

Research Article

Phenotypic Characteristics of Indigenous Chicken in Awi Zone, Amhara Regional State, Ethiopia

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Abstract

This study aimed to describe the phenotypic characteristics of indigenous chickens in three districts of Awi Zone, Amhara region, Ethiopia. Nine qualitative and 12 quantitative traits from 486 chickens were considered for morphological parameters. The General Linear Model procedures (PROC GLM) of SAS 9.0 software to analyze body measurements, considering factors like agro-ecology, sex, and their interactions. Mean comparisons were conducted using Duncan's multiple range test, and correlation analysis was applied to examine relationships between quantitative traits. The study revealed that 96.1% of the chickens had feathers, while 3.9% were naked-neck. The most common plumage colors were red (37.7%), white (19.8%), black (10.1%), Gebsema (17.3%), Teterma (8.8%), and multi-colored (6.4%). All measured quantitative traits in the study area showed statistically significant differences ($P < 0.001$) between male and female chickens, with males displaying greater body weights and sizes than females. The average body weight of indigenous chicken was 1.67 ± 0.31 kg for males and 1.47 ± 0.29 kg for females. The overall mean body length was 37.09 ± 1.25 cm, and this did not vary significantly ($P > 0.05$) across different agro-ecological zones. Male chickens had an average body length of 37.37 ± 1.47 cm, compared to 36.95 ± 1.10 cm for females. The study found significant phenotypic variations among indigenous chickens across different agro-ecological zones. It recommends further genetic studies using molecular markers were needed to assess genetic diversity and relationships within these populations.

Keywords

Agro-ecology, Indigenous Chicken, Qualitative, Quantitative Traits

1. Introduction

According to the [1] report, Ethiopia's poultry population is approximately 56 million, with indigenous chickens making up 88.2%, while crossbred and exotic breeds account for 5.6% and 6.4%, respectively. Rural communities primarily raise indigenous chickens under a scavenging management system, supported by favorable agro-climatic conditions.

Despite their diversity, indigenous chickens have low

productivity, characterized by slow growth, late maturity, small eggs, limited clutch sizes, broodiness, and high chick mortality. To enhance poultry production, the Ethiopian government has introduced exotic breeds, importing egg-laying and dual-purpose commercial chickens to meet the increasing demand for poultry products. However, this has led to continuous gene flow, causing genetic erosion of indigenous

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Received: 29 May 2025; Accepted: 23 June 2025; Published: 15 July 2025



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chicken breeds. The replacement of native breeds with exotic ones, along with uncontrolled crossbreeding, threatens the survival of certain indigenous chicken breeds, putting them at risk of extinction, especially on small-scale farms [2].

Characterization is the foundational step for long-term genetic improvement, serving as the basis for livestock development initiatives and guiding the design of effective breeding programs. It involves describing a breed's origin, development, structure, population, and both quantitative and qualitative traits under specific management and climatic conditions [3].

Breeds can be identified using morphological and molecular methods, with phenotypic characterization being a cost-effective and simple approach [3]. While extensive research has been conducted on indigenous chicken characterization across Ethiopia, including the Amhara region, no recent studies have focused on the Awi Zone, specifically in Banja, Dangila, and Jawi districts. Therefore, gathering baseline data on the morphological traits of indigenous chickens is essential to assess genetic variation and the relationships among different populations.

2. Materials and Methods

2.1. Description of the Study Areas

The study was conducted in Awi Zone, Amhara regional state, Ethiopia. Awi Zone is one of the 11 zones in the region and is named after the Awi sub-group of the Agew people, some of whom reside there. It borders with the Benishangul-Gumuz Region to the west, the Semien Gondar Zone to the north, and Mirab Gojjam to the east. The administrative center of the zone is Injibara.

Awi Zone features relatively flat and fertile terrain, with elevations ranging from 1,200 to 3,100 meters above sea level. The area receives an average annual rainfall of 1,750mm, and monthly temperatures range between 17 °C and 27 °C [4]. This zone is traversed by nine permanent rivers that flow into the Abay (Blue Nile) River. It also has notable water bodies, including the crater lakes Zengena and Tirba, as well as the Zimbiri marsh, located 5 km southwest of Addis Kidam. The livestock population in Awi Zone includes 1,231,447 cattle, 676,509 sheep, 162,576 goats, and 206,035 equines (96,136 horses, 93,052 donkeys, and 16,667 mules), 1,151,708 poultry, and 128,906 bee colonies [5].

Table 1. Description of the study districts.

