

# Production system and breeding practice of indigenous chickens in selected districts of Dawro zone and Konta special district, Southern Ethiopia

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**Abstract.** Melak A, Kenfo H, Aseged T, Hailu A. 2021. Production system and breeding practice of indigenous chickens in selected districts of Dawro zone and Konta special district, Southern Ethiopia. *Asian J Agric* 5: 72-83. This study was conducted to understand the production system, breeding practices, selection criteria, and production constraints of chickens to have a baseline for future production strategies in the study area. The data was collected through individual interviews, focus group discussions, and personal observations. A semi-structured questionnaire using Food and Agriculture Organization Guidelines was used to avail the views of the respondents. Based on chicken population, production potential, and road accessibility, a total of 90 households from six kebeles were considered for an individual interview. The data was analyzed using SPSS software version 23.0 and an index was calculated for all ranked variables like the importance of livestock, purpose of keeping chicken, selection criteria, culling criteria, and constraints of chicken production. The index value of meat production and income generation in midland agroecology were 0.28 and 0.26 respectively. Also, the index value of income generation and meat production in lowland agroecology were 0.31 and 0.25 respectively. It is concluded that both female and male chickens are maintained mainly for income generation followed by meat sources. A variable that was given a higher priority in breeding selection was body size and health conditions, for male and female chickens respectively. Most of the respondents select their breeding hen in health, egg production, and age with an index value of 0.44 and 0.36 and 0.15 respectively; while their breeding cock in body size, disease resistance, and color with an index value of 0.36, 0.29, and 0.28 respectively. Disease and predators were the major constraints of chicken production mentioned in the study area. Therefore, addressing these constraints is important to design a successful genetic improvement scheme.

**Keywords:** Constraints, Ethiopia, identification, indigenous chicken, selection criteria, trait preference

## INTRODUCTION

It is believed that the livestock population in Ethiopia is the largest in Africa (Tsegay and Gebreegziabher 2016). Livestock is an important source of income for the agricultural communities, and one of Ethiopia's major sources of foreign currency through the exportation of live animals, meat, and skin (Habtamu 2015). Climate change and livestock issues have been only modestly considered, even though livestock production is the most important sector (Niemi 2013). Livestock production and productivity are negatively affected by climate change, and it needs justification on the need to conserve and sustainably use local animal genetic resources. Conservation and sustainable utilization of local Animal Genetic Resource (AnGR) requires information on their morphology and production system (Osei-Amponsah 2017).

In Ethiopia, indigenous chickens are largely kept by the rural society and have large variations in body conformation, plumage color, and comb-type (Moges 2009 and Halima 2007). The naturally or farmer-selected indigenous chickens that have adaptive fitness to a specific area, are often poor in their egg production and characterized by long broodiness as well as late maturation (Moges 2010 and Negasa 2014).

The economic contribution of indigenous chickens is not proportional to their large population, this is because of their low genetic potential, the prevalence of diseases and predators, limited feed resources, constraints related to institutional, socio-economic, and infrastructural practices.

Besides these indigenous chickens are good scavengers and foragers, being well adapted to harsh environmental conditions. Their minimal space requirements make chicken rearing a suitable activity and an alternative income source for the rural Ethiopian farmers. Besides, the local chicken sector has been playing a significant role in poverty alleviation, food security, and economic empowerment for vulnerable groups, women, and children (Moreki 2010; Negassa 2014).

The mean annual egg production of indigenous chickens has not exceeded 60 eggs/hen with an average egg weight of 40gm (Abegaz and Gemechu 2016; Hunde et al. 2016; FAO 2019). However, when compared to commercial chickens, the production potential of indigenous chickens is low due to adapting to harsh environments and are recognized for their ability to survive and reproduce in these conditions, they have added advantages of sustainable development (Fisseha et al. 2010; Wong et al. 2017). Indigenous chickens maintained under the traditional system contributed about 94.31% of the total

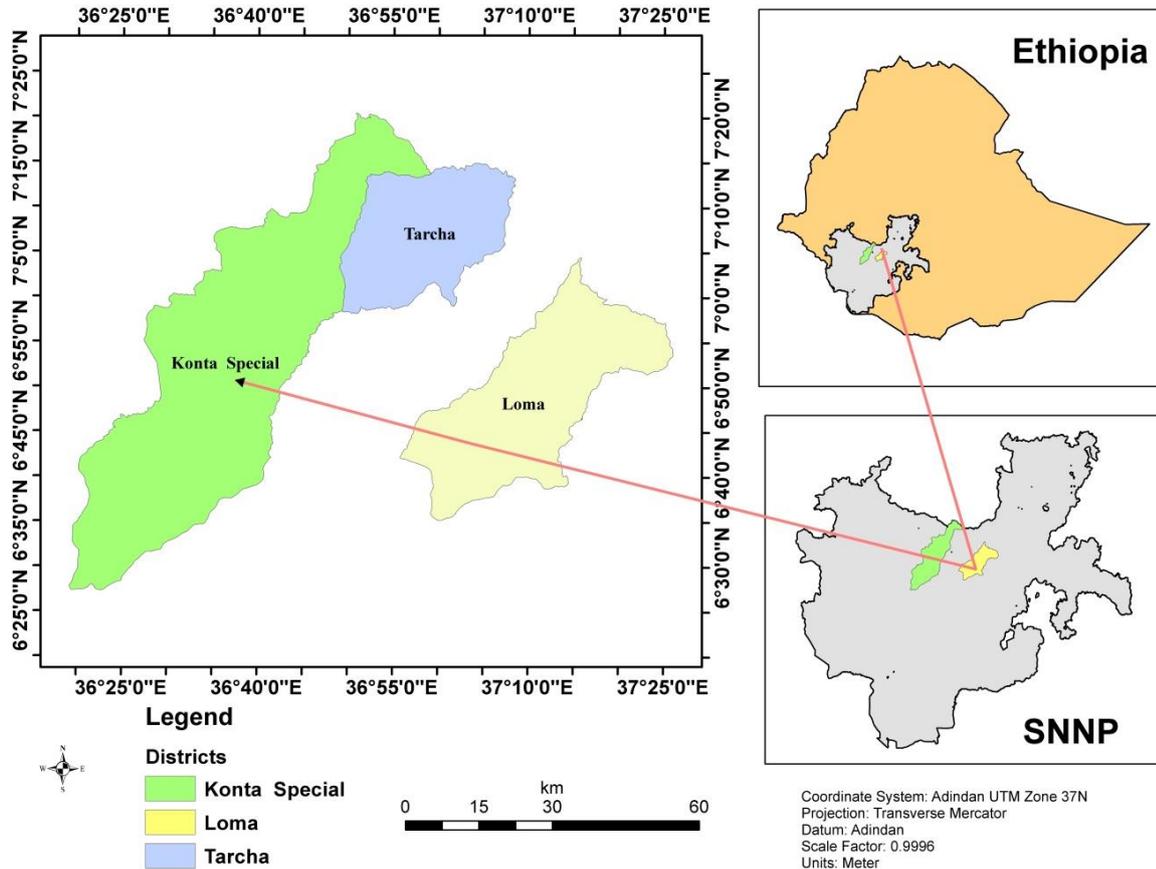
national poultry products (eggs and meat), while the remaining 2.49% is obtained from an intensively kept exotic breed of chickens, and 3.21% are obtained from hybrids (CSA 2016/2017).

