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ASSESSMENT OF HUSBANDRY PRACTICES, EGG PRODUCTION PERFORMANCE AND EGG QUALITY TRAITS OF CHICKENS IN THE BAKA DAWULA DISTRICT, SOUTHERN ETHIOPIA

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Abstract

This study assessed the husbandry practices, egg production performances, egg quality traits, and constraints and opportunities for chicken production in Baka Dawula district. Six kebeles were selected based on production practices and availability of different chicken breeds. A total of 168 respondent households were interviewed and 108 eggs (36 from each breed) were evaluated based on their internal and external qualities. The majority of respondent households (86.9%) practiced scavenging type of feeding with maize, wheat and sunflower supplementation. All the respondent households provided free water access to their chickens. The majority (66%) of respondents kept their chickens in separate houses. The health care practiced was mainly traditional using plants extracts. The main purpose for chicken keeping was income generation followed by stock replacement. The average ages at first-egg laying for local and exotic (Sasso and Bovans brown) breeds were 7 and 5 months, respectively. The total number of eggs produced per hen per year was 206.79, 192.35 and 55.75 for Sasso,

Bovans brown, and local breeds respectively. Most external and internal egg quality traits varied significantly (P<0.05) between agro ecologies and chicken breeds. Generally, the egg production performance of the exotic chickens was higher than the local breed.

Keywords: Chicken, Egg, Production, Quality, Husbandry practices.

تقييم ممارسات التربية وأداء انتاج البيض والصفات النوعية للبيض للدجاج في مقاطعة باكا داولا جنوب اثيوبيا

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الخلاصة

أجريت هذه الدراسة لتقييم ممارسات التربية وأداء انتاج البيض والصفات النوعية للبيضة والمعوقات والفرص المتعلقة بإنتاج الدجاج في مقاطعة باكا دولا. استخدم في هذه الدراسة ستة سلالات من دجاج كيبلي اعتمادا على أدائها الإنتاجي ومدى توفر هذه السلالات. تمت مقابلة 168 اسرة للإجابة على محاور الدراسة، واستخدم لتقييم 108 بيضه (36 من كل سلالة) على أساس نوعيتها الداخلية والخارجية. وجد ان اغلبية الاسر المستجيبة (86.9%) تغذي الدواجن تغذية حرة على الذرة الصفراء والحنطة وزهرة الشمس. وجميع هذه الاسر توفر الماء للدجاج بشكل حر أيضا. ومعظم هذه الاسر (66%) تربي الدجاج في مساكن معزولة. اغلب الممارسات المتعلقة بالعناية الصحية تعتمد بشكل عام على الطرق التقليدية المتمثلة باستخدام المستخلصات النباتية. والهدف الرئيسي من تربية الدجاج لهذه الاسر هو زيادة الدخل المادي وكذلك كمخزون غذائي. كان معدل العمر عند وضع اول بيضة لسلالات الدجاج المحلي والاجنبي (ساسو والبوفانس البني) كان 7 و5 أشهر على التوالي. وعدد البيض الكلي المنتج لكل دجاجة في كل سنة 206.79 و192.35 و55.75 لكل من سلالة الساسو والبوفانس البني والمحلية على التوالي. اغلب الصفات النوعية للبيضة سواء الداخلية او الخارجية اختلفت معنوياً (P<0.05) بين البيئة الزراعية وسلالات الدجاج بشكل عام أداء انتاج البيض للسلالة الأجنبية كان اعلى من السلالة المحلية.

كلمات مفتاحية: دجاج، بيض، انتاج، نوعية، ممارسات التربية.

Introduction

Livestock production in general and chickens in particular play an important socio-economic role in supplying a cheap source of good-quality animal protein in the form of eggs and meat (31). Chickens are reared in different management and production systems in Ethiopia. These involve free-ranging, semi-intensive and intensive production systems (42). Ethiopia's chicken population is estimated at 56.99 million of which 44.94 million are local 78.86%, 6.85 million hybrids 12.02%, and 5.19 million exotic breeds 9.12% (33).

Ethiopia's vast chicken flock is underutilized due to lack of better management practices and lack of skilled manpower (29). The productivity of local hens (30-60 eggs per year/hen with average 38g egg weight) is extremely low under village management conditions (2) where as a typical exotic layer can produce 250 eggs per year with 60 g of egg weight (11).

