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Performance of Indigenous Chicken, Farmers Breed and Trait Preference in Enarj Enawga and Enemay District, East Gojjam Zone, Amhara Region, Ethiopia

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Abstract: This study was undertaken to collect basic information on the performance of indigenous chicken, farmers breed and trait preference in Enarj Enawga and Enemay districts using structured questionnaire. Three kebeles from each districts were selected purposely based on chicken population for this study. For household survey, 180 households (90 from each district) having at least five chickens were selected. Both Statistical Packages for Social Sciences (SPSS) and Statistical Analysis System (SAS) software were used to analysis qualitative and quantitative data. In the study area there was no a significant (P>0.05) difference in number of eggs produced per year per hen between districts. The overall egg production per hen per year was 76.9±1.39. There was a significant difference on the age at first egg laying of local pullet (P<0.05) and the average age at first mating of local cockerels (P<0.01) between districts. The average age at first mating of local cockerels was 4.9±0.08and 5.3±0.05 months for Enarj Enawga and Enemay, respectively. The average age at first egg laying of local pullet was 5.7±0.06and 6.1±0.04 months for Enarj Enawga and Enemay, respectively. In the study area, 37.78% % (Enarj Enawga) and 62.22% (Enemay) of them had their own breeding cocks. Breed preference also differ in the study areas, local breeds were most important preferred breeds in Enarj Enawga district where as exotic breeds were the most important (68.89%) preferred breeds in Enemay district followed by cross breeds in both districts. In both districts give the highest emphasis for body weight as the most important trait preferred by farmers for males chickens (index: 0.38 and 0.38) and egg production followed by plumage color and body weight in Enarj Enawga and body weight followed by plumage color and egg production in Enemay district for female chickens. In general production performance of indigenous chicken breeds are low in the study area and breed improvement should be considered farmers breed and trait preferences. Householders should be avoid uncontrolled mating practices to avoid unwanted traits.

Keywords: Breed and Trait Preference, Chicken Performance, Indigenous Chicken

1. Introduction

In Ethiopia there is huge number of indigenous breeds and the households keep chickens for household consumption, alternative source of income and reproduction purposes including other social and cultural roles [28]. They are good scavengers and foragers, well adapted to harsh environmental conditions and their minimal space requirements make chicken rearing asuitable activity for the rural farmers. In addition, the local chicken plays a significant role in poverty alleviation, food security and economic empowerments for vulnerable groups, women and children. A traditional stew

(Doro wot dish) is served in festivities and to honor guests and demonstrates respect to guests, that strengthens social relationship.

Indigenous chicken have low productivity. It is now understood and it appears reasonable to start genetic improvement by trying to understand the present performance/practices rather than prescribing a scheme [32, 42]. In most of the studies it was identified that there were a large genetic variations in morphological appearances, conformation and body weights between and within groups of indigenous chickens. It could, therefore, be noted that there are good opportunities to start chicken genetic improvement programs. With all the above facts, designing and implementing appropriate chicken breeding strategy using the vast indigenous genetic resource and indigenous knowledge would obviously bring sustainable change.

Therefore, assessing the production system, indigenous knowledge of managing the breed, identifying list of breeding goal traits, describing morphological characters and productivity level of the breeds in their habitat with full participation of the community are prerequisites to set up genetic improvement program at smallholder levels [27].

Thus, this study was aimed at characterization of the indigenous chickens in Enarj-Enawga and Enemay district with the following objectives.

Objectives

1) To characterize the production and reproduction performance of indigenous chicken in their environment;
2) To asses farmers breed and trait preferences in the study areas.

2. Materials and Methods

Before conducting this study information regarding chicken population, distribution and suitability for chicken production in each district of East Gojjam were collected from Zonal office of Livestock and Fishery. Based on the information collected from Zonal office of Livestock and Fishery, two districts namely, (Enarj Enawga and Enemay) were selected.

2.1. Site Selection and Sampling Technique

A rapid field survey was conducted by the researcher and by the respective District Livestock and Fishery Development Office professionals in each of Enarj Enawga and Enemay districts. Three kebeles in Enarj Enawga (*Aba Jember, Shiferie* and *Mazagenet*) and three kebeles in Enemay (*Telma, Woyira* and *Gotera*) were selected based on chicken flock size per household, suitability of the area for chicken production, market and road and willingness of the farmers participate in the program.

A total of 180 households (30 from each kebele) were randomly select for the interview from within the selected kebeles. For body linear measurements a total of 660 adult chickens (600 female and 60 male> 1 year old) as judged by comb and wattle size were selected within the selected sites.

2.2. Methods of Data Collection

Data were generated by administrating a pre-tested structured questionnaire, employing field measurements, organizing group discussion and from secondary sources.

2.3. Questionnaire Administration and Group Discussion

A structured questionnaire were prepared and pre-tested before administering and some rearrangement, refining and correcting in accordance with respondents perception were done. The questionnaires were administered to the randomly selected household heads by a team of enumerators recruited and trained for this purpose with close supervision of the researcher.

