

Village Chicken Flock Characteristics and Performances in Western Amhara, Ethiopia

Birhan Kassa Gebeyehu (✉ birhankassa56@gmail.com)

ARARI <https://orcid.org/0000-0003-1949-8737>

Yosef Tadesse

Haramaya University

Wondmeneh Esatu

International Livestock Research Institute

Tadelle Dessie

International Livestock Research Institute

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Abstract

Methodology:

The study was carried out to generate baseline information on village chicken flock characteristics and production performances in South Achefre, Banija and Fagita Lekoma districts of Western Amhara, Ethiopia. Multi-stage sampling procedures were employed to select the study villages and respondents and then nine villages were selected purposively. The 180 participants were chosen by random sampling techniques for qualitative and quantitative research. Data were collected by individual survey using open data kit. The collected data were analyzed using General Linear Model (GLM) of SAS software version 9.1 and Duncan Multiple Range Test (DMART) was also used to locate treatment means that were significantly different.

Result

From the flock composition the Hen contributes the highest proportion (39.2%) followed by Chicks (31.2%). Mean sexual maturity of local Hen and Cock was 24.95 ± 0.269 and 23.56 ± 0.36 weeks, respectively. Mean egg production performance of local chickens in the study area was 14.89 ± 0.36 per clutch with a clutch length of 23.98 ± 0.61 and 2.47 ± 0.07 clutch cycle per year.

Conclusion

The production performance of indigenous chicken and their survival performance in the study area are low to medium. Therefore, in order to improve production and survival performance, appropriate interventions in terms of supplementary feeding, selection and disease control are important strategies.

Introduction

In Ethiopia, the agricultural sector is a corner stone of the economic and social life of the people. The livestock sector in Ethiopia contributes 12 and 33% of the total and agricultural Gross Domestic Product (GDP), respectively, and support livelihood of 65% of the population [1]. The sector also accounts for 12–15% of the total export earnings [2]. The diverse agro-ecology and agronomic practice prevailing in the country together with the huge population of livestock in general and poultry in particular, could be a promising attribute to boost up the livestock sector and increase its contribution to the total agricultural output as well as to improve the living standards of the poor livestock keepers [3]. Poultry production, as one segment of livestock production, has a peculiar privilege to contribute to the sector. Poultry in Sub Saharan African countries is a source of self-reliance for women since, poultry and egg sales are decided by women both of which provide women an immediate income to meet household expenses and sources of food [4]. In Ethiopia, chicken production is practiced in nearly all poor rural smallholder households [5]. Chicken production is practiced in both traditional and modern production systems in which the former is

most widespread and almost every rural family owns chicken, which provides valuable sources of family protein and income [5]. It is cheap to produce, require little investment, used for food and religious celebrations under the smallholder farmers of the country [6]. The total chicken population in Ethiopia is estimated at 60.51 million [7], with regard to breed, 94.33 percent of the total poultry were indigenous chickens, while the remaining 3.21 and 2.47 percent of the total poultry were reported to be hybrid and exotic, respectively. Ethiopia's chicken industry, which is still in its infancy, holds considerable potential for growth, especially when considering that average per capita poultry consumption of 0.5 kilogram is among the lowest in the world and by comparison, Per capita consumption in Sub-Saharan Africa is 2.3 kilogram [8]. Assessment of flock characteristics and performance is important for considerable relevance in intervention research and development directions and strategies. Therefore, the objective of the study was to understand the flock characteristics and performances under their production system.

