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Review Article

Review on Phenotypic Characterization of Indigenous Chicken and Farmer Breeding Trait Preference Ecotypes in Sekela Woreda, Northern Ethiopia

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Abstract: This study was conducted in Sekela woreda in Surba Bifeta and Gisha Abay kebeles to characterize chickens phenotypically. A total of 226 chicken owner households were selected randomly. Ten qualitative traits from 446 local chickens and eleven quantitative traits from 48 local chickens were used. The overall predominant plumage color of chicken in the study area were red (34.4%) followed by gray mixture (17.7%) and brownish (17.3%). The commonest comb color observed was red color combs. The majority of chickens possessed comb shape was double shape (44.6%), followed by single (38.8%) comb shape. Double comb shape was predominant in male chicken in Surba Bifeta than Gish Abay Sekela. The result indicated that crest head shape were the common predominant observed head shape in Surba Bifeta both female (40.5%) and male (32.8%). while flat plain head shape were highest proportion observed in Gish Abay both female (86.5%) and male (91.2%), thus there was significancely ($p<0.05$) differences in head shape between the study area. The overall predominant earlobe color was red (36.1%) followed by red and white (34.3%). Almost all chickens (91.6%) of the study area were not having spurred. The spurs were more proportion observed in male chickens similarly in both study rather than female chickens. The predominant observed eye coloration was orange color in both study area. The most observed predominant feather distributions were normal feathered. The most predominant observed shank color was white (44.2%) followed by yellow (28.5%). Almost all chicken in the study area had no Shank feathers. The plumage color, comb type, sex of chicken, shank color, smoothness of shank, and body size were the major factors that cause vary in the price of chickens. The selection criteria of farmers' used to breeding hen, egg size, plumage color, broodiness, disease resistance and hatchability was the highest selection criteria and ranking. The quantitative traits were indicated the significance differences ($P<0.05$) were observed between agro ecology with respect to wing spin (17.61), neck length (18.72), spur length (8.42), chest circumferences (28.3), body length (19.66), wing length (22.51), and shank length (11.47), But not significance differences were observed on the body weights (2.36), wattle length (2.33), thigh circumferences (11.40) and breast width (13.09) traits.

Keywords: Chicken Ecotype, Quantitative Trait, Qualitative Trait, Farmers Trait Preference, Selection and Ranking

1. Introduction

Identification and characterization of the chicken phenotypic resources generally requires information on their adaptation to a specific environment, ways of breeding, possession of unique traits of current or future economic value and socio-cultural importance, which are crucial point to decisions on conservation and utilization [34]. Phenotypic characterization includes all activities related with the description of the origin, development, structure, population,

quantitative and qualitative characteristics of the indigenous chicken in defined management and Climatic conditions [12]. Chickens can be characterized by morphological (phenotypic) and molecular tools, however phenotypic characterization is a comparatively easy and cheap tool of indigenous chicken Characterization [6, 12]. Researches on phenotypic characterization of indigenous chickens of Ethiopia have been carried out at Debre Ziet agricultural research center at Southern Nations, Nationalities and Peoples Regional State (SNNPR) and at North Wollo zone of Amhara regional state that has identified a large variations in morphological appearances, conformation and body weights of indigenous chicken is very important to conduct broad studies that can cover the full characteristics of morphological, functional, and adaptive traits [9, 16]. Identifying farmers' breeding objectives, breeding practices and trait preference of local chickens' producers with "people –Centered" perspective. This will serve as a foundation for proper conservation, utilization and phenotypic diversity improvement program.

The unique adaptation features and morphological variations of Ethiopian indigenous chicken populations have been reported by several scholars reported the phenotypic variation of indigenous chicken populations in northwest Ethiopia [17]. Similarly, studies conducted by Duguma R. and Dana Almekinders, T. were focused on the characterization of indigenous chicken populations found at specific locations that may not necessarily represent the genetic resources of indigenous chickens distributed in the whole country in general [9, 7].

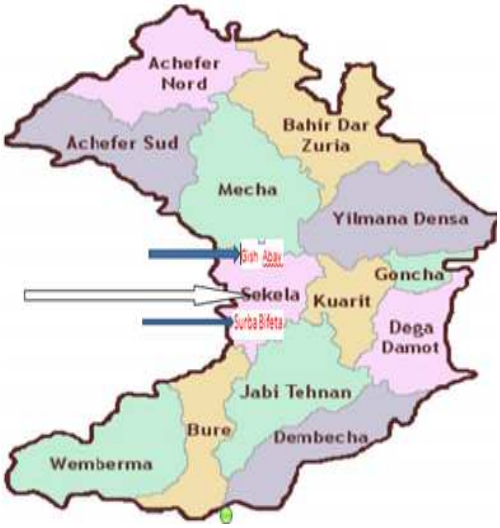
In recently a phenotypic diversity improvement program has been initiated for increasing productivity of indigenous chickens of Ethiopia through selective breeding, quantitative and qualitative trait characterization as a means to improve the livelihood of poor people and conserve the existing phenotypic diversity through utilization [8, 26]. Developing appropriate animal breeding programs for village conditions requires characterizing local chickens in defining the production environments and identifying the breeding practices, production objectives, and trait choices of rural farmers [30]. Therefore, these existing chicken ecotypes have to be characterized for their overall qualities and for subsequent improvement.

