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Research Article

Zootechnical and Morphological Characteristics of Indigenous Chicken Populations of Koundoul Areas

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Abstract

Background and Objective: In rural areas, local chicken production is very important as the first source of animal protein and a good source of income. This study aimed to identify the zootechnical and phenotypic characteristics of local chickens in Koundoul area. **Materials and Methods:** A total of 100 households participated in the interview and 400 indigenous chickens were inventoried. Characteristics of farmers such as sex, matrimonial situation, level of study and the principal activities of the survey, the management of the flock, the main constraints, the characteristics of the plumages and the color of the eyes, tarsus, the color and the shape of the beak barbell and the crest were the main focus of the data collection. **Results:** Results indicated that chicken farming was largely practiced by men and illiterates. This findings revealed that the majority of respondents are married. The average chicken puberty age was 22 ± 0.02 weeks, with 12.43 ± 0.41 eggs laid per clutch, with 51.55 ± 0.69 eggs per year and 3.05 ± 0.8 clutches per hen per year. The hatchability of eggs from indigenous chicken was 66.66%. Indigenous chickens of the Koundoul area had a black plumage color, orange-red eye color and black beak but the tarsus colors were gray. However, the barbel and crest were pink. The form of the barbel was round and the crest form was simple. Disease, predators and theft were the main constraints faced by local chicken breeding. **Conclusion:** Although, the performance of domestic chickens in Koundoul area is low, they have a qualitative trait diversity.

Key words: Local chickens, peri-urban zone, phenotypic characteristics, socioeconomic importance, zootechnical performances

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

There is an increasing shortage of animal protein sources due to human population pressure. To address this issue, short-cycle livestock farming has emerged as an effective solution. Among livestock farming, poultry farming stands out as a non-restrictive practice that can be adopted by individuals from all socioeconomic backgrounds. Domestic chickens are self-reliant and hardy birds, able to cope with harsh weather conditions and adopt to adverse environment¹. In rural areas, indigenous poultry farming plays a significant role in reducing poverty². Indeed, in many sub-Saharan African countries, such as Chad, where animal protein is needed coupled with high poverty rates, indigenous chicken farming offers several advantages, including its short production cycle and relatively low investment requirements³. Despite their low productivity, local chickens play a significant role in rural and urban livelihoods in sub-Saharan Africa³. Domestic chicken production often serves as living banks of stored capital similar to an interest-earning investment, it provides income, particularly for women⁴ and a ready source of capital for financing on-farm agricultural investment as well as a financial security, it is also the primary source of animal protein and nutritional reserve during periods of adverse climatic fluctuations⁵. Indigenous chickens provide food security and income to rural communities. It is important to improve indigenous chicken production, this can be done by promoting appropriate management such as disease control, adequate housing, improved nutrition, nutrition and morphological and zootechnical characterization. In Chad, morphological and zootechnical characterization studies^{6,7} have revealed genetic diversity that can be harnessed. However, these studies focus on the southern and eastern regions of Chad and there is a scarcity of similar research in the peri-urban area of N'Djamena (Koundoul). Hence, this study aimed to identify the phenotypic characteristics and zootechnical performances of local chickens in the peri-urban zone of Koundoul Sub-Prefecture in general.

MATERIALS AND METHODS

Study area: The study was conducted in the peri-urban zone of Koundoul Sub-Prefecture, located in the Chari Baguirmi region of Chad, within the Chari department. The area is situated between 11° 98'N latitude and 15° 14'E longitude. The estimated population is 38,871, comprising 19,105 men and 19,766 women⁸. The climate is Sahelian, characterized by a rainy season from June to September, spanning four months. In addition, there is a dry season from November to May, lasting eight months. The average annual precipitation ranged

from 200 to 600 mm, with an average temperature of 30°C. The area experiences two dominant winds: the harmattan during the dry season and the monsoon during the rainy season.

Methods of data collection: This survey study was conducted by using a structured questionnaire administered to 100 randomly selected households involved in chicken farming from August 15th to September 15th, 2022. A total of 400 chickens were included in this study. Information was collected about the profiles of the farmers, poultry management practices, phenotypic characteristics, age at sexual maturity and the onset of egg-laying, egg production per hen per year, number of eggs per hen per laying cycle, number of eggs set for incubation per female per year, laying period, constraints of local chicken breeding, sales, utilization of income from sales, health management practices and hatchability rate.