Materials And Methods

Area description

The study was conducted in three districts of Western Amhara, Ethiopia namely South Achefer, Banija and Figita Lekoma. These districts were selected based on number of chickens, number of households rearing chicken, availability of feed resources for chicken and strategically selected for their accessibility and safe for research work. South Achefer district is found in West Gojam administrative zone of Amhara National Regional State. It lies 11° 04'- 11° 05' North latitude and 36°52'-36° 54' East longitude with an altitude of 1500-2600 meters above sea level. The total annual rainfall is ranges from 1365-1623 mm and the temperature is ranged from 11.8 to 28.4 °C [9]. Banija district is found in Awi Zone administrative zone of Amhara National Regional State. The district lies within 11.36⁰to12⁰ 09'North latitude and 36⁰95'-38⁰95'East and the altitude of the study area ranges from 1800 to 2953 Meter above sea level. The mean annual rainfall of the study area ranges from 1700 mm to 2560 mm, with mean monthly minimum and maximum temperature ranging from 7°C to 12°C, and 20°C to 25°C, respectively [9]. Fagita Lekoma district is found in Awi Zone administrative zone of Amhara National Regional State. The district is located at 10⁰ 52'to 11⁰ 03'North latitude and 36⁰ 38'to 37⁰ 8'East longitudes and altitude ranges from 2000-3200 m above sea level. The average annual rainfall of the district is 2379 mm. Temperature varies between the mean annual maximum of 25°C and mean annual minimum of 11°C across the elevation gradient [9].

Sampling technique and sample size

Multi-stage sampling technique (purposive and random) was applied for the selection of both villages and participants in each district, respectively. Villages were selected based on number of chickens, number of households rearing chicken, availability of feed resources for chicken and for their accessibility and safe for research work. Based on those criteria three villages per district and a total of nine villages in the three districts were selected. Computerized random sampling procedures were applied

to select 20 village chicken producer's households in each village and a total of 180 households were selected.

Methods and type of data collection

A structured questionnaire survey tool was developed, tested and implemented using Open Data Kit (ODK) data collection tool. The major quantitative data collected during the survey were flock size and composition, flock performance (such as age of sexual maturity, clutch size per year, egg production per clutch, clutch length, number of times the hen hatches in a year, number of eggs set per brood, number of chicks hatched per brood and chick livability to adulthood per brood).

Statistical analysis

The collected data were analyzed using appropriate statistical analysis procedures. Descriptive statistics and cross-tabulations were employed where they are appropriate. The General Linear Model (GLM) of SAS software version 9.1, on qualitative variables was used. The Duncan Multiple Range Test (DMART) was also used to locate treatment means that were significantly different.

Results And Discussion

Flock size and composition per household

The overall mean number of total chicken per household was significantly different ($p < 0.001$) among the study districts. The overall mean total number of chickens per household across the study districts was 7.40 ± 0.57 (Table 1). The average number of chicken per household was higher in south Acheferere than Banija district and it was related to the presence of more scavenging space in the household garden and the ability of respondents to give supplementary feed for their chicken. Similarly, chicken producers in South Acheferere district were mainly keeping chicken for adult chicken sale. Therefore, a higher number of hens and chicks per household could be higher to rear up to reach marketable weight. This result was in line with the report of [10] explained that the overall mean flock size per household was 7.13 in north western Amhara, but lower than the report of [11] 13 and 12 chicken per household in Burie and Fogera districts of north western Amhara, respectively and [12] 9.22 chicken per household in Southern Ethiopia. Difference in flock size might be differences in scavenging space owned by the household, season during the study, availability of feed resource and supplementary feed.

There was a significant ($p < 0.05$) difference in the number of local chicken owned per household among the study districts which were higher in South Acheferere district than Banija and Fagiata Lekoma which is related to feed access and scavenging space. The overall mean number of local chicken per household was 6 ± 0.49 (Table 1). The result was higher than the mean local chicken reported in Dawo and Seden Sodo districts of Southwest Showa Zone of Oromia region and Mehale Amba and Mehurena Aklil districts of Gurage zone, southern region with the flock size of 5.41, 4.11, 5.13 and 4.75 chicken per household, respectively [13]. But higher result was reported by [14] which were on average 24 chicken per

household in Western zone of Tigray. The mean number of local cocks which were used for breeding purpose in South Achefer district was significantly higher than Banija district. This result indicates that a chicken producer in Banija district uses common cock in a village.