Most of the indigenous chickens have evolved through adaptation to various agro climatic conditions. They possess gene combinations and special adaptations not found in other improved modern breed [10]. Variations in major morphological traits such as outline and feather on tours, shank and ear-lobe colors, and comb types are common among indigenous chicken populations [33]. These characteristics provide a basis for grouping according to their phenotypic and morphological appearances. Therefore this study was conducted the following Objectives: (1) to characterization local chicken phenotypic varation ecotype in Sekela district. (2) To characterize local chickens in terms of physical, functional, and adaptive traits in their Production system. (3) To assess farmers' trait preference and breeding selection criteria of chickens in the study area and (4) to quantify farmers' beeding practices.

2. Materials and Methods

2.1. Description of the Study Area

This study was conduct in Sekela Woreda of West Gojjam, Amhara Regional state of Ethiopia on two Kebeles, namely, Surba Bifeta and Gish Abay. Sekela Woreda is located at 459 km North West of Addis Ababa, the capital city of Ethiopia. It is located 160 km South East of Bahir Dar, the capital of Amhara National Regional State.



Source: Sekela Woredas Maps in West Gojjam (2006)

Figure 1. *Showing Location of the study area on map.*

Sekela Woreda is located at an elevation of 3062 meter above sea level. It is bordered on the southwest by Bure Woreda, on the west by Awi Zone, on the north by Mecha Woreda, on the northeast by Yilmana Densa Woreda, on the east by Quarit Woreda and on the southeast by Jabi TehnanWoreda. The administrative center of Sekela Woreda is Gish Abay town. According to CSA (2007), Sekela Woreda consists of 1 urban and 36 rural Kebeles with a total population of 138,691 but (Surba Bifeta >16,000 and Gish Abay> 45000) peoples at recently. With an area of 768.83 square km, it has a population density of 180.39 persons per square km, which is greater than the Zone average of 158.25 persons per square km. Only 4.89% of the total populations are urban residents and the majorities (95.11%) of the populations are rural residents. Besides, from 49.76% male population of the Woreda, 47.31% of them are living in rural areas and the remaining 2.45% are urban residents. In addition to that, from the 50.24% female populations of the Woreda, 47.79% of them are living in the rural areas and the other 2.44% are urban residents (CSA, 2007). The study localities (Kebeles) were selected based on agro climatic zones, i.e. *Woina Dega* (midland) and *Dega* (highland) with altitudinal ranges of 1500–2500 and >2500 m a.s.l, respectively, and the presence of most chicken productivity activities as means of consumption, income and religious sacrifice.

2.2. Sampling Methods

This study was conducted by using structured questionnaires, interview and field surveys in the two Kebeles. A structured questionnaire was designed to collected data both on poultry Production systems and breeding preference of farmer for phenotypic traits values. Before the beginning of the survey the questionnaires was pretested using sample household (HHs) and appropriate adjustments were made on specific contents. The interviews were conducted at farmers' houses with the assistance of local agricultural extension officers to get as required information from each Kebele. The total households used in the study were determined through the formula given by Arsham H [2].

$$N=0.25/SE2$$

Where, N= Sample size,

SE= Standard error, Thus, using the standard error of 0.0333 with 95% confidence level.

2.3. Data Collection

The two study kebeles were purposely selected the one from Surba Bifeta (woina dega) and the other from Gish Abay (dega). The agro ecology Selection of the study area were based on chicken production potential, advancement trait prefers of chickens, community poultry, selection criteria's of chicken ranking, qualitative and quantitative traits. A total of 226 households' (farmers) were randomly selected 116 from Surba Bifeta and 110 from Gish Abay for discussion and interviewed. The sample size were selected based on the willingly of household, number of chickens, financial concerning and, assesse farmer. Data were collected through structured and semi-structured questionnaires, field observation, farmers' discussions, from secondary sources and own flock ranking**.** Information on selection criteria of chicken, breeding objective, trait preference, phenotypic diversification factor that determine the price of chicken like plumage and comb type, were collected through structured and semi-structured questioners, interview, field observation and survey in each study area.

2.3.1. Qualitative Data Collection

From the direct observation of chickens qualitative traits and interviews of households on sexually matured chicken and additional information of the households a total of 446 chickens were considering five-month or above this age. This age was chosen through considering the slow maturation of indigenous chickens to reach the adult age. The chickens' age was determined by interviewed farmers, which was 271 from Surba Bifeta and 175 from Gish Abay were used to collect qualitative data such as plumage color, comb type, feather morphology like feather structure, feather distribution, shank feather presence and absence, presence or absence of spurs, shank color, earlobe color, eye color and head Shape were assessed in local indigenous chicken, based on standard format breed descriptor list of FAO [12].

2.3.2. Quantitative Data Collection

The total of 48 chickens were selected in Surba Bifeta (24) and Gish Abay (24) equivalently, this was depend on the problem of measurement, willing of farmers', and catching of each chicken and required help of second persons to measure. Quantitative traits data were collected on body weight and linear body measure from 48 (Female = 24, Male =24) adult chickens whose age was approximately 20 weeks or above. Based on the methodology developed by FAO, linear body measurements, namely, breast width, thigh circumference, chest circumference, shank length (SL), neck length (NL), body length (BL), wing length, wingspan, wattles length were measured by using a textile measuring tape to the nearest unit Centimeter, While the chicken was standing upright and the Body weight was measured in gram using sensitive balance [12].