Egg quality traits refer to the qualities of an egg, which affects its acceptability for producers, consumers, hatching purposes and the egg market (7 and 22). Egg quality characteristics are influenced by nutrition, environmental factors, genotype, and age (20). The quality of eggs is evaluated by their external and internal qualities (19).

The demand for chicken and chicken products in Ethiopia increases in tandem with population growth, higher household income levels and urbanization (9). As the result, multiple exotic layers have been imported into the country due to their better productive performance to balance the demand and supply of eggs and meat (12). However, previously introduced exotic breeds failed to produce according to their potential under farmers management conditions (15). However, information on this is limited as no studies have been conducted on exotic chicken breeds distributed to different areas of the south Omo zone including the study district, management practices, production performance and egg quality traits at smallholder farmer levels. Hence, an assessment of husbandry practices, egg production performance, egg quality for different breeds (local and exotic) is crucial to examine breed differences and to formulate productivity improvement measures in the area.

Materials and Methods

Study District: The study was conducted in the Baka Dawula district of the south Omo zone of southern Ethiopia. It is one of the districts that recently separated from south Ari and located at 5^0 67' - 6^0 19' N and 36^0 30' - $36^0$73' E. The mean annual rainfall ranges between 81.41 to 97.05 mm while annual temperatures range between 15.72^{o}C to 40.1^{o}C. The district has 14 kebeles or simplest administrative units. Agroecologically, three kebeles are in the highlands, four in the midlands, and the rest in the lowlands.

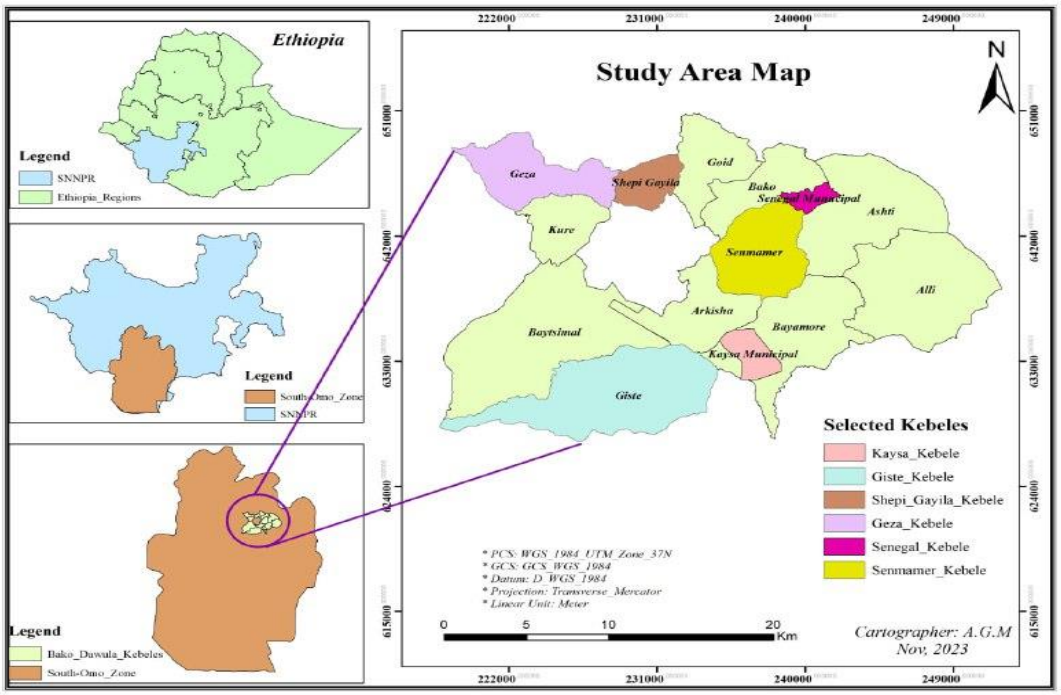

Figure 1: Map location of Baka Dawula district.

