
PRODUCTIVITY AND GROWTH PERFORMANCE OF CHICKENS FROM SMALL HOLDER FARMERS IN DODOMA, TANZANIA

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ABSTRACT

This study focused on the productivity of chickens in terms of stocking and growth performance of chickens kept by small-scale chicken holders and the associated factors in the Dodoma municipality in three wards, namely, Nkuhungu, Chang'ombe and Mnadani. A cross-sectional survey using a semi-structured questionnaire was conducted to collect data on the perceptions of farmers raising chickens in terms of productivity. Similarly, a longitudinal survey was made by monitoring the chicks ages, ranging from 0 to 60 days (2 months). This study was used to collect data on the management performance of chicks from five selected farmers. A total of 390 individuals were interviewed, of whom 26.15% (n = 102) were from Nkuhungu, 41.28% (n = 161) from Chang'ombe, and 32.56% (n = 127) from Mnadani wards. Adult males (26 – 35 years old) (66.67%) were more likely to be involved in chicken keeping in Mnadani ward. Household size and chicken breed significantly contributed to the productivity of chickens in Dodoma, where layers production were leading. The growth performance of chicks over time was affected by the management system (e.g., free range and semi-intensive), age and sex of chickens, cleanliness, treatment regime, and flock size. In order to improve the productivity of chickens in Dodoma through the stocking rate and growth performance of chicks, we recommend that, the socio-demographic characteristics of the farmers raising chickens and other factors such as management strategies and systems be considered.

Keywords: Chicken productivity, Factors affecting, Growth performance

INTRODUCTION

Tanzania is an East African country that along with Kenya and the other five member states that form the East African Community, shares a more or less comparable natural environment. Diseases, markets for chickens' products, rearing techniques, predator types and parasites were identified as key obstacles in chicken production in Tanzania (Ngongolo *et al.*, 2019). A few studies have been conducted in Dodoma

to better understand the issues of chicken production and growth.

Smallholder farmers in African countries such as Tanzania benefit substantially from chicken production because of improved food security, poverty alleviation, and gender equality (Alemayehu *et al.*, 2018). Chicken farming enhances household income and economic resilience, employment, food and nutrition security, aesthetic value, manure and spiritual value (as offerings) in communities (Kabir *et al.*,

2015; Kattel, 2016; Ngongolo *et al.*, 2019; Ngongolo *et al.*, 2021). Despite the significant contribution of chickens to the socio-economic well-being of societies, little information is available on the growth performance of chicks and how they are influenced by different factors, such as management practices in Dodoma.

Management strategies are key contributors to chicken production. For instance, a study in Babati, Tanzania, reported that an intensive management system had a higher output than other systems because of the security provided to hens against predation and feed usage efficiency (Marwa *et al.*, 2018). Furthermore, another study in Morogoro, Tanzania, reported that management strategies have substantial impact on chicken productivity and growth performance (Mwalusanya *et al.*, 2002). However, the effects of several elements, such as management practices and the socio-economic status of farmers raising chickens, were not considered.

After the re-location of the all-government offices to Dodoma from Dar es Salaam in 2018, chicken production has become crucial for maintaining the region's rapidly growing population. In the quest for work, business, and other official activities, more people move into the new city. Chickens are popular among young people and women because they are easy to raise, require minimal starting capital, and provide a high level of income in a short period of time (Kryger *et al.*, 2010). Chicken production balances gender participation, provides high-quality protein sources, and increases household economic resilience through egg and live chicken businesses (Mapiye *et al.*, 2008; Ngongolo *et al.*, 2021).

This study focused on the perceptions of the farmers who raise chickens about the productivity and growth performance of chickens in Dodoma. In addition, the factors that may affect the productivity and growth performance of chicks below two months of age in the study area were also studied. This study hypothesized that productivity and growth performance would differ and be influenced by factors such as management practices, sex, the

socio-economic status of the keeper, and diseases.

MATERIALS AND METHODS

Ethics: The ethical clearance for this study was provided by the University of Dodoma Ethical Committee with reference number MA.84/261/02.