2.4. Data Analyses

The qualitative data were analyzed using descriptive statistics [31] and General linear model was employed. The quantitative traits were subjected to analysis of variance (one way ANOVA) and using the general linear model procedure (PROC GLM) of SAS 9.1. The body weight shank ratio was calculated as an index of bird density [15]. The statistical differences were based on ($p < 0.05$). The ranking analyses were used to assess the data on breeding objective, farmers' traits preferences, and conformation traits as related to selection of chicken were used to calculate by the following formula employed by Musa *et al*. [25].

$$Index = \frac{(\sum \mathrm{Rn} \times \mathrm{C1} + \mathrm{Rn}-1 \times \mathrm{C2} \ldots\ldots + \mathrm{R1} \times \mathrm{Cn}) \text{ for individual variable}}{(\sum \mathrm{Rn} \times \mathrm{C1} + \mathrm{Rn}-1 \times \mathrm{C2} \ldots\ldots + \mathrm{R1} \times \mathrm{Cn}) \text{ for all variable}}$$

Where, Rn = the last rank (example if the last rank is 8th, then Rn = 8, Rn-1 = 7, R1 = 1).

Cn = the % of respondents in the last rank, C1 = the % of respondents ranked first.

3. Results

3.1. Qualitative Trait Characterization

3.1.1. Plumage Color

The result indicated as observed and interviewed very diversification plumage color of chickens' population was observed. The brown (26.7%) female and red (67.2%) male were the predominant color in Surba Bifeta, and red color was predominant in Gish Abay both female (29%) and male (67.7%). Brown plumage color female chicken were high proportion in Surba Bifeta and red plumage color was high proportion in Gish Abay but red plumage color cock were similar proportion in both districts. The overall predominant plumage color of local chicken populations were red (34.4%) followed by gray mixture (17.7%) and brownish (17.3%), while plumage Color like white, black, white with red strips, wheaten, black with red strips, and red brownish color which accounted for 4.3%, 6.3%, 1%, 7.6%, 0,7% and 4.9%, were least observed color respectively.

Table 1. *Plumage color characteristics of indigenous chicken population in both study area.*

Qualitative traits	Surba Bifeta (N=271)		Gish Abay (N=175)		over all (N=446)		Sum (n=446)	X^2 values	$P_{-values}$
Plumage color	Female (n=210)	Male (n=61)	Female (n=141)	Male (n=34)	Female (n=351)	Male (n=95)			
	N%	N%	N%	N%	N%	N%	N%		
White	4.8	6.6	2.8	2.9	4.0	5.3	4.5	36.77	0.0001
Black	3.8	1.6	13.5	0.0	7.7	1.1	6.3		
Red	21.4	67.2	29	67.6	24.5	67.4	34.4		
Grayish	23.8	8.2	16.3	2.9	20.8	6.3	17.7		
Multicolor	3.3	9.8	7.8	17.6	5.1	12.6	6.7		
Brownish	26.7	0.0	14.9	0.0	21.9	0.0	17.3		
Golden color	6.7	6.6	0.7	8.8	4.3	7.4	4.9		
Wheaten	6.7	0.0	14.2	0.0	9.7	0.0	7.6		
White with red strips	1.9	0.0	0.0	0.0	1.1	0.0	1		
Black and red	0.95	0.0	0.7	0.0	0.9	0.0	0.7		

Figure 2. *Plumage color of indigenous chicken in the study area.*

3.1.2. Comb Color, Comb Pattern and Head Shape

As the result indicated that the red comb color was dominated both in the female and male chickens, while brown and black comb color was observed least diversification in both districts. The majority of chickens possessed comb shape were double shape (44.6%) followed by single comb shape (38.8%) (Table 3). Double comb shape was predominant in male chicken in Surba Bifeta than Gish Abay. The overall significant was observed ($P<0.05$) between single comb females (42.5%) and double comb males (66.3%). The result indicated that crest head shape was the common predominant observed head shape in Surba Bifeta both female (40.5%) and male (32.8%), while flat plain head shape were highest proportion observed in Gish Abay both female (86.5%) and male (91.2%). The overall most predominant head shape of local chickens was flat plain (71.3%) and lowest observed head shape was crest (28.5%). There was significancely ($p<0.05$) differences between head shape.

Table 2. *Comb color, Comb pattern and Head shape of indigenous chicken in the study area.*

Qualitative traits	Surba Bifeta (N=271)		Gish Abay (N=175)		over all (N=446)		Sum (n=446)	X^2 values	P values
Comb color	Female (n=210)	Male (n=61)	Female (n=141)	Male (n=34)	Female (n=351)	Male (n=95)			
	N%	N%	N%	N%	N%	N%	N%		
Red	94.8	95	94.3	97	94.6	95.8	94.8	12.11	0.52
Brown	2.9	4.9	1.4	2.9	2.3	4.2	2.7		
Black	2.4	0.0	4.3	0.0	3.1	0.0	2.5		
Comb pattern Single	40.5	19.7	45.4	35.3	42.5	25.3	38.8	21.31	0.035
Pea	20.0	8.2	15.6	8.8	18.2	8.4	16.1		
Double	39.5	72.1	39%	55.9	38.7	66.3	44.6		
Head shape Crest	40.5	32.8	13.5	8.8	29.4	24.2	28.5	15.13	0.101
Flat plain	59.5	67.2	86.5	91.2	70.4	75.8	71.3		

