TROPICAL DRYLANDS
Volume 1, Number 2, December 2017 E-ISSN: 2580-2828
Pages: 90-99 DOI: 10.13057/tropdrylands/t010205

Production system, population and productivity of exotic versus indigenous chickens in selected districts of North Western Amhara, Ethiopia

TILAHUN SISAY[1,♥], KEFEYALEW ALEMAYEHU[1], ZEWDU WULETAW[2]
[1]Bahir Dar University, College of Agriculture and Environmental Sciences, Department of Animal Production and Technology, Ethiopia.
♥email: tilahunsisay80@gmail.com
[2]Sustainable Land Management Organization (SLM)/GIZ, Bihar Dar, Ethiopia.

Manuscript received: 11 April 2017. Revision accepted: 27 November 2017.

Abstract. *Sisay T, Alemayehu K, Wuletaw Z. 2017. Population dynamics and performance of exotic versus indigenous chicken population in the selected districts of North Western Amhara, Ethiopia. Trop Drylands 1: 90-99.* Chicken in Ethiopia contributes to 98.5% and 99.2% of the national egg and chicken meat production, respectively. The total chicken population is estimated to be 56.87 million of which 95.86, 2.79 and 1.35% are indigenous, crossbred and exotic breeds, respectively. The objectives of this paper were to investigate the production systems, population and performance of exotic versus indigenous chicken populations in the selected districts of northwestern Amhara, Ethiopia. Banja and Burie districts and six Kebeles were purposively selected. A total of 180 respondents were selected by systematic and simple random sampling techniques for the survey. On the other hand, a total of 90 exotic chicken owners were purposively selected for monitoring and evaluation. GLM procedure of SAS (2002) was used to quantify the fixed effects of agroecology and breeds on egg production performance. The results revealed that the majority (91.12%) of distributed exotic chickens were kept in traditional/backyard production system. The overall mean egg production for exotic chickens (141.58±11.5) was too low. Significantly, the mean number of clutch per year per hen of Bovans Brown chicken was higher (4.51±0.11 days) than Bovans white breeds (3.5±0.10 days). Shortage at first egg was attained from midland of Koekoek chicken breed (5.38±0.24 months) than from highland (6.54±0.10 months) in Bovans Brown chicken. A highly significant difference in mortality was observed between Bovans Brown (89%) and Koekoek breed (32.4%), respectively due to traditional farmers' management practice. Distribution of different exotic chicken genotypes in the region is increasing from time to time for the upgrading of local chicken ecotypes but, the survival, productivity and population size of exotic and their crosses were too low. On the other hand, the population size of the indigenous chicken and its productivity remain almost constant. Causes of chick mortality in the study area were disease and predator which need to be considered in the development plan of the districts. This is due to the inappropriate production system, genotype, and management. Therefore, production and productivity will be increased through the selection of indigenous chicken ecotypes and crossbreed or upgrading by introducing exotic cocks, pullets, and/or fertile eggs of high egg producing strains with an appropriate production system and management in respective production system.

Keywords: Genotypes, performance, production system, population dynamics, dissemination trend

INTRODUCTION

Ethiopia ranks first in Africa and tenth in the world in livestock production; and this sector plays important socio-economic roles for rural poor (Salam 2005; Fessiha et al. 2010). Among the livestock species, chicken is widespread and important source of income for rural families (Tadelle et al. 2003; Fessiha et al. 2010). The total chicken population in the country was estimated at about 56.87 million (CSA 2015/16). Approximately 99% of these chicken populations are maintained under the traditional production systems. Rural poultry system is dominated by indigenous chickens (Alders and Pym 2009) which are well adapted to harsh environmental conditions (Ajayi 2011). These indigenous chickens vary in body size, feather distribution, plumage color, comb type, shank color, poor production, and productivity. These variations, according to Tadelle et al. (2003) and Halima et al. (2006) are caused by their adaptive nature in different production environments (Gueye 1998; Nigussie et al. 2010). Therefore, many efforts have been done to improve village chicken production and distribution through introduction of exotic chickens (Alemu and Tadelle 1997). Nevertheless, despite the large distribution of exotic chicken, its contribution to the improvement of local chicken is very low (Hailemariam et al. 2006). Even though more than 50 million local chickens in the country were reported (CSA 2011), their productive and reproductive performance is very poor than exotic chickens.

In Amhara region, the total chicken population is about 18 million. The current production system, however, according to Hailemariam et al. (2006) is lack of knowledge on chicken husbandry, lack of complementary inputs, high disease prevalence and predation, lack of strong extension follow up, unavailability of credit services and market are the limiting factors. Distribution of pullets, day-old chicken and fertile eggs, cockerels, layers, and duals breeds, has been one of the poultry extension packages accomplished by the Regional Office of Agriculture, for the last 20 years with the objective to

improve chicken production and productivity. Even though governments and NGOs distributed a large number of different exotic breeds to farmers in Amhara region, the contribution (adoption rate) of improved chicken in the current production system of the area is very low, mainly due to the high mortality rate of chicks (Hailemariam et al. 2006). The objectives of this work were to investigate the production systems, population and performance of exotic versus indigenous chicken population in the selected districts of northwestern Amhara, Ethiopia

MATERIALS AND METHODS

Study area

Banja District

Banja District is one of the administrative districts of Awi zone in Amhara regional state of Ethiopia. The district is 122 km far from the regional city Bahir Dar to the south and 447 km north to Addis Ababa. This district is characterized by a predominantly mountainous location with geographical coordinates of 10°57′N 36°56′E bordered in the south by Ankesha and Gougusa Shikudad woreda, in the west by Guangua woreda, in the north by Fagta Lakeoma woreda and in the east by Sekele woreda. The area is part of the north-western part of Ethiopian highlands where 80% of the area is highland and 20% is midland (BDARDO 2007). It has unimodal rainfall distribution pattern. The rainy season for the area starts in May and extends to the end of October. The average elevation of the district is 2560 m above sea level (BDARDO 2007). The district has a total of 26 Kebeles. As with parts of the country, agriculture is the main economic activity and livestock supports crop production. The district is classified into one agro-climatic zone, which is highland with wet and cool weather conditions (BDARDO 2007).

