Vol. 10(1), pp. 24-32, January 2019
DOI: 10.5897/IJLP2018.0551
Article Number: 29A483559621
ISSN 2141-2448

http://www.academicjournals.org/IJLP

ACADEMIC JOURNALS
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International Journal of Livestock Production

Full Length Research Paper

Productive and reproductive performance of indigenous chickens in Gena Bossa District of Dawro Zone, Ethiopia

Matawork Milkias[1]*, Meseret Molla[2] and Samuel Tilahun[3]

[1]Jimma University,College of Agriculture and Veterinary Medicine, Department of Animal Science, Jimma, Ethiopia.
[2]University of Gondar College of Veterinary Medicine and Animal Science. P.O.Box 196, Ethiopia.
[3]Samuel Tilahun:- Jimma University,College of Agriculture and Veterinary Medicine, Department of Animal Science, Jimma, Ethiopia.

Received 12 November, 2018; Accepted 12 December, 2018

This study was conducted in Gena Bossa district with the objective of assessing the productive and reproductive performance of indigenous chickens. Multistage stratified purposive and random sampling methods were used and a total of 138 households were interviewed in the study area. Fifteen, fifty four and sixty nine farmers selected for interviews from highland, midland and lowland agro-ecologies, respectively. From the interviewed farmers, 47, 47 and 44 farmers were poor, medium and rich wealth leveled, respectively. Farmers were categorized to their education level and 34, 34, 35 and 35 respondents were interviewed from illiterate, reading and writing, primary first and primary second cycle education level, respectively. Age at sexual maturity of pullets and cockerels were 5.64 and 5.25 months, respectively. The clutch number, eggs per clutch and total eggs/hen/year were 3.04, 12.78 and 38.53, respectively. In this survey, hatchability and survival rate of chicks were 81.72 and 38.85%, respectively. Sexual maturity, number of eggs per clutch and hatchability were significantly ($p<0.05$) different at different agro-ecology and education levels but not significantly ($p>0.05$) different at different wealth levels of farmers. Generally, low productive and reproductive performance of indigenous chickens were recorded under farmer's management condition in Gena Bossa District of Dawro Zone which needs further improvement from the government by organizing trainings for farmers on disease control, housing and feeding of chickens to improve productive and reproductive performance.

Key words: Agro-ecology, education level, wealth status, productive and reproductive performance, Indigenous chickens, Gena Bossa.

INTRODUCTION

Agriculture dominates the Ethiopian economy and contributes 45% of gross domestic product (GDP) and provides more than 80% of employment. Ethiopia has the highest livestock populations in Africa and accounts for 17, 20, 13 and 55% of cattle, sheep, goats and equines, respectively (CSA, 2016). Livestock production accounts for about 32% of agricultural GDP and 61% agricultural total export (NABC, 2010; PIF, 2010; Tsegaye, 2014).

The global poultry population has been estimated to be about 16.2 billion, of which 71.6% is found in developing

*Corresponding author. E-mail: mataworkmilkias@gmail.com.

countries (Gueye, 2005). In Africa, village poultry contributes over 70% of poultry products and 20% of animal protein intake (Kitalyi, 1998). In East Africa, over 80% of human population live in rural areas and over 75% of these households keep indigenous chickens. The Ethiopian poultry population is estimated to be about 60.5 million, of which 94.33, 2.47 and 3.21% is indigenous, exotic and hybrid chickens, respectively (CSA, 2016). According to CSA (2016) report, 83.5, 7.1 and 9.4% meat and egg product come from indigenous, hybrid and exotic breeds of chickens in Ethiopia, respectively.

The Ethiopian indigenous chickens are known to possess desirable characters such as thermo tolerant, resistance to some diseases, good egg and meat flavor, hard egg shells, high fertility and hatchability as well as high dressing percentage (Aberra, 2000). According to Abubakar et al. (2007), the impact of the Ethiopian village chicken in the national economy and its role in improving the nutritional status, family income, food security and livelihood of many smallholders is significant owing to its low cost of production. The diverse agro-ecology and agronomic practices prevailing in the country together with the huge population of livestock in general and poultry in particular, could be a promising attribute to boost up the sector and increase its contribution to the total agricultural output as well as to improve the living standards of the poor livestock keepers (Aleme and Mitiku, 2015; Hunduma et al., 2010). Poultry production, as one segment of livestock production, has a peculiar privilege to contribute to the sector. Poultry is small in size and rapid in human food production due to its short reproductive cycle compared to other livestock kept in Ethiopia. Poultry fits well with the concept of small-scale agricultural development. Moreover, it goes eco-friendly and does not compete for scarce land resources (Mekonnen, 2007; Sonaiya, 1997).

