

*Full Length Research Paper*

# **Native chicken farming: A tool for wealth creation and food security in Benin**

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**Poultry is the second largest livestock in Benin (contributing to 22% of the total meat produced), and chickens are the most reared poultry in the country. The objective of this study was to assess the current trends of local chicken breeding and factors that influence their production performance, and thereby to deliver information for production improvement and sustainable use of indigenous chicken breeds. An electronic tool was used to collect information from 269 respondents selected through a chain referral sampling method. The results showed that there were three production systems; however, the most common production system used was free-range extensive system (70%). Regarding flock ownership, men owned the birds in the majority of the cases (63%) and had overall higher population of chickens than women. The most predominant constraints for chicken production, in descending order of importance, included theft, access to bank loan, lack of training, limited investment, disease spread and mortality. From our results, gender, financial resources, main activity of the flock owner, weaning practice, and the production area had a significant effect on flock size. To enhance the indigenous chicken production, changes in traditional management practices combined with breeding program focusing on within breed selection (closed nuclear system) is a better approach.**

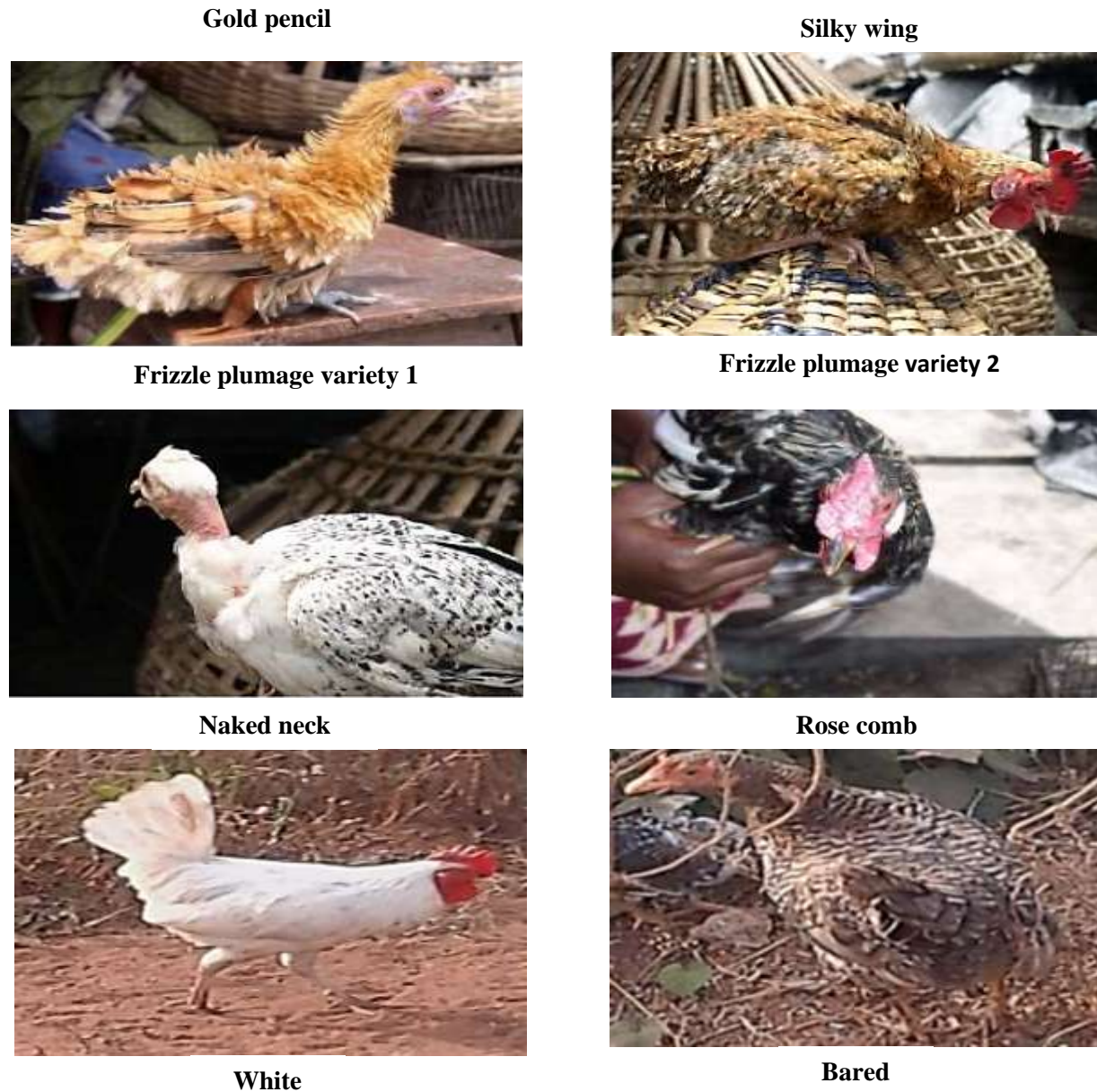
**Key words:** Biodiversity, cluster analysis, food security, farmer livelihood, local chickens.

## **INTRODUCTION**

Benin faces the challenge of increasing food production and reducing poverty. One option is to intensify agricultural production and diversify into more profitable and competitive livestock enterprises. According to a previous study, managing livestock in Africa is likely to be more profitable than growing crops under future climatic

conditions (Dinar et al., 2012). In Benin, the livestock subsector contributes approximately 6% of the agricultural Gross Domestic Product (USDA, 2014). Poultry is the second most important livestock enterprise in rural households where more than 70% of the country's population live and derive their livelihood (FAO,

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**Figure 1.** Documented breeds of local chickens.

2015). It contributes up to 22% of total meat production and the major poultry species kept are chickens, guinea fowls, ducks, turkeys, and pigeons with chickens dominating (Fanou, 2006). Therefore, chickens form an important component of livelihoods as a source of protein food security, income, insurance against emergencies, and have the potential for commercialization and wealth creation. The chicken of importance in Benin is the indigenous chicken (*Gallus domesticus*), with an estimated population of about 19,830,000 in 2017 while hybrid chicken number was estimated at 8,13,000 (DE, 2018). The diversity in agro-ecology, climatic conditions,

and variation in the purpose of chicken rearing in different regions and production environments in the tropics are believed to contribute to the current high diversity in chicken genetic resources (Padhi, 2016). In Benin, there are approximately eight different breeds of local chickens that have been documented (Figure 1) (Tchabi, 2008). Although local chickens have a great potential for development, smallholder farmers keeping them face the challenge of improving the productivity of their flock for increased food products and income (Tchabi, 2008). Major constraints include socio-economic factors, erratic and unpredictable weather, zoonotic diseases and pests,

inadequate capacity for service delivery, weak extension services, and demographic factors among others. Benin's poultry meat demand was estimated at 40,000 MT in 2018 while the domestic poultry meat production was just about 10,000 MT. However, a conservative estimate of poultry meat imports into Benin that year exceeded 2,00,000 MT (Aguehoude 2018; Dognon, 2018). This implies that poultry meat imports into Benin not only cover national poultry meat deficit but also Nigeria and hinterland country's needs.

The purpose of this study is to provide information about the current trends and the key factors influencing local chicken production in tree major chicken farming regions. The study then would give recommendations to the relevant authorities and the indigenous chicken farmers to address those factors aimed at increasing indigenous chicken production and subsequently improving the standard of living of the community through poverty reduction while maintaining the genetic attribute of the indigenous chicken that is appreciated by the consumers and producers.

## MATERIALS AND METHODS

### Sampling procedure and Study area

This study was conducted from July to October 2019 using the animal genetic resources characterization, inventory, and monitoring tool (AnGR CIM Tool) across, peri-urban and rural areas in 3 regions including Oueme, Zou, and Colline. The AnGR CIM Tool is a comprehensive tool designed by the African Union Inter-African Bureau for Animal Resources (AU-IBAR) using the Open data kit (ODK) software version 1.22.4 (AAGRIS, 2019). The tool was installed on a tablet with the latest version of Android OS. Due to resources limitation, municipalities where local chicken breeding is the most popular within each region were considered. These include Misserete and Adjara in Oueme; Abomey, Bohicon, Zokpota and Zogbodomey in Zou; Dassa and Glazoue in Colline (Figure 2). A total of 269 respondents (92 in Colline, 91 in Oueme and 86 in Zou regions, respectively) were selected using a chain referral sampling method. In order to ensure sample diversity, different sample seeds (initial subject) were identified as suggested by Kirzherr and Charles (2018). The study population within department is considered to be homogenous as communities living in the selected areas are close to each other and have similar livestock keeping practices. Therefore, going by Singleton et al. (1993), the sample size within each region would be considered adequate.

The Oueme region is subdivided into nine municipalities located in southern Benin in a coastal area that has interconnected lakes and lagoons and elongated coastlines with wide marshes. It receives two spells of rain from March to July and September to November, with an average annual rainfall of less than 1,200 mm (McColl, 2014). According to Benin's 2013 census, the total population of the region was 11,00,404, with 5,34,814 males and 5,65,590 females (Census of Benin, 2013). Oueme's indigenous chicken population was estimated at 9,44,766 in 2015 (PAFILAV, 2015).

