

Research Article

# Local Family Poultry Production System and the Main Constraints to Its Sustainable Development in the Ouaddaï Province in Eastern Chad

Oumar Bada Algom<sup>1,\*</sup> , Issa Youssouf Adoum<sup>2</sup> 

<sup>1</sup>Departement of Animal Science and Technology, Higher National Institute of Sciences and Techniques of Ab éh é Ab éh é Chad

<sup>2</sup>Higher Teacher Training College of N'Djamena, N'Djamena, Chad

## Abstract

The objective of this study is to characterize the family poultry production system and to identify certain management constraints that could undermine farm operations and hinder their sustainable development in the Ouaddaï Province of eastern Chad. Random and retrospective cross-sectional surveys conducted in 40 family farms. Socioeconomic characteristics revealed farms managed equally by men and women (50% each), with 92.5% of the farms managed by married parents. Family poultry farming is a secondary activity, a form of adaptation, as the farmers were originally engaged in agriculture and gardening (31.9%) and the condiment trade (22.8%). These poultry farmers provided rudimentary sheds made of straw and wood (31.9%) and banco (22.8%). Investments in chicken housing are very low (4.5%). In 50% of farms, free-range chickens receive a handful of millet or red sorghum, millet bran and about a third of a liter of water as a supplement to their feed. According to the poultry farmers surveyed, diseases (58.3%), animal and theft (37%), and feed costs (4.7%) appear to be the main constraints faced by producers, leading to mortality. 90% of family farms impacted by the lack of chicken vaccination practices. 52.5% of poultry farmers have resorted to using traditional medicine and local ethno-veterinary knowledge. Furthermore, 53.4% of sales were of chickens at a unit price of 2,809 FCFA, and 46.6% of egg sales at 125 FCFA. 20% of the chickens and 14% of the eggs are intended for family consumption. Whatever, family poultry farming faces several constraints, yet most poultry-farming families report being satisfied with their net monthly profit margins of 15,350 FCFA. This indicates that local chicken production plays a significant socioeconomic role. It is therefore undeniable that improvements in management and health systems could help improve performance and revenue for the development of sustainable family poultry farming in this Sahelian Province of Chad.

## Keywords

Socioeconomic Characteristics, Constraints of Family Poultry Farming, Ouddai Province, Eastern Chad

\*Correspondence: Oumar Bada Algom (oumarbada2019@gmail.com)

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## 1. Introduction

Local family poultry farming is an activity of great importance that contributes significantly to food security and poverty reduction, notably strengthening social cohesion and gender equality [19]. Local poultry breeds are therefore genetic resources that are resistant to disease and demonstrate good adaptability to the extensive farming system [9]. This local extensive farming system is practiced in all rural areas, particularly by the most vulnerable groups, namely women and children [20, 21]. Traditional farms constitute between 80 and 95% of the chicken population, while modern poultry farming represents only 2 to 5% of the poultry herd CTA [11]. It provides economic autonomy by generating supplementary income and contributes to family food security [28]. Chicken holds socio-cultural importance through its use in sacrificial rites, offerings, and ceremonies for welcoming distinguished guests and dignitaries. From a nutritional standpoint, chicken meat provides high-quality protein. Traditional, extensive local poultry farming supports rural development through job creation. It demonstrates significant potential that can strategically contribute to sustainable food security and serve as a lever for combating poverty and promoting gender equality [20]. Free-range hens forage in their immediate environment. Indeed, the growing demand for chicken and egg consumption stems from the expansion of our urban areas and, in particular, the emergence of a middle class with purchasing power that seems ready to maximize its consumption. However, local chicken and egg production has remained low and does not always meet the needs of the population. The Food and Agriculture Organization of the United Nations (FAO) recommends identifying and characterizing livestock systems and animals [20]. Nevertheless, the local breed of chicken appears to be better adapted to Sahelian conditions, with low input and investment costs [37]. Despite its considerable importance to the family economy as source of high-quality animal protein, local poultry farming faces immense constraints related to climate, food insecurity, and low productivity at the technical and organizational levels. The objective of our study was to characterize and evaluate the local family chicken production system and to identify the main constraints limiting its sustainable development. Specifically, this involves: - Characterizing the production practices and management of extensive livestock farming - Analyzing the socio-economic characteristics of local poultry farmers - and identifying the constraints to its sustainable development.

