Chicken production, flock size, management systems, and challenges in the Dodoma region in Tanzania

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ABSTRACT Dodoma’s population is growing rapidly creating a high demand for food security like chicken products. However, the distribution of chickens’ management systems, breed of chicken kept, and challenges facing chicken production in Dodoma are less documented. This study focused on finding out the productivity of chicken in terms of flock size and how it is affected by the management system, types/breed of chicken keeping, and evaluating the challenges facing chicken production in Dodoma. A cross-sectional survey using a semi-structured questionnaire was used to generate data from the two randomly selected districts namely, Kongwa and Dodoma Municipal. The results showed that the average flock size was significantly higher in Dodoma municipal (mean = 124.56 ± 35.08, n = 200) than in Kongwa district (mean = 42.55 ± 5.54, n = 200). Broiler and layers keeping under the intensive system were dominant in Dodoma municipal while local breed chicken under the free-range system was dominant in Kongwa district (P < 0.001). Diseases were the main challenge facing chicken production. It was eminent that, diseases and other challenges such as theft, predation, lack of experts, unavailable space and huts for keeping chicken, and insufficient feed staffs for chicken significantly lowered the chicken production in Dodoma (P < 0.05). It is conclusive that, the demand for chicken products in Dodoma is higher and will continue to increase. There is a need for chicken keepers to increase production to overcome the current deficit. The increases in production should go hand in hand with solving the challenges which face chicken production in Dodoma.

Key words: chicken, production, management, challenge, dodoma

INTRODUCTION

Chicken production has been constrained by various factors in local communities in Tanzania. In other countries such as Kenya, studies reported that diseases and parasites, high feeding costs, poor housing skills, predation, and little knowledge in rearing chicken were among the challenges (Mutua, 2011). Tanzania is among the countries which make the east African community together with Kenya and have a more-less similar ecological nature. A study in Tanzania showed that the major challenges in chicken production were diseases, the lack market for chickens’ products, the rearing system, predators, and parasites (Ngongolo et al., 2019). More studies need to be done in Tanzania particularly in Dodoma to understand the challenges facing chicken production.

Chicken production is essential in supporting the fast growing population of the Dodoma region since all government offices were shifted into the region from Dar es Salaam. More people shift to the new city in search of employment, business, and other official activities. Chickens, being easy to produce and small capital requirements attract more the youths and women who generate high income in the households within households within a short time (Kryger et al., 2010; Hundie et al., 2019). In Zimbabwe, studies have shown that chicken production provides, balance in gender participation, high-quality protein sources, income through sales of eggs, and live chicken (Mapiye et al., 2018). Moreover, the flock size was observed to relate to egg production in Pakistan (Javed et al., 2003). The value of chicken and benefits associated will increase in Dodoma if their challenges are elucidated and addressed.

This study has explicated the challenges facing chicken production in the Dodoma region in Tanzania and the association existing between the chicken...
productions with the identified challenges. Besides, we highlighted the breed of chicken kept by the local communities in Dodoma. In addition, the study focuses on assessing the variation of chicken productivity under different management systems, breeds of chicken kept, and geographical differences (urban versus peri-urban). The Management systems considered in this study were Intensive, semi-intensive and free range systems. It was anticipated that chicken production would vary and be affected by the identified challenges, management system, flock size, a study is which are Dodoma municipal (urban) and Kongwa District (Peri-urban) would vary significantly.

MATERIALS AND METHODS

Study Area

A multistage random sampling of the districts, wards, and households was conducted and questionnaires were administered. The study took place 4 mo from July to October 2020. The selected districts were Kongwa and Dodoma Municipal (Figure 1). In Kongwa district 3 wards, namely Mlali, Kongwa, and Kibaigwa were selected whereas, in Dodoma municipal, the selected wards were Nkuhungu, Chang’ombe, and Mnadani. Reviewed personnel were randomly selected from each household of the wards. The list of each household was obtained from the livestock field officers or district veterinary officers of the respective areas. All districts in the Dodoma region are known to have local communities that practice chicken keeping. Chicken keepers recruited for interviews were also randomly selected. The random selection for districts, wards, and households for sampling was performed using a random number selector from the provided list. The list of farmers in each ward was generated with the assistance of the livestock officers from the respective districts and wards.