Inclusion criteria: The study focused exclusively on household poultry farming, specifically local chickens. The selected farmers included in the study had a minimum of 10 chickens, including 5 hens. The participating households were voluntary and willing to participate in the study and were located within the villages of Koundoul Sub-Prefecture. The sampling sites covered 17 villages within the Koundoul Sub-Prefecture, with an average of 10 households per village. The study sites were accessible throughout the year.

Statistical method: The collected data were analyzed using XLSTAT software (version 6.1.9). Descriptive statistical analysis was performed to describe the main features of a dataset such as measures of central tendency (Mean \pm standard deviation), ranges and frequencies. Data were analyzed using one way analysis of variance (ANOVA) followed by Newman-Keuls (SNK) test for comparisons among means with a significance level of 5%.

RESULTS

Breeder's profile: Table 1 shows that 77.89% of poultry farmers were men and 22.11% were women, 63% were illiterate, followed by 20% with primary education and 17% with secondary education, 82.91% of respondents were married, 4.52% were single, 4.52% were divorced and 2% were widows. The average age of the majority of participant was 36 years and agriculture was their major occupation followed by trade (Table 2).

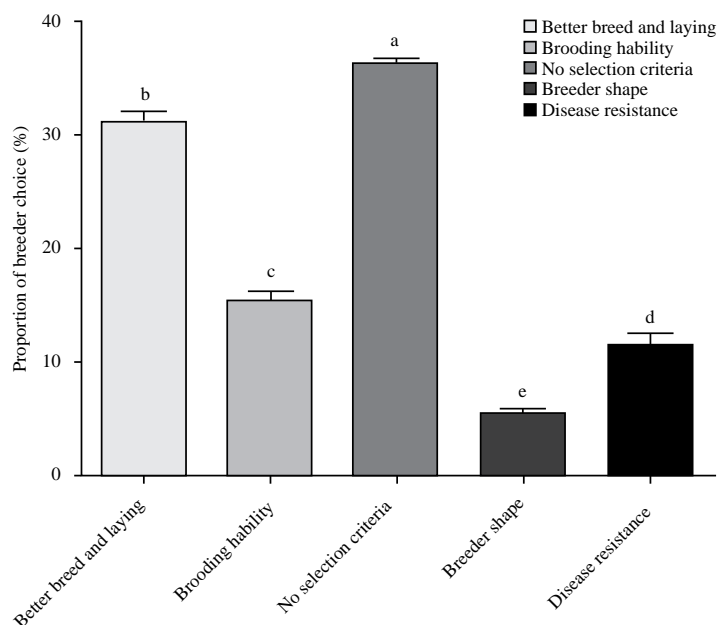


Fig. 1: Existing or no choice criteria of indigenous chicken breeders²

Table 1: Profile of respondent in Koundoul city

Parameter	No. (N=100)	Proportion (%)
Sex of respondents (%)		
Men	78	78.89
Women	22	22.11
Average age of respondents (year)	36.14±0.10	
Years of local poultry producers experience	4.25 ±0.23	
Marital status		
Married (%)	83	83.00
Single (%)	10	10.00
Widowed (%)	4	4.00
Divorced (%)	3	3.00
Educational level (%)		
Illiterate	63	63.00
Primary education	20	20.00
Secondary	16	16.00
High school	1	1.00

Table 2: Distribution of respondents by major occupation

Occupation	No. (n = 100)	Percentage
Agriculture	48	48.00
Agriculture and trader	8	8.00
Traders	40	40.00
carpenter	4	4.00

Table 3: Performance of local chicken

Parameters	No.
Age at first egg (weeks)	22.00±0.02
Egg number per clutch	12.43 ± 0.41
Clutch number per hen per year	3.05±0.8
Egg number per hen year ⁻¹	51.55±0.69
Hatchability (%)	66.66

Production and breeding parameters of local chickens: The average age of sexual maturity for local hens was 22 weeks. The average egg number laid per hen per year was 51.55 ± 0.69 with 3 clutches. Within each laying cycle, the average egg laid per hen was 12.43 ± 0.41 eggs and egg hatchability was 73% (Table 3). Figure 1 shows that more than 37% of the traditional poultry farmers select chicken breeders without any selection criteria, while 32.2% of farmers select chickens for their better breed and egg laying performance, 15.5% for their brooding ability, 11.6% for their disease resistance, 5.4% for the breeder shape. Poultry breeding periods vary among different breeds according to their performances. The majority of respondents affirmed that the rainy season was good period of production (Fig. 2).