## 2. Materials and Methods

### 2.1. Presentation of the Study Area

The study area is located in the Sahel region of eastern Chad. This province extends between 13°39' North latitude and 21°44' East longitude (Figure 1). It comprises three departments: Ouara, Abougudam, Djourouf Al Ahmar, and Assoungaha, and covers an area of 29,980 km<sup>2</sup> with a population of 731,679 [32]. This area is influenced by an intertropical climate with a nine-month dry season from October to June and a three-month short rainy season from July to September. The pattern of these two seasons is defined by fluctuations between dry air masses (harmattan) from the north and humid maritime air masses (monsoon) from the southwest. The average rainfall is 300 mm and the average annual temperature is 28 °C, which varies in the cold season (December-February) and in the hot dry season, between 25 and 41 °C MDAMN [27].

### 2.2. Sampling

The survey method used was probability sampling. A total of 40 cross-sectional, random, and retrospective surveys were conducted in family chicken farms located in the peri-urban area of Abéché (14) and in rural areas: West of Abéché (13) and East of Abéché (13).

### 2.3. Survey Data Collection

The data collected were gathered from surveys of poultry farmers who raise local chickens on a family scale. Data was collected using structured questionnaires. Information focused on the socio-economic situation: the farmer's profile (age, civil status, marital status, occupation, and education level). Management and breeding practices, animal species, flock size, herd structure, type of feed, and weight were also recorded. The health status of the chickens and income from the sale of poultry products were also assessed.

### 2.4. Processing and Analysis of Survey Data

The collected quantitative data were created in Excel 2013 spreadsheets and processed and analyzed using XLSTAT software (6.1.9). Descriptive statistical analysis was used to calculate dispersion parameters (frequencies, means  $\pm$  standard deviations), and analysis of variance (ANOVA) was performed on comparisons of means, along with the Newman-Keuls test (SNK) at the 5% significance level. Subsequently, average monthly margins derived from livestock farms were calculated.