Data Collection on the Challenges for Chicken Production

A cross-sectional survey using a semi-structured questionnaire was conducted to generate data from the respondents used to generate information in the study area. The survey was conducted in a cross-sectional way to collect data from respondents in the two districts. The interviewees were randomly nominated in every ward from the list of the chicken keepers. A total of 400 farmers were interviewed, whereby 200 from each district and at least 66 from each ward. The farmers were from Kongwa District while 200 farmers were from Dodoma Municipal. The required sample size for this study was at least 384 individuals. The sample size was determined based on the existing population of the Dodoma region which is around 2 million (Tanzania Population and Housing Census, 2012) and is more than 1 million (Survey monkey, 2020). In each district, a total of 200 questionnaires which comprised both closed and open-ended questions were addressed to the selected farmers. Pre-set challenge statements in the questionnaire were ranked by the farmers in the range of 1 to 5 using Likert scaling classifying as...
Strongly agree, agree, undecided, disagree, and strongly disagree with the score of 5, 4, 3, 2, and 1, respectively (Nemoto and Beglar, 2014). The questions were set to address the amount of chicken kept by the farmers, the management system used for chicken production by the farmers (i.e., intensive, free-range, semi-intensive), breed category of chicken kept by the farmers (broiler, layers, local breed), challenges of chicken production, diseases management control strategies because diseases were the main challenges of chicken production in Dodoma. Under free range system, the chickens are scavenging while semi-intensive the chicken are partially allowed to scavange and partially kept under intensive system.

### Statistical Analysis

The difference in view on responses between interviewees in various categories of responses was determined using either Kruskal-Wallis statistical test (H) or Mann-Whitney statistical test (U) due to none parametric nature of data (Mann and Whitney, 1947; Kruskal and Wallis 1952). The variations were considered significant if $P < 0.05$. The influence of these variables on the number of chicken kept by the farmers was evaluated using a generalized linear mixed model through R statistical software. The selected wards were the random effect during generalized linear mixed model while other factors (variables) such as diseases, theft, and predation were the fixed effects.

### RESULTS

#### The Demographic Structure of Respondents

Out of the 400 households interviewed, 69.64% were female while 30.36% were male. Also, 43.64% were of age above 40 yr, 34.55% of age between 31 to 40 years, and 21.82% of age between 21 to 30 years old. Furthermore, the interviewed households comprised individuals with an education level of primary education (72.22%) and above (27.78%).

#### The Demographic Structure of Chicken Kept

The flock size from the sampled population had a mean = 68.03 ± 11.83, n = 400. The flock was dominated with chicks (m= 27.46 ± 6.39, n = 400), hen (m = 26.057 ± 7.51, n = 400) followed by young hen/pullet (mean = 6.51 ± 0.92, n = 400) while lowest abundance was observed for cockerels (m = 4.19 ± 0.79, n = 400) followed by cocks/rooster (mean = 4.39 ± 0.71, n = 400). The difference among the age groups was significant ($H = 149.091, P < 0.0001$).

#### Flock Structure and Size of Chicken in Each District

The average flock size in Dodoma municipal was significantly higher (mean = 124.56 ± 35.08, n = 200) than that of Kongwa district (mean = 42.55 ± 5.54, n = 200) ($H = 24.253, P < 0.0001$). The difference was significantly contributed by chicken in each district (Table 1).

