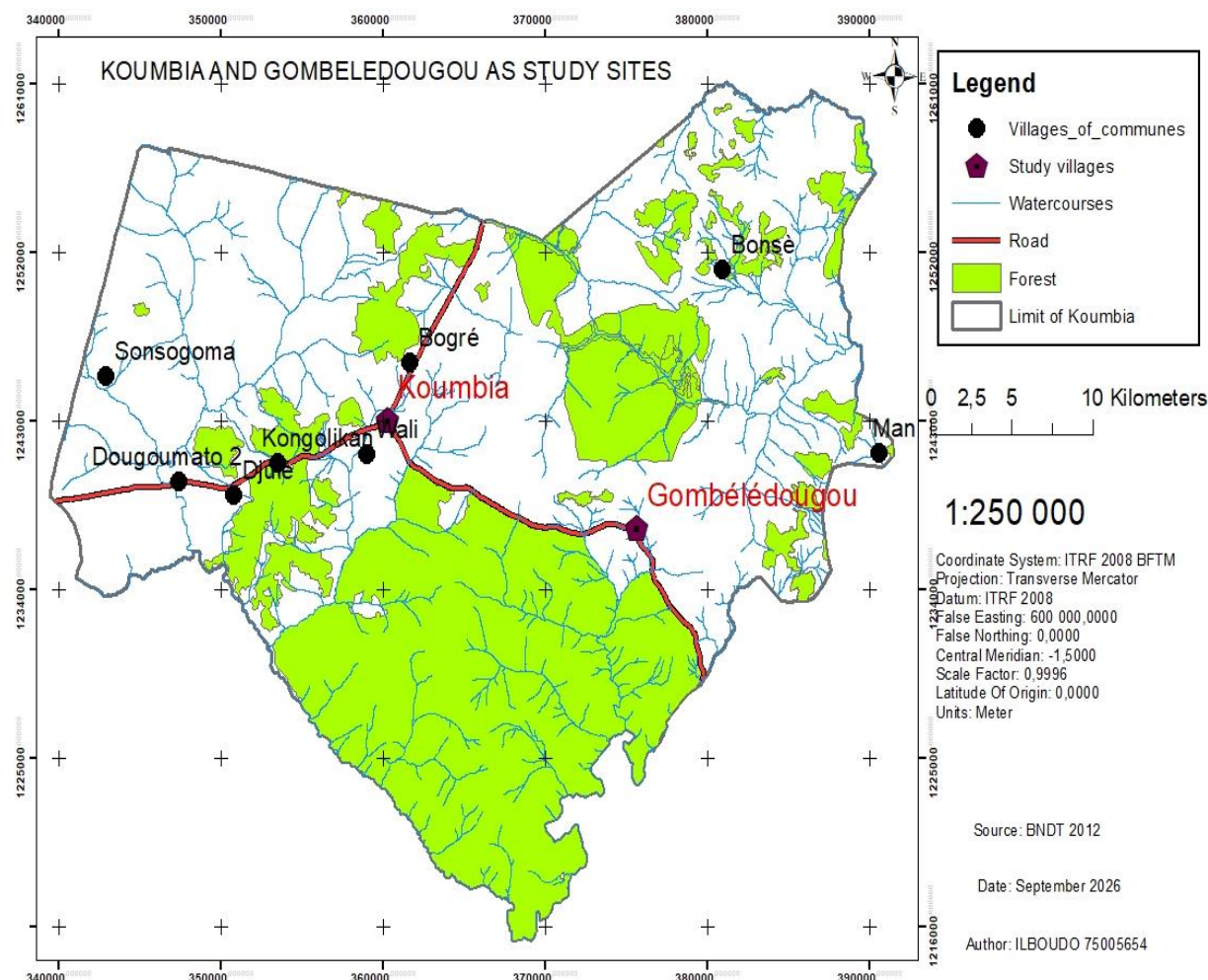


Figure 1: Map of the municipality of Koumbia

Data Collection Tools

A structured survey questionnaire was used to collect data. It provides information on the general and structural characteristics of the farm, production practices, and production constraints in livestock systems.

