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On-Farm Productive and Reproductive Performance of Local, Exotic and Crossbred Chickens in Southern Tigray, North Ethiopia

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Abstract
On-farm productive and reproductive performance of local, exotic and crossbred chickens in Southern Tigray, North Ethiopia was conducted to generate base line data that could be potentially used in the chicken selection, improvement program and strategy under typical farmers' management condition. For this purpose, semi-structured questionnaires, participatory rural appraisal (PRA) and field observation were employed. One hundred and eighty household chicken owner respondents (60 per district) were considered for semi-structured questionnaires. Descriptive statistics and General Linear Model (GLM) of SPSS version 20 (2011) were used to analyze the data. Mean number of egg production was higher for exotic breed (235.86±3.02 egg/hen/year) than that of crossbred (51.09±1.97 egg/hen/year) and local breeds (44.71±0.87 egg/hen/year). Moreover, Significant difference ($p<0.05$) were observed for local and exotic chickens egg production performances among the agro-ecological zones. The overall survival rate of exotic, cross and local chicken breeds were 45.96%, 43.52% and 46.26%, respectively ($p>0.05$). On the other hand, hatchability rate of local and crossbred chickens were (86.97%) and (80.46%) ($p>0.05$), respectively. Higher egg production and better reproductive life span is obtained from exotic chickens than local and crossbred ones. Moreover, overall survival rate of exotic and crossbred chickens are found comparable to local chicken. Therefore, introducing Bovans Brown chickens having better productive and reproductive performance is important to enhance productivity. Non-genetic factors should also be considered to improve the performance of existing local chicken population.
Keywords: Productive performance, reproductive performance, local chicken, crossbred chickens, exotic chickens

Introduction

In Ethiopia, there are about 44.8 million chickens: of which 96.6% are local chickens, indicating the significance of indigenous chicken as principal potential farm animal genetic resources of the country (CSA 2012). These chickens have been reported to adapt very well to the traditional small-scale production system of the rural community (Halima et al 2007; Fisseha et al 2010a; Aberra and Tegene 2011). The research efforts on improvement of village poultry production have been focused on technical aspects of poultry keeping by reducing some constraints such as provision of simple shelter and locally available feed products (Mammo et al 2008). As a result, although local chicken populations are more numerous than commercial type of imported poultry breeds, little research has been undertaken on village chicken (Galal et al 2007).

With the aim of improving chicken productivity, different breeds of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) were imported to Ethiopia since the 1950’s (Abraham and Yayneshet 2010). Since then higher learning institutions, research organizations, the Ministry of Agriculture and Non-Governmental Organizations (NGO’s) have disseminated many exotic breeds of chicken to rural farmers and urban-based small-scale poultry producers (Solomon 2008). There has been chicken development interventions carried out by governmental and non-governmental bodies in the study area. This development intervention is mainly through introduction of new exotic chicken breeds. The breeds which are introduced to the study area are Bovans Brown, Kuroiler, Red dominance CZ, Koekoek, White Leghorn and T44 breeds. These chicken breeds are introduced to the study area across different periods. Bovans Brown, Kuroiler and Red dominance were introduced to the study as extension packages by the bureau of agriculture and rural development. Likewise, Koekoek and White Leghorn were introduced by the Tigray Agricultural Research Institute (TARI) for research purpose to evaluate their adaptability and production performances. Bovans Brown was introduced since 2012 and is largely populated in the study area. Other chicken breeds are not commonly seen as they were introduced in limited number for research works and/or they are genetically diluted in the chicken population (SZT 2014).

However, lack of recorded data on the performance of chicken and all aspects of management, makes it difficult to assess the importance and contributions of the past attempts to improve the sector (Fisseha et al 2010a). In addition, most of the exotic breeds studied under village production system are not high yielding hybrids type used in the international poultry industry (FAO 2010). Consequently, there is a need to define the present performance of high yielding, Bovans Brown (BB) chicken breed in Southern Zone, Tigray region.

Moreover, the low genetic potential of local chickens could be improved substantially through crossbreeding programs with exotic chicken breeds (Ajayi 2010; Aberra et al 2011a). However; according to FAO (2010) the common approach of importing exotic animal breeds to boost productivity of livestock by crossbreeding is now being rethought in recognition of the fact that native breeds are far more likely to be productive under low-input conditions and places thousands of native breeds at risk of genetic dilution or replacement by imported stocks. Hence, this study was made to focus on local, exotic and crossbred chickens to see their breeding practice, evaluate their adaptability, productive and reproductive performance under the farmer's condition in order to exploit them fully in the agricultural development program.

