Production Systems, Productive Performances, Constraints and Rate of Inbreeding of Indigenous Chicken Populations in Kaffa Zone, South Western Ethiopia

Abiyu Tadele1# Aberra Melesse2 Mestawet Taye2
1. Department of Animal Science, Bonga University, Ethiopia
2. School of Animal and Range Sciences, Hawassa University, Ethiopia

#Correspondence to: Abiyu Tadele, P.O. Box 334, Department of Animal Science, Bonga University, Ethiopia

Abstract
The main objective of this study was to describe the production systems, productive performances and associated constraints of indigenous chicken populations in Kaffa Zone. Data on production systems, productive performances and constraints of chickens were collected from 300 purposively selected households using a semi-structured questioner. The results indicated that majority of the respondent were female (71.1%) and 56% of the interviewed farmers were illiterate. The average family size per household was 5.86. Farmers mainly keep their chickens in the kitchen (60.7%) and main houses (30.7%). Maize (55.7%) and sorghum (20.3%) were the major feed supplements provided by the households. The average chicken flock size, age at first egg (months), average egg/hen/clutch (clutch size), clutch number and annual egg/hen/year were 8.68, 6.09, 12.3, 3.6 and 44, respectively. The average hatchability was 80.5%. The major production constraints were predators (72.7 %) and diseases (27.3 %) across the studied districts. The type of predators which are commonly occurring included Buteo jamaicensis locally known as “Gace”, Helogale hirtula locally known as “Shitoo” or “Wociwoco”, Felis silvestris locally known as “Haalaro” and Felis catus locally known as “Kubbi Kullaro” accounted about 54.6, 24.4, 15.5, and 4.58 % respectively. The effective population size and rate of inbreeding were 486 and 0.111% indicating chicken populations in the study area are not exposed to inbreeding. In conclusion, the current study indicates illiterate female farmers were mainly involved in care and managing of chickens under scavenging system. The performances of chickens were comparable with the national reports under scavenging system; however these performances were influenced by predators and diseases. Therefore, educating and training of women’s should be implemented to improve the overall socio economic status of the family and benefit them. In addition successful intervention strategy should be carried out to effectively utilize the existing potentials of indigenous chicken populations in line with predator and disease control programs. Again, conservation of the indigenous chicken populations should also be considered before they have been diluted with exotic breeds.

Keywords: Effective population size, Household Characteristics, Indigenous chicken, Productive performance, Rate of inbreeding.

DOI: 10.7176/JBAH/9-5-08

Publication date: March 31st 2019

Introduction
In Ethiopia most of the rural communities keep indigenous chicken populations under scavenging management system (Tadele et al., 2018). Due to the presence of various agro-climatic conditions which enables the rural societies to keep a wide varieties of indigenous chicken populations under scavenging management systems (Azage et al., 2010; Tadele et al., 2018). In Ethiopia chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tadelle et al., 2003). The total chicken population in the country is estimated to be 56.53 million and of these 94.3 % indigenous which are mainly kept by small holder farmers in scavenging environments (CSA, 2017). The most dominant chicken types reared in Ethiopia are local ecotypes, which show a large variation in body conformation, plumage color, comb type and productivity (Halima et al., 2007; Tadele et al., 2018). However; the economic contribution of the sector is not still proportional to the huge chicken numbers, attributed to the presence of many productions, reproduction and infrastructural constraints (Aberra, 2000). In the rural areas of Ethiopia indigenous chickens has been mainly kept by the poor due to their significance for source of animal protein, generation of extra cash incomes and religious /cultural (Alders et al., 2009).

Moreover, the indigenous chicken’s populations which have been kept by majority of rural farmers in Ethiopia are good scavengers and foragers, well adapted to harsh environmental conditions and their minimal space requirements make chicken rearing a suitable activity and an alternative income source for the rural farmers. In addition, the local chicken sector constitutes a significant contribution to human livelihood and contributes significantly to food security of poor households. Horst (1988) considered the indigenous fowl populations as gene reservoirs, particularly for those genes naked neck (Na) that have adaptive values in tropical conditions. Despite the important roles of local chickens, rearing them can be considered as a side line agricultural activity. However,
the indigenous chicken populations in Ethiopia were neglected for conservation, rather they have been diluting with the imported exotic breeds (Halima et al., 2007).

The indigenous chicken populations which are found in large proportions are often low in their egg production, late in maturation, long broodiness and unimproved (Fisseha et al., 2010; Aberra, 2000). Due to their low genetic potential, incidence of diseases and predators, limited supplementary feed resources, constraints related to institutional, socio-economic and infrastructural as well as poor management practices contributed for the low production and productivity of chickens.

Therefore, the present study was conducted to describe the existing production systems, productive performances and associated constraints of indigenous chicken populations reared in three districts of Kaffa Zone.

