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Indigenous Chicken Production System and Breeding Practice in Southern Tigray, North Ethiopia

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Abstract

Village chicken production plays crucial role in improving the livelihood of smallholder farmers. A study was conducted in southern Tigray, North Ethiopia with the aim to generate data on indigenous chicken production system and breeding practice. The generated data could be potentially used in the chicken selection, improvement program and strategy under typical farmers' management condition. To address the study objective, semi-structured questionnaires, participatory rural appraisal (PRA) and field observations were employed. A multi-stage sampling procedure was employed to select study sites and respondents. First the study area was stratified into three agro-ecological zones (highland, midland and lowland) based on altitude. About 180 chicken producers (60 from each agro-ecology) were involved in the individual household survey. Descriptive statistics and General Linear Model (GLM) of SPSS version 20 (2011) were used to analyze the data. It was found that the indigenous chicken production system is characterized with backyard scavenging (100%) with seasonal supplementation of feed (100%). The average chicken holding per households was 24.31 ± 1.21 with 57% exotic, 37% local and 6% crossbred. Farmers rank body weight, conformation, plumage color and comb type as 1st, 2nd, 3rd and 4th, respectively as trait for chicken selection. Newcastle disease (Locally called fengil) is the most important disease in the areas. Farmers dominantly use traditional medications (ethno-veterinary treatment) to address the diseases problem. Access to health extension service is very limited. The local chickens are valued for majority of important adaptive and economically important traits. The trend in introducing, dissemination and crossbreeding activities are increasing form to time. Awareness should be created on chicken production and management, immunization programs, risk and preventive measures on exposure of chickens to disease and predators as well as breeding practice.

Keywords: Indigenous chicken; Production system; Breeding practice

Introduction

In Ethiopia, there are about 44.8 million chickens; of which 96.6% are local chickens, indicating the significance of indigenous chicken as principal potential farm animal genetic resources of the country [1]. These chickens have been reported to adapt very well to the traditional small-scale production system of the rural community [2]. The research efforts on improvement of village chicken production have been focused on technical aspects of chicken keeping by reducing some constraints such as provision of simple shelter and locally available feed products. Although local chicken populations are more numerous than commercial type of imported poultry breeds, little research has been undertaken on village chicken [3].

Knowledge and understanding of the indigenous chicken production system and breeding practices are important in the design and implementation of chicken based development programs. Furthermore, characterization can identify breeds and/or populations which are at risk of extinction or which are highly desired by farmers, and hence is an important input into nation's chicken development planning [2]. Hence, this study was carried out to generate data on the indigenous chicken production system and breeding practice that could be potentially used in the chicken selection and improvement program under the smallholder chicken production system.

Materials and Methods

Descriptions of the study area

The study was undertaken in southern zone of Tigray, northern Ethiopia. The Southern Zone Tigray is geographically located at 12°25'50" N latitude and 39°30'0" E longitude with altitude range of 930 to 3925 masl. The zone comprises high, low, and mid-altitude agro-ecologies (dominated by mid-altitude) [4]. The mean annual temperature ranges from 9 to 32°C. The annual mean rainfall ranges from 400 to 912 mm. The rainfall is bimodal that relying on the Belg (short rain season) from mid-January to March, and the Kiremt (rainy season) rains from mid-June to mid-September. The highest rainfall occurs during rainy season. Mixed crop-livestock farming is the predominant feature of the study areas. The main crops grown in the Belg season are barely, wheat and peas. Similarly, barley, wheat, sorghum, teff, peas, lentils and fababeans are the main crops cultivated during summer. The major feed resources in the area are natural pastures, crop residues and cactus pear [4].

Sampling size and sampling methods

A multi-stage sampling procedure was employed in this study. First the study area was stratified into three agro-ecologies based on altitude as high altitude (>2500 masl), mid altitude (1500-2500 masl) and low altitude (<1500 masl). This classification was found to be relevant to investigate the variation in indigenous chicken production systems and

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breeding practices to each agro-ecology. A rapid reconnaissance survey was done before the main survey to understand the overall chicken production and management system in the districts and kebeles. From nine districts of the zone three districts representing each agro-ecological zone were chosen purposively and nine kebeles (three from each district) were also selected using purposive sampling techniques. The sample size was calculated based on Kothari [5] and thus a total of 180 households (60 from each agro-ecological zone) were randomly sampled for questionnaire interview.