Knowledge and understanding of the chicken productive and reproductive system are important in the design and implementation of chicken based development programs, which can benefit rural societies (Ashenafi et al 2004). Furthermore, characterization can identify breeds and /or populations are highly desired by farmers, and hence is an important input in to nation's chicken development planning (Halima et al 2007). The productive and reproductive characterization aimed at description and understanding of the indigenous, crossbred and exotic chicken breeds in their respective production environments of the southern zone Tigray as basis for genetic improvement is not studied and documented. Therefore, this study tried to characterize the indigenous, exotic and cross breed chickens to generate base line data that could be potentially used in the chicken selection, improvement program and strategy. Hence, this study was initiated to conduct on-farm productive and reproductive performance of local, exotic and crossbred chickens in Southern Tigray, North Ethiopia.

Materials and methods

Study area

The Southern Zone Tigray (SZT) is one of the seven zones in Tigray Regional State located 590 km from Addis Ababa to north. The zone is bordered by Amhara Regional State in the west and south east, eastern Tigray zone in the north and Afar Regional State in the north east. The zone has high, low, and mid-altitude agro-ecologies (SZT 2014). The altitude variation in the zone ranges from 930 to 3925 masl. Similarly, the mean annual temperature ranges from 9 to 32 c. The rain fall is bimodal that relying on the *Belg* (short rain season) from mid-January to March, and the *Kiremt* (rainy season) rains from mid-June to mid-September and the highest rain fall occurs during rainy season. The annual mean rain fall ranges from 400 to 912 mm. The main crops grown in the *Belg* season are barely, wheat and peas. Similarly, barley, wheat, sorghum, teff, peas, lentils and fababeans are the main crops cultivated during summer. The major feed resources in the area are natural pastures, crop residues and cactus pear (SZT 2014).

Sampling technique

A multi-stage sampling procedure was employed for this study. First the study area was stratified into three agro-ecologies based on altitude as: high altitude (>2500 masl), mid altitude (1500-2500 masl) and low altitude (<1500 masl). This classification was found to be relevant to investigate the variation in productive and reproductive performance of local chicken, exotic (Bovans Brown) and crossbred to each agro-ecology. A rapid reconnaissance survey was done before the main survey to understand the distribution and concentration of local, crossbred and exotic chicken in the districts and *kebeles*. From nine districts of the zone three districts representing each agro-ecological zone were chosen purposively and nine *kebeles* (three from each district) were also selected using purposive sampling techniques. The sample size was calculated based on (Kothari 2004). Hence, a total of 180 households (60 from each district) were randomly sampled for questionnaire interview.

Data collection and analysis

Questionnaire survey was administered to the randomly selected household heads by a team of enumerator recruited and trained for this purpose with close supervision by the researcher. In addition to semi-structured questionnaires, focus group discussion and field observation was employed to investigate the required information. The focused groups were composed of youngsters, women, village leaders and socially respected individuals who are known to have a good understanding in animal breeding and management. The questionnaire survey conducted on different aspects of the productive and reproductive ability of chickens was developed based on FAO (2011) and Hendrix (2013). The collected data were subjected to the GLM of SPSS (2011) for statistical analysis. The effects of class variables and their interaction were expressed as Least Square Means (LSM) ± SE. Mean comparisons were made using Tukey`s studentized range test method at $p<0.05$.

Results and discussion

Productive and reproductive performance of local chickens

The mean age at first lay 24.62±0.25 weeks (6.15 months) recorded in this study (Table 1) is comparable with the result reported by Meseret (2010) with 6.33 months and Nebiyu et al (2013) with 6.53 months but lower than the result reported by Mekonnen (2007) with 7.07 months and higher than of Barua and Yoshimura (2005), 5.75 months and Addisu et al (2013), 23.84 weeks. Moreover, the age at first egg of local pullet for low altitude was significantly ($p<0.05$) lower than high altitude but no significant difference ($p>0.05$) was observed between mid altitude and the two agro-ecologies. The mean age at first mating of cockerel in the study area was observed to be 22.64±0.17 weeks (5.66 months) (Table 1). This is comparable with the results reported 5.87 months (Bogale 2008), 24.6 weeks (Fisseha et al 2010a), 5.7 months (Hagan et al 2013) and 26 weeks (Alem 2014). Furthermore, age at first mating of local cockerel of low altitude was significantly ($p<0.05$) lower than high altitude but no significant difference ($p>0.05$) was observed between low altitude and mid altitude.