Study Areas: The study was conducted in Dodoma Municipality from July 2020 to December 2021. The wards, namely, Nkuhungu, Chang'ombe and Mnadani (Figure 1) were purposefully selected for inclusion in the study from the 41 wards of Dodoma Municipal because they are known to have farmers who are keeping chicken.

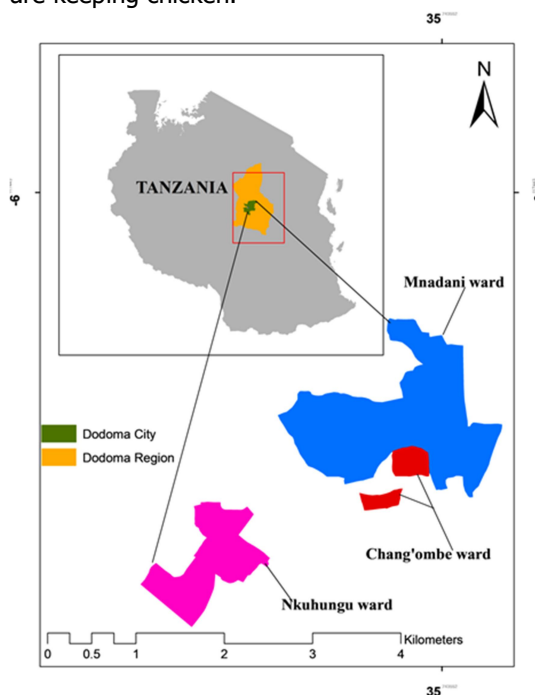


Figure 1: Map showing study wards in Dodoma city (Created using QGIS 3.26 Buenos Aires)

The three wards were chosen based on Dodoma Municipal is the capital of the Dodoma region, which is the capital city of the country, located 281 miles west of the former capital and the business city of Dar es Salaam and 274 miles south of Arusha, the headquarter of the East African community. The district is one of the seven districts in the Dodoma Region of Tanzania. It is bordered to the west by the Bahi District and to the east by the Chamwino District. The capital city of Dodoma has a

population of about 3,085,625 in 2022 (Wikipedia, 2022). Dodoma is located at 6°10'23"S 35°44'31"E in the center of the country and features a semi-arid climate with warm to hot temperatures throughout the year.

Study Design: A cross-sectional survey was conducted to collect farmers' perceptions of the productivity and performance of chickens. From July 2020 to October 2021, a questionnaire survey was conducted. Following a purposive sampling of the district and wards based on the availability of local farmers who raise chickens in free range and semi-intensive management systems, a multistage sampling of villages and farmers was conducted. A longitudinal survey was conducted between November 2020 and January 2021 to determine chick growth performance and the factors influencing it. A team of five farmers was assembled for this survey. Chang'ombe contributed two farmers, Nkuhungu two, and Mnadani one. Every visit included the collection of data on chicken growth performance.

Data Collection on the Factors for Chicken Production: A total of 390 farmers were interviewed, with at least 130 farmers from each ward. The sample size was calculated based on the Dodoma municipality's available population estimate, which was approximately 3,085,625 in 2022 (Wikipedia, 2022). Farmers were given 130 questionnaires with both closed-ended and open-ended questions. The researchers used Likert scales to rank pre-set challenge statements in the questionnaire on a scale of 1 – 5, with scores of 5, 4, 3, 2, and 1 representing acceptance, agree, disagree, undecided, disagree and strongly disagree (Nemoto and Beglar, 2014). The questions were designed to address the number of chickens kept by farmers, the management system used by farmers for chicken production (i.e., intensive, free-range and semi-intensive) and the breed category of chickens kept by farmers (broiler, layers, local breed). Also recorded were socioeconomic activities such as sex of farmer, educational level and occupation, as these were thought to be among the factors influencing

chicken productivity among the selected farmers.

