academicresearchJournals

Vol. 5(7), pp. 521-528, November 2017
DOI: 10.14662/ARJASR2017.083

ISSN: 2360-7874
http://www.academicresearchjournals.org/ARJASR/Index.htm

Academic Research Journal of Agricultural Science and Research

Full Length Research

Production Objectives, Breeding Practices and Selection Criteria of Indigenous Chicken in Central Zone of Tigray, Northern Ethiopia

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Accepted 17 October 2017

The study was conducted in three districts of central zone of Tigray, with the aim to assess farmers' breeding objectives, breeding practice, and traits of preference for local chickens. A total of 242 chicken owners was selected for the study. The farmers practice breeding using the exotic chicken as responded with (36.7%) and using improved indigenous chicken as responded by 63.3%. Culling is practiced by 78.9% of households based on different criteria's. The main breeding objectives of the respondents were for household consumption, income generation and for replacement of the flock. The effective population size (Ne) and the rate of inbreeding (ΔF) calculated for the indigenous chicken flock were 3.99 and 0.13, respectively.The selection criteria used for selection of breeding hen were egg size, plumage color, broodiness, disease resistance and hatchability with an average index value of 0.067, 0.064, 0.062, 0.054, 0.042. The highest selection criteria used for selection of breeding cock were egg number of the dam, comb type, plumage color, and disease resistance, with an index value of 0.053, 0.052, 0.045 and 0.044, respectively. In conclusion, there is a need to be considered production objectives, trait preference of the indigenous chicken owners and breeding practices among agro ecologies in designing sustainable breeding strategy to improve productivity of chicken in the study area.

Key words: Culling, Midland, Highland, Traits Preference

Cite this article as: Fitsum M (2017). Production Objectives, Breeding Practices and Selection Criteria of Indigenous Chicken in Central Zone of Tigray, Northern Ethiopia. Acad. Res. J. Agri. Sci. Res. Vol. 5(7), pp. 521-528

INTRODUCTION

Ethiopia has one of the largest and most diverse chicken populations in Africa. According to CSA (2014), there are 53 million chickens in Ethiopia of which 96.6% are indigenous. These indigenous chickens produce 90% of total eggs and 95% of total meat in the country. According to CSA (2010), the total poultry population in Tigray region is estimated to be about 4,308,595, which are about 8.74% of the total national indigenous chicken population and contributes about 15% of the total annual national egg and poultry meat production. About 80.90% of the total regional chicken populations are found in rural areas while the urban areas constitute 19.10% (CSA, 2010). Central administration zone of Tigray accounts for more than 1.1 million chickens, which account for about

34.68% of the total regional poultry population (CSA, 2010).

The traditional poultry production system is characterized by small flock sizes, low input, low output, and periodic devastation of the flock by disease (Tadelle *et al.,* 2003). With a number of challenges, backyard poultry production is still important in low-income, food-deficit production systems to supply the fast-growing human population with high demand for quality protein (Tadelle *et al.,* 2003). Backyard poultry is also a source of employment for underprivileged groups in many local communities (Mengesha *et al.,* 2008). According to Aklilu (2007), village poultry is the first step on the ladder for poor households to climb out of poverty and is a source of self-reliance for women, since poultry and egg sales are decided by women and provide women with an immediate income to meet household expenses. A traditional stew (Doro wot dish) is served in the festivities and to honor guests and demonstrates respect to guests, that strengthens social relationship.

Despite the importance of indigenous breeds in rendering income, posses' cultural value and source of nutrition for the household, they are under threat due to various factors such as changing production systems and indiscriminate crossbreeding (Besbes, 2009). Importation of exotic chicken breeds for commercial investments has gradually increased during the past years due to the high local demand for chicken products in the region. This has encouraged a continuous gene flow and genetic erosion of local chicken genetic resources. The replacement of local by exotic breeds and/or uncontrolled breeding with local populations has been posing a serious threat to the existence of few local chicken breeds on small-scale farms, putting these local animal genetic resources at risk of extinction (Kadim *et al.,* 2009).