The region of Zou is also located in southern Benin and subdivided into nine municipalities. It receives two spells of rain from March to July and September to November (McColl, 2014). In 2013, the total population of the region was 8,51,580, with 4,07,030 males and 4,44,550 females (Census of Benin, 2013). Zou's

indigenous chicken population was estimated at 12,13,918 in 2015 (PAFILAV, 2015).

Collines is located in central Benin and is subdivided into six communes (DESA, 2004). As of 2013, the total population of the region was 7,17,477, with 3,53,592 males and 3,63,885 females (Census of Benin, 2013). It receives one season of rainfall from May to September (McColl, 2014). Colline's indigenous chicken population was estimated at 14,42,911 in 2015 (PAFILAV, 2015).

### Data analysis

The data collected were downloaded from the AnGR CIM Tool platform and analysed with the version 3.5.1 of the R software (Team, 2013). Research methodology utilized both descriptive and inferential analysis. Descriptive statistics was used to establish the general characteristics of the study sample analysed that were compared using the bilateral Z test in Agricola Package in R software. For each relative frequency P, a margin of error (ME) was

calculated using the formula:  $ME = 1.96 \sqrt{\frac{P(1-p)}{n}}$  where p is the relative frequency and n the sample size (Lesaffre, 2009). Under inferential analysis, the Tukey test was used on one-way analysis of variance to determine the influence of independent variables on the flock size. Also, a Gower distance analysis was performed to cluster the mixed data using the 'gower\_dist' function in the 'gower' package ver. 0.1.2 in R software (van der Loo, 2017). A descriptive analysis was performed on the clusters based on selected variables and differences between clusters were tested through chi-square test (frequencies) and T-student test (mean) where necessary.

## RESULTS

### Demographic factors that influence indigenous chicken production

Demographic factors likely to influence local chicken production are presented in percentages and frequencies in Table 1 and Figure 3. These include gender, education levels, and age of the respondents.

Table 1 shows that in general most of the chicken farmers (63%) were males. Comparison within regions yields the same result. Inclusively in the three regions of the study, male respondent rate was significantly higher than female, that is, 68, 62 and 59%, respectively in Colline, Oueme and Zou. The general illiteracy rate among respondents was 27%; however comparison within region exhibits different pattern. This rate is very low in the region of Zou (6%) and very high in the region of Oueme (43%). The information in Figure 3 shows that majority of chicken farmers belong to the age category of 41-61 years. However, chicken farmers in the region of Colline were much younger as majority of them were between 21 to 41 years old (42%).

### Socio-economic factors that influence indigenous chicken production

Socio-economic factors likely to influence local chicken production include the average number of chickens in the

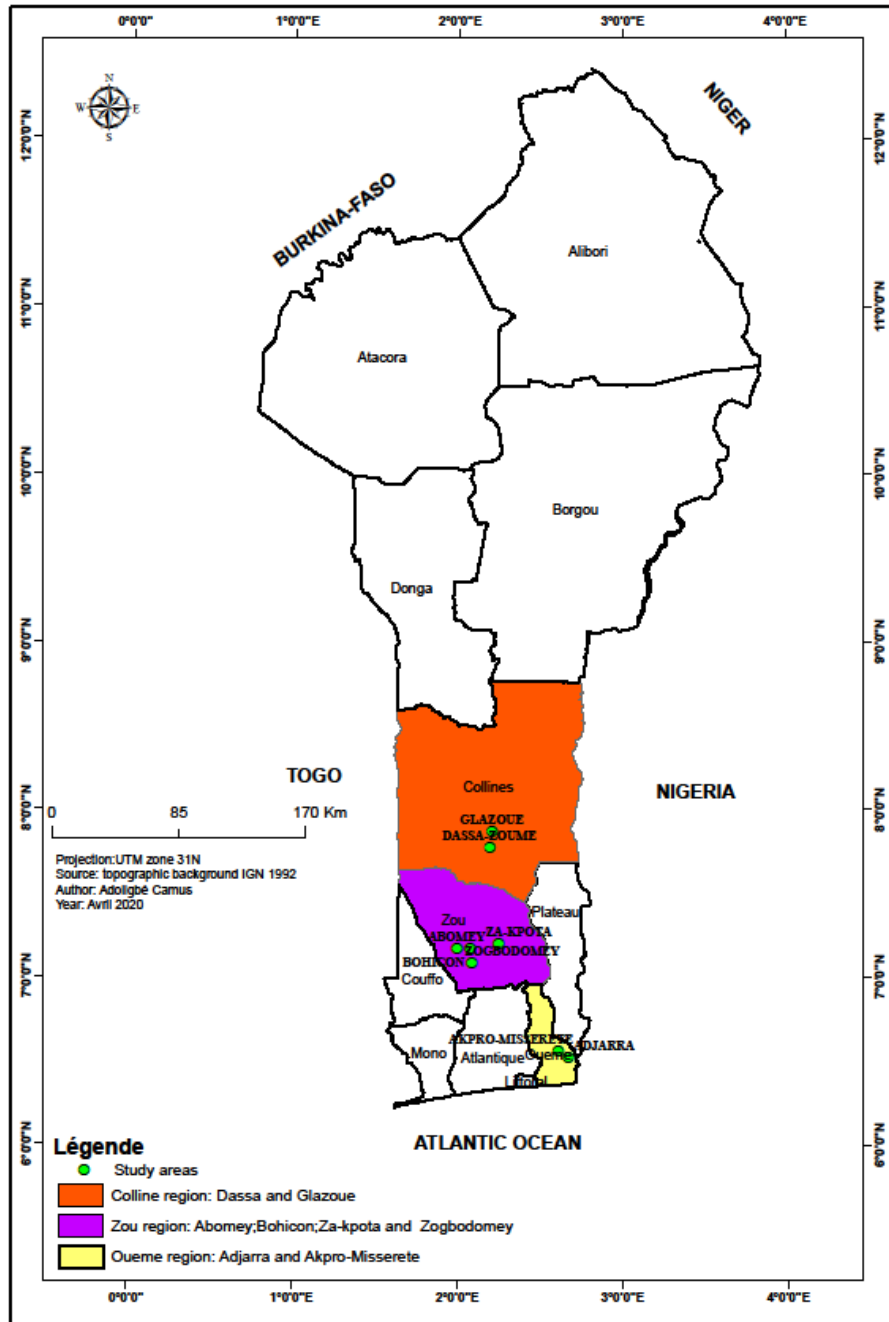


Figure 2. Map of Benin showing the study areas.

homestead of the respondents, ownership of chickens in the household, flock owner main activity, method of breeding stock acquisition, reason for keeping indigenous chicken and production objectives.

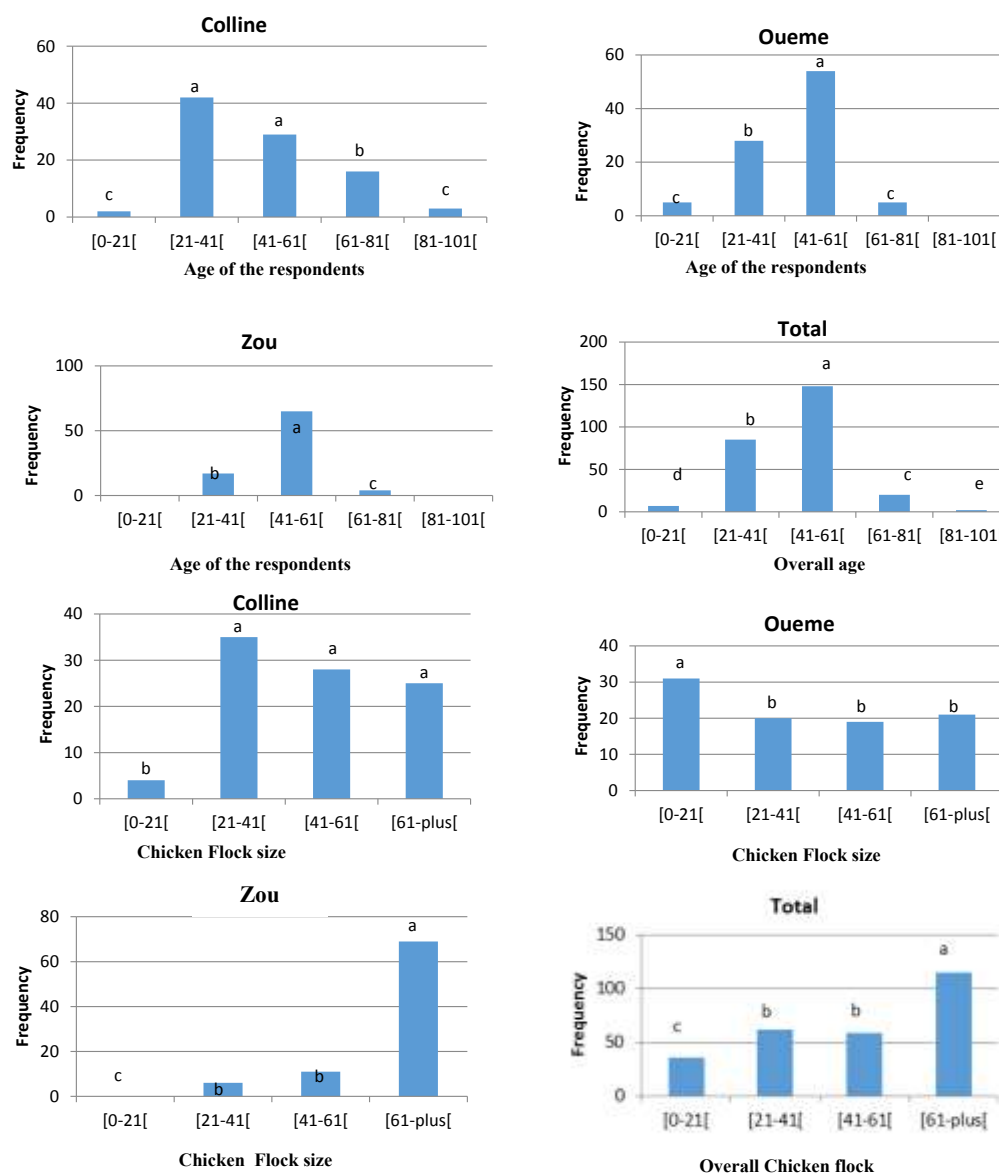
Table 2 shows that in general indigenous chicken was mainly owned by the household head (49 %). Also, majority of the respondents interviewed were crop farmers (26%); however, the respondents' main activity varies from region to region (Table 2). Therefore, majority