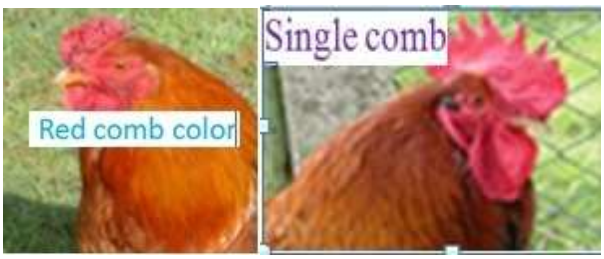


Figure 3. *Some Comb color and patterns of indigenous chicken.*

3.1.3. Earlobe Color and Spur

The result indicated that the overall predominant earlobe color was red (36.1%), followed by white and red (34.3%) and white (28.0), while white and black (0.2%), black (0.9%) and orange (0.4%) were least proportion (Table 4). Almost all chickens (91.6%) of the study area were not having spurred. However 8.4% of the Chickens have spurs. The spurs were more proportion observed in male chickens

Table 3. *Ear lobe color, and Spur presence of indigenous chicken population in the study area.*

Qualitative traits	Surba Bifeta (N=271)		Gish Abay (N=175)		Over all (N=446)		Sum (n=446)	X^2 Values	P Values
Ear lobe color	Female (n=210)	Male (n=61)	Female (n=141)	Male (n=34)	Female (n=351)	Male (n=95)			
	N%	N%	N%	N%	N%	N%	N%		
White	31.9	16.4	31.9	8.8	31.9	13.7	28	7.19	0..813
Red	25.2	62.3	31.2	76.5	26.6	67.4	36.1		
White and red	40.5	21.3	35.5	14.7	38.5	18.9	34.3		
Black	1.4	0.0	0.7	0.0	1.1	0.0	0.9		
White and black	0.0	0.0	0.7	0.0	0.3	0.0	0.4		
Orange	1	0.0	0.0	0.0	0.6	0.0	0.4		
Spur Present	2.8	32.3	0.0	33.3	1.7	32.7	8.4	0.92	0.34
Absent	97.2	67.7	100	66.7	98.3	67.3	91.6		

Figure 4. *Some Earlobe color of indigenous chicken.*

3.1.4. Eye Color and Feather Distribution

The result indicated that predominant observed eye color was orange color in both study area. While brown, yellow, blue, and red were observed least proportion. The overall predominant eye color was orange (96.4%), while brown (1.8%), red (0.7%), blue (0.7%) and yellow (0.4) color was observed in least diversifying in study area (Table 5). The study indicated that the predominant observed feather distribution was normal feathered in both study area. Local chicken as observed were mostly normal feathered, but no necked neck chickens. Feathered shank and feet chickens were hens (1.7%), cock (1.1%).

Table 4. *Eye color and feather distribution of indigenous chicken in the study area.*

Qualitative traits	Surba Bifeta (N=271)		Gish Abay (N=175)		Over all (N=446)		Sum (n=446)	X^2 Values	P Values
Eye color	Female (n=210)	Male (n=61)	Female (n=141)	Male (n=34)	Female (n=351)	Male (n=95)			
	N%	N%	N%	N%	N%	N%	N%		
Orange	94.8	96.7	97.9	100	96	97.9	96.4	41.12	0.0412
Yellow	0.5	0.0	0.7	0.0	0.6	0.0	0.4		
Brown	2.9	3.3	0.0	0.0	1.7	2.1	1.8		
Blue	0.5	0.0	1.4	0.0	0.9	0.0	0.7		
Red	1.4	0.0	0.0	0.0	0.9	0.0	0.7		
Feather distribution									
Normal	97.7	98.3	99.3	100	97.7	98	98.6	16.18	0.0000
Necked neck	0.0	0.0	0.0	0.0	0.6	0.0	0.0		
Feathered shank & feet	2.4	1.6	0.7	0.0	1.7	1.1	1.6		

3.1.5. Shank Color and Feathers

The commonest shank color observed was white (44.2%), yellow (28.5%), black (9.4%), brown (5.6%), green (5.6%), gray blue (3.4%), red (1.8%), and orange (1.6%). As the result indicated that the most predominant shank color was white (44.2%), followed by yellow (28.5%),

Table 5. *Shank color and feather of indigenous chicken of the study area.*

Qualitative trait	Surba Bifeta (N=271)		Gish Abay (N=175)		Over all (N=446)		Sum (n=446)	X^2 Values	P Values
	Female (n=210)	Male (n=61)	Female (n=141)	Male (n= 34)	Female (n=351)	Male (n=95)			
Shank color	N%	N%	N%	N%	N%	N%	N%		
White	42.9	21.3	59.6	29.4	49.6	24.2	44.2	31.05	0.0043
Red	1.9	6.6	0.0	0.0	1.1	4.2	1.8		
Brown	4.8	0.0	3.5	29.4	4.3	10.5	5.6		
Yellow	33.8	63.9	6.4	23.5	22.8	49.5	28.5		
Black	8.6	4.9	14.2	2.9	10.8	44.2	9.4		
Gray blue	6.7	1.6	0.0	0 0.0	4.0	1.1	3.4		
Green	1.4	1.6	12.8	8.8	6.0	4.2	5.6		
Orange	0.0	0.0	3.5	5.9	1.4	2.1	1.6		
Shank feather Presence	4.8	1.6	0.7	2.9	3.1	2.1	2.9	21.07	0.0081
Absence	95.2	98.4	99.3	97.1	96.9	97.9	97.1		

Figure 5. *Some shank color of indigenous chicken.*

3.2. Quantitative Traits Characterization

As the result indicated that there was significance difference (P<0.05) observed between the study kebele respect to shank length, spur length, chest circumferences but highly significant difference (P<0.01) were observed in body length, neck length, wing span, and wing length, While respect to breast width, wattle length, body weights and thigh circumference was no significant difference.

