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Poultry Systems and Zootechnical Performances of Traditional Local Chicken in Côte D'ivoire

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Abstract: A study was carried out to evaluate the impact of the farming system on certain breeding performances of traditional chicken. Four batches, each consisting of four hens and one cock, were bred for six months, one in semi-intensive condition with food supply and the other three in extensive condition by three different farmers where the animals are left wandering for their food need. The mean number of broods (3) per hen obtained in the improved breeding system was significantly different from that established for the indigenous farming system (1.83). The average spacing of broods was significantly reduced (66.83 days) in improved condition compared with the indigenous breeding system (114.78 days). The hatching rate was 83.49% with the improved breeding system and 74.28% with the extensive system, showing an increase by approximately 10% with the improved breeding system. The average live weight at 150 days was significantly higher in semi-intensive (1017.68 g) than in extensive (854.73 g). The survival rate of chickens at 150 days of semi-intensive farming (53 individuals) is twice as high as the survival rate of chickens in the indigenous farming condition (22 chickens). The improved breeding conditions have resulted in a considerable increase in the zootechnical performance of traditional chickens. This work opens up promising prospects for an economically profitable and

sustainable breeding model that can be proposed to the actors of the traditional poultry sector.

Key words: Traditional chickens, improved and farmer breedings, zootechnical performances, Côte d'Ivoire

INTRODUCTION

In developing countries, poultry constitutes the smallest livestock investment for a rural household [1]. Indeed, in resource-poor settings, chickens are among the most economically affordable animals. Thus, small-scale poultry production systems are found mainly in resource-poor and often food-insecure rural areas[2]. For small farmers, family poultry is one of the few opportunities for savings, investment, access to health care and education, and protection against risk. It is a source of nutrient-rich foods. In addition, small-scale poultry production systems are a particularly important income-generating activity for women contributing to their empowerment. In Cote d'Ivoire, a socio-economic study conducted by N'goran et al.[3] in the region of Korhogo showed that poultry farms are small with livestock sizes ranging from 10 to 105 chickens. The workforce is typically composed of family members. However, they remain a secondary activity and, therefore, are combined with other agricultural activities and/or dairy cattle husbandry. Mainly women (60%) and young people (62.27%) practice the traditional breeding of poultry. It is an activity mainly destined for consumption (82%), and a small percentage (20%) of the production is for sale. The conditions of poultry farming are precarious with an extensive breeding system that has primitive characteristics without any real animal feed and care. This leads to poor production performance of the indigenous chickens. It therefore appears necessary to improve the breeding conditions of the local indigenous chickens in order to define standards for sustainable and economically profitable exploitations and thus contribute to food security. It will also help to preserve the local breeds whose continuous disappearance at an accelerating pace is a disaster for the universal gene pool by the irreversible loss of characters unknown today but which may be potentially useful tomorrow [4,5] . In this perspective, the present work proposes to study some zootechnical performances of the local indigenous chicken « *Gallus gallus domesticus* » in two different farming systems.

MATERAL AND METHODS

Study Area: This study took place between June 2016 and February 2017 in the department of Dabakala, Cote d'Ivoire, with geographic coordinates 8° 22' Latitude North and 4° 25' Longitude West. Located in North-Central Cote d'Ivoire, in the sudanian zone, Dabakala has savannah woodland-type of vegetation, severely degraded by bush fires that roam the area in the dry season. The climate is tropical sudano-guinean with a single rainy season[6] with rainfall ranging from 900 mm to 1200 mm. The experiment was carried out at two sites: one site was established in the city of Dabakala and has the improved farming system. The other site is in the village of Ouassegbogo, 14 km north of the city of Dabakala, and has the extensive farming system.

Material and Data Collection: The study population consisted of indigenous local chickens, commonly called « bicycle chickens ». With the extensive farming system, three farms of four hens weighing on the average 932.46 g and one rooster with average weight of 1171.25 g were set up. The chickens were left rambling in the farm for the search of their own food. Sometimes farmers provided them with a food supplement consisting of dried corn kernels, millet, corn bran or sorghum or even termites. In the improved system, the management of the farm involved a batch of four subjects,

including three hens with an average weight of 857.25 g and one cock of 1154 g. These animals were bred in a box of 12 m^2 of an improved hen house and fed with commercial feed. Eggs were brooded by the mother hens. The chicks were fed on crumbs of food with the care of the mother hens until weaning (15-30 days old). The weaned subjects were fed on food grown commercially in a 12 m^2 box separated from the parental lodge. A period of six months of activity has been defined for each breeder from the date of reception of the breeding subjects. During that period, the number of broods and the average number of eggs per clutch were determined. Eggs were weighed and measured (length, big-end diameter). The chick weight at birth and the egg yield estimated as the ratio of the chick weight at birth to egg weight were determined. The subjects were weighed every two weeks from birth to 150 days of age. The number of offspring of each batch of broodstock obtained at the end of six months of rearing was determined.