Table 1: Flock size and composition per household in the study area (Mean \pm SE)

Flock size (Number)	District			Overall mean	Significance level
	South Achefer (N=60)	Banija (N=60)	Fagita Lekoma (N=60)		
Total chicken	10.71 ^a \pm 1.15	4.65 ^b \pm 0.56	6.83 ^{ab} \pm 0.98	7.40 \pm 0.57	***
Cock	0.77 \pm 0.12	0.42 \pm 0.08	0.67 \pm 0.13	0.60 \pm 0.06	NS
Hen	2.77 ^{ab} \pm 0.18	2.42 ^b \pm 0.22	3.70 ^a \pm 0.61	2.96 \pm 0.23	**
Cockerels	1.22 ^a \pm 0.28	0.23 ^b \pm 0.09	0.20 ^b \pm 0.11	0.55 \pm 0.11	***
Pullets	1.53 ^a \pm 0.25	0.33 ^b \pm 0.10	0.65 ^b \pm 0.19	0.84 \pm 0.12	***
Chick	4.43 ^a \pm 0.76	1.28 ^b \pm 0.44	1.67 ^b \pm 0.47	2.46 \pm 0.35	***
Local chicken	9.9 ^a \pm 1.12	3.58 ^b \pm 0.51	4.48 ^b \pm 0.58	6 \pm 0.49	***
Cock	0.7 ^a \pm 0.11	0.3 ^b \pm 0.06	0.5 ^{ab} \pm 0.09	0.5 \pm 0.05	***
Hen	2.5 ^a \pm 0.17	1.9 ^a \pm 0.17	2.4 ^a \pm 0.32	2.3 \pm 0.14	NS
Cockerels	1.1 ^a \pm 0.27	0.2 ^b \pm 0.09	0.1 ^b \pm 0.09	0.5 \pm 0.11	***
Pullets	1.4 ^a \pm 0.22	0.3 ^b \pm 0.08	0.3 ^b \pm 0.09	0.7 \pm 0.09	***
Chick	4.1 \pm 0.76	1.0 ^b \pm 0.40	1.1 ^b \pm 0.36	2.07 \pm 0.32	***
Exotic chicken	0.17 \pm 0.15	0.28 \pm 0.92	0.68 \pm 0.30	0.38 \pm 0.12	NS
Cock	0.03 \pm 0.02	0.60 \pm 0.24	0.02 \pm 0.13	0.02 \pm 0.01	NS
Hen	0.2 \pm 0.12	2.8 \pm 1.02	0.5 \pm 0.27	0.24 \pm 0.10	NS
Pullets	0.05 \pm 0.05	0.03 \pm 0.17	0.10 \pm 0.07	0.50 \pm 0.03	NS
Chick	0.05 \pm 0.05	0.07 \pm 0.07	0.10 \pm 0.07	0.07 \pm 0.04	NS
Cross breed	0.65 \pm 0.27	0.78 \pm 0.28	1.67 \pm 0.52	1.03 \pm 0.22	NS
Cock	0.03 \pm 0.05	0.13 \pm 0.05	0.17 \pm 0.04	0.09 \pm 0.02	NS
Hen	0.20 ^b \pm 0.08	0.32 ^{ab} \pm 0.09	0.82 ^a \pm 0.22	0.44 \pm 0.09	***
Male grower	0.08 \pm 0.05	0.05 \pm 0.03	0.07 \pm 0.07	0.07 \pm 0.03	NS
Female grower	0.08 \pm 0.06	0.06 \pm 0.04	0.21 \pm 0.13	0.12 \pm 0.05	NS
Chick	0.25 \pm 0.14	0.25 \pm 0.19	0.45 \pm 0.23	0.32 \pm 0.11	NS

^{a, b} Means within a row followed by different superscripts show the presence of significant differences ($P < 0.05$), *** $P < 0.001$, ** $P < 0.01$, NS (Non-significant)

