



Research Article

Productivity Parameters of Native Chickens in Chad

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Abstract

Background and Objective: Chickens are the main source of animal protein for rural populations in Chad, as well as a source of income for farmers, particularly women. The purpose of this study was to improve knowledge of the productivity parameters of indigenous Chadian chicken. **Materials and Methods:** The study was undertaken in three agro-ecological regions [Sudanian zone in the south (West Mayo-Kebbi), the Sahelian in the North-West (Hadjer Lamis/Lac) and Guera in Central Chad]. A sample of 221 hens was monitored for 13 months for productivity parameters. Descriptive statistical analysis was performed to describe the main features of a dataset such as measures of central tendency (Mean \pm standard deviation) and percentages. **Results:** The average numbers of chickens vary from 20.48 heads in Hadjer-Lamis/Lac to 28.92 in West Mayo-Kebbi and most poultry farmers raise other animals. The chicken start laying at the age of 182.22 days or 3 months with an average weight of 1.43 kg and lay 12 eggs on average, with a hatching rate of 79% and wean 6.53 chicks after 63 days. On average, hens lay 3.42 times a year. **Conclusion:** Throughout the study area, breeding practices and performance were characteristic of an extensive removal system.

Key words: Animal protein, agro-ecological zones, Chad, egg production, local chicken, productivity parameters

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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.

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INTRODUCTION

Chad is a pastoral country but the demand for animal protein is increasing due to population growth. The pastoral economy is primarily based on ruminant breeding, which contributes significantly but also encounters additional difficulties. Monogastrics (pigs and poultry) reproduce more quickly and produced a higher carcass yield in units of time and are suitable for rural areas¹. Although, poultry are present in many families but they play a small role in the country's economy. It is common for chickens to roam freely throughout the whole year in most towns and villages. They are also kept in small numbers (5-10 heads) by families. Their meat and eggs have a pleasant taste compared with the meat and eggs produced by commercial chickens. It is estimated that there are 47.8 million chickens in the national herd, most of which are produced by families². It has been reported by several authors that poultry contribute to meet animal protein needs and provide important financial resources for producers³⁻⁵. Capitalization also allows farmers to create ruminant farms, acquire agricultural inputs, organise sacrifices, make donations and welcome guests, thus strengthening social ties⁶⁻⁸. The objective of this study was to estimate the productivity of native chickens in three ecological zones of Chad.

MATERIALS AND METHODS

Study site: Three sites have been selected, two in the Sahelian zone and one in the Sudanian zone of Chad. These zones correspond to the administrative divisions of first instance of the country, namely the Regions.

- **The region of guera:** Mongo as its capital city and the Department of the same name. It is the tenth city of Chad by number of inhabitants (20.676 in 2009) and is located between latitude 12.190 N and longitude 18.690°E.
- **The regions of Hadjer-Lamis and Lake Chad:** Massakory is the support center, capital of Region and Department. The survey covers as far as the Lake Chad Region, Bol is the capital city. The latter is located between latitude 12°10' and 14°20' N and between longitude 13°30' and 15° 40' E.
- **The Region of West Mayo-Kébbi:** Pala is the capital city of the Region and is the Department of Mayo-Dallah. It is the seventh largest city in Chad by population (26.100 at the 2009 census) and lies between latitude 9,360°N and longitude 14,900°E. 87. The West Mayo-Kébbi region is known for its cotton and cereal production, while the other two sites are predominantly livestock-based.

Sampling and data collection: In order to conduct a comparative study of these three ecological sites in the study area, 15 villages per region were selected after poultry farmers and local administrative officials were sensitized to participate in the survey, i.e. 45 households in total. Depending on the number of chickens in households (at least eight hens in breeding), only five households per region were selected for a one-year follow-up, yet at least five hens per household: 75 hens in West Mayo-Kebbi, 71 in Guera and 75 in Hadjer-Lamis/Lac. For data collection, two methods were implemented:

- In order to monitor reproduction parameters (number of laying per year, eggs per laying, hatching rate, survival rate, etc.), five households per site (at least five hens per household) were selected to monitor the productivity parameters of chicks until the date of their re-entry into laying. In the follow-up, one visit per week was made to the households over a period of 13 months, started in January 2021 and ended in April 2022.
- Each interviewer was visited twice during the data collection phase after training on collection techniques and the completed sheets were validated as the progress was made. In case of non-satisfaction, the cards were resumed. The significant losses of some animals were noted in follow-up (chicks and hen) due to Newcastle disease that occurred in West Mayo-Kebbi and Guera in January and February 2022.