Materials and Methods

Description of the study area

This study was conducted in Kaffa Zone which is located between 6°24’ to 8°13’ North latitude and 35°30’ to 36°46’ East longitude in South Western part of South, Nation, Nationalities and Peoples Region. The Zone has a total area of 10,602.7 km² which accounts 7.06 % of the total area of the region. Administratively, Kaffa Zone is divided into ten districts and has three conventional climatic zones based on variations in altitude and temperature. These are highland (2500 - 3000 m a.s.l), midland (1500 - 2500 m a.s.l) and lowland (500 – 1500 m a.s.l) (KZBoFED, 2014). Out of the total area of the Zone, highland, midland and lowland cover 11.6%, 59.5% and 28.9%. The mean annual temperature of the area ranges 10.1 °C – 27.5 °C. The warmest months are February, March and April while the coldest months are July and August. According to the meteorological data obtained from the Zone, the annual rainfall ranges from 1001-2200mm (KZBoFED, 2014). Kaffa Zone is a part of the South West Ethiopian regions which receive the highest amount of rainfall. This is attributable to the presence of the evergreen forest cover on top of the windward location to the moist monsoon winds.

Sampling technique and methods of data collection

The study districts were purposively selected based on their potential for chicken population, accessibility and presence of indigenous chicken production. Before the main survey was commenced, a preliminary assessment was made to identify whether there are pure exotic and/or their crosses in the study areas. From ten districts of Kaffa Zone, three districts namely Decha, Chena and Gimbo districts were selected from which 15 rural kebeles (seven from Decha; four from each Chena and Gimbo district) were randomly sampled. Then, a total of 300 households, 20 households from each rural kebeles, that posses a minimum of 5 matured indigenous chickens were randomly selected. Closely adjacent households were also skipped to avoid the risk of sampling chickens sharing the same cock.

Effective population size

Data on effective population size was collected from the surveyed chicken populations which were mature male and female. However, pullets and cockerels which are not ready for breeding were excluded from both districts to
estimate the effective population size. Effective population size for a randomly mated population was calculated following the equation given by Falconer and Mackay (1996).

\[ N_e = \frac{4(N_m \times N_f)}{N_m + N_f} \]

Where; \( N_e \) = effective population size; \( N_m \) = number of breeding males and \( N_f \) = number of breeding females.

**Estimation of rate of inbreeding**

Data on the rate of inbreeding was calculated from effective number of breeding indigenous chickens from the studied districts to determine the current status of inbreeding. Effective population size (\( N_e \)) was used to estimate the rate of inbreeding in a population. Rate of inbreeding (\( \Delta F \)) for each studied districts and total populations were estimated from the effective population size data following the model adopted from (Falconer and Mackay, 1996; Maiwashe *et al.*, 2006).

\[ \Delta F = \frac{1}{2N_e} \]

Where;
- \( \Delta F \) = rate of inbreeding
- \( N_e \) = effective population size

**Statistical Analysis**

Data collected on socio economic, production systems, productive performances and constraints of chicken populations were coded and entered into a computer using Microsoft Office Excel 2007. Descriptive statistics were employed to analyze the data in each district and Chi-square (\( \chi^2 \)) test was also employed to compare the significance of district by using Statistical Analysis System (SAS, 2002, ver. 8.2).

**Results**

**Household Characteristics of the Study Areas**

The household characteristics of the respondents are presented in Table 1. From the total interviewed indigenous chicken owning farmers, 70.7, 70 and 72.5 % were females in Decha, Chena and Gimbo districts, respectively. Higher proportion of female respondents (71.1%) than males (28.9%) was observed. This indicates that female farmers are mainly involved in managing and caring of chickens in the study districts.

The average age of respondents in the present study was 39.9, 41.3 and 39.2 years in Decha, Chena and Gimbo districts, respectively. The educational level of respondents showed that, about 66.4, 58.7 and 42.5 % in Decha, Chena and Gimbo districts, respectively were illiterate. This might be due to the fact that farmers in rural communities particularly in this area did not have access to education before. Others can read and write and some were involved in formal education such as primary first cycle (1-4th); second cycle (5-8th) and high school (9-10th or 12th) and above in all study districts. The average family size in Decha, Chena and Gimbo districts was 5.97, 5.83 and 5.7 persons, respectively with the overall mean family size of 5.86 persons.

**Table 1.** Household characteristic of respondents in three districts of Kaffa Zone, South Western Ethiopia (N = 300)

| Household characteristics | Decha N = 140 | Chena N = 80 | Gimbo N = 80 | Overall N = 300 |
|---------------------------|--------------|-------------|--------------|----------------|
| **Sex of respondents (%)** |              |             |              |                |
| Male                      | 41(29.3)     | 24(30)      | 22(27.5)     | 28.9           |
| Female                    | 99(70.7)     | 56(70)      | 58(72.5)     | 71.1           |
| **Average age of respondents (years)** | 39.9 | 41.3 | 39.2 | 40.1 |
| **Educational level (%)** |              |             |              |                |
| Illiterate                | 93(66.4)     | 47(58.7)    | 34(42.5)     | 56             |
| Read and write            | 10(7.14)     | 7(8.75)     | 12(15)       | 10.3           |
| Primary first cycle (1-4) | 10(7.14)     | 10(12.5)    | 14(17.5)     | 12.4           |
| Primary second cycle (5-8)| 19(13.6)     | 9(11.3)     | 12(15)       | 13.3           |
| High school (9-12 and above) | 8(5.71) | 7(8.75) | 8(10) | 8.2 |
| **Average family size (number)** | 5.97 | 5.83 | 5.7 | 5.86 |

\( N \), Number of observations; Numbers in parenthesis are percentage values.

