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*RESEARCH ARTICLE*

# ANALYSIS OF LIVESTOCK PRODUCTION SYSTEMS IN THE VILLAGES OF GOMBÈLEDOUGOU AND KOUMBIA IN THE SUDANESE REGION OF BURKINA FASO

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## *Abstract*

In Burkina Faso, livestock systems in the Sudanese agropastoral zone face climatic, economic, and demographic pressures. This study analyzed the diversity of livestock systems and their production constraints. An investigation was conducted with128 farms in the villages of Gombèlèdougou and Koumbia in western 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 fowls ($p = 0.007$), 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 (42.9% in Koumbia versus 13.6%, $p = 0.002$), and the use of plains during the dry season (46.40% in Koumbia versus 22.70% in Gombèlèdougou, $p = 0.015$).Difficulties in watering livestock during the rainy season are significantly more frequent in Koumbia (36.9%) than in Gombèlèdougou (4.5%) ($\chi^2 = 14.16$; $p < 0.001$).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 Gombèlèdougou face greater difficulties with access to water ($p = 0.001$), animal care ($p < 0.001$), animal transport ($p < 0.001$), marketing ($p < 0.001$), access to credit ($p= 0,067$) than those in Koumbia. These results support the need for differentiated and targeted interventions in development policies.



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## 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 and al., 2023). With an estimated cattle population of more than 9 million heads, 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 and 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 andal., 2021). Despite this major economic contribution, livestock systems in Burkina Faso's Sudanese agropastoral zone are facing a multidimensional structural crisis that compromises 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 and al.., 2021; Bullock and 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 and 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 and 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 and 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 and al., 2022). Previous studies have analyzed breeds and genetic breeding systems (Zoma-Traoré and al., 2020), the integration of crop and livestock farming in the cotton-growing region through energy flows and agronomic practices (Vall and al., 2021; Ouédraogo and 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.Compared to previous studies, the originality of this study lies in its consideration of the gender dimension in livestock labor allocation and the inter-zonal diversity within the two villages.

## Material and Methods:-

### Material:-

### Presentation of the study site:-

The study was conducted in two villages, Gombèlèdougou and Koumbia, in the Guiriko region. These villages were selected because they were sites for the CORAF/OID project (West and Central African Council for Agricultural Research and Development / Sustainable Intensification Options), which promoted the integration of crop and livestock farming. Furthermore, the commune of Koumbia, where these two villages are located, contains three classified forests, a factor that complicates livestock rearing. These villages are located in western 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 Koumbiaare: 11°14′11″ North, 3°41′47″ West, 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 and 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 heads 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 and al., 2012).

**The river system consists of several seasonal watercourses:-**

- The *Saramboué*, which marks the boundary between the village's territory and the MouProtected 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 Termina lia lascif lora ;*
- an open forest dominated by perennial grasses and shrubs such as *Gardenia erubesce*ns and *Daniellia oliveri*;
- a dense wooded savanna dominated by *Cochlospermum planchoni* 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 velutina, Acacia dudgeoni, Parkia biglobosa and Anogeissus leiocarpus;*
- a marshy shrub savanna consisting of: *Vetiveria nigritana, Anadelphia afzeliana, Hygrophila auriculata, Mitragyna inermis, Acacia sieberiana, Nauclea latifolia, Terminalia macroptera.*

The village of Gombèlèdougou is located at 11°11′21″ North, 3°33′11″West 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 the west; the Lovokari to the south and the Bilkari to the north.

**The vegetation of the Gombèlèdougou 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 avicennoïdes, Combretum micrantum, Acacia machrostachya, Piliostigma thonningii, Ptleopsis suberosa*. The wooded savanna dominated by *Burkea africana, Detarium microcarpa, Crossopteryx febrifuga, Afromosia laxiflora, Entada africana, Ptleopsis suberosa.*

Economic activities in Gombèlèdougou 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 and 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.