Information on production environments, breeding practices, breeding objectives, and farmers' trait preferences require for designing, planning, and implementing agroecological friendly and sustainable genetic improvement programs of indigenous chickens can then be used to help small-scale farmers. Particularly by ensuring sustainable improvement, utilization, and conservation of indigenous chicken genetic resources and uplift their contributions on the livelihoods of small-scale farmers. However, to date in the Dawro zone and Konta special district of the southern nation nationality and people (SNNP) region, very little effort has been made to identify breeding objectives and farmer's chicken breeding practices and production system of indigenous chicken ecotype before genetic improvement is made through cross and breeding selection. Therefore, the main objective of this study is to characterize the production system, describe the production objectives and breeding practices of the chicken producers, generate information on the chicken ecotypes and breeding systems, and provide baseline information for designing breeding programs for indigenous chicken in Dawro zone and Konta special district.

**MATERIALS AND METHODS**

**Description of the study area**

The study was conducted in the Dawro zone and Konta special district of SNNP in Southern Ethiopia (Figure 1). The districts were selected for it is known as the center of distribution for chicken ecotypes. Dawro zone is in the SNNPR of Ethiopia, about 500 km southwest of Addis Ababa, the capital city of Ethiopia. Tarcha is located about 535 km south of Addis Ababa and the study area's elevation ranges from 1000 to 2300 meters above sea level. The rainfall distribution is bimodal with the highest fall at the wet season (April to September) and lowest fall at the last half of the dry season (February to March). The mean annual rainfall ranges from 650 to 1100 mm, and the mean daily temperature ranges between 18 - 23 °C (TZWOA, 2018). According to agro-ecological classification criteria, the district is partitioned into three agro-ecological zones, namely highland (Dega), midland (Woinadega), and lowland (Kola) with the total land holds of 53%, 30%, and 17%, respectively. The major crops are maize, teff, *enset* (*Ensete ventricosum*), and sweet potato and to a lesser extent other crops (Tarcha Zuria Agricultural Office 2018).



**Figure 1.** Map of the study area in the Dawro zone and Konta special district of SNNP, Southern Ethiopia.

Loma is one of the administrative districts in the Dawro zone of SNNPR. The total surface area is 116,320 ha. The agro-ecology of the district comprises 45.6% lowland (less than 1500 m.a.s.l), 41.4% midland (between 1500 and 2300 m.a.s.l), and 13% highland (more than 2300 m.a.s.l). The mean annual temperature ranges between 15.1 and 29.5°C, and the mean annual rainfall is between 900 and 1800 mm. The land use pattern followed is 50,701 ha cultivated; 36,172.17 ha covered by bush shrubs; 16, 202 ha under settlement; 120,60 ha for grazing; 852.33 ha covered with forest; and the rest is 332.50 ha covered by others. The district is comprised of 34 rural and five urban *kebeles* (the lowest administrative region) (SNNPRS-BoFED 2012).

Konta special district is located 464 km to the south of Addis Ababa. It is situated at an altitude ranging from 870 to 2850 meters above sea level, and latitude 7 0 42 N and 360 50'E. The area has a mean annual rainfall ranging from 500 mm – 2200 mm. The rainfall is bimodal, with the long rain happening from the beginning of June to the end of September, and the short rainfall from the beginning of March to the end of April, with more rainfall measures from July to August. The mixed crop-livestock production system is common in the district (Konta special district livestock and fishery office, unpublished data).

#### Sampling procedure and data collection

Data was collected through interviews with 90 randomly selected chicken owners from Tarcha zuria, Loma, and Konta special districts. Two different agro-ecologies (mid-altitude and lowland) of the districts were purposively selected based on their poultry population and accessibility. To check on the clarity of the questionnaire to respondents and the appropriateness of the questions, the questionnaire was designed, pre-tested, and modified before the commencement of the actual administration. Staff from the Ethiopian Biodiversity Institute administered the modified and finalized questionnaire. The questionnaire gathered information on socio-demographic characteristics of the households (age, gender, educational background, family size), livestock holding, flock characteristics (number and composition), source of income, livestock and their importance, farming system characteristics, the purpose of keeping, selection criteria, culling criteria, reproductive characteristics, and constraints of chicken production in the study area.

#### Data analysis

The entered data was transported and analyzed using descriptive statistics of statistical package for social sciences (SPSS version 23.0, 2015). Descriptive statistics of SPSS 23.0.0.0 software were used to describe the survey. An index was calculated to provide an overall ranking of the importance of livestock, the purpose of keeping chickens, selection criteria, culling criteria, and constraints of chicken production, according to the formula: Index =  $\Sigma$  of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular qualitative variables divided by  $\Sigma$  of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all-qualitative variables. The rank was calculated by Microsoft

Excel 2010.  $X^2$  test was calculated to evaluate the relationship among the categorical variables. The map of the study area was mapped with arc GIS (arc map 10.8).

