Uttar Pradesh Journal of Zoology

Volume 45, Issue 4, Page 137-151, 2024; Article no.UPJOZ.3238
ISSN: 0256-971X (P)

Phenotypic Characterization and Husbandry Practice of Indigenous Chicken Ecotypes at West Guji, Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author NH did the data collection, analysis, and wrote the manuscript. Author BT performed study design, planning, data analysis, wrote and edited the manuscript. Author DD edited the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.56557/UPJOZ/2024/v45i43916

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3238

Original Research Article

Received: 06/12/2023
Accepted: 11/02/2024
Published: 22/02/2024

ABSTRACT

This study was conducted with the objectives of characterization of indigenous chicken ecotypes and their husbandry practice at West Guji. A total of 204 households were randomly selected from two purposively selected woredas and 612 mature chickens were used for qualitative and quantitative traits data collection. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS Version, 20) and the General Linear Model procedure (PROC GLM) of SAS. The qualitative data of feather distribution, plumage color, beak color, eye color, comb types, earlobe color, head shape, and shank color were collected. The result showed a significant

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difference between the districts (P< 0.05). Further, wing span, chest circumstance, body weight, and body length quantitative data were also recorded. The result revealed that there was a significant difference in quantitative traits in the study areas (P< 0.05). Egg production potentials, body weight, plumage color, hatchability, growth rate, and mothering ability were traits preferred by the household for female selection. The average age at first egg laying of indigenous chicken was 6.69±0.36 months and the number of eggs per hen per clutch was 12.16±0.26. The current finding revealed that about 93.5% of the observed chicken's ecotypes were feathered and 6.45% were naked necks. The dominant chicken's plumage colors identified were; brownish (29.28%), red (24.05%), and multicolor/ambesma (14.65%). The production systems practiced in the study area were extensive. Finally, phenotypic characterization of indigenous chicken ecotypes and performance evaluation should be supported by genetic characterization methods.

Keywords: Indigenous chicken; phenotypic trait; production system; qualitative; quantitative.

1. INTRODUCTION

"The global poultry population has been estimated to be about 16.2 billion, with 71.6% in developing countries, producing 6.7 million metric tons of chicken meat and 5.8 million metric tons of hen eggs" [1]. "The Indigenous chicken production system was recognized as a strategy for capital build-up, poverty reduction, overcoming malnutrition, and hunger reduction among the resources of poor households" [2]. "In Africa, village poultry production systems were mainly based on scavenging indigenous chickens found in almost all households in rural areas. They are characteristically an integral part of the farming systems requiring low inputs with low outputs accessible at both inter-household and intra-household levels" [3]. "In Ethiopia, particularly, poultry production was an integral part of the mixed crop-livestock farming system practiced by most rural households. Poultry in Ethiopia is similar to chicken which accounts for 60.5 million" [4].

"Village poultry production typically uses indigenous genetic resources, which can adapt to a harsh environment" [5-7]. "This is mainly why indigenous chickens in Ethiopia provided major opportunities for increased protein supply and income for smallholders. Nearly all families in developing countries at the village level, including the landless and the poorest, are owners of poultry" [7]. "Backyard poultry production in Ethiopia represents a significant part of the national economy in general and the rural economy in particular which contributes 83.5% of the national egg and meat products" [4]. "However, indigenous chicken breeds had slow growth rates and producers of small-sized eggs" [7]. "Despite these disadvantages, indigenous chickens are also characterized by many advantages such as good egg and meat flavor, good brooding, and natural incubation capacity, and they require low cost with little care for production" [8,5,7]. In short, they are well suited to the very limited input that poor producers can provide.

"Indigenous breeds' characterization was the first step of long-term genetic improvement as it provides the basis for any other livestock development interventions and pre-requisite information for designing appropriate breeding programs for conservation and utilization. Characterization of the chicken genetic resources generally requires information on their adaptation to a specific environment, possession of unique traits of current or future economic value, and socio-cultural importance" [9]. Indigenous chickens have variable morphological identities carrying genes that have adaptive values to their environment and diseases. According to Horst [10], "indigenous chickens can be considered as gene reservoirs, particularly, for those genes that have adaptive values in tropical conditions such as Naked neck, Frizzle, Dwarf, Silky, Slow feathering, Non-inhibitor, Fibro-melanosis, Pea comb, and a blue shell". "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 breeds" [11]. "Variations in major morphological traits such as outline and feather contours, shank and ear-lobe colors, and comb types are common among indigenous chicken populations" [12]. These characteristics provide a basis for grouping according to their phenotypic and morphological appearances. Nigussie [8] examined "the morphological and genetic characterization of indigenous chickens in different parts of Ethiopia

and identified that there was sufficient genetic variation between groups of indigenous chickens". Halima et al. [13] reported that, "the phenotypic variation of indigenous chicken populations in North West Ethiopia".

