Original Article

Effect of management systems, practices, flock size, and age group on the growth performance of chicks from local chickens' farmers

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Abstract

The improved growth performance of chicks determines the production efficiency of chicken to local chicken farmers. Little has been done to understand the contribution of management systems and practices to the growth performance of chicks from farmers who are involved in rearing local chickens in Dodoma. We focused on assessing how the growth performance of chicks (length and weight) from local chicken farmers is affected by management systems (Free range and semi-intensive systems), management practices such as water provision, supplement feeding, regular cleaning, flock size, and size of banda (hut) used to raise chickens. Data were collected for 8 rounds within 2 months (once per week) from 5 farmers in three wards: Nkuhungu (n=2), Mbwanga (n=2), and Mtube (n=1). In each round, data were collected from 10 chicks per farmer (n=400 chicks for all 8 rounds and 5 farmers). Kruskal Wallis was used to determine the variation in growth performance while generalized linear model was used to assess the effect of flock size, management system on the growth performance of chicks. Growth performance was significantly increased and affected by age (P<0.05). The management system significantly contributed to the growth performance of the chicks (P<0.001). In addition, the small size of the banda (hut) with large flock size reduced the growth performance of chicks due to increased competition in terms of space, supplements, water supplied, feed provided, and treatment (P<0.05). In raising local chicken, local farmers need to be concerned in applying management practices such as supplement feeding, treatment, flock size and size of huts.

Introduction

Chicken production contributes greatly to the socio-economic development of smallholder farmers in African countries including Tanzania by improving food security, poverty alleviation and gender equality (Alemayehu et al., 2018). Other studies have shown that, chicken production increases household income, employment, food, aesthetic value, manure, and spiritual value (as an offering) communities (Kabir et al., 2015, Kattel, 2016, Ngongolo et al., 2019, Ngongolo et al., 2021). Regardless of the valuable contribution of chicken in terms of socio-economic value, the influence of management systems and practices used by farmers, flock size, and age group on the growth performance of chicks from local chicken farmers have not been intensively studied in Tanzania specifically in the Dodoma region.

Other studies have revealed that management systems affect chicken production. For instance, a study in Babati, Tanzania revealed that a management system specifically an intensive system had higher productivity than other systems because of the security they offered to chickens against predation and feed utilization efficiency (Marwa et al., 2018). Management systems have contributed to the production of local chickens to small holders' farmers. Supplementary studies have shown that chicken production in terms of the growth performance of chicks is significantly related to management practices. For instance, a study in Morogoro, Tanzania pointed out that, management practices had significant effects on the growth performance of chicken (Mwalusanya et al., 2002). However, in this study, the effects of management practices focused much on older chickens. Little is known about how the growth performance of chicks for less than 2 months is affected by management practices, flock size, and age group.

This study focused on understanding the effect of management systems and practices used by farmers on the growth performance of local chicks under 2 months. In addition, we assessed, how to size, and age group flock are influencing the growth performance of chicks from local chickens kept by smallholders' farmers in Dodoma.

Methods

Study area

The study took place in three wards of Dodoma municipality: Mbwanga, Mtube and Nkuhungu. The three wards were selected purposively because of the availability of farmers who are keeping local chickens under free range and semi-intensive management systems. Data were collected from November 2020 to January 2021. Five farmers were recruited for this study. Two of them were from Mbwanga, two from Nkuhungu and one from Mtube. The selection of farmers in each ward was performed randomly among the listed farmers

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from the targeted ward.

Data collection from the selected farmers

Each farmer recruited in this study was supposed to have local chickens with at least 10 chicks with the age of 2 months and below. 10 chicks were monitored for data collection from each selected farmer. Data were collected 8 times in a repetitive manner for the 10 selected chicks at intervals of 1 week (7 days). This involved a cross-sectional survey in each round with longitudinal follow up of 8 days (rounds). In each round, information on growth variables was measured for each chick. The growth variables included during the measurement were weight (g) and length (cm). Length was measured using tape measure (ABS+Stainless Steel+High Carbon Steel, 0-25FT) with resolution of 0.02 mm and precision of 0.02 mm The length categories considered in this study were wing length (WL), back length (BL), height (H), (Toe to comb), beak to comb length (BCL), shank length (SL), beak length (BKL) and toe to back length (TBL) as suggested by Adekoya et al. (2013) (Fig. 1). In addition to that, information about the system used for keeping each chick, age in days, flock size kept by farmers, supplement feeding, and regular cleaning of hut (banda), and treatment provision were taken. The supplement considered in this study was provision of sources of minerals, vitamins, protein and energy such vegetable, sold multivitamins, sardine remains (Dagaa). Treatment provision focused to understand the means and ways by which the farmer treats their chicken when they are sick birds. For easy analysis, chicks were classified as very young chicks (0-20 days), young chicks (21-40 days), old chicks (41-60 days), and mature chicks (>60 days).