The flock composition (flock composition is the percentage of each flock age category from the total flock) of Banija and Fagita Lekoma districts was dominated by Hens followed by Chicks whereas, in South Achefer district, the flock composition was dominated by Chicks and followed by Hens (figure 1). The overall mean composition of flocks in the study area was dominated by Hens followed by Chicks. Keeping of higher proportion of Hens and Chicks could be to produce higher number of egg for market sale, household consumption and hatching for stock replacement for a sustainable manner and to grow Chicks for live adult chicken sale. The lower proportion of Cocks and male growers observed within the flock in the study was in agreement with report of [15] and [16] and this might be attributed to the selling of cockerels for income generation. The cock hen ratio was calculated based on the number of breeding hens and cocks available during the study period and in the study village. Based on that the average breeding male to breeding female ratio are 1:3.51, 1:9.4 and 1:4.8 in South Achefer, Banija and Fagita

Lekoma district, respectively. In this regard the recommended cock to hen ratio in light breed is 1:8-10 [17]. In South Achefer and Banija district, the cocks were underutilized and there is the need to eliminate some by either selling or consuming them to ensure proper utilization of cocks. This could be attributed to the lack of knowledge on chicken husbandry and breeding management.

Productive and Reproductive Performance of Chicken

The productive and reproductive performances of local, exotic and cross (local x exotic) chicken breeds under the village production system are indicated in Table 2 and 3. Age of sexual maturity of female chicken, average number of days per clutch (clutch is the time between that the hen starts to lay egg and come up with broody), average number of eggs per brood, number of chicks hatched per brood and number of chicks surviving to weaning per brood of local hens were significantly different among the study district.

Age of sexual maturity

Age of sexual maturity of female chicken for Banija and Faguta Lakuma districts were higher than south Achefer district. The overall mean age of sexual maturity of local hen was 24.95 ± 0.269 weeks. The result showed that pullets in South Achefer district had relatively matured faster than chicken of the other districts. Differences might be ecotype difference which is Mecha chicken ecotype in South Achefer and Tilli chicken ecotype in Banija and Fagita Lekoma and or management in supplementary feed and availability of scavenging resources. The current result is in line with 5.5 months reported by [10] in western Amhara, respectively, for village chickens. Contrary to this study, indigenous village chickens in Eastern Gojjam zone attained their sexual maturity at an average of 7 months [18] and 6.8 months [5].

The overall mean age of sexual maturity for local male chicken was 23.56 ± 0.36 weeks (Table 2). Similarly, [10] reported that the majority of local cocks in northwest Ethiopia reach sexual maturity between 20–24 weeks of age. This finding is also comparable with the findings of [18] in which the average age of the cock at first mating was 4.7 ± 0.58 months, and 5.71 month reported by [14] for male in western zone of Tigray. There was significant variation between local, exotic and crossbred chickens in terms of age of sexual maturity of hen and cock (Table 3). Exotic and crossbred male and female chicken were early mature than local chickens. Difference in age of sexual maturity could be due to genotypic differences.

Egg production per clutch

The overall mean number of egg production for local hen/clutch in the three districts was 14.89 ± 0.36 (Table 2). The result is in line with the report of [11] in which mean number of egg production per local hen per clutch was 15.7 ± 3.2 and 13.2 in Burie and Fogera districts of north western Amhara, respectively, but higher than those reported by [3] and [19] in which the mean egg number laid per clutch per hen of local chickens in north Wollo zone, north Gondar Amhara region and Ethiopia were 12.64, 11.53, (8-15) and 12 (national average of egg yield/hen/clutch), respectively. But it was lower as

compared with findings of [5] reported 17.7 eggs in five agro-ecological zones of Ethiopia, and [20] reported 16.6 eggs in Fogera district. Variation in egg production could be due to number of clutches, inter brooding length and average day for weaning young chicken and unknown genetic factors associated with the local breed [12]. In general, the annual egg production in a flock is a function of egg production per hen per clutch, clutch length and the proportion of matured hens in a flock which are a function of management. Long clutch length in the study areas contributes for higher number of eggs per clutch.

