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Full length Research Paper

Determination of environments and genes on the interaction effects of fixed factors on biometrical traits of local chicken ecotypes, Ethiopia

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Abstract

An exploratory field survey was conducted in the three districts of Quara, Alefa and Tachearmacheho, Ethiopia to determine the Role of Environments and Genes on the Interaction Effects of Fixed factors on Biometrical Traits of Local Chicken Ecotypes. Interaction effect results of live body weight and linear body measurements in the fixed effect of sexes, ecotype and their interactions are main effect. Males is significantly (P<0.01) influenced and main source of variation in all traits than females except keel length. Therefore, the fixed effect of sex was the main cause of variations of the measurable traits from the population mean. Whereas Ecotype effect on body weight and linear body measurements of Necked neck ecotype had largely oriented in bodyweight and liner body measurements than Gasgie and Gugut ecotypes. Whereas, Gasgie ecotype is significantly (p<0.01) longer with interaction effect of keel length among the others. Except shank circumstance, smaller body weight and linear body measurements are obtained from the effect of Gugut chicken ecotype than the others. Sex by ecotype interaction effect on comb width, wattle length, wattle width, spur length, shank circumstance and keel length of matured chicken ecotype was observed (Table 1). However, there was no significant (P>0.05) sex by ecotype interaction effects on wingspan, shank length, body length, comb length and beak length among the three breeds. The other quantitative traits had significant (P<0.05) effects and this implies the significant variation were indicted that stable parameters are highly associated or governed by genotype rather than environmental effects.

Key words: Genes, environments, biometrical traits, chicken ecotypes, Ethiopia

INTRODUCTION

Poultry species contributed important socio-economic roles for food securities, generating additional cash incomes and religious/cultural reasons (Salam, 2005). In Ethiopia almost all rural and many peri-urban families keep small flocks scavenging local chickens (Jens et al., 2004). Indigenous chickens are largely dominated flock size and have good potential to adapt different agro-ecologies through habitual management systems (Tadelle and Alemu, 1997).

The performance of available genetic resource of indigenous chicken is poor and the performance could be predicted by linier body measurements (FAO, 2011). Some researchers (Tadelle, 2003; Halima, 2007; Nigussie et al., 2009) have made phenotypic and genetic characterization of indigenous chicken in some parts of Ethiopia. Poultry production and marketing system in three districts of southern Ethiopia was conducted by Mekonnen (2007), phenotypic and genetic

characterization of indigenous chickens in Northwest Ethiopia by Halima (2007), genetic parameters on Horro chickens for weights and egg production trait variations at sex, ecotype and their interaction was reported by Nigussie et al. (2010) and breeding objective and trait preference of village poultry producers in same selected parts of Ethiopia by Nigussie (2011). However, the above mentioned authors are not reported the effects of environments and genes through interactions of fixed effects on biometrical traits on local indigenous chicken ecotypes in organized form. Therefore, this investigation was carried out to evaluate the roles of environments and genes on the interaction effects of fixed factors on biometrical traits of local chicken ecotypes in North Gondar Zone, Ethiopia

MATERIALS AND METHODS

The study was conducted from Quara, Alefa and Tache Armacheho of northwest Ethiopia. Of which Quara district is located in western part of north Gondar Zone between $11^0$47' and $12^0$21'N latitude and $35^0$16' and $35^0$47'E longitude. It is 1123 km far from Addis Ababa and 324 km from Gondar town and the elevation ranges between 528 and 654 masl with annual temperature ranges of 25-44^0c and mean annual rainfall of 600 - 1000 mm (QADO, 2010). Human population of the district was about 105,995 with total area of 858, 588ha. The livestock populations was 173, 863 cattle, 3845 sheep, 146,209 goats, 172,121 poultry, 6532 donkey, 141 mule, 654 camels and 12485 bee colonies (QADO, 2010). Alefa district is located at 162km in southwest of Gondar town and 909 km from Addis Ababa and lies with the average altitude of 1700 masl with the temperature ranging from 25 - 30^0c and annual rainfall of 900-1400 mm (AADO, 2011). Total human population of the district was 154, 940 with 189,054 ha of land. The livestock population was also 268, 695 cattle, 27,421 sheep, 86,992 goats, 964, 432 chickens, 18,952 beehives, 1, 122 mule, 19, 445 donkey, 18 horse and 6 camels (AADO, 2011). Tache Armacheho district is also found 814 km northwest of Addis Ababa and 65km North west of Gondar town with the altitude, temperature and mean annual rainfall range of 600-2000 masl, 25 - 42^0c and 800-1800 mm, respectively (TADO, 2011). Total human population of the district was 88,701 with the total area of 268,512ha and the livestock population was 321,539 cattle, 123,585 goats, 149 sheep, 133,332 chickens, 11,273 donkeys, 471 mule, 9,328 beehive and 92 camels (TADO, 2011).