of the respondents were animal farmers in the region of Zou (50%), crop farmers in the region of Colline (45%) and tradesman in the region of Oueme (33%). As shown in Tables 2 and 3, breeding stocks were mainly purchased (97%) and indigenous chickens were raised mostly to be sold (98%). Production of indigenous chicken was mainly driven by the fact that they are less demanding in terms of inputs (95%). However, their meat quality and the market demand were pointed out by a

**Table 1.** Demographic distribution of gender and instruction level of the respondents.

Variables	Parameter	Collines (92)		Ouémé (91)		Zou (86)			Total (269)				
		N	%	ME	N	%	ME	N	%	ME	N	%	ME
Gender	Male	63	68.48 <sup>a</sup>	9.49	56	61.54 <sup>a</sup>	10	51	59.30 <sup>a</sup>	10.38	170	63.20 <sup>a</sup>	5.76
	Female	29	31.52 <sup>b</sup>	9.49	35	38.46 <sup>b</sup>	10	35	40.70 <sup>b</sup>	10.38	99	36.80 <sup>b</sup>	5.76
Instruction level	Primary	38	41.30 <sup>a</sup>	10.06	30	32.97 <sup>a</sup>	9.66	55	63.95 <sup>a</sup>	10.15	123	45.72 <sup>a</sup>	5.95
	Illiterate	28	30.43 <sup>ab</sup>	9.4	39	42.86 <sup>a</sup>	10.17	5	5.81 <sup>c</sup>	4.95	72	26.77 <sup>b</sup>	5.29
	Secondary	24	26.09 <sup>b</sup>	8.97	20	21.98 <sup>b</sup>	8.51	25	29.07 <sup>b</sup>	9.6	69	25.65 <sup>b</sup>	5.22
	Tertiary	2	2.17 <sup>c</sup>	2.98	2	2.20 <sup>c</sup>	3.01	1	1.16 <sup>c</sup>	2.27	5	1.86 <sup>c</sup>	1.61

N, observed number of cases for each modality at the different location; % , Relative frequency ; ME, Margin of error . Frequencies within column with different letter are significantly (P<0.05) different according to z-test.



**Figure 3.** Respondents age structure and chicken flock size (Relative frequency). Rectangle followed by different superscripts show the presence of significant differences (p<0.05)

**Table 2.** Demographic distribution of ownership, main activity, and method of acquisition.

Variables	Colline (92)			Oueme (91)			Zou (86)			Total (269)			
	N	%	ME	N	%	ME	N	%	ME	N	%	ME	
Ownership	Household head	42	45.65 <sup>a</sup>	10.18	49	53.85 <sup>a</sup>	10.24	42	48.84 <sup>a</sup>	10.56	133	49.44 <sup>a</sup>	5.97
	Household head and spouse	10	10.87 <sup>bc</sup>	6.36	0	0.00 <sup>d</sup>	0	10	11.63 <sup>c</sup>	6.78	10	3.72 <sup>cd</sup>	2.26
	Household head, spouse and son	4	4.35 <sup>cd</sup>	4.17	0	0.00 <sup>d</sup>	0	0	0.00 <sup>e</sup>	0	4	1.49 <sup>d</sup>	1.45
	Household head and son	4	4.35 <sup>cd</sup>	4.17	1	1.10 <sup>d</sup>	2.14	0	0.00 <sup>e</sup>	0	15	5.576 <sup>c</sup>	2.74
	In a foster care	7	7.61 <sup>bc</sup>	5.42	0	0.00 <sup>d</sup>	0	0	0.00 <sup>e</sup>	0	7	2.6 <sup>cd</sup>	1.9
	Spouse	16	17.39 <sup>b</sup>	7.75	31	34.07 <sup>b</sup>	9.74	2	2.33 <sup>de</sup>	3.19	49	18.22 <sup>b</sup>	4.61
	Spouse and son	7	7.61 <sup>bc</sup>	5.42	0	0.00 <sup>d</sup>	0	5	5.81 <sup>cd</sup>	4.95	12	4.46 <sup>cd</sup>	2.47
	Son	2	2.17 <sup>d</sup>	2.98	10	10.99 <sup>c</sup>	6.43	27	31.40 <sup>b</sup>	9.81	39	14.49 <sup>b</sup>	4.21
Main activity	Crop farmer	41	44.57 <sup>a</sup>	10.16	18	19.78 <sup>b</sup>	8.18	11	12.79 <sup>c</sup>	7.06	70	26.02 <sup>a</sup>	5.24
	Trader	17	18.48 <sup>bc</sup>	7.93	23	25.27 <sup>ab</sup>	8.93	25	29.07 <sup>b</sup>	9.6	65	24.16 <sup>a</sup>	5.12
	Animal farmer	9	9.78 <sup>c</sup>	6.07	2	2.20 <sup>c</sup>	3.01	43	50.00 <sup>a</sup>	10.57	54	20.07 <sup>a</sup>	4.79
	Craftman	21	22.83 <sup>b</sup>	8.58	30	32.97 <sup>a</sup>	9.66	0	0.00 <sup>d</sup>	0	51	18.96 <sup>a</sup>	4.68
	House keeper	1	1.09 <sup>d</sup>	2.12	13	14.29 <sup>b</sup>	7.19	2	2.33 <sup>d</sup>	3.19	16	5.95 <sup>b</sup>	2.83
	Civil servant	2	2.17 <sup>d</sup>	2.98	4	4.40 <sup>c</sup>	4.21	3	3.49 <sup>d</sup>	3.88	9	3.35 <sup>bc</sup>	2.15
	Mixed crop-animal farmer	1	1.09 <sup>d</sup>	2.12	1	1.10 <sup>c</sup>	2.14	2	2.33 <sup>d</sup>	3.19	4	1.49 <sup>c</sup>	1.45
Method of acquisition	Giftng	4	4.35 <sup>b</sup>	4.17	5	5.49 <sup>b</sup>	4.68	0	0.00 <sup>b</sup>	0	9	3.35 <sup>b</sup>	2.15
	Purchasing	86	93.48 <sup>a</sup>	5.05	89	97.8 <sup>a</sup>	3.01	86	100.00 <sup>a</sup>	0	261	97.03 <sup>a</sup>	2.03
	Inheritance	4	4.35 <sup>b</sup>	4.17	5	5.49 <sup>b</sup>	4.68	0	0.00 <sup>b</sup>	0	9	3.35 <sup>b</sup>	2.15
	Fostering	2	2.17 <sup>b</sup>	2.98	1	1.09 <sup>b</sup>	2.14	0	0.00 <sup>b</sup>	0	3	1.12 <sup>b</sup>	1.25

N, observed number of cases for each modality at the different location; % , Relative frequency ; ME, Margin of error . Frequencies within column with different letter are significantly ( $P < 0.05$ ) different according to z-test

significant number of respondents from Oueme (99 and 98%, respectively) and Zou region (100 and 95%, respectively) (Table 3).

### Technological factors that influence indigenous chicken production

These include animal excreta management, weaning practice, main rearing system, flock size, average number of eggs per clutch, and major challenges faced by indigenous chicken farmers.