Local chicken habitats: The results showed that 90% of the chicken rooms were constructed using local materials, while 10% of households have constructed rudimentary shelters for chickens (Fig. 3).

Feeding and watering: The results also revealed that cereals (maize, red and white sorghum along with household waste) formed the basis of the indigenous diet, followed by the mixture of cereals and oilseed like sesame (Fig. 4).

Herd health monitoring: The results regarding indigenous chicken health showed that 81% of the surveyed farmers use

plants, 13% use synthetic products and plants and 6% use synthetic products exclusively to treat chicken diseases (Fig. 5).

Qualitative traits of local chicken

Plumage color: Five plumage colors were observed in indigenous chicken (Table 4). Black was the dominant color of the plumage (35%) followed by partridge (23,5%) and white (22,25%. Other colors like red (13,5%) and mahogany (5,75%) were also observed at low proportions.

Skin and eye colors: According to the present study, white skin (65.5%) is more prevalent than yellow skin (34.5%).

However, the result of eye color indicated that the dominant color was orange-red (58.25%) followed by black-brown color (36%). The yellow color (5.75) was also observed at a low percentage (Table 4).

Beak color and shape: Indigenous chickens have distinct beak colors, black beaks were more prevalent (51.5%) than white (34.5%) and yellow beaks (14%). The majority of chickens have straight beak (58%) followed by curved beak (42%) (Table 4).

Crest and barbel color and shape: Table 5 shows that the pink crest color and single shape crest were more prevalent