## RESULTS AND DISCUSSION

### Individual and household characteristics of the respondents

Most of the indigenous chicken-owning households were male-headed (60%) while the remaining (40%) were headed by females (Table 1). The number of male respondents in the lowland agroecology is significantly higher than the number of male respondents in midland agroecology. There was a significant difference ( $P < 0.05$ ) among agro-ecologist. As the results revealed that farmer respondents are significantly higher in the midland agroecology than the lowland agroecology ( $P < 0.05$ ). The educational status of the respondents was 32.2% illiterate, 22.2% read and write, 12.2% grade (1-4), 21.1% grade (5-8), 8.9% grade (9-12), and 3.3% others, and there was no variation ( $P > 0.05$ ) among the agro-ecologies (Table 1).

### Livestock holding and composition, chicken ownership, and flock structure

The average reported livestock holding in the household is presented in Table 2. The mean ( $\pm$ SEM) number of cattle, sheep, goat, chicken, donkey and bee hives per household were  $4.31 \pm 0.28$ ,  $1.90 \pm 0.32$ ,  $2.79 \pm 0.20$ ,  $8.90 \pm 0.52$ ,  $1.44 \pm 0.18$ ,  $6.00 \pm 1.23$ , respectively. The respondents do not have a horse, mule, and camel. Mostly the household head (husband) and spouse jointly, are flock owners. The number of chicks per household was  $4.79 \pm 0.46$  which was followed by layers ( $3.28 \pm 0.15$ ). In the case of livestock holding and flock structure, there was no difference ( $P > 0.05$ ) among the agro-ecologies (Table 2).

### Gender involvement in village chicken management

Decision-making and division of labor on chicken production in the households are provided in Table 3. Most activities like chicken feeding, buying, treating, house cleaning, and egg collection were significantly ( $P < 0.05$ ) occupied by females above 18 years old. The women play a primordial role in brooding eggs (61.1%), cleaning chicken pens (47.8%), treating sick chicken (48.8%), selling eggs (61.1%), and feeding (61.1%) of the household. The results showed buying chicken, disease treatment, collecting of egg, feeding the chicken, cleaning house was significantly higher in the age group above 18 years of female (Table 3).

### Housing materials and conditions of chickens

The results showed most of the respondents (77.8%) replied that their chickens spend the night inside perch trees and the remaining 13.3% and 8.9 % spent the night in the basket and the house with the households, respectively (Table 4).

**Table 1.** Household characteristics.

Variable		Mid altitude N=45		Low altitude N=45		Overall N=90		X <sup>2</sup>	p-value
Age of household		38.29±1.45		33.49±1.59		35.89±1.10		36.616 <sup>a</sup>	0.081
Family size		5.31±0.37		6.04±0.43		5.68±.28		8.887 <sup>a</sup>	0.713
Landholding		1.86±0.17		1.67±0.19		1.76±0.13		27.600 <sup>a</sup>	0.539
		Frequency	Percent	Frequency	Percent	Frequency	Percent		
Sex	Male	22	48.9	32	71.1	34	60	4.630 <sup>a</sup>	0.031
	Female	23	51.1	13	28.9	36	40		
Job	Farmer	40	88.9	39	86.7	79	87.8	11.013 <sup>a</sup>	0.026
	Merchant	0	0	5	11.1	5	5.6		
	G/employee	3	6.7	0	0	3	3.3		
	Student	2	4.4	0	0	2	2.2		
	Carpenter	0	0	1	2.2	1	1.1		
Education	Illiterate	16	35.6	13	28.9	29	32.2	7.278 <sup>a</sup>	0.201
	Read and write	10	22.2	10	22.2	20	22.2		
	Grade (1-4)	4	8.9	7	15.6	11	12.2		
	Grade (5-8)	12	26.7	7	15.6	19	21.1		
	Grade (9-12)	1	2.2	7	15.6	8	8.9		
	Others	2	4.4	1	2.2	3	3.3		

**Table 2.** Mean (±SEM) livestock holdings.

Livestock		Mid altitude (N=45)	Low altitude (N=45)	Overall Mean ± SEM (N=90)	X <sup>2</sup>	P-value
Flock structure	Cattle	4.50±0.37	4.12±0.44	4.31±0.28	9.407 <sup>a</sup>	0.58
	Sheep	1.92±.46	1.86±0.40	1.90±0.32	3.234 <sup>a</sup>	0.52
	Goat	2.40±0.19	3.22±0.35	2.79±0.20	11.594 <sup>a</sup>	0.072
	Chicken	8.51±0.66	9.29±0.80	8.90±0.52	13.097 <sup>a</sup>	0.79
	Donkey	NA	1.44±0.18	1.44±0.18	NA	A
	Beehive	5.67±1.36	6.67±2.68	6.00±1.23	3.150 <sup>a</sup>	0.68
	Layer	3.52±0.21	3.05±0.22	3.28±0.15	10.556 <sup>a</sup>	0.10
	Pullet	1.58±0.13	2.11±0.44	1.81±0.21	4.252 <sup>a</sup>	0.37
	Female grower	1.56±0.22	1.93±0.34	1.73±0.20	1.402 <sup>a</sup>	0.84
	Male grower	1.44±0.20	2.42±0.51	1.86±0.26	6.477 <sup>a</sup>	0.17
	Cock	1.71±0.18	1.87±0.24	1.79±0.14	3.147 <sup>a</sup>	0.68
	Chicks	5.46±1.06	4.46±0.44	4.79±0.46	10.730 <sup>a</sup>	0.30

Note: N: number of respondents; SEM: standard error of the mean; A: no statistics were computed; NA: Not available