Information on the socio-economic characteristics of production and reproduction traits, selection criteria and breeding practices were captured after the end of the survey.

Focal group discussions were held in each of the selected kebele. The groups were composed of youngsters, women, village leaders and socially respected individuals who are known to have better knowledge on the present and past social and economic status of the area to strengthen the data collection using questionnaires. Discussions were focused on the indigenous knowledge on management of breeding, husbandry practices and their perception on the local and exotic chicken breeds using a prepared check list. Similarly, secondary data like chicken breeds, economic contribution, the overall plan of the region to improve the productivity of chickens and other related information were collected from Agriculture and Livestock Resource Office.

2.4. Data Management and Analysis

Data collected through questionnaire (survey) regarding production system were entered into Statistical Package for Social Sciences Statistical Package for Social Sciences (SPSS 25.0 for windows, 2016) and Statistical Analysis System (SAS, release 9.1, 2008). Chi-square or t-test was employed when required to test the independence of categories or to assess the statistical significance.

An index were calculate to provide overall ranking for qualitative data such as selection criteria of females and males and function of male and female chickens and so on according to the following formula: Index = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular qualitative variables divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all qualitative variables considered [38, 69, 68]. The rate of inbreeding from effective population size for a randomly mated population was calculate as:

$$\mathrm{Ne} = \frac{(4\mathrm{Nm}\ \mathrm{Nf})}{(\mathrm{Nm} + \mathrm{Nf})}$$

Where,

Ne = effective population size,

Nm = number of breeding males and

Nf = number of breeding females.

The rate of inbreeding coefficient (F) was calculated from Ne as $\Delta F = 1/2\mathrm{Ne}$.

3. Result and Discussion

3.1. Farmers Breed and Trait Preferences

Farmer's breed and trait preferences in the studied area are presented in Table 1. Breed preference differ in the study areas, local breeds are most important preferred breeds in Enarj Enawga district where as exotic breeds are the most important (68.89%) preferred breeds in Enemay district followed by cross breeds in both districts and exotic breeds and local breeds in Enarj Enawga and Enemay districts, respectively. This result is not in line with Habtamu *et al*., (2013) who reported most (97.9%) of the respondent interested to raise exotic chicken in the study area and the rest of the respondents were not interested to raise exotic chicken. [31]

All interviewed farmers practiced selection to pick breeding and replacement cocks and hens to improve the performances of chickens based on color, live weight, comb type, shank color and egg production of chickens. The emphasis given to each trait category is different in sexes in both districts like the report of Addis *et al.,* (2014) and unlike to Dana (2011) and Hana (2016) who reported color (0.38), weight (0.26) and comb (0.17) the selection criteria's of householders in that order. [2, 49, 33] In both districts give the highest emphasis for body weight as the most important trait preferred by farmers with index values of 0.38 and 0.38in Enarj Enawga and Enemay districts, respectively for male chickens. The other traits for male chickens preferred by farmers followed by body weight are plumage color and comb type with index values 0.36 and 0.15 in Enarj Enawga where as 0.28 and 0.26 in Enemay district, respectively. The other traits for female chickens preferred by farmers are egg production followed by plumage colorand body weightwith index values 0.4, 0.31 and 0.29 in Enarj Enawga and in Enemay district body weight followed by plumage colorand egg production with index values 0.39, 0.35 and 0.26, respectively. The result is not in line with Halima (2007) reported that in Dembiya, G/Zuria and Lay Armacheho district for both male and female chicken's farmers give the highest emphasis for plumage color as used as the most important preferable traits with index value of 0.35, 0.37 and 0.41, respectively. [32]

The emphasis given to each trait category for male chickens is similar between the districts while the emphasis given to each trait category for female chickens is not similar between districts except plumage color which is almost equally important character for selection of chickens. In addition, this preference is critical point for farmers to select chickens from purchasing of breeding cocks and hens for production, religious contribution and home consumption.

Farmer's color trait preferences were different for male and female chicken in both districts (Table 2). As the result showed that red plumage color for male chicken and white plumage color for female chickens was the first most important trait preferences of smallholder farmers in both Enarj Enawga and Enemay districts. Gray/*gebsima* plumage color for males, red plumage color for females was the second preferences in Enarj Enawga district, where as white for males and red plumage color was the second plumage color preferences in Enemay district. The third plumage color preferences of small holder farmes were white and *dirra* color for male and female chickens in Enarj Enawga district and gray/*gebsima* and *Dirra* for males and females in Enemay respectively. According to Getachew *et al., (*2016) in Bench Maji Zone, SNNPR the most preferred plumage color for cock in overall study zones was red (61.5%) followed by black (23.4%), white (12.6%) and golden (2.7%) whereas the most preferred plumage color for hen was red (60.4%) followed by golden (19.8%) and white (18.9%). [69] Similarly, according to Alemayehu *et al*., 2013 plumage color preference of the respondents for cocks was red followed by white and red, red and black, white and mixed color in its descending order. [8] The same authors also described the most preferred plumage color for hens were red and red and white.