Methodology

Sampling

The target population consists of all livestock farmers in the villages of Gombélédougou and Koumbia. The list of farms was compiled in collaboration with local veterinary services, livestock farmers' associations, and village chiefs. Stratified random sampling was used, with the village serving as the stratum, to ensure proportional representation of both locations while guaranteeing a sufficient sample size for comparative statistical analyses. The sample size was determined using Cochran's (1977) formula for proportions:

$$n = (Z^2 \times p \times q) / e^2$$

Using: $Z = 1.96$ (95% confidence level), $p = 0.5$ (proportion maximizing variance), $q = 1 - p = 0.5$, and $e = 0.05$ (accepted margin of error). This yields a minimum theoretical sample size of $n \approx 96$ farms. The final sample, following field validation, comprises a total of 128 farms—44 in Gombèlèdougou and 84 in Koumbia—exceeding the minimum size by 33% and thereby strengthening the statistical robustness of the comparative analyses.

Data Collection and Analysis

The survey was conducted during the post-harvest period to provide livestock producers with a comprehensive annual overview of their herds and practices. Interviewers received prior training on the questionnaire, variable definitions, and interview techniques. Each questionnaire was completed during an individual interview lasting an average of 60 to 90 minutes. Daily supervision of the collected data was conducted to detect and correct errors or inconsistencies in the field before the end of each survey day.

To compare the proportions of qualitative variables between the two villages, Pearson's chi-square test of independence (χ^2) was used. This test determines whether the distribution of a qualitative variable differs significantly depending on the village of origin. The significance level used was 5%. To compare the means of the quantitative variables between the two villages, a one-way analysis of variance (ANOVA) was performed. The ANOVA tests the null hypothesis $H_0: \mu(\text{Gombèlèdougou}) = \mu(\text{Koumbia})$ against the alternative hypothesis H_1 : the two means differ significantly. The Fisher-Snedecor F-statistic is calculated as the ratio of between-group variance to within-group variance at the 5% significance level. All statistical analyses were performed using Python 3.13.5.

Results

Livestock composition and animal management

The table I presents average livestock numbers by village. There are significantly more goats in Koumbia (7.70 ± 7.03 heads) than Gombèlèdougou (3.90 ± 6.66 heads) ($F = 8.72$; $p = 0.004$), as well as the chickens (16.01 ± 15.25 vs 10.73 ± 10.03 ; $F = 4.30$; $p = 0.040$) and locally raised guinea fowls (2.15 ± 4.34 vs 0.32 ± 1.34 ; $F = 7.46$; $p = 0.007$). However, the number of cattle is higher in Gombèlèdougou than in Koumbia, even though the difference between the two villages is not significant. ($p > 0.05$).

Two variables related to grazing practices show significant differences. The number of feed sheds is higher in Gombèlèdougou (1.16 ± 0.75 vs 0.90 ± 0.51 ; $F = 5.22$; $p = 0.024$) as well as the maximum grazing distance (9.58 ± 5.68 km vs 6.63 ± 4.75 km, $F = 9.71$; $p = 0.002$).

Table I : Average livestock numbers by species and by village

Variables	Gombèlèdougou(n=44)	Koumbia (n=84)	Total (n=128)	F	P
Cattle for breeding	19.66 ± 24.10	14.57 ± 19.75	16.32 ± 21.38	1.64	0.202
Draft cattle	2.93 ± 1.59	3.33 ± 1.98	3.20 ± 1.86	1.35	0.247
Sheep	6.28 ± 7.49	8.35 ± 9.51	7.63 ± 8.90	1.56	0.213
Goats	3.90 ± 6.66	7.70 ± 7.03	6.39 ± 7.11	8.72	0.004***
Chickens	10.73 ± 10.03	16.01 ± 15.25	14.19 ± 13.87	4.3	0.04**
Guinea fowls	0.32 ± 1.34	2.15 ± 4.34	1.52 ± 3.70	7.46	0.007***
Fodder Shed	1.16 ± 0.75	0.90 ± 0.51	0.99 ± 0.61	5.22	0.024**
Hours of grazing per day	8.37 ± 1.88	8 ± 1.77	8.12 ± 1.81	1.21	0.274
Maximum distance to pasture (km)	9.58 ± 5.68	6.63 ± 4.75	7.65 ± 5.26	9.71	0.002***