Bure District

Bure District is located in the northern part of Ethiopia. The district has a total of 27 administrative Kebeles which five are urban, and 22 are rural. Burie administrative and commercial center of the district is located 420 km from Addis Ababa and 148 km from Bahir Dar. The district has a total land area of 2207.2 km, and, the district has three agro-climatic zones, i.e. 80% w/Dega, 10% Dega and 10% kola, respectively (BDARDO 2007).

Sampling methods

The two districts as mentioned before (i.e. Banja for highland and Burie for midland) were purposively selected; six Kebeles that have been participating in the improvement of poultry extension package were also chosen purposively. The selection was done with the help of experts from agriculture livestock offices of the two districts based on high potentiality of exotic chicken distribution from high and midland agro-ecologies. As many as 180 exotic chicken farmers were selected from household package beneficiary's registration book of each selected Kebeles using systematic and simple random sampling techniques. Finally, a total of 90 exotic chicken farmers who have three different chicken breeds were selected purposively for monitoring activities.

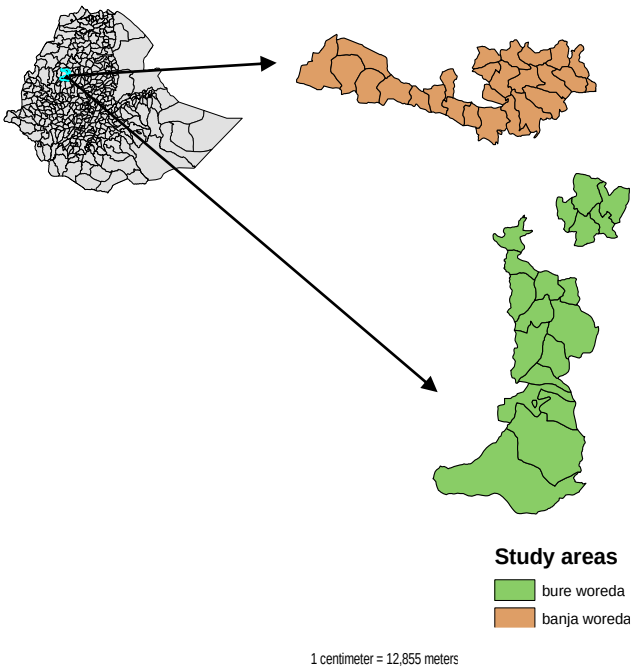

Figure 1. Map of the study districts are indicated by arrows, i.e. Banja (*above*) and Burie (*bottom*) of Ethiopia

Table 1. Environmental characteristics, and human and chicken populations in the studied areas

District	Altitude	Annual rainfall	Mean annual temp.	Human population	Total chicken population	Indigenous chicken	Exotic chicken
Banja	1900-2700 m. asl	2,200-2400 mm	12°-25°C	111,975	97497	78,054	9,443
Burie	700-2750 Masl	713-2832 mm	17-27°C	281,310	203079	183,307	19,772

Source: BBDARDO 2007

For the interview, a semi-structured questionnaire was prepared, pretested on two non-random sampled households from each study site during the rapid field survey. The interview was carried out with the head of the household. Enumerators were selected among the development agents of the agricultural office of the administration. Personal observations and informal discussions with the experts and key informants were carried out. Also, the semi-structured questionnaire survey, focus group discussion (FGD), and monitoring work was employed to collect the required data. Experts from agriculture and rural development agents, extension staff, district administrators in both districts at Kebeles also participate in the group discussions. Continuous supervision was considered to reduce errors during data collection.

Data collection procedures

Questionnaire survey and group discussion

The questionnaire survey was conducted on different aspects of the backyard poultry production systems and pre-tested before the actual data collection. Qualitative data (the type of management systems and husbandry practices) were the core points considered in the process. Quantitative data like production and reproduction performance were collected through predesigned questionnaires from farmers involved in chicken production.

Group discussions were performed with focus group established from each Kebeles with a group comprising of 5 to 7 members. The focus group members include people believed to be aware of past and present social and economic status of the area, community elders, women, and extension agents. Discussions were focused on basic data on the type of management system of chicken, chicken husbandry, season of extra feeds offer, feed shortage season, production and reproduction performance. Also, the average number of eggs was taken from farmers (estimation of eggs laid/hen/year), cause and rate of mortality, season of chicken mortality, occurrence, and severity of disease outbreak. Other vital aspects in chicken production were collected through group discussion.

Monitoring activities

Functional traits were collected from 90 purposively selected exotic chicken owners (45 per agroecology and 15 households for each breed) and regularly monitored with ten days interval for three months. A total of 900 eggs of three exotic breeds (450 eggs per agroecology and 150 eggs for each breed) were collected for monitoring to determine fertility and hatchability using local broody (mother hen) using natural incubation method. Eggs were candled to identify and remove infertile eggs. On the 21st day, the numbers of hatched chicks including the normal, weak, abnormal chicks and dead chicks after hatched were recorded. During monitoring, chick survival rate, cause (diseases or predators) and percentage of chick mortality parameters were recorded through monitoring. Moreover; fertility and hatchability were also calculated during the candling using the following formula.

$$\text{Percent fertility} = \frac{\text{Total fertile eggs during candling}}{\text{Total number of egg set}} \times 100$$

Percent hatchability from two points of view:

$$\%\ \text{hatchability on fertile egg basis} = \frac{\text{number of chicks hatched}}{\text{Total number of fertile egg}} \times 100$$

$$\%\ \text{hatchability on total eggs set basis} = \frac{\text{number of chicks hatched}}{\text{Total number of egg set}} \times 100$$

Data management and statistical analysis

Data were managed both in hard and soft copies. All collected data were entered into Microsoft Excel computer program. The qualitative data were analyzed using descriptive statistics of frequency procedures and cross-tabulation of SPSS version 16 (2008) to observe frequency, percentage and mean used to calculate survey data like husbandry practices, mortality. GLM procedure (SAS 9.0 ver. 2002) was used to analyze the effect of agroecology on the productive and reproductive performance of exotic chickens. ANOVA model was used to investigate the effect of breeds on different response variables and for continuous data type (productive and reproductive) performances like sexual maturity.