In Ethiopia, the contribution of indigenous chickens to farm household and rural economies is not proportional to their large numbers. The production systems are affected by different constraints which cause low productive and reproductive performance of chickens. The constraints which affect chicken production include diseases, poor management practices, predation and lack of organized markets. Of these constraints, diseases, poor housing and predation are the most important among village chicken production systems in Ethiopia (Aberra, 2000; Halima, 2007; Nebiyu et al., 2013; Solomon et al., 2013).

To understand the productivity status/potential of village chicken in various parts of Ethiopia, several studies have been conducted. There are numerous chickens existing in the study area but still now producers got little products from their chickens. However, the productivity of indigenous chicken and the production system has not been studied extensively in Gena Bossa district of SNNPR. Cognizant of this, this research was designed with the objectives of assessing the productive and reproductive performance of indigenous chickens in the Gena Bossa district of SNNPR.

MATERIALS AND METHODS

Description of the study area

This study was conducted in the district of Gena Bossa. The district is found in Dawro zone of South Nation Nationalities and Peoples Region State (SNNPRS). Karawo is the town of the district which is located at about 508 km south west of Addis Ababa across Shashemene and Wolayita, 303 km from Hawassa Town of SNNPRS. The total surface area of the district is 90,122 ha. The total population of Gena Bossa district is about 109,401 and from this 54,870 is male and 54,531 is female. The livestock resources of the district are 287,046 cattle, 77,350 sheep, 84,750 goats, 277 horses, 4,440 mules, 4,000 donkeys and 147,780 chickens (Livestock Office of the District, 2016).

Selection of study households

Multistage stratified purposive and random sampling methods were used to study population that rears indigenous chickens. Based on the number of chicken population and the potential of each *kebeles* and its representativeness to the district, three *kebeles* from lowland, two *kebeles* from midland and one *kebele* from highland were selected to collect data. Farmers were categorized to different wealth levels (poor, medium and rich) based on land ownership, livestock number and kilo calorie intake per day to select farmers for PSNP according to ICRA (1991) and Temesgen et al. (2016) wealth level classification bases. Then, those farmers separated by wealth status were re-categorized by education level. Finally, 138 respondents randomly selected from different agro-ecologies which were categorized based on wealth and education level (Table 1).

Fifteen, fifty four and sixty nine farmers were selected from highland, midland and lowland agro-ecologies, respectively to determine the effect of agro-ecology on productive and reproductive performance of indigenous chickens. This is also divided to wealth status and 47, 47 and 44 farmers were selected from poor, medium and rich wealth leveled farmers, respectively to determine the effect of wealth on chicken productive and reproductive performance of indigenous chickens. Finally, 34, 34, 35 and 35 farmers from illiterate, reading and writing, primary first cycle and primary second cycle education level, respectively were selected from those farmers classified by wealth status to determine the effect of education level of respondents on indigenous chicken productive and reproductive performance.

Sample size determination

The total size for household was determined by using probability proportional size-sampling technique Cochran's (1963).

$$no = \frac{Z^2 * (P)(q)}{d^2}$$

where n_O = desired sample size according to Cochran's (1963) when population greater than 10,000; Z = standard normal deviation (1.96 for 95% confidence level); P = 0.10 (proportion of population to be included in sample, that is, 10%); q = 1-P, that is, 0.90; d = degree of accuracy desired (0.05).

Table 1. Sampling frame of households in the study area.