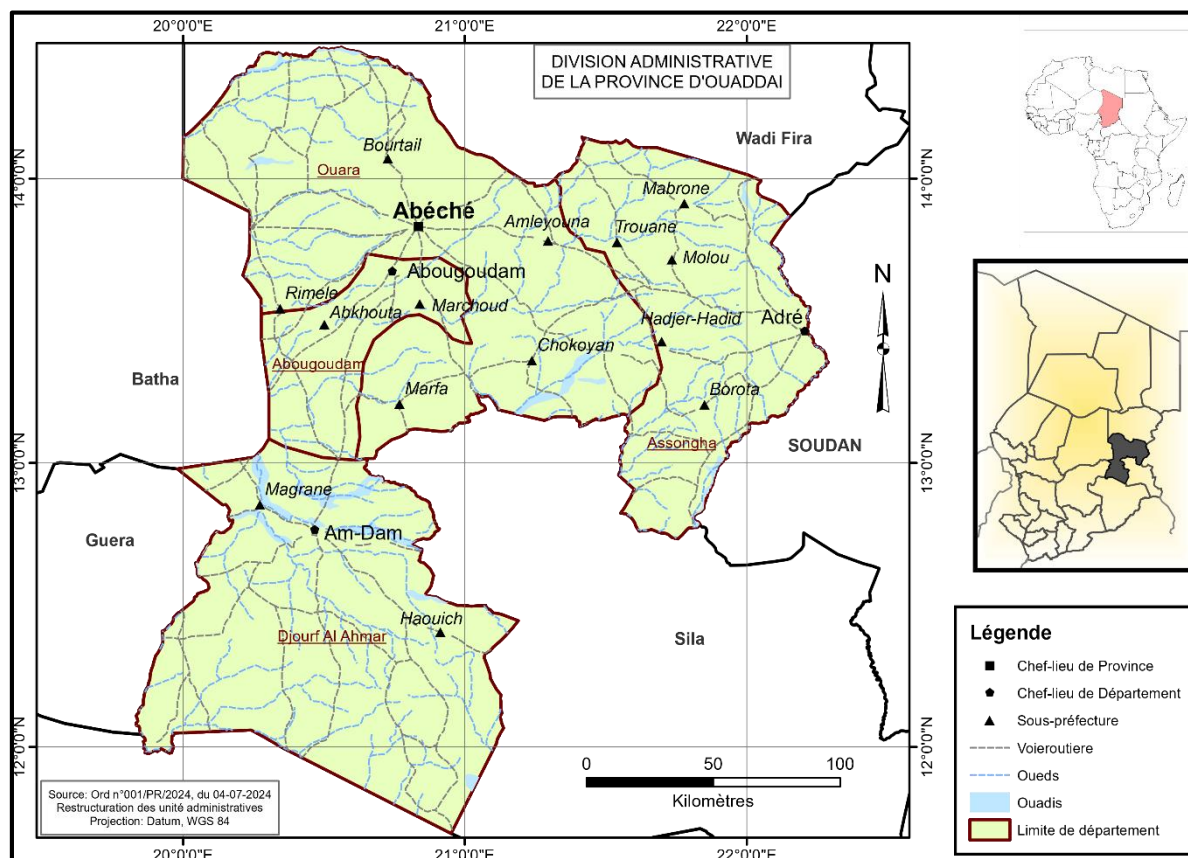


Figure 1. Map of Ouadda iProvince, Source: CNAR (2021); NRSC [33].

### 3. Results

#### 3.1. Socioeconomic Characteristics of Local Poultry Farmers and Farming Practices

The socioeconomic and technical characteristics made it possible to identify local poultry farmers, their education levels and professions, as well as to determine the origins of the

chickens raised, the numbers, the average flock structure and the main constraints encountered.

Family-run poultry farming is characterized by raising local chickens in an extensive farming system. All family members are involved in managing the chicken coop. The socioeconomic characteristics of the poultry farmers, including their education levels, marital status, and occupations, are presented in Table 1 and Table 2.

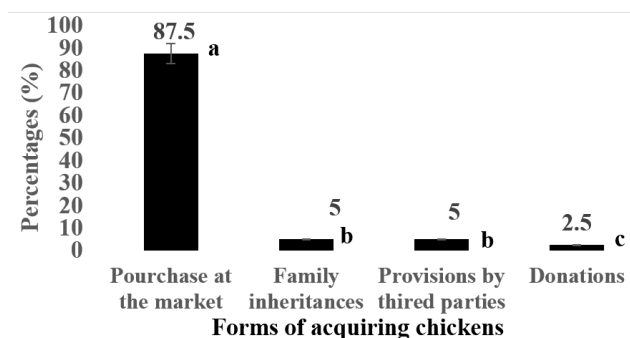
Table 1. Socioeconomic characteristics of local poultry farmers.

Main ethnic groups of producers (%)	Number (n= 40)	Percentage (%)
Ouaddaians	22	55
Arabs: Bani Halba, Djatn é	10	25
Other ethnic groups: Dadjo, Zakhawa, Moundang, Mimi, Khouchta, Foulb é and Hadjara i	8	20
Marital status (%)		
Married	37	92.5
Widowed	2	5
Single	1	2.5

Main ethnic groups of producers (%)	Number (n= 40)	Percentage (%)
Length of Producer Experience (years)	3.6 ±0.30	
Average Age of Local Chicken Producer (years)	36 ±0.82	
Education level (%)		
French primary education	18	40.9
Arabic primary education	20	54.5
Higher level	2	4.6

**Table 2.** Distribution of livestock farmers by main occupation.

Professions of origin	Number (n= 40)	Percentage (%)
Agriculture/Market gardening	13	31,9
Condiment trade	9	22,8
Catering	4	9,2
Carpentry	5	13,5
Méchanics	1	10,1
Buthery	3	7
Housewife	1	1
Assistant to the local chief	4	4,5

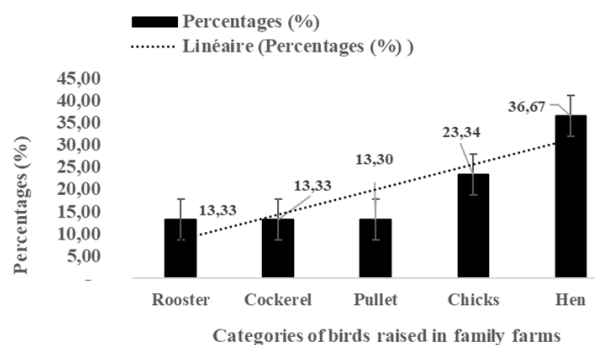


**Figure 2.** Origins of hens in the surveyed farms. Proportions with two different letters indicate a significant difference (*ab; ac: P<0.05*).