Data analysis: The data were analyzed using two-way analysis of variance (ANOVA) and descriptive statistics. Student's t-test was used to compare the different averages at the 5% level of significance. Descriptive statistical analysis was performed using the Statistical Package for Social Science (SPSS)⁹ 18.0.5 for Windows (SPSS, Inc., IBM, Chicago, Illinois, USA).

RESULTS

Characteristics of village livestock: There were 75 farms surveyed in West Mayo-Kebbi, 71 in Guera and 75 in Hadjer-Lamis/Lac. Among the total number of farms, 18.23% of farms raise chickens alone, 18.75% raise other poultry and the rest raise other animals (cattle, goats, sheep and equidae). The poultry farmers in the Hadjer-Lamis/Lac did not own cattle and those in West Mayo-Kebbi did not own equines. The chickens were owned by 42.25% of the family, 30% by the mother, 15.39% by the father, 7.04% by the children and 1.97% had been entrusted. In West Mayo-Kebbi, 72.41%

Table 1: Percentage of species association in traditional livestock farming in the three zones

Association type	West Mayo-Kebbi	Guera	Hadjer-Lamis/Lake	Total
Chicken alone	16.98	12.00	26.56	18.23
Chicken+other poultry	30.18	16.00	12.50	18.75
Poultry+cattle	16.9	26.66	0	15.10
Poultry+small ruminants	28.30	24.00	37.50	29.69
Poultry+equidae	7.53	21.33	23.44	16.14

Table 2: Chicken population structure and composition (mean and standard deviation) of the surveyed traditional farms in the study area

	Chick	Pullet	Cockerel	Hen	Rooster	Total
Average	12.83	4.23	447	2.63	3.25	12.69
Standard deviation	8.05	6.45	10.92	2.59	2.49	14.32
Maximum	38	40	69	12	11	69
Minimum	2	1	1	1	1	1
Total	590	182	170	121	143	1206
Percentage	48.92%	15.09%	14.10%	10.03%	11.86%	100%

Table 3: Monthly average production of farm in the three study areas

Region	Mortality						Total
	Total	Chicks	Sale	Predation	Consummate	Accident	
West Mayo-Kebbi	13.79±5.50 ^a	10.38±5.09 ^a	7.57±4.65 ^a	9.62±4.60 ^a	4.55±2.149 ^a	2.83±2.14 ^a	32.60±12.75 ^a
Guera	2.92±1.83 ^b	2.91±1.92 ^b	5.17±2.21 ^a	1.92±0.67 ^b	2.17±1.47 ^b	1.33±0.59 ^b	9.79±4.15 ^b
Hadjer-Lamis/Lake	10.25±6.20 ^a	7.20±4.82 ^c	10.57±9.15 ^b	5.11±2.60 ^c	2.57±1.69 ^b	2.67±2.08 ^a	27.95±13.39 ^c
Total	10.00±9.84	7.96±6.55	9.23±8.08	5.71±4.60	3.01±2.21	2.42±1.83	26.61±8.12

The averages of columns with different letters are significantly different at the 5% threshold

chickens belonged to the family and 13.79% chickens were entrusted, a practice that does not exist in the other two regions. On the other hand, women are mostly owners in Guera and Hadjer-Lamis/Lac, respectively 50% and 43.48% as compared to 3.45% in West Mayo-Kebbi. West Mayo-Kebbi has a low rate of "father" homeowners (3.45%) but Guera has a high rate (35%). In most of the study area, it appears that the "father" owners do not own cattle. There is a wide variety of domestic animal species owned by households (Table 1). Pork was previously more widely reared by housewives but it was no longer reared by them during the survey period.