**Livestock ownership and flock characteristics**

As presented in Table 2, the overall mean size of livestock populations was 3.4, 2.4, 0.9 and 0.2 heads of cattle, sheep, goat and equine, respectively. The lowest proportions of cattle and sheep were reported from Decha which is significantly lower (\( P<0.05 \)) than Chena and Gimbo districts, respectively.

56
Table 2. Livestock ownership of households in three districts of Kaffa Zone, South Western Ethiopia (mean ± SE)

| Livestock | Decha     | Chena     | Gimbo     | (Mean ± SE) |
|-----------|-----------|-----------|-----------|-------------|
| Cattle    | 2.97±0.1  | 3.51±0.17 | 3.65±0.18 | 3.4±0.08    |
| Sheep     | 2.04±0.08 | 2.71±0.21 | 2.57±0.21 | 2.4±1.6     |
| Goat      | 0.83±0.10 | 0.88±0.13 | 1.05±0.14 | 0.9±1.2     |
| Equine    | 0.15±0.03 | 0.18±0.044| 0.2±0.045 | 0.2±0.4     |

a, b Row means with different superscript letters are significantly different (P < 0.05)

SE = Standard error of the mean

The average chicken flock size per household in Decha, Chena and Gimbo districts was 9.02, 8.83 and 8.01, respectively with the overall mean chicken flock size of 8.68 (Table 3). The largest proportions of chicken populations were reported from Decha and Chena districts and which are significantly higher (p<0.05) than Gimbo district.

Table 3. Chicken flock compositions of households in three districts of Kaffa Zone of South Western Ethiopia (mean ± SE)

| Flock composition | Decha     | Chena     | Gimbo     | (Mean ± SE) |
|-------------------|-----------|-----------|-----------|-------------|
| Chicks            | 1.3±0.16  | 1.40±0.22 | 1.05±0.17 | 1.26±0.11   |
| Pullets           | 1.12±0.08 | 1.01±0.12 | 0.88±0.12 | 1.03±0.06   |
| Cockerels         | 0.54±0.06a| 0.35±0.07a| 0.25±0.06b| 0.4±0.7     |
| Hens              | 4.36±0.07 | 4.33±0.09 | 4.20±0.08 | 4.3±0.8     |
| Cocks             | 1.7±0.05  | 1.74±0.07 | 1.63±0.06 | 1.7±0.03    |
| Overall           | 9.02±0.24a| 8.83±0.34a| 8.01±0.25b| 8.68±0.28   |

a, b Row means with different superscript letters are significantly different (P < 0.05); SE, Standard error of the mean

Reproductive and Productive Performance of Indigenous Chickens

The performance of indigenous chicken populations is presented in Table 4. Age at first egg (months) was significantly longer for chickens reared in Gimbo (6.3 months) district than Chena (6.1 months) and Decha (6 months) districts. Egg number per hen per clutch in the present study was 12.3, 12.2 and 12.6 eggs in Decha, Chena and Gimbo districts, respectively. Average number of days per clutch (clutch length) was lower in Gimbo district than, Decha and Chena districts, which had similar values. Eggs incubated per hen/clutch in Decha, Chena and Gimbo districts were 10.2, 10.2 and 10, respectively. The hatchability percentages of chickens reared in Gimbo district was significantly (P < 0.05) lower than Decha chickens and has comparable with Chena district chickens. District had no significant effect (P > 0.05) on survivability of chicken. In general, the average egg and clutch number per hen per year in the current study were 44 and 3.6, respectively.

Table 4. Performance of indigenous chickens in three districts of Kaffa Zone of South Western Ethiopia (mean ± SD)

| Parameters                  | Decha     | Chena     | Gimbo     | Overall mean |
|-----------------------------|-----------|-----------|-----------|--------------|
| Age at first egg (months)   | 6.0±0.43b | 6.1±0.55b | 6.30±0.69a| 6.1±0.56     |
| Egg number per hen/clutch   | 12.3±1.43 | 12.2±1.64 | 12.6±2.07 | 12.3±1.68    |
| Clutch length/hen/days      | 21.0±5.1a | 21.0±5.7a | 19.0±5.86b| 20.0±5.3     |
| Clutch no per hen/year      | 3.60±0.2  | 3.60±0.2  | 3.65±0.21 | 3.60±0.2     |
| Total egg number per hen/year| 44±5.3ab | 43.4±5.7b | 45.6±7.12a| 44.0±6.0     |
| Eggs incubated per hen      | 10.2±0.94 | 10.2±0.88 | 10.0±1.2  | 10.2±1.0     |
| Number of chicks hatched    | 8.34±1.1  | 8.21±0.94 | 8.0±1.44  | 8.20±1.2     |
| Hatchability (%)            | 81.6±7.0a | 80.3±5.5ab| 78.6±8.9b | 80.5±7.3     |
| Number of chick survived    | 4.10±0.71 | 4.01±0.88 | 3.90±0.97 | 4.00±0.8     |
| Survivability (%)           | 49.1±8.7  | 48.8±10.0 | 49.8±10.3 | 49.2±9.5     |

a, b Row means with different superscript letters are significantly different (P < 0.05); SD = standard deviation

Husbandry Practices of Chickens

Management Systems

Chicken management systems practiced in the three districts is presented in Table 5. The current study has revealed that scavenging/free-ranging as the main production systems practiced in all the study districts.