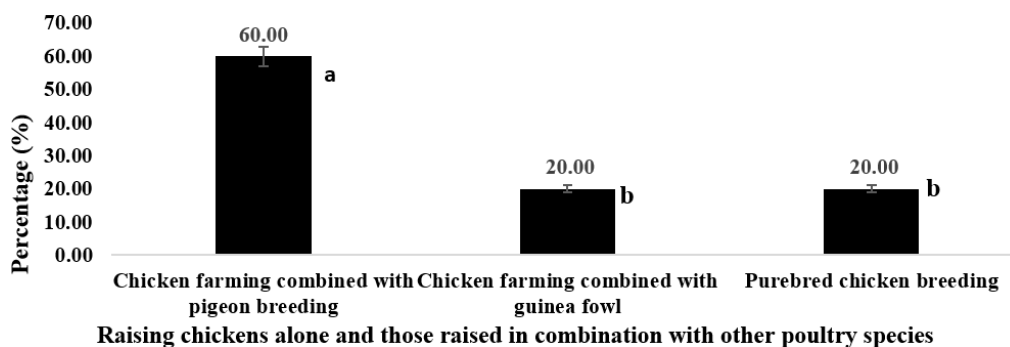
### 3.2. Characterisation of Production Practices and Livestock Management

#### 3.2.1. Chichen Acquisition, Number of Stocks and Flock Structure on Farms

Farmers acquire their chickens through market purchases, family inheritance, donations, and entrustment via third parties (*P<0.05*) (Figure 2). The average flock consists of (4 ±5) breeding roosters + (4 ±5) young cockerels + (11 ±12) laying hens + (4 ±7) pullets and about six chicks (Figure 3).



**Figure 3.** herd composition of an average flock on a farm.



Proportions of other poultry associated with chicken farming. Proportions with two different letters indicate a significant difference (*ab: P<0.05*).

**Figure 4.** Shows farms with only chickens, and farms with chickens raised alongside other poultry, such as guinea fowl and pigeons.

### 3.2.2. Productivity of Local Chickens and Destinations of Poultry Income

Data on average annual clutches, average productivity per hen and per clutch, hatching rate, and embryonic mortality are recorded in Table 3. Income from the sale of products from extensive family poultry farms addresses the immediate financial needs of poultry-farming families. It also contributes to a

significant improvement in the family economy by building up working capital to revive small-scale trading activities and invest in land purchases. This money helps cover expenses such as children's school fees, the purchase of soap, and clothing. Furthermore, chickens play a socio-cultural role, as they are slaughtered to perform certain rituals during sacrificial ceremonies and when welcoming visitors and important guests.

**Table 3.** Productivity parameters of local chickens in family farms.

Parameter	Number (n=40)	Percentage (%)
Total number of chickens	n=1,260	
Average number of chickens	30 ± 38 (max: 219; min: 3)	100
Length of experience (years)	3.5 ± 0.4 (max: ; min: 3)	
Productivity of local hens		
Average weight of the breeding rooster (g)	1,630 ± 0.07 (max: 1,656; min: 1610)	
Average weight of a laying hen (g)	1,265g ± 0.06 (max: 1,300; min: 1230)	
Age at first laying (months)	6.2 ± 0.20	82
Number of broods (year)	3 ± 1.1	18
Number of eggs per clutch (year)	12.41 ± 0.24 (max: 15; min: 9)	
Outbreak rate (%)		
Embryonic mortality rates (%)		

### 3.2.3. Habitat and Predation of Chickens

In the farms surveyed, chickens are raised in rudimentary sheds constructed with straw and wood (55%), in mud-brick shelters (27.5%), and in open-air ranges (17.5%). The average cost of constructing a chicken coop was estimated at 5,286 CFA francs (€8).

### 3.2.4. Feeding and Watering

In half of the farms (50%), free-range hens received a daily supplement of 83 grams of millet or red sorghum and 30 grams of millet bran, and were given 0.3 liters of water daily.