### Flock Size for Each Breed of Chicken Kept in the Study Area

Out of the 400 farmers interviewed, 87.57% (n = 350) kept local breed, 6.93% (n = 28) kept broiler while 5.5% (n = 22) kept layers. 73.53% of local breed keepers were from Kongwa while 26.45% from Dodoma municipal. 66.67% of broilers keepers were from Dodoma Municipal while 33.33% were from Kongwa Districts. In addition, 60% of layers keepers were from Dodoma municipal while 40% were from Kongwa district. The average flock size kept per household was high in layers (m = 406.08 ± 128.04, n = 22) and broiler (mean = 103 ± 50.04, n = 28) while being low for local chicken (m = 36.61 ± 4.41, n = 350). A similar trend was observed in each district (Figure 2). The variation in flock size among breeds of chicken kept was statistically significant ($H = 31.35, P < 0.0001$). The association between study districts and the productivity showed that there is a positive likelihood of productivity in the Dodoma Municipal than in Kongwa districts (Table 3).

#### Chicken Keeping Management System used by Farmers

From the farmers interviewed, 47.09% (n = 190) were practicing a free-range system mode of management,

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**Table 1.** Flock demographic structure in Dodoma municipal and Kongwa District.

| Category by age | Dodoma municipal (n=200) | Kongwa district (n=200) | $P$-value |
|-----------------|--------------------------|-------------------------|-----------|
| Cocks           | 3.13 ± 0.539             | 4.967 ± 0.995           | 0.26      |
| Hens            | 56.981 ± 23.753          | 12.369 ± 1.822          | <0.0001   |
| Cockerels       | 2.528 ± 0.747            | 4.918 ± 1.084           | 0.1       |
| Pullets         | 2.887 ± 0.682            | 8.082 ± 1.262           | 0.001     |
| Chicks          | 62.547 ± 19.834          | 12.213 ± 2.122          | 0.098     |

$p$-values in bold indicate significance at $P < 0.05$.

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**Figure 2.** The average flock size (mean ± SE) for the three breed of chicken kept (broiler, local breed and layers) in district (n = 200).
Table 2. Chicken productivity in terms of flock size in 3 management systems (free-range, semi-intensive and intensive system) in the Dodoma municipal and Kongwa district.

| System         | Dodoma municipal | Kongwa district | P-value |
|----------------|----------------|----------------|---------|
| Mean           | SE  | n  | Mean | SE  | n  |       |
| Free range     | 18.727 | 2.235 | 60   | 23.516 | 1.382 | 131   | 0.06 |
| Semi-Intensive | 83.222 | 43.381 | 31   | 63.764 | 11.53 | 120   | 0.96 |
| Intensive      | 237.083 | 73.11 | 47   | 59.667 | 16.954 | 4     | 0.04 |

37.71\% (n = 151) semi-intensives system while 14.75\% (n = 51) practiced intensive system mode of chicken keeping, 92.59\% (n = 47) of the intensive system was practiced in Dodoma municipal, 79.71\% (n = 120) of semi-intensives, and 68.69\% (n = 131) of the free-range system were done in Kongwa district. The average flock size was significantly higher in the intensive system (mean = 217.37 ± 65.76, n = 59) compared to the semi-intensive system (mean = 66.50 ± 11.50, n = 151) and free-range system (mean = 22.29 ± 1.19, n = 190) (H = 41.672, P < 0.0001). In comparison between the two districts, the highest flock size was observed in the intensive system of Dodoma municipal while being highest in the semi-intensive systems in Kongwa districts (Table 2). The association between the management system and flock size revealed that intensive and semi-intensive contribute less in the production if we’re to be compared with free-range contribute (Table 3).

