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Production performance of local and exotic breeds of chicken at rural household level in Nole Kabba Woreda, Western Wollega, Ethiopia

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Production performance of rural chickens was studied in three agro-ecologies of Nole Kabba Woreda of west Wollega zone, about 32, 29 and 31 from mid-highland, highland and lowland agro-ecological zones, respectively and a total of 92 households and 18 key informants were used for the survey work. Finally, all the data collected were subjected to Statistical Package for Social Science (SPSS) version 17.0 and SAS (2002). The results obtained revealed that, statistically significant difference between the agro-ecologies in sexual maturity of indigenous chickens as measured by age at first mate ($P < 0.05$). There was significant difference between local and exotic chickens in rate of egg production ($P < 0.05$). Mean age at first egg of about 7.02 ± 0.220 and 5.66 ± 0.116 months was calculated for indigenous and exotic pullets, respectively. Overall percent hatchability of 82 and 44.36% was reported from eggs of indigenous and exotic chicken, respectively. In summary the results of this study tends to indicate that improvement in exotic chicken eggs hatchability under scavenging condition seems to be the future direction of research in the Nole Kabba Woreda.

Key words: Chicken, indigenous, exotic, household, agro-ecology.

INTRODUCTION

The Ethiopian indigenous chickens are none descriptive breeds closely related to the Jungle fowl and vary in color, comb type, body conformation, weight and may or may not possess shank feather (Alemu and Taddele, 1997). Broodiness (maternal instinct) is pronounced, it is by natural brooding that baby chicks are raised all over rural Ethiopia. The broody hen rearing and protecting few chicks ceases laying during the entire incubation and brooding periods of up to 81 days. Yet the success of the brooding process depends on the maternal instinct of the broody hen and the prevalence of predators such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia (Solomon, 2007a). They are characterized by slow growth, late maturity and low production performance. According to FAO (2004), indigenous chickens lay about 36 eggs in three clutches of 16 days each with about 12 to 13 eggs per clutch. Egg laying period and number of eggs laid per period are to some extent higher in urban than in rural areas (CACC, 2003).

The low productivity of the indigenous stock could also

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partially be attributed to the low management standard of the traditional production system. It has been seen that the provision of vaccination, improved feeding, clean water and night time enclosure improves the production performance of the indigenous chickens, but not to an economically acceptable level (Solomon, 2007b). In Ethiopia, the idea of distributing exotic chickens particularly Rhode Island Red (RIR) was to improve the productivity of local birds by mating them with improved cocks. According to Permin (2008), this scheme usually failed to work due to the fact that the introduced breeds could not adapt to the hot climate, low feeding, and extensive management.

Furthermore, the improved cocks were not as lively and active under village conditions as the local cocks and therefore lost in the mating competition for the hens. When reproduction succeeded, the first generation of these cocks often showed a slight increase in production, but as no strict breeding scheme was maintained, the effect was gone after a few generations. The other important potential disadvantage was loss of broodiness, reduced scavenging capability and survival. Solomon (2003) showed that there was no difference between White Leghorn and local chickens raised under scavenging condition in mean daily body weight gain at 2 months.

A comparative study of the egg production performance of six different exotic breeds, namely: Brown Leghorn, White Leghorn, RIR, New Hampshire, Light Sussex, and Barred Rock was carried out at Debre Zeit Agricultural Research Centre. Egg production, hatchability and mortality data were collected and evaluated over several years. The White Leghorn was rated the best in terms of egg production, adaptability, disease resistance and efficiency (DZARC, 1984).

Solomon (2007a) noted that sexual maturity in White Leghorn under intensive and extensive management ranged from 149 to 169 days, while in RIR and Fayoumi crosses under intensive management ranged from 147 to 151 days (Rahman et al., 2004). Abraham and Yayneshet (2010) reported that hatchability more than 70% of the indigenous and White Leghorn eggs set were hatched.