Data collection

Questionnaire survey was administered to the randomly selected household heads by a team of enumerator recruited and trained for this purpose with close supervision by the researcher. Focus group discussions (FGDs), ranking method and field observations were employed to investigate the required information. The FGDs were composed of youngsters, women, village leaders and socially respected individuals who are known to have a good understanding in chicken breeding and management. Ranking matric is helpful in prioritization of traits and indigenous knowledge in management of chickens. The questionnaire survey conducted on different aspects of the chicken production systems and adaptation performance was developed based on FAO [6] and Hendrix [7].

Statistical analysis

The collected data were subjected to the GLM of SPSS for statistical analysis. Simple descriptive statistics was used to observe frequency, percentage, mean and standard deviations. Chi-square test was used to see if there is any significant difference between the categorical variables. Results were summarized and presented in tables and graphs.

Results

Housing conditions of chickens

Village chicken producers construct chicken house of various types. The majority of the respondents 97(53.9%) did not have separate chicken house. On the other hand, 4(2.2%) of the respondents shelter birds in kitchen, 68(37.8%) share common night shelter with household members, 3(1.7%) shelter in ceiling of the house, 12(6.7%) in basket made up of wood and 10(5.6%) shelter in the house with separate perching. The chicken owners clean the chicken house daily (86.7%), once a week (3.9%) and twice a week (9.4%) indicating most farmers give attention for bio-security measures.

Feeding of chickens

All the interviewed farmers provide supplementary feeds for their chicken daily. Feed sources for chicken include home produced feeds (17.2%), market purchased feeds (10.0%) and both (72.8%). The farmers supplement their chicken three times a day (36.7%), twice a day (27.8%) and once a day (35.6%). Feeds offered to chicken using plastic material and broken pot of clay.

Watering of chickens

The major source of water for village chicken is tap water (99.4%). All the chicken owners have watering trough, made up of plastic equipment (45.6%), broken pot of clay (43.3%) and purchased watering trough (11.1%). Farmers clean the watering trough when they found the equipment dirty (52%), once a week (22%), daily (16%), once on two days (5%), once on three days (4%), and once per four days (4%). The chicken owners provide water to their chickens year round with particular emphasis during the dry season. Concerning the frequency of watering, most chicken producers 116 (64.4%) provide water ad libtum (making water available every time) and the remaining 40 (22.2%), 19 (10.6%) and 5 (2.8%) offer water to chickens once per day, twice per day and three times per day, respectively.

Chicken disease and their management

The chicken producers experience disease outbreaks throughout the year. The major disease recognized by all village chicken producers was Newcastle disease known as by its local name "fengil" which means sudden prostration and death. The disease often occurs during the short and long rainy season. In recent times, however, the disease has been found to be more prevalent and occurs throughout the year. The farmers employ both traditional and modern health care to address the disease problem (Table 1). In an attempt to address the disease problem different efforts are made by local farmers such

Variables	Agro-ecological zone			Over all mean	χ^2 (p-v)
	Low altitude (n(%))	Mid altitude (n(%))	High altitude (n(%))		
Health care mechanism					
Traditional	-	-	-	-	-
Modern	-	-	-	-	
Both traditional and modern	60 (100.0)	60 (100.0)	60 (100.0)	180 (100.0)	
Response of farmers to disease outbreak n(%)					
Slaughter	1 (1.7)	-	-	1 (0.6)	12.41 (0.41)
Treat	18 (30.0)	20 (33.3)	12 (20.0)	50 (27.8)	
Sale	1 (1.7)	2 (3.3)	-	3 (1.7)	
Slaughter and sale	17 (28.3)	15 (25.0)	17 (28.3)	49 (27.2)	
Treat and sale	1 (1.7)	1 (1.7)	-	2 (1.1)	
Slaughter, treat and sale	11 (18.3)	6 (10.0)	9 (15.0)	26 (14.4)	
Do nothing	11 (18.3)	16 (26.7)	22 (36.7)	49 (27.2)	
Problems regarding to chicken health n(%)					
Lack of awareness on vaccines	60 (100.0)	60 (100.0)	60 (100.0)	180 (100.0)	-
Lack of attention	-	-	-	-	
Low availability of vaccines	-	-	-	-	
Lack of awareness on vaccines, attention and availability of vaccines	-	-	-	-	
χ^2 (p-v) =chi-square value (p-value) and significant differences between sampling agro-ecologies at ($p<0.05$)					

Table 1: Chicken disease and their management in the study area.

as treatment/medication 50(27.8%), slaughter 1(0.6%), sale 3(1.7%), slaughter and sale 49(27.2%), treat and sale 2(1.1%), slaughter, treat and sale 26(14.4%). However, the remaining 49(27.2%) do nothing to deal with the disease. Farmers have indigenous knowledge in disease management (Table 2). This includes keeping productive hens, reduction of flock size, appropriate housing, treating at home with local medicaments, partial housing and dry season rearing ranked as 1st, 2nd, 3rd, 4th and 5th, respectively according to their importance.