Statistical Analysis: The data were analyzed with XLSTAT 2017:01.41270 to produce the descriptive statistics including the means and the standard deviations. The comparison of means was performed using the Student's t test with a level of significance $\alpha = 0.05$.

RESULTS

Brooding Parameters: The brooding parameters observed during the six months of breeding are recorded in **Table 1**. With the traditional primitive system, the number of broods per hen varied between 1.5 and 2 broods with an average of 1.83 broods. The interval between two broods under these rearing conditions averaged 114.78 days.

Table 1: Brooding parameters over six months of breeding

Breeders / Parameters	Farmer 1 (M)	Farmer 2 (M)	Farmer 3 (M)	Medium farmer system (M)	Improved system
Number of chickens	04.00	04.00	04.00	04	03.00
Number of breeding hens	02.00	03.00	03.00	02.67	03.00
Breeding rate (%)	50.00	75.00	75.00	66.75	100.00
Total number of broods	03.00	06.00	06.00	05.00	09.00
Average number of broods per hen	01.50	02.00	02.00	01.83	03.00
Interval between broods (days)	70.00	131.67	142.67	114.78	66.83
Total number of eggs	34.00	73.00	68.00	58.33	103.00
Average number of eggs per brood	11	12.17	11.33	11.50	11.44
Number of eggs hatched	32	51.00	47.00	43.33	86.00
Hatching rate (%)	94.12	69.86	69.12	74.28	83.49

M = Mean. % = per cent

On the other hand, in the improved breeding system, the average number of broods was 3 broods per hen, with an interval of 66.83 days between two broods. The total number of eggs harvested from the hens in the improved system was 103 eggs compared to a maximum of 73 eggs and an average of

58.33 eggs for the hens of the primitive system. The average number of eggs per brood was not influenced by the breeding system. It was 11.44 and 11.50 eggs per brood, respectively for the improved and primitive breeding systems. Although a relative hatch rate of 94.12% was recorded in the primitive farm, the average hatching rate determined in the primitive farming system (74.28%) remained below the average hatching rate obtained in the improved farming system (83.49%).

Weight and Dimensions of the Egg: The average weight of the egg in the primitive farming system was 37.09 g. It was 36.17 g in the improved farming system (**Table 2**). The difference between the two was not significant ($p > 0.05$). However, a significant difference ($p < 0.05$) was noted in mean egg lengths, which 49.08 mm in the improved system of rearing and 50.20 mm in the primitive system (**Table 2**). The average diameters of the big extremity of the egg were not significantly different ($p > 0.05$). They were 36.59 mm for the improved system and 36.86 mm for the primitive system (Table 2).

Table 2: Egg weight and measurement

Breeders / **Parameters**	**Farmer 1 (M ± ET-M)**	**Farmer 2 (M ± ET-M)**	**Farmer 3 (M ± ET-M)**	**Average peasant system (M ± ET-M)**	**Improved system (M ± ET-M)**
Mean egg weight (g)	37.69 ± 0.37^{ac}	34.91 ± 0.68^{b}	39.59 ± 0.89^{c}	37.09 ± 0.46^{a}	36.17 ± 0.47^{ab}
Mean length of the egg (mm)	49.55 ± 0.33^{a}	49.45 ± 0.28^{a}	51.66 ± 0.30^{b}	50.20 ± 0.20^{c}	49.08 ± 0.28^{d}
Egg diameter (mm)	37.18 ± 0.16^{a}	36.30 ± 0.23^{b}	37.38 ± 0.30^{a}	36.86 ± 0.15^{ab}	36.59 ± 0.20^{b}

g = grammes. mm = millimeters. a, b, c, d on the same line, the values assigned to the same letter are not significantly different ($p \geq 0.05$). M ± ET-M = Mean ± Standard deviation of the mean.