Legend: * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$

Farming Practices by Village

Grazing practices reveal marked differences between the two villages (Table II). In Gombèlèdougou, free-range grazing predominates (95.5%) against 76.2% in Koumbia with $p < 0.5$, where the mixed grazing system + Housing in stalls is significantly more common (22.6% vs 4.5% ; $\chi^2 = 7.57$; $p = 0.023$). Livestock farmers in Koumbia make greater use of the plains (57.1% vs 25% ; $p = 0.001$) and the slums (42.9% vs 13.6% ; $p = 0.002$) during the rainy season, while farmers in Gombèlèdougou work their fields more intensively (77.3% vs 40.5% ; $p < 0.001$). In contrast, participation in the management of pastoral infrastructure is significantly higher in Koumbia (89.3% vs 59.1% ; $\chi^2 = 14.05$; $p < 0.001$), reflecting better collective organization. The supplementary feeding practices of storing crop residues (93.0%) and purchasing feed (90.6%) do not differ significantly between the two villages.

Table II: Grazing, Watering, and Supplemental Feeding Practices

Variables	Gombèlèdougou (%) n=44	Koumbia (%) n=84	Total (%) n=128	χ^2	P
Grazing					
Free-range grazing	95.5	76.2	82.8	7.57	0.023**
Pasture + barn housing	4.5	22.6	16.4	7.57	0.023**
Grazing on the plains during the rainy season	25	57.1	46.1	10.75	0.001***
Grazing on the Plains During the Dry Season	22.7	46.4	38.3	5.9	0.015*
Grazing in low-lying areas during the rainy season	13.6	42.9	32.8	9.9	0.002**
Grazing in the fields during the rainy season	77.3	40.5	53.1	14.26	<0.001***
Watering					
Surface water as the primary source	95.5	90.5	92.2	2.18	0.337
Participation in the Management of Pastoral Infrastructure	59.1	89.3	78.9	14.05	<0.001***
Supplemental Nutrition					
Storage of crop residues	95.5	91.7	93	0.19	0.666
Purchase of Animal Feed	93.2	89.3	90.6	0.16	0.69
Supplementation for Suckler Cows	25	22.6	23.4	0.01	0.934
Forage Production	63.6	63.1	63.3	0.000	1.000

Legend: * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$

Labor Allocation to Livestock Farming Activities in the Two Villages

Table III presents the results the allocation of family labor. The organization of livestock work is strongly gendered in both villages. Adult men dominate the sale (96.9%) and basic care (93%), while the day-to-day management of the herds is a task shared among underage boys (64.8%) and adult men (31.2%). Milking cows involves adult women (28.1%) than men (7.8%). Overall, there are few significant differences between the two villages regarding the division of labor among adults. The most striking difference concerns the involvement of underage girls: their participation in food distribution is significantly more frequent in Gombèlèdougou (54.5%) than Koumbia (26.2%) ($\chi^2 = 8.89$; $p = 0.003$), as well as than their role in herding animals (47.7% vs 25% ; $\chi^2 = 5.77$; $p = 0.016$).

Table III: Breakdown of livestock farming activities by gender in the two villages