An observation on fertility, hatchability, chick survival and mortality was analyzed using the frequency procedure of chi-square for monitoring data. Tests were considered significant at $p<0.05$. Therefore, GLM procedure (SAS 9.0.ver.2002) was used with the fixed effects of agroecology and breeds on the egg production performances

The following model was used to calculate the production and reproduction performances by considering them as the fixed effects of agroecology and breeds.

Statistical model: $Yik = \mu + A_{i+}Ck_{+} (AC)\, ik_{+}e_{ik}$

Where:

Y_{ik} = the production and reproduction performance (i.e. evaluated parameters of exotic chickens).

μ = Overall mean

A_i = Fixed effect of i^{th} breed (i = 4, Bovans white, Bovans Brown, Koekoek and indigenous)

Ck=the fixed effect Of agroecology of k^{th} (k=2, highland, and midland)

$(AC)_{ik}$ = The fixed effect interaction k^{th} of agroecology with i^{th} of breed

ei_k = random residual error

RESULTS AND DISCUSSION

Chicken production system

Management system

About 91.12% of respondents used backyard chicken management systems in both study areas, whereas 8.89% of farmers kept their chicken by the semi-intensive management system (Table 2). According to the result obtained from group discussion, the majority of the farmers managed exotic chickens extensively under traditional

production systems. The reason might be created by poor awareness of farmers due to lack of strong extension service. This result is higher than that reported by Ahmedin (2014) in Gorogutu District in which extensive management practices was 74.4%. The previous report in the other parts of the study areas is similar to Simegnew et al. (2015) in northwestern Amhara Region and Addis and Malede (2014) who stated that almost all interviewed farmers in the north Gondar zone practiced extensive production system.

Feed and feeding practices

About 72.77% of the respondents managed their exotic chickens under a free scavenging system with no additional feed supplements (Table 2). The remaining 27.22% of the exotic chickens are managed under free scavenging with supplementary feed (Table 2). This result is not in line with reports in East Shewa zone by Desalew (2012) in which 2.2% and 97.8% the managed exotic chickens were scavenging with no additional feed supplements and scavenging with additional supplements for exotic chicken respectively. In Gorogutu District 4.4% of the chickens were scavenging alone and 95.6% were scavenging with supplements (Ahmedin; 2014).

The cumulative feeding frequency was 67.78% of the respondents feed evening and morning, whereas morning, evening and afternoon (4.44%), afternoon only (12.22%), morning only (8.34%) and 7.22% were no feeding practices in both agro-ecologies. Whereas, 82.78% and 17.22% of the respondents throw on the ground and feeding troughs were the major feeding practices in the study areas.

About 90% of the respondents stated that the season of serious feed shortage was in rainy season in both agro-ecologies. Almost 100% of the respondents elicited that season of extra feed was from June to September (long-rainy) in both agro-ecologies, as well as supplementation was mainly in long wet seasons. This report is in line with a report by Leulseged (2005) who reported that more scarcity of feed was in wet season.

Chicken house and watering practices of farmers

About 8.88% of the respondents were cleaning daily, while 21.11% of the respondents were reported cleaning weekly as well as 65.56% of the respondents were cleaning monthly and 13.33% of the respondents did not do cleaning practices frequently in highland agro-ecologies. Whereas 12.22% of respondents were cleaning daily, 33.33% of the respondents reported cleaning weekly as well as about 43.33% of the respondents were cleaning monthly, and 11.11% of the respondents did not do cleaning practices frequently in high and midland agroecology (Table 2). This result indicated that lack of frequent cleaning of chicken shelters could easily cause infectious disease and increase mortality rate.

From the total respondents, 16.11% of them kept their chicken at night at a separate shelter in both agro-ecologies. About 43.89% of the respondents shelter the chickens in the family house and the remaining (25%) in a separate house with other animals and in bamboo cage in both agro-ecologies (Table 2). This result is not in line with finding of Desalew (2012) in East Shewa zone, where 95.6% of the respondents constructed a separate house at village production system, and in Gorogutu district where 36.7%, 40% and 23.3% of the respondents sheltering the chickens in a separate house, different shelter during night and share the same room with family, respectively (Ahmedin, 2014). Similar research result was reported from the northwestern part of Ethiopia (Halima 2007) and from Fogera (Bogale 2008) that revealed 50.77% and 59.7% of farmers kept their chicken outside the house, respectively. The main reason for not constructing separate chicken houses in both agro-ecologies was lack of awareness and risk of predators.

Water plays an important role in feed digestion and metabolic activity of chickens. About 85.56% from high land and 88.89% from midland agro-ecologies respondents provide water once/day at any time. Whereas, 14.44 % from highland and 11.11% from midland agro-ecologies provided water twice/day. This result is not in line with the result of Desalew (2012) in East Shewa zone where 95.6% of the respondents have free access under improved management system, and with Ahmedin (2014) in which 20% of the respondents in Gorogutu district, eastern Hararghe have the overall watering frequency twice/day and once/day.

Exotic chicken breed dissemination trend in Amhara

Introduction of exotic breeds of chicken into the northwestern part of Amhara Region has been conducted over the last two decades, and the trend is increasing in the region (Figure 2). Such massive introduction of exotic genotypes was performed via distribution of fertile eggs, day-old chickens, crossbred pullets, and exotic cockerels. However, neither the exotic chicken breed/crossbred increased in sizes nor the egg production in the areas distributed (Figure 2).