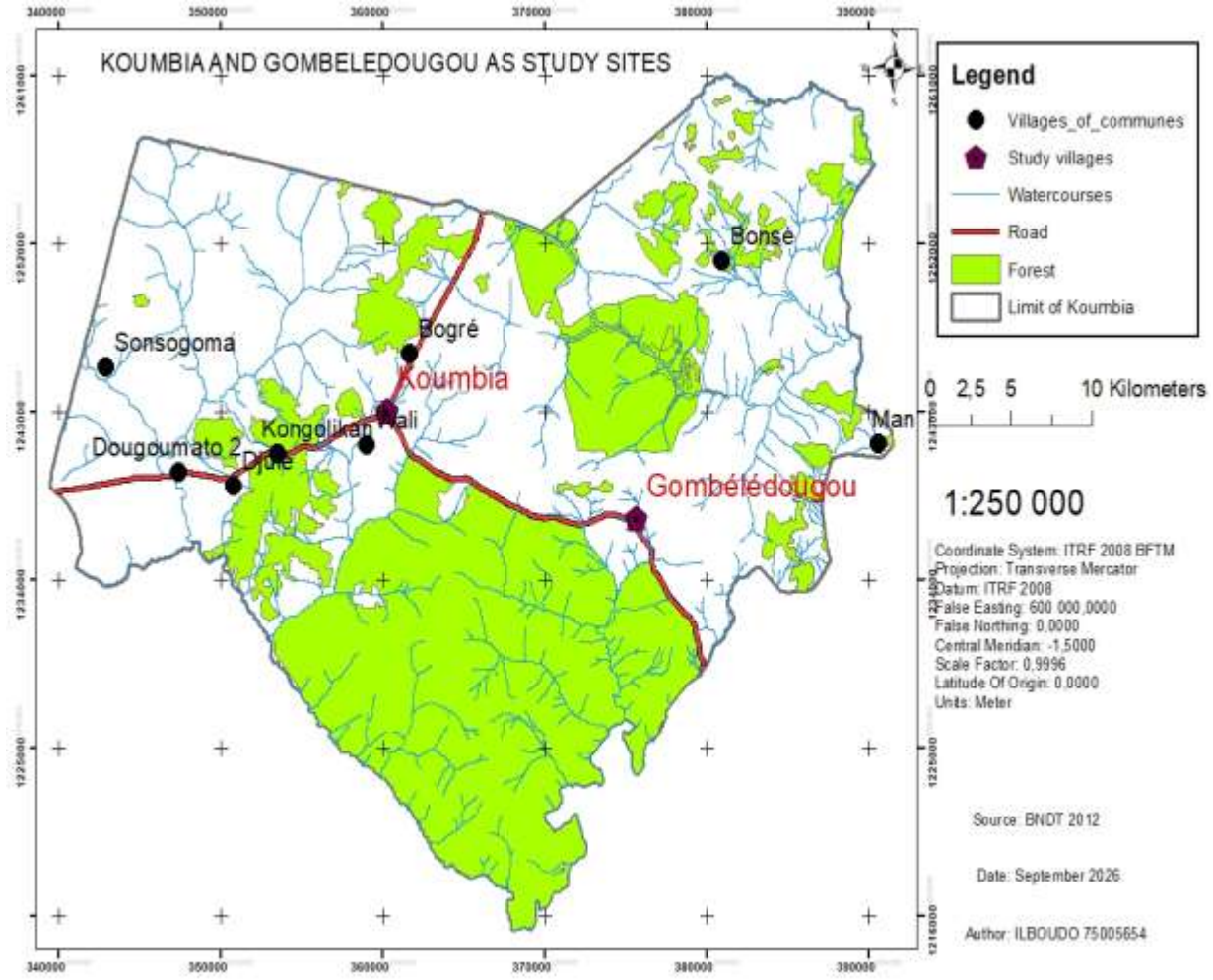


**Figure 1: Map of the municipality of Koumbia with study villages (Koumbia and Gombèlèdougou)**

**Data Collection Tools:-**

A structured survey questionnaire was used to collect data. It was developed by a multidisciplinary team (socio-economists, agronomists, and animal scientists).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 Gombèlèdougou and Koumbia. The list of farms was compiled in collaboration with local veterinary services, livestock farmers' associations, and village chiefs. The number of family farms is estimated at 800 in Koumbia and 400 in Gombelèdougou (Dabiré and al., 2011).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:

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

Using: Z = 1.96 (95% confidence level), p = 0.5 (proportion maximizing variance), q = 1 − p = 0.5, and e = 0.01 (accepted margin of error). This yields a minimum theoretical sample size of n ≈ 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% to improve the precision of estimates and the power of statistical tests. The farms surveyed were selected randomly using the snowball method, meaning the first producer surveyed listed three other producers with whom the survey could be conducted. To account for diversity, the survey was conducted based on the farm's cultivated area and number of cattle.