Sampling Techniques and Frame Works

First single rapid exploratory field observation was considered before the main data collection work was started to know and strengthen the concentration and distribution of each local chicken ecotypes. Purposive sampling technique was employed where the first districts known for the dominant chicken ecotypes in their particular production environment, followed by potential Peasant association (PAs) were identified. Accordingly, three district and nine PAs (3 per district) were purposively selected. Chicken owned respondent households were selected by using systematic random sampling technique from each PA. Therefore, a total of 90 chicken owner respondents 30 (10 per PA) per ecotype were randomly selected for the biometrical measurements, all matured chicken ecotypes n = 450, 150 cocks and 300 hens were taken and measured from the selected households.

Types of Data and Collection Methods

From the present investigation quantitative data like body weight (kg), body length (BL), wing span (WS), shank length (SL) and circumference (SC), wattle length (WL and width (WW), keel length (KL), spur length (sl), beak length (bl), comp length (CL) and width (CW) measured and saw the effects separately for females and males using spring balance for bodyweight (kg) and centimeter (cm) for liner body measurements in the nearest two digital techniques adopted from livestock characterization research manual (FAO, 2011).

Data Management and Statistical Technique

Data was managed both in hard and softcopies. All collected datum were entered and managed using Microsoft Excel computer programme. General Linear Model (GLM) procedure of (SAS, 9.0 versions, 2002 release) was employed on measurement data to identify the effects of sexes and ecotypes variation was analyzed by Turkey comparison test. The first model was used for mature body weight and linear body measurement of chickens by considering as the fixed effects of sexes and ecotypes

Model: 1. $Y_{ijk} = \mu + A_i + D_j + AD_{ij} + e_{ijk}$

Where:

Y_{ijk} = the observed body weight and linear body measurement of chickens

μ = overall mean

A_i = fixed effect of i^{th} eco type (1 = Necked neck, 2 = Gasgie and 3 = Gugut)

D_j = fixed effect of j^{th} sex (j = male and female)

AD_{ji} = the interaction effect of i^{th} eco type with j^{th} of sex

e_{ijk} = random residual error

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents: Household characteristics of interviewed village chicken

Figure 1: Socio-economic status of chicken owners of the study area (N = 90)

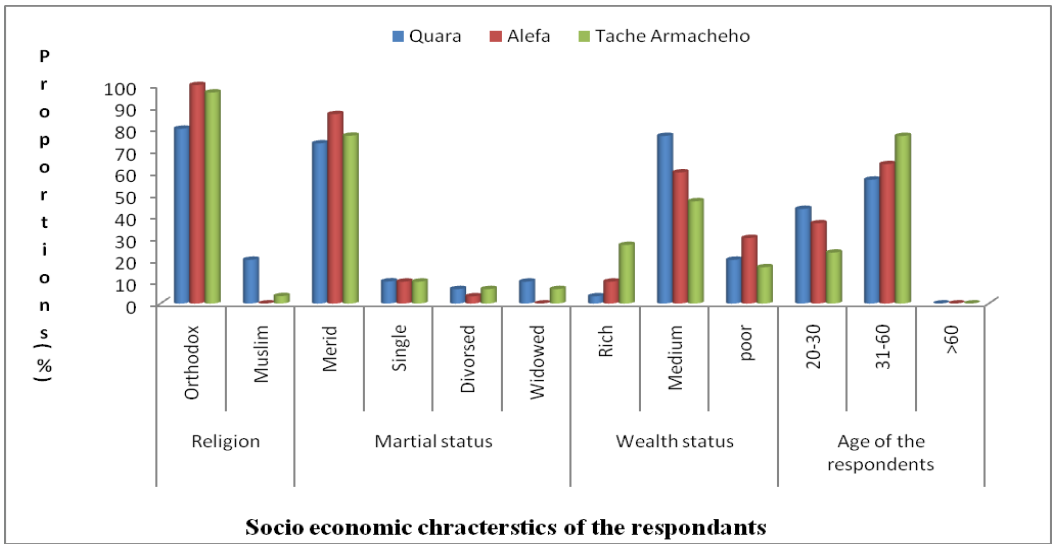
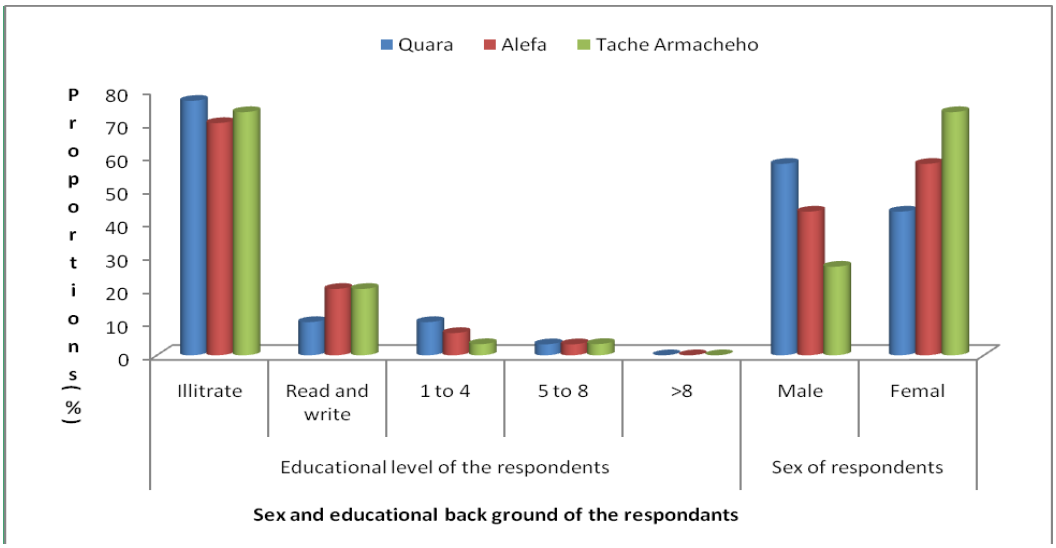