Socialgroupe	Gombèlèdougou (%) n=44	Koumbia (%) n=84	Total (%) n=128	χ^2	p
Food Distribution					
Adult men	77.3	72.6	74.2	0.13	0.72
Adult woman	31.8	35.7	34.4	0.06	0.807
Minor boys	63.6	58.3	60.2	0.15	0.695
Minor girls	54.5	26.2	35.9	8.89	0.003***
Herding Animals to Pastures					
Adult men	25	34.5	31.2	0.82	0.366
Adult woman	2;3	2.4	2.3	0.00	1.00
Minor boys	65.9	64.3	64.8	0.00	1.00
Minor girls	47.7	25	32.8	5.77	0.016***
Milking Dairy Cows and Selling Milk					
Adult men	6.8	8.3	7.8	0.00	1.00
Adult woman	25	29.8	28.1	0.13	0.717
Minor girls	9.1	8.3	8.6	0.00	1.00
Providing Primary Care for Animals					
Adult men	97.7	90.5	93	1.35	0.246
Adult woman	-	1.2	0.8	0.00	1.00
Sale of Animals					
Hommes adultes	100	95.2	96.9	0.88	0,349
Femmes adultes	-	2.4	1.6	0.08	0,778

Legend: * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$

Health Practices in the Two Villages

The table IV presents farmers health practice in both villages. The farmers of Gombèlèdougou (97.7%) have greater access to the vaccination center than those in Koumbia (77.4%) with $\chi^2 = 7.59$; $p < 0.006$. Paradoxically, 59.1% turn to other sources (neighbors, traditional healers) for their animals' care more than they do in Koumbia (17.9%) avec $\chi^2 = 28.41$; $p < 0.001$. State veterinary services are seeing increased demand from livestock farmers in Koumbia (82.1%) than those from Gombèlèdougou (40.9%) with $\chi^2 = 28.41$; $p < 0.001$. Vaccination rates and rates of external and internal parasite treatment are higher in Koumbia than in Gombèlèdougou ($p > 0.05$).

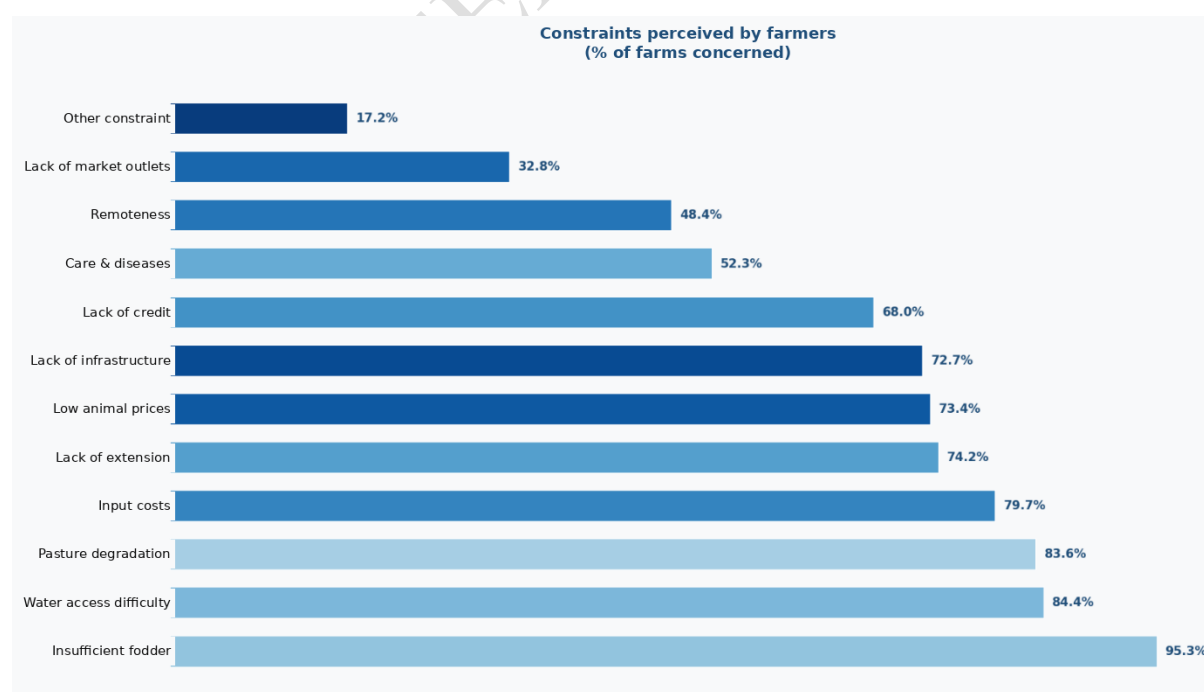
Table IV: Health Practices in the Two Villages

