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# Farmers' preferences towards breeding objective for indigenous chickens in different agro-ecologies of Ethiopia

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**A study was conducted in different agro-ecologies of Ethiopia with the objective of understanding the farmers' preferences towards breeding objectives in indigenous chickens. For the interview, 245 households (60 from lowland, 100 from midland and 85 from highland) were randomly selected. Farmers in lowland had significantly (p<0.05) lower chicken populations while comparing with the remaining agro-ecologies. The average age of village pullets at first egg was 6.54±0.063 months. There was significantly (p<0.05) higher egg production in midland. There was significant difference (p<0.05) in clutch number among the three agro-ecologies. Among the three agro-ecologies; midland showed significantly (p<0.05) higher number of eggs set/hen. Effective population size of village chickens per household was calculated as 4.43, 7.8 and 7.18 in lowland, midland and highland respectively. Most of the farmers (91%) were practicing culling their chickens for getting old, sickness, brooding frequency and low production for hens and getting old, sickness and fighting each other for cocks. Comparing the preferences of traits, female farmers preferred egg production, unlike the male farmers who gave equal emphasis both for egg and meat. Egg production for sale was prioritized by the farmers, especially for women, followed by live chicken sale. Body weight is the most considered trait to select male chickens for breeding, followed by plumage color, across thee agro-ecologies. For female chickens, brooding frequency is most considered in lowland (48.3%) and midland (37%) unlike in highland where age at first egg (47.1%) is prioritized. This study can be the base to design the breeding strategy of the chicken population in the study sites and beyond.**

**Key words:** Agro-ecology, breeding objectives, effective population, farmer preference, inbreeding coefficient, local chickens.

## INTRODUCTION

Local chickens have played a pivotal role in capital build up, poverty, malnutrition and hunger reduction among the resource poor rural households in developing countries because of their low input requirements for production,

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**Table 1.** Description of agro-ecological zones.

| Agro-ecology | Features |
|---|---|
| Lowland | Hot semi-arid, 800-1100 m.a.s.l, low vegetation, rain fall (400-500 mm), agro-pastoral, poor infrastructure |
| Midland | Hot sub humid, 1501-2500 m.a.s.l, high vegetable, rain fall (1001-1200 mm/year), temperature (16-20°C), mixed farming system, moderate infrastructure |
| Highland | Humid and sub humid, 1600-3348 m.a.s.l, high vegetable, rainfall (>1300 mm/year), temperature (7-12°C), mixed crop farming, poor to moderate infrastructure |

m.a.s.l = meter above sea level, °C = degree Celsius.
Source: Solomon et al., 2007; Sefa et al 2016.

short generation intervals, scavenging ability and adaptability to harsh environment conditions (Aberra and Tegene, 2011; Aberra, 2014). Village poultry are readily available assets to local populations throughout Africa and they contribute to food security, poverty alleviation and promote gender equality, especially in the disadvantaged groups, (HIV and AIDS infected and affected people, women and poor farmers) and less favored areas of rural Africa where the majority of the poor people reside. On top of these merits, village poultry can provide the start of the owner climbing the "livestock ladders'' leading to other livestock species such as goats and cattle or serve as "transport (transitional) bridge" from small livestock to large livestock species production (Dolberg, 2003).

Small number of breeding cocks per household for different reasons like marketing breeding males might contribute in surging further inbreeding. The extremely small flock size of the breeding local chickens confirms the extreme drop in the total population of chicken in Ethiopia since the past decade (Nigussie *et al*., 2010).

According to the study conducted by Aboe *et al*., (2006), although indigenous village chicken is the most prominent class of livestock in the country and constitutes about 60-80% of the total poultry population, their productivity is low because of poor nutrition and low genetic potential. The local chicken production systems in Africa are mainly based on scavenging indigenous chickens found in almost all households in the rural areas. They are an integral part of the farming systems requiring low inputs with outputs accessible at both inter-household and intra-household levels. Village chickens also fulfill a number of other functions for which it is difficult to assign any monetary value. Ethiopia has an estimated 60 million chickens of which 96.83% are non-descriptive local ecotypes, 2.37% are hybrid chickens, and 0.8% are exotic breeds (CSA, 2015).

## Objectives

i) To identify the preferences of village poultry keepers at different agro-ecologies.
ii) To identify breeding objectives of the local chickens at different agro-ecologies.
iii) To measure inbreeding coefficient of local breeding chickens.