Sample size and sampling techniques: This was a cross-sectional study using multi-stage sampling procedures. The Baka Dawula district was specially selected based on production potential and chicken population. In the second stage, all the kebeles in the district were divided into three based on their agro ecologies highland (>2300 masl), midland 1500–2300 masl and lowland (<1500 masl) (28). In the third stage, two representative kebeles were selected per agro ecology based on chicken production practices, chicken population and availability of chicken breeds. In the fourth stage, households having chicken production experiences were identified and listed. Finally, 168 households were selected based on simple random sampling. Then total number of households were determined using the (40) formula at 95% confidence interval i.e., n = N/1+N (e) 2, where n is the required sample size, N the number of people in the population, and e representing the allowable error 0.05%.

Data collection technique:

Survey: The study consisted of a questionnaire survey and evaluation of egg quality. Both secondary and primary data sources were used. The primary data was collected through questionnaires, focus group discussions and field observations. A structured questionnaire was prepared in English and translated into the local language for data collection. Kebele development workers/DA/who were fluent in the local language were used and trained on data collection methods and interviewing techniques. Soon after training, they commenced collecting data under close supervision. Data was collected on household characteristics (sex, education level, marital status), husbandry practices and egg production performances (feeding, housing, water, and healthcare practices, total number of eggs produced per hen/year and monthly age at first laying). Secondary data was based on reports by the district livestock and fishery development office and other published and unpublished sources.

The focus group discussions involved 10 members in each kebele. Extension workers, livestock experts, village leaders, elders, women and socially respected individuals, district development agents were included in the discussions that focused on chicken production practices, productivity constraints and opportunities.

Egg quality measurements: Quality evaluations of internal and external eggs were carried out on 108 eggs (36 from each breed). They were examined visually in water in sunlight and labeled according to breed and agro ecology and transported to Hawassa University for external and internal quality evaluations. Both internal and external egg quality parameters were tested. The eggs were individually weighed using a digital weighing balance (SF-400) while their widths and length were measured with a digital vainer caliper meter. Then the eggs were broken onto a glass-covered table and the albumen and yolk separated and individually weighed. Albumen and yolk heights were measured at their widest part using a height meter (dial compressor gauge) while yolk diameters were

measured horizontally using a digital caliper meter. Yolk color was determined by comparing it with the Roche Yolk Color Fan containing 15 scales with a standard colorimetric system. The cleaned egg shells were weighed with a digital balance and their thickness measured using a digital caliper meter based on the average thickness at the large, center, and narrow ends. Further, the egg yolk index was calculated as follows:

$$\text{Yolk index (\%)} = \frac{\text{Yolk height}}{\text{Yolk diameter}} \text{x}100 \qquad (32)$$

Data analysis: The collected data was coded and entered into Microsoft excel and SPSS. Descriptive statistics were used to describe the results and the data analyzed using the Statistical Package for Social Sciences (37). Statistical variations for categorical data were tested by means of cross tabs, with significant differences at $P< 0.05$. Pearson correlation was used to determine the linear relationship between egg quality traits. Moreover, egg quality traits were analyzed to see the effect of agro ecology and chicken breeds. The significant means for the continuous variable was compared using the Tukey test, with values considered significant at $P<0.05$.

An index value was calculated for ranking the qualitative data based on the formula by (25):

$$\text{Index} = \frac{Rn*C1+Rn-1*C2\ldots.+R1*Cn}{\Sigma Rn*C1+Rn-1*C2\ldots+R1*Cn;}$$

Where, Rn = Value for the least ranked level (if the least rank is 3rd, then Rn = 3, Rn-1 = 2, R1 = 1).

Cn = Counts of the least ranked level (in the above example, the count of the 3rd rank = Cn, and the count of the 1st rank = C1).

Two models were used to analyze the data on husbandry practices (feeding, housing, health care, watering), productivity and egg quality parameters.

1. Model for analyzing husbandry practices across different agro ecologies:

$Yijk = \mu + Ai + eij$,

Where, Yijk = observation of k survey data in the i^{th} agro ecology

μ = is the overall mean
Ai = is the effect of agroecology
eij = is the random error

2. Model for analyzing egg production performance and egg quality trait:

Yijk = μ + Ai+ Bj + Ai*Bj + eijk,
Where, Yijk = the observed k variable in the i th agroecology and jth breed
μ = Overall mean of the observed variables
Ai = Effect due to ith agro ecology (i = lowland, midland and high land)
Bj = Effect due to jth breed of chickens (j = Exotic and Local)
Ai*Bj = Effect due to interactions between ith agroecology and jth breed
eijk = Random residual error.