Agro-ecology	Number of respondents based on agro-ecology	Number of respondents based on wealth status			Number of respondents based on education level			
		Poor	Medium	Rich	Illiterate	R&W	PFC	PSC
Highland	15	5	6	4	4	3	3	5
Midland	54	20	17	17	13	15	14	12
Lowland	69	22	24	23	17	16	18	18
Total	138	47	47	44	34	34	35	35

PFC: Primary first cycle (grade 1-4), PSC: primary second cycle (grade 5-8), R&W: reading and writing.

Table 2. Demographic structures, land size and livestock number of the respondents.

Household profile	Frequency	Percentage
Sex of respondents		
Male	79	57.2
Female	59	42.8
Marital status		
Married	101	73.2
Divorced	15	10.9
Widows	22	15.9
Farming system		
Mixed farming system (crop-livestock)	138	100
Total land and livestock	**Mean±SE**	
Total land per household (ha)	2.02±0.16	
Livestock per household (No.)	13.22±0.45	

Data collection methods

Questionnaire survey

The data were collected by using both primary and secondary source of data. The primary data were collected by using semi-structured pre-tested questionnaire. The parameters like productive and reproductive performances were gathered by using questionnaire. The secondary data (total population of chickens and other relevant data) were collected from written document of Gena Bossa Agricultural and Natural Resource Development Office, Animal and Fisher Development Office of the district and other sources.

Data management and analysis

Descriptive statistics such as percentage and mean were calculated and all survey data were analyzed by using SPSS (Version 20). The descriptive statistics (mean, standard error of mean) for numerical survey data were calculated to analysis of variance (ANOVA) using the general linear model procedure of SPSS. ANOVA model statement was used to investigate the effects of altitude difference, wealth status and education level of respondents on various performances related parameters.

Statistical model for this study (Model for survey).

$$Yijk = \mu + Ai + Wj + Ek + Ai\times Wj + Ai\times Ek + Wj\times Ek + Ai\times Wj\times Ek + Єijk$$

where Yijk = the value of the respective variable mentioned above pertaining i^{th} agro-ecology, ^{jth} wealth status, k^{th} educational level and interactions; μ = over all mean of the respective variable; Ai =the effect of i^{th} agro-ecology (i=3, highland, midland or lowland) on the respective variable on flock size, productive and reproductive performance of chickens; Wj = the effect of j^{th} wealth of producer (j=3, poor, medium or rich) on the respective variable on flock size, productive and reproductive performance of chickens; Ek = the effect of k^{th} educational level of producer (k=4, illiterate, reading and writing, primary first cycle or primary second cycle) on the respective variable on flock size, productive and reproductive performance of chickens; Ai×Wj, Ai×Ek, Wi×Ek and Ai×Wj×Ek= the interaction effects agro-ecology, wealth and education level on the respective variable on flock size, productive and reproductive performance; Єijk = random error term.

RESULTS AND DISCUSSION

Demographic characteristics, land size and livestock number of households

Demographic data like land size and livestock numbers of the study area as shown in Table 2. According to the data collected, 57.2% were males and the rest 42.8% were

females. The average ages of respondents were 37.66 years and the mean family size per household was 6.8. About 63.8% of respondents were the followers of protestant followed by Orthodox and Catholic religious followers. Regarding to marital statuses of respondents, 73.2% were married and the rest were divorced and widows.

Productive performance of indigenous chickens

Productive performances of indigenous chickens were evaluated under farmer management conditions. The productive performance of indigenous chickens at different agro-ecology, wealth status and education level of respondents is shown in Table 3.

Clutch number

The overall mean clutch number of chicken in the study area was 3.04±0.10 per year (Table 3). This result was similar to Melkamu and Wube (2013) in Debsan Tikara Kebele at Gonder Zuria Woreda in which average clutch number was 3 per year. This result was comparably lower than the clutch numbers of 3.8 and 3.7 reported in Bure and Dale districts, respectively (Fisseha et al., 2010a). This result was also lower than reported by Meseret (2010) in Gomma Wereda (3.43) and CSA (2015/2016) the national average of Ethiopia (4).

The clutch number was not significantly different ($p>0.05$) at different agro-ecologies, wealth status and educational levels of the respondents (Table 3).