## MATERIALS AND METHODS

### Basis of the study

The basis of this study was comparing the issues related with chicken production and breeding across three agro-ecologies of the country.

### Agro-ecological zones

### Identification of households

Three agro-ecologies were selected using a stepwise purposive sampling technique that was based on the local chicken populations, information on dissemination of exotic/crossbred chickens in the past, and the topographical accessibility.

Within the agro-ecologies, 245 households (60 from lowland, 100 from midland and 85 from highland) were randomly selected for filling the questionnaire on the productive and reproductive performance of village chickens, breeding objectives, culling practices, keeping purpose, selection criteria, and preferences of farmers, and management of indigenous chicken populations. Preferences were disaggregated by gender (Table 1). For identification of the locations and the respondents, assistance was sought from the local authorities of the selected study sites. Focus group discussions were conducted at each selected site with the selected members. Members of the focus groups included farmers experienced with rearing chickens and those have knowledge about past and present social and economic status of the area, including community elders, women, veterinarians, and extension agents. Furthermore, at the beginning of the study, informal discussions were conducted with village elders and those who have experience in poultry rearing to know about the types of local chickens that might be available in the area and also their physical descriptions and local names.

### Data collection

A semi-structured questionnaire was developed, pretested and interviewed. Interviews were conducted with farmers who were associated with village chicken rearing. The survey included information on livestock demography.

Household members responsible for a part of the husbandry practices were identified and the enumerator tried to capture their

**Table 2.** Characteristic of the farmers in different agro-ecologies.

| Descriptor | Agro-ecology | | | | | | Average | |
|---|---|---|---|---|---|---|---|---|
| | Low (N=60) | | Mid (N=100) | | High (N=85) | | | |
| | N | % | N | % | N | % | N | % |
| **Sex** | | | | | | | | |
| Female | 44 | 73.3 | 81 | 81 | 77 | 90.6 | 202 | 82.4 |
| Male | 16 | 26.7 | 19 | 19 | 8 | 9.4 | 43 | 17.6 |
| **Education level** | | | | | | | | |
| Cannot read and write | 26 | 43.3 | 28 | 28 | 13 | 15.3 | 67 | 27.3 |
| Read and write | 18 | 30 | 43 | 43 | 36 | 42.4 | 97 | 39.6 |
| Primary | 10 | 16.7 | 14 | 14 | 17 | 20 | 41 | 16.7 |
| Above primary | 6 | 10 | 15 | 15 | 19 | 22.3 | 40 | 16.4 |

experiences in that regard. Recall method was used to collect information on current flock demography and recent changes in flock structure after five years. The study also documented any special attributes of a genotype of chickens which have socio-cultural significance but may not relate to productivity or reproduction.

#### Data analysis

The data were analyzed using the SPSS and Microsoft Excel. The (Ne) and ΔF were calculated for male and female breeding chickens as follows

$$Ne = 4 \times Nm \times Nf/Nm + Nf$$

$$\Delta F = 1/Ne \times 2$$

Where; Ne = effective population size
ΔF = inbreeding coefficient
Nm = number of male chickens
Nf = number of female chickens.

## RESULTS AND DISCUSSION

Details of general household characteristics are presented in Table 2. In this study, respondents from three ago-ecologies keeping local chickens participated. Of the total interviewed farmers, majority of them were females (82.4%). During the interview, there was communication with farmers to decide who would be the participant (male or female). After convincing, more women were interviewed, and for those did not have interest, male farmers were interviewed. The number of females was high in this survey because female farmers are better with the poultry production and breeding.

The large proportions (43.3%) of farmers in lowland area could not read and write; whereas, 43% in midland and 42.4% in highland responded as they can read and write. This survey result showed that more than half (51%) of the respondents were able to read and write, which indicates that farmers are in good condition to accept trainings on poultry production and local chickens conservation affairs, and also to easily implement opportunities in a relevant way.