Variable	Districts		
	Banja	Dangila	Jawi
Temperature	11-19 °C	16-27 °C	32- 40 °C
Rainfall (mm)	2200-2400	1500-2200	700-1200

Variable	Districts		
Altitude (m. a. s. l)	2300-2870	2137	1225
Human Population	101,300	158,688	71,357
Poultry population	92,106	116,854	107,124
Cattle population	171,221	182,383	169,574
Sheep population	50,562	52,654	42,876

Source: [6]

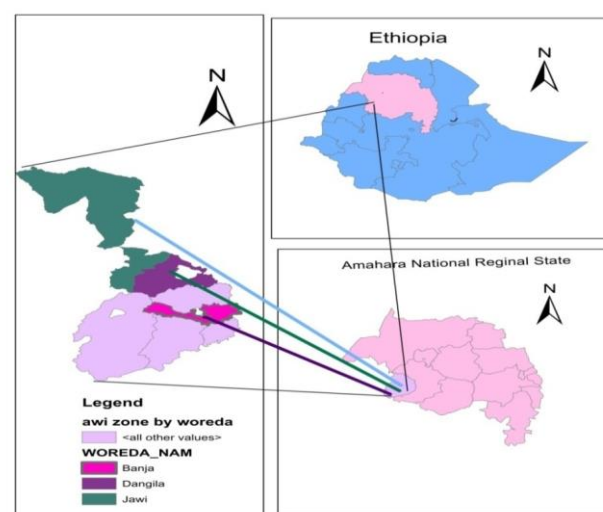


Figure 1. Map of the study districts.

2.2. Sampling Techniques and Sample Size Determination

A preliminary field survey was conducted before the main study to confirm the geographical distribution, concentration, and population size of indigenous chickens. This survey also helped identify the peasant associations within each sample district and establish a sampling framework for selecting districts. The districts were categorized into three agro-ecological zones: highland, midland, and lowland. Based on their potential for chicken production, Banja was selected from the highland zone, Dangila from the midland, and Jawi from the lowland. In consultation with the district agricultural offices, selection criteria such as indigenous chicken population size, production potential, and road accessibility were considered. As a result, three peasant associations per district and a total of nine rural peasant associations were purposively chosen for phenotypic measurements.

2.3. Data Collection

2.3.1. Qualitative Traits

Through direct observation of sexually mature chickens

and additional details provided by their owners, a total of 486 chickens, each at least six months old (162 from each district), were used to collect qualitative traits. These traits included feather distribution, plumage color, comb type, shank feathering, beak color, shank color, earlobe color, eye color, and head shape, following the standard breed descriptor list [3]. Data on these qualitative characteristics were recorded by photographing each surveyed chicken.

2.3.2. Quantitative Traits

For linear body measurements, 486 adult indigenous chickens, each over six months old, were selected by asked chicken owners. Of these, 162 (1%) were cocks (male chickens) and 324 (2%) were hens (female chickens), following [7] guidelines. Measurements were taken early in the morning to prevent feeding and watering from affecting the chickens' size and body conformation. Following the [3] methodology, the linear body measurements included body weight, chest circumference, shank length, neck length, body length, wingspan, wattle width, wattle length, earlobe length, beak length, comb length, and comb width. Body dimensions were recorded to the nearest centimeter, while body weight was measured in kilograms using a spring balance.

2.4. Data Management and Statistical Analyses

The qualitative and quantitative traits of the indigenous chicken populations were entered and coded in statistical package for the social science (SPSS version 22) for analysis. Descriptive statistics were used to summarize the qualitative data, and the chi-square (χ^2) test was applied to compare categorical variables for significance across different agro-ecologies. For the analysis of linear body measurements, the General Linear Model (PROC GLM) procedure in SAS 9.0 was employed, considering fixed effects such as agro-ecology, sex, and their interactions. Means were compared using Duncan's multiple range test, with values considered significant at $P < 0.05$. Additionally, correlation analysis was performed to explore the relationships between quantitative morphological traits.

The statistical model used for linear body measurements were:

$$Y_{ijk} = \mu + A_i + B_j + AB_{ij} + e_{ijk}$$

Where: Y_{ijk} : The corresponding quantitative trait of indigenous chicken in the i^{th} agro-ecology and j^{th} sex

μ : overall population mean for the corresponding quantitative trait

A_i : fixed effect of i^{th} agro-ecology (i = highland, midland, and lowland)

B_j : fixed effect of j^{th} sex (j =male & female)