Data Collection from the Selected Farmers: Every farmer who took part in this study was required to keep at least ten local hens under the age of two months. In order to collect data, each farmer was given ten chicks to monitor. The data was repeated eight times at weekly interval for the ten selected chicks. Each round included a cross-sectional survey followed by an 8-day longitudinal follow-up. In each cycle, data on growth characteristics was collected for each chick. Weight (g) and length (m) were the growth variables used in the measurements (cm).

Length categories investigated in this study were wing length (WL), back length (BL), height (H), toe to comb length (BCL), shank length (SL), beak length (BKL), and toe to back length (TBL), as suggested by Adekoya *et al.* (2013). Furthermore, information was gathered on the technique used to retain each chick, its age in days, the size of the flock held by farmers, supplement feeding, frequent cleaning of the hut (banda), and treatment supply. For ease of analysis, chicks were divided into four groups: very young (0 – 20 days), young (21 – 40 days), old (41 – 60 days), and mature (>60 days).

Statistical Analysis: The non-parametric data were analyzed using either Kruskal-Wallis (H) or Mann-Whitney (U) statistical tests (Mann and Whitney, 1947; Kruskal and Wallis, 1952), and the statistical significance was detected by actual p-value if it was less than 0.05. The impact of these variables on the number of chickens kept by farmers was assessed using the R statistical program and a generalized linear mixed effect model (GLMM) (R Development Core Team 2011). t-test for pairwise comparison was used for comparison of males and female, while ANOVA with a post hoc was used for analysing growth performance parameters and coefficient estimate for the association between productivity and other socio-economic parameters.

RESULTS

The Demographic Structure of the Study Respondents:

A total of 390 respondents were interviewed, of whom 102(26.15%) were from Nkuhungu, 161(41.28%) from Chang'ombe and 127(32.56%) from Mnadani wards. Also, 252 (64.62%) of the respondents were females, while 138(35.38%) were males. The demographic structure varied across the three study wards. For instance, moderate family size and business men and women were dominant in Chang'ombe and Mnadani, whereas small family size and self-employed people were dominant in Nkuhungu (Table 1).

The Proportions of Respondents on Chickens' Productivity in Different Stocking Densities and Breeds:

About 84(21.54%) of respondents kept broilers, 30(7.69%) kept layers, and 18(4.62%) kept local chickens with either broilers or layers with a stocking number of more than 100 chickens. The majority of respondents (53.85%, $n = 210$) were observed to keep local chickens in abundance, ranging from 1 to 40. In addition, a few individuals (16.92%, $n = 18$) were observed to keep chickens in the abundance range of 40 – 100. Generally, a large stock was observed for people keeping layers and broilers, while medium and small stocks were kept by people keeping local chickens (Table 2).

The Variation of Chickens Productivity Across the Study Wards, Breeds and Family Size:

The productivity of chickens varied among the study wards, breeds of chicken kept, and family sizes. For instance, Mnadani ward showed significantly higher productivity of chicken per household than the other two wards, Nkuhungu and Chang'ombe (Kruskal-Wallis Test Statistic = 113.65, $p < 0.001$) (Figure 2). In addition, the productivity of layers in the study area was highest compared to the other breeds of chicken (Kruskal-Wallis Test Statistic = 209.44, $p < 0.001$, $df = 2$) (Figure 3) while in terms of family size of the household, large family size showed a significant contribution in terms of the average number of chickens kept per household (Kruskal-Wallis Test Statistic = 9.24, $p < 0.01$,

$df = 2$) (Figure 4). Furthermore, the productivity of chicken was observed to vary among different categories of occupations (Kruskal-Wallis Test Statistic = 123.35, $p < 0.0001$) (Figure 5) or activities involved by the individual who kept chicken (Table 3).

Performance of Chicks at Various Ages in Terms of Growth:

The toe to back length, wing to back length, back to back length, shank to beak length, height and weight increased significantly with time (age) (Figure 6). Growth rate in terms of weight was inversely related to length. On the other hand, wing and beak lengths grew at a faster rate than other length factors.