Egg production

The average numbers of egg per clutch in this study was 12.78±0.29 (Table 3). This study is in line with Melkam and Wube (2013), Meseret (2010) and Bikila (2013) in Debsan Tikara Keble at Gonder Zuria Woreda, Gomma woreda and Chelliya district where the average egg numbers was 13, 12.92 and 12.93, respectively. This result agrees with that of Solomon et al. (2013) in which the average eggs per clutch were 14.72, 13.98, 13.46 and 12.15 in Pawe, Dibate, Wombera and Guba district of Metekel zone, respectively. On the contrary, the present result was lower than that of Fisseha et al. (2010b) who reported the average number of eggs per clutch were 15.7, 13.2 and 14.9 in Bure, Fogera and Dale districts, respectively. The average day per clutch for egg production was 25.27±0.54 for indigenous chickens and total mean egg produced annually per hen was 38.53±1.37. According to Alem (2014) report in Central Tigray, the average numbers of eggs produced annually were 43.4 and the average days per clutch was 21.6. This result was lower than Fisseha et al. (2010a); who reported an average of 60 eggs per hen per year in Bure district.

Average number of eggs per clutch and average number of days per clutch were significantly ($p<0.001$) different at different agro-ecologies and educational levels (Table 3). In this study, average numbers of eggs per clutch were 11.92±0.33, 13.77±0.69 and 12.66±0.15 at highland, midland and lowland agro-ecologies, respectively. Significantly ($p<0.001$), the highest number of eggs was produced at midland (13.77±0.69) agro-ecology. This difference might be due to farmer's providing better management (health care, feed type and feeding frequency) and proper weather conditions of midland agro-ecology which improves chickens egg production performance. The highest and lowest temperature of lowland and highland agro-ecology also decreases egg production performance of indigenous chickens, respectively. Shishay et al. (2015) reported that the average number of eggs per clutch were 12.56, 12.07 and 11.41 at highland, midland and lowland areas of western Tigray, respectively. This result was slightly higher than Matiwos et al. (2013) results in Nole Kabba Woreda of western Wollega, the average number of eggs per clutch were 11.17, 11 and 11.52 at highland, midland and lowland agro-ecologies, respectively. In this study, the average numbers of days per clutch were 23.67±0.74, 27.18±0.38 and 24.95±0.33 in highland, midland and lowland agro-ecologies, respectively. According to Gebreegziabher and Tsegay (2016), the average numbers of days per clutch were 24.6, 27.2 and 26 at highland, midland and lowland areas in Wolaita zone of Southern Ethiopia, respectively.

The average number of eggs produced and average days per clutch were significantly ($p<0.001$) different at different education level. The average numbers of eggs per clutch were 11.54±0.26, 12.02±0.27, 13.35±0.27 and 14.22±0.24 at illiterate, reading and writing, primary first and second cycle education level, respectively. Also, average numbers of days per clutch were 23.11±0.59, 23.91±0.63, 26.65±0.62 and 27.39±0.55 at illiterate, reading and writing, primary first and second cycle education level, respectively (Table 3).

The mean annual egg production was significantly ($p<0.001$) different only at different educational levels of the farmers. The average number of eggs per hen per year was 32.02±1.51, 36.85±1.59, 42.04±1.58 and 43.21±1.40 at illiterate, reading and writing, primary first and second cycle education level of respondents, respectively (Table 3). The average numbers of egg per clutch, average days per clutch and total average number of eggs per hen per year were the highest at PFC and PSC educated farmers than illiterate and R&W education level of respondents. This difference might be due to better management practice given (feeding, housing and health care) from educated farmers to their chickens which they got from different training. In agreement with the current study, Adebayo and Adeola (2005) and

Table 3. Productive performances of the indigenous chickens (Mean±SE).