Statistical analysis

The variation in growth performance in terms of length and weight of chicks under different age groups was analyzed using the Kruskal-wallis statistical test either (H) or Mann-whitney statistical test (U) because of lack of parametric nature (Mann and Whitney, 1947; Kruskal and Wallis, 1952). The data were non-parametric in nature because the kurtosis was between -2 to -1. In addition, if the p-value was less than 0.05, then the variation was considered to be statistically significant. The influence of these variables on growth performance in terms of the weight of chicks was evaluated using generalized linear model (GLM) using R statistical software (R Development Core Team 2011).
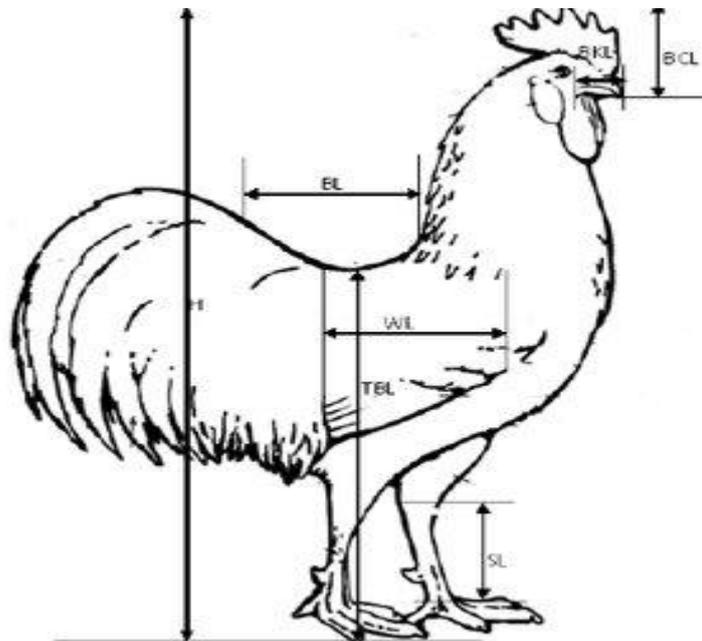
Figure 1. Body parts where measurements for length. WL , Wing length; BL, Back length; H, Height (Toe to comb); BCL, beak to comb Length; SL, Shank length; BKL, Beak length; TBL, Toe to back length. (Adekoya et al., 2013)

Results

Flock size kept by the five chicken keepers under the study

Of the five farmers under investigation 60% (n=3) and 40% (n=2) were men and women respectively who were involved in chicken keeping. The total number of chickens kept by farmers was recorded to be 567 per round thus making a total of 7657 chickens recorded for 8 rounds. The overall average flock size kept by the farmers were Mean±S.E=32.86±0.86 with maximum =53, Minimum=11 and range=42, n=400. The average flock size varied significantly among farmers (H = 214.51, P<0.0001, df=4) (Fig. 1).

Growth performance of chicks at different age group

The growth of chicks was observed to increase significantly with time (age) in terms of toe to back length, wing length, back length, shank length, beak length, height and weight (Table 1). The association of growth rate in terms of weight was negatively related to the growth in terms of length. However, wing length and beak length showed higher growth rate compared to other length variables (Table 2).
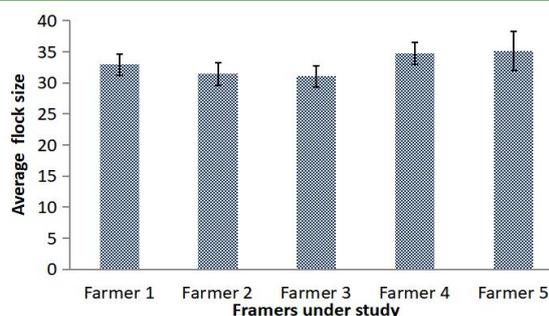
Figure 1. The average Flock size (Mean±S.E) for each farmer who were involved in the study