Flock characteristics and composition

The average chicken flock size per household was found to be 24.31 ± 1.21 comprising of hen (13.29 ± 1.01), cocks (1.72 ± 0.10), pullets (4.84 ± 0.50), cockerel (0.46 ± 0.08) and chicks (3.70 ± 0.42). The mean flock size was higher in low altitude areas (29.87 ± 2.10 chickens/HH) than that of mid altitude (18.90 ± 2.10 chickens/HH) and high altitude (24.17 ± 2.10 chickens/HH). Similarly, the average number of cocks (2.05 ± 0.18) and pullets (6.40 ± 0.87) in low altitude was significantly higher than mid altitude agro-ecological zone ($p<0.05$). However, there was no any significant difference ($p>0.05$) in flock size of cock and pullet per household between high altitude and the two agro-ecological zones (Table 3). The high number of chicken in low altitude areas could be attributed to the socio-economic condition of the farmers and the availability of cereals and grain as sources chicken feed. Regarding the local chicken flock size, higher number was recorded in low altitude (12.80 ± 0.89) and followed by high (9.35 ± 0.89) and mid (4.90 ± 0.89) altitudes (Table 3). However, there was no any significant difference on the flock size of cross and exotic chickens among the three agro-ecological zones ($P>0.05$). The flock composition is dominated by hens (55%), pullets (20%) and chicks (15%).

Traits of adaptive and economic importance

Adaption to production environment: According to this study adaptation to the production environment of local chickens was rated as 1st followed by crossbred and exotic ones consecutively and this was the same across the three agro-ecological zones (Table 4). This shows that local chickens have the ability to adapt adverse

Agro-ecological zones	Indigenous knowledge regarding to chicken disease management				
	Dry season rearing	Reduction of flock size	Keeping only some productive hens and cocks	Housing and treating at home	Partial housing
Low altitude					
Rank 1	2	7	45	2	4
Rank 2	2	50	7	-	1
Rank 3	3	-	2	53	2
Rank 4	1	1	4	2	52
Rank 5	52	2	2	3	1
Index	0.08	0.24	0.34	0.18	0.14
Mid attitude					
Rank 1	1	3	51	2	3
Rank 2	2	51	3	1	3
Rank 3	4	1	1	53	-
Rank 4	2	3	3	-	52
Rank 5	51	2	2	4	2
Index	0.08	0.25	0.31	0.19	0.14
High altitude					
Rank 1	3	6	45	2	4
Rank 2	3	49	5	1	2
Rank 3	1	1	3	53	2
Rank 4	2	2	4	3	49
Rank 5	51	2	3	1	3
Index	0.08	0.24	0.27	0.19	0.19
Index=sum of [5 for rank 1+4 for rank 2+3 for rank 3+2 for rank 4+1 for rank 5] for particular trait divide by sum of [5 for rank 1+4 for rank 2+3 for rank 3+2 for rank 4+1 for rank 5] for all traits.					

Table 2: Indigenous knowledge regarding to chicken disease management in the study districts.

Variables	Breed	Agro-ecological zones			Overall mean
		Low altitude	Mid altitude	High altitude	
Hen		15.63 ± 1.7a	11.87 ± 1.7a	12.38 ± 1.7a	13.29 ± 1.01
Cocks		2.05 ± 0.18a	1.52 ± 0.18b	1.60 ± 0.18ab	1.72 ± 0.10
Pullets		6.40 ± 0.87a	3.55 ± 0.87b	4.57 ± 0.87ab	4.84 ± 0.50
Cockerel		0.53 ± 0.14a	0.35 ± 0.14a	0.48 ± 0.14a	0.46 ± 0.08
Chicks		4.23 ± 0.72a	1.63 ± 0.72b	5.23 ± 0.72a	3.70 ± 0.42
	Local	12.80 ± 0.89a	4.90 ± 0.89c	9.35 ± 0.89b	9.02 ± 0.51
	Crossbred	1.40 ± 0.27a	1.05 ± 0.27a	1.97 ± 0.27a	1.47 ± 0.15
	Exotic	15.67 ± 1.98a	12.95 ± 1.98a	12.85 ± 1.98a	13.82 ± 1.14
Total flock size		29.87 ± 2.10a	18.90 ± 2.10b	24.17 ± 2.10ab	24.31 ± 1.21
[a, b, c] means with different superscript letters across a raw are significantly different at $p<0.05$. SE: Standard Error; HH: Household					

Table 3: Chicken age groups and average number of chicken breeds in the study districts.