"Phenotypic characterization is a systematic documentation of the distinct qualitative and quantitative nature of an animal with their production environment" [14]. "Characterization studies are essential for planning improvement, sustainable utilization, and conservation strategies of a breed at local, regional, national, and global levels" (FAO, 2012). However, there was little information and very little research has been done on phenotypical characterization, reproduction performance, breeding practice and ways to conserve, improve, and utilize genetic resources of this native chicken in this zone. Hence, this study was designed to assess the phenotypic characteristics of indigenous chicken ecotypes, and husbandry practices to ensure sustainable improvement, utilization, and conservation of indigenous chicken genetic resources. Therefore, this study was designed to characterize indigenous chicken ecotypes and husbandry practices in the West Guji zone, Ethiopia.

2. MATERIALS AND METHODS

2.1 Description of the Study Areas

The study was carried out in the Bule Hora and Dugda Dawa Districts of the West Guji zone from November 2022 to April 2023. The districts are located 467 km from the capital city of Addis Ababa, Ethiopia, and 100 kilometers north of Yabello town. The town's geographical coordinates were approximately 5°38°N Latitude and 38°14°E Longitude.

2.2 Research Design

The research design was a survey and questionnaires as an instrument to collect data on phenotypic characteristics of local chickens, production and reproduction performance, and trait preference of the households.

2.2.1 Sampling techniques and sample size determination

The study districts were selected based on the chicken production potentials, facility, and agroecological representation. Two *kebeles* per district and a total of four *kebeles* from both districts were selected based on the indigenous poultry population and chicken production potentials. A total of 204 households (123 households from Bule Hora and 81 from Dugda Dawa) districts were randomly selected. The households' sizes were determined using Yamane's [15] households (HHs) sample size determination formula.

$$n = \frac{N}{1+N(e)^2}$$

Where:

N - Is the population size/households.
n - Is the sample size
e - Is the acceptable estimated error

Three chickens per household and a total of 612 (369 in Bule Hora and 243 in Dugda Dawa) with adult indigenous chickens of both sexes were selected for quantitative and qualitative data collection. Accordingly, 411 were female chickens and 201 were male chickens as per the recommendation of FAO [14].

2.2.2 Quantitative and qualitative data collection

The quantitative traits and body weight were taken from sampled indigenous chickens of both sexes using a rubber tape (cm) and a hanging spring balance (50 kg). The data of quantitative were taken from both sexes following FAO's descriptor for the characterization of chicken genetic resources with the help of measuring guidelines.

2.2.3 Qualitative traits

Based on the FAO (2012), guidelines morphological features were assessed for phenotypic characterization. Each chicken was grouped by sex and assessed for qualitative traits.

2.3 Data Collection

The primary and secondary data collection methods were applied. The primary data were collected from HH interviews, semi-structured questionnaires, and focus group discussions. The Secondary data were collected from published and unpublished resources.