Housing System

Housing system had significantly differed (p<0.05) among the studied districts. As presented in Table 5, about 60.7 % of households keep their chicken in the kitchen while 30.7 % of them shared their main houses with their
chicken and other farm animals.

**Feed and Feeding Practices**

In the current study, supplementary feeding for chickens was provided in all study districts. In Gimbo, all the interviewed households provide supplementary feeds to their chickens, whereas 98.6 and 97.5 % in Decha and Chena districts respectively provide supplementary feeds. The major supplementary feed in the study districts was Maize (55.7 %) followed by Sorghum (20.3 %) and Wheat (10.3 %). The majority (39.7 %) provide feed twice per day.

**Watering practices**

With regard to provision of water in the current study, all respondents in Gimbo district provide water while 98.6 and 97.5 % of them in Decha and Chena districts, respectively provide water for their chickens. In the study districts river water was the major source of water (69.3 %) followed by Borehole water (22.3 %).

### Table 5. Chicken husbandry practices in three districts of Kaffa Zone, South Western Ethiopia.

| Parameters                  | Decha | Chena | Gimbo | Overall (%) | X²-test |
|-----------------------------|-------|-------|-------|-------------|---------|
| Management system           |       |       |       |             | ns      |
| Scavenging/free-ranging     | 140(100) | 80(100) | 80(100) | 100         |         |
| Housing system              |       |       |       |             | 9.7*    |
| In the kitchen              | 91(65) | 38(47.5) | 53(66.3) | 60.7       |         |
| Main houses                 | 41(29.3) | 32(40) | 19(23.7) | 30.7       |         |
| Mud houses                  | 8(5.71) | 10(12.5) | 8(10) | 8.67        |         |
| Supplementary feeding       |       |       |       |             | 1.9ns   |
| Yes                         | 138(98.6) | 78(97.5) | 80(100) | 98.7       |         |
| No                          | 2(1.43) | 2(2.50) | NR     | 1.33       |         |
| Frequency of feeding        |       |       |       |             | 38.3**  |
| Once a day                  | 18(12.8) | 16(20) | 32(40) | 22         |         |
| Twice a day                 | 49(35) | 34(42.5) | 36(45) | 39.7       |         |
| Three or more time a day    | 71(50.7) | 28(35) | 12(15) | 37         |         |
| None                        | 2(1.43) | 2(2.50) | NR     | 1.33       |         |
| Feed supplements (%)        |       |       |       |             | 35.8**  |
| Maize                       | 74(52.8) | 37(46.3) | 56(70) | 55.7       |         |
| Sorghum                     | 27(19.3) | 28(35) | 6(7.50) | 20.3       |         |
| Wheat                       | 13(9.29) | 4(5) | 14(17.5) | 10.3       |         |
| Barley                      | 21(15) | 7(8.75) | 2(2.50) | 10         |         |
| Teff                        | 3(2.14) | 2(2.50) | 2(2.50) | 2.33       |         |
| No feed                     | 2(1.43) | 2(2.50) | NR     | 1.33       |         |
| Watering Practices (%)      |       |       |       |             | 1.9ns   |
| Yes                         | 138(98.6) | 78(97.5) | 80(100) | 98.7       |         |
| No                          | 2(1.43) | 2(2.50) | NR     | 1.33       |         |
| Source of water (%)         |       |       |       |             | 72.8**  |
| Bore hole                   | 10(7.14) | 15(18.7) | 42(52.5) | 22.3       |         |
| Well                        | 7(5.00) | 12(15) | 2(2.50) | 7.33       |         |
| River                       | 121(86.4) | 51(63.7) | 36(45) | 69.3       |         |
| No water                    | 2(1.46) | 2(2.50) | NR     | 1.00       |         |

X²-test= chi-square test; ns = non- significant; *p<0.05; **p<0.01; NR, not Reported;
Numbers in parenthesis are percentage values

**Production Constraints of Indigenous Chicken in the Study Area**

Data pertaining to constraints in chicken production is presented in (Table 6). Predators were the most important problem reported to be affecting poultry productivity in all the study districts accounting for 74.3, 80 and 62.5 % in Decha, Chena and Gimbo districts, respectively. Disease was the second constraint as reported by 25.7, 20 and 37.5 % of respondents in Decha, Chena and Gimbo districts, respectively. In all the production constraints reported, significance differences (P< 0.05) were observed among the study districts.

The type of predators commonly occurring in the study districts were significantly differed (P < 0.05) across the different sites. These predators, which are mentioned by their scientific and local name included *Milvus migrants* locally known as “Gace”, *Helogale hirtula* locally known as “Shiifoo” or “Wociwoco”, *Leptailurus serval* locally known as “Hallaroo” and *Felis silvestris* locally known as “Kubbi Kullaaro” accounted for about 54.6, 24.4, 15.5, and 4.58 %, respectively. In addition, *Papio anubis* locally known as “Sheexxo” (4%) was also reported from Gimbo districts which cause loss of chickens.
The prevalence of chicken diseases in Decha and Gimbo districts was higher with 98.6 and 97.5%, respectively and in Chena 88.7% (Table 6). Season had significant effect (p < 0.05) on the occurrence of disease and highest outbreak was recorded on rainy season, as witnessed by 71.8, 53.2 and 52.1% of respondents in Gimbo, Chena and Decha districts, respectively. This indicates rainy season was more favorable for the growth of disease causing agents across the study districts. Overall, the chi-square test suggests there was significant differences (p < 0.01) in the prevalence of disease and in favorable season of disease occurrences (p < 0.05) across the study districts.