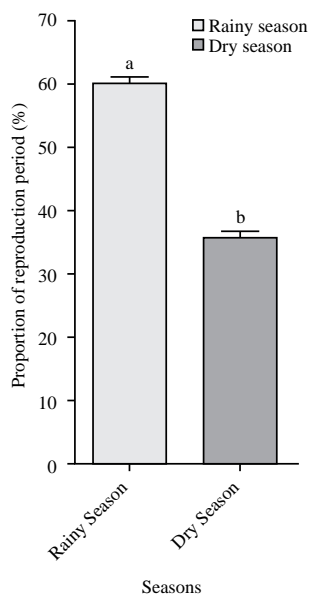


Fig. 2: Period of good reproduction

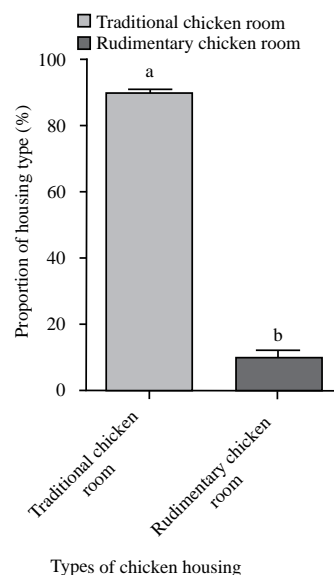


Fig. 3: Main chicken housing in Abeche City

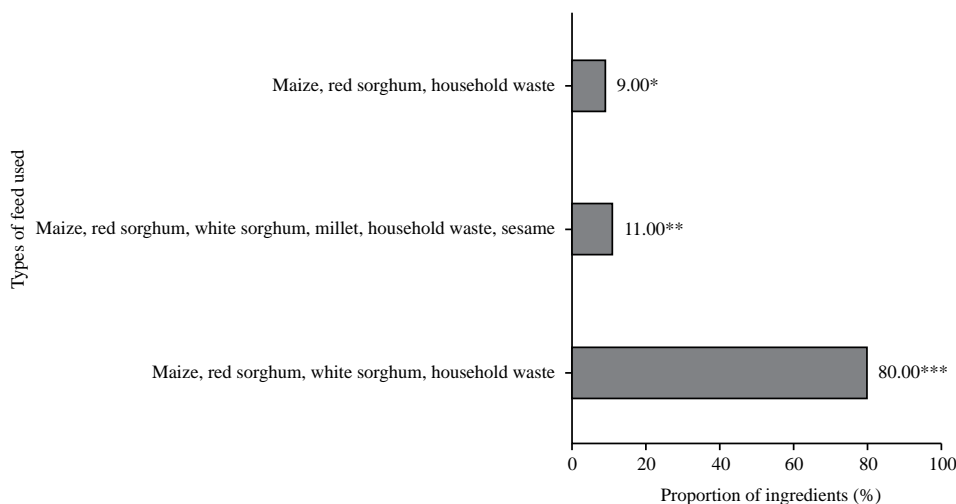


Fig. 4: Different types of feed used in local chicken feeding

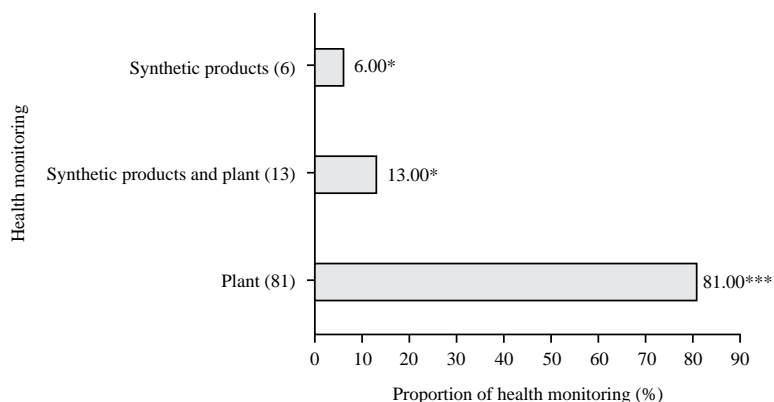


Fig. 5: Health monitoring in the chicken breeding

Table 4: Distribution of colors of plumage, eye, beak and beak shape of indigenous populations of chickens

Qualitative traits	No.	Proportion (%)
Plumage color		
Black	140	35.00
Partridge	94	23.50
White	89	22.25
Red	54	13.50
Mahogany	23	5.75
Skin color		
White	262	65.50
Yellow	138	34.50
Eye color		
Orange red	233	58.25
Black brown	144	36.00
Yellow	23	5.75
Beak color		
Black	206	51.50
White	138	34.50
Yellow	56	14.00
Beak shape		
Straight	232	58.00
Curved	168	42.00

Table 5: Distribution of colors and forms of crest and barbel of indigenous populations of chickens

Qualitative traits	Colors		Forms	
	Red	Pink	Single	Double
Crest				
No.	196	204	264	136
Frequency (%)	49.00	51.00	66.00	34.00
Barbel				
Number (n)	194	206	274	126
Frequency (%)	48.5	51.5	68.50	31.50

Table 6: Local chicken weight and body measure

Sex	Body weight (g)	Body length (cm)	Tarsal length (cm)	Body girth (cm)
Male	1406±0.33	31.06±0.29	11.58±1.03	29.46±1.56
Females	1019±0.36	29.40±0.37	7.89±1.22	25.00±1.02

than the red color and double crest shape. Pink was the dominant barbel color (51.5%), followed by red (48.5%) but the barbel shape varies among flocks, majority of chickens had a round shape (68.5%) followed by oval shape (31.5%) (Table 4).

Tarsal color: The present finding showed that the black tarsal color was more prevalent than the gray, white and yellow color (Fig. 6).

Body measurements of indigenous chicken: According to these results, the average live weight (1406 ± 0.33 g) of the indigenous rooster was higher than that of the hen (1019 ± 0.36 g). The body length (31.06 ± 0.26 cm) of the rooster was higher than that of the hen (29.4 ± 0.37 cm) (Table 6). Table 6 shows that the tarsal length varies according to sex. The tarsal length (11.58 ± 1.03 cm) of the rooster was higher than that of the hen (7.89 ± 1.22 cm). The rooster's body girth (29.46 ± 1.56 cm) was heavier than that of hen (25 ± 1.02 cm).

The main constraints of local chicken: Figure 7 presents the different constraints of family poultry farming. According to this figure, diseases were the main constraint (51.89%), followed by the predator coupled with theft. Feed problems and lack of technical supervision was also observed in low proportions.