There are very few examples of breeding programs for indigenous breeds in Africa and around the world. Recently a genetic improvement program has been initiated for increasing productivity of indigenous chickens of Ethiopia through selective breeding, as a means both to improve the livelihood of poor people as well as conserve the existing genetic diversity through utilization. Developing appropriate animal breeding programs for village conditions requires defining the production environments and identifying the breeding practices, production objectives, and trait choices of rural farmers (Soelkner *et al.* 1998).

Understanding the purposes of keeping chicken selection criteria and breeding practices is a prerequisite for designing sustainable chicken genetic improvement programs and strategies for the future development of indigenous breeds. The objectives of this study were to evaluate the production objectives, breeding practices used by smallholder chicken farmers and to investigate the existence of selection criteria of farmers used for selecting indigenous chicken in the two agro-ecological zones of the central zone of Tigray.

MATERIALS AND METHODS

Descriptions of the Study areas

The study was conducted in three rural districts of the central zone of Tigray- Laelay Maichew, Ahferom and Adwa. The Central Tigray zone is bounded by Eritrea in the north, East Tigray zone in the East and south east Tigray, West Tigray zone in the west and Amhara National Regional State in the south. The central zone of Tigray covers about 9741 km^2 with a total population of 1,132,229 of which (51% are female). The central zone is divided into nine districts and three major marketing towns, Axum, Adwa and AbyiAdi. The zone consists of about 859,066 cattle, 134,223 sheep, 711,624 goats, 98,910 honeybee colonies, 1,117,881chicken and about 26709 ha irrigated area largely used for vegetable and fruit (CSA, 2010).

The Central zone of Tigray extends between 13°15' and 14°39' North latitude, and 38° 34' and 39°25' East longitude. The larger part of the zone receives mean annual rainfall ranging from 400 to 800mm. The mean monthly maximum and minimum temperatures of the zone are 30°C and 10°C, respectively (National Meteorological Service Agency of Ethiopia, 1996).

Sampling Method and Sample Size

Stratified sampling technique was employed to stratify kebeles (the smallest administrative unit in Ethiopia) of the three districts into midland or wainadega (1500-2500 masl) and highland or dega (>2500masl) (EARO, 2000). Ahferom (Sefo and Mayqeyahkebeles) represented highland, Laelaymaichew (Dura and Medegokebeles) and Adwa (Mariam Shewito and Bete Yohanneskebles) represented as midlands.

A rapid field survey was done before the main survey, to know the geographical distribution, concentration of local chicken ecotypes, the kebeles of each sample districts and sampling framework from which sampling of the district was taken. Multi-stage sampling technique was employed to select both sample kebeles and respondents. Six sample kebeles were selected purposively to represent midland and highland (four kebele from midland and two kebele from highland agro ecology) based on the village poultry population density, chicken production potential, road accessibility and agro-ecological representation. A total of 242 (124 from midland and 118 from highland agro ecology) village chicken owners having three or more chickens were selected randomly for the interview and the numbers of respondents per midland and highland agro ecology were determined by a proportionate sampling technique based

on the households' size and they were interviewed using a pre-tested well structured questionnaire. One focus group discussion that included 10 elderly members per agro ecology having similar sex, religion and literates were carried out to collect data other than the individual interviews. Members of the focus groups were selected from the community known to have a good understanding of poultry production.

Data collection

For the interviews, structured and semi structured questionnaires were used that covered the following topics. Before the survey was conducted, enumerators were trained and the questionnaire was pretested. Data were collected through structured and semi-structured questionnaires and group discussions.

Statistical data analysis

Survey data were analyzed using descriptive statistics by Statistical Package for Social Sciences (SPSS 16.0 for windows, release 16.0, 2006).Ranking analyses were used for computing data on breeding objective, farmers' traits preference, and conformation traits as related to selection of chicken. Indexes were used to calculate data collected from rankings using weighed averages by the following formula employed by Musa *et al*. (2006).