AB_{ij} : interaction effect of agro-ecology and sex

e_{ijk} : residual error

3. Results and Discussions

3.1. Variation in Qualitative Traits

Table 2 presents the qualitative traits of the indigenous chicken population in Awi Zone, Amhara Region, Ethiopia. The study found that 95.9% of the chickens were predominantly normal feathered, while 3.9% had naked-neck traits. This finding is consistent with [8], who reported that 95% of chickens in Bench Maji Zone, South-Western Ethiopia, were normal, feathered, with the remaining 5% being naked-neck. Similarly, [9] observed that 75.9-83.6% of local chickens in West Hararge Zone, Oromia Region, Ethiopia, had normal feathers, while 3.2-5% was naked-neck and 12.3-20% was crested. The naked-neck gene is considered important for heat tolerance and overall fitness in tropical chickens. The low frequency of this trait may be due to farmers' preferences against naked-neck chickens, which has led to the selection against this gene. This poses a threat to the adaptation of chickens to tropical conditions, particularly in lowland areas, unless conservation efforts are made to preserve this valuable genetic trait.

The predominant plumage color of indigenous chickens in the study area was red (39.9%), followed by white (17.5%) and grayish (*Gebsema*) (17.3%). In the highland region, female chickens primarily had red (38%), white (20.4%), and grayish (16.7%) plumage, while male chickens displayed red (40.7%), white (13.0%), grayish (16.7%), and *Teterma* (14.8%). In the midland, the majority of female chickens exhibited red (44.4%), white (18.5%), and grayish (14.8%) plumage, while male chickens were characterized by red (37%), white (18.5%), and multi-colored (16.7%) plumage. In the lowland, female chickens were mostly red (38%), *Gebsema* (21.3%), and white (16.7%), while male chickens were red (40.7%), white (14.8%), and *Gebsema* (11.1%). The preference for red and white plumage could be attributed to random mating, natural selection, and farmers' preference for these colors, as they influence consumer demand in the market. This finding aligns with Agide (2015), who observed similar plumage colors in North Shewa Zone, Amhara Region, Ethiopia. Likewise, [8] found that red, *Gebsema*, and white plumage were common in chickens in Bench Maji Zone, South Western Ethiopia. Feather color variations are influenced by genetic differences, including sex-linked traits and gonadotropic hormones [11].

The most common beak colors across all agro ecologies were yellow (38.7%), white (30.2%), red (22.8%), and black (8.2%). In the highland, female chickens had white (36.1%) and yellow (35.2%) beaks, while male chickens primarily had yellow (48.1%), red (22.2%), and white (22.2%) beaks. In the midland, both female and male chickens had predominantly white, red, and yellow beaks. Similarly, yellow, white, and red beaks were most common in the lowland for both sexes. This variation in beak color is likely due to differences in breed types among indigenous chicken ecotypes. The study also

found that the most common comb type was double (61.9%), followed by pea (22.4%) and single (15.6%) combs. Double combs were dominant in both male and female chickens across all agro ecologies, which is consistent with the findings of [9]. In contrast, [12] reported that indigenous chickens in Tanzania predominantly had single combs. Combs play an essential role in heat dissipation, which is especially important in the tropical climate where high temperatures prevail.

The majority of indigenous chickens in the study area (93.6%) did not have shank feathers. This is in line with findings from [8, 13], who also observed a high percentage of chickens without shank feathers in other parts of Ethiopia. The predominant shank colors in the study area were yellow (33.3%), red (29.2%), white (22.2%), black (9.7%), and

brown (5.6%). In the highland, female chickens had yellow (40.7%), red (29.6%), and white (19.4%) shanks, while male chickens had white (29.6%), red (25.9%), and yellow (14.8%) shanks. In the midland, female chickens mostly had yellow (44.4%), red (23.1%), and white (19.4%) shanks, while male chickens had yellow (37%), red (24.1%), and white (18.5%) shanks. The preference for a deep yellow shade in shanks among buyers may be linked to consumer preferences. Additionally, certain poultry diseases, such as coccidiosis, can cause shank pigmentation changes. Yellow pigmentation is linked to carotenoid pigments, while varying shades of black are due to melanic pigments. The findings also align with [8], who observed a high frequency of yellow shanks among indigenous chickens.

Table 2. Qualitative traits of indigenous chicken in the study area.