The study showed that there were three major production systems, namely free-range extensive system, backyard extensive or semi-intensive system (Table 4). The common production system used in general was mostly the free-range extensive system (70%). However, in the region of Zou, backyard extensive system was predominant (67%). Generally, most chicken farmers used the animal excreta as a fertilizer (55%), but in the region of Colline there was no management of the excreta in the majority of cases (79%). Chicks weaning practice was not common among the

farmers except in Zou where majority of the respondents (67%) practice chicks weaning. Average number of eggs per clutch was 11 (Table 5) with a slightly higher number at Colline (12) and a lower number at Zou (10). The chicken flock size was higher than 60, for the majority of respondents. Similar trend was observed in the region of Zou while majority of the farmers at Colline owned in between 21 and 40 chickens and the majority of farmers in the region of Oueme less than 21 (Figure 3). With regards to the major challenges cited by indigenous chicken farmers,

**Table 3.** Demographic distribution of reasons and objectives of production given by the respondents.

Variables	Collines (92)			Oueme (91)			Zou (86)			Total (269)			
	N	%	ME	N	%	ME	N	%	ME	N	%	ME	
Reasons of production	Meat quality	22	23.91 <sup>b</sup>	8.72	90	98.90 <sup>a</sup>	2.14	86	100.00 <sup>a</sup>	0	198	73.61 <sup>b</sup>	5.27
	Market demand	12	13.04 <sup>bc</sup>	6.88	89	97.80 <sup>a</sup>	3.01	82	95.35 <sup>b</sup>	4.45	183	68.03 <sup>b</sup>	5.57
	Resistance to disease	2	2.17 <sup>d</sup>	2.98	58	63.74 <sup>b</sup>	9.88	2	2.33 <sup>c</sup>	3.19	62	23.05 <sup>d</sup>	5.03
	Tradition	7	7.61 <sup>cd</sup>	5.42	4	4.40 <sup>c</sup>	4.21	78	90.70 <sup>b</sup>	6.14	89	33.09 <sup>c</sup>	5.62
	Less demanding	85	92.39 <sup>a</sup>	5.42	89	97.80 <sup>a</sup>	3.01	81	94.19 <sup>b</sup>	4.95	255	94.80 <sup>a</sup>	2.65
Objectives of production	Self-consumption	84	91.3 <sup>ab</sup>	5.76	25	27.47 <sup>b</sup>	9.17	66	76.74 <sup>b</sup>	8.93	175	65.06 <sup>b</sup>	5.7
	Selling	91	98.91 <sup>a</sup>	2.12	88	96.7 <sup>a</sup>	3.67	84	97.67 <sup>a</sup>	3.19	263	97.77 <sup>a</sup>	1.76
	saving	83	90.22 <sup>b</sup>	6.07	84	92.31 <sup>a</sup>	5.47	1	1.16 <sup>c</sup>	2.27	168	62.45 <sup>b</sup>	5.79

N, observed number of cases for each modality at the different location; % , Relative frequency ; ME, Margin of error . Frequencies within column with different letter are significantly (P<0.05) different according to z-test.

**Table 4.** Demographic distribution of excreta management, weaning practice and production system.

Variables	Collines (92)			Oueme (91)			Zou (86)			Total (269)			
	N	%	ME	N	%	ME	N	%	ME	N	%	ME	
Excreta management	Sale	0	0 <sup>c</sup>	0	2	2.197 <sup>c</sup>	3.01	0	0.00 <sup>b</sup>	0	2	0.74 <sup>d</sup>	1.03
	Fertiliser	12	13.04 <sup>b</sup>	6.88	51	56.04 <sup>a</sup>	10.2	86	100.00 <sup>a</sup>	0	149	55.39 <sup>a</sup>	5.94
	Gifting	6	6.52 <sup>bc</sup>	5.05	5	5.49 <sup>c</sup>	4.68	0	0.00 <sup>b</sup>	0	11	4.09 <sup>c</sup>	2.37
	No management	73	79.35 <sup>a</sup>	8.27	37	40.66 <sup>b</sup>	10.09	0	0.00 <sup>b</sup>	0	110	40.89 <sup>b</sup>	5.88
Weaning practice	Yes	5	5.43 <sup>b</sup>	4.63	15	16.48 <sup>b</sup>	7.62	58	67.44 <sup>a</sup>	9.9	78	29.00 <sup>b</sup>	5.42
	No	87	94.57 <sup>a</sup>	4.63	76	83.52 <sup>a</sup>	7.62	28	32.56 <sup>b</sup>	9.9	191	71.00 <sup>a</sup>	5.42
Production system	Free-range extensive	78	84.78 <sup>a</sup>	7.34	84	92.31 <sup>a</sup>	5.47	27	31.40 <sup>b</sup>	9.81	189	70.26 <sup>a</sup>	5.46
	Backyard extensive	12	13.05 <sup>b</sup>	6.88	2	2.2 <sup>bc</sup>	3.01	58	67.44 <sup>a</sup>	9.9	72	26.77 <sup>b</sup>	6.94
	Small scale intensive	2	2.17 <sup>c</sup>	2.98	5	5.49 <sup>b</sup>	4.68	1	1.16 <sup>c</sup>	2.27	8	2.97 <sup>c</sup>	2.03

N, observed number of cases for each modality at the different location; %, Relative frequenc ; ME, Margin of error. Frequencies within column with different letter are significantly (P<0.05) different according to z-test.

**Table 5.** Descriptive analysis of average number of eggs per clutch.

Variables	Collines		Ouémé		Zou		Total		ANOVA
	Moy	ES	Moy	ES	Moy	ES	Moy	ES	
Mean	12.47 <sup>a</sup>	0.37	11.39 <sup>b</sup>	0.3	9.98 <sup>c</sup>	0.1	10.97 <sup>b</sup>	0.18	***

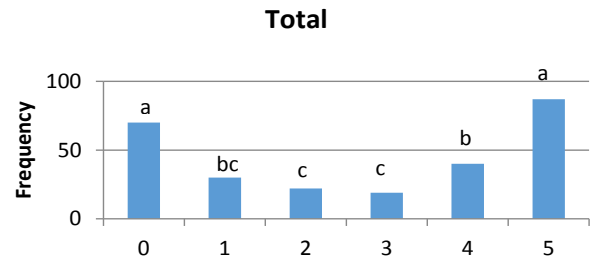
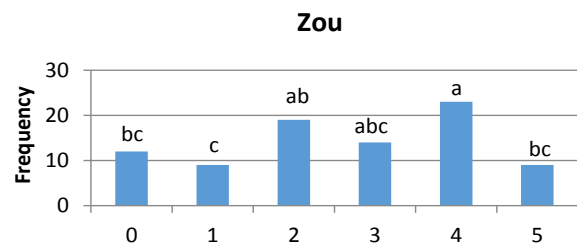
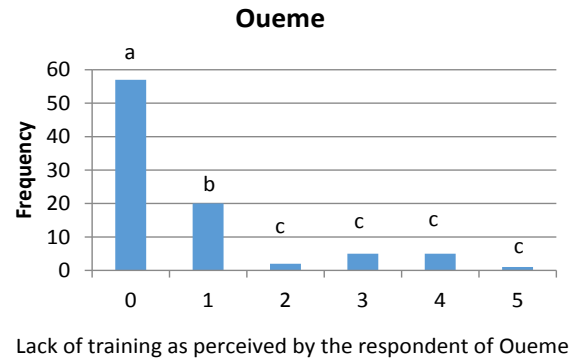
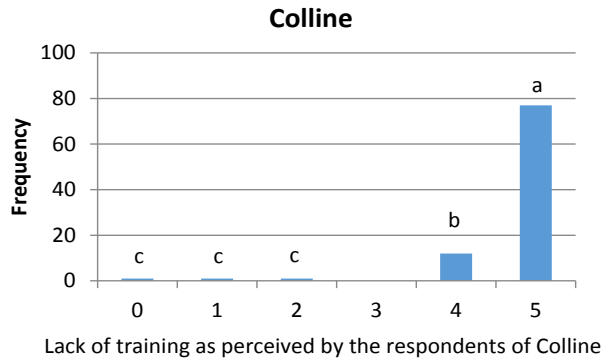
Means with different letter are significantly (P<0.001) different according to anova.

theft rank first, followed by mortality, disease, access to bank loan, investment, and lack of training (Figures 4, 5, 6 and Table 6).