Results and Discussion

Household characteristics: Household details across the three agroecology areas are presented in Table 1. Of the household respondents, 51.8% were females and 48.2% were males. This proportion differs from that reported by (25) who noted 81% females and 19% males in the Cheha district of Gurage zone, southern Ethiopia. This might be due to the fact that rearing chickens and their production is mainly considered a role for women and also that males traditionally avoided those activities.

Table 1: Household characteristics of respondents in the study area.

Parameters	Agroecology			Overall (N=168)	X^2-Test	P-value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)			
	N (%)	N (%)	N (%)	N (%)		
Sex						
Male	31 (55.4)	15 (39.5)	35 (47.3)	81 (48.2)	2.332	0.312
Female	25 (44.6)	23 (60.5)	39 (52.7)	87 (51.8)		
Educational Status						
Illiterate	21 (37.5)	25 (65.8)	50 (67.6)	96 (57.1)	27.590	0.002
Primary (Grades 1-4)	15 (26.8)	9 (23.7)	14 (18.9)	38 (22.6)		
Elementary (Grades 5-8)	18 (32.1)	2 (5.3)	7 (9.5)	27 (16.1)		
Secondary (Grades 9-10)	0 (0)	0 (0)	3 (4.0)	3 (1.8)		
Preparatory (Grades 11-12)	1 (1.8)	1 (2.6)	0 (0)	2 (1.2)		
College	1 (1.8)	1 (2.6)	0 (0)	2 (1.2)		

N (%) = Frequency and percentage, X^2= Chi-square.

Chicken flock composition: Flock composition is described in terms of proportion of different sexes and age groups as shown in Table 2. Respondents in all the agro ecologies kept a higher number of hens than other classes of chicken. Significantly higher ($P<0.05$) numbers of local chickens were observed in the highland than in midland agroecology areas. The higher number of indigenous chickens in the highlands might be due to farmers practicing hatching of eggs for flock replacement. The mean value for local chicken flock size per household of 8.44 and 9.13 chickens

were reported by (4) in the west Gojjam zone and Yeki woreda southwestern Ethiopia, respectively.

Table 2: Average chicken flock size in the study area (Mean±S.E).

Chicken Class	Agro ecology			Overall (N=168)	P - value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)		
Exotic					
Pullet	0.77±0.16	1.29±0.22	1.05±0.18	1.01±0.11	0.193
Hen	3.79±0.25	3.79±0.26	4.81±0.72	4.24±0.34	0.318
Cock	1.64±0.20	1.61±0.27	1.69±0.19	1.65±0.12	0.963
Total	6.20±0.34	6.71±0.36	7.54±0.76	6.90±0.36	0.263
Local					
Pullet	0.82±0.17	0.45±0.13	0.47±0.10	0.58±0.08	0.096
Hen	2.09±0.11[a]	1.68±0.09[b]	2.00±0.09[ab]	1.96±0.06	0.030
Cock	0.70±0.13	0.47±0.12	0.74±0.12	0.67±0.07	0.353
Chick	1.70±0.37	0.97±0.24	1.11±0.19	1.27±0.16	0.165
Total	5.25±0.37 [a]	3.58±0.27 [b]	4.32±0.20 [ab]	4.46±0.17	0.001

Different superscripts in the rows indicate significant differences at P<0.05.

Chicken feed sources and feeding: Feeding practices for the chickens in the study area are presented in Table 3. About 87% of the respondents use scavenging type of feeding with additional supplements. About 44% of respondents provide feed in the mornings and evenings, while 11% provide only morning feeds. This might be due to the difference in awareness and attention given to chickens in the three agro ecologies of the study district. According to (8), 24%, 45% and 32% of chicken owners offer feed thrice, twice, and once a day, respectively in south west Showa and Gurage zones of Ethiopia. (16) disclosed that most respondents 98% provided supplementary feeds once a day while 2% did not do so in the Lume district.

Table 3: Chicken feeding practices in the study area.