Accordingly, the Bureau of the Amhara National Regional State of Agriculture and Rural Development (BoARD) schemed poultry development strategy starting from 2010 (Figure 2). The main purpose of the strategy was to enable farmers to generate income through rearing day-old chickens of three exotic breeds, Bovans-Brown (BB), Potchefstroom Koekoek (PK) and Bovans white breeds (BW) which were hatched and distributed from poultry multiplication centers located at Andassa, Kombolcha, and Ethio-chick. During the periods of 2010 to 2016, over 32,134,426 (31,319,335 day-old chickens, 642378 two month pullets and cockerels and 172713 fertile eggs) were distributed in the region (Figure 2).

Distribution of pullets, cockerels, day-old chickens and fertile eggs, layers and duals purpose breeds is one of the poultry extension packages accomplished by the Regional Office of Agriculture aiming at improving chicken production and productivity. The highest chicken population of the region (206 200, 513705 and 17311216 exotic, hybrid and indigenous, respectively) is found in Amhara region (CSA 2015/16) (Figure 3).

Table 2. Chicken management systems, feed and feeding practices in the study areas

Parameters	Agroecology		
Management practices (%)	Highland % (N)	Midland % (N)	Cumulative % (N)
Backyard	95.56 (86)	86.67 (78)	91.12 (164)
Semi-intensive	4.44 (4)	13.33 (12)	8.89 (16)
Frequency of feeding (%)			
Morning, evening and afternoon	7.78 (7)	1.11 (1)	4.44 (8)
Morning and evening	66.67 (60)	68.89 (62)	67.78 (122)
Afternoon only	13.33 (12)	11.11 (10)	12.22 (22)
Morning only	12.22 (11)	18.89 (17)	15.56 (28)
Overall	100 (90)	100 (90)	100 (180)
Feeding practice (%)			
Throw on the ground	95.56 (86)	70 (63)	82.78 (149)
On feeding trough	4.44 (4)	30 (27)	17.22 (31)
Feed resources (%)			
From the house	94.44 (85)	87.78 (79)	91.11 (164)
Purchased	5.56 (5)	12.22 (11)	8.89 (16)
Type of feeding system (%)			
Only scavenging	72.22 (65)	73.33 (66)	72.77 (131)
Scavenging with additional feed	27.78 (25)	26.67 (24)	27.22 (49)
Season of extra feed (%)			
Long-rainy(Jun-Sep)	100 (90)	100 (90)	100 (180)
Short –rainy (Apr-Jun)	NA	NA	NA
Season of feed shortage severe (%)			
Rainy season (Jun-Aug)	100 (90)	95.56 (86)	90 (176)
Dry season (Feb.-May)	NA	NA	NA
Hygiene status (%)			
Cleaning Daily	8.88 (8)	12.22 (11)	10.55 (19)
Cleaning Weekly	21.11 (11)	33.33 (30)	22.77 (41)
Cleaning Monthly	65.56 (59)	43.33 (39)	54.44 (98)
No cleaning practices	13.33 (12)	11.11 (10)	12.22 (22)
Housing type (%)			
In bamboo cage	26.67 (24)	23.33 (21)	25 (45)
In the family house	47.78 (43)	40 (36)	43.89 (83)
Night separate shelter	4.44 (4)	27.78 (25)	16.11 (29)
Separate house with other animals	21.11 (19)	8.89 (8)	15 (27)
Watering practices (%)			
Once a day at any time	85.56 (77)	88.89 (80)	87.22 (157)
Twice/ day	14.44 (13)	11.11 (10)	12.77 (23)

Note: NA: Not available

The exotic versus indigenous chicken population in Ethiopia

According to the CSA (2015/16), the total chicken population in Ethiopia is about 56.87 million, of which 95.86, 2.79 and 1.35 % are indigenous, crossbred and exotic breeds, respectively. However, the survival, productivity and population size of either exotic (1.35 %) or crossbred (2.79 %) is too low to consider (Figure 4).

Productive and reproductive performances aspect of exotic chickens

Mean number of clutches per year per hen of Bovans Brown chicken breed (4.51±0.11 days) was significantly higher than Bovans white breeds (3.5±0.10 days) in high and midland, respectively (Table 3). This result is not in line with the result of Alem (2014) in central Tigray (3.3 days) rural poultry of RIR exotic breed. According to the key informants during group discussion and the farmers, Bovans Brown, Bovans white, and Koekoek exotic breed hen didn't show broody nature but having clutch nature when they are out of production due to poor management practices (during feed shortage) because of commercial layer (BB and BW) are sensitive for feed shortage.

Clutch length among breeds was significantly longer ($P<0.05$) in Bovans white breed (43.77±7.31 days) than Koekoek breed (33.63±7.94 days) in highland agroecology (Table 3). This result is not in line with the finding by Alem (2014) who reported an average clutch length of 46.6 days for RIR. As explained by the key informants in the group discussion, clutch number and clutch length of exotic breed hens were hardly identified by the farmers because it was very difficult for the farmers to know whether the interruption of egg production is due to nature of the hen or shortage of feed because exotic breeds are sensitive to feed shortage. Significantly higher average number of eggs laid per clutch among breeds was obtained in Bovans white

breed (41.2±1.33) than Bovans Brown (29.60±1.47) in highland agroecology. This result is lower than that of the finding of Alem (2014) in central Tigray for RIR breed (46.3). However, it is greater than that reported by Ahmedin (2014) in Gorogutu district (33.28) for exotic chicken and reported by Matewos et al. (2013) in Nolekobba woreda (26.14) for exotic breeds.