Variable	NCPY	ANEPC	ANDPC	ANEL/H/Y	AWC (kg)	M/SAC (M)	M/SAH (M)
Agro.							
HL	3.08±0.14	11.92±0.33^{b}	23.67±0.74^{b}	36.42±1.89	1.46±0.03	8.17±0.24^{a}	7.62±0.31^{a}
ML	2.95±0.07	13.77±0.69^{a}	27.18±0.38^{a}	40.45±0.97	1.51±0.02	7.50±0.13^{b}	6.81±0.16^{b}
LL	3.07±0.06	12.66±0.15^{b}	24.95±0.33^{b}	38.73±0.85	1.47±0.01	7.96±0.11^{ab}	7.37±0.14^{ab}
p-value	0.40	0.001	0.001	0.13	0.19	0.01	0.01
Wealth							
Poor	2.99±0.09	12.91±0.23	25.63±0.52	38.54±1.31	1.49±0.02	7.92±0.17	7.09±0.21
Med.	3.16±0.09	12.71±0.23	24.97±0.49	39.70±1.26	1.49±0.02	7.94±0.16	7.44±0.21
Rich	2.96±0.10	12.73±0.24	25.20±0.54	37.35±1.38	1.45±0.02	7.76±0.18	7.24±0.23
p-value	0.31	0.79	0.65	0.46	0.09	0.45	0.74
Educ.							
Illit.	2.82±0.11	11.54±0.26^{b}	23.11±0.59^{b}	32.02±1.51^{b}	1.36±0.03^{c}	7.96±0.19	7.38±0.25
R&W	3.08±0.12	12.02±0.27^{b}	23.91±0.63^{b}	36.85±1.59^{b}	1.36±0.03^{c}	8.04±0.21	7.33±0.26
PFC	3.14±0.12	13.35±0.27^{a}	26.65±0.62^{a}	42.04±1.58^{a}	1.50±0.02^{b}	7.69±0.20	7.09±0.26
PSC	3.10±0.10	14.22±0.24^{a}	27.39±0.55^{a}	43.21±1.40^{a}	1.69±0.02^{a}	7.80±0.18	7.26±0.23
p-value	0.19	0.001	0.001	0.001	0.001	0.60	0.86
A×W	NS	NS	NS	NS	NS	NS	NS
A×E	NS	NS	NS	NS	NS	NS	NS
W×E	NS	NS	NS	NS	NS	NS	NS
A×W×E	**	NS	NS	**	NS	NS	NS
Overall	3.03±0.10	12.78±0.29	25.27±0.54	38.53±1.37	1.48±0.02	7.87±0.18	7.26±0.23

$^{a, b, ab, c}$Least square means with different superscript within a column are significantly different ($p < 0.05$). NCPY: Number of clutch per year, ANEPC: average number of eggs per clutch, ANDPC: average number of days per clutch, ANEL/H/Y: average number of eggs laid per hen per year, AWHCAM (kg): average weight of hens and cocks at 6 months(Kg), M/SAC: market/slaughter age of cocks, M/SAH: market/slaughter age of hen, SE: standard error, HH: highland, ML: midland, LL: lowland, Agro.: agro-ecology, Edu.: education, Med.: medium, PFC: primary first cycle, PSC: primary second cycle, R&W: reading and writing, M: month, kg: kilo gram, A×W: interaction of agro-ecology and wealth level, A×E: interaction of agro-ecology and education, W×E: interaction of wealth and education, A×W×E: interaction of agro-ecology, wealth and education, NS: Not Significant, **Significant.

Nebiyu (2016) reported that educational level of farmers had effect on average egg production, which implies the higher educational level; the better would be in understanding of farm operation and efficiency.

The mean total eggs produced per hen per year was not significantly different ($p>0.05$) at different agro-ecologies. Mean total eggs produced per hen per year were 36.42±1.89, 40.45±0.97 and 38.73±0.85 at highland, midland and lowland agro-ecologies, respectively (Table 3). This result was lower than Fisseha et al. (2010a) results in Bure district. Average eggs produced per clutch were 16.7, 16.1 and 14.4, and also total eggs produced per hen per year were 60, 61 and 59 at highland, midland and lowland agro-ecologies, respectively. Shishay et al. (2015) reported the highest number of eggs per hen per years from indigenous chickens of western Tigray, in which annual eggs produced per hen were 54.2, 54.87 and 48.98 at highland, midland and lowland areas, respectively. Also, Gebreegziabher and Tsegay (2016) reported highest number of eggs per hen per year from local chickens of Wolaita which were 66.2, 60 and 51.1 at highland, midland and lowland areas, respectively.