Relationship Between Weight of Chicks with the Length and Management Practices:

The regression coefficient was used to determine the association using the following equation: $y = -0.0781X + 0.115$, whereby 0.0781 is the coefficient, X is the predictor, and 0.115 is the constant. The findings showed that the relationship between weight gain in chickens was significantly associated with personal responsibility for management, education level of the chicken keepers, age and sex of the chickens, and family size of the chicken keepers. For instance, cocks and moderate family size had positive association with the growth performance of chickens in terms of weight (Table 3).

DISCUSSION

Both sex (male and female) with moderate family sizes (4 – 6 family members) from all educational levels (primary, secondary and higher education) were found to be engaged in chicken production in this study. Sexes considerations are vital in chicken production, according to a study conducted in Dodoma (Alemayehu *et al.*, 2018; Ngongolo *et al.*, 2021; Ngongolo and Chota, 2022). The business men and women was the most common occupational group involved in chicken production, presumably because of their ability to raise chickens and supply the necessary resources for management, such as food, shelter, water and medication.

Table 1: The demographic structure of the study respondents, breed of chicken kept and the person responsible for keeping chicken at household level

S/N	Variable	Classification	Studied wards		
			Nkuhungu (n=102) (%)	Chang'ombe (n=161) (%)	Mnadani (n=127) (%)
1	Sex	Male	66.67*	20.20	52.52*
		Female	33.33	71.80*	47.48
2	Age (Years)	16-25 (youth)	0.00 ^a	7.69 ^a	21.58 ^a
		26-35 (adult)	55.56 ^c	30.77 ^b	51.80 ^b
		36 and above (old)	44.44 ^b	61.54 ^c	26.62 ^c
3	Family Size (Number of individuals)	1-3 (Small)	44.44 ^a	33.33 ^a	23.08 ^a
		4-6 (Moderate)	33.33 ^b	51.28 ^b	69.23 ^b
		7 and above (large)	22.23 ^c	15.71 ^c	19.31 ^c
4	Education Level	Primary	12.96	66.67 ^c	8.63 ^a
		Secondary	64.82	13.25 ^a	49 ^b
		High education (colleges)	22.22	20.09 ^b	32.37 ^c
5	Occupation	Students	0 ^a	0 ^a	8.63 ^b
		Self Employed	55.56 ^b	23.08 ^b	5.03 ^a
		Employed	11.11 ^c	10.25 ^c	17.27 ^c
		Business	33.33 ^d	66.67 ^d	69.07 ^d
6	Responsible person in household in keeping chicken	Youth	0 ^a	0 ^a	34.53 ^c
		Parents	11.11 ^b	5.13 ^b	12.23 ^a
		Mother	11.11 ^b	23.08 ^d	21.58 ^b
		Father	22.22 ^c	7.67 ^c	12.95 ^a
		All Family members	55.56 ^d	58.97 ^e	12.95 ^a
7	Breed of Chicken Kept	Local	31.65 ^c	79.92 ^d	24.46 ^c
		Layers	22.22 ^b	5.13 ^b	8.63 ^b
		Broiler	46.30 ^d	5.13 ^b	29.30 ^d
		Local and Broiler	0 ^a	25.64 ^c	0 ^a
		Local and Layer	0 ^a	0 ^a	86.33 ^d

Percentages with asterisks () within the same column for a specific parameter are significantly different (p<0.05), ^{abcd}Percentages with different letter superscript within the same column for a specific parameter are significantly different (p<0.05)

Table 2. Productivity in terms of stocking density of different breed of chicken in three study wards; Nkuhungu, Chang'ombe, Mnadani

