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Productive and reproductive performances of indigenous chicken population and traits preference of smallholder farmers in Bale Zone, Oromia Regional State, Ethiopia

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ABSTRACT: A study was conducted on productive and reproductive performances of indigenous chicken population and traits preference of smallholder farmers in Bale Zone, Oromia Regional State, Ethiopia for assessing productive and reproductive performances of indigenous chicken population and farmers traits preference in study area. The study was conducted in five selected districts (Madda Walabu, Delomena, Berbere, Ginnir and Sinana districts) of Bale zone, south east Ethiopia. For this study, a total of 390 household having indigenous chicken population were sampled using simple random sampling techniques. The collected data were coded and inserted on Microsoft excel spread sheet and analysed using SAS software version 9.13. Growth rate and egg production traits are the first and second selection criteria preferred by farmers/pastoralists across study districts. Weight is the main trait preference by farmers/pastoralist both for male and female chicken across all study districts. The average age of indigenous cockerels and pullets at first mating and laying was 4.30 ± 0.1 and 4.50 ± 0.1 months, respectively. The number of clutches per hen and eggs per clutch and total eggs produced per hen per year were 4.0 ± 0.12, and 20.18 ± 0.66 eggs, respectively. The hatchability and survival rate of chicks were 76.25 and 74.35%, respectively. The result of study indicated that farmers/pastoralists in study area were practices different selection criteria and trait preference both for male and female chicken. Therefore, the study suggested that there is an opportunity for genetic improvement through selection and there is a need of in-depth breed characterization and the relationship of trait preference of farmers/pastoralists with economical values of the traits.

Keywords: Indigenous chicken, management practices, productive, reproductive, trait preference.

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa (CSA, 2013). The livestock sector has been contributing considerable parts to the economy of the country, contributes 20% to the total GDP, supporting the livelihoods of 70% of the population, and generates about 11% of annual export earnings. Livestock sector are still promising to the economic development of the country (CSA, 2011). The total chicken population at country level without Addis Ababa is estimated to be about 56.87 million. Chicken includes cocks, cockerels, pullets, laying hens, non-laying hens and chicks. Consequently, most of the poultry are chicks (37.68 percent), followed by laying hens (33.1 percent). Pullets are estimated to be about 5.91 million in the country. Cocks and cockerels are also estimated separately, and are 5.81 million and about 3.21 million, respectively. The others are non-laying hens that make up about 2.95 percent (1.68 million) of the total poultry population in the country. With regard to breed, 95.86 percent, 2.79 percent and 1.35 percent of the total chicken were reported to be indigenous, hybrid (cross with

different exotic breeds) and exotic, respectively (CSA, 2015).

In Ethiopia, most chicken populations are non-descriptive type. However, they showed a great variation in their production environment which might be due to their wide spread distribution and adaptive response to different ecological conditions (Tadelle, 2003; Halima, 2007; Moges et al., 2010a; Getu et al., 2013). Indigenous chicken (95.86%) in Ethiopia is found in huge number distributed across different agro-ecological zones (CSA, 2015) under a traditional family-based scavenging management system (Tadelle and Alemu, 1997). This indicates that they are highly important in farm animals kept as a good source of animal protein and income to most of the rural populations. From that, more than 90% of the national chicken meat and egg output is from indigenous chickens (Dana et al., 2011). However, the productivity of indigenous chicken is low as compared to exotic breeds with average annual egg production of 60 eggs per hen (Moges et al., 2010a). On the other hand, the live weight of indigenous chicken is about 1.6 kg and 1.3 kg for male and female respectively at 6 months of age (Mekonnen, 2007). Indigenous chicken production has a comparative advantage over other livestock because of they have short generation interval, high feed conversion efficiency, natural brooding and a capacity to have a great number of chickens per unit area (Upton, 2004).