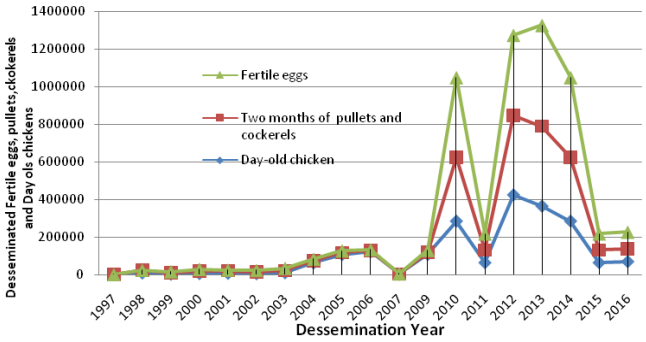

Figure 2. Trends of exotic chicken distribution in Amhara region

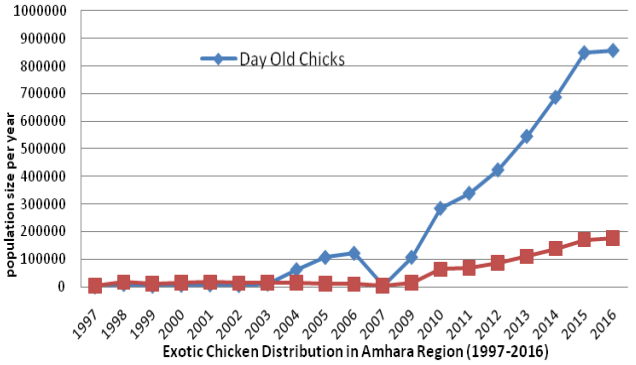

Figure 3. Trends of exotic Chicken distribution in Amhara region (1997-2016).

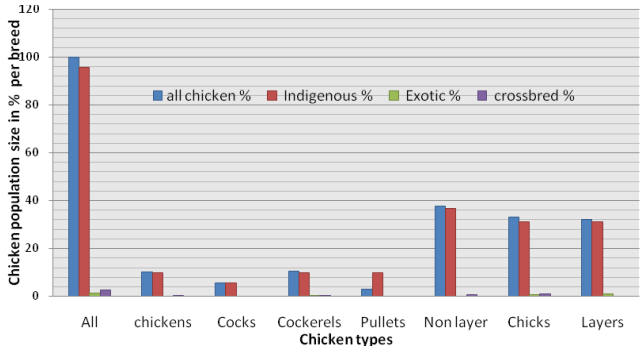

Figure 4. Indigenous, exotic and crossbred chicken population size in Ethiopia

Significantly higher mean annual egg production was observed in commercial layer (Bovans White) breed (156.56±8.13) than dual purpose (Koekoek) breed (130.46±4.01) in highland agroecology (Table 3). According to the respondents' point of view, the current weak performance difference could be created in genetic variation and management (lack of supplementary feed, water intake and parasite infection, diseases and poor health care) of farmers to their chickens. As the key informants explained during group discussion, commercial types mainly Bovans Brown chicken require more feed and balanced diet to sustain maximum egg production over time. This result is significantly lower than the finding of Desalew (2012) mean egg production/hen/year (276.1, 266.32, and 187.04) of Isa Brown, Bovans Brown and Koekoek exotic breeds, respectively, in East Shewa zone under village production system with additional feed supplementation. In addition, the current study was lower than other exotic chickens reported by Abraham and Yayneshet (2010) in North Ethiopia for White leghorn (173), Rhode Island Red (185) chicken under village household condition, the maximum number of eggs/year under Oromia agricultural research institute (156) and (176), Alganesh et al. (2003) in Ethiopia (250), FAO (2007) and Halima et al. (2007a) found at research farm, breeding center and commercial farms (197.40, 200 and 230), respectively. However, the current result is higher than the result of Solomom (2007) who reported 82 eggs/hen for WLH based on evaluation under rural household conditions with additional supplements. This finding is almost similar to that reported by Ahmedin (2014) from Gorogutu district, i.e. 150.2 for exotic chickens, 144 in Fayoumi breed as reported by Abraham and Yayneshet (2010) in North Ethiopia under village household condition and Alem (2014) who reported average egg production of 150.3 for RIR breed in Tigray. According to Mwalusanya et al. (2004), the low productivity of chickens in Tanzania is due partly to the prevailing inadequate management practices, especially the lack of proper health care, poor nutrition and housing.

This study revealed that shortage at first egg was attained from midland of Koekoek chicken breed (5.38±0.24) than from midland (6.5±0.45 months) for Bovans white breed and from highland (6.54±0.10) in Bovans Brown chicken breeds, respectively (Table 3). However, the current result is higher than the finding of Desalew (2012) mean egg production (5.35, 5.52 and 5.11 months) of Isa Brown, Bovans Brown and Koekoek breeds (Figure 5.A), respectively, in East Shewa zone under village production system, and also higher as compared to other exotic chickens reported by FAO (2007) and Halima et al. (2007a) found at research farm, breeding center and commercial farm (4.98 months), (5 months) and (4.83 months), respectively. According to the result obtained from different key informants during group discussion and interviewed farmers, the differences in reaching age at first egg among breeds might be due to poor management practices (feeding and disease) and variation of genotype.

Table 3. Performance aspect of exotic chickens in Banja and Burie districts (Mean±SD)

Parameters	Highland Exotic chicken breeds			Midland Exotic chicken breeds			Overall mean	P-value
	Bovans Brown	Koekoek	Bovans White	Bovans Brown	Koekoek	Bovans White		
Aaffsm (month)	6.54±0.10[a]	5.5±0.00[a]	6.04±0.30[a]	6.49±0.11[a]	5.38±0.24[b]	6.5±0.45[a]	6.07±0.14	(0.0001)**
Aafmsm(month)	NA	4.8±0.33[a]	5.64±0.52[a]	NA	5.12±0.24[a]	6.36±0.13[a]	5.48±0.16	(0.0001) **
Egg no per year	133.49±7.03[a]	130.46±4.01[a]	156.56±8.13[a]	135.42±5.7[a]	141.44±9.14[a]	152.13±6.93[a]	141.58±11.5	(0.0001) **
Clutch /year (day)	4.51±0.11[a]	3.95±0.06[a]	3.8±0.05[a]	4.12±0.08[a]	3.93±0.08[a]	3.9±0.10[a]	4.03±0.83	(0.0001) **
Egg/clutch/hen	29.60±1.47[a]	33.03±1.31[a]	41.2±1.33[a]	32.87±1.97[a]	35.99±1.03[a]	39.01±1.32[a]	35.28±1.27	(0.0001) **
Clutch length (day)	30.26±5.4[a]	33.63±7.94[a]	43.77±7.31[a]	33.66±2.43[a]	35.71±6.55[a]	41.13±5.52[a]	36.36±4.21	(0.0001) **

Note: Aafmsm = age at first male sexual maturity, Aaffsm = age at first female sexual maturity, means with different superscripts within a row are significantly different (P < 0.01), SD=Standard Deviation, NA=Not available

Figure 5. A. Bovans Brown, Bovans White (commercial layers) and Potchefstroom Koekoek (dual purpose). B. Ethiopian local chicken type (female)

Performance of Indigenous chickens

Results of this study indicated that the indigenous chicken production and reproductive traits performance are varied and expressed as low production and reproductive performance (Table 4 and Figure 5.B). The mean result of age at first egg (156.2 days) was recorded for indigenous chicken ecotypes in the study areas. The current result is similar to Bogale (2008) in Fogera district.