Average number of eggs per clutch, average number of days per clutch and average eggs per hen per year were not significantly ($p>0.05$) different at different wealth level of the respondents (Table 3). There were significant ($p<0.001$) difference on mean number of eggs per hen per year at the interaction point of agro-ecology, wealth status and education level of the farmers. This might be when agro-ecology were proper for chicken production and educated farmers had the highest level of wealth they provide necessary things (feeding, watering, constructing separate house and clean chicken house, treating by using modern medicine and vaccinating chickens) which they got by education and different training to improve the mean numbers of eggs per hen per year.

Market/Slaughter age of chickens

The mean market or slaughter age of cocks and hens were 7.87±0.18 and 7.26±0.23 months in the study area,

respectively (Table 3). According to GAIN (2017), the average slaughter age of Ethiopian indigenous chicken ranges from 8 to 12 months. But in this finding, chickens reach slaughter age earlier than Aman et al. (2017) report in three agro-ecologies of SNNPR indigenous chickens reach slaughter age at 9.9 months. On the contrary, eastern Tigray indigenous chickens were reported to reach an earlier slaughter age of 4.66 and 4.5 months for male and female chickens, respectively (Shishay et al., 2015).

The market/slaughter age was significantly different ($p<0.01$) for cocks and hens at different agro-ecology of the study area (Table 3). Chickens require significantly longer time to reach market age at highland and compared to the ones at midland agro-ecology. The reason might be chicken uses more energy for maintaining their body temperature in the highland than midland. This difference also might be due to midland farmers provide different types of feed (maize, sorghum, wheat and others) at different times of the day as well as they provide better health care. On other hand, longest time was recorded from indigenous male chickens of Wolaita zones in southern Ethiopia in which chickens reach slaughter age at 8.6, 9.4 and 8.9 months at highland, midland and lowland areas, respectively (Gebreegziabher and Tsegay, 2016). Late slaughter age also reported by Aman et al. (2017) from three agro-ecologies of SNNPR, the average slaughter age of chickens were 9.8, 7.0 and 10.4 months in highland, midland and lowland areas, respectively. The mean market age of cocks and hens were not significantly ($p>0.05$) different at different wealth status and education levels of the respondents.

Average weight of chickens at six months

The mean weight of chickens (hens and cocks) at 6 months of the ages in the study area was 1.48±0.02 kg (Table 3). According to Fisseha et al. (2010b) report at Fogera and Dale district, the mean weight of cockerels was 1125 and 1600 g as well as pullets were 933 and 1300 g, respectively. Also Fisseha et al. (2014) reported other result from selected districts of north western Amhara region in which the average weight of local hens ranges from 0.6 to 2.1 kg and local cocks ranges from 0.6 to 2.5 kg. According to Bogale (2008) report, the mean weight of cocks was 1.5 kg and hens were 30% less to male weight at 6 months of the age. Average weight of hens and cocks chickens at 6 months of ages in the study area was not significantly different ($p>0.05$) at different agro-ecologies and wealth levels of the respondents (Table 3).

The mean weight of chickens at 6 months of ages was significantly different ($p<0.001$) at different education level of the respondents. The mean weight of chickens was highest (1.69±0.02 kg) at primary second cycle educated farmers than the others. Lowest chicken weight (1.36±0.03kg) was observed at 6 months of ages from illiterate, and reading and writing education levels of farmers. This weight variations might be due to primary second cycle educated farmers provide better managements in terms of feeding, watering and health care which improves weight of chickens.

Reproductive performance and survival rate of indigenous chickens

Age at sexual maturity

Age at sexual maturity was measured age at first egg and age at first mate for female and male chickens, respectively. Age at sexual maturity in the study area was 5.63±0.22 and 5.25±0.15 months for pullets and cockerels, respectively (Table 4). Sexual maturity depends on management and overall production systems of farmers mainly on feeding, watering and disease control mechanisms. This result agrees with Endale et al. (2017) in Mezhenger, Sheka and Benchi-Maji zones in which the first egg laying and first mating age of pullets and cockerels were (5.59 and 5.00), (5.19 and 4.90) and (5.14 and 5.28) months, respectively. Chickens in this study reach sexual maturity earlier than that of Fisseha et al. (2010a) result in Bure district cockerels reach sexual maturity at 6.06 months (24.6 weeks) and pullets reach at 6.87 months (27.5 weeks) and Kugonza et al. (2008) in Eastern Uganda the sexual maturity of cockerels requires 5.5 months and pullets require 6.5 months.