Table 6. *Means of neck length, shank length, and other body measurements of local chickens (mean ±SE).*

Quantitative traits	Surba Bifeta (N=24)	Gish Abay Sekela (N=24)	Over all (N=48)	F Values	P Values
SL	11.34±0.44**	11.60±0.45**	11.47±0.31**	0.169	0.0083
TC	11.38±0.45*	11.42±0.44*	11.40±0.31*	0.003	0.957
BRWTH	13.06±0.2828*	13.12±0.284*	13.09±0.2*	0.015	0.904
Cc	28.32±1.14**	28.28±1.14**	28.30±0.79**	0.001	0.009
WAL	2.3438±0.071*	2.31±0.08756*	2.33±.056*	0.052	0.820
SPL	4.88±2.52053**	11.96±0.4665**	8.42±1.37**	7.651	0.008
NL	12.32±0.264**	24.85±1.16**	18.72±1.10**	105.207	0.000
BL	26.56±0.174**	12.46±0.508**	19.66±1.071**	713.768	0.000
WL	12.74±0.195**	32.73±0.388**	22.51±1.52**	2179.284	0.000
WS	32.77±0.358**	2.44±0.074**	17.61±2.22**	6867.988	0.000
Bwt	2.39±0.072*	2.32±0.068*	2.36±0.049*	0.409	0.526

Means within row with subscript ** high significantly (p<0.01) and subscript * significantly (p<0.05)
BWT Body Weight, Brwth Breast Width, SPl Spur Length, TC Thigh Circumference, Cc Chest Circumference, SL Shank Length, NL Neck Length, BL Body Length, WL Wing Length, WS Wing Span, WAW Wattle Width, and WAL Wattle Length.

As the result indicated that there was significantly strong positive correlation between shank length with body length (r=0.97), between shank length with neck length (r=0.91), body length with neck length (r=0.99), body length with wing span (r=0.99) neck length with wing span (r=0.98), while positive and negative correlation was observed respecte to body weight, breast width and thigh circumferences and no correlation with other traits but the rest traits has significancely weak correlations (Table 7).

Table 7. *Correlation between shank length, body length and body weight of indigenous chicken in the study area.*

	SL	TC	BRWTH	Cc	WAL	SPL	NL	BL	WL	WS	BWT
SL	1**	0.56	0.47	0.82*	0.91*	0.79*	0.91*	0.97*	0.78*	0.84*	0.63
TC		1**	0.35	0.55	0.47	0.35	0.63	0.44	0.46	0.61	0.63
BRWTH			1**	0.57	0.45	0.55	0.32	0.55	0.27	0.47	0.55
Cc				1**	0.66*	0.78*	0.88*	0.86*	0.71*	0.84*	0.55
WAL					1**	0.78*	0.87*	0.89*	0.97*	0.85*	0.58
SPL						1**	0.88*	0.97	0.35	0.54	0.18
NL							1**	0.99*	0.89*	0.98*	0.32
BL								1**	0.47	0.55	0.44
WL									1**	0.56	0.47
WS										1**	0.32
BWT											1**

Correlation with subscript across the table *show correlation but no subscript no correlation ** Subscripts indicate completely correlated

3.3. Farmers Selection Criteria and Traits of Preference for Indigenous Chicken

3.3.1. Phenotypic Traits Effect on Marketing Values (Price) of Indigenous Chickens

The study indicated that almost all the household respondents' reported that the price of chicken was varied depend on different determinant factors such as quantitative and qualitative traits in each study area. The plumage color (21.7%), comb type (8.4%), sex of chicken (6.2%), shank color (4.4%), plumage color and comb type (15%) and smoothness of shank, and body size (15%) were the major factors that cause variation in the price of chickens, while breed (0.9%), comb and shank, (0.9%), weight and plumage, body size, plumage and shank color, (1.3%), and sex and shank color (4%) were the lowest factors that vary the price of chickens in both study area (Table 8).

Table 8. *Phenotypic traits that determine price of indigenous chicken in the study area.*

Phenotypic traits	Percent of Respondents			X^2 values	P-values
	Surba Bifeta (N=116)	Gish Abay (N=110)	Over all (N=226)		
	N%	N%	N%		
Plumage color	21.6	21.8	21.7	35.8	0.001
Comb types	2.6	14.5	8.4		
Sex of chicken	2.6	10.0	6.2		
Shank color	4.3	4.5	4.4		
Plumage color and comb type	15.5	14.5	15.0		
Smoothness of shank and body size	21.6	8.2	15.0		
Plumage color, comb type and shank color	19.0	9.1	14.2		
Plumage color and shank color	2.6	0.0	1.3		
Plumage color and sex	5.2	7.3	6.2		
Breed	0.9	0.9	0.9		
Body size	0.0	1.8	0.9		
Sex and shank color	4.3	3.6	4.0		
Weight of body	0. 0	1.8	0.9		
Comb and shank	0.0	1.8	0.9		

-Number in bracket is referred to total number of respondents
-N% refers to number of respondents

3.3.2. Phenotypic Traits Used as Selection Criteria for Breeding Chicken

As discussed with Household (Farmers') on selection criteria of hen and cock were shown in (Tables 9 and 10) respectively. The study indicated that the highest selection criteria and ranking criteria of farmers' used for selection of breeding hen was egg size, plumage color, broodiness, disease resistance and hatchability with an average index values 0.131, 0.124, 0.121, 0.105, and 0.082 respectively, while mothering ability, egg number, body size, growth rate, good scavenging, longevity, and fighting ability of hen trait was lowest selection criteria and ranking with average index values of 0.08, 0.071, 0.071, 0.064, 0.056, 0.053 and 0.043, respectively. In the result showed that the selection criteria and ranking of farmers' used for selection of breeding hen was relatively similar in both Surba Bifeta and Gish Abay districts.