Structure of surveyed chicken herd: The average backyard population was 31.03±13.19 head and chickens were 25.44±11.40 per farm. The averages for the three regions were not significantly different. It was observed that 48.92% of the population was Chicks, 29.19% were juveniles (pullets and cockerels), 78.11% were under 5 months (chicks and young) and 21.89% were adults (roosters and hens). Compared to adult chickens (1.206 head), 25.96% of the population were males and 25.12% were females. The ratio of chicks to the rest of the population was 0.49. The ratio of the young under 5 months to adults was 0.29. In contrast, the ratio of youth (aged 3 to 5 months) to adults was 1.33 (Table 2). The ratio of average backyard to average household size was 4.88 chickens per person.

Population movements in livestock: The average farm outflow was 27.61±8.12 chickens per month, ranging from 9.79±4.15 in Guera to 32.60±12.75 in the West Mayo-Kebbi region. The Hadjer-Lamis/Lac region had an intermediate average of 27.95±13.39 chickens per month. Mortality, sale and losses by predation were the main causes of exits with proportions of 36.86, 33.36 and 19.59% respectively. In terms of total mortalities, chick loss accounts for 28.48% of total output with an average rate of 77.25%.

Table 3 shows that the average mortality rate in Guera was significantly lower than Hadjer Lamis/Lac or West Mayo-Kebbi (13.79±5.50) about three chickens per month compared to triple in Hadjer Lamis/Lac or even quadruple in West Mayo-Kebbi. The mean predation (9.62±4.60) and consumption (4.55±2.149) in West Mayo-Kebbi were significantly higher ($p \leq 0.05$) than sale in Hadjer Lamis/Lac (10.57±9.15). In Sahel, sales profit was used for field work, school supplies, children's clothes, cereals, tea, sugar, oil and small ruminants, while in the southern zone mainly for field work and daily needs. It is estimated that poultry farmers in the study area consume three chickens per month on average, with a higher value in the West Mayo-Kebbi ($p \leq 0.05$).

The main sources of entry into village farms in the study area were hatching, purchases, donations and bequests. Hatching accounted for 22.44±13.24 chicks per month or 81.69% of the total, was the main source of entries, followed

Table 4: Monthly average of entries monitored on farms in the three study areas

Region	Hatching	Purchase	Donation	Entrustment	Total
West Mayo-Kebbi	29.44±14.41 ^a	2.00±2.56 ^a	2.13±1.36 ^a	2.00±0.89 ^a	31.56±15.00 ^a
Guera	13.40±5.81 ^b	0	0	0	13.40±5.81 ^b
Hadjer Lamis/Lac	21.33±12.44 ^c	6.66±3.53 ^b	2.17±1.27 ^a	1.40±0.55 ^b	27.92±14.71 ^c
Total	22.44±13.24	5.87±3.80	2.16±1.27	1.73±0.79	27.20±12.94

The averages of the lines with different letters are significantly different at the threshold of 5%

Table 5: Average of productivity parameters monitored in the three zones

Parameters	West Mayo-Kebbi	Guera	HadjerLamis/Lake	Total
Laying rank	2.48±1.29 ^a	1.80±0.91 ^b	2.12±0.73 ^c	2.13±1.03
Number of laying per year	3.38±0.68 ^a	4.01±1.22 ^b	2.86±0.93 ^a	3.42±1.03
Number of eggs laid	12.76±2.55	11.20±2.04	11.96±2.32	11.97±2.37
Number of eggs incubated	12.00±2.24	10.56±1.80	11.30±2.16	11.45±2.15
Brooding rate (%)	95.00±7.00 ^a	95.00±10.00 ^a	99.00±5.00 ^b	96.00±8.00
Number of chicks hatching	9.45±2.72	7.80±2.47	9.96±2.07	9.06±2.57
Hatching rate (%)	78.00±14.00 ^a	73.00±17.00 ^b	85.00±10.00 ^c	79.00±14.00
Chick weight at hatching (g)	28.55±3.71	25.39±4.20	31.07±4.15	28.55±3.75
Age at weaning (d)	60.88±18.21 ^a	72.08±11.39 ^b	51.44±7.86 ^c	61.47±15.55
Number of weaning chicks	7.56±2.29	5.40±1.87	6.64±2.29	6.53±2.31
Weaning rate (%)	80.00±15.00	70.00±19.00	66.00±20.00	72.00±19.00
Weaning weight (g)	375.28±5.00 ^a	272.64±45.94 ^b	432.00±90.00 ^c	316.64±160.15
Age at 1st laying (d)	199.96±8.84 ^a	201.40±17.15	183.75±15.27 ^b	182.22±30.07
Weight at 1st laying (g)	1570.20±103.21 ^a	1457.76±175.97 ^b	1241.67±147.20 ^c	1430.05±263.39