Agroecology							
	Highland		Midland		Lowland		Overall
Variable	Female (108)	Male (54)	Female (108)	Male (54)	Female (108)	Male (54)	(486)
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Feather distribution							
Normal	108 (100)	50 (92.6)	102 (94.4)	50 (92.6)	106 (98.1)	51 (94.4)	467 (96.1)
Naked neck	-	4 (7.4)	6 (5.6)	4 (7.4)	2 (1.9)	3 (5.6)	19 (3.9)
X ² value /p value		412.971/.000					
Plumage colour							
Red	41 (38)	22 (40.7)	48 (44.4)	20 (37)	41 (38)	22 (40.7)	194 (39.9)
White	22 (20.4)	7 (13.0)	20 (18.5)	10 (18.5)	18 (16.7)	8 (14.8)	85 (17.5)
Black	14 (13)	4 (7.4)	14 (13)	2 (3.7)	13 (12)	2 (3.7)	49 (10.1)
Gebsema	18 (16.7)	13 (24.1)	16 (14.8)	8 (14.8)	23 (21.3)	6 (11.1)	84 (17.3)
Teterma	9 (8.3)	8 (14.8)	7 (6.5)	5 (9.3)	9 (8.3)	5 (9.3)	43 (8.8)
Multi colour	4 (3.7)	-	3 (2.8)	9 (16.7)	4 (3.7)	11 (20.4)	31 (6.4)
X ² value /p value		219.284/.000					
Beak colour							
White	39 (36.1)	12 (22.2)	41 (38)	11 (20.4)	33 (30.6)	11 (20.4)	147 (30.2)
Yellow	38 (35.2)	26 (48.1)	34 (31.5)	29 (53.7)	36 (33.3)	25 (46.3)	188 (38.7)
Red	22 (20.4)	12 (22.2)	21 (19.4)	10 (18.5)	32 (29.6)	14 (25.9)	111 (22.8)
Black	9 (8.3)	4 (7.4)	12 (11.1)	4 (7.4)	7 (6.5)	4 (7.4)	40 (8.2)
X ² value /p value		97.325/.000					
Eye colour							
Red	34 (31.5)	12 (22.2)	31 (28.7)	14 (25.9)	35 (32.4)	12 (22.2)	138 (28.4)
Orange	38 (35.2)	28 (51.9)	38 (35.2)	28 (51.9)	40 (37)	30 (55.6)	202 (41.5)

Agroecology							
	Highland		Midland		Lowland		Overall
Variable	Female (108)	Male (54)	Female (108)	Male (54)	Female (108)	Male (54)	(486)
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Brown	22 (20.4)	3 (5.6)	25 (23.1)	2 (3.7)	18 (16.7)	3 (5.6)	73 (15)
Blue	14 (13)	11 (20.4)	14 (13)	10 (18.5)	15 (13.9)	9 (16.7)	73 (15)
X ² value/p value		94.29/.000					
Comb type							
Double	65 (60.2)	36 (66.7)	61 (56.5)	34 (63)	66 (61.1)	39 (72.2)	301 (61.9)
Pea	31 (28.7)	8 (14.8)	34 (31.5)	9 (16.7)	21 (19.4)	6 (11.1)	109 (22.4)
Single	12 (11.1)	10 (18.5)	13 (12)	11 (20.4)	21 (19.4)	9 (16.7)	76 (15.6)
X ² value/p value		182.259/.000					
Head shape							
Plain	44 (40.7)	15 (27.8)	45 (41.7)	24 (44.4)	42 (38.9)	36 (66.7)	206 (42.4)
Crest	64 (59.3)	39 (72.2)	63 (58.3)	30 (55.6)	66 (61.1)	18 (33.3)	280 (57.6)
X ² value/p value		11.267/.001					
Ear lobe colour							
White	28 (25.9)	18 (33.3)	29 (26.9)	10 (18.5)	27 (25)	19 (35.2)	131 (27)
Red	32 (29.6)	18 (33.3)	31 (28.7)	14 (25.9)	39 (36.1)	19 (35.2)	153 (31.5)
Black	5 (4.6)	-	7 (6.5)	-	3 (2.8)	2 (3.7)	17 (3.5)
White & red	43 (39.8)	18 (33.3)	41 (38)	30 (55.6)	39 (36.1)	14 (25.9)	185 (38.1)
X ² value/p value		131.975/.000					
Shank feather							
Present	-	4 (7.4)	7 (6.5)	6 (11.1)	10 (9.3)	6 (11.1)	31 (6.4)
Absent	108 (100)	50 (92.6)	101 (93.5)	48 (88.9)	98 (90.7)	48 (88.9)	455 (93.6)
X ² value/p value		369.91/.000					
Shank colour							
Yellow	44 (40.7)	8 (14.8)	48 (44.4)	20 (37)	34 (31.5)	8 (14.8)	162 (33.3)
Red	32 (29.6)	14 (25.9)	25 (23.1)	13 (24.1)	45 (41.7)	13 (24.1)	142 (29.2)
White	21 (19.4)	16 (29.6)	21 (19.4)	10 (18.5)	23 (21.3)	17 (31.5)	108 (22.2)
Black	5 (4.6)	12 (22.2)	7 (6.5)	6 (11.1)	3 (2.8)	14 (25.9)	47 (9.7)
Brown	6 (5.6)	4 (7.4)	7 (6.5)	5 (9.3)	3 (2.8)	2 (3.7)	27 (5.6)
X ² value/p value		141.67/.000					