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

Where, R_n = the last rank (example if the last rank is 8^{th}, then $R_n = 8$, $R_{n-1} = 7$, $R_1 = 1$).

C_n = the % of respondents in the last rank, C_1 = the % of respondents ranked first Index was ranked using auto ranking with MS-Excel 2007.Chi-square test was employed to variables describe in percentage across agro ecologies.

RESULT AND DISCUSSION

Breeding objectives and breeding practice

Clear definition of breeding objectives might be difficult under the subsistence level of managements with a wide range of production objectives and marketing strategies (Kebede *et al.,* 2012). In general, the results of this study suggested that farmers have multiple breeding objectives of chicken. In this study, almost all selected sample households were engaged in poultry keeping but the purpose of production differs based on the interest of producer households. The main purpose of producing poultry includes cash from sales, meat consumption, egg consumption, for replacement, for brooding, spiritual/religious, ceremony, cultural and manure with an Index values of 0.101, 0.092, 0.115, 0.120, 0.242, 0.093, 0.046, 0.018 and 0.003 (Table 1). Similar purposes have also been reported by Mengesha *et al* (2008) reported that, in Jamma district the purpose of keeping poultry was mainly for sale (38.1%), followed by for home consumption (31.7%) and no defined (16.3%), at last for religious purposes (13.9%).

The main production objectives of chicken in the midland of agro ecology were for brooding, for replacement, meat consumption, cash from sale of chicken and egg, egg consumption, spiritual/religious, ceremony, cultural and manure with an index value of 0.174, 0.083, 0.080, 0.068, 0.066, 0.061, 0.027, 0.013, and 0.002. While the main production objectives of chicken in highland of agro ecology were for brooding, for replacement, meat consumption, cash from sale of chicken and egg, spiritual/religious, egg consumption, ceremony, cultural and manure with an index value of 0.136, 0.073, 0.069, 0.065, 0.064, 0.051, 0.037, 0.010 and 0.001.

The study reviles that village poultry kept for brooding purpose, home consumption and income generation; which in one way or other improve the nutrition status of the family. Similarly, Tadelle (2003) also reported that income generation followed by consumption was the main production objectives for keeping chicken. Halima (2007) also reported that income generation was the primary objectives of chicken rearing in Southern and North western Ethiopia.

Concerning breeding practice 80.1% of respondents have practice breeding practice in improving their chicken productivity through importing exotic (36.7%) and improving indigenous (63.3%) by cross breeding (60.3%) and by pure breeding (39.7%) methods (Table 2). This result shows an agreement with the report of Fisseha (2009) reported that about 92.2% of chicken owner farmers in Bure district had the tradition of selecting cocks for breeding stock but is not in line with the report of Meseret (2010) in which traditional chicken production system was characterized by lack of systematic breeding practice in Gomma district and finding of Nigussie (2011) reported that breeding is completely uncontrolled and replacement stock produced through natural incubation using broody hens in different parts of Ethiopia.

The scavenging habit of village chickens does not allow farmers to directly influence the exact mates of the breeding stock. However, in the study area 66.5% of the respondents exercise controlled breeding system at the community level by retaining the best cock and hen (86.1%) ,culling unproductive chicken (6.7%), culling unwanted color of chicken at young age (6.1%) and preventing mate of unwanted cock (1.2%). Chickens that were not retained for breeding purposes were culled