Table 1. *Farmers breed and trait preferences in the study area.*

Trait preference	Districts							
	Enarj Enawga				Enemay			
	Rank				Rank			
	1st	2nd	3rd	Index	1st	2nd	3rd	Index
Male								
Body weight	56	10	11	0.38	51	19	13	0.38
Plumage color	34	37	13	0.36	17	12	33	0.28
Shank color	-	19	17	0.10	1	13	10	0.07
Comb type	-	24	33	0.15	21	26	25	0.26
Female								
Egg production	43	39	9	0.40	11	31	48	0.26
Body weight	10	45	35	0.29	48	23	19	0.39
Plumage color	37	6	46	0.31	31	36	23	0.35
Breed preference								
Local	41	28	21	0.37	9	20	61	0.24
Cross	33	-	51	0.28	62	15	9	0.42
Exotics	16	62	3	0.33	19	55	20	0.35

Index = Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] given for particular valued trait preference divided by Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] summed for all valued trait preferences.

Table 2. *Farmers Plumage Color Preferences in the study areas.*

Color preferences	Districts							
	Enarj Enawga				Enemay			
	Rank				Rank			
	1st	2nd	3rd	Index	1st	2nd	3rd	Index
Males								
White	25	4	15	0.25	25	36	12	0.36
Red	42	30	4	0.48	65	20	3	0.54
Gray/*gebsima*	23	15	6	0.27	-	11	22	0.1
Female								
White	22	32	30	0.36	30	40	-	0.38
Red	41	2	21	0.34	36	33	2	0.40
Dirra	27	23	1	0.29	24	6	13	0.22

Index = Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] given for particular valued color preference divided by Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] summed for all valued color preferences.

3.2. Selection Criteria's of Chicken

Ranking of smallholder farmers for the selection of female and male chickens to be parents of the next generation are presented in Table 3. For the selection of female chickens egg number and body size ranked first for Enarj Enawga and Enemay chicken owners with an index of 0.46 and 0.31, respectively. Plumage color, body size, shank color, mothering ability, egg size and good scavenging and disease resistance were ranked second, third, fourth, fifth, six and seventh with index of 0.26, 0.24, 0.04, 0.02, 0.006, and 0.004, respectively in Enarj Enawga area. In Enemay area plumage color, egg number, mothering ability, disease resistance and mothering ability, broodiness and egg size and good scavenging were ranked second, third, fourth, fifth, six and seventh important traits with index of 0.27, 0.15, 0.07, 0.06, 0.05 and 0.02, respectively. This study is agreement with Habte *et al*., (2015) in Amaro district, SNNPR for selection characters of female chicken egg production was the first priority followed by body size and plumage color with percentage value of 56.4%, 20.5% and 7.7%, respectively. [71] The study is not in line with T. M. Magothe et al., (2012), who reported plumage color (1st), egg yield /clutch (2nd) and comb type (3rd) were the most preferred traits used for selection of breeding female chickens in Western Zone of Tigiray, Northern Ethiopia. [73]

Table 3. *Selection criteria's of chicken.*

Selection Criteria's	Districts							
	Enarj Enawga				Enemay			
	Rank				Rank			
	1st	2nd	3rd	Index	1st	2nd	3rd	Index
Male								
Body size	35		20	0.24	17	33	4	0.22
Disease resistance	27	18	10	0.25	6	31	32	0.21
Plumage color	28	35	7	0.31	34	13	3	0.24
Fighting ability	-	6	19	0.06	14	6	10	0.13
Good scavenging	-	3	5	0.02	14	5	22	0.14
Comb type	-	28	6	0.12	5	-	9	0.04
Females								
Egg number	47	32	-	0.43	13	12	12	0.15
Body size	10	43	-	0.24	28	32	2	0.31
Mothering ability	-	-	9	0.02	7	4	4	0.07
Broodness	-	-	-	-	1	10	2	0.05
Disease	-	-	2	0.004	4	2	15	0.06
Egg size	-	-	3	0.006	-	-	8	0.02
Plumage color	29	10	17	0.26	32	13	9	0.32
Fighting ability	-	-	-	-	5	3	5	0.06
Good scavenging	-	-	2	0.004	-	3	4	0.02
Shank color	4	4	-	0.04	-	-	-	-

Index = Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] given for particular valued selection criteria divided by Σ of [3× number of household ranked 1st + 2× number of household ranked 2nd + 1× number of household ranked 3rd] summed for all valued selection criteria's.