### Livestock under each agro-ecology

The livestock possession of the sampled households is summarized in Table 3. The reported mean chicken per household in this study was 4.82±0.28 in the lowland, 8.10±0.34 in the midland, and 7.67±0.348 in the highland. From this result, it is obvious that local chickens in lowland agro-ecology were enormously lower than the two remaining agro-ecologies (midland and highland). Farmers in lowland had owned significantly lower number of chickens but higher numbers of goats and mules in lowland agro-ecology. This result is higher than the report of Meseret (2010) in which the average flock size per household in Gomma district is 6.23. Whereas it is lower than the report of Fisseha *et al.,* (2010) who reported that the mean flock size of chicken was 9.2 chickens per household in Dale district. This difference might be due to the study sites coverage. Both studies were conducted in a single district for each unlike the current study which covered wider areas of different agro-ecologies.

### Productive performance of indigenous chickens

There were no differences in age at first egg of local pullets in the lowland and highland agro-ecologies (Table 4). The average age pullet at first egg is 6.54±0.063 months. Age at first egg of pullets is significantly ($p<0.05$) shorter at midland agro-ecology. This is a longer while comparing to the study conducted by Melaku (2016) who reported that 5.68 months in Southern Wollo for pullets to lay the first egg. Also congruent with the report of Gebreegziabher and Tsegaye, (2016) who stated that the age at first egg was 6.3, 6.2 and 7 months in lowland,

**Table 3.** Livestock possession of farmers across different agro-ecologies of Ethiopia.

| Descriptor | Agro-ecology (Mean ± SE) | | | Average (Mean ± SE) | Significance |
|---|---|---|---|---|---|
| | Lowland | Midland | Highland | | |
| Chickens | 4.82±0.28[a] | 8.10±0.34[b] | 7.67±0.348[b] | 7.15±0.214 | 0.000 |
| Cattle | 8.85±0.376[a] | 7.93±0.349[a] | 7.74±0.454[a] | 8.1±0.232 | 0.166 |
| Sheep | 1.28±0.16[a] | 1.95±1.57[b] | 3.35±0.2[c] | 2.27±0.115 | 0.000 |
| Goats | 3.67±0.356[b] | 1.49±0.118[a] | 1.15±0.133[a] | 1.91±0.127 | 0.000 |
| Donkeys | 0.98±0.056[a] | 0.97±0.39[a] | 0.96±0.035[a] | 0.07±0.024 | 0.957 |
| Horses | 0.57±0.065[a] | 0.43±0.05[a] | 0.45±0.054[a] | 0.47±0.032 | 0.217 |
| Mules | 0.43±0.069[b] | 0.20±0.04[a] | 0.31±0.05[ab] | 0.29±0.03 | 0.008 |

[a,b] Different superscripts with in row indicate the presence of significant difference (p<0.05); [a,a or b,b] same superscripts with in row indicate the absence of significant difference (p>0.05) and [a, b, ab] indicate that absence of significant defiance (p>0.05) of [ab] with [a] and [b].

**Table 4.** Productive performance of the local chickens across three agro-ecologies of Ethiopia.

| Variable | Agro-ecologies (Mean ± SE) | | | Average |
|---|---|---|---|---|
| | Lowland | Midland | Highland | |
| Average age of pullet at first egg (months) | 6.67±0.123[b] | 6.21±0.095[a] | 6.85±0.1[b] | 6.54±0.063 |
| Average number of eggs per hen per clutch | 13.75±0.19[b] | 14.94±0.18[c] | 13.02±0.177[a] | 13.98±0.119 |
| Average number of clutches per year | 3.52±0.077[a] | 3.94±0.076[b] | 4.59±0.119[c] | 4.06±0.061 |
| Total number of eggs per hen per year | 57.32±0.68[a] | 65.36±0.71[c] | 61.05±0.81[b] | 61.89±0.48 |
| Clutch length (days) | 32.6±0.53[b] | 30.14±0.26[a] | 31.98±0.29[b] | 31.38±0.21 |

[a,b] Different superscripts within row indicate the presence of significant difference (p<0.05); but [a,a or b,b] same superscripts with in row indicate the absence of significant difference (p>0.05).

midland and highland, respectively in Wolaita Zone; whereas, Addisu *et al,* (2013) in North Wollo reported that the shorter age at laying 5.43 for pullets.

Average egg production per hen per clutch was 13.75, 14.94 and 13.02 eggs in lowland, midland and highland, respectively. This was higher than the report of (Berhanu and Temesgen, 2019) who stated that mean egg production/clutch is 10.73eggs/hen in Hadiya Zone. This might be due to the scope of the study; the current study covered all types of agro-ecologies and the wider sites to gather information while comparing with the mentioned report.