Challenges of Chicken Production

The main challenge of chicken production which scored highest by the 400 interviewed farmers was diseases (mean = 4.929 ± 0.043), other challenges mentioned by farmers were theft (mean = 2.839 ± 0.02), predation from wildlife and domestic carnivore (mean = 1.929 ± 0.20), lack of capital (mean = 3.393 ± 0.22), lack of market (mean = 3.482 ± 0.19), little production (mean = 2.732 ± 0.21), lack of livestock expertise (mean = 2.25 ± 0.206), Low price of chicken products (mean = 2.089 ± 0.2), insufficient space available (mean = 1.61 ± 0.17) and availability of water and feedstuff (mean = 1.18 ± 0.13). The variation in opinions of the farmers among the mentioned challenges in chicken production varied significantly during Likert scoring (H = 186.351, P < 0.001). The presence of diseases, theft, predation, low production, lack of experts, unavailable space and huts for keeping chicken, and insufficient feed staffs for chicken is negatively associated with the production of chicken (Table 4).

DISCUSSION

Most of the households were dominated by chicks and hen with a mean flock size of 68.03 ± 11.83, which was larger compared to the mean flock size of 26.1 ± 0.69 established in Pakistan (Javed et al., 2003). The variation can be due to the fact that in Pakistan only local chicken kept in the backyard was considered in the study whereas, in our study, broilers, layers, and local chickens in all management systems were considered.

Flock Size in the Study Area

The mean Flock size was higher in Dodoma municipal than in Kongwa and this can be explained by the fact that broilers and layers which are kept in large numbers for commercial purposes were from Dodoma municipal where intensive management is deployed. Household who kept layers and broiler were all from Dodoma municipal. In Kongwa ward located in Kongwa, most of the farmers keep local chicken under free-range or semi-intensive management who kept the local breeds in a free-range system that was dominant in Kongwa district. In Dodoma municipal, people who kept layers and broiler used the intensive system which can accommodate large flock size per unit area. The Dodoma municipal is an urban where the human population is high and the consumption of chicken products is higher. The easiest way to overcome the demand of the chicken market in the urban is by using broiler and layer chicken in an intensive system. This mode of production, produce much in a very short time with small space requirement. This agrees with the study which was conducted in Ghana and which showed that both broilers and layers

Table 3. The association existing between the productivity in term of flock size and the breed of chickens, district of study, and management system used by farmers.

| S/n | Level of measurement | Variables     | EC  | SE  | z value | P     | Comments |
|-----|---------------------|---------------|-----|-----|---------|-------|----------|
| 1   | Management system   | Intercept     | 4.74 | 0.33 | 14.29   | < 2e-16 | ***      |
| 2   |                     | Intensive     | 0.36 | 0.07 | 5.35    | 8.66e-08 | ***      |
| 3   |                     | Semi-intensive| 0.72 | 0.04 | 16.54   | < 2e-16 | ***      |
| 4   | Breed of chicken    | Local breed   | -0.54 | 0.09 | -5.84   | 5.37e-09 | ***      |
| 5   |                     | Layers        | 0.26 | 0.11 | 2.32    | 0.02024 | *        |
| 6   | District of study   | Kongwa District| -1.22 | 0.29 | -4.10   | 4.09e-05 | ***      |
| 7   | Random effect       | Wards         | 3099.0 | 0    |        |       |          |
| 8   |                     | logLik        | -1466.5 | 0    |        |       |          |

Abbreviations: AIC, Akaike’s an information criterion; EC, estimate coefficient; Family used was Poisson since the data had counting value.
* Significant; ** High significant; *** = highly significant.

The intercept for management system was free-range; while that for breed of chicken was broilers and for district of study was Dodoma Municipal.
Table 4. The association between productivity in terms of flock size with the challenges facing chicken production in Dodoma.