Table 6. Major production constraints of chicken in three districts of Kaffa Zone, South Western Ethiopia

| Parameters                  | Decha | Chena | Gimbo | Overall (%) | X²-test |
|-----------------------------|-------|-------|-------|-------------|---------|
| Production constraints (%)  |       |       |       |             |         |
| Diseases                    | 36(25.7) | 16(20) | 30(37.5) | 27.3 |         |
| Predators                   | 104(74.3) | 64(80) | 50(62.5) | 72.7 |         |
| Types of predators (%)      |       |       |       |             |         |
| Milvus migranis (Gace)      | 63(59.6) | 32(50) | 25(50) | 54.6 |         |
| Helogale hirtula (Shiifoo/Wociwocoo) | 27(26) | 16(25) | 10(20) | 24.4 |         |
| Leptailurus serval (Hallaroo) | 10(10.6) | 14(21.8) | 9(18) | 15.5 |         |
| Felis silvestris (Kubbi Kullaaro) | 4(3.85) | 2(3.13) | 4(8) | 4.58 |         |
| Papio anubis (Sheexxo)      | NR    | NR    | 2(4) | 0.92 |         |
| Prevalence of disease (%)   |       |       |       |             | 12.7**  |
| Yes                         | 138(98.6) | 71(88.8) | 78(97.5) | 95.7 |         |
| No                          | 2(1.43) | 9(11.3) | 2(2.50) | 4.33 |         |
| Favorable season (%)        |       |       |       |             | 7.9*    |
| Rainy                       | 75(53.6) | 51(63.7) | 58(72.5) | 61.3 |         |
| Dry                         | 65(46.4) | 29(36.3) | 22(27.5) | 38.7 |         |

X²-test = Chi-square test; **p<0.01; *p<0.05; NR, not Reported
Numbers in parenthesis are percentage values; Names of predators are in their scientific name, and names in brackets are in Kafigna language, official working language of Kaffa Zone.

Effective Population Size and Rate of inbreeding

As presented in Table 7, the overall effective population size (Ne) was found to be 486 while the rate of inbreeding were 0.073, 0.126 and 0.133% in Decha, Chena and Gimbo districts, respectively with the overall rate of inbreeding 0.111% across the study areas. In Decha district the percentage value of rate of inbreeding was comparatively lower than Chena and Gimbo districts, however, Chena and Gimbo districts had comparable percentage value. The variation of Ne in the studied district might be due to the small number of cocks kept in the studied households.

Table 7. Effective population size and inbreeding rate of indigenous chicken populations reared in three districts Kaffa Zone, South Western Ethiopia

| Study districts | Nm | Nf | N | Nm/Nf (%) | Ne | Ne/N (%) | ΔF% |
|-----------------|----|----|---|-----------|----|----------|-----|
| Decha           | 238 | 611 | 849 | 39 | 685.1 | 80.7 | 0.073 |
| Chena           | 139 | 346 | 485 | 40.2 | 396.7 | 81.8 | 0.126 |
| Gimbo           | 130 | 336 | 466 | 38.7 | 375 | 80.5 | 0.133 |
| Overall         | 507 | 1293 | 1800 | 39.3 | 486 | 81 | 0.111 |

Ne, Effective population size; ΔF, Rate of inbreeding; Nm = Number of breeding male chicken; Nf = Number of breeding female chicken; Nm/Nf (%) = Ratio of Male: Female chickens in percents; N = Total breeding chicken populations (Nm+Nf); Ne/N (%) = Ratio of breeders contributing efficiently genes to the population.

Discussions

Household Characteristics and Respondents Profile in the Study Area

Household Characteristics of the Study Area

In the present study the highest percentage of females (71.1) than males (28.9) was observed, which was in agreement with the results of various scholars in the country (Moreda et al., 2013; Hailemichael, 2013; Wondu et al., 2013). However, the highest value of males (62%) was reported by Mulgeta and Tebikew (2013). The result on educational level obtained in the current study with higher illiterate (56%) was also in line with the findings of different scholars (Halima et al., 2007; Moreda et al., 2013; Hailemichael, 2013; Wondu et al., 2013). The average family size in the present study (5.86) was in close agreement with the findings of Halima et al. (2007), Emebet et al. (2013) and Hailemichael (2013). Lower family sizes: 4.5 and 4.06 person per households was reported by Mulgeta and Tebikew (2013) and Solomon et al. (2013), respectively. From the present findings and the reports from various parts of the country, it is clear that, female farmers are the main to care and manage chickens. Hence,
it is important to empower women’s through better education as they are the most to contribute a significant role in the improvement of indigenous chicken production systems. In line with this Halima et al. (2007) also indicated that, educating women will improve the overall socio-economic status of the family and the society.