### Relationship between variables

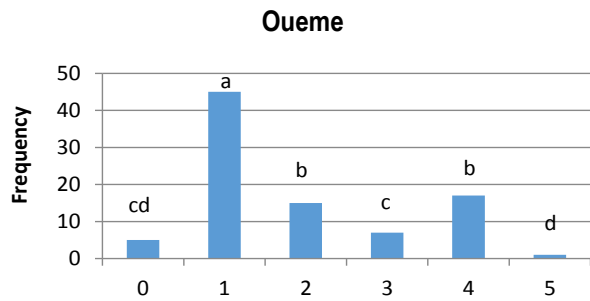
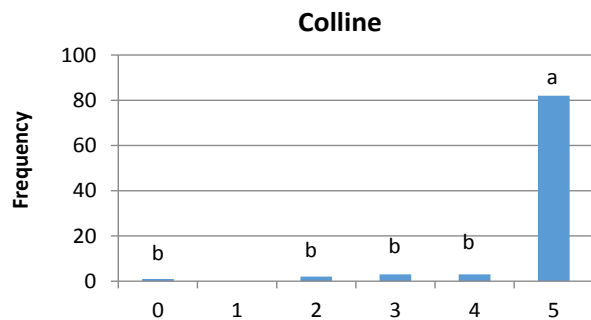
Chicken flock size variation has been used as an indicator to assess how different factors affect the performance of the indigenous chicken enterprises in the study areas. From our results (Table 7), gender and the main activity of the chicken farmer significantly influence

the flock size. Therefore, male chicken farmers have larger flocks than female chicken farmers. On the other hand, animal farmers own more chickens than crop farmers, tradesmen, craftsmen, and public servants. Likewise, flock size is larger when weaning is practiced, and excreta is used as fertilizer. There is also a variation in flock size between municipalities with the municipalities of Zogbodomey, Abomey, and Za-kpota having the largest flock sizes. It is worth noting that chicken farmers who mentioned access to bank loan to be their biggest constraint and those who have chosen to rear the indigenous chicken mainly because they can survive in



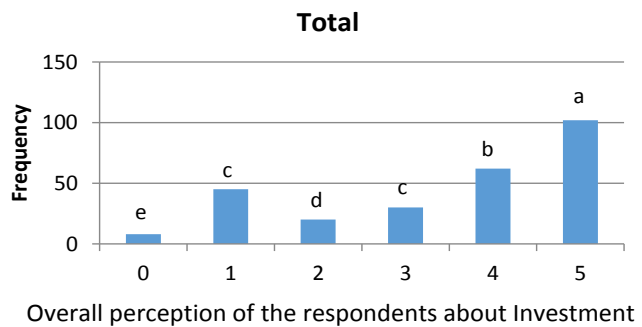
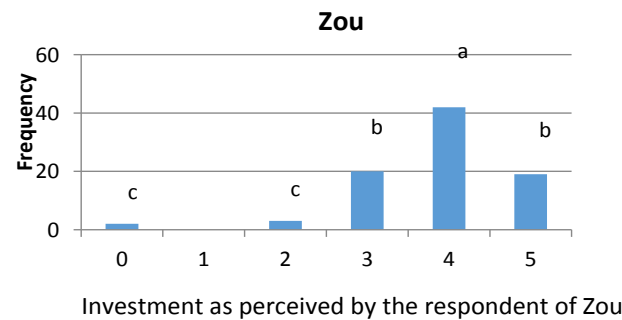
Lack of training as perceived by the respondent of Zou

Overall perception of the respondents about lack of training



Investment as perceived by the respondents of Colline

Investment as perceived by the respondents of Oueme

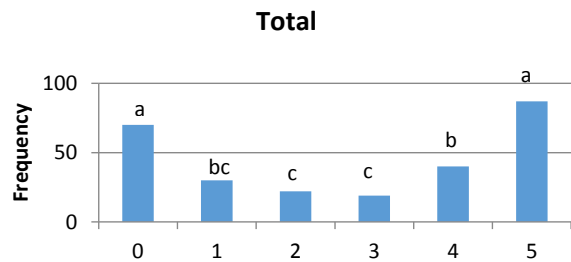
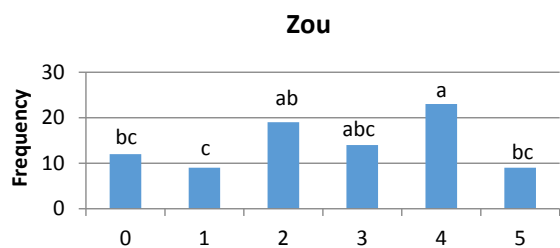
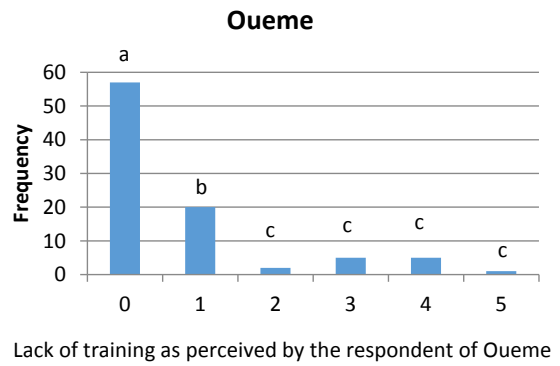
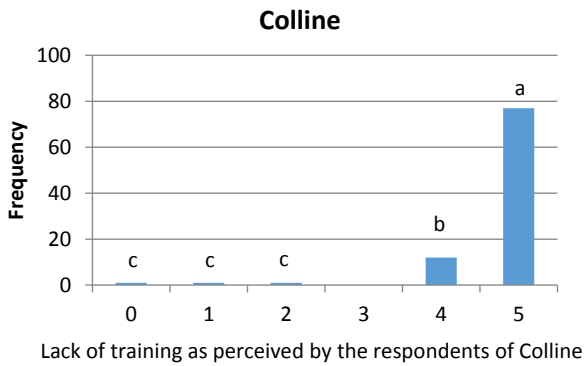


Investment as perceived by the respondent of Zou

Overall perception of the respondents about Investment

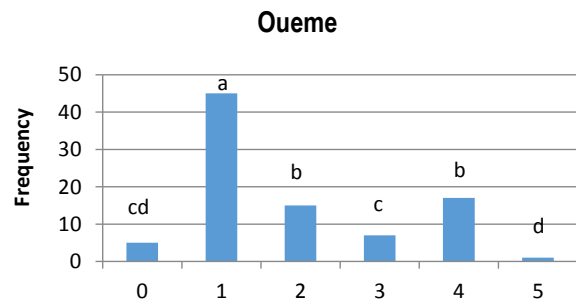
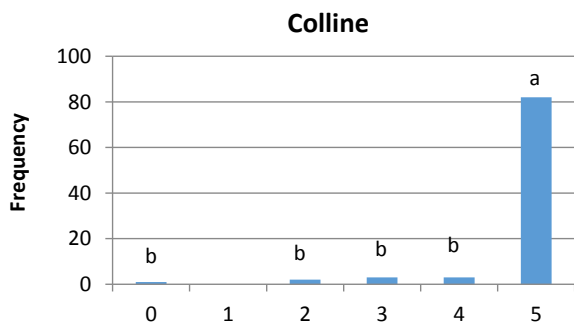
**Figure 4.** Perception of the respondents about Theft and Access to bank loan as a constraint (Relative frequency. Rectangle followed by different superscripts show the presence of significant differences( $p < 0.05$ ); 0, 1, 2, 3, 4,5 represent the extent of the constraint as perceive by the respondent: 0=not a constraint, 1=yes at a lower extent, 2= yes at a medium extent, 3= major constraint, 4=one of the biggest constraint, 5=the biggest constraint.





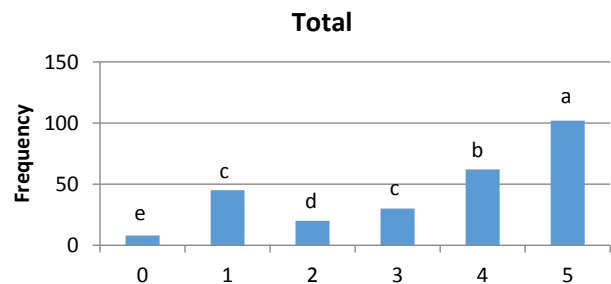
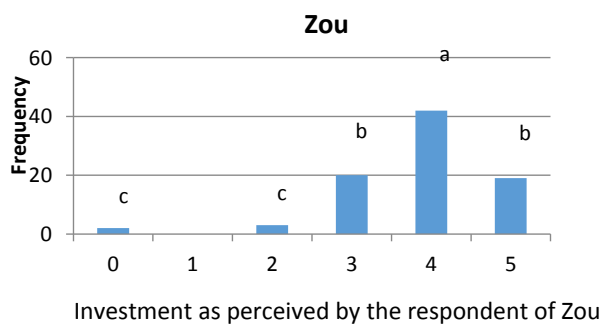
Lack of training as perceived by the respondent of Zou