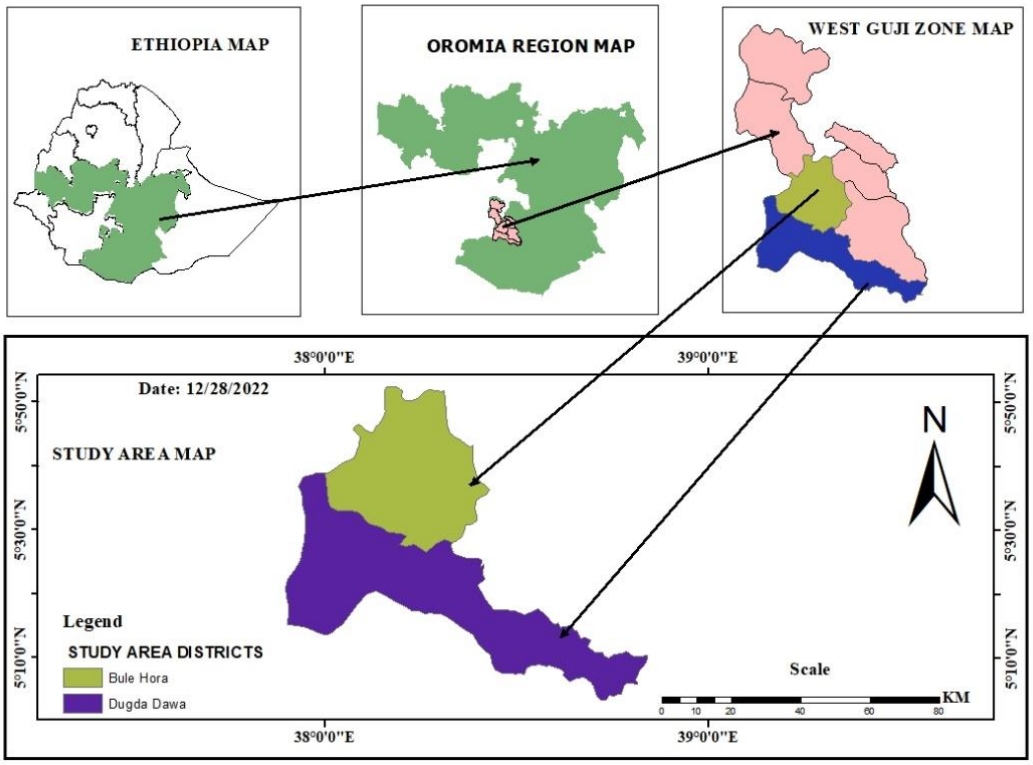

Fig. 1. Map of the study areas

2.4 Method of Data Analysis

The data collected were coded and entered into a statistical package for social science (SPSS) software version 20. The qualitative data were analyzed using descriptive statistics to compare categorical variables for significance between the study areas. ANOVA model statements were employed to make the comparison among different group variables between the two agroecology data. General Linear Model procedures (PROC GLM) of SAS were used for the analysis of linear body measurements with the fixed effects of agroecology, sex, and their interactions. Means were compared using Duncan's multiple range Z- test and values were considered at a significance level of $P< 0.05$. Correlation analysis was conducted to identify the relationship between quantitative morphological traits.

2.5 Statistical Model

Data on the effects of districts, sex of chicken, and their interaction was used by the following linear model:

$$Yij= \mu + D_i + S_j + DiS_j + e_{ijk}:$$

Where:

Y_{ij} = the overall value of observed variables,
μ =overall mean of the variables;
D_i = the effect of i^{th} districts (i= Bule Hora, Dugda Dawa);
S_j = the effect of sex (j=male and female) on the variables;
D_iS_j = interaction of agroecology and sex effects on the variables and
eijk = random residual error.

3. RESULTS AND DISCUSSION

3.1 Flock Size and Structures

The overall mean chicken flock size per household is presented in Table 1. A total of 612 chickens were reported from 204 HHs in the study areas. Accordingly, 2.865±0.22, 1.64±0.14, 2.51±0.148, and 2.065±0.195 were pullets, cocks, hens, and cockerel, respectively. These results showed that a higher number of chickens per household was registered from Bule Hora 4.68±0.328 compared to Dugda Dawa (4.58±0.456) districts. However, the flock size observed in the present study is higher than the mean flock size per household of chick

(3.27±3.78), pullet (1.55±1.88), hen (3.54±2.47), cocks (0.75±1.05), and cockerel (0.87±1.61) reported by Mearg [16] in Central Zone of Tigray. This variation might be due to the differences in feed availability, disease prevalence, predators, and climatic conditions. Further, the current result is comparable with the 12-13 chicken/household reported from other regions of Ethiopia [17,18], and 9.22 chickens/household in South Ethiopia with the report of Mekonen [19]. The interviewed households were replacing their poultry stock mainly by hutching traditionally at home, purchasing from the market as well as in rare cases by gift.

Chickens were kept in the study area mainly for home consumption (37.65%) and income generation. Based on the study districts 22.8%, 22.7%, and 16.8% were for home consumption, income generation, and used for gifts, respectively. The result showed there was a highly significant difference (P<0.05) between the districts. Tadelle et al. [20] reported that about 30.6% of mature birds are kept as replacements, 44.4% are sold and 20% are used for home consumption.

3.2 Poultry Management Practices in the Study Areas

Poultry management refers to production techniques or husbandry practices that help to increase production efficiency. Sound management practices are essential to optimize production. Housing is the most important to chickens as it protects them against predators, theft, and rough weather and provides shelter for egg-laying and broody hens. Poultry houses consist predominately of wooden material and are usually single-storied. The current result showed that 54.8% of the respondents constructed chicken shelters separately, while 45.2% of the respondents did not. The present result is in line with the reports of Halima et al. [13]; Bogale [21], who reported that the majority of the rural households (51%) of northwest Ethiopia and 59.7% of Fogera woreda had separate sheds for their chickens, respectively.