S/N	Breed	Productivity in terms of Stocking density Classification	Studied wards		
			Nkuhungu (n=102) (%)	Chang'ombe (n=161) (%)	Mnadani (n=127) (%)
1	Layer	Small (1-20)	0 ^a	0 ^a	0 ^a
		Medium (21-40)	0 ^a	0 ^a	0 ^a
		Large (41-100)	5.88 ^b	0 ^a	0 ^a
		Very large (Above 100)	5.88 ^b	7.45 ^b	9.44 ^b
2	Broiler	Small (1-20)	0 ^a	0 ^a	0 ^a
		Medium (21-40)	0 ^a	0 ^a	0 ^a
		Large (41-100)	0 ^a	0 ^a	0 ^a
		Very large (Above 100)	23.53 ^b	7.45 ^b	33.07 ^b
3	Local	Small (1-20)	11.76 ^c	94.21 ^d	4.72 ^a
		Medium (21-40)	0 ^a	29.81 ^c	14.7 ^c
		Large (41-100)	0 ^a	7.53 ^b	18.90 ^d
		Very large (Above 100)	4.90 ^b	0 ^a	5.51 ^b
4	Local and broiler	Small (1-20)	0 ^a	9.91 ^c	0 ^a
		Medium (21-40)	0 ^a	0 ^a	0 ^a
		Large (41-100)	0 ^a	0 ^a	4.72 ^b
		Very large (Above 100)	0 ^a	3.72 ^b	4.72 ^b
5	Local and layers	Small (1-20)	0 ^a	0 ^a	0 ^a
		Medium (21-40)	0 ^a	0 ^a	0 ^a
		Large (41-100)	0 ^a	0 ^a	0 ^a
		Very large (Above 100)	0 ^a	3.73 ^b	9.44 ^b

^{abcd}Percentages with different letter superscript within the same column for a specific parameter are significantly different (p<0.05)

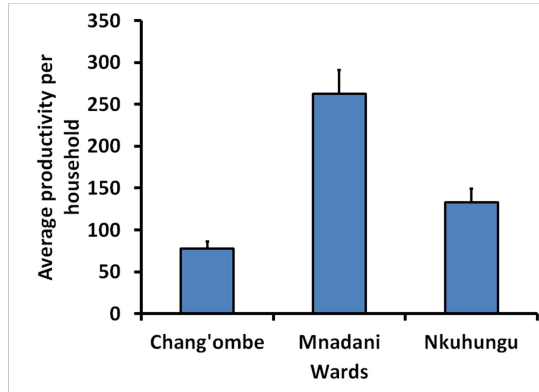


Figure 2: Average Chicken productivity in terms of stocking density per household in three study wards in Dodoma

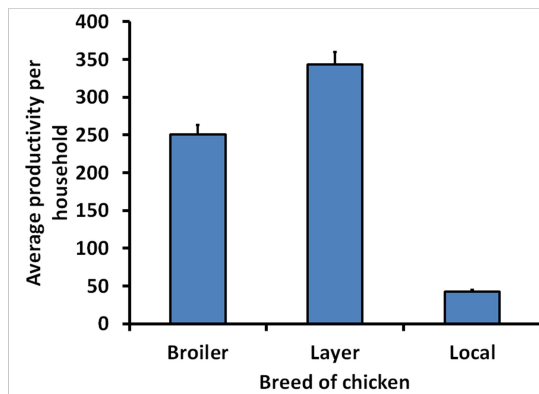


Figure 3: Average productivity of the three breeds of chicken kept in terms of stocking density per household by the farmers in the communities

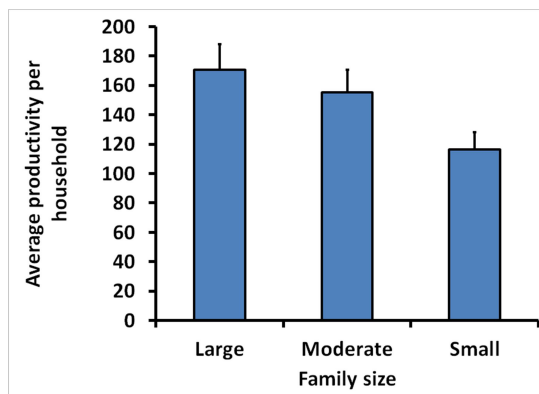


Figure 4: Average chicken productivity as influenced by family size in terms of stocking density per household among farmers in the communities involved in chicken keeping

A related phenomenon was reported in Bangladesh, where business men and women were among the people involved in chicken production (Kabir *et al.*, 2015). Despite the fact

that all breeds of chicken (local, broiler and layers) were domesticated in the study area, the local breed was the most popular because of its ease of management and the fact that the majority were kept in a free-range system.