N= sample size, X²=chi square test

3.2. Variation in Quantitative Traits

The body weight (kg) and linear body measurements (cm)

of indigenous chickens across different agro-ecologies, sexes, and interaction effects are shown in Table 3. All quantitative traits exhibited highly significant differences ($P < 0.001$) between males and females, with male chickens showing higher

body weights and measurements than females. This indicates sexual dimorphism, which can be attributed to the higher levels of male sex hormones responsible for greater muscle development in males [14].

The overall average wing span of indigenous chickens across agro-ecologies was 37.10 ± 1.57 cm. Male chickens had an average wing span of 37.68 ± 1.42 cm, while females had 36.82 ± 1.57 cm, with a highly significant difference ($P < 0.0001$) between sexes. This finding aligns with [15], who reported similar results in the Eastern Amhara Region, Ethiopia. However, there was no significant interaction effect ($P > 0.05$) between agro-ecology and sex for wing span.

The overall mean wattle length across agro-ecologies was 2.33 ± 0.15 cm. Wattle length varied significantly across the agro-ecologies, with the lowest values in the highland (2.31 ± 0.13 cm) and midland (2.32 ± 0.14 cm), and the highest in the lowland (2.36 ± 0.18 cm). This variation is due to environmental factors, as wattles help with heat dissipation in hot climates. Male chickens had a significantly higher average wattle length (2.46 ± 0.15 cm) than females (2.27 ± 0.12 cm). These results were lower than those reported by [15] the average wattle length of male and female chicken in the eastern Amhara, region Ethiopia was 2.8 ± 0.1 and 2.7 ± 0.1 cm, respectively.

The overall mean chest circumference of indigenous chickens across agro-ecologies was 27.41 ± 1.59 cm, with no significant difference ($P > 0.05$) across agro-ecologies. However, male chickens had a significantly larger chest circumference (28.15 ± 1.4 cm) than females (27.03 ± 1.56 cm), which is likely due to sexual dimorphism and higher male sex hormones promoting greater muscle development. This finding is similar to the results of [16] who reported that the average chest circumference of male and female chicken in Ethiopia was 28.85 ± 0.36 and 27.22 ± 0.24 cm, respectively.

The overall mean shank length was 8.30 ± 1.57 cm, with no significant difference ($P > 0.05$) across agro-ecologies. Male chickens had significantly longer shanks (8.93 ± 1.28 cm) than females (7.98 ± 1.31 cm). This result was lower than the findings of [16] who reported that the shank length of male and female indigenous chicken in Ethiopia was 9.99 ± 0.12 and 8.51 ± 0.08 cm, respectively. Similarly, [19] who indicated that the average shank length of male and female chicken in Guji zone of Oromia national regional state, Ethiopia was 9.7 ± 0.10 and 8.0 ± 0.05 cm, respectively. Longer shank lengths are advantageous for avoiding predators and improving heat dissipation in tropical climates.

pation in tropical climates.

The overall mean body weight of indigenous chickens was 1.53 ± 0.31 kg, with no significant difference ($P > 0.05$) across agro-ecologies. Male chickens had an average weight of 1.67 ± 0.31 kg, while females weighed 1.47 ± 0.29 kg. The average body weight of indigenous chicken had a highly significant difference ($P < 0.0001$) between male and female chicken ecotype. Similarly, [16, 17] reported that the average body weight of male and female chicken in Ethiopia and in Sheka Zone, South Western Ethiopia was 1.69 ± 0.03 and 1.29 ± 0.02 ; 1.68 ± 0.2 and 1.42 ± 0.2 kg, respectively. The variation in body weight may be attributed to inaccuracies in weighing scales, individual measurement differences, the chicken's age, and seasonal variations in feed availability.

The overall mean body length was 37.09 ± 1.25 cm, with no significant difference ($P > 0.05$) across agro-ecologies. Male chickens had an average body length of 37.37 ± 1.47 cm, while females had 36.95 ± 1.10 cm. These results are consistent with the findings of [10, 18] reported that the average body length of male and female local chicken in north Shewa zone, Amhara, Ethiopia and in Benishangul-Gumuz Region, Western Ethiopia was 37.82 ± 0.20 and 36.57 ± 0.08 ; 37.8 ± 4.32 and 35.31 ± 3.29 cm, respectively. However, the current findings were lower than the report of [19], who indicated that the average body length of male and female chicken in guji zone of Oromia national regional state, Ethiopia was 43.4 ± 0.36 and 38.9 ± 0.17 cm, respectively.