Table 1. The chicken flock structure and composition in the study area

Variables	District			
	Bule Hora Mean ± SE	**Dugda Dawa** Mean ± SE	**Over All** Mean ± SE	**P - Value**
Flock composition				
Chicks	4.68±0.33	4.58±0.46	4.63±0.39	0.48
Pullets	3.62±0.21	2.11±0.24	2.865±0.2	0.46
Cocks	1.56±0.10	1.72±0.18	1.64±0.14	0.78
Hen	2.67±0.14	2.35±0.16	2.51±0.15	0.56
Cockerel	1.13±0.10	3.00±0.25	2.065±0.20	0.53
Total chicken per household	13.6±0.88	13.8±1.28	13.63±1.10	0.56
Source of replacement stocks				0.20
Hatching	62.5	64.2	63.35	
Purchasing	28.3	23.5	25.90	
Gifts	9.2	12.3	10.75	

Table 2. Purpose of keeping the poultry in the study area

Variable	Districts			
	Bule Hora (%=100)	**Dugda Dawa (%=100)**	**Over All (%=100)**	**P - Value**
Purpose to rear poultry				0.000
Home consumption	28.3	17.3	22.8	
Generate Incomes	15.8	29.6	22.7	
Home consumption and Generated incomes	33.3	42.0	37.7	
For gifts	22.5	11.1	16.8	

Table 3. Poultry management practiced in the study areas

Parameter	Districts			
	Bule Hora (%=100)	Dugda Dawa (%=100)	Overall (%=100)	P Value
Housing and types of production systems practiced for raising chicken				0.025
Free range/Extensive/	87.0	93.8	90.4	
Small-scale/Semi-intensive	13.0	6.2	9.6	
Having separated poultry house				0.000
Yes	75.0	34.6	54.8	
No	25.0	65.4	45.2	
Poultry feed supplementation				0.000
No	90.2	93.8	92	
Yes	9.8	6.2	8	
Types of poultry houses				0.000
Yes	95.0	98.8	96.9	
No	5.0	1.2	3.1	
Poultry vaccination				
Yes	100	100	100	

Local chickens were reared predominately under a free-range scavenging system. During the daytime birds freely scavenge in the area around the household and at night birds are provided with shelter. Kitchen leftovers, insects, worms crop residues, grass, and grains were mainly used as feed materials, although most of the farmers provided the supplementary feed, but the amount is unknown and variable in most cases. Provision of feed supplementation of chicken in the study areas was very poor (92%) and all practiced free-ranging. Corn was the most common supplement, followed by wheat, whereas very few used commercial feed. The chicken supplementary feed identified in the study areas were maize (59.3%), wheat (13.9%), barely (8.35%), sorghum (6.15%), the mixture of different cereals (5.3%), and kitchen leftover (6.9%). The result showed significant differences between the districts ($P<0.05$).

As far as water is concerned, there is free access to it but the quality is poor due to unhygienic waterers and unreliable water sources. In the aspect of health management, very few farmers reported that they consulted veterinary institutions regarding disease or other technical input and practiced proper cleanliness and hygiene of waterers and poultry houses. Vaccination was not done for any disease and no specific disease was reported although as per the description of symptoms by the farmer Newcastle disease (NCD) may be prevalent. About 91.3% of economically important poultry disease outbreaks occurred during the rainy season. Newcastle disease was the major poultry disease in the study areas. The majority (53.15%) of the households treated sick chickens at home traditionally using, eucalyptus leaf, *Ocimum gratissimum* (*demakese)* leaf, lemon juice, Local alcohols (*Arekie*), and a mixture of chilli, garlic, and ginger. However, the dose of traditional drug supplementation is unknown which might have an impact on the health status of the chickens.

3.3 Poultry Trait Preferences for Production

The poultry morphological traits preferred by the households are presented in Table 4. The survey indicated that morphological traits such as plumage color and comb type were assessed. The result showed significant aesthetic value (26.7%), high market value (50.1%), cultural and religious value (17.15%), and protection from predators (6%). Red color plumage (47.4%) and brown plumage color (28.2%) followed by white & black (10.55%), white (9.1%) and black (4.75%) were the most identified preferable body plumage colors. The most preferred comp types were single comb "*Netela*" (29.4%) and double comb "*Turcha*" (61.9%).