Figure 5: Average chicken productivity as influenced by occupation in terms of stocking density per household among farmers in the communities involved in chicken keeping

Previous research in the same area revealed that all breeds of chicken were kept in the areas, with dominant differences between the Kongwa District and Dodoma Municipality (Ngongolo and Chota, 2022).

Chicken Productivity in Terms of Stocking Density:

The chicken stocking density varied by ward across the keepers, whereby Mnadani experienced the highest productivity compared to the rest. This may be associated with factors that motivate chicken production, such as, markets for chicken products, available space, breed categories and the purpose of chicken keeping. For instance, layers and broilers showed high productivity in terms of stocking density. This can be explained by the fact that majority of people who kept broilers and layers focused on commercial production, while local chickens were kept for subsistence, focusing on commercial only when opportunity arose. Other benefits associated with chicken keeping in Dodoma have been reported to include sources of meat, manure, offerings, revenue, aesthetic value (beauty), and employment (Ngongolo *et al.*, 2021), while contributing significantly to food security and women's empowerment (Kryger *et al.*, 2010).

Table 3: Association of chicken productivity (final weight) with socio-demographic structure, person responsible for keeping and the age/sex of chicken

Variables	Classification	Coefficient estimate	Standard Error	Z-value
Sex	Male	1.15 ^{e-01***}	40.22	40.22
	Female	3.69 ^{e-02***}	23.039	23.039
Age (years)	Old	8.554e-02	1.377e-02	6.213
	Youth	2.892e-01	2.528e-02	11.440
Family size (number)	Moderate	1.804e-01	1.636e-02	11.025
	Small	-1.89e-02	1.81e-02	-1.05
Occupation	Employed	-1.118e-01	2.089e-02	-5.352
	Self employed	1.043e-01	1.748e-02	5.966
	Students	1.300e-01	3.670e-02	3.542
Education level	Primary	-1.201e-02	2.118e-02	-0.567
	Secondary	-1.256e-02	1.259e-02	-0.997
Who is involved in management	Father	1.356e-01	2.611e-02	5.193
	Mother	-5.189e-01	2.178e-02	-23.824
	Parents	-5.616e-01	2.507e-02	-22.403
	Youth	-4.191e-01	2.404e-02	-17.433
Breed of chicken	Layer	-3.937e-01	1.979e-02	-19.890
	Local	-3.289e-01	3.647e-02	-9.019
Age and sex of chicken	Cocks	4.484e-02	1.924e-03	23.308
	Hen	1.974e-03	3.732e-05	52.888
	Cockerels	-1.525e-02	2.678e-03	-5.693
	Pullets	2.317e-02	3.005e-03	7.711
	Chicks	1.285e-03	4.376e-05	29.359

Percentages with asterisks () within the same column for a specific parameter are highly significantly different ($p < 0.001$); Random effect = Wards; AIC = 4952.80; logLik = -2446.40