There was significance variation between local, cross and exotic chickens with regard to mean egg production per clutch (Table 3). The current result revealed that the numbers of eggs produced/clutch/hen was higher for exotic and cross breed chickens as compared to that of local chickens. Indigenous chickens are generally known to lay fewer eggs as compared to exotic chickens. Variation among those breeds in egg production could be genotypic differences. The result of the present study is lower than the report of [21] who found egg production per clutch of 31.66 and 26.14 for cross and exotic respectively, but higher than 11.23 for indigenous chickens in Nole Kobba woreda.

Clutch length

The mean clutch length for local chicken was highly significantly ($p < 0.01$) different among the study districts (Table 2) and mean number of days per clutch in Banija and Fagita Lekoma district was significantly higher than South Achefer district and the overall mean number of days per clutch in the districts was 23.98 ± 0.61 . The average length of egg-laying period per hen was also determined by breeds and management systems and the estimated numbers of days were 21, 36 and 105 days for local, hybrid and exotic breeds, respectively [23].

Clutch size

The overall mean of clutch size per year for local hen was 2.47 ± 0.07 which is comparable with that of 2 to 3 clutches per hen per year (Halima, 2007) in western Amhara but lower than 3.83 per year [11] in Burie district, 3.7 [12] in Dale, Wonsho and Loka Abaya Woredas of Southern Ethiopia and 4.12 [24] in Lemo district, Hadiya Zone. The variation could be attributed to the genetic make-up of the local chickens, environmental factors and management practices provided by the chicken producers [25; 26].

Number of eggs set per brood and number of chicks hatched per brood

Mean number of eggs set per brood and number of chicks hatched per brood in Fagita Lekoma and Banija districts were significantly higher than South Achefer district and the overall mean of number of eggs set per brood and hatched per brood in the three districts were 13.89 ± 0.22 and 11.91 ± 0.24 (Table 2). The current result is higher than the finding of [12] in which on average number of eggs per set and number of chicks hatched per set were 11.18 and 9.33 respectively. These differences could be attributed to season of incubation, brooding experience, availability of eggs, size of eggs, body size of broody hen and her maternal instinct behavior [17]. These traits are known to determine the number of eggs placed per brooding hen [22]. According to [15] and [22], hatchability of eggs and the survival rate of the hatched

chicken are among the major factors that determine the productivity of chicken. The current finding was higher than 10.0 the result reported by [25] and [27] in southern Ethiopia, 8.1 reported by [15] in Ethiopia and 8.7 by [17] for Ghana in number of eggs hatched per brood.

Number of chicks surviving up to weaning

Mean number of chicks surviving to weaning per brood in Fagita Lekoma was significantly higher than South Achefer and Banija districts and on average, out of the hatched chicks in the present study only 7.63 ± 0.23 chicks survived. This result was similar with 7.1 chicks that survived [27] but higher than the 5.5 chicks that survived as reported by [25].

Hatchability

The overall mean of hatchability of local brooding hen was 85.75% (Table 2). This result is comparable to 82.8% of the result reported by [28] in east Gijam. The percentage of survival rate of chicks to adulthood was 61.09% in South Achefer, 60.49% in Banija and 67.46% in Fagita Lekoma districts with the overall mean of 64.06%. The higher survivability indicates that the lower mortality rate. The current result is better than the finding of [15] who reported 41% of chick mortality for indigenous chickens in Gomma woreda. The reason behind the mortality rate difference could be management differences among chicken keepers. Hatchability depends on instinct maternal behavior of the hen, degree of management of the hen during brooding and prevalence of predators [22]; [17] while the survival rate of the hatched chicks depends on the prevalence of predation and disease [17].