There were significant differences ($p<0.001$) in sexual maturity of cockerels and pullets at different agro-ecologies of the study area. The ages of sexual maturity of pullets and cockerels were earlier in midland than both highland and lowland agro-ecologies. This difference might be the weather condition in midland was good for fast growth and the farmers in midland provided better management (feeding different types of feed and health care) for chickens. Comparable sexual maturity age of chickens were reported by Gebreegziabher and Tsegay (2016), the sexual maturity age of male and female chickens were (5.9, 5.9), (5.5, 5.2) and (5.5, 5.4) months at highland, midland and lowland agro-ecologies in Wolaita zones of southern Ethiopia, respectively. In this study, chickens reach sexual maturity earlier than Aberra et al. (2013) report in which the average sexual maturity of pullets at first egg laying were 6.94, 6.43 and 6.57 months in highland, midland and lowland agro-ecologies, respectively. There was no significant ($p>0.05$) difference of sexual maturity of pullets and cockerels between different wealth status and education levels of respondents (Table 4).

Hatchability and survival rate of chicks

The average number of eggs incubated per broody hen

Table 4. Reproductive performance and survival rate of indigenous chickens (Mean ± SE).

Variable	HAFEL (M)	CAAFM (M)	NEI	NCHPS	H%	SRC(5M)%
Agro.						
HL	5.92±0.20[a]	5.67±0.21[a]	11.92±0.33[b]	8.67±0.33[b]	72.56±1.36[b]	38.06±2.13
ML	5.21±0.10[b]	4.79±0.11[b]	13.77±0.69[a]	12.00±0.17[a]	87.04±0.70[a]	39.14±1.09
LL	5.78±0.09[a]	5.29±0.09[a]	12.66±0.15[b]	10.85±0.15[a]	85.57±0.61[a]	39.35±0.95
p-value	0.001	0.001	0.001	0.001	0.001	0.86
Wealth						
Poor	5.55±0.14	5.18±0.14	12.91±0.23	10.74±0.23	82.89±0.95	36.55±1.48
Med.	5.74±0.13	5.36±0.14	12.71±0.23	10.43±0.22	81.38±0.91	38.76±1.45
Rich	5.63±0.15	5.21±0.15	12.73±0.24	10.34±0.24	80.89±1.00	41.23±1.56
p-value	0.60	0.60	0.79	0.46	0.31	0.09
Educ.						
Illit.	5.62±0.16	5.36±0.16	11.54±0.26[b]	9.32±0.26[b]	80.70±1.09[b]	37.81±1.7[b]
R&W	5.71±0.17	5.27±0.17	12.02±0.27[b]	9.59±0.27[b]	79.59±1.15[b]	32.88±1.79[b]
PFC	5.64±0.17	5.27±0.17	13.35±0.27[a]	11.14±0.27[a]	82.86±1.15[a]	31.87±1.78[b]
PSC	5.55±0.85	5.09±0.15	14.22±0.24[a]	11.96±0.24[a]	83.75±1.02[a]	52.83±1.58[a]
p-value	0.91	0.69	0.001	0.001	0.03	0.001
A×W	NS	NS	NS	NS	NS	NS
A×E	NS	NS	NS	NS	NS	NS
W×E	NS	NS	NS	NS	NS	NS
A×W×E	NS	NS	NS	NS	NS	NS
Overall	5.63±0.22	5.25±0.15	12.78+0.29	10.50±0.24	81.72±0.99	38.85±1.55

[a, b ,ab, c]Least square means with different superscript within a column are significantly different ($p < 0.05$). HAFEL: Hen (pullet) age at first egg laying, CAAFM: cockerels age at first mating, NCHPS: number of chicks hatched per set, H%: hatchability, NEI: number of eggs incubated, SRC(5M): survival rate of chicks at 5 months, SE: standard error, HH: highland, ML: midland, LL: lowland, Agro.: agro-ecology, PFC: primary first cycle, PSC: primary second cycle, R&W: reading and writing, M: month, A×W: interaction of agro-ecology and wealth level, A×E: interaction of agro-ecology and education, W×E: interaction of wealth and education, A×W×E: interaction of agro-ecology, wealth and education, Educ.: education, Illit.: illiterate, NS: not significant.