**Table 3.** Division of labor in percent.

	Buying chicken	Selling chicken	Disease treatment	Collecting egg	Feeding	Selling egg	Brooding egg	Cleaning house	Other activities
< 18 years male	1.1	16.7	16.7	16.7	0	0	0	0	0
< 18 years female	31.1	5.6	5.6	35.6	30.0	31.1	30.0	43.3	0
> 18 years male	24.4	28.9	28.9	0	8.9	7.8	8.9	8.9	0
> 18 years female	43.3	48.9	48.9	47.8	61.1	61.1	61.1	47.8	17.8
X <sup>2</sup>	2.698 <sup>a</sup>	8.493 <sup>a</sup>	18.788 <sup>a</sup>	23.624 <sup>a</sup>	11.798 <sup>a</sup>	2.735 <sup>a</sup>	3.978 <sup>a</sup>	16.480 <sup>a</sup>	A
P value	0.44	0.037	0	0	0.03	0.26	0.14	0	A

Note: A: no statistics were computed

**Table 4.** Housing material and type of chicken house.

Materials		Iron steel	Grass	Wood	Plastic	Mud	x <sup>2</sup>	p-value
Housing material for roof	Frequency	75	15	0	0	0	13.520 <sup>a</sup>	0.00
	%	83.3	16.7	0	0	0		
Housing material for wall	Frequency	0	0	76	14	0	16.579 <sup>a</sup>	0.00
	%	0	0	84.4	15.6	0		
Housing material or floor	Frequency	0	0	29	26	35	2.133 <sup>a</sup>	0.344
	%	0	0	32.2	28.9	38.9		
Housing type		Inside house	Inside perch trees	Basket house	Total			
	Frequency	8	70	12	90		14.914 <sup>a</sup>	0.001
	%	8.9	77.8	13.3	100			

The results showed that there was a highly significant difference in housing types ( $P=0.001$ ) between the midland and lowland agro-ecologies. Results also showed that houses/night shelters were made using locally available materials such as grass, wood, plastic, and mud. There was a significant difference between the housing material for the roof of the chicken and most of the respondents constructed their chicken roof from iron steel. There was also a significant difference between the housing material for the wall of the chicken and most of the respondents construct their chicken wall from wood ( $P<0.05$ ) (Table 4).

### Livestock and their importance

The uses of livestock are presented in Table 5. The results showed that cattle are the leading livestock species used for the lives of the respondents. Cattle were significantly higher than other livestock species in the study area ( $P<0.05$ ). Chickens and goats were the second and third important livestock species, respectively.

### Purpose of keeping chicken

The results in Table 6 present the purpose of keeping chicken in the area. Male chickens were mainly kept for meat (43% and 42%), cash generation (29% and 34%), and for production (breeding) 20% and 15% in the mid and low land, respectively. Whereas females were kept mainly for egg production (49% and 50%) followed by income generation 23% and 28% in mid and low land areas, respectively.

### Selection of breeding chickens and trait preferences

The result showed the selection of breeding cock by size, color, disease resistance was significantly higher at midland agroecology. Selection by the performance of

breeding cock was not significantly different between the midland and lowland agro-ecologies. The selection of breeding hen by egg production was significantly high in the lowland rather than in the midland. On the other hand, the selection of breeding hen by health and non-broodiness was significantly higher in the midland than in the lowland. Selection by age of breeding hen was not significantly different between the midland and lowland agro-ecologies. The selection criteria for chicken in Tarcha, Loma, and Konta special districts with corresponding index values are presented in Table 7.

Most of the respondents select their breeding cock based on body size (index = 0.38, and 0.33 in the midland, and lowland agro-ecologies, respectively) being the most important cock selection trait followed by disease resistance (index = 0.33, and 0.25 in the midland, and lowland agro-ecologies, respectively), and the next selection criteria that the respondents prefer were color (index = 0.29, and 0.27 in the midland, and lowland altitude, respectively) and performance with an index value of 0.15 in the lowland altitude (Table 7).

Table 5. Importance of livestock.

Livestock breeds	Rank1	Rank2	Rank3	Index
Cattle	76	5	3	0.48
Sheep	1	3	7	0.03
Goat	0	43	11	0.19
Chicken	11	34	38	0.28
Donkey	0	0	0	0.00
Beehives	0	1	4	0.01
Others	0	0	0	0.00
Total	88	86	63	1.00

Table 6. Purposes of keeping chicken.

Item	Male				Female				AVI	
	Rank1	Rank2	Rank3	Index	Rank1	Rank2	Rank3	Index		
Mid land	Meat	25	20	0	0.43	3	12	0	0.12	0.28
	Egg	0	0	0	0.00	42	2	0	0.49	0.24
	For breeding	0	24	6	0.20	0	0	31	0.12	0.16
	Manure	0	0	0	0.00	0	0	0	0.00	0
	Saving	0	0	3	0.01	0	0	12	0.05	0.03
	Wealth status	0	0	15	0.06	0	0	0	0.00	0.03
	Culture	0	0	0	0.00	0	0	0	0.00	0
	Income generation	17	2	23	0.29	0	30	0	0.23	0.26
	Others	0	0	0	0.00	0	0	0	0.00	0
	Total	42	46	47	1.00	45	44	43	1.00	1
Low land	Meat	25	20	0	0.42	1	4	12	0.09	0.25
	Egg	0	0	0	0.00	44	1	0	0.50	0.25
	For breeding	5	5	16	0.15	0	0	15	0.06	0.1
	Manure	0	0	0	0.00	0	0	0	0.00	0
	Saving	0	2	18	0.08	0	4	11	0.07	0.08
	Wealth status	0	0	1	0.00	0	0	2	0.01	0.01
	Culture	0	0	0	0.00	0	0	0	0.00	0
	Income generation	14	23	6	0.34	0	36	4	0.28	0.31
	Others	0	0	0	0.00	0	0	0	0.00	0
	Total	44	50	41	1.00	45	45	44	1.00	1

Note: AVI: average index

Most of the respondents select their breeding hen in which health (index = 0.44, and 0.36 in the midland, and lowland agro-ecologies, respectively) was the most important male chicken selection trait followed by egg production (index = 0.28, and 0.45 in the midland, and lowland agro-ecologies, respectively), and the next selection criteria that the respondents prefer were age (index = 0.19, and 0.11 in the midland, and lowland altitude, respectively) and non-broodiness with an index value of 0.09 and 0.08 in the midland and lowland altitude, respectively.