- farmers: operators owning fewer than 10 heads of cattle;
- crop-livestock farmers: operators owning more than 10 heads of cattle and cultivating more than 5 hectares;
- livestock farmers: operators owning more than 10 heads of cattle and cultivating fewer than 5 hectares.

**Data Collection and Analysis:-**

The survey was conducted during the post-harvest period from February 1st to May 2026 to provide livestock producers with a comprehensive annual overview of their herds and practices. The questionnaire was then pilot-tested with producers prior to the launch of the actual data collection.Interviewers received prior training on the questionnaire, variable definitions and interview techniques. Each questionnaire was completed during an individual interview with each participating farm manager in the local Dioula language lasting an average of 60 to 90 minutes. Participation in the survey was entirely voluntary. Verbal informed consent was obtained from each farm manager before the interview began, following an explanation of the study's objectives and assurances of confidentiality and anonymity.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.Missing data were handled as follows: (i) for coded qualitative variables, imputation using the most frequent category (highest code value); (ii) for continuous quantitative variables (animal numbers, distances, times), imputation using the observed mean; (iii) for discrete quantitative count variables (number of employees), imputation using the mode. Outliers were examined.

To compare the proportions of qualitative variables between the two villages, Pearson's chi-square test of independence ($\chi^2$) 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 $H_0$: μ(Gombèlèdougou) = μ(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. The assumptions for ANOVA—normality of residuals and homogeneity of variances—were verified using the Shapiro-Wilk test and Levene's test, respectively. In cases where the normality assumption was violated, the non-parametric Kruskal-Wallis test was used instead.This study is exploratory and descriptive; unadjusted p-values were therefore retained as the primary results. A total of 49 statistical comparisons were performed (9 ANOVAs and 40 chi-square tests), grouped into distinct thematic families (livestock composition, grazing and feeding practices, labour division, health practices, and production constraints).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) thanGombèlèdougou (3.90 ± 6.66 heads) (F = 8.72 ; p = 0.004), as well asthe 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 Gombèledougou 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 fodder storage area is higher in Gombèlèdougou(1.16 ± 0.75 vs 0.9 ± 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 ( mean ± SD)**

| Variables | Gombèlèdougou(n=44) | Koumbia (n=84) | Total (n=128) | F | P |
|---|---|---|---|---|---|
| **Cattle for breeding (head)** | 19.66 ± 24.1 | 14.57 ± 19.75 | 16.32 ± 21.38 | 1.64 | 0.202 |
| **Draft cattle (head)** | 2.93 ± 1.59 | 3.33 ± 1.98 | 3.20 ± 1.86 | 1.35 | 0.247 |
| **Sheep (head)** | 6.28 ± 7.49 | 8.35 ± 9.51 | 7.63 ± 8.9 | 1.56 | 0.213 |
| **Goats (head)** | 3.90 ± 6.66 | 7.70 ± 7.03 | 6.39 ± 7.11 | 8.72 | 0.004*** |
| **Chickens (head)** | 10.73 ± 10.03 | 16.01 ± 15.25 | 14.19 ± 13.87 | 4.3 | 0.04** |
| **Guinea fowls (head)** | 0.32 ± 1.34 | 2.15 ± 4.34 | 1.52 ± 3.7 | 7.46 | 0.007*** |
| **Fodder storage area (number)** | 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 = 0.023, where the mixed grazing system + Housing in stalls is significantly more commont (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 grazing inlow-lying areas (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%) 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 | $\chi^2$ | p |
|---|---|---|---|---|---|
| **Grazing** | | | | | |
| **Free-range grazing** | 95.5 | 76.2 | 82.8 | 7.57 | 0.023** |
| **Free-range grazing + barn housing1** | 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*** |

[1]maintained, seasonal, in an enclosed space

| | | | | | |
|---|---|---|---|---|---|
| **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:-**

The table III presents the results the allocation of family labor. The respondents reported household practices and multiple activities could be selected regarding gender and age. 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%) thanKoumbia(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** | **$\chi^2$** | **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 |
| **Minor2 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 | | | | | |
| **Adult men** | 100 | 95.2 | 96.9 | 0.88 | 0.349 |
| **Adult woman** | - | 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. Vaccination parks are available in Gombèlèdougou (97.7%) than 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%) thanthose from