Livestock Ownership and Flock Characteristics

The average cattle (3.4), sheep (2.4) and goat (0.9) number per household in the study area were comparable with the reports of Hailemichael (2013). However, those reported by Emebet et al. (2013) and Solomon et al. (2013) are higher than the present study. The result on average chicken flock size (8.68) per household in the current study was comparable with the reports of Nebiyu et al. (2013) who reported 8.5 chickens per household in Hallaba districts of Southern Ethiopia. The number of chickens per household reported by Halima et al. (2007) in Northwest Ethiopia (7.1), Aberra et al. (2013) in Southern region (7.9) and Mulgeta and Tebikew (2013) in Amhara region (7.76) are also in line with the present study. However, the findings obtained by other scholars in various parts of Ethiopia showed higher values than the present study (Tadele et al., 2003; Wondimu et al., 2013; Deneke et al., 2014). There are also reports that show lower values (4.85 flock size per household) than found in the present study (Moreda et al., 2013). The variations in flock size seen in different parts of the country might be due to the presence of seasonal outbreak of diseases, predators, feed resource availability, economic aspects of the community, environmental conditions and settlement pattern of the societies.

Reproductive and Productive Performance of Indigenous Chickens

The average age at first egg (6.1) of chickens in the current study was in close agreement with the findings of Deneke et al. (2014) from the Southeastern Oromia Zone. High age values at first egg of indigenous chickens was reported from various parts of the country by Tadele et al. (2003), Aberra et al. (2013), Melkamu et al. (2013) and Nebiyu et al. (2013). Low age at first egg was also reported from Northwest Ethiopia by Addisu et al. (2013) and Solomon et al. (2013) with 5.6 and 5.2 months, respectively. Different report on age of chickens at first egg might be due to lack of proper supplementary feeds, availability of scavengable feed resources, disease outbreak and provision of clean water by the households.

The present finding with regard to average egg production per clutch per hen (12.3), number of eggs incubated (10.2) and number of chicks hatched (8.2) differed from the results of Melkamu and Andarge (2013), Nebiyu et al. (2013) and Solomon et al. (2013). However it was in close agreement with the findings of Addisu et al. (2013), Mulgeta and Tebikew (2013) and also was comparable with the reports of CSA (2015). Highest value of eggs/clutch/hen was reported from Eastern Gojam Zone by Melkamu and Andarge (2013) 17 eggs/clutch/hen. The average clutch number per hen per year (3.6) and total egg number per hen per year (44) in the current study was comparable with the findings of Addisu et al. (2013) which was 3.62 and 46, respectively. However, high values of clutch number and egg number per hen per year were reported by Melkamu and Andarge (2013) and Solomon et al. (2013). The management aspects of the households chicken rearing might be the reason contributing for the observed variations in the production and reproduction traits of indigenous chickens in the country.

The average hatchability (80.5 %) of chickens in the current study was comparable with the results of Aberra et al. (2013) and Deneke et al. (2014) in which the hatchability percentages were 79.1 and 81.5 percent, respectively. However, observations by several scholars in various parts of the country were higher than the present study (Worku et al., 2012; Nebiyu et al., 2013; Solomon et al., 2013). On the other hand, lower hatchability values were reported from various parts of the country (Melkamu and Andarge, 2013; Getachew et al., 2015). The average survival rate of chickens in the present study (49.2 %) was lower than those reported by Aberra et al. (2013), Nebiyu et al. (2013), Deneke et al. (2014) and Getachew et al. (2015) with the respective values of 58.3, 52.3, 62.7 and 66.5 percent. These variations in the hatchability and survivability of chicks might be due to storage condition of the egg, incubation materials, quality of eggs, to some extent the hen factors, seasonal outbreak of disease, predator attacks, poor nutrition and management, availability of scavenging feed resources and feed supplements.

Husbandry Practices of Chickens in the Study Area

In the present study, all the studied districts manage their chickens in scavenging system. This findings is in close agreement with the observations of different scholars in various parts of the country, where scavenging was the dominant type of chicken rearing (Melkamu and Andarge, 2013; Nebiyu et al., 2013; Solomon et al., 2013). This management system might be due to the fact that indigenous chickens can best fits as they receive few inputs such as feed supplementation and health care for their survival, production and productivity.

The majority of chickens in the study area are kept in the kitchen (60.7%) and main houses (30.7%) during night time which is in agreement with the reports of Halima et al. (2007), Addisu et al. (2013), Moreda et al. (2013) and Mulgeta et al. (2013). A study conducted in western Kenya indicated, similar scenario where majority of the households (73%) in the rural areas kept their chickens in the kitchen or in main houses (Justus et al., 2013).

In the study districts chickens were provided with supplemental feeds (98.7%), which is in line with those
reported by Addisu et al. (2013), Melkamu and Tebikew (2013), Mulgeta et al. (2013) and Solomon et al. (2013).

Water is provided for chicken from different sources such as river (69.3%), Borehole (22.3%) and well (7.33%) which is also common scenario in various areas (Addisu et al., 2013; Nebiyu et al., 2013; Solomon et al., 2013; Wondu et al., 2013). The present study agrees with the findings of Nebiyu et al. (2013) and Solomon et al. (2013) who noted river water as the major source for chickens. However, the current study disagrees with the reports of Wondu et al. (2013) who found that, tap water as the major source (92%) for chickens reared in Northern Gonder Zone of Amhara region. Thus, the current study suggests most of the rural society in the studied districts depends mainly on river, borehole or well water due to lack of tap water.