The mean clutch number per year 3.46±0.04 recorded in this study (Table 1) is lower than the results reported by Mammo (2006), 5.2, Mekonnen (2007), 3.7, Bogale (2008), 3.7, Fisseha et al (2010a), 3.83, Addisu et al (2013), 3.62, Nebiyu et al (2013), 3.81 and higher than 2 (Ssewannyana et al. 2008), 3 (Hagan et al 2013) and 3.2 (Alem 2014) But it is in agreement with 3.43 for Gamo districts (Meseret 2010). This might indicate the variation of broodiness behavior among the Ethiopian chickens. In addition, number of clutch period in years of local chickens in low altitude was significantly ($p<0.05$) lower than high altitude but there was no significant difference ($p>0.05$) between mid altitude and the two agro-ecologies.

The number of eggs per clutch found in this study was 12.98±0.13 (Table 1). This is lower than the result reported 14.9 eggs/hen/clutch (Mekonnen, 2007), 14 eggs/hen/clutch (Ssewannyana et al 2008), 15.5 eggs/hen/clutch (Moreki 2010), 18 eggs/hen/clutch (Melese and Melkamu 2013), 13.3 eggs/hen/clutch (Nebiyu et al 2013) and 13.6 (9-18) eggs/hen/clutch (Alem 2014). But it is almost similar with 11-15 eggs/ hen/clutch (Aboe et al 2006), 12.92 eggs/hen/clutch (Meseret 2010), 10-18 eggs/hen/clutch (Samson and Endalew 2010), 12.64 eggs/hen/clutch (Addisu et al 2013) and 12.8 eggs/hen/clutch (Hagan et al 2013). It is also shown the number of eggs laid in clutch of low altitude was significantly ($p<0.05$) higher than the two agro-ecologies but there was no significant difference ($p>0.05$) between the two agro-ecologies.

The clutch length (in days) of local chickens was investigated to be 22.54±0.44 (Table 1) which is lower than the result reported 26.2 days (Mekonnen, 2007) and 26 days (Nebiyu et al 2013) but higher than 21.6 days ranged from 15 to 28 days for Central Tigray, North Ethiopia (Alem, 2014). Inter-clutch length (in days) found in this study area was 65.05±0.63 (Table 1) which is lower than 2.8 months reported by Ssewannyana et al (2008).

The mean egg production of the local chickens was investigated to be 44.71±0.87 (Table 1). This is actually comparable with other research works; 27-45 eggs for Mulugeta and Tebkew (2011) and 43.4 eggs for Alem (2014). However, the figure is higher than 38.2 eggs for Hagan et al (2013) and lower than 46.8 eggs for Moreki (2010), 49.51 eggs for Addisu et al (2013) and 50.8 eggs for Nebiyu et al (2013). The result of focus group discussion also showed that higher egg production is often expected from additional supplementation of feed, at the time of sowing, and during and after harvesting in which the availability of scavenging feed resource is adequate. It is advocated that extra effort in the management and improvement of local chickens in the areas of housing, breeding, feeding and health care can go a long way to improve the productive performance of local chickens in Ghana (Hagan et al 2013).

The average reproductive life span of hen and male chickens (years) were 2.70±0.06 and 2.41±0.04, respectively (Table 1). This is higher than the result reported by Bogale (2008), where the average reproductive life span of hens and cocks, according to respondents, were 26.61 and 18.43 months, respectively. The number of chickens grown to market in low altitude was significantly ($p<0.05$) higher than the two agro-ecologies but no significant difference ($p>0.05$) was observed between mid altitude and high altitude. Additionally, days of production cycle in low altitude was significantly ($p<0.05$) lower than the two agro-ecologies but no significant difference ($p<0.05$) was observed between mid altitude and high altitude (Table 1). The variation in local chickens' performance of this study relative to other studies might be associated to many factors, mainly variations in breed, availability of feed resources for scavenging, agro-ecological impacts, socio-economic status and management system of chicken owners.