Table 4. The color preference of the chicken in the study areas

Parameter	Districts			
	Bule Hora (%=100)	Dugda Dawa (%=100)	Over All (%=100)	
The color preference of the chicken			0.000	
Black	3.3	6.2	4.75	
White	8.3	9.9	9.1	
Red	46.7	48.1	47.4	
Brown	29.2	27.2	28.2	
White & black	12.5	8.6	10.55	
Comb types				0.000
Double	60.8	63.0	61.9	
Single	29.2	29.6	29.4	
Other	10.0	7.4	8.7	
Reason for plumage color and comb type preferences				0.000
Aesthetic value	25.0	28.4	26.7	
High market value	50.8	49.4	50.1	
Cultural & religious value	15.8	18.5	17.15	
To protect it from predator	8.3	3.7	6	

Bodyweight, egg number, plumage color, hatchability, mothering ability, and growth rates were traits used for female chicken selection. The overall index values were 0.127, 0.140, 0.114, 0.104, 0.099, and 0.107, respectively (Table 5). The egg production ability was the major selection criterion for female chickens ranked first in both districts. The average number of eggs laid by indigenous hens was 13.05±0.26 per hen per clutch and the mean clutch length of indigenous chickens in the study area was 21.69±0.06 days. Further, plumage color, body weight, comp type, and growth rates were traits used for cock selection.

3.4 Age at First Mating of Cockerel and Female Chicken in Month

The study results for the mean age of sexual maturity of males and females of indigenous chicken were 5.5±0.4 and 6.21±0.43 months, respectively (Table 6). The delayed sexual maturity observed for local chickens in the study might be a result of a poor management system and poor selection among local chickens. Chickens in the study area attain sexual maturity earlier**.** This might be due to environmental conditions, breed differences, and management**.**

3.5 Age at First Egg Laying

The overall mean age at first egg laying for female chickens in the study area was 6.69±0.36 months (Table 6). The current result is relatively similar to the report of Melkamu and Wube [22], who reported that 6 months of age at first egg laying for local chicken breeds at Gondar Zuria Woreda. However, the current result value is lower than the finding of Shishay et al. [23], who reported that the overall age at first egg laying of pullet was 7.19±0.04 months in Western Tigray. These variations in age at first egg laying might be due to a lack of proper supplementary feeds, availability of scavenge feed resources, and disease outbreaks in the study areas.

3.6 Number of Eggs Incubated, Chicken Hatched, and Egg Wasted

The average numbers of eggs incubated, hatched, and wasted eggs were 12.66±0.28, 14.13±0.31, and 2.87±0.38, respectively (Table 6). The result was comparable with the finding of Addisu et *al*. (2013) reported that the mean number of indigenous chickens incubated eggs and chicken hatched per clutch in the North Wollo Zone was 11.36±0.09 and 9.60±0.10, respectively. Similarly, Alemayehu (2017) reported that the mean number of indigenous chickens incubated eggs and chicks hatched per clutch in Lume district was 12.0±3.0 and 9.2±2.3, respectively.

3.7 Hatchability Percentage

The hatchability percentage was 78.32% at Bule Hora and 75.94% at Dugda Dawa (Table 6). The result was lower than the findings of Alem [24]; Birhan [25] who reported that the overall mean hatchability percentage of local chicken in Halaba district, and western Amhara were 85.8

and 85.75%, respectively. Fisseha et al. [17] reported the hatchability percentage of the egg was 82.6, 78.9, and 89.1% at Bure, Fogera, and Dale woredas, respectively. However, the current value is higher than the result obtained by Melkamu and Wube [22] at Gonder Zuria Woreda (72%). Aganga et al. [26] reported that among indigenous chickens in Botswana, the hatchability of eggs was 61.8%. The variation in the hatchability percentage might be due to temperature, egg storage condition, quality of eggs, husbandry practice, outbreak of disease, predator attacks, availability of scavenging feed resources, and feed supplementations.

3.8 Phenotypic Characteristics of Local Chicken

The future improvement and sustainability of local chicken production systems are dependent on the availability of genetic variation [27]. Characterization of a breed of livestock is the first approach to a sustainable use of its animal genetic resource [28]. In addition, morphometric measurements have been found useful in contrasting the size and shape of animals [29-32]. The majority of indigenous chicken ecotypes were predominantly normal feathered (91.7% and 92.6 %) for males and (94.2% and 95.7%) for females in Bule Hora and Dugda Dawa (Table 7). The traits found in indigenous chicken ecotypes are considered to have a desirable effect on heat tolerances. The present result is in agreement with the results of Getachew et al. [33], who reported that 95% of the feather distribution of local chicken was normally feathered while 5% of them had a naked neck in the Bench Maji Zone of South Western Ethiopia. The naked neck gene was described as one of the major genes found in indigenous chickens of the tropics that possess desirable effects on heat tolerance and adult fitness [34-35].