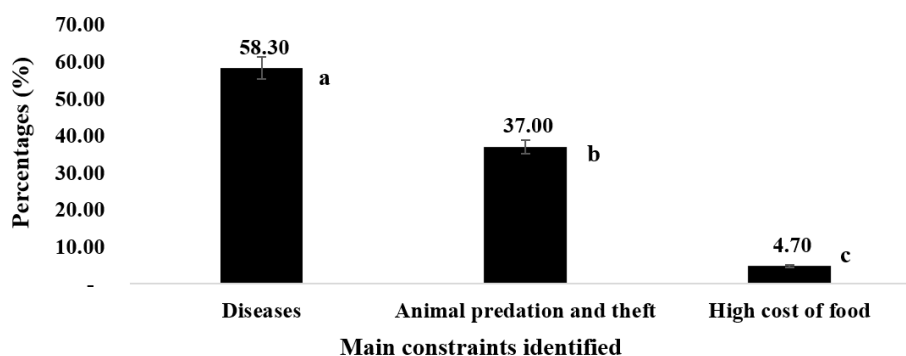
### 3.2.5. Hygiene and Animal Health, Mortality and Recommended Treatments

Vaccination against Newcastle disease using the inactive Ita-New vaccine was only effective in 10% of farms. The lack of vaccination practices for chickens appears to have impacted 90% of family farms. This disease caused significant mortality. In an attempt to contain it, 52.5% of poultry farmers resorted to traditional treatments and the use of ethno-veterinary knowledge. In 5% of farms, this involved decoctions of *Aca-cia tortilis* (garrat) pods and wild cucumbers (*Echinocystis lo-bata*), while in 2.5% of farms, it involved water solutions: salt

water (sodium chloride), chili pepper water (*Capsicum fru-tescens*), sorrel calyx (*Hibiscus sabdariffa*), and even camel urine. In reality, Newcastle disease, which appeared during the cool dry season, was associated with infectious *Coryza* (ab-iyen é) and *Fowlpox* (djederi, ab-ri òsse) in 10% and 15% of farms, respectively. During the dry season, the lack of hygiene and biosecurity practices on farms contributed to the resurgence of external parasites such as chicken lice (dalam). To combat these diseases, farmers indiscriminately used modern medications, including *oxytetracycline* (37.5%) and *amprolium* (5%) antibiotic capsules, and insecticides (5%), purchased from inexperienced street vendors without any expertise or advice from a veterinarian. This abusive, massive and anarchic use by inexperienced people could induce resistance and constitute a potential danger to wild birdlife and carnivorous predators of prey.

## 3.3. Main Constraints on Poultry Farming and Behavior of Local Poultry Farmers

Figure 5 classifies the constraints: diseases, animal predation and the high cost of feed which were responsible for several chicken mortalities.



**Figure 5.** Main constraints of family chicken farming. Proportions with two different letters indicate a significant difference ( $^{ab}$ ;  $^{ac}$ ;  $^{bc}$ ;  $P < 0.05$ ).

The breeding male with a higher live weight compared to the hen, respectively  $1\ 630\ \text{g} \pm 0.07$  (max: 1 656; min: 1610) and  $1265\ \text{g} \pm 0.06$  (max: 1300; min: 1230) with a significant difference ( $^{ab}$ ;  $P < 0.05$ ).

To avoid the risk of losses due to disease-related mortality, especially the much-feared Newcastle disease, local poultry farmers advocate management strategies that involve adopting practices deemed harmful and contrary to public health standards. Indeed, when the disease re-emerges, it leads to high morbidity and mortality rates. Poultry farmers panic and rush to slaughter live chickens showing early signs of the disease. These chickens are then transported haphazardly to the nearest market for liquidation, often at rock-bottom prices. This intractable situation traps the local chicken industry in a vicious

cycle each year, reducing production activity to at most eight months, from July to March. During the hot dry season, at most, only 25% of the chicken population will remain in the area. These are survivors of the disease, emaciated and of no economic value, and they are still able to eliminate the virus between 7 and 60 days after their recovery. The absence of vaccination practices and hygiene and biosecurity measures is noted in 90% of the farms.

Table 4 shows the total costs, the average annual turnover from the sale of live chickens (53.4%) and eggs (46.6%), and the net margins. Household consumption of chickens and eggs is 20% and 14%, respectively.

**Table 4.** Operating account for an average family-run live chicken farm.

Items	Unit	Quantity	Constant unitprice (FCFA)	Value (FCFA)	P.100
Total Products (TP)				299 349	100
Chickens sold	Unit	45	2809	126 405	53.40
Eggs sold	Unit	882	125	110 250	46.60
Home-consumed chickens	Unit	16	2809	44 944	20
Home-consumed eggs	Unit	142	125	17 750	14
Cost of mortality	Year	19	2809	53371	23.75
Total eggs produced	Unit	1024	125	128 000	100
Total hens produced	Unit	80	2809	224 720	100
Watering	Year			8200	7
Feeding	Month	12	3600	43200	37,5
Vaccinations/Veterinary Care	Ann é	1		500	0,5
Variable Costs (VC)				107700	93,5
Provisions (2% VC)				2154	2
Depreciation				5285	4,5
Fixed Costs (FC)				7439	6,5