The averages of the lines with different letters are significantly different at the threshold of 5%

by purchases (15.18%). As compared to West Mayo-Kebbi (29.44±14.41) and HadjerLamis/Lac (21.33±12.44) (Table 4), the outbreak was the only source of entry to Guera with a lower mean of 13.40±5.81.

Zootechnical performance: In all three zones, hens lay on average of 3.42±1.03 times per year. The mean number of eggs per clutch was 11.97±2.37, based on an average laying row of 2.13±1.03 eggs per clutch. There was an average of 11.97±2.37 eggs incubated per clutch, representing a brooding rate of 96% and a hatching rate of 79% for an average number of 9.06±2.57 chicks per clutch. The weight of chicks at hatching was 28.55±3.75 g. The average number of chicks weaned per pont was 6.53±2.31, at the age of two months (61.47±15.55 days) with an average weaning rate of 72%. The average weight of hens when they lay was 1,430.05±26.39 g at the age of 182.22±30.07 days. The best productivity performance was better in West Mayo-Kebbi and the HadjerLamis/Lac region. In Guera, these parameters were generally lower as shown in Table 5.

DISCUSSION

Over a period of 13 months, a study in three ecological zones of Chad determined the number and composition of village chicken herds and evaluated productivity parameters. In the study area the average number of chickens per household (25.44) was higher than that reported in Togo

(21 heads)¹⁰, in Niger¹¹ (12 heads), Cameroon (10.3 heads)¹², Senegal¹³ (5-15 heads). It was also observed in the range of 20-30 heads in Mali¹⁴ 20 to 50 heads in Madagascar¹⁵ and 26.6 heads in Guera, Chad². Within the regions, numbers vary from 20.48 at Hadjer-Lamis Lac to 28.92 at West Mayo-Kebbi and are linked to the socio-economic importance and environmental factors of the three areas. This could explain the high number of chickens per household. The proportion of roosters to adults (23.21%) was higher than that reported in Chad: 14.5% in rural N'Djamena¹⁶ and 19% in southern Chad⁷ compared with 9.5% in vaccinated areas in Burkina Faso¹⁷. The proportion of hens was lower than the results (89.5%) of Brunet *et al.*¹⁹. The high proportion of roosters observed could be explained by a high rate of subjects less than 5 months of age (chicks and young) which represent 78.11% of the average population.

The number of clutches per year (3.42) was close to 3.8 clutches reported by Mopate *et al.*² in Guera. It is higher than the range of 2.7 to 3 observed in Burkina Faso¹⁸, 2.5 in Ghana¹⁹, 2.1 in Central Mali²⁰, 3 in Tanzania²¹ and 3.20 in Côte d'Ivoire²². In contrast, it is lower than that in Sudan (4.5)²³. In addition, study carried out in an integrated system in the South Pacific Region²⁴ had shown that the wandering hen performs a maximum of 3 breeding cycles per year, whereas in an integrated operating system, it produced at least 5 cycles.