The dominant plumage color identified in the study areas were brown (29.28%) followed by red (24.05%), multicolor (*gambesma*) (14.65%), *gebsima*/yellowish (6.47%), white (6.25%), black (6.23%), black with white strips/*teterma* (5.05%), liberal/*wesare* (4.25%) and wheaten (3.05%). The result showed a significant difference ($p<0.05$) between the study areas. The current result is contradictory to the study conducted by Getachew et al. [33] reported that the majority of the chicken population in the shako district of Bench Maji Zone was characterized by red (68.33%), *gebsima* (15.0 %) and White (8.33%) plumage colors. Geographical isolation as well as periods of natural and artificial selection could be the reason for large variations in plumage color [35].

3.9 Beak and Eye Color

Overall, about 36.2% of the observed chicken had red beak color followed by browns (32.95%), black (29.55%), and white (15.5%). The result showed a significant difference ($p<0.05$) as indicated in the study areas. The dominant beak color of male and female chickens was red in both districts of the study areas. The variation in beak color might be attributed to differences in breed type among the indigenous chickens in the study area. The sampled chickens' eye colors were 31.5, 23.5, 21.03, 13.63, and 10.33% for red, orange, yellow, pear, and grey eye colors, respectively. The result showed a significant difference ($p<0.05$) between the study districts. Eye colors to a large extent depend on the pigmentation (carotenoid pigments and blood supply) of many structures within the eye [36].

3.10 Comb Type, Head Shape, and Earlobe Color

The majority of sampled chickens had double comb types (50.15%) followed by single (32.88%) and pea (17%) comb types. The result showed a significant difference in the study districts ($p<0.05$). The dominant comb types identified for male chicken were double comb types whereas the female chickens had pea comb types in both districts (Table 7). Bogale et al. [37] also reported that the double comb type was predominant followed by single and pea comb in the west Hararghe zone. Combs are important structures for heat loss in birds [38].

The overall earlobe colors were 31.7% and 27.08% for red and brown earlobe colors, respectively while 18.73, 15.5, and 7.5% for white, black, and other earlobe color, respectively. In both study districts, the dominant earlobe color of male and female chickens was both red and brown red followed by white and black color. This earlobe color variation might be due to the adaptability of chickens to local conditions and genetic origin. Getachew et al. [33] reported that the major earlobe color of local chicken in the Bench Maji Zone of South Western Ethiopia was white and red.

Table 5. Selection criteria of Hen and Cock for Breeding in the study districts

Variable	Districts														
	Bule Hora							Dugda Dawa							
	R1	R2	R3	R4	R5	R6	I	R1	R2	R3	R4	R5	R6	I	Overall
Breeding hen															
Egg number	60	20	5	14	10	11	0.070	16	40	10	6	5	4	0.070	0.140
Bodyweight	26	59	10	5	8	12	0.068	12	10	35	8	5	11	0.059	0.127
Plumage Color	16	20	40	18	9	17	0.057	20	10	5	28	8	10	0.057	0.114
Hatchability	23	20	8	36	17	16	0.053	50	6	7	7	3	8	0.050	0.104
Mothering Ability	17	13	16	20	31	23	0.048	15	10	10	7	27	12	0.051	0.099
Growth Rates	23	26	16	11	16	28	0.054	11	22	10	9	4	25	0.053	0.107
Breeding Cock															
Plumage Color	51	16	11	24	18		0.054	43	12	7	14	5		0.061	0.115
Bodyweight	23	32	21	31	13		0.049	12	30	10	11	18		0.048	0.100
Growth rate	22	25	29	21	23		0.046	13	3	28	20	17		0.042	0.088
Comb Type	26	18	25	28	23		0.046	20	16	8	27	10		0.049	0.094
Farmers Traits Preferences															
Egg Number and Size	53	18	11	20	18		0.054	48	10	8	5	10		0.062	0.116
Bodyweight	28	45	7	17	23		0.051	17	39	9	6	10		0.055	0.106
Plumage Color	19	23	41	17	20		0.046	13	15	33	11	9		0.049	0.095
Comb Types	25	20	19	35	21		0.045	17	15	10	27	12		0.046	0.091

Table 6. The productive and reproductive performances of indigenous chicken (Mean ± SE)