Table **1**. Ranking of purpose for keeping chickens

Purpose of keeping chicken	In midland chicken owner								In highland chicken owner								average Index
	Rank								Rank								
	1	2	3	4	5	6	Sum	Index	1	2	3	4	5	6	Sum	Index	
Cash from sale	47	16	29	14	11	0	277	0.068	24	17	42	16	2	1	264	0.065	0.101
Egg consumption	25	54	24	9	2	3	269	0.066	57	42	12	2	3	1	206	0.051	0.092
Meat consumption	32	29	34	14	8	6	324	0.080	20	49	30	11	2	3	280	0.069	0.115
For replacement	4	7	17	29	22	7	337	0.083	2	3	9	36	19	4	298	0.073	0.120
For brooding	13	13	14	47	41	39	708	0.174	13	4	15	27	42	28	552	0.136	0.242
Spiritual/religious	3	4	3	4	11	26	247	0.061	2	3	8	15	11	19	261	0.064	0.093
Ceremony	0	1	1	1	9	9	108	0.027	0	0	1	5	12	11	149	0.037	0.046
Cultural	0	0	0	0	3	6	51	0.013	0	0	0	0	2	5	40	0.010	0.018
Manure	0	0	0	1	1	0	9	0.002	0	0	0	0	1	0	5	0.001	0.003

Percentages do not add up to 100% since respondents selected based on more than one trait category
Index=the sum of (6times first order +5times second order ..... + 1times six order) for individual variables divided by the sum of (6times first order +5times second order ….. +1times six order) for all variables.

Table 2. Mating system, mating control, culling practice of less productive chickens and traits preference of farmers in the study area

Variable	Agro ecology				Over all		X^2	P
	Midland(124)		Highland (118)		(242)		Value	value
Practice of breeding							0.30	0.584
	freq	%	freq	%	freq	%		
Yes	101	41.9	92	38.20	193	80.10		
No	23	9.50	25	10.40	48	19.90		
Kind of breeding method practice							55.131	0.000
Importing exotic	18	7.60	69	29.10	87	36.70		
Improving indigenous	106	44.7	44	18.60	150	63.30		
Was of improving local breeds							24.502	0.000
Cross breeding	56	23.4	88	36.80	144	60.30		
Pure breeding	68	28.5	27	11.30	95	39.70		
Mating system of the flock							11.516	0.001
Controlled	67	32.1	72	34.40	139	66.50		
Uncontrolled	51	24.4	19	9.10	70	33.50		
If controlled mating by what techniques							4.782	0.189
Culling unproductive chicken	5	3.00	6	3.60	11	6.70		
Culling unwanted color of chicken at young age	9	5.40	3	1.80	12	7.30		
Retaining the best cock and hen	63	38.2	79	47.90	142	86.10		
Have you know inbreeding concept							3.182	0.74
Yes	12	4.60	4	1.70	16	6.20		
No	112	46.5	114	47.30	226	93.80		

-Number in bracket is referred to total number of respondents

through sale (18.90%), consumption (25.20%), sales and consumption (49.50%) (Table 2). This result agrees with the findings of Addisu (2013) who reported that slaughtering (53.27%), selling (41.18%) and devour or sell eggs of unwanted hens (5.56%) were a major means of culling less productive chicken from the flock in North

Table 3. Reported culling and selection of breeding hen and cock

Variable	Agro ecology				Over all		X^2	P
	Midland(124)		Highland(118)		(242)		Value	value
	N	%	N	%	N	%		
Practice of culling							8.293	0.004
No. of respondent who cull	107	44.2	84	34.70	191	78.90		
No. respondents who didn't cull	17	7.00	34	14.00	51	21.10		
Reasons for culling								
Old age	102	42.1	86	35.50	188	77.70	0.113	0.080
Low production	106	43.8	84	34.70	190	78.50	0.174	0.007
Unwanted plumage color	78	32.2	55	22.70	133	55.00	0.164	0.011
Illness	43	17.8	38	15.70	81	33.50	0.016	0.684
low hatchability	9	7.3	31	26.3	40	16.3	0.256	0.000
Bad temperament	31	12.8	16	6.60	47	19.40	0.145	0.025
Purpose of culling							0.290	0.002
For home consumption	24	11.7	33	16.10	57	29.70		
For sale	16	7.80	23	11.20	39	18.90		
Sale and consumption	66	32.0	36	17.50	102	49.50		
All	8	3.90	0	.00	8	3.90		
Practice of selection breeding male and female							1.620	0.203
Yes	120	49.60	110	45.50	230	95.00		
No	9	1.70	8	3.30	12	5.00)		
Selection Age for breeding male (mean ±SD)	4.38±1.81		4.22±1.00		4.31±1.48		0.676	0.412
Selection Age for breeding female (mean ±SD)	4.52±1.85		4.50±1.16		4.51±1.55		0.015	0.902