Items	Unit	Quantity	Constant unitprice (FCFA)	Value (FCFA)	P.100
Total Costs				115139	100
Annual Gross Margin (FCFA)				184210	
Monthly Net Margin (FCFA)				15350	

Revenue = Quantity sold x Unit price; Gross Margin (GM) = Total Products – Total Expenses

## 4. Discussion

### 4.1. Socioeconomic Characteristics and Poultry Farming Practices

The local poultry farms studied are run equally by women and men (50% each), which does not corroborate the findings of studies reporting that family poultry farming is primarily a female vocation where women dominate, as reported by [38] (52%) [16] (56%) in the Democratic Republic of Congo (DRC) [36] (72%) and [31] (68.2%), respectively in the Dakar and Saint-Louis regions, eastern Senegal and Upper Casamance (Kolda). In contrast, [13] (52.27%) [25] in Chad, [15] (51.9%) in the DRC, and [9] (59%), as well as. [17] (79.6%) in Côte d'Ivoire, indicated a predominance of men. Indeed, the presence of women could be explained by their dynamism in income-generating activities, thanks to the awareness-raising and advocacy efforts promoted by the United Nations for achieving the Sustainable Development Goals, so that women acquire economic autonomy and dignity. Even though, according to [23] socio-cultural considerations still grant men the right to manage the family. Agriculture, market gardening, and the trade of condiments are the primary activities of poultry farmers, while family farming represents a secondary activity for them. Multifunctionality and diversified farming, combining chicken farming with other poultry species, are resilient adaptation strategies that diversify income sources. These reasoned conclusions are similar to those of [2] in Abéché Chad, and [15] in the Democratic Republic of Congo. According to the [7], according to the BIT [8], diversifying production activities can significantly influence poverty reduction and strengthen compensatory mechanisms in the event of crop yield difficulties or price instability. For acquiring new breeding stock to revitalize their farming activities, 87.5% of the poultry farmers surveyed prefer to buy them directly from the market. This rate appears higher than that described by [2] (81.8%) in Chad and [17] (59%) in Ivory Coast.

### 4.2. Characterization of Production Practices and Farm Management

Free-range chickens receive supplementary feed in 50% of farms, which seems very low compared to the 70.4% observed

by [25] in Chad. These natural supplementary feeding practices, which use millet, sorghum, and bran, are consistent with the findings of [15] in the Democratic Republic of Congo, [34] in Burkina Faso, [29] in Chad, and [4] in Algeria. [5], the development of local poultry farming must involve improving cereal-based feed. However, there is competition for food between families and chickens. Price ratios are very unfavorable in our countries. Indeed, a local breed hen can consume up to 100g/day, or 36kg/year during the laying period. Feed is a limiting factor for the development of family poultry farming. In reality, cereal production by households rarely guarantees both their own food security and poultry feed. The average flock size of 30 chickens recorded is higher than that described by [17] (23) from Ivory Coast [4] (20) from Algeria, and [31] (21.9) from Senegal. Local hens, representing 17.5% of local farms, prefer outdoor ranges, which is low compared to the 22.5% and 73.3% reported by [17]. In Ivory Coast. In recent years, tentative attempts at genetic improvement, with limited results, have been undertaken using the “breed-improving cockerel” of European and American strains, which has been promoted by Non-Governmental Organizations and the Livestock Delegation. The total number of annual broods (n=3) of the farms studied is almost identical to those obtained by [7] and [13] in Chad and [3] in Congo. The proportion of local farms using full outdoor rangeland (17.5%) is lower than the 22.5% and 73.3% of farms reported respectively by [25] in Chad and [17] in the savannah zone of Ivory Coast. According to the results of the work of [30], semi-confined rearing increases the number of reproductive cycles from 3.4 to 5.6 per year and the viability of chicks by 41.2%. The proportion of variable costs is greater than that of fixed costs, which explains why constraints in livestock farming stemming from a structural situation can be attributed to low investment. Family poultry farming is a financially profitable activity that generates income. These observations are consistent with the results described by [19, 23] and [10]. The proportion of chickens sold (53.4%) is higher compared to the rates reported by [34] (49.7%) and [39] (40%) in Burkina Faso, [30] in Senegal (51.7%), and [24] (38.1%) in Ethiopia and [1] (18%) in the Keita region of Niger, however, it is lower than the rate of [26] (87.6%) in Chad. Furthermore, the percentage of 20% of chickens allocated to family self-consumption is higher than the 10.9% indicated by [34] in Burkina Faso, while it is lower compared to those presented by. [31] (38.8%) in Senegal, [1]