Production Constraints of Chickens in the Study Area
The major constrains of chickens in the study districts were predators (72.7%) and diseases (27.3%). This result is in agreement with the reports of Melkamu and Wube (2013), Alem (2014), Matiwos and Selamawit (2014) where predators were reported to be the major problems in indigenous chickens reared in various parts of the country. In the current study the types of diseases affecting chicken production were not included as farmers could not identify clearly the types of diseases affecting their chickens. However, the various types of predators which are reported in their scientific names and local languages such as *Milvus migrans* locally known as “Gace”, *Helogale hirtula* locally known as “Shiifoo” or “Wociwoco”, *Leptailurus serval* locally known as “Hallaroo” and *Felis silvestris* locally known as “Kubbi Kullaaro” accounting 54.6, 24.4, 15.5, and 4.58 %, respectively, which are also reported in various parts of the country. As reported by Alem (2014), Hawk, Genet, Wild cat, Fox and snake were found to be the most important predators occurred in the low and mid land agro ecological zones of central Tigray. Similarly, as reported by Matiwos and Selamawit (2014), Wild cats, Wild Egyptian vulture, Honey bagger and Snakes were being the most challenging predators in Amaro districts. Hence, the various types of predators observed in the current study and elsewhere might be due to the agro ecological suitability of the country for predators.

Effective population size (Ne) and rate of inbreeding (ΔF)
To obtain some idea on the Ne and rate of inbreeding over generations, Ne was calculated based on the total chicken flocks of farmers who possessed their own breeding male and female chickens. The Ne in the current study ranged from 375 to 685 with the average Ne of 486 implying number of breeding individuals were comparatively low. According to Maiwashe et al. (2006) Ne is a measure of genetic variability within a population where large values of Ne indicate more variability and small values of Ne indicate less genetic variability. The low Ne estimated in the current study suggests that the breeding population might be too small. Even if neighboring flocks were scavenging together, which gives an opportunity for breeding cocks to mate with hens, the number of cocks per flock is still considered lower than required.

Effective breeding population size and the corresponding ΔF reported by Nigussie et al. (2010) by considering the average mean flock size of chickens for Mandura, Horro and Konso, village chickens, Eskindir et al. (2013) from Jarso districts and Hailemichael (2013) for Endamehari, Ofa and Raya- Azebo districts’ chicken population were in agreement with the present study. However, the report of Eskindir et al. (2013) from Horro districts (3.73) was lower than the current study due to the fact that they considered the average flock size rather than taking the total number of chickens in computing both parameters, *i.e.*, Ne and ΔF. However, the result reported by Hagan et al. (2013) from Ghana for Coastal, Forest and Guinea Ecological Zones which were 13.3, 11.3 and 12.9 respectively had three fold higher than those reported in Ethiopia. The current study was also in similar scenario with the result reported by Rusfidra et al. (2014).

The average rate of inbreeding (0.111%) in the current study was in good agreement with the reports of various scholars in the country. Hailemichael (2013) reported 0.16, 0.15 and 0.14 rate of inbreeding for Endamehari, Ofa and Raya-Azebo districts of chicken population, respectively. The rate of inbreeding reported by Eskindir et al. (2013) falls in the range of 0.13 to 0.12 which is in line with the current study. The rate of inbreeding values reported by Hagan et al. (2013) was comparable with the observed values in Decha chicken populations. According to Henson (1992), the acceptable level of inbreeding rate per generation is between 1% and 2%. Therefore, the rate of inbreeding obtained from the current study was low which suggests that chicken populations in study area are not exposed to inbreeding.

Conclusion and Recommendations
The current study indicated scavenging as the major chicken production systems practiced across all the study districts. Majority of the respondents in the study area provide supplementary feed and water to their chickens. The results on productive performances of chickens obtained in the present study were comparable with the reports of many scholars and also in line with the national reports of CSA (2015) under scavenging system. The major production constraints were predators and diseases across the studied districts. The result relating to effective population size and rate of inbreeding obtained in the present study indicates the chicken populations are not exposed for inbreeding. Therefore, appropriate intervention strategy should be carried out to effectively utilize...
the existing potentials of indigenous chicken populations in combination with conservation of chickens before they have been diluted with exotic chicken breeds.

Acknowledgements
The authors would like to acknowledge the Ministry of Agriculture and Natural resource, Mizan Agricultural, Technical, Vocational and Educational Training College, for their financial support during the research work. We further express our deepest gratitude for Kaffa Zone, Decha, Gimbo and Chena district Livestock and Fishery development offices for their kind support. Finally we are also indebted to thank those farmers and development agents who participated in this study.