The mean number of eggs (12) per clutch observed in the present study was in the range of 12 to 18 reported in Burkina Faso¹⁸, 12 to 15 in Mali¹⁴, 12 to 13 in Tanzania²¹ and 10 to

12 eggs in DRC²⁵. This average value is also in the range of 10 to 15 eggs reported in Côte d'Ivoire²⁶. On the other hand, it is higher than that reported by Wilson *et al.*²⁰ (8.8 eggs), by Aklobessi *et al.*⁶ (10 eggs) by Wilson²³ (10.9 eggs) and by Mopate *et al.*² (11 eggs). In Chad, overall results of the present study (3.42 clutches/year and 12 eggs/clutch) were close to those obtained (3.6 clutches/year and 11 eggs/clutch) in Guera². On the other hand, they were higher than those (3 clutches/year, 10.5 eggs/laying) observed in rural N'Djamena¹⁷ but lower in number of eggs per clutch (13.7) per year (47) in southern Chad⁷. Different driving practices (housing, food and care) are implemented in different regions, which can explain the differences in the parameters observed. There were best results in West Mayo-Kebbi during the wet season when vegetation protects the chicks and provides abundant food (young shoots and harvests) and temperatures suitable for brooding.

Our average brooding rate (96%) was higher than that of the DRC (84.5%)²⁵, southern Chad (86%)⁷, Mali (86.7%)¹⁴, Guera (87%)² and Darfur (90%), Sudan²³. Probably because most laying and brooding takes place in family huts or under attics that provide good protection for eggs, this rate is relatively good. Family huts also provide some security against predation.

Village hens here reach laying age at 182 days with an average weight of 1.43 kg, older than that of the Egyptian Mandarrah breed at 139 days²⁷, local Moroccan hens at 174 days²⁸ and Tanzanian hens at 149 days²⁹. This age is close to the laying age of local hens in Brazzaville from 6.13-6.26 months³⁰ and lower than the age of the local hen of Bas-Congo with 202 days²⁵. The hatchability rate of 79% recorded in this study was lower (84.5%) than that of Moula *et al.*²⁵ in DRC and was in the range of 62.7 to 83.5% as observed by Akouango *et al.*³⁰ in Congo. The weaning rate (72%) of chicks with an average age of 61.47 days and the number of weaned chicks (6.53) were similar to those observed by Mourad *et al.*³¹ and Benabdeljelil and Arfaoui²⁸ in local breeds in Morocco and Guinea, where rates were above 77%. In Bas-Congo in the DRC, the results of Moula *et al.*²⁵ were significantly lower (40%).

The average clout per year (3.42) was similar to those reported by Mopate *et al.*² (3.8) in Guera. It was higher than those observed in Burkina Faso (2.7-3)¹⁸, Ghana (2.5)¹⁹, Central Mali (2.1)²⁰, Tanzania (3)²¹ and Côte d'Ivoire (3.20)²². On the other hand, it was lower than those reported in Togo (4)⁶ and Sudan (4.5)²³. In addition, a non-integrated farming system in the South Pacific region²⁴ found that the wandering hen performs a maximum of 3 reproductive cycles per year, whereas in an integrated farming system, they produce at least 5.

The mean number of eggs (12) per clutch was similar to those observed in Burkina Faso¹⁸ (12 to 18 eggs), Mali¹⁴ (12 to 15), Tanzania²¹ (between 12 and 13) and in Bas-Congo²⁵ (10 to 12 eggs). This average is also in the range of 10 to 15 eggs reported in Côte d'Ivoire²⁶. On the other hand, it is higher than those reported by Wilson *et al.*²⁰ (8.8 eggs), Aklobessi *et al.*⁶ (10 eggs), Wilson²³ (10.9 eggs) and Mopate *et al.*² (11 eggs). In Chad, our results (3.42 clutches/year, 12 eggs/clutch) were higher (3 clutches/year, 10.5 eggs) than those observed in rural N'Djamena¹⁶ but lower in number of eggs per clutch (13.7) per year (47) than those observed in southern Chad⁷.

CONCLUSION

In this study, the production characteristics and productivity of local chickens were assessed. Despite the traditional management of the farms surveyed, the results indicate that native hens are productive and their performance can be improved through improved farm management. In addition, the results of the present study can be used to implement innovations aimed at improving farm productivity.

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