Table 1. Mean growth performance under different age group in terms if toe to back length, wing length, back length, shank length, beak length, height and weight

No	Age group	Very young chicks	Young Chicks	Old Chick	Matured chicks	P-Value
1	Classification	0-20 Days	21-40 Days	41-60 Days	61 and above	
2	Toe to back length TBL (cm)	7.11±0.14	8.94±0.31	14.27±0.21	19.39±0.35	<0.001
3	Wing length WL (cm)	4.18±0.21	7.16±0.31	12.5±0.23	16.59±0.37	<0.001
4	Back length BL (cm)	5.56±0.10	7.34±0.28	11.75±0.17	16.10±0.18	<0.001
5	Shank length SL (cm)	1.89±0.03	2.21±0.08	3.26±0.06	4.59±0.15	<0.001
6	Beak length BKL (cm)	0.94±0.02	1.42±0.06	2.23±0.04	2.67±0.04	<0.001
7	Height (toe to comb) H (cm)	9.41±0.21	12.67±0.45	19.29±0.38	27.01±0.61	<0.001
8	Weight (gm)	36.38±1.16	72.26±4.14	212.89±5.09	424.97±12.21	<0.001

Table 2. Relationship between weight of chicks with the toe to back length, Wing length WL, Back length BL, Shank length SL, Beak length BKL, Height (toe to comb), and age group

No	Variables	Coefficient Estimate	Standard error	z value	P-value	Comments
1	Intercept	3.84	0.09	42.18	< 2e-16	***
2	Toe to back length	-0.02	0.01	3.56	0.0004	***
3	Wing length WL	0.08	0,01	7.00	2.39e-12	***
4	Back length BL	0.23	0.02	1.16	0.25	
5	Shank length SL	-0.14	0.04	-4.04	5.34e-05	***
6	Beak length BKL,	0.23	0.03	8.04	15e-16	***
7	Height (toe to comb)	0.03	0.004	7.83	4.72e-15	***
	Age group					
9	Very young Chicks	-0.91	0.08	-11.85	< 2e-16	***
10	Young Chicks	-0.61	0.06	-11.01	< 2e-16	***
11	Old chicks	-0.18	0.03	-6.66	2.73e-11	***

Table 3. The association between weight of chicks with the toe to back length, wing length WL, back length BL, shank length SL, beak length BKL, height (toe to comb), and age group

No	Variables	Coefficient Estimate	Standard error	z value	P-value	Comments
1	Intercept	5.81	0.08	76.24	< 2e-16	***
2	Free range	0.30	0.11	2.60	0.00927	***
3	Semi-intensive	0.42	0.11	4.00	6.29e-05	***
4	Supplement feeding	-0.49	0.08	-6.23	4.67e-10	***
5	Treatment	-0.21	0.01	-17.08	<2e-16	***
6	Cleaning	-0.03	0.02	-1.72	0.09	
7	Banda (Hut) size	0.004	0.001	5.06	4.14e-07	***
8	Flock size	0.02	0.0005	42.24	< 2e-16	***

Influence of management system and practices on the growth performance of chicks

Out of the 400 records of chicks taken, 11.11% (n=44) were kept under semi-intensive while 88.89% (n=356) kept under the free-range system. All farmers (100%, n=5) said that they do provide supplement feedings to their chicks and provide water and feeding regularly. The banda were conserved cleaned of cleanness was at least twice a week. The type of supplement provided to chicks were sources of minerals, vitamins, protein and energy such vegetable, sold multivitamins, maize brain, and sardine remains (Dagaa). In addition, 69.10% (n=276) of the chicks under investigation were subjected to regular treatment and vaccination while not for 30.90% (n=124) on the chicks under investigation. Furthermore, 34.64% (n=139)

chicks investigated were not kept clean bandas (hut) while 65.24% 9 (n=261) were kept clean bandas. Growth performance in terms of weight was all the management systems used by farmers, supplement feeding, treatment such as deworming, provision of antibiotic and prevention through vaccination, size of banda, and flock size (Table 3). However, in comparison between the two management systems used by the farmers, significant high growth performance was noted to those who practice semi-intensive chicks keeping (Table 3).