Enarj Enawga breeders consider plumage color, disease resistance, body size, comb type, fighting ability and good scavenging as the first six reasons for male chicken selection in that order with an index of 0.31, 0.25, 0.24, 0.12, 0.06 and 0.02, respectively. Enemay chicken breeders also consider plumage color, body size, disease resistance, fighting ability, good scavenging and comb type as the six more important traits with an index of 0.24, 0.22, 0.21, 0.14, 0.13 and 0.04,

respectively. In the study areas male chickens had has a significant role for the formation of chicken has good plumage color during hatchery practice. Therefore, priority is given to traits of Male chickens that would ensure the formation of aesthetic nature of hatched chicken.

3.3. Production and Reproductive Performance of Indigenous Chickens

Production and reproductive performances of indigenous chickens are presented in Table 4. The average age at first mating of local cockerels was 4.9±0.08 and 5.3±0.05 months for Enarj Enawga and Enemay, respectively. The result indicated that there was a significant (P<0.01) difference on cockerel sexual maturity between districts. Sexual maturity of chickens always depends on chicken management systems and overall production systems of the households mainly on feeding and disease management practices. The result of both districts are in line with the findings of Hana (2016) who reported that a mean age at first sexual maturity of cockerel was 5.1±0.03, 5.0±0.27, 4.9±0.02 and 5.0±0.27 months in Dembiya, Gonder zurya and Lay Armachiho, respectively. [33] Therefore, the result indicated us the average age at first female sexual maturity was much earlier than Fisseha *et al*., (2010) who reported faster age of sexual maturity of cockerels, i.e., 6.15 months (24.6 weeks) in North West Ethiopia. [28] The result was also earlier than the 6.1 months for local cocks reported by [74] in West Amhara Region of Ethiopia. Similarly, This age (5.1±0.05 months) was faster than that reported by Alem (2016) from central Tigray, an average age at first mating of cockerels was 6.5 months (26 weeks) for local and this age difference might have occurred due the farmers management system (feeding, housing and health care). [7]

The average age at first egg laying of local pullet was 5.7±0.06 and 6.1±0.04 months for Enarj Enawga and Enemay, respectively. There was a significant (P<0.05) difference on the age at first egg laying of local pullet between districts (Table 4). The variation in age at first egg laying may be due to management practices like feeding, housing and health care of the farmers. The result of both districts indicated partially erlier sexual maturity than 6.6 months for local female breeds reported [74] in West Amhara Region of Ethiopia and Fikadu *et al*., (2018) who reported that the average age (overall mean) at first egg laying of local pullet was 6.64 months in Seka Chekorsa and Kersa districts of Jimma zone, Southwest Ethiopia. [70]

There were not significant (P>0.05) different on the average number of incubation per year and the average number of eggs hatched between the study area. The average number of incubation per were 1.3±0.06 and 1.2±0.05 in Enarj Enawga and Enemay, respectively. The average numbers of eggs hatched in the study area were 10.2±0.40 (Enarj Enawga) and 11.0±0.13 (Enemay) and the overall value of 10.6±0.22 with 85.8% of hatching rate. This result was greater than the study of Melkamu and Andargie (2013) reported that chicks hatched from 8 set eggs and hatchability percentage was 59.6. [43] It is also greater than Agide Yisma (2015) chicken stayed alive up to 8 weeks during wet season was range from 5.6 to 6.8 in Benishangul Gumuz. [6]

There was a significant difference (P<0.01) on number of eggs laid per hen per clutch of local chicken between districts (Table 4). The number of eggs/clutch/hen were 14.6±0.44 and 12.9±0.23 in Enarj Enawga and Enemay districts, respectively. Management level of the farmers and chickens genetic factors may create difference in the production potential of the chickens. The low production and productivity of the indigenous chickens was attributed to the poor management practice of the farmers, according to Alem (2016) in central Tigray, Northern Ethiopia. [7] These results were in agreement with the reports of Melkamu and Wube (2013) who reported the number of eggs produced/clutch/hen of indigenous chicken was 13 in Gonder zuria woreda. [74] Nevertheless, the average eggs laid per clutches reported in the current study was higher than compared with Habte *et al*., 2015 who reported the number of eggs produced/clutch/hen of indigenous chicken was 11.23 in Nole Kabba Woreda, western Wollega. [71] This result also has greater compared with Fikadu *et al*., 2018 who reported that the number of eggs produced/clutch/hen of indigenous chicken was 11.56 in Seka Chekorsa and Kersa districts of Jimma zone, Southwest Ethiopia. [70]

The number of clutches/year in the study was show a significant difference (P<0.05) between in districts (Table 4). The numbers of clutch in the study area were 5.53±0.08 and 5.78±0.08 in Enarj Enawga and Enemay districts, respectively. The number of clutch in Enemay districts is higher compaired with cluch number of Enarj Enawga district. The result of this study in both districts is higher than the mean clutches reported (4.3) [2] in North Gonder and the number of clutch per year of 4.29 reported by Siraj (2017) from Metekel zone, Northwest Ethiopia. [56]

The clutch length/days for local chickens were 18.73±0.54 and 16.68±0.26 for Enarj Enawga and Enemay, respectively and the mean clutch length in days for local chickens in the two districts was 17.71±0.31 days. There was significant difference (P<0.01) on the average clutch length in days among the two districts of the study areas (Table 4). In contrast the clutch length/days for local chickens in Enarj Enawga are higher than the value of Enemay district. The result of this study in both districts was lower compared with that reported by Meseret (2010) where the mean clutch length was 25.29 days in Gomma Woreda. [44] This was also less than that reported [42], in Halaba and Wonsho and Loka Abaya districts of southern Ethiopia the average clutch length were 26.0 days and 26.2 days respectively. This variation might be associated with the availability of feed resources for scavenging, supplementation, and ecotype of indigenous chickens.