### Culling reasons for chickens

Culling criteria for chickens in Tarcha, Loma, and Konta special districts with corresponding index values are presented in Table 8. Most of the respondents cull their chickens in which body disease (index = 0.54, and 0.27 in the midland, and lowland altitude, respectively), and decrease production (index = 0.21, and 0.44 in the midland, and lowland altitude, respectively) were the most important chicken culling criteria followed by age (index = 0.13, and 0.27 in the midland, and lowland altitude, respectively), and the next culling criteria were comb-type with an index value of 0.07, and 0.02 in the midland and lowland altitude, respectively. The results showed that the culling of chickens by decrease production was significantly high at lowland agro-ecology than the midland agro-ecology. On the other hand, the culling of chickens by disease was significantly high at midland agro-ecology than lowland agro-ecology, but the culling of chickens by comb type and age has no significant difference among the agro-ecologies

in the study area (Table 8).

### Mortality of chicken

The mortality of chickens by age is presented in Table 9. Most of the respondents (84.4%) reported that there was chicken mortality for the last year. There is no significant difference ( $P < 0.05$ ) in average chicken mortalities among different age groups.

### Traits of adaptive and economic importance

According to a survey conducted, farmers identify traits of preference mainly on brooding ability, feed consumption, mothering ability, egg production, meat quality growth performance, disease resistance, and scavenging ability (Table 10).

### Mothering and brooding ability

The results showed that the mothering and brooding ability of chickens in the study area is highly significant (Table 7). In the case of brooding ability and mothering ability, there was a significant difference among the agro-ecologies. Brooding ability was high at the midland agro-ecology in the medium intensity preference. Mothering ability was high at the lowland agro-ecology at high-intensity preference. In the case of brooding ability and mothering ability, there was a significant difference among the agro-ecologies. Brooding ability was high at the midland agro-ecology in the medium intensity preference. Mothering ability was high at the lowland agro-ecology at high-intensity preference.

**Table 7.** Ranked selection criteria for breeding males and females.

Item	Agro-ecological zones								Average index	X <sup>2</sup>	P-value	
	Midland				Lowland							
	R1	R2	R3	Index	R1	R2	R3	Index				
Selection criteria of cock	Size	15	29	1	0.38	26	6	0	0.33	0.36	17.366 <sup>a</sup>	0
	color	15	2	28	0.29	1	26	18	0.27	0.28	34.955 <sup>a</sup>	0
	Performance	0	0	0	0.00	13	0	0	0.15	0.07	A	A
	Disease resistance	15	14	16	0.33	5	13	27	0.25	0.29	7.851 <sup>a</sup>	0.020
	Total	45	45	45	1.00	45	45	45	1.00	1		
Selection criteria of hen	Egg production	16	14	0	0.28	40	0	0	0.45	0.36	23.333 <sup>a</sup>	0
	Age	0	6	39	0.19	0	0	30	0.11	0.15	1.008 <sup>a</sup>	0.315
	Health	29	16	0	0.44	5	40	0	0.36	0.4	27.227 <sup>a</sup>	0
	Non-Broodiness	0	10	5	0.09	0	3	15	0.08	0.09	8.567 <sup>a</sup>	0.003
	Total	45	46	44	1.00	45	43	45	1.00	1		

Note: R: rank, A: no statistics were computed

**Table 8.** The culling reason for male and female chicken in Tarcha, Loma, and Konta special district, Southern Ethiopia

Item	Agro-ecological zones								Average index	X <sup>2</sup>	p-value
	Mid altitude				Low altitude						
	R1	R2	R3	Index	R1	R2	R3	Index			
Decrease production	1	21	5	0.21	27	15	2	0.44	0.33	23.718 <sup>a</sup>	0
Age	0	5	22	0.13	4	29	0	0.27	0.20	3.676 <sup>a</sup>	0.055
Disease	39	6	0	0.54	4	29	0	0.27	0.40	42.769 <sup>a</sup>	00
Broodiness	0	0	14	0.06	0	0	0	0.00	0.03	a	a
Color	0	0	0	0.00	0	0	0	0.00	0	0	0
Comb	0	6	4	0.07	0	2	1	0.02	0.04	0.043 <sup>a</sup>	0.835
Temperament	0	0	0	0.00	0	0	0	0.00	0	0	0
Shape	0	0	0	0.00	0	0	0	0.00	0	0	00
Total	40	38	45	1.00	35	75	3	1.00	1		

### Disease resistance

Disease resistance was also found to be very important. The results showed that there was a significant difference among the agro-ecologies. Disease resistance of indigenous chicken ecotypes was high at the midland agro-ecology at high-intensity preference.

### Scavenging ability

The results showed that the scavenging ability of chickens was not significant among the agro-ecologies. Based on this, the local breeds were appreciated by the local farmers for their scavenging ability irrespective of the agro-ecological zones (Table 10).

### Chicken breeding and reproduction performances

#### Age at sexual maturity

The average age at sexual maturity for male and female chickens varies from breed to breed. Reproductive performances of the studied chicken population are summarized in Table 11.