DISCUSSION

Profile of poultry farmers: The results of the study revealed that most poultry farmers are married men aged 36 years, which confirms the findings of Tellah *et al.*⁹ and Leng *et al.*¹⁰. The predominance of men in family poultry farming has also

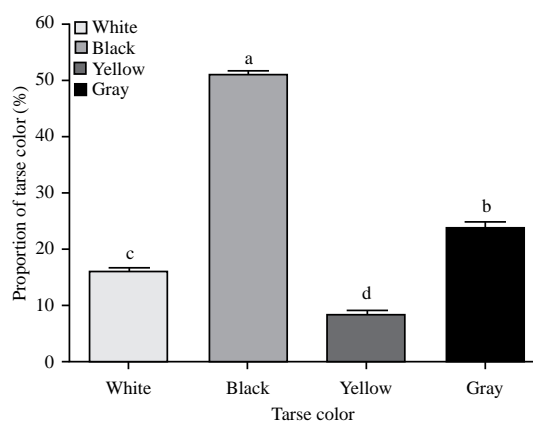


Fig. 6: Tarsal color

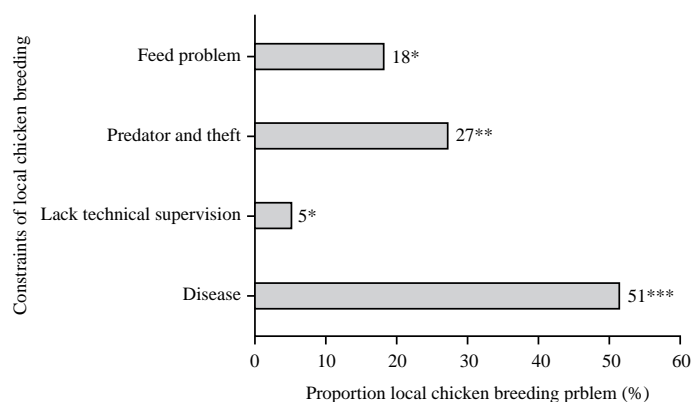


Fig. 7: Mains constraints of local chicken breeding

been observed in Senegal and the Democratic Republic of Congo^{11,12}. However, in Burkina Faso, poultry farming is generally practiced by women¹³. In contrast, Fall *et al.*⁴, reported that poultry farming is practiced by various socio-professional categories with an age range of 15-69 years. Agriculture was the main activity of poultry farmers (48.74%), followed by commerce. These results are supported by Youssouf *et al.*⁶ in Chad.

Management of the flock: Results of the present study showed that the majority of surveyed farmers built shelters for their poultry using locally available materials such as straw roofs and earthen walls. These results are confirmed by Fall *et al.*¹⁴, who showed that 95.71% of poultry farmers have shelters for their birds. However, according to Bisimwa *et al.*¹⁵, majority of farmers (81.11%) use their own houses or kitchens to shelter chickens at night, while others spend the night under trees.

Feeding practices: After free-ranging, poultry is supplemented with household waste and grain groups (such as maize, white sorghum and red sorghum). The results of the study showed that the majority of family poultry farmers provide complementary feed to their poultry, while a lower proportion of households do not supplement their poultry. Similar observations were reported by Fall *et al.*¹⁴.

Health monitoring: The survey results revealed that the majority of farmers use plant bark or leaves to counter different bird pathologies, while a minority use synthetic treatments. These results confirm the assertion of Nahimana *et al.*¹⁶, who found that in Senegal, farmers use traditional pharmacopeia or modern treatments in case of illness. The phenotypes observed in the indigenous chickens of the study area are characterized by great diversity. The observed feather colors were either solid or multicolored. The black plumage color was the most prevalent with a