| S/n | Variables | EC   | SE   | z value | Comments          |
|-----|-----------|------|------|---------|-------------------|
| 1   | Intercept | 3.29 | 0.19 | 17.13   | <2e-16 ***       |
| 2   | Diseases  | 0.11 | 0.01 | 7.66    | 1.93e-14 ***     |
| 3   | Theft     | -0.04| 0.01 | -3.12   | 0.00183 ***      |
| 4   | Predation | 0.08 | 0.01 | 8.12    | 4.74e-16 ***     |
| 5   | Lack of capital | 0.001| 0.01 | 0.14    | 0.89             |
| 6   | Lack of market | -0.01| 0.01 | -1.64   | 0.10             |
| 7   | Low production | -0.23| 0.01 | -24.35  | <2e-16 ***       |
| 8   | Lack of experts | -0.07| 0.01 | -6.36   | 2.04e-10 ***     |
| 9   | Low product | 0.33 | 0.01 | 37.47   | <2e-16 ***       |
| 10  | Unavailable space and huts (bandas) | -0.15| 0.02| -9.94   | <2e-16 ***       |
| 11  | Insufficient feed staffs and water supply | 0.04| 0.01| 3.26    | 0.001 **         |
| 12  | Random effect | Wards |      |         |                   |
| 13  | AIC       | 3815.8 |      |         |                   |
| 14  | logLik    | -1895.9 |      |         |                   |

Abbreviations: AIC, Akaike’s information criterion; EC, estimate coefficient.

Family used was Poisson since the data had counting value.
*: Significant; **: High significant; ***: highly significant.

have great potential in generating income with high profitability at the household level (Anang et al., 2013).

**Flock Size Under Different Management System**

Mean flock size in the intensive system was higher compared to those kept under the semi-intensive and free-range systems, this is associated with the requirements for keeping chickens, in intensive system chickens, are kept for commercial purpose so are kept in large numbers. Other factors like feeding, safety from predations are more secured in chickens kept in intensive systems than the local chickens kept in the free-range system (Marwa et al., 2018). Regardless of positive potential, the intensive system management can offer in the production of chicken in Dodoma, yet, the current production and its contribution to the chicken. The production industry in Dodoma is still low. This can be due to a few people who are engaged in the intensive chicken production system, high production costs such as feeding, veterinary services, human labor, and disease control management.

**Challenges for Chicken Production**

Diseases were the main challenge hindering chickens production in Dodoma. Other challenges that were highlighted in this study were theft, predation, low production, lack of experts, unavailable space and huts for keeping chicken, and insufficient feed staff for chicken. These challenges were observed to negatively affect the chicken production industry in Dodoma. Mortality due to diseases, predation, insufficient feedstuffs, and lack of experts reduces the number of chicken in the production firm. Low production and unavailable space made the firm less capable to produce chicken products which can meet the demand of Dodoma market. Other studies support the findings that high mortality in chicken production has been attributed to the disease. For instance, a study done in Tanzania revealed that, Newcastle can cause mortality of up to 100% (Sindiyo and Missanga, 2018) and it was noted that Newcastle diseases alone cause a loss of US$ 288.49 million per annum in Bangladesh (Khatun et al., 2018).

**CONCLUSION**

The higher flock size in Dodoma municipal was associated with the breed of chicken kept (broilers and layers) in the intensive system which is central to the flock size in Kongwa which comprised of local chicken kept under the free-range system. The chicken production firm has a high potential to generate income, support livelihood in Dodoma, but the production and productivity in terms of flock size are low. The intensive system management of broilers and layers is the main opportunity to overcome the scarcity of chicken products in Dodoma urban. However, few people are involved in keeping broilers and layers due to the fact that the natives do prefer more local chickens to broilers and layers. With the changing community composition, it may be preferable to accommodate more local chickens into the semi-intensive system of management.

Diseases of chicken were noticed as the major challenge of threatening chicken production in Dodoma. Other constraints for chicken production in Dodoma were reported to be theft, predation, low production, lack of experts, unavailable space and huts for keeping chicken, and insufficient feed staff for chicken.

Chicken based-markets were not seen as a significant challenge in chickens’ production firm, this shows that the demand for the chicken products is still higher in Dodoma. This demand will continue to increases as the urban grow faster. There is a need for more chicken producers to invest in this venture so as to meet the demand for chicken products in Dodoma. However, for better and profitable production, the highlighted challenges need to be addressed among farmers.

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Informed consent was obtained from all participants included in the study.

DISCLOSURES

The authors declare that they have no conflict of interest.

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