The relatively higher proportion of eggs hatched by the indigenous birds may be attributed to a number of factors such as lighter egg weight, small clutch size, and the presence of higher mortality of indigenous chicks that forced the farmers to restock the lost birds (Tadelle et al., 2003). Only 39% of the eggs produced by RIR hens were hatched, probably due to a negative correlation between heavier egg weight and its hatchability (Yassin et al., 2008). Hatchability of eggs is a function of both maternal and paternal components, and the former has an overriding effect on genetic variation in hatchability of a fertile egg, which is attributed to the quality (external and internal) of the laid egg. Eggs stored for a longer period of time and collected from older age flocks are known to have lower hatchability (Yassin et al., 2008). Poultry development initiatives have been made in the Nole Kabba Woreda of west Wollega zone, Ethiopia, focusing on Hop-cock and RIR breeds. Still, along distribution of different breeds of poultry to rural household farmers in the Woreda, no attempts have been made to assess their production performances. The present work aimed to generate information on comparative production performance of indigenous and exotic chicken under traditional management system.

MATERIALS AND METHODS

Description of the study area

This study was conducted in Nole Kabba Woreda of western Wollega Zone of Oromia Regional State, located at 491 km west of Addis Ababa. The altitude of Nole Kabba ranges between 1400 and 2576 m.a.s.l. and the Woreda is predominantly classified as mid-highland (Woinadega). The mean annual temperature ranges from 13.5 to 27.5°C. The annual rainfall of the study area ranges between 1600 and 2000 mm. Nole Kabba has high potential for livestock production and the total chicken population of the Woreda is estimated at 42,075 heads.

Selection of study site and households

Nole Kabba Woreda was stratified into 3 agro-ecological zones based on altitude. One kebele from each agro-ecological zone were purposely selected based on poultry, and human population and total area coverage. A total of 92 households and 18 key informants were used to assess the production and productivity of local and exotic breeds of chicken. During household selections the household in the agro-ecology were randomly selected.

Data collection

Structured questionnaire was used to collect data from primary source which mainly comprised of households, development agents and key informants followed by review of the available secondary data source. A visit to physical facility of live bird and egg markets and open discussion with poultry farmers was also made. Finally, data on poultry production performance (egg production, number of clutches, age at first egg and hatchability) including the performance of the distributed exotic chickens were collected using the questionnaire prepared. Appropriate timing for data collection was fixed after negotiation with respondent, placing special emphasis on women, while interviewing the households.

Statistical analysis

All data collected were analyzed by using Statistical Package for Social Science (SPSS, 2009) version 17.0 for windows. Mean difference was assessed by Duncan's multiple range test, where F-values were significant (Duncan, 1955). Chi-square procedure was carried out to examine significance difference of some parameters. Analysis of variance (ANOVA) was carried out to examine variance of the data collected. For qualitative factors, descriptive statistics was used. Standard error of mean (SE) was used while describing mean.

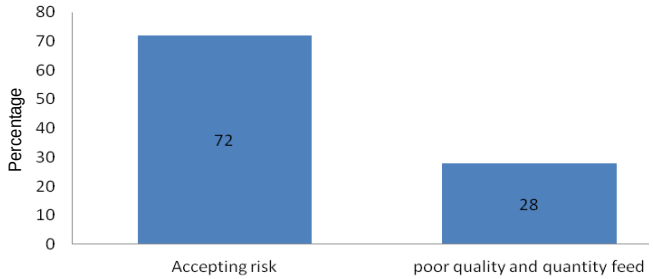

Figure 1. Reasons of poor exotic breed preference's (% HH).