The number of eggs across the three agro-ecologies was different. Number of eggs in the midland was significantly (p<0.05) higher than the remaining two agro-ecologies. The total annual egg production/hen of local hens, under existing farmer management condition, is estimated to be 61.89±0.48. This was higher than the report of Addis et al, (2013) and Mekonen, (2007) in North Gonder and in Southern Ethiopia, reported that the annual egg production per hen is 51.08 and 55.2, respectively. This might be due to the site difference and also due to better clutch numbers.

The average numbers of clutches per hen in this study were 3.52±0.077, 3.94±0.076 and 4.59±0.119 per year in lowland, midland and highland, respectively. There was significant difference (p<0.05) in clutch number among the three agro-ecologies. Chicken in highland agro-ecology showed significantly higher clutch number than the remaining agro-ecologies. The current study agreed the report of Gebreegziabher and Tsegaye, (2016) in which the mean clutch number of local chickens in Wolaita zone, of SNNPRs was 3.6, 4.1 and 4.59 per year in lowland, midland and highland, respectively.

## Reproductive performance of local chickens

The average number of eggs set/hen was 11.67 ± 0.162, 12.68 ± 0.138 and 11.88 ±0.137 in lowland, midland and highland areas, respectively. Among the three agro-ecologies; midland showed significantly (p<0.05) higher number of eggs set per hen.

On average 8.17±0.177, 10.2±0.187 and 8.64±0.197 eggs were hatched in lowland, midland and highland, respectively. The current study is lower for the eggs set per hen per clutch than the report which was conducted by Fisseha et al. (2010) who stated that, 13 eggs set per hen per clutch in lowland, 13 eggs set per hen per clutch in midland and 14 eggs set per hen per clutch in highland, in Bure district of North West Ethiopia. Overall mean of hatched chicks in this study was 9.16. This

**Table 5.** Reproductive performance of the local chickens across three agro-ecologies of Ethiopia.

| Variable | Agro-ecologies (Mean ± SE) | | | Overall |
|---|---|---|---|---|
| | Lowland | Midland | Highland | |
| Number of eggs laid per hen | 11.67±0.162[a] | 12.68±0.138[b] | 11.88±0.137[a] | 12.16±0.088 |
| Number of eggs hatched per hen | 8.17±0.177[a] | 10.2±0.187[b] | 8.64±0.197[a] | 9.16±0.124 |
| Number of chicks raised per hen | 5.15±0.178[a] | 6.68±0.187[b] | 4.87±0.159[a] | 5.68±0.117 |
| Hatchability (%) | 70.1±1.2[a] | 80.2±0.98[b] | 72.5±1.27[a] | 75±0.72 |
| Survivality (%) | 62.97±1.7[b] | 65.3±1.3[b] | 56.6±1.4[a] | 61.7±0.87 |

[a,b] Different superscripts within row indicate the presence of significant difference ($p<0.05$); but [a,a or b,b] same superscripts with in row indicate the absence of significant difference ($p>0.05$).

**Table 6.** Effective population size and inbreeding coefficient of local chickens in different agro-ecologies.

| Agro-ecology | Flocks | Total chickens | $N_m$ | $N_f$ | $N_e$ | ΔF |
|---|---|---|---|---|---|---|
| Lowland (N=60) | Combined total | 289 | 104 | 185 | 266.3 | **0.002** |
| | Mean per HH | 4.82 | 1.73 | 3.08 | 4.43 | **0.113** |
| Midland (N=100) | Combined total | 810 | 327 | 483 | 780 | **0.0006** |
| | Mean per HH | 8.1 | 3.27 | 4.83 | 7.8 | **0.128** |
| Highland (N=85) | Combined total | 652 | 244 | 408 | 610.75 | **0.00082** |
| | Mean per HH | 7.67 | 2.87 | 4.79 | 7.18 | **0.07** |

$N_e$ = effective population size, $N_m$ = number of breeding male, $N_f$ = number of breeding female and ΔF = change in inbreeding coefficient.

report is congruent with the study conducted by Sefa et al., (2016) who stated that 9.33 chicks hatched per set in Lemo district, Hadiya Zone of Southern region, Ethiopia.