Table 1. Productive and reproductive performance of local chickens in the study districts

Productive and reproductive traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Age at first mating of cockerel in weeks	21.73±0.30[b]	22.55±0.30[b]	23.65±0.30[a]	22.64±0.17
Age at first egg of pullet in weeks	23.66±0.44[b]	23.51±0.44[b]	25.60±0.44[a]	24.62±0.25
Number of egg laid in clutch	13.85±0.24[a]	12.95±0.24[b]	12.16±0.24[b]	12.98±0.13
Number of clutch period in years	3.25±0.08[b]	3.50±0.08[ab]	3.65±0.08[a]	3.46±0.04
Egg production in year	45.21±1.50[a]	44.96±1.50[a]	43.96±1.50[a]	44.71±0.87
Clutch length in days	23.30±0.76[a]	22.43±0.76[a]	21.90±0.76[a]	22.54±0.44
Inter-clutch in days	64.11±1.09[a]	65.03±1.09[a]	66.03±1.09[a]	65.05±0.63
Number of chickens grown up to market	6.23±0.31[a]	5.03±0.31[b]	4.48±0.31[b]	5.25±0.17
Reproductive life span of hens (years)	2.80±0.10[a]	2.73±0.10[a]	2.56±0.10[a]	2.70±0.06
Reproductive life span of male chickens (years)	2.45±0.07[a]	2.41±0.07[a]	2.38±0.07[a]	2.41±0.04
Days of production cycle	119.28±0.85[b]	124.01±0.85[a]	125.73±0.85[a]	123.01±0.49
Days of incubation	21.00±0.00[a]	21.00±0.00[a]	21.00±0.00[a]	21.00±0.00
Days of brooding	60.00±0.00[a]	60.00±0.00[a]	60.00±0.00[a]	60.00±0.00

[a, b, c] means with different superscript letters across a raw are significantly different at $p<0.05$; SE=standard error

Productive and reproductive performance of exotic Chickens

Average age at sexual maturity (174 days) obtained for the exotic chicken breed (i.e Bovans Brown) in this study (Table 2) is lower than the result reported for backyard production performance of Fayoumi chicken breed in Adami Tulu agricultural research center where 183.5 days (Samson et al 2010) and 231 days by Abraham and Yayneshet (2010), but higher than 163.63 days for hen by Khan et al (2006). This is also lower than age at first egg of White Leghorn 245±6.08 days, Fayoumi 231±5.53 days and Rhode Island Red 239±5.73 days (Addis and Malede 2014). It is also found age at first egg of exotic pullet in low altitude was significantly ($p<0.05$) lower than that of high altitude but no significant difference ($p>0.05$) was observed between mid altitude and high altitude. The result for mean age at first matting of cockerel (139 days) in this study (Table 2) is lower than the result reported for Rhode Island Red chicken breeds in Central Tigray, North Ethiopia 25.2 weeks (Alem 2014).

The mean egg production (235.86±3.02) found in this study (Table 2) is higher than the result reported 140.70 eggs/hen/year by Khan et al (2006), 144 eggs by Abraham and Yayneshet (2010) and 150.47 eggs/hen/year by Samson et al (2010) for Fayoumi chickens managed under backyard management condition. The current study result is also higher than the result reported by Addis and Malede (2014) where egg production per year from White Leghorn, Yarkon, Fayoumi and Rhode Island Red was 173±9.35, 160, 144±6.97 and 185±8.82, respectively. The variation in exotic chickens' performance of this study relative to other studies might be associated to many factors, mainly variations in breed, availability of feed resources for scavenging, agro-ecological impacts, socio-economic status and management system of chicken owners. Moreover, egg production in year of exotic chicken in low altitude was significantly ($p<0.05$) higher than the two agro-ecologies but no significant ($p>0.05$) difference was observed between mid altitude and high altitude. The reproductive life span of hen in low altitude was significantly ($p<0.05$) higher than high altitude but no significant difference ($p>0.05$) was observed between mid altitude and the two-agro ecologies. In addition, reproductive life span of male chicken in high altitude was significantly ($p<0.05$) higher than the mid altitude but no significant difference ($p>0.05$) was observed between low altitude and the two agro-ecologies (Table 2).