Table 2. Least square mean (Mean \pm SE) of productive and reproductive performances of chicken under village production system

t	District			Overall mean	Significance level
	South Achefer	Banija	Fagita Lekoma		
Local chicken					
Age of sexual maturity for female (weeks)	23.83 ^b \pm 0.52	25.58 ^a \pm 0.54	25.20 ^{ab} \pm 0.44	24.95 \pm 0.269	**
Age of sexual maturity for male (weeks)	22.79 \pm 0.53	23.75 \pm 0.58	23.87 \pm 0.61	23.56 \pm 0.36	NS
Mean number of eggs per clutch	14.56 \pm 0.68	15.03 \pm 0.69	14.98 \pm 0.56	14.89 \pm 0.36	NS
Clutch length	20.96 ^b \pm 0.97	25.62 ^a \pm 1.04	24.57 ^a \pm 0.96	23.98 \pm 0.61	***
Mean number of eggs set per brood	12.76 ^b \pm 0.46	13.79 ^{ab} \pm 0.37	14.58 ^a \pm 0.31	13.89 \pm 0.22	***
Number of chicks hatched per brood	11 \pm 0.47 ^b	11.62 ^{ab} \pm 0.39	12.60 ^a \pm 0.37	11.91 \pm 0.24	**
Number of times the hen hatches in a year	2.60 \pm 0.11	2.46 \pm 0.13	2.40 \pm 0.13	2.47 \pm 0.07	NS
Number of surviving chicks at weaning	6.72 ^b \pm 0.38	7.03 ^b \pm 0.33	8.50 ^a \pm 0.36	7.63 \pm 0.23	***
Hatchability (%)	86.21 ^a	84.76 ^b	86.42 ^a	85.75	
Survival ability up to adulthood (%)	61.09 ^b	60.49 ^b	67.46 ^a	64.06	**
Exotic chicken					
Age of sexual maturity of hens (weeks)	20	20 \pm 0.50	22.14 \pm 1.09	21.68 \pm 0.83	NS
Age of sexual maturity of cocks (weeks)	24	21.67 \pm 1.20	22 \pm 0.64	22 \pm 0.58	NS
Mean number of eggs per clutch	NA	25	25	25	NS
Cross breed chicken					
Age of sexual maturity of hens (weeks)	24	21.60 \pm 0.98	23.47 \pm 0.66	23.214	NS
Age of sexual maturity of cocks (weeks)	23 \pm 1	21 \pm 0.63	21.47 \pm 0.47	21.607	NS
Mean number of eggs per clutch	26.67 \pm 3.33	22.38 \pm 2.69	27.36 \pm 0.95	25.454	NS

^{a, b}Means within a row followed by different superscripts show the presence of significant differences ($P < 0.05$), *** $P < 0.001$, ** $P < 0.01$, NS (Non-significant)

Table 3. Least square mean (Mean \pm SE) of productive and reproductive performances of chickens under village production system

Trait	Breed			Significance level
	Local	Exotic	Cross breed	
Age of sexual maturity of hens (weeks)	24.95 ^a \pm 0.29	21.68 ^b \pm 0.82	22.90 ^b \pm 0.53	***
Age of sexual maturity of cocks (weeks)	23.56 ^a \pm 0.36	22 ^{ab} \pm 0.59	21.31 ^b \pm 0.45	***
Average number of eggs per clutch	14.89 ^b \pm 0.37	25 ^a \pm 0.00	23.94 ^a \pm 1.98	***

^{a, b}Means within a row followed by different superscripts show the presence of significant differences ($P < 0.05$), *** $P < 0.001$, ** $P < 0.01$, NS (Non-significant)

Constraints of chicken Production in the study area

Constraints of chicken production in the study area are presented in graph two. According to the survey result lack of improved breed (0.188), disease occurrence (0.185), lack of veterinary service (0.151) and poor extension service (0.117) were major constraints of chicken production. In line with the current result, Halima reported that diseases and predators were a major factor that causes loss of chicken in Northwest Ethiopia. Predators like a hawk, wild animals and cat were main cause of mortality in the study area. As observed in transect walk farmers tie hen in and around the gate with rope to reduce the loss of young chicken with predator.