RESULTS AND DISCUSSION

Production and reproduction performance

Egg production performances

The respondents were requested to rank the comparative production performance of the indigenous and exotic chickens kept in the study area. It has been found that the number of exotic chickens and their crosses are low in all the agro-ecologies studied as compared to the number of indigenous chickens attributed to low adaptability to the local conditions of the study areas. About 71.7% of all the respondents indicated that local chickens performed well than exotic chickens and their crosses in terms of survivability, disease résistance and alertness against predators. About 72 and 28% of all the respondents reported that risk of disease and predation and lack of supplementary feeding are the major limitations to the productivity of exotic chickens and their crosses under rural household conditions respectively (Figure 1). On the other side, the result of the discussion made with key informants indicated that all the respondents agree that the egg production performance of exotic chickens and their crosses is superior to the egg production performance of indigenous chicken under improved management system. This result is in agreement with that of Alemu and Tadelle (1997) who reported that indigenous flocks are considered to be very poor in egg production performance attributed to low genetic potential, poor management and long natural reproductive cycle.

All the respondents reported the existence of mating preference by both exotic and indigenous cocks which might have negatively affected fertility and hatchability of eggs collected from exotic chickens and their crosses (Table 1). The results of the discussion made with key informant showed that household members of the study area purchase breeding cocks of pure exotic or crossbred on the basis of size and body conformation. According to the respondents' responses, the farmers remove their local cocks before introducing pure exotic cocks. The respondents confirmed that the first crosses are good layers but need to have the second cock for back crossing to maintain broodiness. All the respondents said to prefer pure and cross of RIR to local chickens in terms of egg production. However, pure RIR and their crosses are said to be susceptible to disease and predators. The pure RIR breeds of chicken are reported to be characterized by seasonal fluctuation in egg production and poor in alertness against predation and scavenging ability compared to indigenous chickens. There was statistically significant difference between the agro-ecologies in sexual maturity of indigenous chickens as measured by age at first mate ($P < 0.05$). Mean age at first mate of about 7.0 and 6.0 months was calculated for indigenous cock of mid-highland and lowland, respectively the values of which are significantly ($P < 0.05$) longer than that of highland (5.69 months). There was no statistically significant difference between the agro-ecologies in sexual maturity of indigenous chickens as measured by age at first egg ($P > 0.05$). However, mean age at first egg of about 6.73 and 6.08 months was calculated for indigenous pullets of mid-highland and highland respectively, the values of which are significantly ($P < 0.05$) longer than that of crossbreds (5.66 months). The results of this study indicated that the mean age at first egg of indigenous pullets of mid-altitude (6.73 months) is longer than that of low and highlands indicating that pullets of mid-altitude are characterized by late sexual maturity compared to the pullets of low and high lands. This variation might be associated with the variation in feed availability. The mean age at first egg recorded from this study is shorter than those recorded by Udo et al. (2001) and Tadelle et al. (2003) who reported average age at first lay of 8 and 6.8 months, respectively.

As indicated in Table 2, there was significant difference between local and exotic chickens in rate of egg production ($P < 0.05$). It is revealed that the numbers of eggs produced/clutch/hen was higher for the crossbreds (31.7) as compared to that of indigenous chickens (11.23).

Breaking broodiness

The traditional methods of breaking broodiness are shown in Table 3. All the respondents reported to exercise traditional methods of breaking broodiness aimed at increasing egg productivity. About 30.4% of the respondents were reported to exercise disturbing of the broody hen in the laying nest including replacing of eggs with some other foreign materials. About 29.3% of the respondents tie both legs of broody hen and suspend it from branches of trees in upside down position for 3 to 4 days. About 16, 15 and 9% of the respondents exercise piercing shank feather into nostril of the broody hen, hanging of broody hen upside down position and taking broody hen to neighborhoods for 3 to 4 days, respectively. According to the results of the discussion made with key informants, disturbing the laying nest (Place some material on egg laying place), and tying the legs of broody hen and hanging of the hen upside down

Table 1. Mating preference toward exotic breed of chickens (% of HH).

Preferred sex	Mid-highland	Highland	Lowland	Overall
Exotic cocks towards local hen				
Good	46.9	48.3	54.8	50.0
Poor	21.9	20.7	32.3	25.0
No preference	31.3	31.0	12.9	25.0
Local cocks towards exotic hens				
Good	43.8	41.4	29.0	38.0
Poor	21.9	24.1	38.7	28.3
No preference	34.4	34.5	32.3	33.7

Table 2. Age of sexual maturity (months) of crosses and local chickens and egg produced/clutch/hen of local, crosses and exotic chickens.