-Number in bracket is referred to total number of respondents
-N stands for number of respondents

Gonder. Bogale (2008) also reported that home consumption and selling were the main culling means of chicken from their flock and Halima (2007) also revealed that farmers cull poor productivity and old age chickens through selling.

Selection and culling practices

The culling and selection criteria for breeding cock and hens are shown in Table 3. On average 78.9% of households of the study area cull chickens with an age 4.31±1.48 and 4.51±1.55 years with male and female birds. There were no significant differences between agro ecology with respect to practice of selection and age of selection for male cock and hen but it was observed that highland and midland agro ecology differed with respect practice of culling and purpose of culling chickens.

In both midland and highland agro ecology, low production of chicken, old age, unwanted plumage color, ill that was in poor health bad temperament of hens and cocks and low hatchability were highly ranked as culling criteria. As a result, farmers in different agro ecological zones show almost similar trait preferences and use of the same breeding practices. Birds that were not retained for breeding purposes were culled through sales, consumption and gift. The culling criteria used give an indication of the implicit farmers' breeding goals (Muchadeyi *et al.,* 2004). The higher frequency of farmers culling chickens for productive than morphological traits implies that village chickens are kept mainly for economic and food security reasons.

Breeding hen and cock selection criteria of farmers in the study area

Farmers' decisions on choice of breeding stock are shown in Table 4. Chicken owners in the present study area also considered both morphological and production selection criteria. The current study showed that the selection criteria used for selection of breeding hen wereegg size, plumage color, broodiness, disease resistance and hatchability were the traits of highest importance for selection purpose with an average index value of 0.067, 0.064, 0.062, 0.054 and 0.042; while mothering ability, egg number, body size, growth rate, good scavenging, longevity, fighting ability were ranked

Table 1. Selection criteria used for selecting breeding hen and cock in midland and highland agro ecology

Selection criteria	In highland chicken owner Rank														
	1	2	3	4	5	6	7	8	9	10	11	Sum	Index	Average Index	traits rank
Breeding hen															
Egg number	45	24	26	15	5	0	1	0	0		0	263	0.031	0.036	6
Body size	35	20	35	12	1	3	2	0	0	0	0	265	0.031	0.036	6
Growth rate	8	19	21	14	16	5	0	1	0	0	0	283	0.033	0.033	7
Hatchability	13	16	5	35	19	11	2	0	0	0	0	375	0.044	0.042	4
Mothering ability	4	10	4	2	19	8	7	3	2	1	0	288	0.034	0.040	5
Broodiness	4	4	6	4	14	19	5	15	7	5	5	553	0.065	0.062	3
Disease resistance	3	4	2	13	13	19	26	1	4	1	0	484	0.057	0.054	4
Egg size	2	21	15	11	15	11	16	14	7	1	0	571	0.067	0.067	1
Plumage color	4	0	2	9	5	19	20	18	11	0	0	568	0.067	0.064	2
Fighting ability	0	0	2	2	0	2	1	7	2	0	2	129	0.015	0.022	10
Good scavenging	0	0	0	0	0	2	9	1	4	5	5	224	0.026	0.028	8
Longevity	0	0	0	0	0	0	0	6	7	5	1	172	0.020	0.027	9
Breeding cock															
Egg number	9	11	15	19	17	1	3	9	16	0	0	480	0.057	0.053	1
Body size	50	32	25	7	0	1	0	2	0	0	0	239	0.028	0.029	9
Growth rate	7	22	28	23	13	7	1	0	4	2	0	397	0.047	0.041	5
Hatchability	1	1	3	20	12	13	7	0	0	0	0	279	0.033	0.032	8
Mothering ability	0	1	1	2	8	7	3	2	2	6	0	210	0.025	0.025	10
Broodiness	0	0	2	2	6	6	11	4	1	1	6	274	0.032	0.033	7
Disease resistance	4	9	6	11	17	11	18	4	1	0	0	402	0.047	0.044	4
Egg size	1	7	3	2	16	6	10	13	0	1	0	332	0.039	0.041	5
Good scavenging	0	2	1	4	1	9	2	20	6	3	0	340	0.040	0.039	6
Plumage color	12	10	22	5	3	15	9	1	5	4	2	401	0.047	0.045	3
Fighting ability	2	0	0	0	0	0	8	11	7	0	3	242	0.029	0.022	11
Fertility	30	17	9	12	8	7	1	0	0	2	1	259	0.031	0.033	7
Comb type	2	6	3	10	6	16	3	2	8	10	5	453	0.053	0.052	2