Table 9. *Phenotypic traits used as selection criteria of farmers for breeding.*

Selection Criteria	Surba Bifeta (N=116)			Gish Abay (N=110)			over all (N=226)		
Breeding hen	Sum	Index	Rank	Sum	Index	Rank	Sum	Index	Rank
Egg No,	390	0.077	6	261	0.063	8	650	0.071	7
Body size	388	0.077	6	263	0.063	8	649	0.071	7
Growth rate	310	0.061	10	281	0.068	7	589	0.064	8
Hatchability	382	0.076	8	373	0.09	5	753	0.082	5
Mothering ability	442	0.087	5	286	0.069	6	726	0.08	5
Broodiness	571	0.113	3	551	0.132	3	1120	0.121	3
Disease resistance	484	0.096	4	482	0.116	4	964	0.105	4
Egg size	641	0.127	1	569	0.137	1	128	0.131	1
Plumage color	580	0.115	2	566	0.136	1	1144	0.124	2
Fighting ability	266	0.053	10	127	0.031	11	391	0.043	10
Good scavenging	290	0.057	11	222	0.054	9	510	0.056	9
Longevity	313	0.062	9	170	0.041	11	481	0.053	9

Index=the sum of (11 times first order + 10 times second order +…… + 1 times eleventh order) for individual variables divided by the sum of (11 times first order + 10 times second order +…….. + times eleventh order) for all variables.

As the study the quantitative and qualitative traits indicated that the highest ranking and selection criteria of farmers' used for selection of breeding cock was egg number, comb type, plumage color, disease resistance, egg size, growth rate, and good scavenging, with average index values 0.108, 0.106, 0.092, 0.09, 0.085, 0.083, and 0.08 respectively, while broodiness, fertility, hatchability, body size, mothering ability and fighting ability was rank the lowest ranking and selection criteria with an average index values of 0.069, 0.068, 0.065, 0.06, 0.051 and 0.045, respectively (Table 10). In the result showed that the selection criteria of farmers' used for selection of breeding cock were significancely similarly both in Surba Bifeta and Gish Abay districts.

Table 10. *Phenotypic traits used as selection criteria of farmers for breeding cock.*

Selection Criteria	Surba Bifeta (N=116)			Gish Abay (N=110)			over all (N=226)		
Breeding cock	Sum	Index	Rank	Sum	Index	Rank	Sum	Index	Rank
Egg no,	466	0.104	2	480	0.111	1	946	0.108	1
Body size	289	0.064	8	239	0.055	11	528	0.06	9
Growth rate	332	0.074	6	397	0.092	3	729	0.083	5
Hatchability	294	0.065	8	279	0.065	8	573	0.065	8
Mothering ability	237	0.053	10	210	0.049	9	447	0.051	10
Broodiness	329	0.073	6	274	0.064	8	603	0.069	7
Disease resistance	386	0.086	4	402	0.093	3	788	0.09	4
Egg size	416	0.093	3	332	0.08	6	748	0.085	5
Good scavenging	358	0.08	4	340	0.08	6	698	0.08	6
Plumage color	411	0.09	2	401	0.093	3	812	0.092	3
Fighting ability	152	0.034	11	242	0.056	11	394	0.045	11
Fertility	339	0.075	5	259	0.060	8	598	0.068	7
Comb type	483	0.108	1	453	0.105	2	936	0.106	2

Index=the sum of (11 time's first order + 10 time's second order +… + 1 times eleventh Order) for individual variables divided by the sum of (11 times first order + 10 times second Order +…….. + times eleventh order) for all variables.

3.3.3. Owners Preference of Chicken Traits for Improvement

Phenotypic trait preference of household wanted to be improved chicken that given a choice of farmers in Surba Bifeta were comb type, plumage color, meat quality, broodiness, disease resistance, fertility, growth, egg number, body size, mothering ability and temperament with Index value 0.126, 0.111, 0.081, 0.085, 0.082, 0.074, 0.069, 0.06, 0.055, 0.054, and 0.039 respectively. Similarly in Gish Abay plumage color, comb type, meat quality, fertility, disease resistance, broodiness, growth rate and mothering ability were the major improved prefer traits with index values 0.120, 0.119, 0.093, 0.088, 0.084, 0.08, 0.072, and 0.059 respectively. There was no significant difference in the ranking of traits preference for genetic improvement with respect to the agro-ecological zones of the study areas.

Table 11. *Owners' preference of chicken trait for improvement.*

	Surba Bifeta (N=116)			Gish Abay (N=110)			over all (N=226)		
Trait Preferred	**Sum**	**Index**	**Rank**	**Sum**	**Index**	**Rank**	**Sum**	**Index**	**Rank**
Comb type	751	0.126	1	662	0.119	2	1413	0.123	1
Plumage color	659	0.111	2	667	0.120	1	1326	0.115	2
Meat quality	484	0.081	6	518	0.093	4	1002	0.087	3
Disease resistance	487	0.082	5	464	0.084	6	951	0.083	5
Broodiness	504	0.085	4	444	0.08	7	948	0.082	4
Fertility	442	0.074	7	489	0.088	5	931	0.080	6
Growth rate	411	0.069	8	398	0.072	8	809	0.070	7
Egg number	356	0.060	9	267	0.048	10	623	0.054	8
Mothering ability	320	0.054	11	325	0.059	9	645	0.056	8
Body size	328	0.055	10	250	0.045	11	578	0.050	10
Prolificacy	214	0.036	14	247	0.044	12	461	0.040	11
Temperament	252	0.042	13	164	0.030	13	416	0.036	12
Heat resistance	264	0.044	12	124	0.022	15	370	0.032	13
Drought resistance	176	0.030	15	123	0.022	15	299	0.026	14
Good scavenging	130	0.022	16	111	0.02	18	241	0.021	15
Egg shell color	87	0.015	17	118	0.021	17	205	0.018	16
Chicken shape	39	0.007	18	165	0.030	13	204	0.017	17
Egg yolk color	38	0.006	18	14	0.003	19	52	0.005	18