Table 2. Productive and reproductive performance of exotic chickens in the study districts

Productive and reproductive traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Age at first mating of cockerel in weeks	19.66±0.19[a]	19.96±0.19[a]	20.11±0.19[a]	19.91±0.11
Age at first egg of pullet in weeks	23.63±0.41[b]	25.38±0.41[a]	25.65±0.41[a]	24.88±0.24
Egg production in year	250.18±5.23[a]	229.70±5.23[b]	227.71±5.23[b]	235.86±3.02
Number of chickens grown up to market	8.05±1.46[a]	6.18±1.46[a]	6.33±1.46[a]	6.85±0.84
Reproductive life span of hens (years)	3.70±0.10[a]	3.53±0.10[ab]	3.23±0.10[b]	3.48±0.05
Reproductive life span of male chickens (years)	3.46±0.09[ab]	3.33±0.09[b]	3.75±0.09[a]	3.51±0.05

[a, b, c] means with different superscript letters across a raw are significantly different at $p<0.05$; SE=standard error

Productive and reproductive performance of crossbred chickens

The mean age at first mating of cockerel (22.97±0.20 weeks) in this study (Table 3) is lower than the result reported for Central Tigray, Northern Ethiopia 24.9 weeks (Alem 2014). Moreover, age at first mating of crossbred cockerel of high altitude was seen to be significantly higher ($p<0.05$) than that of low altitude but with no significant difference between mid altitude and the two agro-ecologies ($p>0.05$). On the other hand the mean age at first egg of pullet in weeks (24.62±0.26) of this study (Table 3) is lower than 25.7 weeks ranged from 24 to 27 weeks reported by the same author and across between Yarkon and any local (205 days), Fayoumi and Necked Neck (196 days), Rhode Island Red and any local (198.3 days) and White Leghorn and any local (224.3 days) (Addis and Malede 2014). In addition to this, age at first egg of crossbred pullet of high altitude was considerably higher than the two agro-ecologies ($p<0.05$) but with no difference ($p>0.05$) between low altitude and mid altitude. The average egg production per year of this study (51.09±1.97) (Table 3) is lower than across between Yarkon and any local (129 eggs), Fayoumi and Necked Neck (119 eggs), Rhode Island Red and any local (90.8 eggs) and White Leghorn and any local (120 eggs) reported by the same authors. Variation in crossbred chicken performance relative to other studies might be associated to many factors, mainly variations in breed, availability of feed resources for scavenging, agro-ecological differences, socio-economic status and management system of chicken owners.

Table 3. Productive and reproductive performance of crossbred chickens in the study districts

Productive and reproductive traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Age at first mating of cockerel in weeks	22.16±0.36[b]	22.98±0.36[ab]	23.76±0.36[a]	22.97±0.20
Age at first egg of pullet in weeks	23.76±0.46[b]	23.88±0.46[b]	26.23±0.46[a]	24.62±0.26
Number of egg laid in clutch	20.63±0.85[a]	19.71±0.85[a]	18.11±0.85[a]	19.48±0.49
Number of clutch period in years	2.48±0.07[a]	2.50±0.07[a]	2.56±0.07[a]	2.51±0.04
Egg production in year	55.00±3.42[a]	50.98±3.42[a]	47.30±3.42[a]	51.09±1.97
Clutch length in days	27.88±1.73[a]	25.76±1.73[a]	22.65±1.73[a]	25.43±1.00
Inter-clutch in days	57.46±0.61[b]	59.08±0.61[ab]	60.48±0.61[a]	59.01±0.35
Number of chickens grown up to market	5.90±0.23[a]	4.76±0.23[b]	4.13±0.23[b]	4.93±0.13
Reproductive life span of hens (years)	2.88±0.12[a]	2.85±0.12[a]	2.76±0.12[a]	2.83±0.07
Reproductive life span of male chickens (years)	2.91±0.10[a]	2.60±0.10[ab]	2.51±0.10[b]	2.67±0.05
Days of production cycle	117.86±0.95[b]	118.80±0.95[b]	122.96±0.95[a]	119.87±0.55
Days of incubation	21.00±0.00[a]	21.00±0.00[a]	21.00±0.00[a]	21.00±0.00
Days of brooding	60.00±0.00[a]	60.00±0.00[a]	60.00±0.00[a]	60.00±0.00

[a, b, c] means with different superscript letters across a raw are significantly different at $p<0.05$; SE=standard error

Hatchability and survival rate of local chickens

According to focus group discussion, artificial incubation is not practiced by the respondents of all districts because of having no artificial incubator facilities. Consequently, it was observed that for the hatching of chicken eggs and growing chicks, farmers depend on broody hens. The study revealed that wet season was the most non-preferred season of the year for egg incubation and brooding of young chicks using broody hen because of poor survivability performance of young chicks due to mud, rain (cold stress), disease and feed shortage. In agreement with this study result Mulugeta and Tebkew (2011) reported for hatching of chicken eggs, farmers depend up on broody hens but not in line with Samson and Endalew (2010) where 54% and 42% respondents in mid rift valley of Oromia were observed to practice incubation at any time and in dry season, respectively.