The egg production per hen per year was 79.40±2.11 and 74.43±1.78 for Enarj Enawga and Enemay, respectively and the mean egg production per year per hens was 76.92±1.39. The result indicated that there was no a significant (P>0.05) difference in number of eggs produced per year per hen between districts (Table 4). This result has agreement with T.

M. Magothe *et al*., (2012) that hens lay about 45 eggs per year with a range between 30 and 75 eggs under free-range and semi-free-range systems. [73] This result was greater than compared with the report of Alem (2010), where the average egg production per year per hen was 43.4 eggs for local hen in central Tigray, Northern Ethiopia [7] and also this study greater compared with the report of Meseret (2010) the mean annual egg production of the indigenous chicken was reported to be 43.8 eggs in Gomma Woreda. [44] According to Solomon (2007) there was lower eggs laid by local hens, as relatively compared with the current study (76.92 eggs), the number of eggs produced by a hen per clutch and year was 14.1 and 45.7, respectively in west Amhara region of Ethiopia.

Table 4. *Average of some reproductive and productive performance of local hens recalled by respondents of the study areas (Mean ± SE).*

Parameters	Districts		Over all	Tests	
	Enarj Enawga (90)	Enemay (90)		F value	P values
Average number of incubation/year	1.3±0.06	1.2±0.05	1.2±0.04	0.03	0.87
Average number of eggs set	12.0±0.34	12.7±0.13	12.4±0.19	3.48	0.06
Average hatch rate in number	10.2±0.40	11.0±0.13	10.6±0.22	3.76	0.54
Survival rate of chicks to 8 wks	7.5±0.29	8.5±0.17	8.0±0.18	7.14	0.008
Age at first service (cockerel)/ month	4.9±0.08	5.3±0.05	5.1±0.05	19.18	0.00
Age at first egg laying (pullet)/ month	5.71±0.06	6.14±0.04	5.92±0.04	0.00	0.00
Average number of clutch/year	5.5±0.08	5.8±0.08	5.7±0.05	5.60	0.019
Average number of egg per clutch	14.6±0.44	12.9±0.23	13.8±0.26	3.23	0.001
Length of clutch in days	18.7±0.54	16.7±0.26	17.7±0.31	0.001	0.001
Average number of eggs per year	79.4±2.11	74.4±1.78	76.9±1.39	11.79	0.074

Number in bracket is referred to total number of respondents.

3.4. Incubation Practice in the Study Areas

The result indicated that period of egg storage before incubation/day, criteria of egg selection, interval of two consecutive brooding period in month, period of egg storage before incubation/day and material used for incubation were significantly (P<0.01) different and the rest was no significant (P>0.05) difference between districts.

From the survey result, it is understood that exclusively natural incubation and hatching is practiced by all (100%) of chicken producers (Table 5). The average number of eggs set for incubation was 12.0±0.34 per hen in Enarj Enawga and 12.7±0.13 per hen in Enemay from which relatively fair number (84.8%) chicks in Enarj Enawga and 86.9% in Enemay were hatched. From this study, it was also understood that almost 88.89% of respondents in Enarj Enawga and 84.44% of respondents in Enemay experienced in practicing exclusively incubation trend. All of the respondents experienced with natural incubation and hatching, besides majority of them used different egg selection methods to increase hatchability, from which 34.44% used medium size of an egg, 20%(shape of egg), 17.78%(cleaness) and 17.78%(shell condition/crackness) in Enarj Enawga and 27.78% (medium size of an egg), 35.56% (cleaness) and 35.56%(shell condition/crackness) in Enemay district were used a criteria for egg selection.

In this regard, relatively, chicken have supposed for hatching after 2.3±0.05 and 2.2±0.07 clutch period for natural incubation in Enarj Enawga and Enemay districts, respectively. This study also revealed that 56.66% of the respondents in Enarj Enawga and 55.56% of the respondents in Enemay were preferred to set eggs in November and the rest 11.11%, 18.88%, 2.22% in Enarj Enawga and 11.11%, 17.78% in Enemay were preferred to set eggs in October, December and January, respectively. The average number of days eggs stored before incubation is 3.4±0.07 days in Enarj Enawga and in Enemay eggs stored for 2.7±0.11 days before incubation. Comparatively, in Enarg Enawga districts household's stored eggs before incubation more than Enemay district. This storage of eggs before incubation is important to check the broody hens finished to lay eggs and supposed for incubation.