#### Egg production and hatchability

The egg production and hatchability of the female chicken population are summarized in Table 11. The average reported age at sexual maturity for studied chicken ecotypes were  $5.33 \pm 0.13$  and  $6.14 \pm 0.15$  months for males and females, respectively (Table 11). The present study showed that the average number of eggs laid by indigenous hens was  $10.81 \pm 0.31$  eggs per hen per clutches and the mean annual egg production was  $61.70 \pm 0.95$  eggs per hen per year (Table 11). The average age at sexual maturity of female chicken, the maximum brooding interval in weeks, average market age of males in months, average market age of females in months, number of hatches per year, low yield number of eggs produced annually, number of hatches per year, medium yield number of egg produced annually, have a significant difference between the midland and lowland agro-ecologies. Whereas average age at sexual maturity, the minimum brooding interval in weeks, average brooding interval in weeks, hatched number per one natural incubation, number of chicks surviving, the average number of eggs laid in a single clutch, and maximum number of eggs produced annually were not significant in the studied agro-ecologies (Table 11). The result showed

the average number of egg/clutch/hen was  $11.17 \pm 0.31$  and the average number of times a hen hatches in a year was  $2.80 \pm 0.13$  with an estimated average egg number of  $61.70 \pm 0.95$  per year.

#### Major constraints of chicken production

The major constraints of chicken production as mentioned by the households were disease, predator, unknown causes, and drought (decreased in both size and productivity) (Table 12). The result showed in the case of chicken production constraints there was no significant difference between the midland and lowland agro-ecologies ( $P > 0.05$ ). Most of the respondents' major cause of loss of chicken identified in this study was a disease with an index value of 0.44 (Table 12).

**Table 10.** Trait preference of chicken ecotypes by agro-ecology (%)

Variables	Intensity of preference	Agro-ecological zones		X <sup>2</sup>	P-value
		Mid altitude	Low altitude		
Brooding ability	High	0	44.4	34.615 <sup>a</sup>	0.000
	Medium	100	55.6		
	Low	0	0		
Feed consumption	High	0	53.3	32.727 <sup>a</sup>	0.000
	Medium	100	46.7		
	Low	0	0		
Mothering ability	High	56.6	91.1	14.545 <sup>a</sup>	0.000
	Medium	44.4	8.9		
	Low	0	0		
Egg production	High	51.1	60	0.720 <sup>a</sup>	0.396
	Medium	48.9	40		
	Low	0	0		
Meat quality	High	46.7	35.6	3.809 <sup>a</sup>	0.149
	Medium	44.4	62.2		
	Low	8.9	2.2		
Growth performance	High	33.3	55.6	3.487 <sup>a</sup>	0.062
	Medium	57.8	42.2		
	Low	8.9	2.2		
Disease resistance	High	80	57.8	5.184 <sup>a</sup>	0.023
	Medium	20	42.2		
	Low	0	0		
Scavenging ability	High	100	97.8	1.011 <sup>a</sup>	0.315
	Medium	0	2.2		
	Low	0	0		

Note: X<sup>2</sup>: chi-square test

**Table 9.** Mortality of chicken within one year period and chicken age category.

Mortality by age	Mean ± SEM	Frequency	%	X <sup>2</sup>	p-value	
Mortality in the last 12 months		Yes	76	84.4	1.353 <sup>a</sup>	0.245
		No	14	15.6		
Less than 1 week	1.48±0.26			12.024 <sup>a</sup>	0.150	
1 week-2 month	1.63±0.23			13.931 <sup>a</sup>	0.084	
2-5 months	1.46±0.19			11.429 <sup>a</sup>	0.076	
More than 5 months	2.10±0.28			21.116 <sup>a</sup>	0.032	

**Table 11.** Production and productivity of chicken (Mean and SD, N=90).

Item	Agro-ecological zones		Overall	X <sup>2</sup>	p-value
	Mid altitude	Low altitude			
Average ASM of male	5.33±1.02	5.33±1.41	5.33±1.23	10.511 <sup>a</sup>	0.105
Average ASM of female	6.29±1.09	5.99±1.65	6.14±1.40	22.554 <sup>a</sup>	0.007
minimum BI in weeks	8.16±5.53	5.38±1.66	6.77±4.29	17.977 <sup>a</sup>	0.082
Average BI in weeks	10.06±6.73	6.3±1.37	8.18±5.19	24.133 <sup>a</sup>	0.087
Maximum BI in weeks	12.61±8.70	7.46±1.77	10.03±6.76	25.400 <sup>a</sup>	0.031
Average MA of males in months	8.99±2.52	6.33±1.67	7.66±2.51	38.984 <sup>a</sup>	00
Average MA of females in months	9.69±2.58	7.04±1.55	8.37±2.50	36.781 <sup>a</sup>	00
HA per one natural incubation	11.64±2.85	10.69±3.0	11.17±2.99	14.349 <sup>a</sup>	0.350
No- of chicks surviving	6.87±3.67	6.38±2.55	6.62±3.15	17.624 <sup>a</sup>	0.128
Average NoEL in a single clutch	11.44±2.89	10.18±2.8	10.81±2.90	18.130 <sup>a</sup>	0.201
No- of hatches per year	2.64±1.52	2.96±.74	2.80±1.20	14.121 <sup>a</sup>	0.015
NoEP annually low yield	47.07±8.75	50.78±7.0	48.92±8.10	41.940 <sup>a</sup>	0.002
NoEP annually medium yield	59.93±9.75	63.47±7.9	61.70±9.00	33.203 <sup>a</sup>	0.044
NoEP annually maximum yield	72.82±9.67	77.53±11.08	75.18±10.61	25.081 <sup>a</sup>	0.244

Note: ASM: age at sexual maturity, BI: Brooding interval, MA: market age, HA: hatched number, NoEL: Number of eggs laid, NoEP: number of eggs produced

**Table 12.** Major Chicken production constraint in Tarcha, Loma, and Konta special district, Southern Ethiopia.

Causes of mortality	Agro-ecological zones								Av. index	X <sup>2</sup>	P-value
	Mid land				Low land						
	R1	R2	R3	Index	R1	R2	R3	Index			
Predator	14	24	0	0.42	14	22	0	0.40	0.41	0.033 <sup>a</sup>	0.856
Disease	23	14	0	0.45	22	13	0	0.43	0.44	0.004 <sup>a</sup>	0.951
Drought	0	0	0	0.00	0	0	13	0.06	0.03	A	A
Unknown	0	1	25	0.13	0	0	23	0.11	0.12	1.217 <sup>a</sup>	0.270
Total	37	39	25	1.00	36	35	36	1.00	1		