The number of eggs set for hatching was determined by the past performance and the body size of the broody hen. The mean number of eggs incubated (12.97±0.10) and hatched (11.28±0.13) (Table 4) were recorded to be higher than 10.3 eggs incubated (Hagan *et al.,* 2013) and the result reported for Halaba district of Southern Ethiopia where the mean number of eggs, which are incubated and hatched per hen is 12 and 10.1 eggs, respectively (Nebiyu et al 2013) but in line with 13 eggs incubated per broody hen by Melese and Melkamu (2013). Furthermore, the number of eggs incubated and number of eggs hatched were significantly ($p<0.05$) higher in low altitude and followed by mid altitude and high altitude consecutively.

The mean number of eggs hatched (11.28±0.13) (Table 4) is higher than the result reported by Samson and Endalew (2010), 5-10 chicks hatched per clutch, Hagan et al (2013), 8.7 and Addisu et al (2013), 9.6 but this is within the range of 7-12 by Mulugeta and Tebkew (2011). The hatchability percentage (86.97%) (Table 4) seems to be relatively higher than hatchability performance of village hens reported by different researchers as follows: 82.6% by Fisseha et al (2010a) in Bure district, 83.7% by Nebiyu et al (2013) in Halaba district of Southern Ethiopia and 83% by Melese and Melkamu (2013). The differences in percent hatchability recorded in the different zones might be due to different treatments given to broody hens during hatching. The inherent characteristics of broody hens might also be a contributing factor as far as natural incubation is concerned. Apart from the high percent hatchability of eggs of local chickens, their productivity is comparatively low and this is as a result of low investment associated with their production.

The mean number of chicks weaned in this study area is 7.23±0.20 (Table 4). This result is comparable with that of Bogale (2008) with 7.63 weaned chicks in Fogera district but higher than the result reported by Ssewannyana et al (2008) where 6.3 chicks are weaned on average and Addisu et al (2013) where 4.59 were weaned. The low survival rate of chicks (64%) (Table 4) in the study area was due to high mortality rate of chicks (36%). However, this chick mortality rate is lower than the findings of 80% for Southern Ethiopia (Mekonnen 2007), 41% of chick mortality of indigenous chickens for Jimma zone, Gomma district (Meseret 2010), and 57.4% and 40% for any local and Necked Neck chickens (Addis and Malede 2014). It is also observed the number of chicks weaned in low altitude was significantly ($p<0.05$) higher than high altitude with no significant difference ($p>0.05$) between mid altitude and the two agro-ecologies.

The mortality rate of grower and mature chickens in the study area was observed to be lower than 25% (Table 4). Moreover, number of grower chickens in low altitude was significantly ($p<0.05$) higher than the two agro-ecologies but with no significant difference ($p>0.05$) between mid altitude and high altitude. Farmers reported an outbreak of Newcastle diseases which killed most of the chickens resulting in high percentage of chick mortality. Vaccination of chicks especially against one of the major killer diseases, Newcastle, has been found to be effective in controlling chick mortality (Mekonnen 2007). The present study also identified other constraints to local chicken production; prominent among them were poor housing, poor nutrition and low investment. The overall survival rates of local chickens (46.26±1.63%) (Table 4) is lower than the result of 65% survivable rate reported by Moreki (2010) and 52.3% survival rate of chickens to 6 months of age by Nebiyu et al (2013) but higher than 74% of mortality in local chickens of Uganda (Kugonza et al 2008). The overall mean survival rate of grower chickens in this study is higher than 60.5% chickens reached grower stage in Bure district (Fisseha et al 2010a). The variation in hatchability and survival rate of chickens relative to other studies could be due to the variation in type of equipment used for hatching, the difference in breed type, agro-ecological differences, chicken health management and prevalence of predators. It is also found the number of mature chickens in low altitude was significantly ($p<0.05$) higher than the two agro-ecologies but no significant difference ($p>0.05$) were observed between mid altitude and high altitude (Table 4).