Fertility and hatchability of exotic chickens

The monitoring result of fertility, hatchability on fertile egg basis and total egg basis is presented in Table 5. The highest egg fertility on the 18th day of handling was observed in Koekoek breed (75.83%) from highland, whereas, the lowest was recorded in Bovans Brown chicken (34.16%) from midland. This variation might be due to genetic variation among breeds. This result is almost similar to the report of Ahmedin (2014) in Gorogutu district (66.67%). However, this is not in line with Halima et al. (2007a), and FAO (2007) found at research farms, breeding centers and commercial farms (94%, 80%, and 80%, respectively). Similarly, the present result is not in line with result of Shiferaw et al. (2011) at Debre Zeit agricultural research center (90.10%). The fertility of eggs and their hatchability depends on various factors such as breed, season, pre-incubation holding period and temperature, care of hatching eggs, moisture (Silversides and Scott 2001).

The higher hatchability on fertile egg basis was observed in Koekoek breed in monitoring result (87.5%) than Bovans Brown (41.46%) in high and midland, respectively (Table 5). This result is almost in line with the result reported by Halima et al.(2007a), and FAO (2007) found at breeding center (65%) and commercial farm (90%), Ahmedin (2014) in Gorogutu district (76.98%) and in exotic breeds (51.11%), Shiferaw et al. (2011) at Debre Zeit agricultural research center (71.30% and 64.30%), Malese et al. (2013) in Beresa watershed district (67.9% and 54.7%) RIR-crossbreed, Abraham and Yayneshet (2010)in Northern Ethiopia (74.1%) in WLH and Alem (2014) in central Tigray (84.2%). This finding is in line with the report of King'ori (2011) who reported that egg parameters that mostly influence hatchability are: weight, shell thickness and porosity, and the consistency of the contents. The current result is higher than that of a study report based on the five years average of fertility and

hatchability of RIR chickens of the poultry breeding and multiplication centers (88% and 69% at Nazareth, 86.6% and 54.4% at Kombolcha and 82.89% and 62.36% at Andassa, respectively). These figures are below the recommended levels. Bruzual et al. (2000) indicated that the fertility and hatchability percentage of commercial layers are recommended to be around 97% and 90%, respectively. Most previous studies were conducted under intensive management conditions where the housing, feeding, disease and other environmental factors are controlled. In the current study, distributed exotic chickens are only scavenging, and other factors were not controlled which possibly could affect the full genetic expression of chickens.

Chicks performance (survival rate) of exotic chickens

There was significant variation ($P<0.05$) in survival rate between Koekoek (70.3%) and Bovans Brown (35.7%) breeds to reach eight weeks age (Table 5). This could be due to disease prevalence rate, poor management practice of the farmers in the study area. This result is almost higher as reported by Alem (2014) in lowland and midland agro-ecological zones of Tigray mean (65.8).

Mortality rate of exotic chickens

There was a substantially significant difference ($p<0.05$) in mortality rates among breeds. There was highly significant difference ($p<0.05$) in mortality rates of chick in three months between Bovans Brown (89%) and (32.4%) Koekoek breed in highland and midland, respectively (Table 5). This difference could be attributed to high prevalence of disease and poor management practices of the farmer's mainly poor hygienic status and housing system which were quickly exposed to disease and predators attacks. This might be attributed to the difference in management systems like housing and cleaning rate of chicken house. This result is higher than that reported by Abraham and Yayneshet (2010) in Tigray region in mean survival rate of Fayoumi (67.9), WLH (48.8), and also that reported by Alem (2014) in central Tigray (16.14%), Fassil et al. (2010) in sub-tropical environment in Ethiopia (19%), Hailu et al. (2012) in the Northwestern Amhara region (45.0%) and reported by Halima et al. (2007a) in traditional production system, and commercial farms (40%) and (5-10%), respectively.

The result from monitoring data for chick mortality due to predator and disease is described in Table 5. Higher mortality (66.7%) observed in Bovans white breeds due to predators (mainly by wild cat and eagle) is higher than from Koekoek (47%) in highland and midland agroecology, respectively. As farmers stated that, the reason might be poor management practices (lack of house) and white feather color of Bovans; white breeds might be easily exposed to predator. Zemene (2011) from Amhara region indicated that predators are the major constraints in village chicken and by Alem (2014)in central Tigray (42.5%). Among breeds, higher mortality rate due to diseases was observed in for Bovans Brown breed (72.4%) (Table 5). However, this result is not in line with that reported by Alem (2014) in central Tigray (90%). According to the farmers, seasonal disease outbreak was the major cause of chick loss during growth period in both agro-ecologies. Farmers responded similarly to symptoms (head and wing dropping and look sleeping and sometimes diarrhea) and name of disease occurrence in the area. This result indicated that the disease might probably be Newcastle disease (local name: "kofis" or Wararshe (Fengel). The reason might be lack of pre-vaccination given to chicks before the time of occurrence of disease due to lack of vaccine availability in the study areas.