One-day Old Chick Weight and Egg Yield: The average birth weights of chicks are 24.18 g and 25.35 g, respectively for the improved and primitive breeding systems (**Table 3**).The egg yield observed in the improved rearing system (66.85%) was not significantly different from the one obtained with the primitive farming system (68.35%) at the level of significance $\alpha = 0.05$, due to the high variability of egg yield resulting in a high standard error of the difference of the two means.

Table 3: One-day-old chick weight and egg yield

Breeders / Parameters	Farmer 1 (M ± ET-M)	Farmer 2 (M ± ET-M)	Farmer 3 (M ± ET-M)	Average peasant system (M ± ET-M)	Improved system (M ± ET-M)
Mean weight of chicks at 1 day of age (g)	25.52 ± 0.74^{a}	26.39 ± 0.47^{b}	24.09 ± 0.57^{a}	25.35 ± 0.34^{a}	24.18 ± 0.37^{a}
Mean egg weight (g)	37.69 ± 0.37^{a}	34.91 ± 0.68^{b}	39.59 ± 0.89^{c}	37.09 ± 0.46^{a}	36.17 ± 0.47^{a}
Yield (%)	67.71^{a}	75.59^{b}	60.85^{c}	68.35^{a}	66.85^{a}

g = grammes. % = per cent. a, b, c on the same line, the values assigned to the same letter are not significantly different ($p \geq 0.05$).M ± ET-M = Mean ± Standard deviation of the mean.

Weight increase of subjects from one to 150 Days of Age: The weight of the subjects, aged between 1 and 150 days, varied on the average from 25.35g ± 0.34 g to 854.73g ± 50.40 g in the primitive farming system, and from 24.18 g ± 0.37 g to 1017.68 g ± 39.67 g in the improved culture (**Table 4**). At birth, chicks in the primitive farming system had a slightly higher average weight than chicks in the improved system. This difference in initial weight was gradually caught and then exceeded by the chicks of the semi-intensive improved system (1017.68 g) became significantly higher than the average weight of chickens in the primitive system (854.73 g) (**figure 1**).

Table 4: Growth of subjects from 1 to 150 days

Breeders / Parameters	Farmer 1 (M ± ET-M)	Farmer 2 (M ± ET-M)	Farmer 3 (M ± ET-M)	Average peasant system (M ± ET-M)	Improved system (M ± ET-M)
Weight 1 day (g) (M ± ET-M)	25.52 ± 0.74^{ab}	26.39 ± 0.47^{ac}	24.09 ± 0.57^{bd}	25.35 ± 0.34^{cd}	24.18 ± 0.37^{b}
Weight 15 days (g) (M ± ET-M)	36.41 ± 1.23^{a}	59.53 ± 2.44^{b}	53.00 ± 2.02^{bc}	49.32 ± 1.58^{c}	40.89 ± 1.59^{a}
Weight 30 days (g) (M ± ET-M)	80.80 ± 4.84^{a}	119.86 ± 5.01^{b}	106.10 ± 3.66^{c}	99.84 ± 3.40^{c}	68.81 ± 3.05^{d}
Weight 45 days (g) (M ± ET-M)	188.75 ± 6.26^{a}	227.75 ± 7.14^{b}	146.05 ± 6.97^{c}	153.17 ± 6.73^{c}	121.27 ± 6.79^{d}
Weight 60 days (g) (M ± ET-M)	Na	335.63 ± 13.48^{a}	213.28 ± 10.80^{b}	274.46 ± 11.80^{c}	233.72 ± 13.33^{b}
Weight 75 days (g) (M ± ET-M)	Na	453.5 ± 23.61^{a}	305.43 ± 10.26^{b}	322.69 ± 15.32^{bc}	371.27 ± 20.11^{c}
Weight 90 days (g) (M ± ET-M)	Na	669.00 ± 00.00^{a}	381.21 ± 15.29^{b}	400.40 ± 23.89^{b}	530.35 ± 28.27^{a}
Weight 120 days (g) (M ± ET-M)	Na	808.67 ± 62.06^{a}	563.27 ± 31.70^{b}	615.86 ± 38.91^{b}	834.23 ± 41.60^{a}
Weight 150 days (g) (M ± ET-M)	Na	956.50 ± 73.37^{a}	796.57 ± 59.70^{b}	854.73 ± 50.40^{b}	1017.68 ± 39.67^{a}

g = grammes. a, b, c, d on the same line, the values assigned to the same letter are not significantly different (p ≥ 0.05).M ± ET-M = Mean ± Standard deviation of the mean. Na = Not available