Variables (n(%)) and χ2(p-v)	Agro-ecological zones								
	Low altitude			Mid altitude			High altitude		
	LI	Cbd	Ec	LI	Cbd	Ec	LI	Cbd	Ec
APE (n(%))									
High	60 (100.0)	51 (85.0)	5 (8.3)	60 (100.0)	53 (88.3)	6 (10.0)	60 (100.0)	53 (88.3)	4 (6.7)
Medium	-	9 (15.0)	50 (83.3)	-	7 (11.7)	50 (83.3)	-	7 (11.7)	48 (80.0)
Low	-	-	5 (8.3)	-	-	4 (6.7)	-	-	8 (13.3)
χ2(p-v)	Cbd=0.39 (0.81) Ec=1.98 (0.73)								
PA (n(%))									
High	-	-	24 (40.0)	-	-	30 (50.0)	-	-	31 (51.7)
Medium	-	11 (18.3)	36 (60.0)	-	14 (23.3)	30 (50.0)	-	14 (23.3)	29 (48.3)
Low	60 (100.0)	49 (81.7)	-	60 (100.0)	46 (76.7)	-	60 (100.0)	46 (76.7)	-
χ2(p-v)	Cbd=0.58 (0.74) Ec=1.91 (0.38)								
SA (n(%))	-	-	-	-	-	-	-	-	-
High	60 (100.0)	49 (81.7)	-	60 (100.0)	47 (78.3)	-	60 (100.0)	52 (86.7)	-
Medium	-	11 (18.3)	37 (61.7)	-	13 (21.7)	45 (75.0)	-	8 (13.3)	38 (63.3)
Low	-	-	23 (38.3)	-	-	15 (25.0)	-	-	22 (36.7)
χ2(p-v)	Cbd=1.44 (0.48) Ec=2.85 (0.24)								
DT (n(%))	-	-	-	-	-	-	-	-	-
High	60 (100.0)	49 (81.7)	-	60 (100.0)	47 (78.3)	-	60 (100.0)	45 (75.0)	-
Medium	-	11 (18.3)	57 (95.0)	-	13 (21.7)	51 (85.0)	-	15 (25.0)	40 (66.7)
Low	-	-	3 (5.0)	-	-	9 (15.0)	-	-	20 (33.3)
χ2(p-v)	Cbd=0.78 (0.67) Ec=16.95 (0.00)								
HT (n(%))	-	-	-	-	-	-	-	-	-
High	60 (100.0)	49 (81.7)	-	60 (100.0)	47 (78.3)	-	60 (100.0)	47 (78.3)	-
Medium	-	11 (18.3)	57 (95.0)	-	13 (21.7)	51 (85.0)	-	13 (21.7)	40 (66.7)
Low	-	-	3 (5.0)	-	-	9 (15.0)	-	-	20 (33.3)
χ2(p-v)	Cbd=0.27 (0.87) Ec=16.95 (0.00)								

LI: local; Cbd: Crossbred; Ec: exotic; APE: Adaptation to production environment; PA: Predator attack; SA: Scavenging ability; DT: Disease tolerance; HT: Heat tolerance and χ^2 (p-v)=chi-square value (p-value).

Table 4: Comparison of different chicken breeds performance in the three agro-ecological zones (APE, PA, SA, DT and HT).

environmental conditions with reasonable production levels, however, farmers respond as exotic chickens are with the reverse characteristics. Moreover, farmers dictate crossbreed chickens to have intermediate values with regard to adaptation and production circumstances.

Predator attack: As per the local farmers, the three chicken breeds (local, crossbred and exotic) are rated as 1st, 2nd and 3rd, respectively from low to high in predator attack (Table 4). This does mean that the exotic chickens are vulnerable to predator attack. In the contrast, local chickens are capable of escaping from predator attack. It was also seen that the crossbred chickens are attacked by predators in mid altitude, high altitude and low altitude according to their importance. The predator attack of exotic chickens was told to be high in high altitude and that was followed by mid altitude and low altitudes consecutively.

Scavenging ability: The three chicken breeds (local, crossbred and exotic) were ranked for the scavenging ability. Based on this, the local breeds were appreciated by the local farmers for their scavenging ability irrespective of the agro-ecological zones. This was followed by crossbred and exotic breeds consecutively (Table 4). The good scavenging ability of the local breeds could be related with their adaptive nature for range based free grazing system. They have developed the free scavenging for long generation as they are the result of natural selection. In the contrast, the exotic chickens are the result of intensive production system.