Overall perception of the respondents about lack of training



Investment as perceived by the respondents of Colline

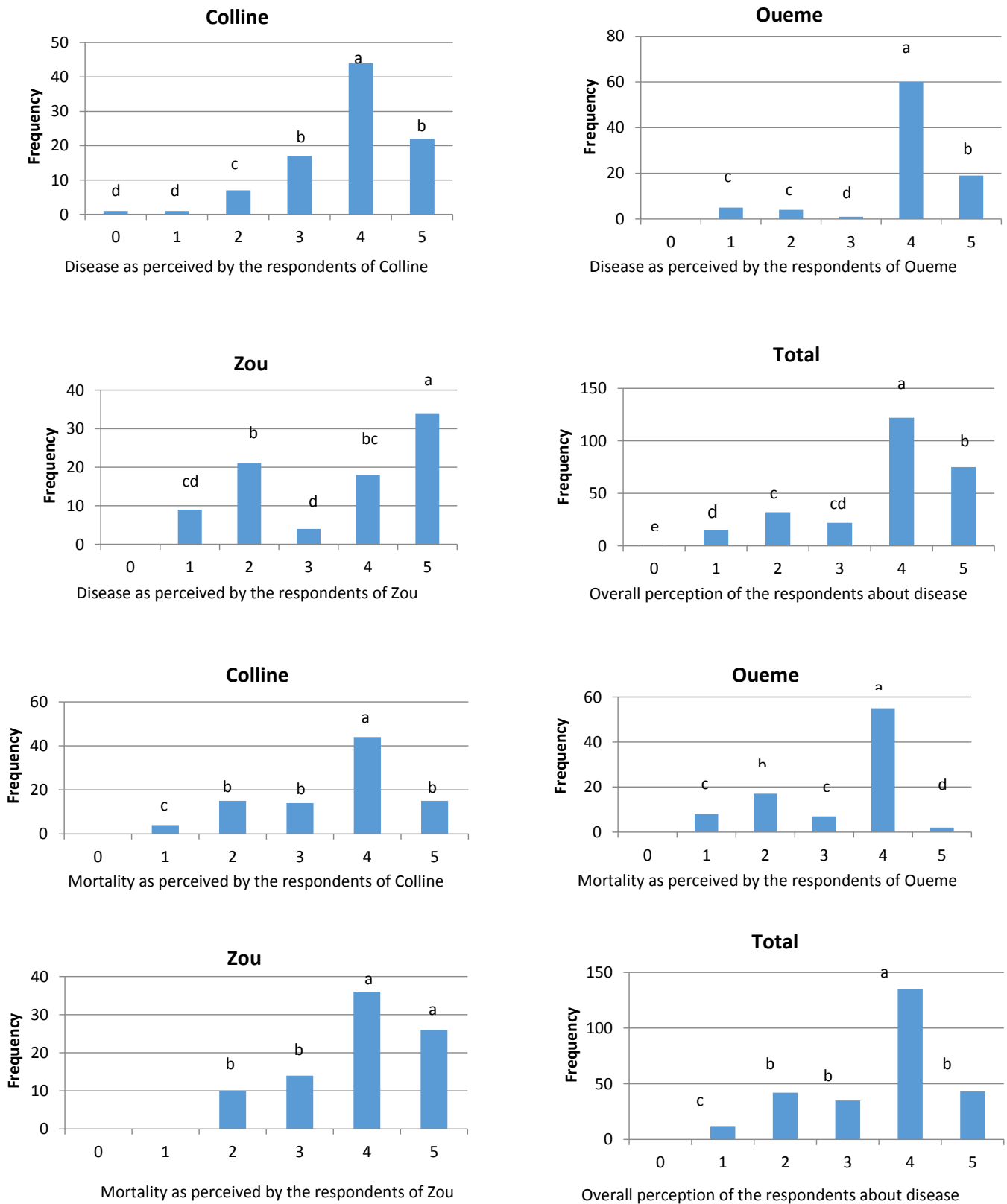
Investment as perceived by the respondents of Oueme



Investment as perceived by the respondent of Zou

Overall perception of the respondents about Investment

**Figure 5.** Perception of the respondents about lack of training and Investment as a constraint (Relative frequency). Rectangle followed by different superscripts show the presence of significant differences ( $p < 0.05$ ); 0, 1, 2, 3, 4, 5 represent the extent of the constraint as perceived by the respondent: 0=not a constraint, 1=yes at a lower extent, 2= yes at a medium extent, 3= major constraint, 4=one of the biggest constraint, 5=the biggest constraint.



**Figure 6.** Perception of the respondents about disease and mortality as a constraint (Relative frequency). Rectangle followed by different superscripts show the presence of significant differences ( $p < 0.05$ ); 0, 1, 2, 3, 4, 5 represent the extent of the constraint as perceive by the respondent: 0=not a constraint, 1=yes at a lower extent, 2= yes at a medium extent, 3= major constraint, 4=one of the biggest constraint, 5=the biggest constraint.

**Table 6.** Constraints as rated by respondents.

Variables	Theft		Mortality		Investment		Lack of training		Acces to bank loan		disease		p-value
	%	ME	%	ME	%	ME	%	ME	%	ME	%	ME	
0	1.12 <sup>bc</sup>	1.26	0.00 <sup>c</sup>	0.00	3.00 <sup>b</sup>	2.04	26.22 <sup>a</sup>	5.28	3.37 <sup>b</sup>	2.16	0.37 <sup>c</sup>	0.73	***
1	6.37 <sup>c</sup>	2.93	4.49 <sup>c</sup>	2.49	16.85 <sup>ab</sup>	4.49	11.24 <sup>b</sup>	3.79	20.22 <sup>a</sup>	4.82	5.62 <sup>c</sup>	2.76	***
2	11.61 <sup>a</sup>	3.84	15.73 <sup>a</sup>	4.37	7.49 <sup>b</sup>	3.16	8.24 <sup>b</sup>	3.30	13.86 <sup>a</sup>	4.14	11.99 <sup>a</sup>	3.90	*
3	15.36 <sup>a</sup>	4.32	13.11 <sup>a</sup>	4.05	11.24 <sup>a</sup>	3.79	7.12 <sup>b</sup>	3.08	10.86 <sup>a</sup>	3.73	8.24 <sup>b</sup>	3.30	*
4	24.72 <sup>b</sup>	5.17	50.56 <sup>a</sup>	6.00	23.22 <sup>b</sup>	5.06	14.98 <sup>c</sup>	4.28	19.85 <sup>bc</sup>	4.78	45.69 <sup>a</sup>	5.98	***
5	40.82 <sup>a</sup>	5.90	16.10 <sup>d</sup>	4.41	38.20 <sup>ab</sup>	5.83	32.58 <sup>bc</sup>	5.62	32.21 <sup>bc</sup>	5.61	28.09 <sup>c</sup>	5.39	***

ME, Margin of error; %, Relative Frequency; Frequencies within line with different letter are significantly (\*P<0.05 or ... P<0.001) different according to a Chi-squared test, 0, 1, 2, 3, 4,5 represent the extent of the constraint as perceive by the respondent: 0=not a constraint, 1=yes at a lower extent, 2=yes at a medium extent, 3= major constraint, 4=one of the biggest constraint, 5=the biggest constraint.

**Table 7.** One-way analysis of variance of municipality, gender main activity, weaning, reason for local chicken rearing, and major constraint as predictor variables for flock size.

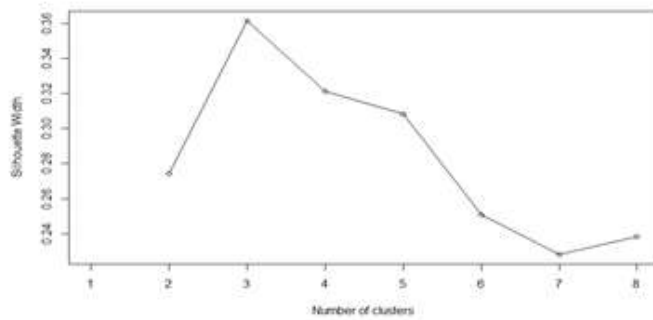
Variable		Mean difference	Significance	95% confidence interval	
				Lower bound	Upper bound
Municipality	Zogbodomey-za-kpota	-129.733	0.000	-212.584	-46.882
	Zogbodomey-abomey	-103.567	0.002	-181.067	-26.067
	Zogbodomey-glazoue	67.176	0.031	3.488	130.864
	Zogbodomey-bohicon	91.850	0.000	45.535	138.165
	Glazoue-adjarra	113.831	0.000	60.399	167.262
	Glazoue-dassa	110.992	0.000	59.437	162.547
	Misserete-glazoue	-105.993	0.000	-160.472	-51.515
	Bohicon-adjarra	89.157	0.000	58.435	119.879
	Dassa-bohicon	-86.318	0.000	-113.646	-58.990
	Misserete-bohicon	-81.319	0.000	-113.828	-48.810
Gender	Male-female	26.284	0.000	13.218	39.350
	Animal farming-plant farming	34.085	0.010	5.026	63.144
Main activity	Animal farming-craftsman	41.154	0.002	9.666	72.642
	Animal farming-tradesman	52.619	0.000	23.077	82.160
	Public servant-Animal farming	-69.589	0.007	-127.354	-11.824
Weaning	Yes-No	29.327	0.000	15.440	43.215
Reason for local chicken rearing: less onerous	Yes-No	-29.581	0.041	-57.950	-1.212
Major constraint: access to bank loan	5-3	-32.782	0.021	-62.417	-3.147

harsh environment with limited food and water resources have fewer animals.