Index=the sum of (12 time's first order + 11 time's second order +… + 1 times twelfth order) for individual variables divided by the sum of (12 time's first order + 11 time's second order +… … ….. + Times twelfth order) for all variables.

4. Discussion

In the study qualitative traits characterization of indigenous chickens showed heterogeneity and diverse plumage color were red, grayish, brownish, wheaten, multi-color, black, white, red brownish, black with red strips, white with red strips constituted as 34.4%, 17.7%, 17.3%, 7.6%, 6.7%, 6.3%, 4.3%, 4.9%, 0.7% and 1% respectively (Table 2). This result is line up with study conducted by Daikwo I. S. and Halima H. reported that 25.49% white, 7.79% black, 16.44% red, 22.23% gebisama and 13.64% black with white strips in North West Ethiopia [6, 17] and also reported by Duguma R. alike variations plumage color of Horro, Tepi and Jarso indigenous chickens [9]. According to Ensminger E. M. plumage colors such as white or light colored feathers have become an important factor in breeding because they are easier to pick clean and preferred for appearance of skeleton and wise body parts have market consequences [11]. The large variations of plumage colors can be the outcome of their geographical isolation and periods of natural and artificial selections.

Morphological characteristics of leg region of indigenous chickens Variations were observed in shank color were white, yellow, black, brow, green, gray blue, red, and orange shank color with overall mean values 44.2%, 28.5%, 9.4%, 5.6%, 5.6%, 3.4%, 1.8%, and 1.6%, respectively. Almost all chicken in the study area (98.4%) had no shank feathers (Table 5). This result is line up with the study conducted by Halima H. and Duguma R. reported that variations in shank color were reported in North West Ethiopia [17, 9] and Msoffe, P. L. M, Muchadeyi, F. Zimbabwe, Mcainsh, C. V., Botswana and Badubi, S. S. similar result and variations were reported in the indigenous chickens of Tanzania [23, 24, 20, 3]. Yellow skin coloration is presently more preferred by consumers of developed nations and this color is linked with carotinoid pigments in the epidermis which obtained through the dietary origin [28].

Morphological characteristics of head region of indigenous chicken variations the single comb were predominant in Surba Bifeta female (40.5%) and double comb male (71.2%) similarly in Gisha Abay single comb predominant (45.4%) for female and double comb (55.9%) for male (Table 3). Similarities in comb types within the two kebeles were reflected the genetic closeness of the two kebeles for comb type. This result is line up with the study reported by Halima H. for indigenous chicken of North West Ethiopia [17], and the size and color of the comb and wattles are associated with gonad development and secretion of sex hormones [28]. Large combs, large wattles and long legs are important morphological traits that allow better heat dissipation in the tropical hot environment. This specialized structure makes up about 40% of the major heat losses, by radiation, convection and conduction of heat produced from body surfaces at environmental temperature below 80°F [28].

The observations on head shape revealed flat plain head shape was higher in both study area with overall average of 71.5% followed by crest head shape (28.4%) (Table 3). The study revealed variations in ear lobe color of indigenous chickens were white and red (40.5%) for female and red (62.3%) for male in Surba Bifeta while white and red (35.5%) for female and red (76.5%) for male was predominant in Gish Abay chicken population. However, the overall average values predominant earlobe color was red (36.1%), followed by white and red (34.3%) and white (28.0), while white and black (0.2%), black (0.9%) and orange (0.4%) were lower. This study is line up with the study conducted by Mcainsh, C. V, Bhuiyan A. K, Badubi, S. S. and Halima H. [20, 4, 3, 17]. As the study of Local chickens were normally feathered (hens 97.7%, cocks 97.9%) and feathered shank and feet hens (1.7%), cock (1.1%) (Table 4). This result is line up with the study of Halima H., Bogale K. and Faruque, S. reported that most of the indigenous chickens have no shank feathers and shanks are yellowish in color [17, 5, 13]. As the study indicated that quantitative traits characterization of local chickens have significance differences ($P<0.05$) was observed between the two kebeles respect to wing spin (17.61), neck length (18.72), spur length (8.42), chest circumferences (28.3), body length (19.66), wing length (22.51), and shank length (11.47), and highly significant difference ($P<0.01$) was observed in neck length (18.72), body length (19.66), wing span (17.61), and wing length (22.51), while no significant differences were observed with respect to body weights (2.36), wattle length (2.33), thigh circumferences (11.40) and breast width (13.09). The study also indicated that there was significantly positive correlation ($r= 0.973$) between shank length with body length and, between shank length with neck length ($r=0.913$) while positive correlation was shank length with body weight ($r= 0.789$), neck length with body weight ($=0.727$) and body length and body weight ($r = 0.634$) were found positive but non-significant.