Among the hatched chicks, 5.15±0.178, 6.68±0.187 and 4.87±0.159 were raised in lowland, midland and highland areas, respectively. This result showed that, 70.1±1.2, 80.2±0.98 and 72.5±1.27 were hatched and from these, 62.97±1.7, 65.3±1.3 and 56.6±1.4 were raised in lowland, midland and highland, respectively. This result is higher than Aberra et al., (2013) who reported that the survivable rate of chickens in highland and lowland agro-ecological zones of Ethiopia were 55.0% and 55.1%, respectively.

There was significant ($p<0.05$) difference in hatchability of chicks in lowland area in this study, this was better than the remaining two agro-ecologies. High hatchability can improve poultry production when there is good chick survival (Table 5).

Generally, the survival rate of chicks in this study was high unlike to the report of Wondmeneh et al. (2014) who reported that the survival rates of chicks kept under natural brooding conditions is very low in Ethiopia.

Based on the information reported in Tables 3 to 5, midland agro-ecology is more favorable for chicken production considering most of the parameters. This is for relative betterment of feed resources, disease outbreaks, and awareness of farmers towards improving management, market access and environment than the remaining agro-ecologies.

## Effective population size and inbreeding coefficient

Effective population size and inbreeding rates of local chickens in this study are presented in Table 6.

While comparing inbreeding rate of household mean chickens and the whole chicken in the study, there was higher for mean per HH which leads to more genetic drift on household flock mean across the three agro-ecologies.

Effective population size and increase in inbreeding over next generation were calculated based on chicken flocks of the farmers. Effective population size of the indigenous chicken flocks per household ranged from 4.43, 7.8 and 7.18 in lowland, midland and highland agro-ecological zones respectively.

Inbreeding coefficients of the chickens were recorded as 11.3, 12.8 and 7% for lowland, midland ad highland areas respectively. This is comparable with the study conducted by Nigussie, 2011 for lowland and midland who reported 12% of inbreeding coefficient; however, there was lower inbreeding coefficient in low altitude. In order to modify inbreeding coefficient of the chickens,

**Table 7.** Breeding objective and culling experiences of farmers in different agro-ecologies.

| Variable | Study site | | | Average [N (%)] |
|---|---|---|---|---|
| | Lowland (N=60) | Midland (N= 100) | Highland (N= 85) | |
| | N (%) | N (%) | N (%) | |
| **Breeding objectives** | | | | |
| Egg | 37 (61.7) | 47 (47) | 47 (55.3) | 131 (53.5) |
| Meat | 8 (13.3) | 13 (13) | 19 (22.4) | 40 (16.3) |
| Both egg and meat | 15 (25) | 40 (40) | 19 (22.4) | 74 (30.2) |
| **Culling practices** | | | | |
| Yes | 52 (86.7) | 94 (94) | 77 (90.6) | 223 (91) |
| No | 8 (13.3) | 6 (6) | 8 (9.4) | 22 (9) |
| **Culling reason for females** | | | | |
| Age | 15 (25) | 13 (13) | 12 (14.1) | 40 (16.3) |
| Sickness | 10 (16.7) | 23 (23) | 23 (27.1) | 56 (22.9) |
| Frequent broodiness | 23 (38.3) | 42 (42) | 26 (30.6) | 91 (37.1) |
| Low production | 12 (20) | 22 (22) | 24 (28.2) | 58 (23.7) |
| **Culling reason for males** | | | | |
| Age | 36 (60) | 66 (66) | 42 (49.4) | 144 (58.8) |
| Sickness | 16 (26.7) | 22 (22) | 36 (42.4) | 74 (30.2) |
| Fighting | 8 (13.3) | 12 (12) | 7 (8.2) | 27 (11) |

increasing chickens number is needed. However, increasing the local chickens may not be profitable strategy for local chickens are of poor genetic makeup. Therefore, it is better to develop breed improvement program so far.

## Breeding objectives and culling practices

Breeding objective refers to the final goal of farmers to produce the chickens. As shown in Table 7, the main objective of the farmers to rear the indigenous chickens was egg production (53.5%) followed by rearing indigenous chickens for both egg and meat (for 30.2% of farmers).

About 91% of the farmers were practicing culling their chickens for getting old, sickness, brooding frequency and low production for female and getting old, sickness and fighting to each other for male indigenous chickens.