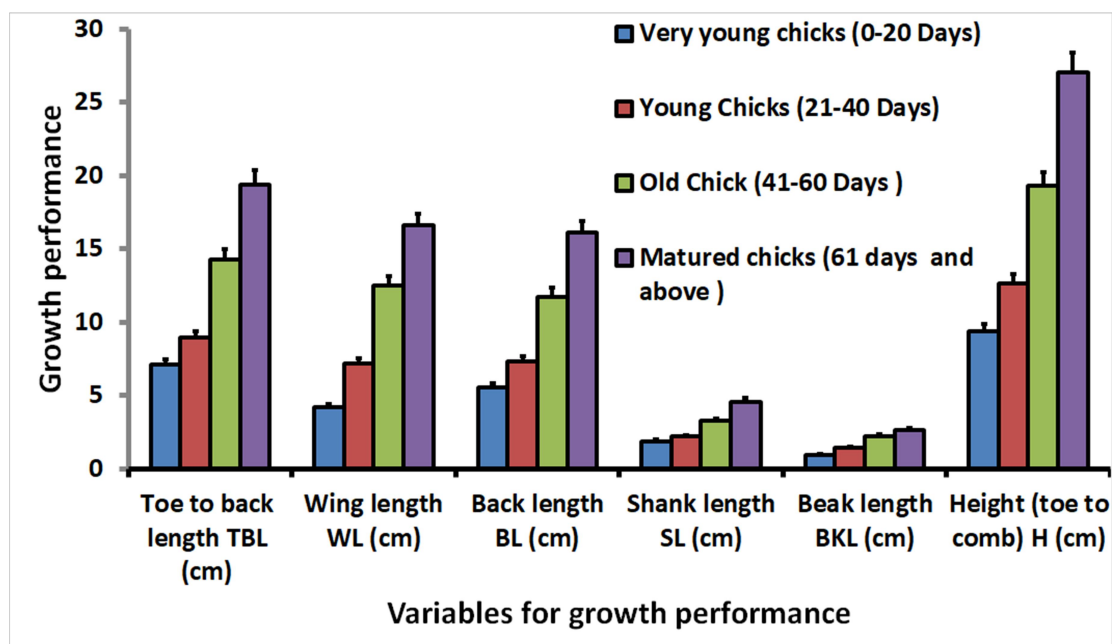


Figure 6: Growth performance differed by age group in terms of toe-to-back length, wing-to-back length, back-to-back length, shank-to-back length, beak-to-back length and height (toe-to-comb length)

Commercial preference of chicken keeping has been reported in other studies (Kabir *et al.*, 2015; Mapiye *et al.*, 2008), in which chicken production contributed highly to the socio-economic boosting of the livelihood of local communities.

The productivity of chickens in Dodoma needs to consider the family size of the chicken keeper, the breed of chicken kept, and the age and sex of the chicken. Possibly because of the high demand for extended family size, production was positively influenced by family size. As a means to overcome the effects of extended family size and the rapid growth in population in Dodoma, broiler keeping was also positively related to productivity, while layer and local chicken keeping were negatively related to productivity. This finding was in line with a study conducted in Ghana (Anang *et al.*, 2013), that both broilers and layers had considerable potential for generating money at the household level. The dominance of broilers cascaded into high production of cocks, followed by pullets, hens and chicks. In this study, it was clear that, cocks contributed positively to the productivity of chickens at the household level, particularly those that kept broilers. Livestock keepers are aware of the fact that cocks grow faster and can give a higher yield of meat compared to hens.

Performance of Chicks at Various Ages in Terms of Growth: The chicks showed encouraging growth over time, while being influenced by several circumstances. Treatment, cleanliness, flock size, management technique (free-range or semi-intensive), and effects on the growing performance of chickens are all part of the farmer's management practices. A rise in pathogen contamination and competition for resources needed for chicks to thrive, including food, fresh air and water may be as a result of incorrect handling, inadequate hygiene and large flock size. Similar findings have been reported by Deng *et al.* (2022) who reported that age and management techniques, like feeding, had substantial impact on the growth performance of chickens. Furthermore, Shafiq *et al.* (2022) showed that breeds with light brown and dark brown phenotypes revealed distinct growth performance and better quality in terms

of cholesterol content. Furthermore, several studies had demonstrated that growth was strongly correlated with nutrition, breed of chicken, environmental conditions, and diseases experienced (Timmerman *et al.*, 2006; Abdullah *et al.*, 2009).

Conclusion: Male or female participants in chicken keeping have an impact on the production of chickens, with men having a greater impact. The quantity of chickens produced also depended significantly on the size of the chicken keeper's family, the breed of hens kept, and the age and sex of the animals. Enhancing food security, reducing poverty and hunger, creating jobs, promoting gender equality, and raising local communities' incomes all depend on the production of chicken in Dodoma and other regions of Tanzania. To do this, it is necessary to consider elements that have an impact on production, such as the size of the chicken keeper's family, the breed of chickens kept, and the age and sex of the chickens.

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