Parameter	Mid-highland	Highland	Lowland	Overall
Age of sexual maturity				
Female(local)	7.44 ± 0.391	6.76 ± 0.396	6.82 ± 0.353	7.02 ± 0.220
Male(Local)	7 ± 0.37^{a}	5.69 ± 0.290^{b}	6 ± 0.278^{b}	6.25 ± 0.191
Crosses (Female)	5.77 ± 0.178	5.79 ± 0.250	5.38 ± 0.145	5.66 ± 0.116
overall	6.73 ± 0.21	6.08 ± 0.189	6.11 ± 0.175	6.32 ± 0.111
Egg produced/clutch/hen				
Locals	11 ± 0.51	11.17 ± 0.653	11.52 ± 0.601	11.23 ± 0.336
Exotics	25.66 ± 0.718	26.14 ± 1.505	27.2 ± 1.935	26.14 ± 0.710
Crosses	32.44 ± 1.142^{ab}	28.41 ± 1.783^{b}	35.23 ± 1.942^{a}	31.66 ± 0.923
Overall	23.03 ± 1.034	20.88 ± 1.191	20.73 ± 1.5	21.75 ± 0.697

^{ab}Means in the same row for each parameter with different letter superscripts are significantly different ($P < 0.05$).

Table 3. Practices of breaking broodiness in the study area (% of HH).

Practice to break broodiness	Mid-highland	Highland	Lowland	Overall
Tying	25.0(8^{NS})	34.5(10^{NS})	29.0(9^{NS})	29.3(27*)
Piercing feather in the nose	21.9(7)	13.8(4)	12.9(4)	16.3(15)
Place some material on egg laying place	31.3(10)	27.6(8)	32.3(10)	30.4(28)
Hanging upside down	15.6(5)	13.8(4)	16.1(5)	15.2(14)
Taking into neighborhoods	6.3(2)	10.3(3)	9.7(3)	8.7(8)
X^2_Value	5.8125	6.3448	6.2581	16.587

*$P < 0.05$ level; NS-Not-significant across the column; Value in the Parenthesis are the numbers of respondent responded in each parameters.

position could break broodiness within 3 to 4 days depending on the degree of strength of broodiness which vary from hen to hen. Similarly, Dereje (2001), Tadelle (2003) and Mammo (2006) reported that piercing the nostril with feather, moving the bird to a nearby house for a couple of days and hanging upside down are effective in breaking broodiness within 3 to 4 days. All the respondents confirmed that the hens resume laying soon after breaking broodiness resulting in increase in total annual egg production. This result is in agreement with that of Rushton (1996) as cited by Kitalyi (1998) who reported higher egg productivity (143 eggs/hen/year) by the Ethiopia indigenous chickens with the proper management of broody hen. These results also agree with that of Tadelle (1996), Dereje (2001), Tadelle et al. (2003) and Resource-Center (2005) who reported that

Table 4. Egg selection, incubation and season of hatching in the study area (% of HH).

Parameter	Mid-highland	Highland	Lowland	Overall
Season of hatching				
Dry season only	82.8	72	86.2	80.7
Both season	17.2	28	13.8	19.3
Selecting eggs for incubation				
Selecting	55.2	40	48.3	48.2
No selecting	44.8	60	51.7	51.8
Size of eggs selected for incubation				
Large size	68.8	80	64.3	70
Medium size	31.3	20	35.7	30
Source of incubating eggs				
Lay at home	62.1	68	65.5	65.1
Both lay at home and purchase	37.9	32	34.5	34.9

Table 5. Storage place of table and hatching eggs (% of HH).

Storage places	Mid-highland	Highland	Lowland	Overall
Inside laying nest	37.5	27.6	19.4	28.3
Clay pot	21.9	24.1	35.5	27.2
Inside teff grain	25	31	29	28.2
Any place	15.6	17.2	16.1	16.3

households traditionally attempt to break broodiness to resume egg laying with final goal of increasing egg productivity.