This result indicated that majority of the farmers have some knowhow to improve hatchability of chicks. The resultalso further indicated that respondent farmers used various locally prepared egg setting equipments, namely 78.88% and 83.33%used equipment's made from mud in Enarj Enawga and Enemay districts, respectively. In Enemay district equipments made from mud is highly practiced tha Enarj Enawga district. The rest 10% and 1.11% used equipments made from wooden/bamboo. Majority of the householder were used teff straw as a bedding material 88.88% in Enarj Enawga and 84.44% in Enemay districts.

Table 5. *Incubation practice in the study areas.*

Parameters	Districts		Over all	Tests	
	Enarj Enawga N (%)	Enemay N (%)		F value	P value
Clutch period and supposed for hatching	2.31±0.05	2.17±0.07	2.24±0.04	2.61	0.11
Period of egg storage before incubation/day	3.40±0.07	2.72±0.11	3.07±0.07	26.81	0.00
Interval of two consecutive brooding period in	5.05±0.11	6.71±0.06	5.93±0.08	186.72	0.00

Table 5. *Continued.*

Parameters		Districts		X^2	Tests
		Enarj EnawgaN (%)	Enemay N (%)		P value
Description of broodness of hens	Common	90 (100)	90 (100)	-	-
Incubation trend	Yes	80 (88.89)	76 (84.44)	0.77	0.38
	No incubation trend	10 (11.11)	14 (15.56)		
Egg selection	Yes	80 (88.89)	76 (84.44)	-	-
	No	10 (11.11)	14 (15.56)		
Criteria of egg selection				24.36	0.00
	Shape of egg	18 (20)	-		
	Cleanness	15 (16.66)	19 (21.11)		
Shell condition (crackness)	16 (17.78)		32 (35.56)		
Preferable month to set egg				1.939	0.59
	October	10 (11.11)	10 (11.11)		
	November	51 (56.66)	50 (55.56)		
	December	17 (18.88)	16 (17.78)		
	January	2 (2.22)	-		
	Not set	10 (11.11)	14 (15.56)		
Material used for incubation				6.41	0.01
	Mud container	71 (78.89)	75 (83.33)		
Wooden/bamboo container		9 (10)	1 (1.11)		
Not used		10 (11.11)	14 (15.56)		
Bedding materials				-	-
	Teff straw (*chid*)	80 (88.89)	76 (84.44)		
	Not used	10 (11.11)	14 (15.56)		
Methods used for brooding and rearing of chickens				-	-
Broody hens		80 (88.88)	76 (84.44)		
	No trend	10 (11.11)	14 (15.56)		

Ns=not significant, ** significant (P<0.01) and * significant (P<0.05).

3.5. Breeding Practice

The result indicated that there was a significant (P<0.01) difference almost all breeding practice between districts except techniques of controlled mating. Breeding practice was one of the important factors to increase productivity and to get desired plumage color in the study area. Majority of the respondents (62.22%) did not have breeding practice in Enarj Enawga district (Table 6). In contrast majority of the respondents (62.22%) in Enemay district have practiced breeding activity in the area. Most of the householders used methods of breeding by improving indigenous chicken (28.89%) and the remaining proportion 8.89% in Enarj Enawga and 11.11% in Enemay district used methods of breeding by importing exotics. In Enemay district majority of the household practiced methods of breeding by using improving indigenous chicken than the methods of breeding used by Enarj Enawga with average percentage of 51.11% and 28.89%, respectively. This result is in line with Mearg *et al*., (2015) in central zone of Tigray 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 [39] and in line with the report of Moges *et al*., (2010) reported that about 92.2% of chicken owner farmers in Bure district had the tradition of selecting cocks for breeding stock [28] but is not in line with the report of Mesert (2010) in which traditional chicken production system was characterized by lack of systematic breeding practice in Gomma district. [44]

In both districts the ways of improving indigenous chicken were different. Majority of the respondents 51.11% in Enemay and 28.89% in Enarj Enawga district were uses line breeding and 8.89% and 11.11% of the householders were uses cross breeding in Enarj Enawga and Enemay districts, respectively. However, line breeding is highly practiced in Enemay district than Enarj Enawga district. This indicated that households between districts have different perception on the effect of line breeding. The other trends of the study area were mating of their indigenous chicken accounted 37.78% and 62.22% in Enarj Enawga and Enemay district, respectively. Among them 20% and 17.78%, 26.66% and 35.56% of the house holders were uses controlled and uncontrolled ways of mating in Enarj Enawga and Enemay districts, respectively. This result has no agreement with Hana (2016) majority of the respondents in North Gondar uses completely uncontrolled way of mating [33] and finding of Dana (2011) reported that breeding is completely uncontrolled in different parts of Ethiopia. [49] Householders that used controlled mating system uses culling unproductive chickens, culling young stage and retaining the best cock and hens techniques with