Knowledge and understanding of the chicken production systems, their unique characteristics, opportunities and constraints which are important in the design and implementation of indigenous chicken-based development programs are still not sufficiently identified (Guèye et al., 1998). There are limited efforts of characterization of chicken production system, breeding practice and traits preference of farmers. In addition, most previous works did not thoroughly include Bale Zone, Oromia Regional State particularly on phenotypic characterization, productive and reproductive performance of indigenous chicken population. Breed genetic improvement and subsequent proper utilization of indigenous chicken population strongly demands comprehensive characterization and conservation, including breeding practice. For further breed improvement of local chicken through selection and introduction of improved chicken breeds for egg and meat production, assessment and identification of productive and reproductive performance of indigenous local chicken has significance values. Therefore, this study was undertaken with objectives of assessing productive and reproductive performances of indigenous chicken population and farmer's traits preference in study area.

MATERIALS AND METHODS

Study areas

The study was conducted in two lowland districts (Dalo Mena and in Madda Walabu) and three highland and midland (Berbere, Ginnir and Sinana) districts of Bale zone, Oromia Regional State, which is located in the South East part of Ethiopia during the period of 2018/19. Berbere district has annual average temperature of 16.5°C whereas the minimum and maximum temperature is 9 and 23°C, respectively. The annual average rainfall is 850mm whereas the minimum and maximum rainfall is 1060 and 1150 mm, respectively. The lowest and highest altitude of Ginnir district is extended from 1200 m below sea level which is located at the southern extreme corner of the district to 2406m above sea level which is found along the northern margin of the district, respectively. The annual average temperature of Ginnir district is 25.45°C whereas the minimum and maximum temperature is 23.2 and 27.7°C, respectively and the annual average rainfall is 700 mm whereas the minimum and maximum rainfall is 200 and 1200 mm, respectively. Sinana district has annual average temperature of 16.5°C whereas the minimum and maximum temperature is 9 and 23°C, respectively. The annual average rainfall is 1,105mm whereas the minimum and maximum rainfall is 1,060 and 1,150 mm, respectively. The mean annual temperature of Dalo Mena district is 29.5°C where the lowest and highest temperature is 21 and 38°C, respectively. The mean annual rainfall is 701.5 mm whereas the lowest and highest rainfall is 628 and 775 mm, respectively. Madda Walabu district is located in the south-Western parts of the Bale zone. The district has a distance of 200 km from zone capital town Robe and 630km from the capital city of the country, Addis Ababa.

Sample size and sampling techniques

Sample size for survey part was sampled from all household that have chicken (target population). The study districts were selected using purposively sampling techniques based on chicken population potential and agro-ecologies. The study was conducted in five districts (three from low land and two from high land districts) in reference with the large numbers of indigenous chicken population and less distribution of exotic chicken lines. Each of the sampling districts was stratified independently into *kebeles* based on difference in altitude and considering chicken population size. Sample size was determined based on the formula recommended by Arsham (2007) for survey studies. $N = 0.25/SE^2$ with the assumption of 2.5% standard error, a total sample size of 390 households having chickens were considered for the study. About three *kebeles* per district were selected using simple random sampling techniques. About 78 households per district were selected using simple random sampling techniques for interview. A total of five focus group discussion, one focus group discussion per district which contains a member of 8 individuals were made. Members of the focal groups included people believed to be knowledgeable about past and present social and economic status of the area, community elders, women and extension agents.

Data collection

Questionnaire and interview were designed to address both the description of the socio-economic practice of the community, description of the production environment and characteristics and management practice of chicken population. Information on socioeconomic condition of each household, family size and their major sources of income was collected. Structured questionnaire was used to collect information. Face to face interview, open discussion and field observation were conducted to collect detailed information. Type of livestock reared by the community in the study area including their number was also assessed using questioners. Chicken flock structure, number and trend, main uses and special attributes of the chicken breed were collected from the local chicken owner through designed questionnaire and focus group discussion.

Data analysis

Collected data were coded and inserted on Microsoft Excel spreadsheet and analyzed by SAS software version 9.1.3 (2002). The qualitative data was analyzed by using chi-square (χ^2) to show the significance of percentages of independence and association between traits of chicken, and chicken management practice among districts based on agro ecology difference. The results were presented in the forms of Tables and Graphs.

Simple descriptive statistics such as average, standard deviation and standard error of the mean and multivariate analysis were applied for numeric or quantitative data, or frequencies and tabulations for qualitative attributes. Multivariate analyses variance technique was used to determine the most interesting traits from a set of traits, in order to differentiate chicken population based on their nature of similarity and production potential.