Disease and heat tolerance: Besides the scavenging ability the local chickens are appreciated for their good diseases and heat tolerance when compared with crossbred and exotic breeds. Likewise, the crossbred was seen to be relatively better than the pure exotic one in disease and heat resistance. This indicates that the local chickens have well developed the traits related with disease and heat tolerance as they are the result of nature selection. The exotic breeds are adaptive to the temperate areas which are characterized by low temperature. However, there is no variation between the male and female chickens of either breed in disease and heat tolerance. As per the respondent farmers the most striking problem in village chicken production systems is the high mortality rate which could reach as high as 90% within the first few weeks after hatching, due to diseases and predation. Newcastle disease (NCD) was also highly infectious and causes more losses than any other diseases in the study area. In such kind of circumstances local chickens are suggested to perform better than the others.

Feed intake: According to the respondents exotic chickens are characterized by high feed intake comparing with local and crossbred chickens (Table 5). Even if local chickens adapt and produce reasonable amount of production in adverse environmental conditions, their feed intake is comparably low. Crossbred chickens have relatively better feed intake than local chickens. Farmers also added that the major limiting factor of village chicken production is feed problem.

Mothering and brooding ability: In this regard the local chicken breed is well noted for its good mothering and brooding ability. The exotic breed has poor mothering and brooding ability (Table 5). This implies that the local chickens can serve considerably in hatching eggs for breeding/reproduction purpose to increases the flock size. Their mothering ability can contribute more for better survival of the chickens. However, brooding can reduce the egg production of local chickens. In the other hand, the poor brooding nature of exotic breeds can contribute more to the increased egg yield. The mothering and brooding ability of the chickens was irrespective of agro-ecological zones.

Egg production: As per the respondents, egg production was mentioned to be high for exotic breed (235.86 ± 3.02 egg/hen/year) and followed by crossbred (51.09 ± 1.97 egg/hen/year) and local (44.71 ± 0.87 egg/hen/year). There was no difference among the agro-ecological zones in this regard (p>0.05) (Table 5).

Availability: The interview with the local farmers showed that the local chickens are more easily available at the time of need when compared with the availability of the exotic breeds (Table 6). A farmer can easily access the local chicken from different source (local market, neighbor, gift etc.). There is no variation in availability amongst the three agro-ecological zones. Similarly, the crossbred chickens are available equally in all agro-ecologies. However, the availability of exotic chickens was mentioned to be relatively better in the low altitude and followed by high altitude and mid altitude consecutively.

Egg and meat preference: Both the egg and meat of local chickens was told to be highly preferred to that of the exotic breeds (Table 6). The local farmers appreciate the products of local chicken for their taste and color. However, it is not clearly known whether there is variation in nutritional composition and sensory attributes between these counterparts. The meat of local chickens is specially preferred to prepare local dishes "Doro Wet" which is invited for honorable guest. In all agro-ecological zones, the farmers preferred the product of local

Variables (n(%)) and χ^2(p-v)	Agro-ecological zones								
	Low altitude			Mid altitude			High altitude		
	LI	Cbd	Ec	LI	Cbd	Ec	LI	Cbd	Ec
Feed intake (n(%))									
High	-	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)
Medium	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)	-
Low	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)	-	-
χ^2(p-v)									
Mothering ability (n(%))									
High	60 (100.0)	41 (68.3)		60 (100.0)	44 (73.3)		60 (100.0)	43 (71.7)	-
Medium	-	19 (31.7)	-	-	16 (26.7)	-	-	17 (28.3)	-
Low	-	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)
χ^2(p-v)	Cbd=0.37 (0.82)								
Brooding ability (n(%))									
High	60 (100.0)	41 (68.3)		60 (100.0)	44 (73.3)	-	60 (100.0)	43 (71.7)	-
Medium	-	19 (31.7)	-	-	16 (26.7)	-	-	17 (28.3)	-
Low	-	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)
χ^2(p-v)	Cbd=0.37 (0.82)								
Egg production (n(%))									
High	-	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)
Medium	-	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)	-
Low	60 (100.0)	-	-	60 (100.0)	-	-	60 (100.0)	-	-
χ^2(p-v)									
LI: local; Cbd: Crossbred; Ec: exotic χ^2 (p-v)=chi-square value (p-value) and significant differences between sampling agro-ecologies (p<0.05).									

Table 5: Comparison of different chicken breeds performance in the three agro-ecological zones (Feed intake, mothering, ability, brooding ability and egg production).