Parameter (Mean±SE)	Districts			
	Bule Hora (N=120)	Dugda Dawa (N=81)	Over All (N=201)	P Value
Number of eggs per hen per clutch	12.28±0.26	13.81±0.26	13.05±0.26	0.30
Clutch length in days	22.29±0.08	21.10±0.03	21.69±0.06	0.89
Number of Clutch/hen/year	3.18±0.04	3.89±0.04	3.54±0.04	0.05
Annual egg production	50.91±0.50	49.88±0.65	50.39±0.58	0.70
Age at first mating of (cockerel) in month	5.67±0.77	5.33±0.08	5.5±0.43	0.62
Age at first mating of pullet in month	6.36±0.78	6.06±0.08	6.21±0.43	0.82
Age at first egg laying	6.74±0.64	6.63±0.07	6.69±0.36	0.58
Incubated egg	12.58±0.25	12.74±0.30	12.66±0.28	0.80
No egg hatched	13.91±0.25	14.54±0.36	14.23±0.31	0.70
No egg wasted	2.70±0.68	3.02±0.08	2.87±0.38	0.75
Hatchability percentages	78.32±0.32	75.94±0.58	77.13±0.45	0.70

3.11 Shank Color and Feather

According to survey results, almost all the indigenous chicken ecotypes in the study areas were lack of shank feathers. The current result was supported by the finding of Getachew et al. [33], who reported that about 97.73, 96.80 and 96.82% of local chickens in North-Bench, Sheko, and South-Bench, respectively were featherless on their shank. The yellow shank color chickens were dominant in both study districts. The yellow shank colors in the study areas had highly significant differences ($p<0.05$) between the districts. The shank color varied between district and sex. The yellow color of the shank might be due to dietary carotenoid pigments in the epidermis when the melanin pigment was absent. Varying shades of black are the result of melanic pigment in the dermis and epidermis. When there is black pigment in the dermis and yellow in the epidermis, the shanks have a greenish appearance. In the complete absence of both of these pigments, the shanks are white.

3.12 Quantitative Traits

Quantitative traits of chickens have high economic importance for both indigenous and improved line breeds of chickens. These traits could be affected by the environment. The mean average of wing span and chest circumference in the study areas were 23.9±0.07cm and 26.37±0.1cm, respectively. The result showed a significant difference ($p<0.05$). The variation of chest circumference might be due to the presence of sexual dimorphism in the level of male sex hormones, which is responsible for greater muscle development in males than in female chicken Ayana (2020).

The overall mean of body length and body weight were 38.2±0.14cm and1.8±0.03 kg respectively in the study areas (Table 8). The finding implies that there was a significant difference ($P<0.05$) in body length and body weight in indigenous chickens across districts. Similarly, the body length and body weight of male and female chickens were 37.99±0.28and 36.02±0.27cm and 1.63±0.03 and 1.37±0.02 kg, respectively. There was a significant difference ($p< 0.05$) between the study areas. This result was comparable with the finding of Habtamu et al. [39] that the average body length of male and female chicken was 37.8±4.32 and 35.31±3.29 cm, respectively in the Benishangul-Gumuz Regional state. Addis *et al.* (2013) reported that the average body weight of male and female chickens was, respectively in the North Gondar Zone. The variation of the live body weight might be due to inaccuracies of weighing scales, individual differences in measuring accuracy, age of the bird, and season. Further, these apparent sex-related differences might be attributed to the usual between-sex differential hormonal effects on growth.