Note: Av: average

## Discussion

The small proportion of female respondents in this study, was not in line with Halima et al. (2007) where households were predominantly headed by females and that most livestock farmers are of old age which is a common phenomenon in most developing countries. The proportion of female-headed households in the present study was lower than the 47.7% for Hawassa town (Haile et al. 2012). This indicated that most of the time the men, whether in male-headed or female-headed households, are responsible for chicken rearing while the women are responsible for crop cultivation and other household chores. The average family size of the households was 5.68±.28 (ranging from 1-14) and this result is higher than the report of Demographic Health Survey (2016) which is 4.8 persons. Large family size was considered very important for chicken production activities. Many members within the family seem to be considered as an asset and security in times of retirement. The current study showed that many of the respondents had formal education and is important to understand extension messages and to realize the importance of new technologies within a short time. According to Ofukou et al. (2009), farmers with high educational levels usually adopt new technologies more rapidly than lower educated farmers.

The current study described and documented indigenous chicken production systems in the traditional sector of Tarcha zuria, Loma, and Konta special districts as

an essential step towards the development of a sustainable breed improvement program.

Flock structure is described in terms of the number and proportion of the different age groups and sex in a flock. The number of chicks in this study was like that of the Gantaafeshum district of Eastern Tigray as reported by Gebresilassie et al. (2015) that was reported as 4.29 and 3.17 for chicks and layers per household, respectively. This indicates that the proportion varies between places and with time due to various reasons.

Results of focus group discussions indicated that the household heads provided chickens for children if they request and mostly, children share the responsibility of chicken feeding and watering that they have the ownership of chicken. This finding is similar to the observation of Gebresilassie et al. (2015) from the Gantaafeshum district of Eastern Tigray, Ethiopia.

The ownership pattern was usually related to decision-making in the selling and consumption of chicken meat and eggs. It was noted that women, followed by men, play the major decision-making role in the selling and consumption of chicken meat and eggs, and the purchase of chickens. This agreed with the report of Aklilu et al. (2007) from Tigray, Northern Ethiopia who reported that live birds and egg sales were decided by women who would serve them as immediate income to meet household expenses instead of expecting their husband to provide the cash.

Women were further responsible to perform most of the activities in chicken rearing except in the construction of chicken pens perch or partitions, which is mainly carried out by the men and youth males. Results of this study showed that adult women have a significant contribution to poultry farming and related activities. The results obtained in this study agree with the reports of Gebresilassie et al. (2015) from the Gantaafeshum district of Eastern Tigray, Ethiopia.

Solomon Zewdu et al. (2013) also reported chicken houses are constructed with locally available materials such as bamboo for making ceilings (86.7%), mud blocks and hat (11.1%), a house made of iron sheet roof (1.5%), and basket made of bamboo (0.7%). The sites are secure overnight places to protect from predators.

One aim of this study was to document information that would be useful when formulating a breeding program for indigenous chickens in the Dawro zone and Konta special district. The results showed that chicken was commonly used as a family income, source of meat, and egg. These could be opportunities that farmers can exploit to better utilize their indigenous chickens. The other use mentioned by our respondents was saving and wealth status. The result showed that both hen and cock are maintained mainly for income generation followed by meat source and egg production (Table 6). This builds financial capital and allows the sale of animals for cash that can be used for other agricultural enterprises, school fees, and medical bills, etc. Functions like saving and wealth status received a lower ranking among chicken breeders. Chickens are a highly valued livestock species in the study area, next to cattle, and are reared to fulfill diverse socio-cultural needs. Chicken production plays a great role as a prime supplier of eggs and meat in rural and urban areas and as a source of income, especially to women (Geleta et al. 2013). The purpose of keeping chicken for culture and manure is zero, due to the beliefs of the society restricting not to believe in such kinds of things and due to ignorance of chicken manure. Dikinya and Mufwanzala (2010) reported the utilization of chicken manure as an organic fertilizer is essential in improving soil productivity and crop production.

The most common way of selecting chickens as parents for the coming generations is to use the offspring of a chosen parent. A linear index is the best strategy for selecting replacements in the livestock industries (Chawala 2019). Therefore, the selection criteria used for breeding hen in this study is not in line with Fitsum (2017) who reported that the selection criteria used for breeding hen were egg size, plumage color, broodiness, disease resistance, and hatchability with an average index value of 0.067, 0.064, 0.062, 0.054, and 0.042, respectively. The highest selection criteria used for breeding cock were egg number of the dam, comb type, plumage color, and disease resistance, with an index value of 0.053, 0.052, 0.045, and 0.044, respectively.

Livestock keepers need to evaluate each animal and decide whether that animal is productive or not, with decreasing production costs. Nonproductive chickens should not be maintained in the flock. The best way to

increase the efficiency of the chicken ecotypes is culling. The culling of cocks for sale or family consumption is another possible factor contributing to the high proportion of hens per flock in this study. Our study showed the respondents cull their chickens mostly through sale and slaughter. As reported by Abera (2014) the respondents cull their chickens by selling and consuming at home and they sell the chicken at an early age. The sale of a chicken at an early age is common in other areas too. Thus, the sale of young animals negatively influenced flock productivity that fast-growing and good-looking pullets and male growers could be removed out from the flock before reaching breeding age and replacing themselves (Abera 2014), and therefore drains the genetic pool of the flock. However, the practice can be taken as an efficient method of culling less productive and unselected animals out of the system, if properly managed. Therefore, care should be taken to maintain the productivity of animals while removing those with unwanted traits.

Most of the respondents considered the scavenging ability as the most important trait followed by mothering ability and egg production. This study is not in line with the report of Abdelqader et al. (2007) where village farmers considered egg production as the most important criterion, followed by mothering ability and body weight, for selecting their breeding stock in Jordan. Identification of traits of economic importance is vital in the development of breeding objectives.