REFERENCES
Aberra Melesse, 2000. Comparative studies on performance and physiological responses of Ethiopian indigenous ("Angete-melata") chicken and their F1 crosses to long term heat stress. Ph.D Thesis. Martin-Luther University, Halle-Wittenberg, Berlin. pp. 4-5.
Aberra Melesse, 2014. Significance of scavenging chicken production in the rural community of Africa for enhanced food security. World’s Poultry Science Journal, 70: 593-606.
Aberra Melesse, S. Maak, R. Schmidt & G. von Lengerken, 2011. Effect of long-term heat stress on some performance traits and plasma enzyme activities in Naked-neck chickens and their F1 crosses with commercial layer breeds. Livestock Science, 141: 227-231.
Aberra Melesse, Zemene Worku & Yosef Teklegiorgis, 2013. Assessment of the prevailing handling and quality of eggs from scavenging indigenous chickens reared in different agro-ecological Zones of Ethiopia. Journal of Environmental and Occupational Science, 2(1):1-8.
Addisu Hailu, Hailu Mazengia & ZewduWuletaw, 2013. Indigenous chicken production system and breeding practice in North Wollo, Amhara region, Ethiopia. Scholarly Journal of Agricultural Science, 3(10): 433-444.
Alem Tadesse, 2014. Production and Reproduction Performance of Rural Poultry in Lowland and Midland Agro-Ecological Zones of Central Tigray, Northern Ethiopia. British Journal of Poultry Sciences, 3 (1): 06-14.
Azage Tegene, Berhanu Gebremedhin & D. Hoekstra, 2010. Livestock input supply and service provision in Ethiopia. Challenges and opportunities for market oriented development. IPMS (Improving productivity and Market success) of Ethiopian farmer project working paper 20. ILRI (International Research Institute). Nairobi, Kenya. pp48.
Central Statistical Agency (CSA), 2017. Agricultural Sample Survey Statistical Bulletin Addis Ababa, Ethiopia. pp188.
Falconer, D.S. & MacKay T.F.C., 1996. Introduction to Quantitative Genetic. Longman, London, New York.
Fisseha Moges, Aberra Melesse & Tadelle Dessie 2010. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. African Journal of Agricultural Research, 5 (13):1739-1748.
Hagan, J. K. M. Bosompem & I. A. Adjei, 2013. The productive performance of local chickens in three Ecological Zones of Ghana. ARPN Journal of Agricultural and Biological Science, 8(1): 51-56.
Halima H., Nesper, F.W.C. & van Marle-Koster, E., 2007. Village based indigenous chicken production system in north-west Ethiopia. Trop. Anim. Health Product. 39: 189–197.
Maiwashe, A., K.A. Nephawe, R.R. van der Westhuizen, B.E. Mostert & H.E. Theron, 2006. Rate of inbreeding and effective population size in four major South African dairy cattle breeds. South African Journal of Animal Science, 36: 50-57.
Matiwos Habte & Selamawit Debele, 2014. Village chicken production performances assess-ment under scavenging management system in Amaro district, SNNPRS of Ethiopia. International journal of innovative research in technology and science, 2(8): 172-188.
Melkamu Bezabih Yitbarek & Andargie Zewdu, 2013. Performance evaluation of local chicken at Enebesie Sar Midir Woreda, Eastern Gojjam, Ethiopia. Unique Research Journal of Agricultural Sciences, 1(2): 006-010.
Moreda E., S. Hareppal, A.Johansson, T. Sisaye & Z. Sahile, 2013. Characteristics of Indigenous Chicken Production System in South West and South Part of Ethiopia. British Journal of Poultry Sciences, 2 (3): 25-32.
Moreki J. C., Dikeme R & Poroga B 2010. The role of village poultry in food security and HIV/AIDS mitigation in Chobe District of Botswana. Livestock Research for Rural Development, 22(55). http://www.lrrd.org/lrrd22/3/more22055.htm.
Nebiyu Yemane, Berhan Tamir & Kelay Belihu, 2013. Characterization of village chicken production performance under scavenging system in Halaba district of southern Ethiopia. Ethiopia Veterinary Journal, 17(1): 69-80.
Nigussie Dana, Tadelle Dessie, Liesbeth H. van der Waaq & Johan A.M. van Arendonk, 2010. Morphological features of indigenous chicken populations of Ethiopia. Animal Genetic Resources, 46: 11–23.
Rusfidra Mendro Gusrizal, Yuda Gusrin, Muhammad H. Abbas, Husmaini, Firda Arlina, Kusnadidi Subekti & Tertia D. Nova, 2015. Flock Composition, Effective Population Size and Inbreeding Rate of Kokok balengek Chicken Breed under In-Situ Conservation. *International Journal of Poultry Science*, 14 (2): 117-119.

Solomon Zewdu, Binyam Kassa, Bilatu Agza & Ferede Alemu, 2013. Village chicken production systems in Metekel zone, Northwest Ethiopia. *Wudpecker Journal of Agricultural Research*, 2(9): 256 – 262.

Tadele A., Melesse A. and Taye M., 2018. Phenotypic and morphological characterizations of Indigenous chicken populations in Kaffa Zone, South Western Ethiopia. *Animal Husbandry, Dairy and Veterinary Science*, 2(1): 1-9.

Wondu Mamo , Mehret Melaku & Berhan Tamir, 2013. Characterization of Urban Poultry Production System in Northern Gondar, Amhara Regional State, Ethiopia. *Agriculture and biology journal of North America*. 4(3): 192-198.

Worku Z., Melesse A. & T/Giorgis Y, 2012. Assessment of Village Chicken Production System and the Performance of Local Chicken Populations in West Amhara Region of Ethiopia. *Journal of Animal Production*, 2(4):199-207.