Variables	Gombèlèdougou(%) n=44	Koumbia (%) n=84	Total (%) n=128	χ^2	p
Animal Vaccination	97.7	95.2	96.1	0.04	0.834
External Pest Control	95.5	91.7	93	0.19	0.666
Internal Deworming	97.7	94	95.3	0.25	0.62
Access to the Vaccination Park	97.7	77.4	84.4	7.59	0.006***
State Veterinary Services	40.9	82.1	68	28.41	<0.001***
Other caregivers (traditional healers, neighbors)	59.1	17.9	32	28.41	<0.001***

Legend: * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$

Livestock Production Constraints in the Two Villages

The main challenges faced by those involved in animal production are insufficient forage supplies (95.3%), difficulties in accessing water (84.4%), pasture degradation (83.6%) and the high cost of inputs (79.7%) (figure 2). A comparative analysis of the two villages reveals significant differences between them. Pasture Degradation (95.5% in Gombèlèdougou versus 77.4% in Koumbia, $\chi^2 = 5.62$ et $p = 0.018$), Watering difficulties during the dry season (93.2% in Gombèlèdougou versus 78.6% in Koumbia, $\chi^2 = 3.49$ et $p = 0.062$), difficulties in accessing water (100 % in Gombèlèdougou versus 76.2% in Koumbia, $\chi^2 = 10.68$ and $p = 0.001$), difficulties in accessing veterinary care (88.6 % in Gombèlèdougou versus 33.3% in Koumbia, $\chi^2 = 33.22$ and $p < 0.001$), the lack of agricultural credit (79.5% in Gombèlèdougou versus 61.9% in Koumbia, $\chi^2 = 3.36$ et $p = 0.067$), isolation (70;5% in Gombèlèdougou vs 36.9% in Koumbia, $\chi^2 = 11.7$ and $p < 0.001$) and the lack of job opportunities (59.1% in Gombèlèdougou versus 19% in Koumbia, $\chi^2 = 19.22$ and $p < 0.001$) are more pronounced in Gombèlèdougou than in Koumbia. On the other hand, difficulties with watering during the rainy season are significantly more common in Koumbia (36.9%) than Gombèlèdougou (4.5%) ($\chi^2 = 14.16$; $p < 0.001$).



Discussion

Diversity of livestock production systems: a finding consistent with the literature

There are significantly more goats in Koumbia (7.70 ± 7.03 head) than in Gombèlèdougou (3.90 ± 6.66 head) ($F = 8.72$; $p = 0.004$), as well as the chickens (16.01 ± 15.25 versus 10.73 ± 10.03 ; $F = 4.30$; $p = 0.040$) and guinea fowl (2.15 ± 4.34 versus 0.32 ± 1.34 ; $F = 7.46$; $p = 0.007$). The diversity of livestock-raising systems observed between our two villages confirms the conclusions of Zoma-Traoré *et al.*, 2020 who had identified four distinct types of cattle-raising systems in southwestern Burkina Faso within the same agroclimatic zone. Our study adds another dimension by showing that this diversity is also evident at the microgeographic scale, between two villages separated by only a few dozen kilometers. These differences suggest that herders in Koumbia are more engaged in raising small ruminants and poultry, activities that require less initial capital and are potentially better suited to their market context. Livestock farming accounts for an average of 23.9% of the income of agro-pastoral households in Bama (Kere *et al.*, 2021).

Two variables related to grazing practices show significant differences. The number of feed sheds is higher in Gombèlèdougou (1.16 ± 0.75 versus 0.90 ± 0.51 ; $F = 5.22$; $p = 0.024$) as well as the maximum grazing distance (9.58 ± 5.68 km vs 6.63 ± 4.75 km, $F = 9.71$; $p = 0.002$). This reflects increased pressure on local pastures in Gombèlèdougou, forcing herders to travel longer distances and stockpile fodder to feed their herds. The reduction in available pastureland in the cultivated savanna areas of western Burkina Faso is a growing structural constraint. (Sib *et al.*, 2018). In light of this situation, farmers are making better use of crop residues (Vall *et al.*, 2021). Increased human pressure on agro-sylvopastoral resources in cotton-growing areas is leading to more intensive farming practices and profoundly altering the relationship between agriculture and livestock farming (Eeswaran *et al.*, 2022).