Feeding practices	Agro-ecology			Overall (N=168)	X^2-Test	P-value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)			
	N (%)	N (%)	N (%)	N (%)		
Feeding systems						
Scavenging only	8 (14.3)	7 (18.4)	7 (9.5)	22 (13.1)	1.876	0.391
Scavenging with supplement	48 (85.7)	31 (81.6)	67 (90.5)	146 (86.9)		
Source of supplementation						
Cereals grains	34 (60.7)	22 (57.9)	57 (77)	113 (67.3)	6.082	0.193
Kitchen waste	0 (0)	0 (0)	2 (2.7)	2 (1.2)		
Different by products	14 (25)	9 (23.7)	8 (10.8)	31 (18.4)		
Ways of supplementation						
Feeding trough (plastic made)	14 (25)	10 (26.3)	22 (29.7)	46 (27.4)	2.061	0.724
Spreading on the floor	34 (60.7)	21 (55.3)	45 (60.8)	100 (59.5)		
Time of feeding						
Morning and evening	18 (32.2)	16 (42.2)	41 (55.4)	75 (44.6)	18.137	0.020
Morning and afternoon	11 (19.6)	1 (2.6)	5 (6.7)	15 (8.9)		
Morning, afternoon and evening	13 (23.2)	7 (18.4)	15 (20.3)	35 (20.8)		
Morning	6 (10.7)	7 (18.4)	6 (8.1)	19 (11.3)		
Season of supplementation						
Dry season	20 (35.7)	9 (23.7)	22 (29.7)	51 (30.4)	4.24	0.644
Wet season	6 (10.7)	6 (15.8)	8 (10.8)	20 (11.9)		
All season	22 (39.3)	16 (42.1)	37 (50)	75 (44.6)		

N (%) = Frequency and percentage, X^2= Chi-square.

Chicken watering practices: All respondents provided water for their chickens (Table 4). There was significant difference in watering equipment used across the three agroecologies ($P<0.05$). This might be due to differences in the availability of watering materials and respondent awareness. (26) reported that broken clay materials, wooden troughs and plastic-made troughs were the most widely used types of watering equipment used in the Bure district.

Table 4: Chicken watering practices in the study area.

Watering practices	Agroecology			Overall (N=168)	X^2-test	P-value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)			
	N (%)	N (%)	N (%)	N (%)		
Water source						
Spring water	22 (39.3)	13 (34.2)	37 (50.0)	72 (42.9)	3.153	0.532
Underground water	18 (32.1)	12 (31.6)	19 (25.7)	49 (29.2)		
Pipe water	16 (28.6)	13 (34.2)	18 (24.3)	47 (27.9)		
Watering equipment						
Plastic made	23 (41.1)	37 (97.4)	67 (90.5)	127 (75.6)	79.555	0.000
Stone made	0 (0)	0 (0)	6 (8.1)	6 (3.6)		
Clay pot	33 (58.9)	1 (2.6)	1 (1.4)	35 (20.8)		
Watering frequency						
Free access	34 **(**60.7)	24 (63.2)	49 (66.2)	107 (63.7)	6.674	0.154
Twice a day	7 (12.5)	0 (0)	4 (5.4)	11 (6.5)		
Once a day	15 (26.8)	14 (36.8)	21 (28.4)	50 (29.8)		

N (%) =Frequency and percentage, X^2= Chi-square.

Chicken housing practices: About 66% of the respondents had separate chicken houses from their family homes. (16) reported that the majority 61% of respondents had separate housing for their chickens while 39% did not in the Lume district, East Showa zone. Conversely, (3) noted that 79% of the households had no separate chicken housing in Gorogutu district. A higher proportion 96% of respondents used separate housing for their chickens in the East Shewa zone (39). There were significant differences in types of chicken housing across the three agroecologies ($P<0.05$). (10) reported that the main reasons for not having separate chicken house were lack of attention to village birds 35%, lack of knowledge or awareness 20%, risk of predators when housed separately 12% and shortage of labor and time 5% in the Bure district. Night sheltering facilities for chickens varied significantly across the three agroecologies ($P<0.05$). (26) stated that 78% of farmers housed their chickens only during the night.

Table 5: Chicken housing practices in the study area.