In this regard, the local chicken ecotypes are well noted for their good mothering and brooding ability. This implies that the local chickens can serve considerably in hatching eggs for breeding/reproduction purposes to increase the flock size. Their mothering ability can contribute more to the better survival of the chickens. However, brooding can reduce the egg production of local chickens. The mothering and brooding ability of the chickens were irrespective of agro-ecological zones (Gebremariam 2017).

The disease resistance of indigenous chickens was high in the midland agroecology at high preference. The importance of disease resistance on preference for traits of chickens and other livestock species is mentioned in the previous studies. (Ouma et al. 2007; Kassie et al. 2009; Faustin et al. 2010). The trait "disease resistance" is maybe a consequence of the economic importance of poultry diseases in rural Ethiopia and the lack of poultry health services. This finding is in line with previous studies in African countries including Benin, Somalia, Cameroon, and Zambia (Guèye 2000; Faustin et al. 2010).

The age at sexual maturity of a male chicken in this study is shorter than the finding of Assefa et al. (2019) who reported that the average sexual maturity of chicken in the shaka zone was 22.4 and 25.2 weeks (5.6 and 6.3 months) for male and female chickens, respectively. Also, the age at sexual maturity in this study is not in agreement with Yadessa et al. (2017) who reported that average sexual maturity was 19.6 and 20.8 weeks (4.9 and 5.2 months) for male and female chickens, respectively. The variation in age at sexual maturity may be due to the variation in environmental factors (temperature and nutrition) in the study districts.

The results of the average number of eggs laid in this study was higher than the mean annual egg production of 50.8 eggs per hen per year reported by Nebiyu et al. (2013) and lower than 65 eggs reported by Yitbarek and Zewudu (2014). The significant difference in the estimated annual egg for local chickens in the different ecological zones might be due to different climate conditions associated with the zones. The differences in annual egg production might also be due to differences in how the birds were managed by the caretakers and the availability of scavenging feed resource base in the various locations. Or it may be due to the types of husbandry practices provided by the households to the chickens as well as the quality and quantity of the feed available in the respective locations. Hence, the development agents in the study area need to appraise the poultry keepers about improved practices and packages of poultry husbandry aimed at poverty alleviation.

The findings of the average eggs/clutch/hen in the current study is lower than the report of Fisseha et al. (2010) who reported 15.70 and 14.90 eggs/clutch with estimated total egg production/birds/year of 60 and 55 eggs in Bure and Dale districts, respectively. The average number of chicks surviving to adulthood and number of chicks hatched per brood in the study districts were  $10.54 \pm 0.51$  and  $7.95 \pm 0.58$ , respectively. This indicates that poor husbandry practices cause loss of one-quarter of the chicken in the study area. The current findings are in line with Fisseha et al. (2010), who reported the average number of chicks survived from the average number of eggs hatched (11 and 10.2) were 6.7 and 7.6 in Bure and Fogera districts, respectively. The different results on indigenous chicken ecotypes showed that good poultry husbandry practices could improve the percentage of survivability of hatched chicken and the income of the households.

The major cause of loss of chicken identified in this study, concurred with findings by Addis (2014) who reported that the major cause of chicken mortality is a disease in Bahir Dar Zuria district and ensured that poor health is the key limiting factor to the productivity of chicken raised by most rural farmers in the study area. As reported by Addis (2014) most farmers interviewed depended on drug suppliers for veterinary help. This raises some doubts about the accuracy of the diagnosis of diseases. Maximum productivity in each system of production emerges when disease control is optimal (Edea 2012). Thus, healthcare is an important problem to consider before the genetic program can be seriously contemplated. Community-based animal health programs may be one way forward and wider utilization of indigenous breeds tolerant to disease another predator was identified as the second constraint for the chicken producers in the study area (Mirkena et al. 2012). Causes of predators were due to the scavenging nature of the chickens, going here and there to search for feed, which will push for the predator. Whereas unknown causes and drought were ranked lowly in the study area (Table 12). Drought as the cause of mortality might be due to the lowland agroecology of the area.

In conclusion, this study provides insight into agricultural production systems, breeding practices, and major production constraints encountered in chicken farming in the study area, which are preconditions in developing breeding programs. Midland agroecology is the most suitable as compared with that of the lowland areas for most parameters. Documenting the productive and reproductive performance of local chicken at different agro-ecologies could be considered as playing a pivotal role as a base for further research. Chicken has a great role in the livelihoods of the community. Indigenous chicken ecotypes in the study area are the most promising for their better adaptability under low input extensive production environments where disease and predator are the two major constraints. Chicken is a highly valued animal by the Southern people next to cattle reared to fulfill diverse socio-cultural needs. Body size and growth performance are given high priority in selecting breeding males among their mates. Similarly, for breeding females, good health conditions, egg production, and age are among the most considered criteria for selection. The study indicated that most of the women actively participate in poultry production using indigenous ecotypes and traditional knowledge of poultry management to generate income. Chickens support food security at the household level through not only direct consumption, but also creating an enabling economic environment that enables farmers to have better purchasing power or better access to purchase food. It also can provide financial support for the schooling of children. The most dominant chicken production systems in the study area were the backyard extensive systems based on the local indigenous birds and scavenging with occasional supplementary feeding of homegrown grains and household food refusals. Most of the respondents have not accessed regular vaccination programs and proper prevention mechanisms for their chickens.

To avoid the early disposal of breeding males, a strong extension service is required to convince farmers and to develop an interest in the benefits of better genotypes or incentives that might be provided for those keeping their best males for breeding purposes. Owing to the small flock size in the study area, reasonable genetic gain demands the formation of breeders' groups or co-operatives, which in turn require full participation and long-term commitment of chicken keepers and other livestock development actors. To realize the full benefits of breeding programs, approaches should be holistic, and a concurrent improvement in the non-genetic factors (disease and feed) is central. To minimize the loss of chickens, the government as well as the concerned bodies need to give attention to the main constraints.

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