The overall mean comb length across agro-ecologies was 2.47 ± 0.31 cm, with significant differences ($P < 0.001$) across the agro-ecologies. The lowland area had the longest comb length (2.53 ± 0.39 cm), which may be attributed to the comb's role in heat loss in hot environments. This result is similar to [10], who reported similar comb lengths in the North Shewa Zone, Amhara. There was also a significant interaction effect ($P < 0.0001$) between agro-ecology and sex for comb length.

The overall mean neck length was 11.55 ± 1.17 cm, with significant differences ($P < 0.05$) across agro-ecologies. This variation may be due to genetic and environmental factors. Male chickens had a longer neck (12.02 ± 1.24 cm) compared to females (11.3 ± 1.06 cm). These findings align with the results of [18] the average neck length of male and female chicken in Benishangul-Gumuz Region, Western Ethiopia, but were lower than those reported by [17], who observed longer necks in chickens from Sheka Zone, South Western Ethiopia.

Table 3. The Mean \pm SD for Quantitative traits of indigenous chicken in different agroecology, sexes and interaction of the study area.

Variables	Agroecology				P value
	Highland	Midland	Lowland	Overall	
WS (cm)	36.98 ± 1.62	37.10 ± 1.57	37.23 ± 1.53	37.10 ± 1.57	0.1938
WL (cm)	2.31 ± 0.13^b	2.32 ± 0.14^b	2.36 ± 0.18^a	2.33 ± 0.15	0.0001

Variables	Agroecology				
	Highland	Midland	Lowland	Overall	P value
BL (cm)	2.32±0.14	2.35±0.15	2.33±0.14	2.33±0.14	0.2344
CC (cm)	27.26±1.47	27.47±1.51	27.49±1.78	27.41±1.59	0.1118
SL (cm)	8.29±1.43	8.25±1.23	8.35±1.44	8.30±1.37	0.5569
BW (kg)	1.54±0.31	1.52±0.31	1.54±0.30	1.53±0.31	0.5547
EAL (cm)	1.68±0.30	1.69±0.32	1.69±0.31	1.69±1.25	0.8124
BD L (cm)	37.02±1.24	37.22±1.31	37.04±1.2	37.09±1.25	0.0856
CL (cm)	2.42±0.24 ^b	2.46±0.27 ^b	2.53±0.39 ^a	2.47±0.31	<0.0001
CW (cm)	2.34±0.22 ^b	2.36±0.25 ^a	2.37±0.28 ^a	2.36±0.25	0.0148
WW (cm)	2.10±0.50	2.06±0.59	2.09±0.54	2.08±0.55	0.9874
NL (cm)	11.39±1.15 ^b	11.66±1.19 ^a	11.60±1.15 ^a	11.55±1.17	0.0176

Table 3. Continued.

Variables	Sex		Sex*agroecology	
	Male	Female	P value	P value
WS (cm)	37.68±1.42 ^a	36.82±1.57 ^b	<0.0001	0.3844
WL (cm)	2.46±0.15 ^a	2.27±0.12 ^b	<0.0001	0.4632
BL (cm)	2.361±0.12 ^a	2.32±0.15 ^b	0.0019	0.4818
CC (cm)	28.15±1.4 ^a	27.03±1.56 ^b	<0.0001	0.1139
SL (cm)	8.93±1.28 ^a	7.98±1.31 ^b	<0.0001	0.0345
BW (kg)	1.67±0.31 ^a	1.47±0.29 ^b	<0.0001	0.750
EAL (cm)	1.86±0.18 ^a	1.6±0.33 ^b	<0.0001	0.2988
BD L (cm)	37.37±1.47 ^a	36.95±1.1 ^b	0.0006	0.1200
CL (cm)	2.75±0.35 ^a	2.33±0.16 ^b	<0.0001	<0.0001
CW (cm)	2.59±0.23 ^a	2.24±0.16 ^b	<0.0001	0.0006
WW (cm)	2.44±0.31 ^a	1.91±0.55 ^b	<0.0001	0.2480
NL (cm)	12.02±1.24 ^a	11.3±1.06 ^b	<0.0001	0.1049

^{a b} Means in a row with different superscript letters denote significant differences at (P<0.05); WS= wing span, WL=wattle length, BL=beak length, CC= chest circumference, SL= shank length, BW= body weight, EAL= ear lobe length, BDL= body length, CL=comb length, CW= comb width, WW= wattle width, NL= neck length

3.3. Correlation Between Body Weight and Other Linear Body Measurements

The correlation coefficients (r) between live body weight and other linear body measurements for the sampled chicken population in the study area are presented in Table 4. Positive

correlations were observed between body weight and various body measurements, with highly significant correlations (P<0.01) between body weight and comb length (r=0.25), comb width (r=0.20), earlobe length (r=0.19), chest circumference (r=0.12), and shank length (r=0.17). These positive correlations suggest that assessing any of these body measurements can serve as a predictor for the body weight of indigenous chickens in rural farming contexts. This implies that

improvements in traits such as shank length and chest circumference could lead to corresponding increases in body weight. The observed effects may be attributed to pleiotropic or gene linkage between these traits in indigenous chickens.