Parameters	Agroecology			Overall (N=168)	X^2-test	P-value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)			
	N (%)	N (%)	N (%)	N (%)		
Separate chicken house						
Yes	42 (75)	17 (44.7)	52 (70.3)	111 (66.1)	10.289	0.006
No	14 (25)	21 (55.3)	22 (29.7)	57 (33.9)		
Type of chicken house						
Bamboo with grass roof	27 (48.2)	7 (18.4)	0 (0)	34 (20.2)	73.074	0.000
Wooden with canvas roof	0 (0)	0 (0)	16 (21.6)	16 (9.5)		
Wooden with grass roof	15 (26.8)	7 (18.4)	28 (37.9)	50 (29.8)		
Wooden with corrugated iron sheet	0 (0)	3 (7.9)	8 (10.8)	11 (6.6)		
Reason for not constructing separate house						
Lack of awareness	4 (7.1)	3 (7.9)	6 (8.1)	13 (7.7)	20.448	0.002
Lack of attention to poultry	6 (10.7)	17 (44.8)	16 (21.6)	39 (23.2)		
Lower predator risk	4 (7.1)	1 (2.6)	0 (0)	5 (3.0)		
Keep chicken at night						
Night perch inside the house	2 (3.6)	2 (5.3)	8 (10.8)	12 (7.1)	22.106	0.001
On ceilings of the house	10 (17.8)	8 (21.1)	5 (6.7)	23 (13.7)		
In human house together	2 (3.6)	11 (28.9)	9 (12.2)	22 (13.1)		

N (%) =Frequency and percentage, X^2= Chi-square.

Chicken health care practices: The majority of farmers 94.6% practiced traditional disease control methods (Table 6) with almost 20% of the respondents not vaccinating their chickens in the study area. (10) reported lack of awareness 71.4%, lack of attention to village chickens 13.6% and low availability of vaccines 15% as the major reasons for this in Bure district. The respondents employed traditional disease control methods such as using *Solanum incanum* (sodom apple), *Citrus limon* (lemon), *local alcohol* (Areki), *Vernonia amygdalina* (Garanty) and *Allium sativum* (nech shinkurt) plants. *Vernonia amygdalina* was finely crushed and mixed with drinking water to treat sick chickens. (41) also noted that farmers used *Artemisia absinthium (simfa/feto), Simza* and *Allium sativum (garlic*) plants with feeds in Gonder Zuria woreda, North Gonder, Ethiopia.

Table 6: Chicken health care practices in the study area.

Parameters	Agroecology				X^2-test	P-value
	Highland (n=56)	Midland (n=38)	Lowland (n=74)	Overall (N=168)		
	n (%)	n (%)	n (%)	N (%)		
Chicken disease						
Yes	56 (100)	37 (97.4)	66 (89.2)	159 (94.6)	8.068	0.018
No	0 (0)	1 (2.6)	8 (10.8)	9 (5.4)		
Disease controlling method						
None	16 (28.6)	8 (21.1)	10 (13.5)	34 (20.2)	18.683	0.005
Vaccination	16 (28.6)	14 (36.8)	12 (16.2)	42 (25.0)		
Traditional	24 (42.9)	15 (39.5)	44 (59.5)	83 (49.4)		
Reasons for no vaccination						
Lack of awareness	14 (25)	16 (42.1)	32 (43.2)	62 (36.9)	21.501	0.001
Lack of vaccines	11 (19.6)	6 (15.8)	11 (14.9)	28 (16.7)		
Lack of attention	31 (55.4)	10 (26.3)	29 (39.2)	70 (41.6)		

N (%) =Frequency and percentage, X^2= Chi-square.

Chicken productivity: Egg productivity of the local and exotic chickens reared in study district is presented in Table 7. There is no difference (P>0.05) in age at the chickens first egg-lying in the study area although the number eggs produced per hen per year varied significantly (P<0.05) for the local and Bovans brown breeds. This might be due to difference management practices. (16) noted annual egg production per hen at 54.96±15.7 for local chickens in southern Ethiopia while (5) reported 59.5 for the similar breed in the Boricha district Sidama zone, southern Ethiopia. The egg production performance of Bovans brown chicken in the current study was higher than the 134.46±6.4 reported by Sisay et al. (36) in selected districts of northwestern Amhara and lower than the 266 reported by (39) in the East Shewa zone under village production systems.