Table 4. Mean productive and reproductive performances of indigenous chickens

Parameters	Min.	Max.	Mean	SD
Average egg weight(g)	35	50.73	51.7	9.13
Mean laying period/ hen (days)	20	240	175	104.08
Eggs/hen per year	56	63	171.9	76.02
Chick mortality (%)	5.5	40	13.3	18.09
Fertility (%)	75	94	82.3	8.18
Hatchability (%)	65	90	77.5	11.90
Age at first egg (days)	158	190	156.2	16.05

Table 5. Fertility, hatchability, chick survival and mortality rate collected through monitoring

Parameters	Highland			Midland		
	Exotic breeds			Exotic breeds		
	Bovans Brown	Koekoek	Bovans White	Bovans Brown	Koekoek	Bovans White
Eggs incubated (no)	150	150	150	150	150	150
Fertility %	40	75.83	60	34.16	71.66	54.16
Hatchability on fertile egg %	43.75	87.85	71.95	41.46	72.91	66.15
Hatchability on total egg %	14	62.66	39.33	11.33	46.66	28.66
Chick mortality /3 month %	89	47	38	63.2	32.4	48.5
Disease cause for mortality %	72.4	61.3	33.3	57.5	53	44.9
Predator cause for mortality %	27.6	38.7	66.7	42.5	47	55.1
Chicks survival to 8 week %	35.7	70.3	49.5	43.02	67.8	38.6

From this study, it was possible to conclude that though chicken production in the rural area reach up to 98.5% and 99.2% of the national egg and chicken meat production, respectively, the production and productivity of chicken remains low. The government of Amhara region has implemented strategies to boost production and productivity through introduction of exotic breeds since 1997. However, the population size of exotic genotypes remains under 5% as compared to the indigenous chicken ecotypes. On the other hand, with increased population size, the production and reproductive traits performance of the local chicken ecotypes are varied and expressed as low production and reproductive performance. The massive introduction of exotic genotypes via distribution of fertile eggs, day-old chickens, crossbred pullets and exotic cockerels (Bovans White, Bovans Brown and Potchefstroom Koekoek) were distributed in Amhara region but still the mean egg production, productivity and survival rate was very low. The main challenges revealed were poorly designed production system and management as per the urban, pre-urban and rural chicken production and indiscriminate introduction of exotic chicken genotypes which could not match with prevailing production system. These challenges could be overcome by selection of indigenous chicken ecotypes and crossbreeding or upgrading by introduction of cocks, pullets and fertile eggs of high egg producing strains. Designing appropriate production systems and management in respective urban, pre-urban, and rural areas could help to increase production and productivity

ACKNOWLEDGEMENTS

The authors would like to thank the farmers found in the study area for their cooperation during data collection. We would like to thank also Sustainable Land Management Organization (SLM) /GIZ for funding this research.

REFERENCES

Abraham L, Yayneshet T. 2010. Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. Live. Res. For Rural Dev. 22 (7): 133. http://www.lrrd.org/lrrd22/7/leml22133.htm

Addis G, Malede B. 2014. Effect of Gene Segregations on Existed Performance of Chicken Ecotypes in Ethiopia. Middle-East J Sci Res 21 (4): 675-680.

Ahmedin A.2014. Study of production practices, fertility, hatchability and egg quality of rural chicken in Gorogutu district, Eastern Harangue.[Thesis]. School of Graduate Studies (School of Animal and Range Sciences), Haramaya University, Ethiopia. [Ethiopia]

Ajayi FO. 2011. Nigerian indigenous chicken: A valuable genetic resource for meat and egg production. Asian J Poult 4: 164-172. DOI: 10.3923/ajpsaj.2010.164.172

Alders RA, Pym E. 2009. Village poultry and human development: R.G. 182 World's Poult Sci J 5: 65-182. DOI: 10.1017/S0043933909000117

Alem T. 2014. Production and reproduction performance of rural poultry in low land midland agro-ecological zones of central Tigray Northern Ethiopia. AFR J Agric Res 9 (49): 3531-3539.

Alemu Y, Tadelle D. 1997. The status of poultry research and development in Ethiopia, research bulletin No.4, poultry commodity research program Debrezeit Agricultural research center. Alemaya University of Agriculture, Ethiopia

Alemu Y. 1995. Poultry production in Ethiopia. World Poultry Science Journal, 51,19-20. and attempts at improvement. World's Poult Sci J 56: 45-54.

Alganesh T, Matewos B, Gizaw K..2003. Survey on traditional livestock production system. Proceeding 11th Annual Conference of Ethiopian Society of Animal Production. Addis Ababa, Ethiopia.

ANRS BoARD [Amhara National Regional State Bureau of Agriculture and Rural Development]. 2006. Poultry Development and Marketing Strategy. Bahir Dar, Ethiopia.

Ashenafi H. 2000. Survey of identification of Major Diseases of local Chickens in Three Selected Agro-climatic zones in Central Ethiopia. DVM, Faculty of Veterinary Medicine, Addis Ababa, Ethiopia.

BBDARDO. 2007. Banja and Burie district Agriculture and Rural Development office Livestock population data Yearly report of 2007.

BDARDO.2007. Banja district Agriculture and Rural Development office. Livestock population data, Yearly report of .2015. Weredas household assessment data.

Bogale K. 2008. In situ characterization of local chicken eco-type for functional traits and production system in Fogera district, Amahara regional state. [Thesis]. Department of Animal Science School of Graduate Studies, Haramaya University, Ethiopia. [Ethiopia]

Bruzual J, Peak SD, Brake J, Peeblest ED. 2000. Effects of relative humidity during incubation on hatchability and body weight chicks from young breeder flocks. Poult Sci 78: 827-830. DOI: 10.1093/ps/79.6.827

CSA [Central Statistical Authority]. 2011. Agricultural sample survey 2010/11, 2: statistical bulletin 505. Report on livestock and livestock characteristics (prevent peasant holdings), Addis Ababa.

CSA [Central Statistical Authority]. 2015/16. Agricultural sample survey. 2014/15 [2007e.c]. Volume ii report on livestock and livestock characteristics. nous chickens in central Ethiopia. Tropical Animal Health and Production, 693-701.