Figure 2: Education status and sex of the respondents in the study area (N = 90)



owners are presented in Figure 1 and 2. The result indicated that about 99% of interviewed households were fully involved in mixed crop-livestock traditional production systems. While, chickens were the main source of income for immediate expenses such as purchasing salt, coffee, clothe and animals' medicine. This finding is in line with the finding of Halima (2007) and Meseret (2010) reported that farmers used chicken as means of livelihood and immediate household expenses, respectively. The majority of the respondents in this study area 57.8% were females. These larger female respondents might be absent of traditional restrictions observed women approaching to outsiders. However, smaller result was reported by Mekonnen (2007) who showed that only 66.7% of the respondents were married. From interviewed respondents most information was generated from females which indicated that mainly women are culturally responsible for rearing of chicken. According to Gueye (1998) in sub Saharan Africa from the total human family size approximately 80% of the chickens were owned and largely controlled by women. So far similar result was also reported by many researchers such as Mekonnen (2007) and Halima (2007). Moreover, about 73.3 % of the average interviewed farmers were illiterate while 16.7 % can read and write. About 6.7% and 3.3% were literate respondents who had gone through primary first cycle (1-4) and primary second cycle (5-8), respectively (Figure 1). Finally illiterate those who read and write educational status of the interviewed farmers in the recent study were

Table 1: Least square means of body weight (kg) and linear body measurements (cm) for the fixed effects of ecotypes, sex and ecotypes by sex interaction effect (Lsm±SE)