Discussion

Successful local chicken production depends on the proper initial management of the chicks in the early stages of growth. In his study, it was eminent that, matured chicks (above 60 days old) showed improved weight gain compared to other age groups. Management systems such as free-range and semi-intensive together with management practices revealed the significant impacts on the growth performance of chicks to the farmers who are keeping local chicken. The management practices considered here were supplement feeding, treatment, and regular cleanness. This is in contrast with other studies which focused only on nutrition content such as a study by Biesek et al. (2020) who studied the impact of nutrition value on the growth performance of chicken specifically broiler.

Flock size kept by the five chicken keepers under the study

In this study, it was clear that the flock size of local chicken varied among farmers who were involved in the study. The variation of flock size kept by the farmer can be explained by variation in the purpose of keeping chicken and challenges encountered by the framers. For instance, a farmer who keeps chicken as a source of protein at the household level will vary with someone who keeps chicken income generation. Our previous study, in Dodoma, showed that farmers do keep chicken for various reasons such as meat, manure, offerings, source of income, aesthetic value (beauty), provision of school fees, and source of employment (Ngongolo et al., 2021). The challenges encountered by most farmers include diseases, predation, theft, drown of chicks (Ngongolo and Andrew, 2021, Marwa et al., 2018).

Growth performance of chicks at different age group

Growth rate performance was observed significantly to vary with age. For instance, at the very young chick stage (0-20 days old), the toe-to-back length was 7.11 ± 0.14 cm while being 14.27 ± 0.21 cm at age of 41-60 days (old chick). However, the length as growth variables showed a negative relationship with body weight. This negative relationship shows that at a certain stage of growth the weight will be increasing in the chicken while the length will not be increasing. Studies on growth performance have been done in other areas but their main focus has been on broiler not the local chicken under the natural environment (Biesek et al., 2020). The variation in growth among age groups can possibly be explained by the variation in the nutritional value of feed

given to chick. Other studies have suggested that the amount of protein feed intake can significantly affect the growth performance of chicken. For instance, a study in Ghana concluded that protein feed intake from the tree (*Samanea saman*) specifically at the treatment of 20 g S. saman diet yielded the best results in the growth performance of chicken (Hagan et al., 2016). This suggests that nutrition value specifically protein contents in feed given to chicken has many contributions in terms of growth performance in chicks.

Influence of management system and practices on the growth performance of chicks

Management systems and practices employed by the farmers into chicks revealed significant impacts on the growth performance of chicks. The management system in this study was a free-range system and semi-intensive system while the management practices considered in this study was supplement feeding, disease treatment, regular cleaning of bandas. In addition, the influence of the size of banda used for keeping chicken and flock size was considered during data analysis. Growth performance showed a significant increase in the semi-intensive systems compared to free-ranging systems. Flock size, banda size, and supplementation revealed a significant impact on the growth performance of chicks. Large flock size in small banda possibly increased competition for food, supplements, space, and other resources among chicken thus reducing the growth performance of chicks. Chicks under the semi-intensive system performed better than from free-range system. Possibly, because of more care in terms of feeding, water provision, protection, reduced energy use through movement under the semi-intensive system. This agrees with the study done in Babati, which showed that management system (free-range) and management practices such as housing, feeding, vaccination, treatment, supplement feeding, and provision of water had contributed to the production performance of local chicken (Marwa et al., 2018).

In conclusion, the growth in terms of length and weight increased with the age of chicks. Older chicks showered significantly higher growth variables (weight and length). The increase in weight was not associated with length but with management systems and practices. The growth performance in terms of weight of chicks from local chicken is affected by the management system, practices, banda, and flock size kept by the framers. To improve the production through growth performance of chicks from local chicks' semi-intensive system is recommended. In addition, management practices such as the provision of clean water, supplement feeding under recommended danda, and flock size are essential.

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Competing interest

The authors declare that they have no conflict of interest.

Ethical clearance

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

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