Ranked variables were indexed by using the formula according to Mula et al. (2006): Index = sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason (attribute) divided by the sum of sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reason.

The effective population size and rate of inbreeding coefficients were calculated on the bases of individual household flock's size and combining all the flock of the community. There are chances of mixing up of the communities' flock on scavenging and there might be a probability of mating among the flock. Furthermore, inbreeding coefficient were calculated for the population. Effective population size for a randomly mated population was estimated as Ne = (4Nm+ Nf)/(Nm +Nf). Where, Ne = effective population size, Nm = number of breeding males and Nf = number of breeding females. The rate of inbreeding coefficient (ΔF) was calculated from Ne as ΔF = 1/2Ne (Falconer and Mackay, 1996).

A general linear model procedure (PROC GLM) of the Statistical Analysis System (SAS version 9.1.3) was used for quantitative variables to detect statistical difference among sample chicken populations in the study districts. Mean comparison was made for variables showing significant differences between sample population.

RESULT AND DISCUSSIONS

General household characteristics

The result of respondents indicates that about 29.49, 50, 56.41, 38.46 and 44.87% are illiterate (cannot write and read) in Delomena, Madda Walabu, Barebere, Ginnir and Sinana, respectively (Table 1). Education is a good approach to facilitate farmers in making decisions, solving problems and learning new technologies as reported in IFPRI, 2010. Across all the five districts, majority of the households were male headed, which were rated as 69.95% in Delomena, 64.10 % in Madda Walabu, 74.36% in Berbere, 67.95 % in Ginnir and 71.79 % in Sinnana districts.

The average age and family size per household of the respondents showed significance difference among the districts ($p<0.05$). This may be because there is probability of one male to have more than one wife in low land districts of Bale zone which results in number of family size per household. The average family size in the study districts is in line with the overall mean family size of sample households and is 6.2 (ranged 1–12) in Bure and 6.9 (ranged from 2–18) in Dale district. Moges et al. (2010a) and Asefa (2007) reported 7 persons per household for the Awassa Zuria district in the Southern Nation Nationality and people Region. The present finding is also higher than the national average of 5.2 persons (CSA, 2013) and 5.4 for North West Amhara (Halima, 2007).

Breeding system and selection of chicken in study districts

Majority of the respondents in the study area were practicing selection of male and female chicken based on different selection criteria (Tables 3 and 4). Farmers have indigenous knowledge and used different variables or traits to select chicken as parents of next generation. Among these criteria growth rate and number of eggs ranked first and second in Delomena, Berbere, Ginnir and Sinana districts with index value of 0.34, 0.29, 0.42 and 0.38 for growth and 0.27, 0.28, 0.3 and 0.3 for egg production, respectively, whereas, mothering ability has low index value in Berbere, Ginnir and Sinana districts. The result indicated that eggs and disease resistance were shows low indices value in Madda Walabu and Delomena districts.

Chicken productivity and Reproductive performance

The average age at sexual maturity/ first egg laying for female and age at first mating for male are 4.3 and 4.5

Table 1. Household characteristics.

Parameters	Districts				
	Delo Mena	Madda	Barbere	Ginner	Sinana
Education levels					
Illiterate	23(29.49)	39(50)	44(56.41)	30(38.46)	35(44.87)
Religious	16(20.51)	7(8.97)	4(5.13)	1316.67()	15(19.23)
1-6	22(28.21)	24(30.77)	26(33.33)	18(23.08)	18(23.08)
1-7	15(19.23)	2(2.56)	4(5.13)	17(21.79)	10(12.82)
Certificate and above	2(2.56)	6(7.69)	0(0)	0(0)	0(0)
χ^2 -Value					55.09**
Sex of household					
Male headed	53(67.95)	50(64.10)	58(74.36)	53(67.95)	56(71.79)
Female headed	25(32.05)	28(35.64)	20(25.64)	25(32.05)	22(28.21)
χ^2 -Value					2.28ns

Table 2. Age and family size of household (mean±SE).