Table 7: Egg production of local and exotic chickens reared in the study area (Mean±SEM).

Parameters	Agroecology			Overall	P-value
	Highland	Midland	Lowland		
Age at first laying (months)					
Local	7.07±0.12	7.13±0.17	7.15±0.12	7.12±0.08	0.903
Sasso	5.05±0.15	5.11±0.18	5.18±0.11	5.12±0.08	0.790
Bovans brown	5.25±0.14	5.11±0.16	5.42±0.12	5.29±0.08	0.296
Total number of eggs/year/hen					
Local	50.16±2.21 [b]	56.26±4.08 [ab]	59.72±2.277 [a]	55.75±1.57	0.029
Sasso	211.91±8.03	205.24±7.06	203.70±5.962	206.79±4.06	0.671
Bovans brown	204.68±7.79 [a]	204.29±7.37[b]	176.88±4.96 [b]	192.35±3.91	0.002

Same superscript indicates non-significant differences at P<0.05, different superscript in rows indicate significant differences at P<0.05., S.E=standard error.

Challenges and opportunities in chicken production: The challenges and opportunities of chicken production in the study district are presented in Table 8. Disease was a major challenge in rearing chickens.

Table 8: Ranking of challenges and opportunities in chicken production in the study area.

Challenges	Respondent choices				Overall rank	
	1st	2nd	3rd	4th	Index	Rank
Disease	78 (46.4)	50 (29.8)	37 (22.0)	3 (1.8)	0.80	1
Theft	14 (8.3)	6 (3.6)	8 (4.8)	140 (83.3)	0.34	4
Predators	33 (19.6)	65 (38.7)	67 (39.9)	3 (1.8)	0.69	2
Veterinary services	44 (26.2)	46 (27.4)	56 (33.3)	22 (13.1)	0.66	3
Opportunities						
Availability of market for eggs/chickens	61 (36.3)	51 (30.4)	36 (21.4)	20 (11.9)	0.73	1
Infrastructure	13 (7.7)	61 (36.3)	47 (28.0)	47 (28.0)	0.56	3
Credit services	15 (8.9)	28 (16.7)	49 (29.2)	76 (45.2)	0.47	4
Price increments	75 (44.6)	29 (17.3)	40 (23.8)	24 (14.3)	0.72	2

(23) reported that prevailing diseases, predators and poor feeding were the major constraints in village chicken production in Jimma district. (21) also noted that predators and diseases were the first and second major constraints in western zone of Tigray. (34) on the other hand reported the increasing prices of chicken and egg as an opportunity for rearing chickens for poor rural households in Lemo district, southern Ethiopia. Similarly, (13) noted strong government support to the sector as a major opportunity in Ethiopia.

Egg quality: External quality traits of chicken egg in the three agroecologies of the study district are presented in Table 9. The egg weight of 47.17g for local chickens in the area was higher than the 39.60g reported by (1) for scavenging local chickens in Amhara regional state. No significant difference (P>0.05) was recorded in the egg weights of the Sasso 56.21g and Bovans brown 56.57g. (24) also noted 53.1±4.79g egg weight for Sasso chicken. (38) reported higher egg weights at 63.46g for Bovans brown chickens under intensive production systems. These variations might be due to different management practices, age of chicken and agro ecological factors.

Table 9: Effects of agro-ecology and chicken breed on external egg quality traits.

Variable		EW	EL	EWd	ESW	EST	ESI
Breed	Local	47.17^{b}	53.66^{b}	40.10^{c}	4.07^{b}	0.26^{a}	33.62^{b}
	Sasso	56.21^{a}	56.14^{a}	41.95^{b}	4.69^{a}	0.213^{b}	36.5^{a}
	Bovans	56.57^{a}	57.05^{a}	43.08^{a}	4.60^{a}	0.215^{b}	37.27^{a}
	SEM	5.51	0.438	0.30	0.125	0.06	0.55
	P-value	0.001	0.000	0.000	0.010	0.000	0.000
Agroecology	Highland	55.48^{a}	56.87^{a}	41.18	4.45^{ab}	0.20^{b}	34.40^{b}
	Midland	53.4^{ab}	55.41^{ab}	41.66	4.67^{a}	0.24^{a}	37.08^{a}
	Lowland	51^{b}	54.57^{b}	42.29	4.24^{b}	0.24^{a}	35.9^{ab}
	SEM	0.84	0.48	027	0.25	0.005	0.55
	P-value	0.001	0.001	0.18	0.057	0.000	0.03
Agroecology* breed	SEM	1.49	0.76	0.47	0.27	0.08	0.95
	P-Value	0.0001	0.5	0.58	0.104	0.000	0.000