Additionally, a significant positive correlation ($P < 0.05$) was found between body weight and wattle length ($r = 0.12$), and between body weight and beak length ($r = 0.10$). However, no significant correlations ($P > 0.05$) were observed between body weight and wing span ($r = 0.09$) or neck length ($r = 0.06$). These findings are consistent with the results of [19], who

reported that live body weight was positively correlated ($r = 0.73, 0.61, P < 0.01$) with chest circumference and shank length, respectively. Overall, understanding the relationships between body weight and linear body measurements is crucial for breed or species identification and for assessing the economic value of poultry. Furthermore, these relationships are valuable for predicting body weight and can be effectively utilized in selection and breeding programs for indigenous chickens.

Table 4. Correlation coefficient between body weight & other linear body measurements of indigenous chicken in the study area.

Traits	BW	WS	WL	BL	CS	SL	EL	BD L	CL	CW	WW	NL
BW												
WS	0.09 ^{ns}											
WL	0.12 [*]	0.26 ^{**}										
BL	0.10 [*]	0.32 ^{**}	0.30 ^{**}									
CS	0.12 ^{**}	0.43 ^{**}	0.30 ^{**}	0.30 ^{**}								
SL	0.17 ^{**}	0.31 ^{**}	0.35 ^{**}	0.22 ^{**}	0.24 ^{**}							
EL	0.19 ^{**}	0.11 [*]	0.29 ^{**}	0.07 ^{ns}	0.14 ^{**}	0.22 ^{**}						
BD L	0.09 [*]	0.11 [*]	0.24 ^{**}	0.06 ^{ns}	0.02 ^{ns}	0.02 ^{ns}	0.04 ^{ns}					
CL	0.25 ^{**}	0.21 ^{**}	0.54 ^{**}	0.19 ^{**}	0.41 ^{**}	0.22 ^{**}	0.33 ^{**}	0.09 ^{ns}				
CW	0.20 ^{**}	0.23 ^{**}	0.41 ^{**}	0.07 ^{ns}	0.34 ^{**}	0.16 ^{**}	0.30 ^{**}	0.12 ^{**}	0.54 ^{**}			
WW	0.13 ^{**}	0.09 [*]	0.27 ^{**}	0.05 ^{ns}	0.14 ^{**}	0.20 ^{**}	0.18 ^{**}	0.08 ^{ns}	0.34 ^{**}	0.35 ^{**}		
NL	0.06 ^{ns}	0.25 ^{**}	0.32 ^{**}	0.29 ^{**}	0.14 ^{**}	0.07 ^{ns}	0.24 ^{**}	0.29 ^{**}	0.22 ^{**}	0.29 ^{**}	0.21 ^{**}	

** . Correlation is significant at 0.01 levels (2-tailed); * . Correlation is significant at 0.05 levels (2-tailed); ns. Correlation is not significant at 0.05 levels (2-tailed). BW= Body Weight; WS= Wing Span; WL = Wattle Length; BL = Beak Length; CS = Chest Circumference; SL= Shank Length; EL= Earlobe Length; BDL= Body Length; CL = Comb Length; CW = Comb width; WW = wattle width; NL = Neck length

SPSS Statistical Package for the Social Science

4. Conclusions and Recommendations

The indigenous chicken populations in the study area exhibited significant qualitative and quantitative variations. This variability presents substantial opportunities for breeders to enhance genetic improvement through selective breeding and crossbreeding of different indigenous chicken ecotypes. Additionally, further research utilizing molecular techniques is required to assess the genetic variation and relationships among the indigenous chicken populations.

Abbreviations

CSA Central Statistical Agency
GLM General Linear Model
SAS Statistical Analysis System

Acknowledgments

The authors would like to thank chicken owners in Dangila, Banja and Jawi district for on condition that they are participated while the data are collected. We would also like to appreciate the study communities, Kebele livestock experts, district experts and zone experts, who have participated while the data are collected in the study area.