Parameters	Districts				
	Delo Mena	Madda	Barbere	Ginner	Sinana
Age	$37.4^{c}\pm1.0$	$39.6^{bc}\pm1.3$	$42.5^{ab}\pm1.0$	$40.3^{abc}\pm1.2$	$43.3^{a}\pm1.0$
Family size	$7.1^{a}\pm0.3$	$6.0^{b}\pm0.4$	$6.3^{ab}\pm0.3$	$6.2^{b}\pm0.3$	$5.5^{b}\pm0.2$

[a-b] Means with the different letters within the same row and class are significantly different ($p<0.05$); SE= standard error.

Table 3. Chicken breed selection index criteria in study area.

Parameters	Districts				
	Delo Mena	Madda	Barbere	Ginner	Sinana
Growth	0.34	0.27	0.29	0.42	0.38
Egg	0.27	0.13	0.28	0.30	0.30
Mothering ability	0.17	0.20	0.13	0.05	0.04
Disease resistance	0.08	0.22	0.14	0.17	0.19
Appearance	0.14	0.18	0.16	0.06	0.09

Table 4. Method of chicken breeding system.

Parameters	District				
	Delo Mena	Madda	Barbere	Ginner	Sinana
Selection of male					
Yes	71(91.03)	67(85.90)	69(88.46)	72(92.31)	72(92.31)
No	7(8.97)	9(8.97)	9(11.54)	6(7.69)	6(7.69)
χ^2 -Value					2.67ns
Selection of female					
Yes	71(91.03)	67(85.90)	69(88.46)	72(92.31)	72(92.31)
No	7(8.97)	11(14.10)	9(11.54)	6(7.69)	6(7.69)
χ^2 -Value					2.67ns

month. The result is lower than the finding of Addisu et al. (2013) for north Wollo zone where the average age at sexual maturity of male and female chicken are 24.25 ± 0.04 and 23.84 ± 0.05 weeks, respectively. According to the finding of Moges et al. (2010b), average age of indigenous pullets at first laying are 6.42 in Bure and 5.9

Table 5. Chicken productivity and Reproductive performance (mean±SE).

Parameter	Districts					
	Delomena	Madda	Barbere	Ginnir	Sinana	Overall
No. of times the hen hatches in a year	2.1±0.1[a]	2.0±0.1[b]	2.0±0.1[b]	2.0±0.1[b]	2.0±0.1[b]	2.02±0.1
Average number of eggs per clutch	16.2±0.2[d]	18.2±0.5[c]	23.7±0.7[a]	20.9±0.7b	21.9±0.7[b]	20.18±0.56
Average number of days per clutch	22.1±0.5[c]	25.5±0.6[ab]	26.2±0.8[a]	25.9±0.7[a]	23.6±0.7[bc]	24.66±0.66
Number of eggs in a set	12.0±0.3[c]	14.5±0.4[b]	15.7±0.7[b]	18.7±0.8[a]	15.3±0.3[b]	15.24±0.5
No. of chicks hatched per clutch	10.1±0.3[c]	11±0.3[bc]	11.3±0.4[bc]	14.0±0.7[a]	11.7±0.3[b]	11.62±0.4
No. of chicks surviving to adult hood	6.8±0.2[c]	7.5±0.4[c]	9.2±0.4b	10.2±0.5a	9.5±0.2ab	8.64±0.34
Age of female sexual maturity (months)	4.6±0.1[a]	4.4±0.1[ab]	3.9±0.1[c]	4.3±0.1[ab]	4.3±0.1b	4.3±0.1
Age of first mating male (month)	5.1±0.1[a]	4.6±0.1[b]	4.0±0.1[c]	4.5±0.1[b]	4.3±0.1[b]	4.5±0.1
How many times brood/year	5.2±0.2[a]	4.0±0.1[b]	3.5±0.1[c]	3.9±0.1[b]	3.4±0.1[c]	4.0±0.12

[a-d] Means with different letters within the same row and class are significantly different ($p<0.05$); SE= standard error.

months in Fogera, while, the average age of cockerels at first mating is 5.74 in Bure and 5.87 months in Fogera.