Table 4. Hatchability and survival rate of local chickens in the three agro-ecological zones of the study districts

Hatchability and survival traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Number of eggs incubated	$14.08±0.18^{a}$	$12.81±0.18^{b}$	$12.03±0.18^{c}$	12.97±0.10
Number of eggs hatched	$12.48±0.22^{a}$	$11.10±0.22^{b}$	$10.28±0.22^{c}$	11.28±0.13
Hatchability percentage	$88.78±1.26^{a}$	$86.54±1.26^{a}$	$85.60±1.26^{a}$	86.97±0.72
Number of chicks weaned (8weeks)	$8.08±0.35^{a}$	$7.21±0.35^{ab}$	$6.40±0.35^{b}$	7.23±0.20
Survival rate of chicks in percent	$65.00±3.17^{a}$	$64.29±3.17^{a}$	$63.04±3.17^{a}$	64.11±1.83
Number of grower chickens (8-20 weeks)	$6.93±0.33^{a}$	$5.70±0.33^{b}$	$4.95±0.33^{b}$	5.86±0.19
Survival rate of grower chicken in percent	$84.12±3.00^{a}$	$77.21±3.00^{ab}$	$72.38±3.00^{b}$	77.90±1.73
Number of mature chickens (>20 weeks)	$6.21±0.30^{a}$	$4.86±0.30^{b}$	$4.43±0.30^{b}$	5.17±0.17
Survival rate of mature chickens in percent	$86.00±3.19^{a}$	$82.72±3.19^{a}$	$83.87±3.19^{a}$	84.20±1.84
Overall survival rate of chickens in percent	$50.22±2.83^{a}$	$44.46±2.83^{a}$	$44.09±2.83^{a}$	46.26±1.63

$^{a, b, c}$ means with different superscript letters across a raw are significantly different at $p<0.05$; SE=standard error

Hatchability and survival rate of exotic chickens

The mean mortality of exotic chicks (38.12±1.50) (Table 5) found in this study is higher than the Rhode Island Red chicken breeds (33.3±8.25%) but lower than White Leghorn (48.8±8.75%), Yarkon (53%) and Fayoumi chicken breeds (67.9±6.52%) (Addis and Malede 2014). The mean mortality rate of grower chickens in this study is (26.71±1.56) (Table 5) higher than Yarkon (14%) and Fayoumi (22.4 ± 4.81%) chicken breeds but lower than White Leghorn (48.5±6.45%) and Rhode Island Red (27.3±6.08%), and the mean mortality rate of mature chickens in this study (19.73±1.59) (Table 4) is higher than Yarkon (14%) and Rhode Island Red (16.3±5.69%) but lower than White Leghorn (21.3±6.03%) and Fayoumi chicken breeds (35.3±4.50%) reported by the same authors. Similar to this research finding the major causes of chicken losses in village chicken production were mortality due to disease, predator and nutritional stress (Samson and Endalew 2010; Moreki 2010). The variation in survival rate of chickens relative to other studies could be due to the variation in breed type, agro-ecological differences, chicken health management and prevalence of predators.

Table 5. Hatchability and survival rate of exotic chickens in the three agro-ecological zones of the study districts

Hatchability and survival traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Number of day old chicken disseminated	15.66±1.98[a]	12.95±1.98[a]	12.85±1.98[a]	13.82±1.14
Number of chicks weaned (8weeks)	9.96±1.59[a]	8.35±1.59[a]	8.25±1.59[a]	8.85±0.92
Survival rate of chicks in percent	62.20±2.59[a]	61.78±2.59[a]	61.64±2.59[a]	61.87±1.50
Number of grower chickens (8-20 weeks)	8.16±1.46[a]	6.25±1.46[a]	6.31±1.46[a]	6.91±0.84
Survival rate of grower chicken in percent	77.16±2.70[a]	73.90±2.70[a]	68.79±2.70[a]	73.28±1.56
Number of mature chickens (>20 weeks)	7.01±1.34[a]	5.23±1.34[a]	5.25±1.34[a]	5.83±0.77
Survival rate of mature chickens in percent	82.73±2.76[a]	79.36±2.76[a]	78.69±2.76[a]	80.26±1.59
Overall survival rate of chickens in percent	44.97±2.55[a]	50.15±2.55[a]	42.77±2.55[a]	45.96±1.47

[a, b, c] means with different superscript letters across a raw are significantly different at p<0.05; SE=standard error