Variables (n(%)) and χ^2(p-v)	Agro-ecological zones								
	Low altitude			Mid altitude			High altitude		
	LI	Cbd	Ec	LI	Cbd	Ec	LI	Cbd	Ec
Availability (n(%))									
High	60 (100.0)			60 (100.0)			60 (100.0)		
Medium		60 (100.0)	50 (83.3)		60 (100.0)	45 (75.0)		60 (100.0)	48 (80.0)
Low			10 (16.7)			15 (25.0)			12 (20.0)
χ^2(p-v)	Ec=1.29 (0.52)								
Egg quality (preference) (n(%))									
High	60 (100.0)	37 (61.7)	4 (6.7)	60 (100.0)	41 (68.3)	7 (11.7)	60 (100.0)	42 (70.0)	4 (6.7)
Medium	-	23 (38.3	17 (28.3)	-	19 (31.7	18 (30.0)	-	18 (30.0)	22 (36.7)
Low	-	-	39 (65.0)	-	-	35 (58.3)	-	-	34 (56.7)
χ^2(p-v)	Cbd=1.05 (0.59) Ec =2.32 (0.67)								
Meat quality (preference) (n(%))									
High	60 (100.0)	36 (60.0)	4 (6.7)	60 (100.0)	37 (61.7)	7 (11.7)	60 (100.0	38 (63.3)	4 (6.7)
Medium	-	24 (40.0)	17 (28.3)	-	23 (38.3)	18 (30.0)	-	22 (36.7)	22 (36.7)
Low	-	-	39 (65.0)	-	-	35 (58.3)	-	-	34 (56.7)
χ^2(p-v)	Cbd=0.14 (0.93) Ec =1.23 (0.87)								
LI: local; Cbd: Crossbred; Ec: Exotic χ^2 (p-v)=chi-square value (p-value) and significant differences between sampling agro-ecologies (p<0.05).									

Table 6: Comparison of different chicken breeds performance in the three agro-ecological zones (Availability, egg quality and meat quality).

chickens. Eggs from local chicken are often favored by respondent farmers because of their deep yellow colored yolks in addition to their taste. It is believed that consumer preference for yolk color is highly subjective and varies widely from country to country. However, it is obvious that beneficial egg quality traits could have immense importance to poultry breeding industries. The determinant of egg quality could be genetic and non-genetic factors or their interactions.

Farmer's selection practices: Farmers make selection for the traits they consider important under their production environment. For selection of male and female chickens farmers mainly use four trait categories such as plumage color, body weight, comb type and conformation (Table 7). The same finding was reported by Nigussie et al. [8] where all farmers interviewed in the different regions of Ethiopia practice selection on breeding and replacement of males and females based on four trait categories: plumage color, live weight, comb type and conformation "qumena". For both sex and three agro-ecological zones farmers rate body weight, conformation, plumage color and comb type as 1st, 2nd, 3rd and 4th, respectively (Table 7).

Discussion

Free range scavenging based village chicken production is a common practice in the study area. Many studies reported that most of the chicken owners keep their chicken in backyard scavenging type of production system with occasional supplementary feeds [8-11]. This study revealed that the famers offer night shelter for their chicken. Housing is important to avoid major causes of losses such as predation, disease and thefts. The reports of Halima et al. [2] indicated the significant size of the rural households of northwest Ethiopia to have separate sheds for their chickens. The farmers clean chicken's house as biosecurity measures to address health problem. Lack of frequent cleaning of poultry house can easily cause diseases and increase morbidity and mortality rate. The housing management is not satisfactory for the wellbeing of chicken and their products management, and thus it needs improvement.

The current study revealed that all the respondents practice supplementary feeding using home grown crops such as maize, barley, wheat, sorghum and household leftovers. Wheat and maize grains are commonly supplemented to the chickens. The grains are either home produced or market purchased feeds. Recent studies in Ghana and Mozambique also showed that from 90 to 100% of farmers offer supplementary feeds to their chickens [9,11]. Young chicks (1-4 weeks old) are given priority towards supplementary feed. Similarly, research findings by Fisseha et al. [12] indicated that 82.9% chicken owners in Bure district, western Ethiopia, give priority for young chicks. The supplementary feeds are provided to increase egg production, encourage growth and maintain flock health.

Water is important for animals including chickens to keep healthy the flock and promote production. Chickens should have access to clean water in free choice using clean watering trough. The frequency of cleaning the watering trough varies from farmer to farmer. Water is offered in all season but during the rainy season the chickens are expected to drink from the surrounding. Halima [2] also reported that almost all of chicken owners in north-west Amhara provide water to village chickens throughout the year with particular emphasis during dry season.