There is statistically significance difference ($p<0.05$) between Woreda for number of times the hen hatches in a year. The average number of eggs per clutch and average number of days per clutch were 20.18 eggs and 24.66 days, respectively. The number of clutch periods showed by local hens per year in study district is 4 times. Accordingly, the total egg production/hen per year of local hens, under existing farmer management condition, is estimated to be 80.72 eggs (Table 5). The present finding was higher than the report of Moges et al. (2010b) where the total egg production/hen per year of local hens were 60.53 in Bure and 55 eggs Fogera. This may be due to the existed breed difference and suitable environments for chicken production. The average number of eggs in a set, average number of chicks hatched per clutch and average number of chicks surviving to adult hood are 15.24, 11.62 and 8.64, respectively. The finding is comparable with the report of Moges et al. (2010b) where the average number of eggs in a set, average number of chicks hatched per clutch and average number of chicks surviving to adult hood in Bure woreda were 13, 11 and 6.7, respectively.

Chicken culling and breeding practice

Methods of breed improvement, reason of culling, methods of culling of chicken in study area were presented in Table 6. About 66.16% of the respondents improved their chicken flock by improving their indigenous chicken through selection and mating while about 33.84% of the respondents improved their chicken through importing other breeds. They cull their chicken for underproductive (30.25%), lack of broodiness (17.18%), frequent broodiness (30.52%) and sickness (22.05). The finding of Moges et al. (2010b) also indicates that poor productivity, old age and sickness were the major reasons for culling chicken. They cull their chicken by culling at young stage (29.23%), mating the best cock and hen during conception period (44.62%) and preventing unwanted cock to mate hens (26.15%).

Traits preference of breeding male

Most of the farmers have no access to improved chicken genotypes; thus, they were only able to describe their trait preferences in the context of available indigenous chicken ecotypes in their respective districts (Table 7). Weight is the first rank of trait preference for male selection for Delomena, Madda Walabu, Barbare, Ginnir and Sinana with index value of 0.38, 0.45, 0.35, 0.37 and 0.31, respectively. Colour is the second rank of preference in Delomena and comb type is the second rank for Madda Walabu, Barbare, Ginnir and Sinana woreda. All farmers prefer red colour to white and black colour since they are not easily visible for predators like white and black. Morphological traits such as body plumage colour and comb types beside other quantitative traits related to growth and egg production were found to have significant aesthetic and economic value.

Trait preference for breeding female

There is variation for trait preference of breeding female

Table 6. Culling and breeding practice.

Parameters	Districts					Overall
	Delomena	Madda	Barbere	Ginnir	Sinana	
Method of breed improvement practice						
Importing	40(51.26)	3(3.85)	27(34.62)	38(48.72)	24(30.77)	132(33.84)
Improving indigenous chicken by itself	38(48.72)	75(96.15)	51(65.38)	40(51.28)	54(69.23)	258(66.16)
χ^2 -Value						68.48**
Why do you cull chicken?						
Underproductive	38(48.72)	39(50.00)	6(7.69)	31(39.74)	4(5.13)	118(30.25)
Lack of broodiness	4(5.13)	13(16.67)	12(15.38)	22(28.21)	16(20.51)	67(17.18)
Frequent broodiness	34(43.59)	9(11.54)	34(43.59)	17(21.79)	25(32.05)	119(30.52)
Sickness	2(2.56)	17(21.79)	26(33.33)	8(10.26)	33(42.31)	86(22.05)
χ^2 -Value						120.65**
Method of culling						
Culling at young stage	42(53.85)	18(23.08)	30(38.46)	16(20.51)	8(10.26)	114(29.23)
Mating best cock and hen	9(11.54)	25(32.06)	28(35.90)	54(69.23)	58(74.36)	174(44.62)
Preventing unwanted cock to mate hens	27(34.62)	35(44.86)	20(25.64)	8(10.26)	12(15.38)	102(26.15)
χ^2 -Value						112.60**

Where X^2 is Pearson chi square test; *significant at p<0.05, **highly significant at p<0.01.

Table 7. Trait preference Index of breeding male.