Summary And Conclusion

Hens and young chicken were the dominant class of chickens in the flock structure of the study area, indicating that the intention of farmers could be for egg production for selling and hatching for stock replacement. Local hens and cocks in the study area were reached at sexual maturity at lately (24.95 \pm 0.269 and 23.56 \pm 0.36 weeks respectively) than exotic hens and exotics cocks have had reach earlier at 21.68 \pm 0.83 and 22 \pm 0.58 weeks, respectively due to genotypic potential difference. The mean egg production of local chickens in the study area was 14.89 \pm 0.36 eggs per hen per clutch with clutch length of 23.98 \pm 0.61 days and the number of clutches per year was 2.47 \pm 0.07 which is lower than improved chickens. Average number of eggs set per brood, hatched and number of chicks surviving to adulthood in the study was 13.89 \pm 0.22, 11.91 \pm 0.24 and 7.63 \pm 0.23 with hatchability and survivability percentage of 85.75 and 64.06, indicating high mortality rate.

In general, the production performance of local chicken and their survival performance in the study area are low to medium. To increase the performance of village chicken production, appropriate interventions are crucial. Therefore, in order to improve production and survival performance, managemental interventions (feeding, housing and husbandry) and or genetic improvements (selection and or cross breeding) are extremely important to be considered for the chicken production program.

Declarations

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Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Availability of data

The datasets analysed in the current study are available from the corresponding author on request.

Contribution

Birhan kassa participated in conceiving and coordinating the overall activity, and carried out the statistical analysis, and drafted the manuscript. Dr. Yosef Tadesse Participated in drafting and reviewing the manuscript and Dr. Wondmeneh Esatu and Dr. Tadelle Dessie participated in the design of the study and reviewing the manuscript