percentages of 12.22%, 5.56% and 2.22% in Enarj Enawga district. In other ways 12.22%, 11.11% and 3.33% of the household that have trends on controlled mating system uses culling unproductive chickens, culling young stage and retaining the best cock and hens techniques in Enemay. The current study is in line with Worku *et al*., 2012 culling poor productive (43.9%) was the first most frequent way of mating control of farmers' flock followed by retaining best cocks and layers for further breeding (36.9%), cull at early age (13.2%) and preventing mate (6%) in Western Zone of Tigray, Northern Ethiopia. [33] This result is no in line with Mearg *et al*., 2015 reported in Centeral Tigray 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%). [39]

Table 6. *Breeding practice, methods of breeding, practice of mating, mating system and techniques in the study areas.*

Variables	Districts				Over all		Tests	
	Enarj Enawga		Enemay					
	N	%	N	%	N	%	X^2	P value
Breeding practice							10.76	0.001
Yes	34	37.78	56	62.22	90	37.78		
No	56	62.22	34	37.78	90	62.22		
Methods of breeding								
Importing exotics	8	8.89	10	11.11	18	10		
Improving indigenous	26	28.89	46	51.11	72	40		
No breeding practice	56	62.22	34	37.78	90	50		
Ways of improving							11.16	0.004
Cross breeding	8	8.89	10	11.11	18	10		
Line breeding	26	28.89	46	51.11	72	40		
No ways of Breeding	56	62.22	34	37.78	90	50		
Mating system							11.57	0.003
Controlled	18	20	24	26.66	42	23.33		
Uncontrolled	16	17.78	32	35.56	48	26.67		
No practice	56	62.22	34	37.78	90	50		
If controlled, techniques							2.11	0.55
Culling unproductive chickens	11	12.22	11	12.22	22	12.22		
Culling young stage unwanted color	5	5.56	10	11.11	15	8.33		
Retaining the best cock & hens	2	2.22	3	3.33	5	2.78		
No practice	72	80	66	73.33	138	76.67		

N=number of respondents.

3.6. Source of Replacement Stock

The result indicated that there was no significant (P>0.05) difference between districts in all sources of replacement stock except own cocks and sources of cock who do not have their own cock. In the study area source of replacement stocks for their chicken population was purchased from market (78.89%) and hatching (21.11%) in Enarj Enawga district. Purchasing from market in Enarj Enawga was greater than Enemay (72.22%) district. The current study has no agreement with Dana (2011) reported that replacement stock produced through natural incubation using broody hens in different parts of Ethiopia. [44]

The entire householder in the study area was buying chicken for their chicken population. Place of buying chicken in both districts were from market (53.33%), commercial chicken farm (33.33%) and extension (13.33%) in Enarj Enawga and from market (53.33%), commercial chicken farm (24.44%) and extension (22.22%) in Enemay. Majority of the householder buy local chickens from market, 57.78% and 58.88% in Enarj Enawga and Enemay districts, respectively. The remaining proportions of the household were buying improved chicken from commercial chicken farm and extension in both districts. Majority of the household (62.22%) in Enarj Enawga district had not their own cock, while in Enemay district (62.22%) had their own cock. The result indicated that in Enemay district partially there is better male to female ratio than Enarj Enawga district. In Enemay district households can boost the productivity of their chicken by using different ways of improvement than the households of Enarj Enawga district. Local breed type were the major breed type (57.78% in Enarj Enawga and 58.88% in Enemay) they buy for their breeding stock from market. The result in Enarj Enawga district had no agreement with the result of [39], who reported 71.1% of the respondents reported that they rear their own local (54.9%), exotic (14.8%) and cross breed (27.5%) cocks in Centeral part of Tigiray and higher than the result of [48] who reported that from 31% to 55.6% of the farmers of different regions of Ethiopia did not own breeding males.

Table 7. *Sources of Replacement stock.*

Variables	Districts			Tests	
	Enarj Enawga N (%)	Enemay N (%)	Over all N (%)	X^2	P value
Own cock				10.76	0.001
Yes	34 (37.78)	56 (62.22)	90 (50)		
No	56 (62.22)	34 (37.78)	90 (50)		
If yes, breed type				0.98	0.61
Local	55 (61.11)	60 (66.66)	115 (63.89)		
Exotic	16 (17.78)	16 (17.78)	32 (17.78)		
Cross	19 (21.11)	14 (15.56)	33 (18.34)		
If no, Sources of cock				10.76	0.001
Purchased from market	34 (37.78)	56 (62.22)	90 (50)		
Neighbors/relatives	56 (62.22)	34 (37.78)	90 (50)		
Source of replacement stock				1.08	0.30
Purchased	71 (78.89)	65 (72.22)	146 (75.56)		
Hatched	19 (21.11)	25 (27.78)	44 (24.45)		
Buying birds for their stock				-	-
Yes	90 (100)	90 (100)	180 (100)		
No	-	-	-		
Place of buy chicken				3.23	0.20
Market	48 (53.33)	48 (53.330	96 (53.33)		
Commercial chicken farm	30 (33.33)	22 (24.44)	52 (28.89)		
Extension	12 (13.33)	20 (22.22)	32 (17.78)		
Market	48 (53.33)	48 (53.330	96 (53.33)		
Types of breed they buy				0.02	0.9
Local	52 (57.78)	53 (58.88)	105 (58.33)		
Improved	38 (42.22)	37 (41.11)	75 (41.67)		

N=number of respondents.