## Preferences by sex of the farmers

As shown in Table 8 below, across all agro-ecologies, majority of the female farmers prefer egg production (79.6%, 74.1% and 48.1% in lowland, midland and highland) respectively. However, male farmers prefer both egg production and adaptation traits from local chickens strongly across three agro-ecologies.

While looking for the preferences up on the purposes of the chicken production, egg production for sale was prioritized by the farmers, especially for women farmers, across three agro-ecologies followed by live chicken sale. The traits egg for home consumption and meat were not preferred by most female farmers.

Farmers prefer multiple traits among the mentioned in Table 8, however, the rank of prioritization is different for most of the farmers.

## Purpose of keeping chickens

The rank for purpose of chicken keeping is presented in Table 9. Chickens might be kept either for home consumption or income generation through different means, like eggs for home consumption, eggs for sale, eggs to be hatched, meat for home consumption, chickens for selling, and cultural issues. Among the mentioned ones, egg sale was the main purpose of chicken rearing across all agro-ecologies to generate income which accounted for 42%, 37%, and 40% farmers for lowland, midland and highland respectively. Unlike to lowland and highland, in the midland the farmers allow their chickens to incubate eggs (17%).

Next to egg sale, live chicken sale was the most common purpose given by farmers across the three agro-ecologies towards keeping indigenous chickens. This indicates that most of the farmers those engaged in

**Table 8.** Preferences of male and female farmers towards different traits of local chickens.

| Parameter | Agro-ecology | | | | | |
|---|---|---|---|---|---|---|
| | Lowland | | Midland | | Highland | |
| | Male (n=16) | Female (n=44) | Male (n=19) | Female (n=81) | Male (n=8) | Female (n=77) |
| | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
| **Trait preference** | | | | | | |
| Egg | 8 (50) | 35 (79.6) | 8 (42.1) | 60 (74.1) | 3 (37.5) | 37 (48.1) |
| Meat | 3 (18.75) | 6 (13.6) | 3 (15.8) | 3 (3.7) | 1 (12.5) | 7 (9.1) |
| Adaptation | 5 (31.25) | 3 (6.8) | 8 (42.1) | 18 (22.2) | 4 (50) | 34 (44.2) |
| **Purpose of traits** | | | | | | |
| Egg for home consumption | 4 (25) | 5 (11.4) | 3 (15.8) | 8 (9.9) | 1(12.5) | 5 (6.5) |
| Egg for sale | 5 (31.25) | 27 (61.4) | 4 (21.1) | 39 (48.1) | 3 (37.5) | 40 (51.9) |
| Egg for incubating | 2 (12.5) | 5 (11.4) | 3 (15.8) | 3 (3.7) | 1 (12.5) | 1 (1.3) |
| Meat | 3 (18.75) | 1(2.3) | 3 (15.8) | 6 (7.4) | 0 (0.00) | 1 (1.3) |
| Chicken sell | 2 (12.5) | 6 (13.6) | 6 (31.6) | 25 (30.9) | 3 (37.5) | 30 (39) |
| **Genotype preference** | | | | | | |
| Local | 4 (25) | 9 (20.5) | 7 (36.8) | 22 (27.2) | 2 (25) | 27(35.1) |
| Exotic | 4 (25) | 23 (52.3) | 6 (31.6) | 38 (46.9) | 4 (50) | 35 (45.5) |
| Crossbred | 8 (50) | 12 (27.3) | 6 (31.6) | 21 (25.9) | 2 (25) | 15 (19.5) |

N **=** number of the respondents.

**Table 9.** Purposes of rearing local chicken across different agro-ecologies of Ethiopia.

| Variable | Agro-ecology | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lowland (N=60) | | | | Midland (N=100) | | | | Highland (N=85) | | | |
| | 1st | 2nd | 3rd | Index | 1st | 2nd | 3rd | Index | 1st | 2nd | 3rd | Index |
| Egg (home consumption) | 0 | 0 | 1 | **0.02** | 7 | 3 | 1 | **0.11** | 3 | 3 | 7 | **0.15** |
| Egg (sell) | 10 | 9 | 6 | **0.42** | 10 | 17 | 10 | **0.37** | 12 | 12 | 10 | **0.4** |
| Egg (incubating) | 2 | 3 | 2 | **0.12** | 7 | 2 | 8 | **0.17** | 5 | 6 | 0 | **0.13** |
| Meat | 1 | 2 | 0 | **0.05** | 2 | 6 | 2 | **0.1** | 4 | 3 | 2 | **0.11** |
| Sell chickens | 6 | 5 | 11 | **0.37** | 9 | 7 | 8 | **0.24** | 6 | 6 | 6 | **0.21** |
| Cultural issues | 1 | 1 | 0 | **0.03** | 0 | 0 | 1 | **0.01** | 0 | 0 | 0 | **0.00** |