[2]Minor meansbelow 18 years and adult more than 18 years

Gombèledougou(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 | $\chi^2$ | 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 |
| **Vaccination Parkavaibility** | 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 figure 2 presents structural constraints perceived by the respondents. They could select multiple constraints. The main challenges frequently listed 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%). A comparative analysis of the two villages reveals significant differences between them. Pasture Degradation ( 95.5% in Gombelèdougou versus 77.4% in Koumbia, $\chi^2$ = 5.62 and p= 0.018), Watering difficulties during the dry season (93.2% inGombelèdougouversus 78.6% inKoumbia, $\chi^2$ = 3.49 and p= 0.062), difficulties in accessing water (100 % inGombelèdougouversus 76.2%inKoumbia, $\chi^2$ = 10.68 and p= 0.001), difficulties in accessing veterinary care (88.6 % inGombelèdougouversus 33.3% inKoumbia, $\chi^2$ = 33.22 and p< 0.001), the lack of agricultural credit (79.5% inGombelèdougouversus 61.9% inKoumbia, $\chi^2$ = 3.36 and p= 0.067), isolation (70.5% inGombelèdougou vs 36.9% inKoumbia, $\chi^2$ = 11.7 and p< 0.001) andthe lack of job opportunities (59.1% inGombelèdougouversus 19% inKoumbia, $\chi^2$ = 19.22 and p< 0,001) are more pronounced in Gombélèdougou than in Koumbia. On the other hand, difficulties with watering during the rainy season are significantly more common in Koumbia(36.9%) thanGombèlèdougou (4.5%) ($\chi^2$ = 14.16 ; p < 0.001).

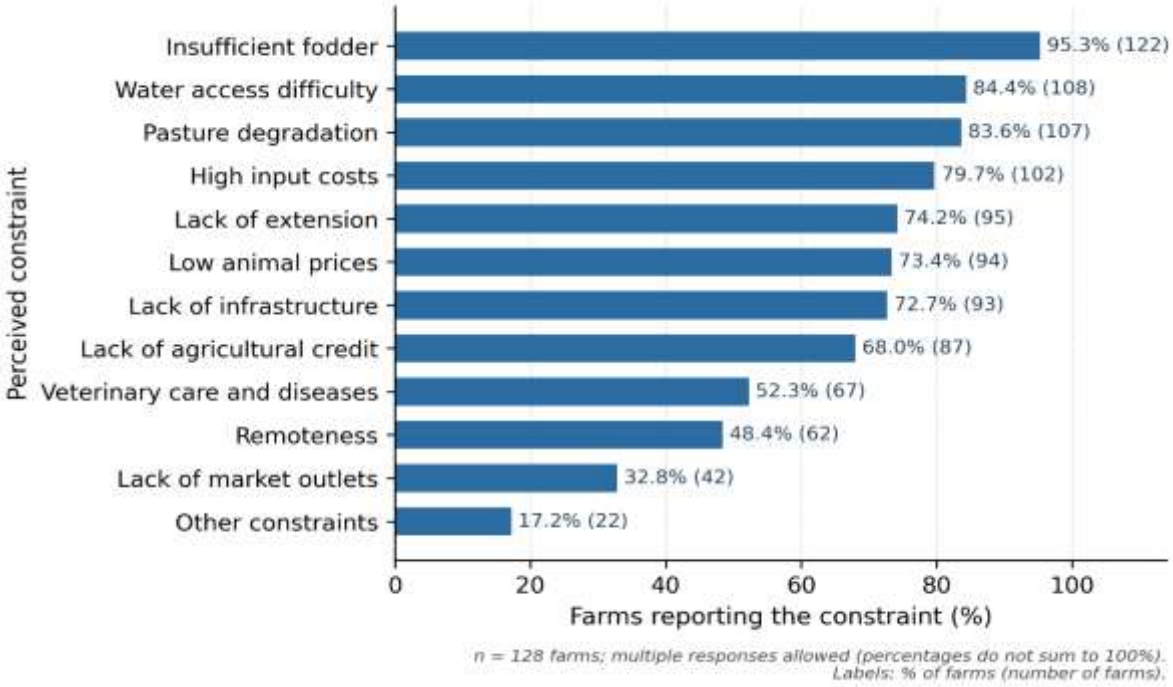


**Figure 2: Constraints perceived by livestock farmers**

## Discussion:-

**Differences in livestock composition:-**

There are significantly more goats in Koumbia (7.7 ± 7.03 heads) than in Gombèlèdougou (3.9 ± 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 fowls (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 and 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 and 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 0.9 ± 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 may reflect increased pressure on local pastures in Gombèlèdougou. The reduction in available pastureland in the cultivated savanna areas of western Burkina Faso is a growing structural constraint. (Sib and al., 2018). In light of this situation, farmers are making better use of crop residues (Vall and 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).