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.

low with an index value of 0.040, 0.036, 0.036, 0.033, 0.028, 0.027 and 0.022. The highest selection criteria used for selection of breeding cock were egg number, comb type, plumage color, disease resistance, egg size and growth rate with an index value of 0.053, 0.052, 0.045, 0.044, 0.041 and 0.041; while good scavenging, broodiness, fertility, hatchability, body size, mothering ability and fighting ability were rank lowest with an average index value of 0.053, 0.052, 0.045, 0.044, 0.041, 0.041, 0.039, 0.033, 0.033, 0.032, 0.029, 0.025 and 0.022. In the study area for breeding hen and cock selection, farmers target was not only for breeding purposes but also they take into consideration the factors or traits that affected the market and cultural value.

The present findings are inconsistent with the report of Duguma. (2010) reported that conformation traits are important criteria of selection under traditional livestock breeding practices. This is because size/conformation heavily determines live bird prices in traditional poultry markets. Similarly the high rating of plumage colour in the present study is in line to the report of Nigussie *et al.*(2010) where this trait was used as a selection criterion. The present findings are also in agreement with reports of Okeno *et al.,* (2011) who reported chickens traits of economic significance such egg number; body size and fertility were highly rated.

Development of a breeding goal for improvement of indigenous birds should focus on the traits perceived important by stakeholders (Okeno *et al.,* 2011). This is because breeding goals developed without considering the needs of all the stakeholders have high chances of rejection by end users.The discussions held with farmer's shows that morphological traits, particularly plumage colour and comb type for cock and hen, determined the market and cultural suitability of chickens and were very important in both midland and highland agro ecology of the study area.

CONCLUSION

There is a clear need to base genetic improvement programs for village poultry producers on indigenous chicken genetic resources. This is emphasized by the fact that the adaptive traits in general, and the superior merits of indigenous chickens to high yielding exotic breeds in particular, were rated of the highest significance by the local farmers. Egg production is the principal function of chickens, followed in respective order by their use as sources of cash income and meat. The market price of chickens is primarily dictated by weight, but farmers rated growth (males) and number of eggs followed by growth (females) as the traits they would like the most to be improved. Therefore, the ultimate breeding goal should be to develop a productive dual-purpose breed that can survive and reproduce under the production environment of village farmers.

ACKNOWLEDGMENTS

This study was sponsored by ILRI/LIVES project and Axum Agricultural Research Center of Tigray Agricultural Research Institute. We would like to thank to members of Livestock researchers of the Center who contributed in the implementation of the project. Greatest gratitude also goes to farmers that participated in individual interview and focus group discussion for sharing their knowledge.

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