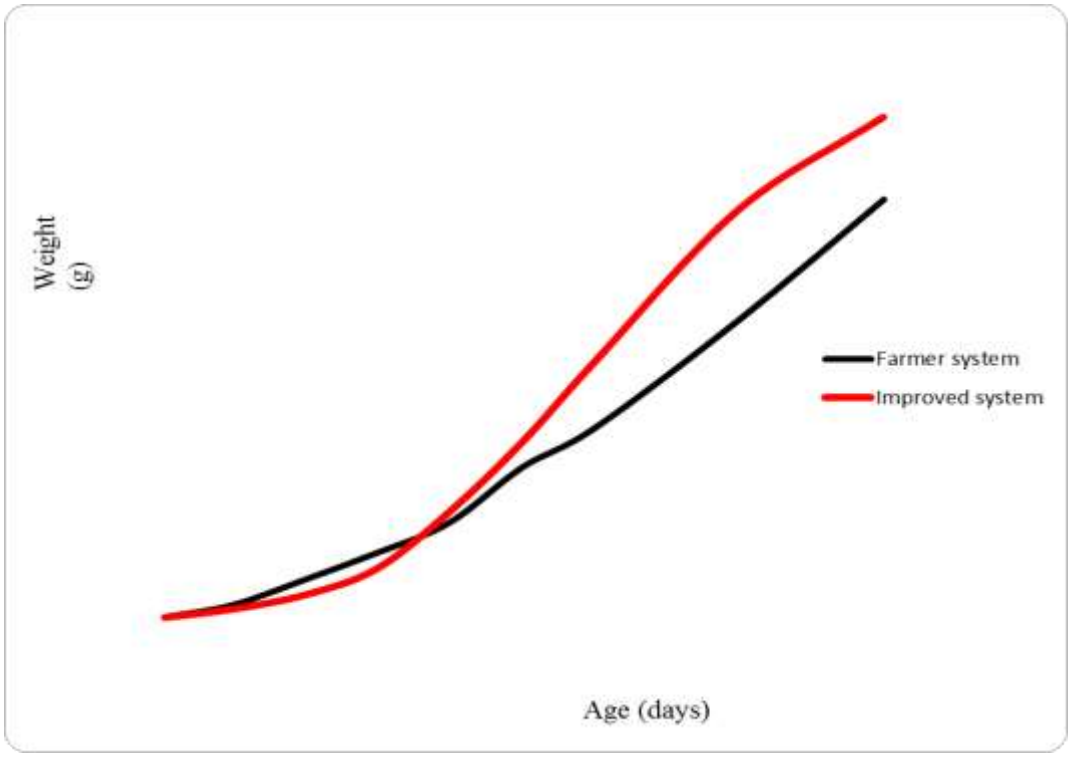

Figure 1: Growth curve of the subjects according to the rearing system

Number of offspring per age group at the end of the study: After six months of activity, the total number of offspring of the three hens of the semi-intensive system was 53 subjects against 30 descendants from the eight hens in all three farms of the primitive farming method (**Table 5**).

Table 5: Number of offspring by age group in each farm at the end of the study

Breeders / Age groups	Farmer 2 (n)	Farmer 3 (n)	Farmer system (n)	Improved system (n)
Age ≤ 15 days	07	07	14	11
15 < age ≤ 60 days	00	00	00	10
60 < age < 150 days	00	05	05	10
Age ≥ 150 days	04	07	11	22
TOTAL	11	19	30	53

n = **Number**

DISCUSSION

The average egg weight obtained in this study for the primitive method of rearing was similar to that (35.5 g ± 0.3 g) obtained by Akouango *et al.*[7]. However, the average weight determined for semi-intensive farming was well below those determined by Akouango *et al*.[8] and Zaza [9]. The difference in egg length, although significant, seemed to have no impact on the weight of the eggs, nor that of the chick at birth and therefore on the yield. For these two parameters, the effects of the two types of breeding were not significantly different. The average hatching rate of eggs was above 70% in both the primitive and semi-intensive breeding methods. The highest values were obtained in primitive farm 1 (94.12%) and in the improved farming system (83.49%). Alloui and Sassia[10] reported lower average hatching rates (0% to 50%) in Algeria than those obtained in this study. However, Akouango *et al.*[8] obtained higher hatching rate (71.7%) in laboratory experiment. According to them, hatching rate and age at the beginning of egg laying are closely related to the weight of the egg; likewise, the number of eggs laid and the weight of the egg.