was 12.7±0.29 and the hatchability in this study was 81.72±0.99% (Table 4). According to Fisseha et al. (2010b), the hatchability of the egg was 82.6, 78.9 and 89.1% at Bure, Fogera and Dale woredas, respectively. This result was higher than Melkam and Wube (2013) report in Debsan Tikara Kebele at Gonder Zuria Woreda (72%) and Aganga et al. (2000) among indigenous chickens in Botswana (61.8%). In this result, the survival rate of chicks up to 5 month of ages was 38.85±1.55%. The survival rate in present result was lower than Fisseha et al. (2010b) report in which the survival rate of chicks were 60.5, 74.3 and 54.2% at Bure, Fogera and Dale woredas, respectively. These low survival rate of the study area might be due to highest prevalence of diseases, predators and lack of vaccination practice of the farmers.

Hatchability was significantly different ($p<0.001$) at different agro-ecologies and educational levels in Gena Bossa district (Table 4). Significantly, the lowest percent hatchability was recorded at highland agro-ecology and this might be due to low temperature of the highland. At low temperature, broody hen gave great time to maintain body temperature by searching feed which affects hatchability of the egg. According to Fisseha et al. (2010a) report in Bure district, the hatchability was 85.7, 84.6 and 76.9% at highland, midland and lowland agro-ecologies, respectively. On the other hand, Gebreegziabher and Tsegay (2016) reported the hatchability of indigenous chickens in Wolaita zone of southern Ethiopia was 83.6, 74.1 and 79.5% at highland, midland and lowland areas, respectively. Comparably, the lowest hatchability was reported by Ahimedin and Mangistu (2016) from Gorogutu district of Eastern Hararghe, the percent hatchability was 57.78, 58.86 and 66.68% at highland, midland and lowland, respectively. Significantly, the highest percent hatchability was recorded from PFC and PSC educated farmers. This difference might be due to better feeding and watering management given to the broody hen at incubating time. Scavenging for feed and water at incubation time decreases the hatchability of chicks due to the fact that broody hen wastes time by searching feed and water. There was no significant difference ($p>0.05$) of hatchability at different wealth level.

There was no significant ($p>0.05$) difference on survival rate of chicks up to five months of ages at different agro-ecologies and wealth status of the farmers (Table 4). However, the survival rate of chicks up to five months of ages was significantly ($p<0.001$) different at different education levels of the farmers. The chick's survival rate was 37.81±1.70, 32.88±1.79, 31.87±1.78 and 52.83±1.58% at illiterate, reading and writing, primary first and second cycle education level, respectively. Comparably, the highest survival rate of chicks was recorded from primary second cycle educated respondents. This difference might be due the fact that educated farmers give better management in terms of feeding, providing separate house and clean house, and health care.

CONCLUSION AND RECOMMENDATION

Average clutch number and annual numbers of eggs produced per hen were 3.04 and 38.53, respectively in Gena Bossa district. Survival rate of chicks were 38.85% and which was the lowest and requires further improvement to increase survival rate of chicks. Also, average weights of chickens (hens and cocks) at six months of age were (1.48 kg). So, the result of this study indicated that lower production performance of indigenous chickens under farmer management system was recorded. Educated farmers confirmed that indigenous chicken produces more number of eggs through appropriate management (feeding, watering, housing and health care) but other farmers could not provide recommended management for chickens. There is a lot of challenges which decreases the reproductive and productive performance of indigenous chickens in Gena Bossa district such as diseases, predators, feed shortage and lack of proper market.

The following recommendations are suggested based on the result of the current study: full package vaccination reduces the outbreak of different diseases which hinder chicken production and it also increases survival rate of chickens. So, government should provide vaccination for chickens to prevent loss of chickens by disease out breaking especially ND. Training improves farmer's awareness in order to improve ways of feeding, housing and vaccinating chickens to increase chicken production performance. So, government should organize training for farmers on disease control, housing and feeding of chickens to improve chicken productivity.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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