Hatchability and survival rate of crossbred chickens

The result for mean number of eggs set for incubation (14.40±0.09) and hatchability percentage (80.46±0.81) (Table 6) is higher than the result reported 10 and 78.97%, respectively (Alem 2014). The mean chick mortality of this study (39.94±1.32) (Table 6) is higher than the cross between Fayoumi and Necked neck (19%) and Rhode Island Red and any local (28.3%) but lower than Yarkon and any local (54.2%) and White Leghorn and Necked Neck (45.23%) (Addis and Malede 2014). It is also shown the survival rate of crossbred chicks in low altitude were significantly (p<0.05) higher than high altitude but no significant difference (p>0.05) were observed between mid altitude and the two agro-ecologies. The mean mortality of grower chickens found in this study (24.67±1.52) (Table 5) is higher than a cross between Yarkon and any local (21.8%), Fayoumi and Necked Neck (17%) and Rhode Island Red and any local (23.89%) but lower than a cross between White Leghorn and Necked Neck (39.4%) with similar context the mortality of mature chickens of this study (18.54±1.61) is higher than a cross between Yarkon and any local (14.3%), Fayoumi and Necked Neck (9%) and White Leghorn and Necked Neck (11%) but lower than a cross between Rhode Island Red and any local (40%) reported by the same authors. Additionally, survival rate of grower crossbred chicken in low altitude were significantly (p<0.05) higher than high altitude but no significant difference (p>0.05) were observed between mid altitude and the two agro-ecologies. The variation in survival rate of crossbred chickens relative to other studies might be due to the variation in breed, availability of feed resources for scavenging, agro-ecological impacts, socio-economic status and management system of chicken owners.

Table 6. Hatchability and survival rate of crossbred chickens in the study districts

Hatchability and survival traits (Mean ± SE)	Agro-ecological zones			Overall mean
	Low altitude	Mid altitude	High altitude	
Number of eggs incubated	14.53±0.17[a]	14.43±0.17[a]	14.25±0.17[a]	14.40±0.09
Number of eggs hatched	11.86±0.26[a]	11.66±0.26[a]	11.31±0.26[a]	11.61±0.15
Hatchability percentage	81.69±1.41[a]	80.39±1.41[a]	79.31±1.41[a]	80.46±0.81
Number of chicks weaned (8weeks)	7.46±0.29[a]	7.20±0.29[a]	6.21±0.29[b]	6.96±0.16
Survival rate of chicks in percent	63.00±2.29[a]	62.04±2.29[ab]	55.10±2.29[b]	60.05±1.32
Number of grower chickens (8-20 weeks)	6.25±0.25[a]	5.18±0.25[b]	4.46±0.25[b]	5.30±0.14
Survival rate of grower chicken in percent	81.09±2.63[a]	75.04±2.63[ab]	69.85±2.63[b]	75.32±1.52
Number of mature chickens (>20 weeks)	5.53±0.22[a]	4.18±0.22[b]	3.55±0.22[b]	4.42±0.13
Survival rate of mature chickens in percent	83.70±2.78[a]	80.60±2.78[a]	80.03±2.78[a]	81.45±1.61
Overall survival rate of chickens in percent	46.33±2.62[a]	43.69±2.62[a]	40.55±2.62[a]	43.52±1.51

[a,b,c] means with different superscript letters across a raw are significantly different at p<0.05; SE=standard error

Conclusions

Higher and the same age at first egg of exotic and crossbred chickens were found relative to local chickens, respectively. According to the studied farmers the egg production was mentioned to be high for exotic breed and this was followed by the crossbred and local one. Exotic egg production performance was higher than the performances of White Leghorn, Yarkon, Fayoumi and Rhode Island Red chicken breeds of other studies. However, with regard to crossbreds, it was lower than the cross of White Leghorn, Yarkon, Fayoumi and Rhode Island Red reported by different authors. Moreover, the reproductive life spans of exotic chickens were also found higher than local and crossbred ones. Relative to other studies the local chickens overall survival rate was kept low. The overall survival rate of exotic and crossbred chickens was shown comparable result to survival rate of local chickens in this study. This was due to non-equitability in vaccination of chickens. Vaccination was given to exotic chickens against to common chicken disease before and after introducing to households of the study area. Therefore, based on the above findings introducing Bovans Brown chicken having better productive and reproductive performance is important to enhance productivity. Moreover, non-genetic factors should be considered to improve the performance of existing local chicken population.

DISCLOSURE OF CONFLICT OF INTEREST

There is no any conflict of interest.

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