Pastoral Resources and Seasonality: A Shared but Differentiated Vulnerability

Grazing practices reveal marked differences between the two villages. In Gombèlèdougou, free-range grazing predominates (95.5%) versus 76.2% in Koumbia with $p < 0.5$, where the mixed grazing and stall-feeding system is significantly more common (22.6% versus 4.5% ; $\chi^2 = 7.57$; $p = 0.023$), indicating a slight trend toward intensification in Koumbia. Farmers in Koumbia are making greater use of the plains (57.1% versus 25% ; $p = 0.001$) and the slums (42.9% versus 13.6% ; $p = 0.002$) during the rainy season, while farmers in Gombèlèdougou work their fields more intensively (77.3% versus 40.5% ; $p < 0.001$), areas more prone to conflicts with farmers. This is likely due to the fragmentation of fields, which reduces the available grazing land. The presence of three protected forests in the municipality limits the mobility of livestock. Some herders use crop residues as their primary forage source during the dry season. Livestock farmers are increasingly turning to purchased feed to compensate for the seasonal forage shortage. (Ayantunde *et al.* 2023). There is fierce competition for land resources between agriculture and livestock farming due to the combined effects of population growth and climate change (Brouillet and Sultan, 2023). In contrast, participation in the management of water infrastructure is significantly higher in Koumbia (89.3% vs 59.1% ; $\chi^2 = 14.05$; $p < 0.001$), reflecting better collective organization. Practices related to supplementary feeding and the storage of crop residues (93.0%) and purchase of food (90.6%) do not differ significantly between the two villages.

Access to Veterinary Services: Regional Disparities

The farmers of Gombèlèdougou (97.7%) have greater access to the vaccination center than those in Koumbia (77.4%) avec $\chi^2 = 7.59$; $p < 0.006$). Gombèlèdougou owns a large number of cattle and is located not far from the pastoral zone. Despite the existence of infrastructure in Gombèlèdougou, the majority of livestock farmers (59.1%) turn to other sources (neighbors, traditional healers) for their animals' care, compared to Koumbia (17.9%) with $\chi^2 = 28.41$; $p < 0.001$). This phenomenon of endogenous adaptation, although technically suboptimal, reflects the resilience of pastoralist communities in the face of institutional constraints (Eeswaran *et al.*, 2022) on adaptation strategies in West African agro-pastoral systems. State veterinary services are seeing increased demand from livestock farmers in Koumbia (82.1%) than those from Gombèlèdougou (40.9%) with $\chi^2 = 28.41$; $p < 0.001$). Vaccination rates and rates of

external and internal parasite treatment are higher in Koumbia than in Gombèlèdougou ($p > 0.05$). These findings raise the issue of regional equity in the provision of public veterinary services. The concentration of services in accessible villages such as Koumbia, at the expense of isolated communities such as Gombèlèdougou, perpetuates and exacerbates development disparities among rural areas.