(26.5%) and [38] (37%) in Burkina Faso. Despite the aforementioned constraints, demand for poultry-produced chicken and eggs has remained high due to the existence of a middle class and urban restaurateurs who demonstrate a strong propensity for chicken consumption. The average monthly profit margin for a local producer is 15,350 FCFA (€23.30). This margin is significantly lower than those reported by AVSF [5] (65,590 FCFA) (€100) in Togo, [12] (50,650 FCFA) (€77) in Burkina Faso, [26] (51,529 FCFA) (€78.55) in Chad and [18] in Senegal. According to [22], the sale of poultry during the lean season allows producers to complete their annual household budget cycle by purchasing grain for their families. The 6.5% investment rate is low. The proportion of variable costs (93.5%) is higher than fixed costs (6.5%). This clearly demonstrates that the vulnerability of livestock farming is also a structural situation explained by the low level of investment (6.5%) and depreciation of fixed assets (4.5%), which hinders efforts toward sustainable development. While solidarity was less pronounced during these exchanges, it nonetheless allowed for the development of networks of obligations and relationships to ensure cohesion within families and between social groups.

### 4.3. Main Constraints on Poultry Farming and Behaviors of Local Poultry Farmers

Mortality rates, primarily caused by epizootic diseases and predators (54.35% and 38% respectively), are identified as the main constraints to the development of family poultry farming. The diseases identified and their treatments, based on traditional medicine, are similar to those described by [35] in Niger and [4] in Algeria. According to Dupont [14], this type of farming faces health and nutrition constraints due to the primary management method, which is free-range farming. To avoid mortality from diseases, especially Newcastle disease, chicken farmers have developed certain behaviors and management strategies that are considered harmful and contrary to current public health standards. Indeed, when faced with major epidemics, local poultry farmers often panic and hastily transport chickens to the nearest market for liquidation, often at rock-bottom prices. To avoid bankruptcy, these farmers sometimes rush to slaughter chickens showing early signs of the disease and then sell them. These practices are similar to the descriptions made by and [4] in the Aurès region (Batna) of Algeria. In reality, this intractable situation leads local chicken farming into a vicious cycle each year that can reduce production activities. In fact, the absence of vaccination practices and the lack of implementation of adequate hygiene and biosecurity measures is observed in 90% of the farms surveyed. According to [6], vaccination and biosecurity measures during flock renewal periods are important to mitigate the impact of the disease. Sales are conducted for cash and meet the needs of families. Income from sales of products from extensive family poultry farming covers families' emergency cash needs and contributes to improving the family economy. This

working capital allows for the revival of small-scale trading activities, investment in land purchases, and the payment of children's school fees. Furthermore, chickens play a socio-cultural role. They are slaughtered during certain rituals and sacrificial ceremonies, and when welcoming imminent guests.

## 5. Conclusion

Large-scale family poultry farming of local chickens plays a vital socioeconomic role and contributes to transforming families' living conditions. The local chicken breed is hardy and adapts well to local climatic conditions. Family poultry farming thus represents a secondary activity and a diversification and adaptation strategy for producers who originally practiced agriculture and the trade of spices. However, in addition to the lack of training and technical support, the main constraints are epizootic diseases and predation, which are exacerbated by the rudimentary housing built from local materials and the high cost of chicken feed. In short, improvements in livestock management and animal health, including vaccination and biosecurity programs, are needed. This management will undoubtedly improve the productivity of family farms, increase farmers' incomes.

## Abbreviations

FAO	Food and Agriculture Organization of the United Nations
AVSF	Agronomists and Veterinarians Without Borders
CNRD	National Research Center for Development
CTA	Technical Centre for Agricultural Cooperation
NISES	National Institute of Statistics and Economic
NRSC	National Research Support Centre

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## Author Contributions

**Oumar Bada Algom:** Conceptualization, Data curation Formal Analysis, Methodology

**Issa Youssouf Adoum:** Supervision, Validation, Visualization, writing – original draft, Writing – review & editing

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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