Index **=** Sum of samples under 1st, 2nd and 3rd rank for each parameter divided by the sum of interviewed households under 1st, 2nd and 3rd per strata.

chicken rearing prioritized income generating through poultry production. The least common purpose of the farmers to rear the chickens was cultural issues across all agro-ecologies. Unlike to mid and highland areas, only 2% of the farmers in lowland preferred egg for home consumption. Generally, the most preferred trait across all agro-ecologies was assessed as eggs for sale.

Rural farmers keep indigenous chickens to fill the requirement of food and income either directly or indirectly like protein. This is in line with the study conducted by Tadelle et al. (2003 and Halima, 2007) who reported that chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income in Ethiopia.

## Selection criteria

All the interviewed farmers across the three agro-ecologies had a trend of selecting the breeding male and female chickens based on the traits body weight, color, brooding frequency and comb type accordingly. According to this study the traits used to select breeding chickens of both sexes are shown in Table 10. Body weight, plumage color, comb type and parental history were the most important traits to select breeding male chickens.

Male chickens that have convincing body weight and color for chicken rearing farmers are the most preferred by most of them across the three agro-ecologies. Of

**Table 10.** Criteria for selecting village chickens at different agro-ecologies of Ethiopia.

| Criteria | Agro-ecology | | | |
|---|---|---|---|---|
| | Lowland (N=60) | Midland (N=100) | Highland (N=85) | Overall (N=245) |
| | N (%) | N (%) | N (%) | N (%) |
| **For selecting male** | | | | |
| Body weight | 31 (51.7) | 41 (41) | 30 (35.3) | 102 (41.6) |
| Plumage color | 13 (21.7) | 33 (33) | 27 (31.8) | 73 (29.8) |
| Comb type | 6 (10) | 18 (18) | 14 (16.5) | 38 (15.5) |
| Parental history | 10 (16.7) | 8 (8) | 14 (16.5) | 32 (13.1) |
| **For selecting females** | | | | |
| Age at first egg | 13 (21.7) | 36 (36) | 40 (47.1) | 89 (36.3) |
| Plumage color | 18 (30) | 27 (27) | 18 (21.2) | 63 (25.7) |
| Brooding frequency | 29 (48.3) | 37 (37) | 27 (31.8) | 93 (38) |

course, color preference depends on a wish of the farmers. This indicates that some colors preferred by some farmers might not be preferred by some others and vice-versa. About 41.6% of the farmers based on the body weight to select breeding males.

Unlike for males, brooding frequency and age at first egg were the most highly considered traits in selecting breeding female chickens (38%) for brooding frequency and (36.3%) for age at first egg. The farmers prefer the hens with low brooding frequency in order to increase number of eggs per a year via increasing the number of clutches. They also prefer the chickens that start egg laying at an earlier age. However, using the color as selection criteria for the farmers was not even across the study agro-ecologies.

## Management system of local chickens

As any other livestock production, chicken breeds require better housing, feeding and veterinary services to increase production, prevent chicken from predators, harsh climatic variables and disease.

More than 94% the farmers reporting supplementary feed such as maize, wheat, sorghum, residues of human food, barley and sometimes industrial by products for their indigenous chickens. However, according to most of the respondents, the veterinary service was poor.

Even though, all the farmers accessed the house for their chickens, only 10, 19 and 14.1% of the interviewed farmers had a separate house for their chickens in lowland, midland and highland agro-ecologies, respectively.

Improving management system towards the indigenous chickens is more important than introducing the exotic ones because adopting exotic chickens might be challenging in tropics. This is in line with the report of (Wondmeneh et al., 2014; Sefa et al., 2016; Teklemariam, 2017) who stated that the main constraints that limit the adoption of exotic poultry were susceptibility to diseases, susceptibility to predators, lack of vaccination access, higher feed requirement, needs more care, expensiveness of the breeding stock and market problem in Ethiopia (Table 11).