Hatchability

Hatchability and rate of chick survival are one of the major determinant factors of productivity in poultry. The results of the hatchability and related factors obtained in this study are shown in Table 4. All the respondents said that they commonly incubate eggs during dry seasons and use ‘’ hammattu” (clay pot with straw bedding) as an incubation box. This result is in agreement with that of Solomon (2007a), who reported that it is by natural incubation and brooding that chicks are hatched and raised all over the rural Ethiopia. A broody hen hatching, rearing and protecting few number of chicks (6 to 8) ceases egg laying during the entire incubation and brooding periods of 81 days. Yet the successes of the hatching and brooding process depends on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia. This result is also in line with the report of Kyvsgaard et al. (2002), who found that most women preferred hatching in dry seasons but disagreed with that of Maphosa et al. (2004) who noted that, there was no seasonal effect on eggs hatchability.

According to the results of the discussions made with key informants, the number of eggs set per hen depends on availability of eggs, size of eggs and size of broody hen and the maternal instinct of the broody hen. The overall mean number of eggs incubated in the study area was reported to be 11.32 eggs with minimum of 6 and maximum 20 eggs per hen, the value of which agrees with Sonaiya and Swan (2004), Udo et al. (2001) and Tadelle et al. (2003) in Ethiopia who indicated that the average number of eggs set per hen is about maximum 16, 14 and 13, respectively.

About 55.4% of the respondents reported to store both hatching and market eggs either in clay pot or inside teff grain for up to 10 days (Table 5) without considering storage position. All respondents believe that temperature of clay pot and teff grain is not detrimental in terms of hatchability and nutritional characteristics. In agreement with this results Sonaiya and Swan (2004) reported safe egg storage in clay pot, while Dereje (2001) and Tadelle et al. (2003) indicated the practice of egg storage for about 2 weeks in the grain-store (especially in teff), without considering egg storage positions.

Table 6. Methods of identifying normal eggs from spoiled (% of HH).

Method	Mid-highland	Highland	Lowland	Overall
By shaking	46.9	55.2	41.9	47.8
Floating techniques	31.3	17.2	25.8	25.0
Visual examination	21.9	27.6	32.3	27.2

Table 7. Hatchability of eggs in the study area (% of HH).

Parameter	Mid-highland	Highland	Lowland	Overall mean
Indigenous				
No. of eggs/incubation	11.28 ± 0.409	11.2 ± 0.574	11.45 ± 0.432	11.32 ± 0.267
No. of chicks hatched/incubator	9.31 ± 0.330	8.88 ± 0.578	9.81± 0.339	9.36 ± 0.239
Hatchability %age (%)	82.57	79.28	85.65	82.74[a]
Exotics				
No. of eggs/incubation	9.54 ± 0.595	9.47 ± 0.515	9.6 ± 0.400	9.52 ± 0.243
No. of chicks hatched/incubator	4 ± 0.519[ab]	4.88 ± 0.392[a]	3.25 ± 0.403[b]	4.22 ± 0.224
Hatchability percentage (%)	41.935[ab]	51.55[a]	33.85[b]	44.36[b]
Age of eggs used for incubation (Day)	10.17 ± 0.643	10.56 ± 0.653	11.07 ± 0.438	10.34 ± 0.365

[ab]Means in the same row for each parameter with different letter superscripts are significantly different (P < 0.05).

The respondents reported to select hatching eggs on the basis of size and shell structure. Large and medium sized egg with smooth shell are said to be the preferred ones for incubation. This practice of selection is in agreement with the report of Dereje (2001) who stated that large and medium sized eggs are selected for incubation in Ethiopia. There was no reported practice of cleaning and treating hatching eggs. In contrast to the results of this study, Mammo (2006) reported that externally dirty and contaminated eggs are cleaned using dry materials (cloth). According to Sonaiya (2004), rubbing slightly the dirty eggs with a rough cloth is better than wet cleaning.