^{abc} Means along the same column with different superscripts at each breed and agroecology are significantly different (P<0.05). SEM = Standard error mean, EW=egg weight, EL=egg length, EWd= egg width, ESW= egg shell weight, EST=egg shell thickness, ESI= egg shell index.

Egg shell thickness for local 0.26 mm, Sasso 0.213 mm and Bovans brown 0.215 mm were recorded. Similarly, (18) revealed egg shell thickness of 0.24 mm and 0.26 mm for Sasso and Bovans brown chickens, respectively in Hawassa Town. (38) also reported egg shell thickness of 0.35 mm for Bovans brown under the intensive management system in East Shewa Ethiopia

Table 10 presents the internal egg quality traits of chickens in the study area. Significantly higher (P<0.05) albumen height 5.38 mm was recorded for Bovans brown chickens compared to the 4.75mm reported by (35) in the Kersa district of Eastern Hararghe zone, Ethiopia. (38) on the other hand recorded a higher 9.51 mm albumen height under the intensive management system employed in East Shewa, Ethiopia.

Table 10: Effects of agroecology and chicken breeds on internal egg quality traits.

Variable		AW	AH	AR	YC	YW	YH	YI
Breed	Local	25.05^{b}	4.5^{b}	55.16	8.81^{b}	16.98^{b}	14.02^{b}	33.62^{b}
	Sasso	31.3^{a}	4.8^{b}	55.91	9.9^{a}	18.60^{a}	15.33^{a}	36.50^{a}
	Bovans	32.1^{a}	5.38^{a}	55.68	8.95^{b}	17.76^{ab}	15.17^{a}	37.27^{a}
	SEM	0.27	0.14	1.11	0.23	0.43	1.96	0.65
	P-value	0.000	0.000	0.54	0.03	0.005	0.000	0.000
Agroecology	Highland	29.05	4.33^{b}	52.55^{b}	10.21^{a}	19.02^{a}	14.76^{ab}	34.40^{b}
	Midland	30.56	5.19^{a}	57.3^{a}	8.3^{b}	18.24^{a}	15.13^{a}	37.08^{a}
	Lowland	29.67	5.17^{a}	58.11^{a}	9.07^{b}	16.07^{b}	14.43^{b}	35.92^{ab}
	SEM	0.72	0.14	1.11	0.23	0.34	1.79	0.55
	P-value	0.33	0.000	0.01	0.000	0.000	0.02	0.003
Agroecology* Breed	SEM	1.24	2.0	1.94	0.4	0.6	0.30	0.95
	P-Value	0.11	0.000	0.20	0.8	0.21	0.000	0.000

^{ab} Means along the same column with different superscripts at each breed and agroecology are significantly different (P<0.05). SEM=Standard error mean, AW=Albumen weight, AH=Albumen height, AR=Albumen ratio, YC= Yolk color, YW= Yolk weight, YH=Yolk height, YI= Yolk index.

The average yolk height of 15.17 mm for Bovans brown chicken was lower than 16.2±0.06 mm reported by (30) under the urban production system. (25) also noted yolk heights of 14.93±0.10 mm in the Cheha district of Gurage zone, southern Ethiopia. (39) reported mean yolk weights of 15.97±1.77 g for the Bovans brown breed in East Shewa, Ethiopia.

Conclusion

Feeding practices in the study district were mainly scavenging with additional supplements (cereal grains). All respondents provided water to their chickens with the major sources being spring, underground, and piped water. Most chicken owners had chicken coops that were separate from their family homes. Egg production by exotic chickens was higher than local chickens while the egg quality parameters for Sasso, Bovans brown and local chickens were found to be optimal. The high prevalence of diseases and predators were the main constraints delaying chicken production in the study district.

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