## Special attributes of indigenous chickens

The special attributes through keeping indigenous chickens were adaptation, resistance to disease, low feed requirement, test of egg and meat test. Most of the participants (81.2%) during group discussion preferred adaptation and disease resistance from keeping the local chickens. This agreed report of (Aberra 2014; Wondmeneh et al., 2014; Wondmeneh, 2015) they stated that the Ethiopian indigenous chicken flocks are said to be disease resistant and adapted to their environment.

## Challenges in managing chicks

Among the interviewed farmers, 91% of them did not practice egg selection for incubating. The chicks from all eggs might not be equal for their size, survival, and growth. Selecting egg is important to have the chicks with such features.

The farmers who were selecting eggs before incubating preferred the medium and large sized eggs to get productive and more surviving chicks to sustain the existing production, and to improve next generation productivity. The current study showed lower proportion of farmers practicing egg selection compared to the study conducted by Melaku (2016) who reported that 72.33% of the respondents had practiced selection of eggs for incubation in Southern Wollo. The farmers, not selecting eggs for incubation have reasons like protecting the eggs from the spoilage due to the contact.

Chick death was another considerable challenge in

**Table 11.** Management of local chickens under different agro-ecologies.

| Parameter | Agro-ecology | | | Overall (N=245) [N (%)] |
|---|---|---|---|---|
| | Lowland (N=60) | Midland (N=100) | Highland (N=85) | |
| | N (%) | N (%) | N (%) | |
| **Provision of supplementary feed** | | | | |
| Yes | 53(88.3) | 93(93) | 81(95.3) | 231(94.3) |
| No | 7(11.7) | 3(3) | 4(4.7) | 14(5.7) |
| **Veterinary service** | | | | |
| Yes | 11 (18.3) | 40 (40) | 33 (38.8) | 84 (34.3) |
| No | 49 (81.7) | 60 (60) | 52 (61.2) | 161 (65.7) |
| **Separate house only for chickens** | | | | |
| Yes | 6 (10) | 19 (19) | 12 (14.1) | 37 (15.1) |
| No | 54 (90) | 81 (81) | 73 (85.9) | 208 (84.9) |

**Table 12.** Challenges in chick management at different agro-ecologies of Ethiopia.

| Parameter | Agro-ecology | | | Average [N (%)] |
|---|---|---|---|---|
| | Lowland (N=60) | Midland (N=100) | Highland (N=85) | |
| | N (%) | N (%) | N (%) | |
| **Selecting egg for incubation** | | | | |
| Yes | 4(6.7) | 11(11) | 7(8.2) | 22(9) |
| No | 56(93.3) | 89(89) | 78(91.8) | 223(91) |
| **Age of chicks' death occurrence** | | | | |
| $1^{st}$ - $3^{rd}$ week | 54(90) | 93(93) | 81(95.3) | 228(93.1) |
| $4^{th}$ - $6^{th}$ weeks | 6(10) | 7(7) | 4(4.7) | 17(6.9) |
| **Main causes of death of chicks** | | | | |
| Disease | 32(53.3) | 41(41) | 47(55.3) | 120(49) |
| Predators | 21(35) | 36(36) | 25(29.4) | 82(33.5) |
| Birds | 7(11.7) | 23(23) | 13(15.3) | 43(17.6) |

chicken production. In this survey for more than 93% of the interviewed farmers, death of chicks might be occurred between the first and third week of their age (Table 12).

## Conclusion

Indigenous chickens are well adapted to the tropics, resistant to poor management, feed shortages and tolerate to locally prevalent diseases. Mid land agro-ecology is the most suitable as compared with that of the low and highland areas for most parameters. Documenting the productive and reproductive performance of local chicken at different agro-ecologies could be considered as playing the pivotal role as a base for further research. Although the village chickens produce small number of eggs, most of the farmers, especially women preferred eggs production trait through poultry production for sale rather than using for home consumption. Inbreeding coefficient of the local chickens was higher and it needs increasing the number of chickens to decrease the chance mate to each other. However, escalating number of local chickens may not be the relevant strategy to optimize profitability. So, developing breed improvement program is advisable to improve profitability through increasing egg production and other relevant traits; because this study can be the base to design breeding strategy.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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