The result from focus group discussion also indicates that traditional treatment (ethno-veterinary) practice is the common type of treatment often used by majority of village chicken owners in all the study districts for diseases like Newcastle. The most widely used traditional treatments are local alcohol ('Katikala'), Holy soil 'Emenet', 'lemon' (citrus limon), 'Feto' (*Brasica* spp.), hot pepper (*Capsicum frutenscens*) and garlic (*Allium sativum*). Similar finding on traditional medicaments indicated that farmers treat chicken using tobacco leaf, lemon juice and table oil, which are administrated with drinking water [13]. Most farmers, however, realized that despite the traditional control methods the losses due to NCD are still huge. However, no any research findings on the effectiveness of these treatments and should be subjected to future research.

Farmers engaged in chicken production claim on occurrence, wide distribution and lack of conventional treatments on external parasite infestation. Accordingly, farmers have their own traditional practices to prevent and control against external parasitism. Some of the traditional remedies widely used in these study areas include "chiendog" and "saerisaero", insecticide spray (Roach killer locally

Agro-ecological zones	Selection trait of male chickens				Selection trait of female chickens			
	Plumage color	Weight	Comb type	Conformation	Plumage color	Weight	Comb type	Conformation
Low altitude								
Rank 1	-	51	-	9	-	47	-	13
Rank 2	-	9	-	51	-	13	-	46
Rank 3	54	-	6	-	54	-	5	1
Rank 4	6	-	54	-	6	-	55	
Index	0.19	0.38	0.11	0.31	0.19	0.37	0.1	0.32
Mid altitude								
Rank 1	-	53	-	7	-	48	-	12
Rank 2	1	7	-	52	-	12	-	47
Rank 3	54	-	5	1	55	-	4	1
Rank 4	5	-	55	-	5	-	56	-
Index	0.19	0.38	0.1	0.31	0.19	0.38	0.1	0.31
High altitude								
Rank 1	-	54	-	6	-	47	-	13
Rank 2	2	5	1	52	1	12	-	47
Rank 3	54	1	3	2	55	-	5	-
Rank 4	4	-	56	-	4	1	55	-
Index	0.19	0.38	0.1	0.3	0.19	0.37	0.1	0.32
Index=sum of [4 for rank 1+3 for rank 2+2 for rank 3+1 for rank 4] for particular trait divide by sum of [4 for rank 1+3 for rank 2+2 for rank 3+1 for rank 4] for all traits.								

Table 7: Selection traits of male and female chickens in the study area.

called "finit"), kerosene (Nech gas), butter and liquid paraffin which are smoked, sprayed and/or applied, respectively. This finding is in line with other research findings on the indigenous knowledge to prevent chickens from external parasites [14].

Predators like bagger (Shelemetimat), domestic cat and wild birds (locally called chilfit) are some of the limiting factors of chicken production in these study areas. The effect of predators on chicken production is not as such significant when compared to Newcastle disease, which causes devastating chicken loss. The negative effects of predators could be prevented by various indigenous measures which include provision of shelters, housing and using dogs. There was variation on chicken disease management across agro-ecological zones. This might be due to the difference in disease and predator prevalence, awareness on chicken disease symptoms and their management.

The overall average chicken flock size (24.31 ± 1.21) found in this study was higher than that of Halima [2], (6.3), in northwest Amhara, Ethiopia but lower than Aboe et al. [9] (28.7) for Accra plain Regions, Ghana. The flock size variation of this study relative to other studies could be due to the variation in availability of feed, the presence of different diseases of various etiologies, predators and the socio-economic status of the owners. Moreover, the highest number of hen observed in this study might be due to rearing of chickens mainly for egg production and dissemination of improved layer chicken breeds by different bodies. The flock composition is dominated by hens and pullets implying that egg production has significant importance in the chicken production system. The higher number of pullets is to replace the hen. The female chicken groups (hens and pullets) together share about 75% of the total flock mass while the male group (cock and cockerels) contribute limited percentage (9%) with cock (7%) and cockerels (2%) indicating the importance of female chickens in the chicken production system. This makes the ratio of female to male to be 8.33 and hen to cock is 7.85.

The breed composition indicated the exotic chicken breed (57%) dominates the flock and followed by local (37%) and crossbred (6%). The high exotic chicken breeds per household might be due to the extensive introduction of exotic chicken breeds by bureau of agriculture and rural development, research centers and NGOs. The agricultural extension office has been introducing exotic breeds for decades. This might have contributed to the positive change in the flock number and breed composition in the chicken production system. The comparative low contribution of crossbreds might be due to the impact of extension agents and disseminators training on negative effects of uncontrolled crossbreeding as a root cause of genetic erosion.