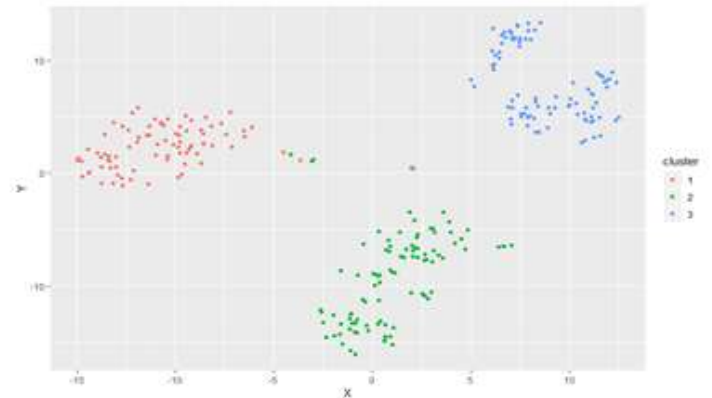
### Clustering

A Gower distance analysis was applied to 11 variables to cluster the respondents included in this study in different groups based on their main similarities and differences (Van der Loo, 2017).

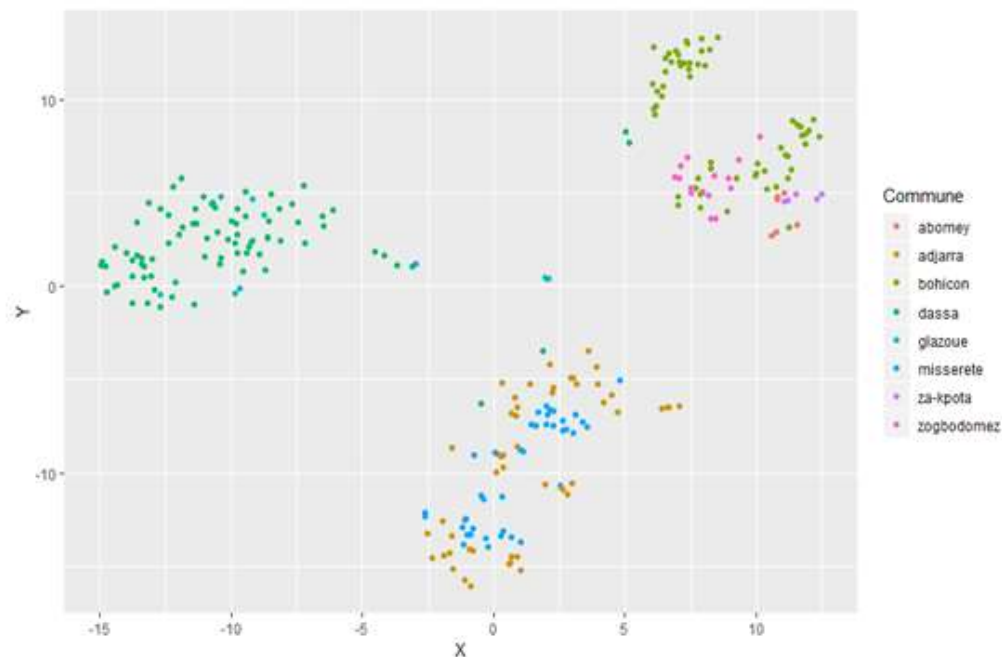
Silhouette analysis showed 3 groups (Figure 7) with 87, 88, and 94 chicken farmers falling into groups 1, 2, and 3, respectively. The majority of the respondents from the municipalities of Dassa and Glazoue of Colline; Bohicon, Zogbodomey, Abomey, and Za-Kpota of Zou; Adjarra and Misserete of Oueme belonged to groups 1, 2 and 3, respectively (Table 8). The majority of the respondents of group 2 were more educated (at least 64% had primary education) and had larger flock sizes (174 on an average) than respondents of group 1(58 on an average)



Silhouette Analysis



Distribution of respondents across clusters (same colour) observed in a lower dimensional space



Distribution of respondents from different municipalities between cluster

Figure 7. Cluster analysis.

and 3(46 on an average). They were mainly animal farmers (50%), adopted backyard extensive system (64%), weaned chicks (59%), and produced organic fertilizer from animal excreta (100%). However, the average number of eggs produced per clutch in this group (10) was lower than what was produced in group 1 (12) and group 3 (11). Although theft was commonly pointed out by respondents from all three groups, the main constraints for chicken production varied from group 1 to group 2. The common reason for raising chickens appears to be its less onerous characteristic. However, meat quality and market demand were also listed by respondents in groups 2 and 3.

## DISCUSSION

Our results indicate that local chicken production is widely practiced in the study areas by a diverse group of people, of different gender, age, ethnicity, instruction level and main activity. This can be attributed to many factors including the relatively short reproductive cycle of chickens, the non-existence of cultural and religious ban on chicken meat, the ease to manage as small size and the ability of the indigenous chicken to survive in harsh environment (Ayssiwede et al., 2013; Bessadok et al., 2003). The predominance of male farmers is in agreement with findings by Pafilav (2015) in other parts of Benin.

**Table 8.** Descriptive analysis of the three different cluster generated via Gower distance.

Variables	Cluster 1	Cluster 2	Cluster 3	Anova/Chi-square
Total number of respondents	87 <sup>a</sup>	88 <sup>a</sup>	94 <sup>a</sup>	NS
	Dassa	Bohicon	Adjarra	50
	Glazoue	Zogbodomey	Misserete	41
Number of respondent from the different municipalities		Abomey	Dassa	2
		Za-kpota5	Abomey	1
		Dassa		
		Glazoue		
Education level of the majority of the respondent (%)	Primary	Primary	None	41
Main activity of the majority of the respondent (%)	Crop farmer	Animal farmer	Tradesman	33
Average number of chicken per cluster	58.37 <sup>b</sup> ± 6.24	173.95 <sup>a</sup> ± 13.12	45.79 <sup>b</sup> ± 4.4	***
Most relevant reason for rearing local poultry breed (descending order)	Less onerous	Meat quality Less onerous Market demand	Meat quality Market demand Less onerous	NSTP
Main Production objectives (descending order)	Selling Saving Self-consumption	Selling Saving Self-consumption	Selling Saving	NSTP
Most relevant breeding system (%)	Free range extensive system	Backyard extensive system	Free range extensive system	91
Poultry manure management (%)	Use as fertilizer	Use as fertilizer	Use as fertilizer	56 <sup>b</sup>
Weaning practice (%)	Yes	Yes	Yes	16 <sup>b</sup>
Mean of number of egg produce per clutch	12.48 <sup>a</sup> ± 0.37	9.98 <sup>c</sup> ± 0.1	11.38 <sup>b</sup> ± 0.3	***
Major constraints (descending order)	Limited investment Lack of training No access to bank loan Animal theft	Mortality Limited investment Disease Animal theft	Disease Animal theft Mortality	NSTP

Means with different letter are significantly ( $P < 0.001$ ) different according to anova for mean and chi-square for percentage; NS=non-significant; NSTP= no statistical test was performed.

However, reports from other African countries point to the contrary where women are key stakeholders in local chicken farming (Mogesse, 2007; Ahlers et al., 2009; Guèye, 2009; Yusuf et

al., 2014; Haoua et al., 2015). Actually, gender-based division of roles and responsibilities in Benin rural society implies that women are often in-charge of the sale of the family enterprise

products on the market while men as a household head have the ownership of the enterprise and have full control over production and the resulting profit. This is quite similar to the findings of

Mahoro et al. (2017) in Rwanda, who reported that the majority of respondents in their study were males (62%) but women (78%) were highly responsible for local chicken management activities. The proportion of illiterates (27%) in this study is higher than that reported by Murekefu (2013) for the district of Vihiga in Kenya (1%). This implies the unlikelihood for households to positively take up innovative and good poultry management practices and agricultural extension education. The results of the survey conducted by Kawsar et al. (2013) in Bangladesh showed that all poultry farm owners were educated, and the sizes of the flock increased in step with level of education. Consistent with this, Chowdhury et al. (2009) showed that 52% of the small-scale broiler farmers who reared smaller flocks in their study had only a primary level of education and suggested that small and medium enterprise farmers must have at least Junior School Certificate and they should be trained on poultry science and technology before allowing/registering for commercial poultry farming. Our clusters analysis agrees with these findings. Respondents from cluster 1 and 2 are more educated than respondents from cluster 3 and had larger flock size.