Desalew T. 2012. Management practices, productive performances and, egg quality traits of exotic chickens under village production system in east Shewa, Ethiopia, Pp. 28

FAO [Food and Agriculture Organization of the United Nations]. 2007. Poultry sector country review, Animal Production and Health Division, Emergency center for transboundary animal diseases socioeconomics, production and, biodiversity unit, Food and Agriculture Organization of the United, Nations, Rome., Italy. ftp://ftp.fao.org/docrep/fao/011/ai320e/ai320e00.pdf.

Fassil B, Ådnøy T, Gjøen HM, Kathle J, Girma A.2010. Production Performance of Dual Purpose Crosses of Two Indigenous with Two Exotic Chicken Breeds in Sub-tropical Environment for village poultry production in Ethiopia. Int J Poult Sci 9 (7): 702-710. DOI: 10.3923/ijps.2010.702.710

Fessiha M, Aberra M, Tadelle D. 2010. Assessment of village chicken production system and evaluation of the productivity and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. Afr J Agric Res 5(13): 1739-1748.

Gueye EF. 1998. Village egg and Fowl meat production in Africa, World's Poult Sci J 54 (1): 73-86. DOI: 10.1079/WPS19980007

Hailemariam T, Dadi L, Alemu Y, Nigussie D. 2006. Determinants of adoption of poultry technology: a double hurdle approach. Livestock Research for Rural Development 18 (3). http://www.cipav.org.co/lrrd/lrrd18/3/tekl18040.htm.

Hailu M, Eshetie T. 2008. Comparative chicken mortality rates in Andassa government poultry farm, Northwest of Ethiopia. ICFAI J Life Sci 2.

Hailu M, Grimachew S, Mehammed N. 2012. Challenges and prospects of village-based exotic chicken development strategy in Amhara regional state, northwest Ethiopia. Glob J Sci Front Res Agric Vet Sci 12 (10): 40-49.

Halima H, Naser FWC, Tadelle D, de Rock A, Van Marle- Koster E. 2006. Studies on the growth performance of native chicken eco-types and RIR chicken under improved management system in North West Ethiopia. Livest Res Rural Dev 18,6.

Halima H, Neser FWC, Van Marle-Köster E, de Rock A. 2007a. Village-based indigenous chicken production systems in northwest Ethiopia. Trop Anim Health Prod 39 (3): 189-197. DOI: 10.1007/s11250-007-9004-6

Halima H. 2007. Phonotypic and genetic characterization of indigenous chicken populations in Northwest Ethiopia. [Dissertation]. Wildlife and Grassland Sciences University, Bloemfontein, South Africa.

Kebede H. 2015. A Review Exotic Chicken Status, Production Performance and Constraints in Ethiopia, 1758.

King'ori AM. 2011. Review of the factors that influence egg fertility and hatchability in poultry. Intl J Poult Sci 10 (6): 483-492. DOI: 10.3923/ijps.2011.483.492

Leulseged Y. 2005.Study on the production system of the indigenous and improved poultry in rural areas of Northern Wollo. [M. Sc. Thesis]. School of Graduate Studies of Alemaya University. [Ethiopia]

Malese A, Alewi M, Teklegiorgis Y. 2013. Evaluating the Reproductive and Egg Production Traits of Local Chickens and Their F_1 Crosses with Rhode Island Red and Fayoumi Breeds under Farmers' Management Conditions. Iranian J Appl Anim Sci 3(2): 379-385.

Matewos H, Negassi A, Solomon D. 2013. Production performance of local and exotic breeds of chicken at rural household level in Nole Kabba Woreda, Western Wollega, and Ethiopia. Afr J Agric Res 8 (11): 1014-1021. DOI: DOI: 10.5897/AJAR2013.6933

Mwalusanya NA, Katule S, Mutayoba M, Mtambo J, Olsenand U, Minga. 2004. Productivity of Local Chickens under Village Management Conditions. Trop Anim Health Product 34: 405-416. DOI: 10.1023/A:1020048327158

Nigussie D, Tadelle D, Waaij LH, Arendonk JAM. 2010. Morphological features of indigenous chicken populations of Ethiopia. Anim Genet Resour 46: 11-23. DOI: 10.1017/S2078633610000652

Salam KR. 2005. Improvement of village chicken production in a mixed (chicken-ram) farming system in Burkina Faso. [Dissertation]. Wageningen Institute of Animal Sciences, Animal Nutrition Group, Wageningen University, Netherlands

SAS [Statistical Analysis System]. 2002. SAS Users" Guide, Version 9.0, (SAS Institute Inc, North Carolina).

Shiferaw M, Tadelle D, Alemu Y. 2011. The effect of spraying vegetable oil and elevating relative humidity during incubation on the hatchability of Rhode Island Red (RIR) eggs at Debre Zeit Agricultural Research Center (DZARC). Glob J Med Res 11 (4): 4-9.

Silversides FG, Scott TA. 2001. Effect of storage and layer age on quality of eggs from two lines of hens. Poult Sci 88 (8): 1240-1245. DOI: 10.1093/ps/80.8.1240

Simegnew T, Fessiha M, Yeshiwas T, Molla H. 2015. Determinants of adoption of exotic poultry breeds among smallholder poultry producers in Northwestern Amhara Region, Ethiopia. Glob J Agric Econ Econometrics 3 (6): 162-168.

Solomon D. 2007. Suitability of hay-box brooding technology to rural household poultry production system. Jimma University College of Agriculture and Veterinary Medicine, Jimma, Ethiopia

Tadelle D, Kijora C, Peters KJ. 2003. Indigenous chicken ecotypes in Ethiopia, Growth and feed utilization potential. Intl J Poult Sci 2 (2): 144-152. DOI: 10.3923/ijps.2003.144.152

Tadelle D, Ogle B. 2001. Village poultry production system in the central high lands of Ethiopia. Trop Anim Health Prod 33: 521-537. DOI: 10.1023/A:1012740832558

Zemene W. 2011. Assessment of village chicken production system and the performance of local chicken populations in West Amhara Region of Ethiopia. [Thesis]. Department of Animal and Range Sciences, AAU, Ethiopia