As shown in Table 4, about 65.1% of the respondents use home laid eggs for incubation, while about 34.9% of the respondents reported to have used eggs purchased from neighborhoods for incubation. About 47.8% of the respondents are capable of identifying spoiled eggs by shaking, visual appraisal and floating in water (Table 6). It is indicated that broody-hen sitting on hatching eggs is placed in hidden and protected areas characterized by minimum disturbances. About 94, 91 and 86% of the respective respondents of lowland, mid-highland and highland, said to have regularly practice incubation and hatching.

Hatching on regular basis indicating that there was no statistically significant difference (P < 0.05) between the kebeles (agro-ecologies) in the frequency of incubation and hatching, even though respondents categorized as poor households tended to frequently practiced incubation and hatching. Overall mean percent hatchability of 82% was reported from eggs of indigenous chicken and there was no statistically significant difference (P > 0.05) between the study sites agro-ecologies in hatchability of eggs collected from indigenous chickens. The highest percent hatchability (86%) was reported from eggs of indigenous chickens of lowland whereas the lowest percent hatchability of 79% was reported from eggs of indigenous chickens of highland (Table 7). The results of hatchability reported from eggs of indigenous chickens in this study is comparable to those reported from different parts of Ethiopia, with the exception of that of Jimma (Brännänng and Pearson, 1990; Tadelle, 1996).

Meseret (2010) reported mean percent total hatchability of 22% from eggs of indigenous chickens of Gomma Woreda of Jimma zone, indicating that hatchability is one of the detrimental factors limiting poultry production in Gomma Wereda.

Overall mean hatchability of 44% was reported from eggs of exotic chickens as reported by all the respondents of the three sites. There was significant difference between the study sites (agro-ecologies) in hatchability of eggs collected from exotic chickens (P < 0.05). The highest hatchability of 52% was reported from eggs of exotic chickens of highland, while the lowest hatchability of 33% was reported from eggs of exotic chickens of lowland.

The results of this study clearly showed that hatchability of exotic chickens was significantly lower than that of the indigenous chickens (P < 0.05). The results of hatchability obtained in this study seem to

agree with that of Sonaiya and Swan (2004) who reported that hatchability using broody hen is around 80% to be normal, but a range of 75 to 80% is considered to be satisfactory. In agreement to the result of this study, Abraham and Yayneshet (2010) revealed that 76 and 39% of hatchability of egg collected from indigenous and RIR, respectively in the semi-arid Tigrayi region of Northern Ethiopia.

Conclusion

The result of the current study revealed that, mean age of sexual maturity for local stock is reported to be longer (7 months) than that of crossbred (6 months) and exotic chickens (5 months). Numbers of eggs per clutch per hen per year for indigenous, exotics and crossbreds were; 11, 26 and 31 eggs, respectively. All the respondents practice natural incubation mainly in dry seasons and reported to attain hatchability of about 83 and 44% through the incubation of indigenous and exotic eggs, respectively.

All the respondents said to prefer pure and cross of RIR to local chickens in terms of egg production. The results of this study indicated that the mean age at first egg of indigenous pullets of mid-altitude (6.73 months) is longer than that of low and highlands indicating that pullets of mid-altitude are characterized by late sexual maturity compared to the pullets of low and high lands. All the respondents reported to exercise traditional methods of breaking broodiness aimed at increasing egg productivity. There was significant difference between the study sites (agro-ecologies) in hatchability of eggs collected from exotic chickens ($P < 0.05$). The result of this study tends to indicate that production performance local chicken is low, not only because of poor egg production performance but also due to long hatching and brooding periods. Therefore, the use of hay box brooder was found to be effective in reduction of mortality and releasing the broody hen to go back to laying. Popularization of the technology within the farming population including the provision of constructional and operational manual in local language seems to be desirable. The critical analysis of poor hatchability of eggs collected from RIR is the future line of work.

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