Our study showed that except from Zou where the majority of respondents rear their animals in a semi-confined system, the birds in the other areas of the study were mostly reared on free-range. This is in agreement with previous reports across other African countries (Ndegwa et al., 2014; Haoua et al., 2015; Mahoro et al., 2017; Assefa et al., 2019). The adoption of the free-range rearing system by a significant number of local chicken farmers could be interpreted in different ways. In fact, we found a relationship between the breeding system, reason for rearing the indigenous chicken, production objectives, and the main activity of the rural chicken farmers. Communities with semi-intensive production systems mainly raise local chicken to meet the market demand and for their own consumption. This implies that local chicken raising is their primary income source and explains why they are more eager to apply improved management practices and keep larger flock. However, in the free-range system dominated communities, the indigenous chickens were kept mostly because of their ability to tolerate the harsh environmental condition and poor management practices. This implies that these communities were not really willing to keep breeds that require too much investment and care or they had low level of income to meet their own basic needs, hence, investing in chicken production is not their first priority. The respondents in the free-range system dominated communities did animal farming as a secondary activity and the products were either sold on the local market or used as saving. Hence, time allocation to their main activity could also be one of the reasons that prevent them to intensify the chicken farming activity. Okeno et al. (2012) reported that utilization of native chickens in their current genetic merit and production environment is more

profitable under free range system and semi-intensive system but not economically viable under intensive system. It was proven that changes in traditional management practices can improve the performance of native chicken and thus contribute to household incomes increase per year (Ondwasy et al., 2006; Sarkar and Golam, 2009). Although these findings are research-based evidence, we believe that intervention to improve production in the traditional system should be community-specific and predetermined. To be sustainable, the perceived needs and interest of the communities must be considered while proposing various recommendations. In our case, we would recommend for farmers of group 1 and group 3 (the free-range dominated groups) to include protein and vitamin supplements from easy growing indigenous plant leaves such as *Moringa oleifera* and *Azolla filiculoides* to balance chicken diets particularly for the young chicks. Assefa et al. (2019) have shown that frequent supplementation of baby chicks is important to enhance their growth until they reach the age of full scavenging potential. Farmers should be trained and encouraged to provide habitat for their animal using local materials. Endemic disease control must be strengthened with the free supply of vaccines. To this regard, recent effort of the Government of Benin to provide free immunization against new castle disease in the rural communities must be encouraged (Procad, 2019). There is a need to organize farmers in groups where they can mobilize their limited resources to carry out activities like group-based vaccination and purchase of inputs such as drugs to save on cost and ensure proper vaccination timing. Finally, it is necessary to insist on improving education and skills of these farmers, particularly farmers of group 3, for a successful implementation of the improved practices. For the farmers of group 2 (semi-intensive dominated group), much more could be done to improve incomes and productivity. Majority of these respondents are already familiar with chicks weaning. But additionally, they need to learn simultaneous hatching of hens to plan production to meet seasonal demand and increase profits but also to make planning for vaccinations easier. In general, we propose the use of solar powered incubators to enable such farmers to hatch more eggs. Their ability to select best laying hen, broody hen and strong cock to make their breeding stock as well as their ability to build housing with local materials that provide the chicken better living condition and protection against the predators should be upgraded through tailor-made training programmes. Additionally, they should be taught to keep record for a better assessment of their economics on farming.

Our study revealed a significant influence of gender, main activity, weaning practice, reason for breeding the local chicken, and major constraint on flock size. We cannot see any reason for female farmers holding much smaller chicken flocks than male farmer except the existence of a gender gap due to social norm. In Benin

and Togo, it is common to see men keeping species such as guinea fowl, turkeys, and pigeons. Some farmers that keep these types of poultry and large flock size of birds have certain prestigious value (Thomsen et al., 2005; Kryger et al., 2010). Nelson et al. (2012) reported that inequality in livestock holdings was particularly acute in Bangladesh, Ghana, and Nigeria, where male holdings are more than three times larger than those of female-headed households. Farms run by female-headed households have less labour available for farm work because these households are typically smaller and have fewer working-age adult members and because women have heavy and unpaid household duties that take them away from more productive activities. However, according to Alemayehu et al., (2018), women dominate chicken's ownership in developing countries. This is due to the low investment nature of chicken farming compared to other livestock enterprises. For example, Ahlers et al. (2009) indicated that it is a common practice in sub-Saharan Africa that indigenous chickens are owned and managed by women and children and female-headed households. Whereas men may assist in the construction of housing (night shelters for the animals) and in some localities in bringing birds and eggs to the market, women and children are, as a general rule, the ones who feed and water the birds, clean the housing and apply treatments (Mutombo 2014; Patbandha et al., 2016). Nduthu (2015) mentioned that any development schemes which aim to improve and promote the chicken sectors to be sustainable should not underestimate the contributions and roles of women. Poultry production enterprise is a potential area for women's groups to: harness income, create job opportunities, improve quality of life, investing not only in food diversity, but also in greater access to health, hygiene and access to education for children in rural communities (Nduthu, 2015; Villanueva-Cabezas, 2018).

Therefore, we are tempted to recommend women empowerment as one of the strategies to improve local chicken production in the study areas. However, most of our respondents (men and women) adopted free-range extensive system and seem not to aspire to become full-time chicken farmers. Just like in the case of local chicken farmers in India, they raise chickens as a secondary activity to alleviate food insecurity, as a mean of social engagement in their communities, or to access fast cash when unexpected costs appear (Kumar et al., 2019). Therefore, to have a successful implementation of women empowerment strategies a search for what approach to adopt should be conducted using a reliable and adapted tool such as the Women's Empowerment in Livestock Index (WELI) developed by Galiè et al. (2019).

The practice of chick weaning was associated with larger chicken flocks. Hens that are prevented from brooding their own chicks will start to lay again more quickly after just 21 days, instead of the usual three months (FAO, 2010). Though this method leads to high

production of indigenous poultry, it should be taken cautiously as extra measure are needed to boost chick survival rate. These include balanced feeding, sanitary measures and a brooder to ensure weaned chick survival. For the respondent that might not be able to afford it we would recommend a late weaning. They can wean their chicks at around 4 weeks of age when the chicks had acquired immunity against common disease and the ability to cope with harsh conditions. This will allow them to circumvent the requirement for raising day old chicks while reducing the inter-clutch interval. Unsurprisingly, animal farmers held much more chicken than any other respondents since they have to develop their main activity in order to get sufficient income to meet out their needs. Respondents who rear the local chickens because they are less demanding had much small scale chicken flocks than the rest. Consistent with our previous insight, these respondents belong to majority that rear the local chickens in scavenging and are less motivated to intensify their chickens breeding activity. Respondents who perceived access to bank loan as their biggest constraint have fewer chickens. This indicates that facilitating access to credit for the farmers willing to take up such activity would play an important role in boosting indigenous chicken productivity.

The performance of the respondents falling in group 2 stress the need to promote best management practices among the indigenous poultry farmers. However, the average number of eggs per clutch obtained in this group was the lowest. This highlights the limitation of the semi-confined breeding system, particularly for large scale flocks, when dietary requirements are not efficiently met. There is a clear relationship between egg production and nutrient intake. Wanjugu (2013) reported that the size and productivity of the village flock ultimately depend on the human population and its household waste and crop residues, and on the availability of other feed resources obtained from scavenging.

Previous researches have discussed different ways to improve the performance of native chickens. For instance, Abdelqader et al. (2007) reported that there was a significant improvement in hatchability, survivability, flock size, number of clutches, egg weight, and egg mass of native fowl of Jordan with improving the management system alone. Bahmanimehr (2012) claimed that body weight and egg weight improvement of Iranian native chickens can be achieved through selection on the basis that breeding value recorded moderate to high heritability estimates. Effects of crossbreeding of exotic chicken with indigenous chicken were reported in the literature with respect to different traits (Chatterjee et al., 2007; Khan, 2008; Magothe et al., 2012). It was observed that many of the major economic traits improved in the crossbreds compared to native chickens indicating that this is one of the tools to improve the performance of indigenous chickens.

However, from our study, the genetic potential of the

indigenous chickens was not pointed as a major constraint. Moreover, the quality of the rural chicken meat and the market demand for the product together with their adaptive traits and ease of keeping justifies the sustainable use and conservation of local chicken ecotypes. Hence, crossbreeding may not be the best option to achieve local chicken performance improvement in the targeted areas. But, changes in traditional management practices combined with the development of breeding programs focusing on within breed selection and a better organization of the local chicken market as suggested by Ndirangu et al. (2015) will certainly yield better results. This would help to maintain the indigenous chicken unique attributes which are appreciated by producers and consumers and avoid genetic dilution and contribute to their conservation.

## Conclusion

This study provides a basis for the improvement, sustainable use, and conservation of local chicken production in southern and central Benin. Our results showed that indigenous poultry farmers can be divided into three main clusters whose management practices, production objectives and reason for keeping the indigenous chicken breed are well determined and interrelated. To be efficient, any intervention to improve production should respect this interrelationship to avoid breaking the delicate balance form by these communities, their chicken, and their environment. A combination of improved management practices with suitable selection program of superior breeding stock is recommended to ensure a more productive and sustainable local chicken industry. But there is a need to adapt the management interventions to appropriate to the socio-economic reality of each community. Like in the case of egg producers from hybrid breed in Benin, there is a need to develop countrywide an indigenous chicken value chain to allow farmers to be able to produce and sell chicken in an environment they fetch higher profit. Local authorities should offer incentives and bring local chicken farmers together as a group and provide infrastructure to support poultry processing marketing (slaughterhouses, processing, and cold storage). Rural women empowerment might be a useful mean to boost the local chicken industry. But proper study is needed to look for the best approach to this end. Although expensive, the creation of a breeding index based on traits of interest would also be an interesting approach.

Innovations like the development of a hatchery for day-old chicks of local chicken could emerge as the indigenous poultry value chain develops further. Service providers will benefit by offering a wider range of services including poultry slaughter facilities. The quality and range of poultry products will increase through value addition. Indeed, the export of local chicken meat to the Nigerian market, for instance, will boost the industry with

employment opportunities emerging as the local chicken value chain becomes fully operational.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

## ACKNOWLEDGMENTS

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