Marketing Constraints: The Structural Disadvantage of Isolation

The main challenges faced by those involved in animal production are insufficient forage supplies (95.3%), difficulties in accessing water (84.4%), pasture degradation (83.6%), the high cost of inputs (79.7%). A comparative analysis of the two villages reveals significant differences between them. Pasture Degradation (95.5% in Gombèlèdougou versus 77.4% in Koumbia, $\chi^2 = 5.62$ and $p = 0.018$), Watering difficulties during the dry season (93.2% in Gombèlèdougou versus 78.6% in Koumbia, $\chi^2 = 3.49$ and $p = 0.062$), difficulties in accessing water (100 % in Gombèlèdougou versus 76.2% in Koumbia, $\chi^2 = 10.68$ and $p = 0.001$), difficulties in accessing veterinary care (88.6 % in Gombèlèdougou versus 33.3% in Koumbia, $\chi^2 = 33.22$ and $p < 0.001$), le manque de crédit agricole (79.5% in Gombèlèdougou vs 61.9% in Koumbia, $\chi^2 = 3.36$ and $p = 0.067$), isolation (70.5% in Gombèlèdougou versus 36.9% in Koumbia, $\chi^2 = 11.7$ and $p < 0.001$) and the lack of job opportunities (59.1% in Gombèlèdougou versus 19% in Koumbia, $\chi^2 = 19.22$ and $p < 0.001$) are more pronounced in Gombèlèdougou than Koumbia. On the other hand, difficulties with watering during the rainy season are significantly more common in Koumbia (36.9%) than Gombèlèdougou (4.5%) ($\chi^2 = 14.16$; $p < 0.001$). Livestock systems in West Africa are facing increasing climate-related constraints that threaten their long-term sustainability (Brouillet & Sultan (2023). The main challenges facing livestock systems are insufficient pasture and high-quality feed, water scarcity, climate change, underdeveloped livestock management and genetic selection practices, and socioeconomic constraints (Eeswaran *et al.*, 2022). The acquisition of pastoral lands by agribusinesses marginalizes rural communities in terms of access to land and weakens the relationship between agriculture and livestock farming (Ilboudo *et al.*, 2025)

Livestock Farming: A Gender-Sensitive Activity

Adult men work in sales (96.9%) and basic care (93%), while the day-to-day management of the herds is a task shared among underage boys (64.8%) and adult men (31.2%). Milking cows involves adult women more (28.1%) than men (7.8%). Women play a key role in the dairy industry (Vallet *et al.*, 2021). Women's involvement in the cattle trade confirms the gendered division of labor (Bullock *et al.*, 2023; Tavenner et Crane, 2019). Overall, there are few significant differences between the two villages regarding the allocation of tasks to adults. The most striking difference concerns the involvement of underage girls: their participation in food distribution is significantly more frequent in Gombèlèdougou (54.5%) than Koumbia (26.2%) ($\chi^2 = 8.89$; $p = 0.003$), as well as their role in herding animals (47.7% versus 25% ; $\chi^2 = 5.77$; $p = 0.016$). This result could be attributed to the region's isolation and the shortage of skilled labor in Gombèlèdougou leading to an increase in the involvement of underage girls in livestock-rearing tasks traditionally considered part of household chores.

Conclusion

This comparative study of livestock systems in two contrasting villages in the Sudanese agropastoral zone of western Burkina Faso provides insights into the intra-zonal diversity of livestock practices and constraints. Livestock systems vary significantly between the two villages, despite their location in the same agroclimatic zone. Small ruminants and poultry are more numerous in Koumbia than in Gombèlèdougou. In contrast, cattle are more numerous in Gombèlèdougou than in Koumbia. Livestock keepers in Gombèlèdougou have more sheds for forage storage and travel longer distances for grazing. Free-range grazing is predominant there (95.5%). The mixed grazing-and-stall system is significantly more common in Koumbia (22.6% vs. 4.5%; $\chi^2 = 7.57$; $p = 0.023$), where herders tend toward intensifying production. As a result, they participate in the collective management of pastoral infrastructure (89.3% vs. 59.1%; $\chi^2 = 14.05$; $p < 0.001$). State veterinary services are used more frequently by livestock farmers in Koumbia (82.1%) than by those in Gombèlèdougou (40.9%), with $\chi^2 = 28.41$; $p < 0.001$. The

rates of vaccination and treatment for external and internal parasites are higher in Koumbia than in Gombèlèdougou (p > 0.05). The main challenges faced by stakeholders in animal production are insufficient forage (95.3%), difficulties accessing water (84.4%), degraded pastures (83.6%), and the high cost of inputs (79.7%). Livestock farming is gender-sensitive in both villages. The development of livestock systems requires a location-specific approach that takes into account the specific challenges of access and isolation.

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