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Figures

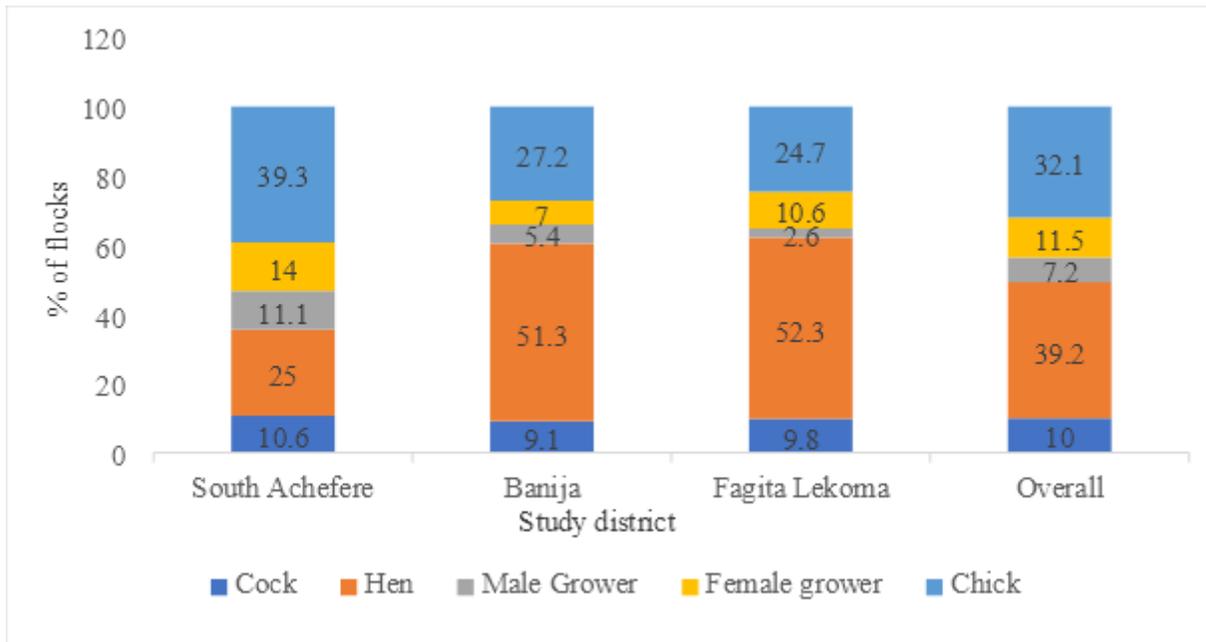


Figure 1

Percentage of chicken flock composition across the study districts

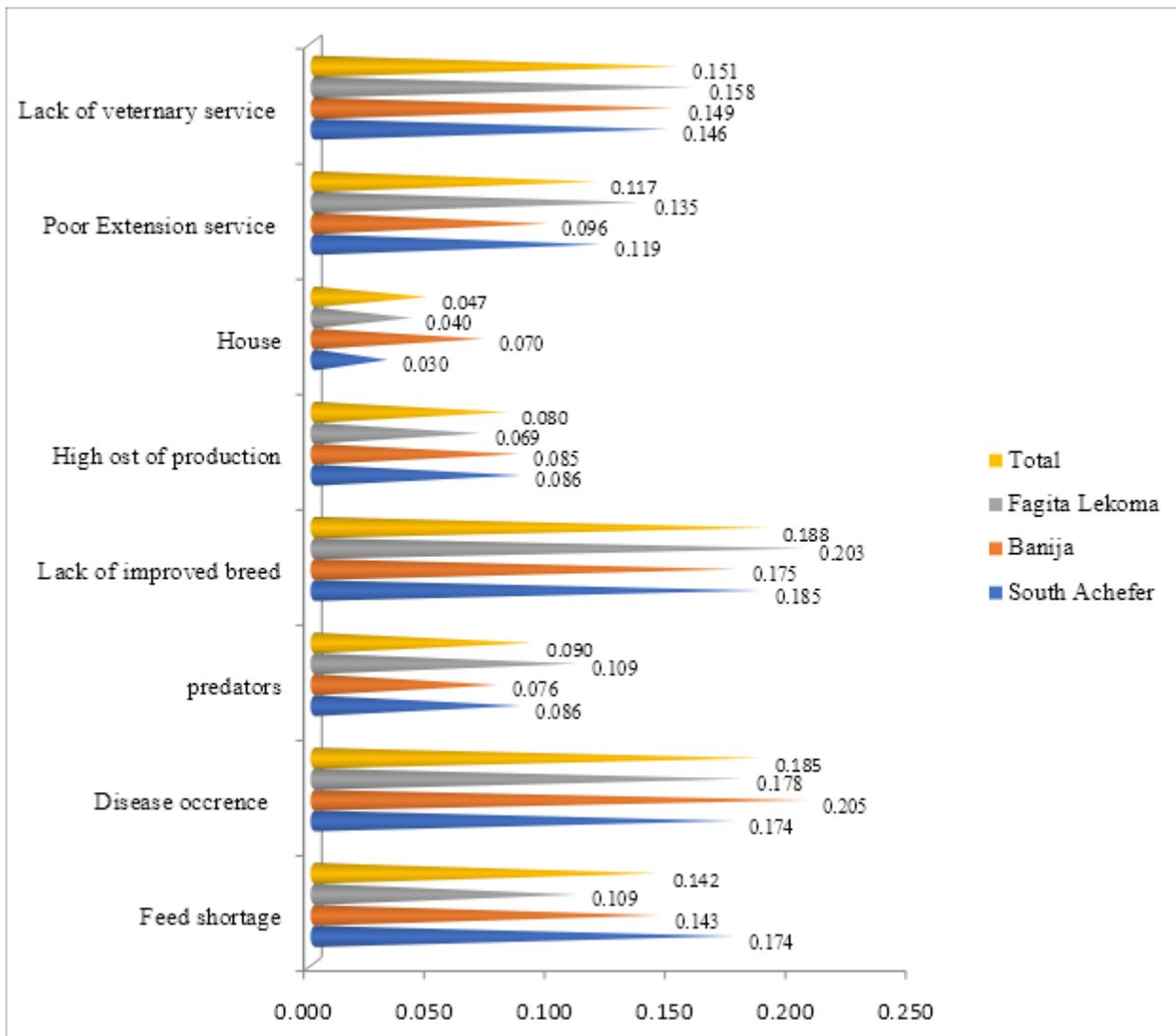


Figure 2

Index values for constraints of chicken production in the study area