Author Contributions

All authors contributed equally to this research work. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

The paper meets all applicable standards with regard to ethics and integrity. As a researcher and educator in animal breeding and genetics and along with the co-author, the paper has been submitted with full responsibility, following due ethical procedure, and there is no duplicate publication, fraud or plagiarism.

Availability of Data and Material

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Central Statistical Agency (CSA) (2017/18). Agricultural sample survey. Report on livestock and livestock characteristics (private peasant holdings); volume II, federal democratic republic of Ethiopia, Addis Ababa, Ethiopia.
- [2] Tassew, M. (2023). A review of genetic diversity erosion in Ethiopia's local chicken gene pool: implications on determination of suitable breeding and conservation strategies. *World's poultry science Journal*. <http://www.fao.org/10.1080/00439339.2023.2262436>
- [3] Food and Agriculture Organization of the United Nations (FAO) (2012). Draft guidelines on phenotypic characterization of animal genetic resources, Commission on Genetic Resources for Food and Agriculture, 13th Regular Session, 18–22 July, 2011, Rome available at <http://www.fao.org/docrep/meeting/022/am651e.pdf>
- [4] Nigatu K, Teshome F (2012). Population dynamics of cattle ectoparasite in western Amhara regional state Ethiopia. *Journal of veterinary medicine and animal health*, 4(1): 22-26.
- [5] Central Statistical Authority (CSA) (2016). Agricultural Sample Survey. Report on Livestock and Livestock Characteristics 2016/17 [2009 E. C] Volume II. Federal Democratic Republic of Ethiopia Central Statistical Agency. 573 Statistical Bulletin. Addis Ababa, Ethiopia.
- [6] OARD. (2019). *Office of Agriculture and Rural Development, Awi Zone Report*. Awi Zone, Amhara Region, Ethiopia.
- [7] FAO. (2011). *Guidelines for the measurement of animal production characteristics*. Food and Agriculture Organization of the United Nations, Rome, Italy.
- [8] Getachew B, Kefelegn K, Negassi A (2015). On-farm Phenotypic Characterization of Indigenous Chicken and their Production System in Bench Maji Zone, South Western Ethiopia. *Science, Technology and Arts Research Journal*, 4(1): 68-73.
- [9] Bogale W, Yosef T, Negassi A (2019). On farm phenotypic characterization of indigenous chicken ecotypes in west Hararghe zone, Oromia region, Ethiopia. *J Vet Med Animal Science* 2(1): 1009.
- [10] Agide Y (2015). On farm phenotypic characterization of indigenous chicken and chicken production practices in north Shewa zone, Amhara, Ethiopia. M. sc. thesis, Haramaya University, Ethiopia.
- [11] Bell DD (2002). Anatomy of the Chicken. In D. D. Bell and W. D. Weaver. *Commercial Chicken Meat and Egg Production*. U. S. A. 5: 45-46.
- [12] Badubi SS, Rakereng M, Marumo M (2006). Morphological characteristics and feed resources available for indigenous chickens in Botswana. *Livestock Res. Rural Dev.* 18(1).
- [13] Emebet M, Singh H, Tesfaye S, Johansson AM (2014). Phenotypic characterization of indigenous chicken population in south west and south part of Ethiopia. *British journal of poultry sciences*, 3(1): 15-19.
- [14] Jansson, J. O. Ed  n, S., and Isaksson, O. 1985. Sexual dimorphism in the control of growth hormone secretion. *Endocrine reviews*. 6(2): 128-150.
- [15] Addis G, Mebratu M, Yared A (2014). Phenotypic characterization of indigenous chicken ecotypes in the eastern Amahara, region Ethiopia. *Glob. J. Anim. Breed. Genet.* 2(4): 079-085.
- [16] Eskindir A, Tadelle D, Banerjee AK (2013). Phenotypic Characterization of Indigenous Chicken Population in Ethiopia. *International Journal of Interdisciplinary and Multidisciplinary Studies*. 1: 24-32.
- [17] Hailu A, Aberra M (2018). Morphological and Morph metric Characterization of Indigenous Chicken Populations in Sheka Zone, South Western Ethiopia. *Poult Fish Wild Sci.* 6: 200.
- [18] Habtamu A, Alemayehu A, Fekadu B, Kedja A (2019). Phenotypic Characterization of Local Chicken Ecotypes of Benishangul-Gumuz Region, Western Ethiopia. *Journal of Biology, Agriculture and Healthcare*, 9(7).
- [19] Abebe H, Manaye M, Abrahm A (2017). On-farm phenotypic characterization of indigenous chicken populations in guji zone of Oromia national regional state, Ethiopia. *International Journal of Development Research*, 07: 16652-16661.