**Grazing and feed-resource strategies:-**

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). This may indicate 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 grazing environment (42.9% versus 13.6% ; p = 0.002) during the rainy season, while farmers in Gombèlèdougou work their fields more intensively (77.3% versus40.5% ; $p < 0.001$), areas more prone to conflicts with farmers. This may be explain by 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 and al. 2023). There is 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% ; $\chi^2 = 14.05$ ; $p < 0.001$). This mayreflects better collective organization in this villageand the concentration of public veterinary services. Practices related to supplementary feeding and the storage of crop residues (93%) and purchase of feed(90.6%) do not differ significantly between the two villages.

**Water and veterinary-serviceaccess:-**

Vaccination park are available in Gombèlèdougou (97.7%) than Koumbia (77.4%) with$\chi^2 = 7.59$; $p < 0.006$). Gombèlèdougouowns a large number of cattle and is located not far from the pastoral zone. Despite infrastructure existence in Gombèledougou,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 could reflect the resilience of pastoralist communities in the face of institutional constraints (Eeswaran and 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%) thanthose from Gombèledougou(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.

**Gender and household labor:-**

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%) thanmen (7.8%). Women play a key role in the dairy industry (Vallandal. , 2021).Women's involvement in the cattle trade confirms the gendered division of labor (Bullock and al., 2023; Tavenner and 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%) thanKoumbia (26.2%) ($\chi^2 = 8.89$ ; $p = 0.003$), as well as their role in herding animals (47.7% versus 25% ; $\chi^2 = 5,77$ ; $p = 0,016$). In the region underage girls are traditionally considered part of household chores.This difference may be associated with differences in household labor availability and village-level socioeconomic conditions.Howeverthese factors and child labor werenot explicitly investigatedand tested in the present study.

**Production constraints:-**

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 Gombelèdougouversus 77.4% inKoumbia, $\chi^2 = 5.62$ and $p= 0.018$), Watering difficulties during the dry season (93.2% inGombelèdougouversus 78.6% inKoumbia, $\chi^2 = 3.49$ and $p= 0.062$), difficulties in accessing water (100 % inGombelèdougou versus 76.2% inKoumbia, $\chi^2 = 10.68$ and $p= 0.001$), difficulties in accessing veterinary care (88.6 % inGombelèdougou versus 33.3% à Koumbia, $\chi^2 = 33.22$ and $p< 0.001$), the lack of agricultural credit (79.5% inGombelèdougou vs 61.9% inKoumbia, $\chi^2 = 3.36$ and $p= 0.067$), isolation (70.5% inGombelèdougou versus 36.9% andKoumbia, $\chi^2 = 11.7$ and $p< 0.001$) andthe lack of job opportunities (59.1% inGombelèdougou versus 19% inKoumbia, $\chi^2 = 19.22$ and $p< 0.001$) are more pronounced in Gombélèdougou than Koumbia. On the other hand, difficulties with watering during the rainy season are significantly more common in Koumbia(36.9%) thanGombèlèdougou (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 and 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 and al., 2025)

**Study limitations :-**

The findings represents the surveyed livestock-farming households in only two villages (Gombèlèdougou and Koumbia) and may not be representative of all livestock systems in the wider Sudanese region. In addition, the data may be limited by cross-sectional survey design; self-reported information; possible recall bias; possible interviewer bias; seasonal timing of the survey; lack of direct measurements of pasture biomass; lack of quantitative livestock productivity measurements; lack of economic profitability analysis and lack of longitudinal data.

During the analyze the important number of comparisons increases the risk of Type I error. Moreverpotentialstatistical-assumption violations and multiple statistical testing may affect the findings. However, the main conclusions are based on differences that were large and consistent across the two villages, and that are supported by the literature. Therefore, while some individual comparisons may be false positives, the overall pattern of results is robust and should be interpreted with caution.

## 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 Gombèledougou (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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