The average shank length observed (11.47cm) was similar to the study by Ensminger E. M from Horro 9.99 cm, Bogale K. from Fogera district 9.8 cm and Halima Hassen from Northwest Ethiopia (10.31 cm) [11, 5, 17], but higher than reported by Addisu Hailu 7.79cm in North Gonder [1]. The average super length observed (8.42) was higher as compare to the findings of Addisu H. from North Gonder (0.18 cm) [1]. The average body length (19.66) was much similar to reported by Badubi, S. S, in Botswana which was 20.2 and 18.1cm for male and female chickens [3] but lower than report of Addisu H. in North Gonder (35.79cm) [1]. The average wing span observed (17.61) was higher than reported by Addisu H. in North West Ethiopia which was found (15.83cm) in Gelila and melo Hamisit male and (14.00cm) found in Tilili and Melo Hamusit female chickens [17].

As the sudy indicated that the plumage color, comb type, sex of chicken, shank color, plumage color and comb type, smoothness of shank, and body size were the major factor that vary the price of chickens, While breed, comb and shank, weight and plumage, body size, plumage and shank color, and sex and shank color were the lowest factor that vary the price of chickens in both study area (Table 9). In smoothness of shank and body size and plumage color, comb type and shank color of chickens had significance difference between the two kebeles (X^2 calculated $>X^2$ tabulated). This result is in line with the study conducted by Markos Shishay, Bogale Kibret, Moges mihrete and Moges Mihrete, and Tadelle Dessie the plumage color, body weight, comb type, shank color, smoothness of shank, sex, spur presence, length of legs, head Shape were the major factor that vary the price of local chickens reported by Markos Shishay [19], Bogale K [5], Moges M. [21] and Moges M. and Tadelle D. [22]. The plumage color, comb type, plumage color and comb type, body weight, age, sex and seasons were relevant factor that brought variations on the price of local chickens in Fogera district and reported by Addisu H. the prices of local chickens were determined by body weight (41.83%), combination of comb type and plumage color (32.35%) and plumage color (25.82%) in buying and selling marketing system in North Wollo zone of Ethiopia [1]. This study also line up with the study report by Soelkner J, Teketel F., Fisseha M. and Nigussie D. the Plumage color, live weight, and comb type were important traits affecting market price of chickens [29, 32, 14, 26].

As the study indicated that the highest selection criteria of households' for selection of breeding hen were egg size; plumage color, broodiness, disease resistance and hatchability, While mothering ability, egg number, body size, growth rate, good scavenging, longevity, fighting ability were the lowest selection and ranking traits. The highest selection criteria of households' for selection breeding cock were egg number, comb type, plumage color, disease resistance, and egg size and growth rate, While body size, fertility, fighting ability, hatchability, mothering ability, broodiness and good scavenging were the lowest selection and ranking traits (Table 10).

As study indicated Phenotypic trait preference of the households wanted to be improved of chickens in Surba Bifet were comb type, plumage color, egg size, broodiness, disease resistance, meat quality, fertility growth, egg number, body size, mothering ability and temperament constituted 0.113, 0.098, 0.07, 0.075, 0.073, 0.072, 0.066, 0.061, 0.053, 0.047, 0.047 and 0.32, respectively, While in Gish Abay plumage color, comb type, egg size, meat quality, fertility, disease resistance, broodiness, growth and mothering ability were the major prefer traits constituted values, 0.107, 0.106, 0.092, 0.083, 0.077, 0.074, 0.071, 0.063 and 0.051 respectively. There was no significant difference in the ranking of traits preference for phenotypic traits improvement in both study areas. This result is not in line up with the study conducted by Nigussie D. in which farmers in different parts of Ethiopia prefer qualitative traits [27].

5. Conclusion and Recommendation

In conclusion, quantitatively and qualitatively trait characterization of indigenous chickens are very importance and cheapest methods for selecting of breeding, ranking, advanced to environment and marketing price rather than expensive and coasty genotypic characterization of local chickens. The phenotypic traits of indigenous chicken is important resource that needs to better characterized, and strategies for improvement and conservation for the present and future generations related to advancement regarding to agro ecology. Characterization of indigenous chicken through quantitative and qualitative traits are very important used by farmers to select breeding hen, cock and traits preferences for effective and significant breeding practice like comb color, spur, eye color, and feather distribution and body weight, breast width and thigh circumference. This finding demonstrate that there is diversifying indigenous chicken ecotypes in quantitative and qualitative traits characterization of the two study districts, and need to more detailed study. The assessed phenotypic characterization and genetic information should be employed to preserve genetic variability and further adulteration.

Based on the findings of current study the following recommendations were forwarded:

1) Genotypic characterization information should be collected and characterize of each indigenous chickens.
2) In the future every researcher must study genotypic traits of indigenous chicken and farmers' preference for specific traits that may invite to design community grounded genetic improvement regarding to phenotypic characterization.
3) Genetic characterization based on molecular assessment should be implemented to validate the detected phenotypic variations and evaluate the genetic diversity among and within indigenous chicken ecotypes.
4) Planning and implementing agro-ecologically responsive and community based genetic improvement programmes, which integrate breeding aims, trait preferences, local chicken adaptive genetic virtues and consumer preferences in order to safeguard sustainable utilization of indigenous chicken genetic resources.

Declarations

Authors' Contributions

Authors were involved in data collection and writing of the manuscript as well as read and approved the final manuscript for submission and publication.

Competing Interests

Authors declare that there are no competing interests.

Availability of Data and Material

The recorded raw data used for analysis and supplementary information files is available at the author's hand and within the article.

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