Parameters	Districts				
	Delomena	Madda	Barbere	Ginnir	Sinana
Weight	0.38	0.45	0.35	0.37	0.31
Color	0.18	0.28	0.30	0.32	0.34
Comb type	0.32	0.16	0.27	0.18	0.19
Pedigree	0.12	0.11	0.08	0.13	0.10
Appearance	0.00	0.00	0	0.00	0.05

Table 8. Trait preference Index for breeding female.

Parameters	Districts				
	Delomena	Madda	Barbere	Ginnir	Sinana
Weight	0.47	0.48	0.47	0.43	0.41
Color	0.16	0.09	0.30	0.31	0.35
Comb type	0.07	0.03	0.01	0.12	0.09
Pedigree	0.30	0.24	0.22	0.15	0.15
Appearance	0.00	0.00	0.00	0.00	0.00

chicken in districts (Table 8). The result indicated that weight is considered as first trait preference for all woreda with index value of 0.47, 0.48, 0.47, 0.43 and 0.41 for Madda Walabu, Delomena, Berbere, Ginnir and Sinana, respectively. Pedigree (history of parents) is the second trait preference for Delomena and Madda Walabu woreda with index value of 0.3 and 0.24 while, color is the second trait preference for Barbare, Ginnir and Sinana woreda with index value 0.3, 0.31 and 0.35, respectively. The present finding is in agreement with the report of Agide (2015) where farmers in kowet and Jiru districts primarily focused on egg production.

Effective population size and level of inbreeding

The rate of inbreeding coefficient calculated for Delomena,

Table 9. Effective population size and level inbreeding.

District	Parameters			
	NM	NF	Ne	ΔF
Delomena	3.1	7.2	8.67	0.057
Madda Walabu	5.9	9.8	14.73	0.033
Barbare	5.5	9.8	14.09	0.035
Ginnir	6.4	7.5	13.81	0.036
Sinana	5.3	6.5	11.68	0.042

Nm=Number of breeding cocks, Nf=Number of breeding hens, Ne= Effective of Population, ΔF=Rate of Change in breeding.

Table 10. Incubation and Brooding Management of chicken.

Parameters	Districts					
	Delomena	Madda	Barbere	Ginnir	Sinana	Overall
Types of incubating and hatching eggs?						
Natural method	78(100)	78(100)	78(100)	78(100)	78(100)	78(100)
Artificial incubation	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Type of chickens do you use						
Broody hen	78(100)	78(100)	78(100)	78(100)	78(100)	78(100)
Non-broody hen	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Type of material for incubation						
Clay pot & straw bedding	40(51.28)	10(12.82)	51(65.38)	62(79.49)	54(69.23)	217(55.64)
Clay pot only/without bedding	0(0.00)	0(0.00)	0(0.00)	7(8.97)	2(2.56)	9(2.31)
Straw only	38(48.72)	68(87.18)	27(34.62)	9(11.54)	22(28.21)	164(42.05)
At which season you are practicing incubating egg?						
Rainy season	36(46.15)	59(75.64)	5(6.41)	7(8.97)	5(6.41)	112(28.72)
Dry season	42(53.85)	15(19.23)	68(87.18)	71(91.03)	70(89.74)	266(68.21)
Not based on season	0(0.00)	4(5.13)	5(6.41)	0(0.00)	3(3.85)	12(3.08)
Do you practice to avoid broody behavior?						
Yes	78(100)	78(100)	78(100)	78(100)	78(100)	78(100)
No	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
If yes, what types of technique do you practice?						
Hanging the bird upside down	25(32.05)	39(50.00)	16(20.51)	43(55.13)	23(29.49)	146(37.44)
Depriving of the birds from feed & water	0(0.00)	0(0.00)	0(0.00)	13(16.67)	4(5.13)	17(4.36)
Disturbing in the nest	40(51.28)	30(38.46)	27(34.62)	0(0.00)	20(25.64)	117(30.00)
Moving to neighbors	13(16.67)	9(11.54)	35(44.87)	22(28.21)	31(39.74)	110(28.21)

Madda Walabu, Barbare, Ginnir and Sinana of indigenous chicken flock considering the existing flock size and keeping practice were 0.057, 0.033, 0.035, 0.084 and 0.042, respectively (Table 9). This is below the maximum acceptable threshold level of inbreeding (0.063) (Armstrong, 2006). The existence of cocks sharing culture within the community could substantially contribute for the reduction of inbreeding depression when flocks were mixed together at communal foraging that could increase population sizes.