The average number of brood per hen recorded in the primitive farms over a six-month period of activity was significantly lower than that recorded in the improved breeding environment ($p < 0.05$). In addition, the values obtained in this study corroborate those determined by Kouadio *et al.*[11] over one year, as well as those of Ayssiwede *et al.*[12] whose number of broods per hen per year was 3.4 in primitive farming system.

The interval between broods was considerably reduced in the improved system (66.83 days) compared to the primitive system (114.78 days). These data confirm the averages obtained (62.99 day, 114.59 days) by Kouadio *et al.*[11] respectively for the two farming systems. The important difference between the number of broods and the time interval between broods, observed between the two farming methods, was due to the better management conditions enjoyed by the hens in the improved system (balanced diet, suitable watering and housing with a good level of hygiene). Indeed, the availability of the rich and balanced food makes it possible to quickly compensate for the weight loss during brooding. In addition, the energy losses allocated for foraging and protecting chicks are minimized. This study confirms the observations of Huque *et al.*[13], Traoré [14] and Kouadio et al.[11] that early separation of chicks from mothers significantly increases the productivity of local indigenous hens. In fact, the early weaning of the chicks by the farmer allows the hen to feed itself better and to reconstitute its reserve even more quickly. The time interval between two broods is, thus, reduced and the number of broods in a year is increased. This has the positive effect of a near doubling of the number of eggs laid by the hens in the improved farming system with a higher hatching rate. The weaning time observed in the primitive farming system in this study is in line with the results from works carried out both in Côte d'Ivoire[11] and in several African countries, particularly in Senegal. Indeed, the average time evaluated is 3.25 months with extremes ranging from 2.1 to 5.7 months[12,14-16]. In natural setting, this time seems necessary to educate chicks, feed them and protect them from predators. On the other hand, early weaning and management of chicks by farmers under the improved conditions ensures their protection, adequate food and sanitary coverage resulting in the improvement of the observed growth. The weight of chicks at birth is identical in the two breeding systems used and are similar to those (23 g to 31 g) obtained by others[12, 17,18].

The rapid increase in live weight observed in the primitive farming environment during the first 75 days of chicks was noted by Buldgen et al.[19]. For many other authors[7, 8, 17, 20-24], growth during this period is greater in improved environment. The stunting observed in the chicks of the improved system in our study could be explained by the inadequacy of their starter feeding. Indeed, these chicks

did not benefit from a specific diet at their age. They were left with the mother hens in the parental lodge where they fed on the crumbs of the parent's spawn food until weaning which occurred at 15-30 days of age. On the other hand, in the primitive culture, although the chicks do not benefit from a specific diet, the selection of their food in soil excavations with the help of the mother hen makes it possible to cover most of the chicks' dietary needs. Hence the higher growth observed. The adaptation of the chicks to their new life condition, and especially to the adequate nutrition that was brought to them through the growth food allowed them to catch up and then exceed the live weight achieved by the chickens of the primitive farming environment.

Even though the local traditional chicken is known for its low productivity compared to that of exotic breeds [12], a significant improvement in weight and numbers and a decrease in the mortality rate of this poultry can be obtained by improving rearing conditions and bird management. In fact, a total of 53 offspring (an average of 17.67 subjects per group), were registered in the improved rearing after 6 months of activity against 30 subjects (average 3.75 subjects per breeding hen), in the primitive breeding system. This result is in agreement with Kouadio *et al.*[11], who, after noting the production of a greater number of semi-intensive breeders than in extensive breeding, concluded that the low productivity of local chicken is not only due to its low genetic value but also to the breeding system of this bird.

CONCLUSION

This study has shown that the current system of primitive farming of local indigenous chicken does not allow the chicken to express its zootechnical performance as best as it could. Indeed, the improvement of the breeding conditions of this bird has shown a better expression of its zootechnical potential, manifested by the reduction of the time interval between broods, the increase in the annual number of broods, the hatching rate and weight gain. These various improvements, coupled with the substantial increase in the number of financially exploitable subjects, already offer good economic prospects for any actor who would like to undertake this activity. Such benefits would contribute to the fight against poverty, to food security, to strengthening social ties and to conserving the genetic biodiversity of local traditional poultry. The achievements of this work open perspectives of investigation to be explored in order to propose to breeders a model of sustainable and economically profitable breeding with a better-elaborated animal management.

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