Table 7. The qualitative traits of indigenous chicken in the study area

Poultry Parameter	Districts					
	Bule Hora		Dugda Dawa		Over All	P Value
	Male %=100	Female %=100	Male %=100	Female %=100	%=100	
Feather distribution						
Normal	91.7	94.2	92.6	95.7	93.55	
Necked Neck	8.3	5.8	7.4	4.3	6.45	
Plumage color						
Completely white	5.0	8.3	3.7	8.0	6.25	
Completely black	7.5	7.5	3.7	6.2	6.23	
Completely red	38.3	18.3	29.6	16.0	24.05	
Gebsima/Yellowish/&Black	8.3	8.3	---	9.3	6.47	
Multi-Color/Ambesma/	10.8	10.8	18.5	18.5	14.65	
Black With White Tips/Teterma/	4.2	4.2	9.9	1.9	5.05	
Brownish	18.3	38.3	24.7	35.8	29.28	
Wheaten	3.3	3.3	2.5	3.1	3.05	
Libera/Wesare/	4.2	4.2	7.4	1.2	4.25	
Beak color						
Black	16.7	22.5	4.9	17.3	29.55	
Red	40.0	25.8	39.5	39.5	36.2	
White	8.30	16.7	24.7	12.3	15.5	
Brown	35.0	35.0	30.9	30.9	32.95	
Eye color						
Orange	30.8	25.0	16.0	22.2	23.5	
Red	35.0	31.7	35.8	23.5	31.5	
Yellow	19.2	19.2	19.8	25.9	21.03	
Pear	8.3	14.2	16.0	16.0	13.63	
Grey	6.7	10.0	12.3	12.3	10.33	
Comb types						
Rose/Double/Comb	50.8	46.7	55.6	47.5	50.15	
Pea Comb	20.0	22.1	12.3	13.6	17	
Single Comb	29.2	31.3	32.1	38.9	32.88	
Earlobe color						
White	19.2	19.2	19.8	16.7	18.73	
Red	32.5	32.5	30.9	30.9	31.7	
Black	15.0	15.0	16.0	16.0	15.5	
Brown and Red	26.7	26.7	25.9	29.0	27.08	
Others	6.7	6.7	7.4	7.4	7.05	
Shank color						
Yellow	42.5	29.2	35.8	25.9	33.35	
Black	5.8	5.8	12.3	1.9	6.45	
Orange	14.2	12.5	13.6	24.7	17.25	

3.13 Correlation Coefficient of Indigenous Chicken's Quantitative Traits in the Study Areas

The correlation coefficient (r) of sampled chicken ecotypes in the study area between the live body weight and other linear body measurements was presented in Table 9. The correlation between body weight with wing span (r= 0.07), body weight with chest circumference (r= 0.38), and body weight with body length (r=0.53). These positive correlations of body weight with other linear body measurements observed in the study area suggest that measuring one of these quantitative traits enables to predict the body weight of indigenous chickens in rural farming society. Body weight was an economically important trait to livestock farmers and the main

Table 8. Mean ± SE for quantitative traits of indigenous chicken in the study district

Para-meter (Mean ± SE)	District				Sex		
	Bule Hora	Dugda Dawa	Over All	P Value	Male	Female	P Value
WS (cm)	23.95±0.02	23.74±0.12	23.9±0.07	**	24.02±0.21	23.09±0.24	0.12
CC (cm)	26.59±0.03	26.14±0.17	26.37±0.10	**	26.74±0.23	25.54±0.23	**
BW (kg)	1.88±0.01	1.738±0.05	1.8±0.03	**	1.797±0.08	1.44±0.06	**
BDL (cm)	38.64±0.04	37.76±0.24	38.2±0.14	**	37.99±0.28	36.02±0.27	**

WS=Wing Span, CC=Chest Circumstance, BW=Bodyweight, BDL=Body Length

Table 9. Correlation Coefficient between body weight and quantitative of indigenous chicken in the study area

Traits	BW	WS	CC	BDL
BW				
WS	0.07			
CC	0.38**	0.10		
BDL	0.54**	0.28**	0.68**	

***Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 (2-tailed) WS=Wing Span, CC=Chest Circumstance, BW=Bodyweight, BDL=Body Length*

selection criterion to improve the productivity of indigenous chickens [40]. Ogah et al. [41] reported that predicting body weight from linear measurements is a common practice in animal breeding.

Generally, linear body measurement information for a particular poultry species or breed was important for breed or species identification and economic valuation in its utilization. The strong relationship existing between body weight and body measurements may be useful as a selection criterion since positive correlations of traits suggest that the traits are under the same gene action (Pleiotropy). Furthermore, the relationships between body weight and linear body measurements are important for predicting body weight and can also be applied speedily in selection and breeding programs in indigenous chicken ecotypes [42].

4. SUMMARY AND CONCLUSION

This study was conducted to assess the characterization of indigenous chicken ecotypes and their husbandry practice. Poultry in the study areas was primarily used as a source of animal protein for children, income generation, hatching, cultural/ceremonies, and gifts for relatives. The productive performance of indigenous chickens was low due to poor feeding, low genetic potential of the birds, and improper housing and health care. The traits used for breeding female chicken selections were egg number, body weight, plumage color, growth rates, and hatchability. Female chickens take 6.2 to 7 months to attain their first mating and egg-lying age while male chickens take 5.5 to 6.5 months for the first mating. The relationships between body weight and linear body measurements are positive which is applied speedily in selection and breeding programs. Thus, designing and implementing the right poultry policy is crucial to improving the indigenous chickens.

ETHICAL APPROVAL

The research is ethically approved by the Bule Hora University research ethics approval committee.

ACKNOWLEDGEMENT

The authors would like to acknowledge all the contributors to the conduct of this research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3238