Number of breeding cocks per household are low because of marketing breeding males might contributed to reduce further inbreeding. Shortage of breeding males and uncontrolled mating of flocks also contributed to reduction

Table 11. Egg storage and selection for hatching and incubation.

Parameters	Districts					Overall
	Delomena	Madda	Barbere	Ginnir	Sinana	
Place of egg storage for incubation and sell?						
Grain	6(7.69)	0(0.00)	0(0.00)	35(44.87)	10(12.82)	51(13.08)
Clay pots	23(29.49)	4(5.13)	52(66.67)	15(19.23)	42(53.85)	136(34.87)
Plastic materials	33(42.31)	12(15.38)	16(20.51)	9(11.54)	14(17.95)	84(21.54)
Cartoons	16(20.51)	59(75.64)	5(6.41)	19(24.36)	9(11.54)	108(27.69)
Bamboo/satera	0(0.00)	3(3.85)	5(6.41)	0(0.00)	3(3.85)	11(2.82)
Do you select size of hens for brooding?						
Yes	63(80.77)	74(94.87)	78(100)	78(100)	78(100)	371(95.13)
No	15(19.23)	4(5.13)	0(0.00)	0(0.00)	0(0.00)	19(4.87)
If yes, which one do you prefer						
Bigger	73(93.59)	46(58.97)	22(28.21)	69(88.46)	36(46.15)	246(63.08)
Medium size	5(6.41)	32(41.03)	50(64.10)	9(11.54)	36(46.15)	132(33.85)
Smaller	0(0.00)	0(0.00)	6(7.69)	0(0.00)	6(7.69)	12(3.08)
Position of eggs at storage						
On side	17(21.79)	35(44.87)	49(62.82)	49(62.82)	50(64.10)	200(51.28)
Small end down	29(37.18)	2(2.56)	3(3.85)	7(8.97)	5(6.41)	46(11.79)
Small end up	18(23.08)	13(16.67)	0(0.00)	12(15.38)	4(5.13)	47(12.05)
Don't know	14(17.95)	28(35.90)	26(33.33)	10(12.82)	19(24.36)	97(24.87)

of inbreeding accumulation of gene (Table 9). The effective population size ranged from 8.67 (Delomena) to 14.73 (Madda Walabu).

Incubation and brooding management of chicken

All respondents were using natural incubation by using broody hen (Table 10). The finding is agreement with the report of Agide (2015) where Kewot, Menze Gera and Jiru districts uses broody hen for incubation. They use materials like clay pot and straw bedding (55.64%) and straw only (42.05%) for incubation. Majority of the respondent incubate their chicken during dry season (68.21%).

Respondent in the study area practice avoiding of brooding (100%). This is due to increase egg productivity from a given hen. They use mechanism like hanging the bird upside down (37.44%), disturbing in the nest (30%), moving to neighbours (28.21%) and depriving of the birds from feed and water (4.36%). The report of Dana et al. (2011) and Addisu et al. (2013) reported that hanging down and moving birds to neighbor are the main mechanism of controlling broodiness.

Egg storage and selection for hatching and incubation

Majority of the respondent practice selection of egg for setting (95.13%) in which majority of them select bigger egg size (63.08%) (Table 11). Egg collection and storage have its own effect on egg quality. They store their egg in clay pots (34.87%), in cartons (27.69%), plastic materials (21.54%), grains (13.08%), and material made from bamboo locally known as satera (2.82%). During storage, majority of them does not consider size and position of egg (24.87%). This is due lack of awareness about the effect of egg position on egg quality.

Conclusion and recommendations

In the study areas, chicken production system was generally characterized by uncontrolled mating. Broody hens were the key means of chick brooding in the study districts and the average numbers of eggs incubated per hen and hatchability rates were comparable with those in most parts of the country.

In general, chicken production system in study area were characterized under extensive production system and they practice farmers/pastoralist trait preference and selection criteria both for male and female chicken. Further research is needed to identify the genetic correlation between trait preferred by farmers/pastoralists with productive and reproductive parameters.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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