proportion of 35%, followed by the partridge plumage color (23.5%). Mahogany plumage was relatively low, accounting for 5%. According to Keambou *et al.*¹⁷, local chickens have a predominantly black plumage coloration and in addition, it may impact predators because the black color is not easily spotted by predators. These results differ from those of Dassidi *et al.*⁷, in Abeche, where the partridge plumage color was the most observed. The result revealed that the majority of local chickens have the same coloration of the beak and tarsal, with a dominant black color. However, it should be noted that these colors do not have equal proportions for the beak and tarsi. Keambou *et al.*¹⁷, observed 8.83% of white beaks, whereas 39.6% of white tarsal in chickens in the same study area. Conversely, Mahammi *et al.*¹⁸, observed 23.7% of yellow beaks and 50.3% of yellow legs in the same population of chickens. There is a genetic connection between the coloration of the beak and tarsi as they are controlled by the same gene¹⁹. In the study area, local chicken population displayed multiple colorations in their eyes, with a predominance of orange-red color (58.28%), followed by brown-black color (36.18%). Yellow color, on the other hand, was in low proportion (5.52%). These results contradict with those obtained in Abeche by Dassidi *et al.*⁷, who observed a high frequency of brown-black color (45.45%), followed by reddish-orange eye colors (43.18%).

Most indigenous chickens in the study area have red and round-shaped barbel. These results partly confirm the assertion of Keambou *et al.*¹⁷ who reported that most local African chickens have round-shaped, red barbel. The results of this study showed that the majority of indigenous chickens have a single crest and pink color. The pink coloration of the barbel and crest observed in this study may be related to the fact that the hens in this study area were in large number, as it is well established that the pink color of the hen's crest can be due to recessive autosomal mutations that reduces the vascularity of the crest and barbel²⁰. Regarding the shape of the crests (single), Dana *et al.*²¹ obtained similar results in Ethiopia, where the majority of crests were single (normal). Christophe *et al.*¹⁹ also observed 85.4% of single crests in Benin. These authors reported that the single crest tends to be more frequent in local chickens from their respective study areas.

As observed, the skin color of local chickens in the study area is predominantly white, followed by yellow. The predominance of white skin color can be explained by the fact that the allele responsible for melanin inhibition is dominant over the wild allele, which produces dark colors ranging from gray to black²². Melanin production is inhibited by the

stimulation of the allele responsible for the deposition of dietary pigments (xanthophylls), giving the skin and tarsi a yellowish color²³.

The present findings revealed that the roosters (1406 g) had higher body weight, length and girth than the hens (1019 g). These results could be attributed to the existence of sexual dimorphism in favor of roosters²⁴. This result is inconsistent with a previous study conducted by Moula *et al.*²⁵, who also reported that roosters had higher body length and body girth than the hens. The current investigation revealed that roosters have significantly higher tarsal length than hens. These results were significantly higher than those reported for local chickens in Côte d'Ivoire by Yapi-Gnaoré *et al.*²⁶ and in Togo by Dao²⁷, who obtained respective values of 9.88 and 9.1 cm. The length of the adult roosters' wattles was 4.6 cm. This is consistent with the findings of Yapi-Gnaoré *et al.*²⁶ in Côte d'Ivoire.

The results also revealed that poultry farmers choose breeders based on their breed quality and egg-laying performance, while others select them based on brooding performance. These results differ from those of Dassidi *et al.*⁷, who select breeders based on plumage color and bird weight.

Productivity: The survey results showed that the average age of onset of egg-laying is 22 weeks. These results are lower than those obtained in Ethiopia by Tadelle²⁸ and in Kenya by Magothe *et al.*²⁹, where the age of onset of egg-laying was 24 and 28 weeks, respectively. This variation in the age of onset of egg-laying may be due to environmental conditions, feeding and a variety of genetic factors. In total, 51.55 eggs were laid per hen per year, with 3.75 successfully brooded and a hatching rate of 72.83%. These results are higher than those obtained in Abéché by Dassidi *et al.*⁷, except for the hatching rate, which is lower than that reported by these authors. Furthermore, the results revealed that during the rainy season, feed supplies were rich and diverse therefore, the rainy season was the period of optimal reproduction. Diseases were identified as major constraints in family poultry farming, as it is well known that pathologies hinder the poultry sector's development³⁰.

CONCLUSION

Local chicken production is an important way for boosting household income and enhancing food security of the poorest population. The research revealed that indigenous chicken of Koundoul city have low production in terms of eggs per hens per year, hatchability and live weight. Domestic

chicken of study area has also phenotypic diversity such as black plumage color, orange red eye color, black beak and gray tarsal. Disease, predators and theft were the main constraints faced by local chicken breeding. It is important to explore genetic and management investigation.

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