3.7. Effective Population Size and Level of Inbreeding of Chickens in the Study Area

In the study areas there were no separated herding of chicken. Chickens are freely moved in every part of the villages for scavenging their feeds. The effective population size (Ne) is influenced by actual number of breeding males and females in the flock at a given time and thus subject to change due to variation in the flock size and type of rearing practice. The rate of inbreeding coefficient per generation changes with any change in the effective population size.

The average numbers of breeding males owned by farmers were 0.2 and 0.3 and the average number of breeding females was 4.2 and 5.3 in Enarj Enawga and Enemay district, respectively. The result of the average breeding males in both districts are lower than the result of [39] who reported the average number of breeding males in Centeral part of Tigiray were 1.62. The average breeding females in the study areas are in line with the result of [39] who reported the average number of breeding females in Central part of Tigray was 5.05. The effective population size (Ne) estimated in Enarj Enawga and Enemay were 0.76 and 1.14, respectively whereas the rate of inbreeding per generation (ΔF) was 0.65 and 0.44, respectively. The result regarding to the the rate of inbreeding per generation (ΔF) in both districts are higher than the result of [39], who reported the overall mean effective population size (Ne) in Central part of Tigray was 0.13.

The effective population size (Ne) of both districts lower than the findings of [48] who reported that the largest effective population size of 3.19 for Sheka and 5.22 for Konso was recorded.

The effective population size gave an idea as to the level of inbreeding in the chicken populations in the two districts using the flocks of farmers who possessed their own breeding males. With this, it was realized that Enarj Enawga with effective population size (0.76) had the lowest population size compared with Enemay (1.14).

According to this result (Ne = 1.13) the number of breeding individuals is very small in the study area. Due to the possibility of the absence of breeding males in some households the estimates on the effective population size as well as the rate of inbreeding might not be accurate, i.e. farmers those didn't possessing their own cocks and used neighbors cock (common cocks) for mating the female chickens the estimation of effective population and also the rate of inbreeding obtained may not be exact.

Table 8. *Effective population size and level of inbreeding of chickens in the study area.*

Districts	N_f	N_m	Ne	(ΔF)
Enarj Enawga	4.2±0.3	0.2±0.04	0.76	0.65
Enemay	5.3±0.4	0.3±0.05	1.14	0.44

Ne=4 Nm × Nf/ Nm + Nf,

ΔF = Rate of change in inbreeding per generation Nm = number of breed males

Nf = number of breed females Ne = the effective population size

4. Summary and Conclusion

In general the study was conducted in Enarj Enawga and Enemay district, East Gojjam Zone aimed to assess the farmers breed and trait preferences and performance of

indigenous chicken in Enarj Enawga and Enemay districts. The study was conducted by implementing single visit questionnaire.

Households give more attention to egg number and body size to select their breeding female chicken for Enarj Enawga and Enemay districts with index =0.43 and 0.31, respectively followed by plumage color with index=0.26 and 0.27 for Enarj Enawga and Enemay districts, respectively. The reported selection criteria by the farmers to select breeding male in the study area was the plumage color of the animal with index=0.31 and 0.24 for Enarj Enawga and Enemay districts, respectively. Disease resistance was the second criteria for selection of breeding male in Enarj Enawga district with index=0.25 while body size was responded as the second criteria in Enemay (I=0.22).

Out of the sampled households in the study area, 37.78% (Enarj Enawga) and 62.22% (Enemay) of them had their own breeding cocks while 37.78% % (Enemay) and 62.22% (Enarj Enawga) of them were not possesses breeding cocks and mate their female chickens through neighbors'. Cock from neighbors was mostly practiced in Enarj Enawga district than in Enemay district. Farmers in Enemay district mainly practice practiced uncontrolled mating system (35.56%) while controlled mating in Enarj Enawga district (20%).

Plumage color such as red color was more preferred for male chickens while white (Enarj Enawga) and red (Enemay) was more prefered for female chickens in across the studied districts communities. Besides these colors, white male and female chickens in Enemay district and gray/gebisma (males) and red (females) in Enarj Enawga were most plumage colors preferred by most farmers. Almost all respondents less preferred black colored chickens due to less demand for this colored chicken in the market.

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