Farmer's ratings of indigenous chickens for various traits/trait categories compared to a reference exotic breed of this study revealed the important adaptive attributes of indigenous chickens. Local chickens were valued for their good adaptation to the production environment, low predator attack, scavenging ability, disease tolerance, heat tolerance, mothering ability, brooding ability, egg preference, meat preference and availability which affect consumption preference and consequently market value. This was in line with the result reported by Ssewannyana et al. [4] where indigenous chickens are valued mainly for their ability to scavenge, disease tolerance, meat quality and general hardiness.

Adaptability of an animal is generally described in terms of traits enabling them to survive, reproduce and be productive in the limits of their production condition [15]. A review by Islam and Nishibori [16] indicated that in Bangladesh and many other developing countries, the meat and eggs of indigenous chickens was highly preferred for its taste and suitability for special dishes resulting in even higher market prices for these chickens than their exotic counterpart. However, this study showed exotic chickens were valued for their high egg production and crossbred chickens were valued for their intermediate characteristics of all adaptive and economically important traits. Similarly, earlier study on adoption of poultry breeds in Ethiopia [17] indicated that trait categories like high egg and meat production ability were among the principal factors determining farmer's adoption of improved chicken breeds. The variation in adaptive and economic important traits might be due to the difference in genotype, environment and their interactions.

Similar to this study, Muchadeyi et al. [18] reported that poultry farmers in Zimbabwe traditionally select compact and mature chickens rather than angular and tallish ones as breeding stocks though they attached no emphasis to plumage color. The same authors also indicated that farmers give high emphasis for reproductive performance, growth and survival and less to plumage color. Incorporation of these traits in breeding programs targeting village chicken producers is highly important. The reason for giving high value for economically important traits in this study area could be due to increment of farmers' awareness and consumers giving value to economically important traits than monogenic qualitative traits.

This study showed no difference in rating of plumage color and body weight for selection of male chicken in the three agro-ecological zones. Similarly, the same go with comb type in selection of male chickens for mid altitude and high altitudes although highest rating was seen in low altitude [19]. In case of conformation for selection of male chicken, equal rating was given for low altitude and mid altitude while lowest rating was shown in high altitudes. In case of female chicken selection processes, plumage color was given equal attention in the three ago-ecological zones. Body weight was ranked first in mid altitude. However, similar value was given to low altitude and high altitude. No difference in rating of comb type was also seen across the agro-ecologies. Taking equal value, low and high altitude showed highest rating followed by mid altitude for selection based on conformation. The variation in rate of selection of this study could be due to the variation in cultural, religious, market and awareness condition of farmers.

According to focus group discussion farmers of the study area practice chicken selection and breeding activities. Several researchers report breeding practices of farmers. Addisu et al. [14] reported that about 17.3% of respondents have breeding practice in improving their chicken productivity either by cross breeding (80.0%) or by line breeding (20.0%) and Fisseha [12] reported about 92.2% of chicken owner farmers in Bure district had the tradition of selecting cocks for breeding stock. As per the farmers eggs are selected for natural incubation based on the size, color, shape, cleanness and breed. The brooding hen is also chosen based on her conformation and past history performance. This kind of selection based on chicken's historical performance had also been witnessed in Ethiopia and Zimbabwe. Moreover, hen without physical problem, free of disease, good brooding feature, broad wings and good history of performance are selected for the purpose of brooding.

Farmers consider economically important traits in selection of chicken for breeding. Adaptive traits, escape from predator, scavenging ability, heat tolerance, disease tolerance, brooding ability, mothering ability, good egg and meat taste, egg production, feed intake are valued. This was similar with Okeno et al. [20] where majority of the farmers

in Kenya considered adaptive and economically important traits. Most of the adaptive and economically important traits are fulfilled by local chickens, but since the farmers have shown great interest in egg and meat production, the trend in introducing, selecting and breeding exotic chickens are increasing from time to time. In time where the exotic chickens are good producers but with lack of adaptability, crossbreeding takes the step for genetic improvement.

Crossbreeding is not advised and recommended by agricultural extension bodies in the study areas due to the impact on genetic diversity and losing the important traits of local chickens rated as superior by themselves. However, there is no good breeding scheme introduced so far to avoid such kind of impacts or else regulator lows to avoid uncontrolled breeding activities [21]. Besides to the above economically important quantitative traits some important monogenic qualitative traits having important market implication on consumer preference are also considered in the breeding system. Red plumage color was rated as first but black as last in selecting breeding stock, rose comb type rated as first but single comb as last. As farmers practice selection for breeding, to the same angle they also practice culling those chickens with less adaptive, productive and reproductive traits. Halima et al. [2] also revealed that farmers cull poor productive and old age chickens via selling.

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