Effect and level	Parameters WS	SL	BL	CL	CW	WL	WW	bl	sl	SC	KL	Wt
Overall mean	37.04± 0.13	7.79 ± 0.15	35.79 ±0.09	2.76± 0.09	1.68± 0.04	1.76± 0.06	1.51 ± 0.06	2.03 ±0.02	0.18± 0.02	3.78± 0.07	8.24± 0.09	1.46 ± 0.01
R^2	0.28	0.65	0.45	0.04	0.22	0.72	0.61	0.30	0.21	0.79	0.77	0.34
CV%	6.30	10.02	7.92	37.13	42.71	35.53	51.49	17.20	27.80	19.49	11.74	17.83
Sex interaction effect												
Male	38.09± 0.24^{a}	8.08 ± 0.11^{a}	36.77 ±0.30^{a}	3.16± 0.07^{a}	2.08± 0.07^{a}	2.43± 0.07^{a}	2.17 ± 0.09^{a}	2.09± 0.30^{a}	0.44± 0.05^{a}	4.81± 0.18^{a}	7.51 ± 0.24^{b}	1.63± 0.03^{a}
Female	36.52±0.14^{b}	7.60 ± 0.07^{b}	35.29± 0.16^{b}	2.55±.13^{b}	1.48 ±0.04^{b}	1.42 ±0.07^{b}	1.18 ±0.07^{b}	1.99± 0.02^{b}	0.054 ±0.01^{b}	3.27±0.03^{b}	8.60 ± 0.05^{a}	1.37± 0.02^{b}
P-value	0.0001	0.0001	0.0001	0.001	0.0001	0.0001	0.0001	0.006	0.001	0.001	0.001	0.001
Ecotype interaction effect												
Necked neck	37.93±0.21^{a}	9.33±0.09^{a}	37.51±0.21^{a}	3.12± 0.25^{a}	1.94±0.07^{a}	2.60±0.06^{a}	2.55±0.08^{a}	2.35± 0.05^{a}	0.37±0.05^{a}	3.44 ±0.05^{b}	8.84± 0.08^{b}	1.65 ± 0.02^{a}
Gasgie	38.49± 0.24^{a}	6.03 ± 0.05^{c}	35.80± 0.22^{b}	2.72± 0.07^{b}	1.50 ±0.07^{b}	2.27± 0.1^{b}	1.75± 0.08^{b}	1.97± 0.01^{b}	0.28± 0.04^{a}	3.18± 0.03^{c}	9.41± 0.07^{a}	1.54 ± 0.03^{b}
Gugut	35.52 ± 0.15^{b}	7.23 ± 0.05^{b}	34.81± 0.28^{c}	2.75 ±0.06^{b}	1.89± 0.05^{a}	0.94± 0.08^{c}	0.75± 0.06^{c}	1.81 ±0.01^{c}	0.10± 0.02^{c}	3.55± 0.19^{a}	5.86± 0.18^{c}	1.32 ± 0.02^{c}
P-value	0.0001	0.0001	0.0001	0.035	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Sex X ecotype interaction effect												
Male X N	38.70 ± 2.61	9.61± 0.15	38.12± 0.30	3.25± 0.12	2.11± 0.12^{a}	2.76± 0.10^{a}	2.76± 0.14^{a}	2.42± 0.06	0.66 ±0.11^{a}	3.59± 0.07a	9.11± 0.14^{a}	1.78 ± 0.04^{a}
Male X Ga	39.61± 0.30	7.25± 0.10	36.99 ±0.34	3.16± 0.12	1.93 ±0.13^{a}	2.70± 0.14^{a}	2.32± 0.16^{a}	2.00± 0.02	0.49± 0.10^{a}	3.25± 0.07^{b}	9.55± 0.15^{a}	1.71 ± 0.05^{a}
Male X Gu	36.01± 1.64	7.37± 0.09	35.27± 0.72	3.12± 0.10	2.18± 0.09^{a}	1.87± 0.09^{b}	1.49± 0.09^{b}	1.84± 0.03	0.19 ±0.05^{b}	3.71± 0.02a	7.72± 0.23^{c}	1.40 ± 0.04^{b}
Female X N	37.17 ± 0.24	9.04 ± 0.12	36.90± 0.03	2.99± 0.37	1.78± 0.08^{b}	2.44± 0.08^{a}	2.34± 0.10^{a}	2.28± 0 .06	0.09± 0.03^{c}	3.31± 0.06^{ab}	8.56± 0.09^{b}	1.52 ± 0.03^{b}
Female X Ga	37.36± 0.26	6.80± 0.06	34.60± 0.26	3.25± 0.07	1.84±0.06^{b}	1.71± 0.04^{c}	1.19± 0.05^{c}	1.93± 0.01	0.08± 0.02^{c}	3.11± 0.03b	9.27± 0.08^{a}	1.36 ±0.03^{b}
Female X Ga	35.03± 0.18	7.08±0.05	34.34± 0.21	2.38 ±0.06	1.60 ±0.06^{c}	-	-	1.78± 0.02	-	3.39± 0.07^{b}	8.01 ± 0.07	1.23 ± 0.01^{b}
P-value	0.08	0.333	0.083	0.347	0.009	0.0001	0.001	0.554	0.001	0.0001	0.0001	0.0167
Effect of noise components												
EMS	6.96	1.66	9.32	3.46	0.57	1.17	1.31	0.17	0.19	1.87	3.36	0.09

EMS = (noise or unobservable component) errors plaid for deviation from population mean not explained by other fixed effects, **N** = Necked neck, **Ga** = Gasgie, **Gu =** Gugut ecotype, means within a column among indigenous chickens with different superscript letters are significantly ($p < 0.05$) different.

slightly similar to southern Ethiopia (67.8 % and 18.9 %) as reported by Mekonnen (2007). Thus, lower educational background obtained in the study area might be associated with due to lack of security to go to school and access to school.

Interaction Effect of Fixed Factors to Quantitative parameters

Interaction effect results of live body weight and linear body measurements of the three newly investigated

chickens in the fixed effect of sex, ecotype and their interactions are presented in Table 1.

Sex effect: The results of least squares mean analysis indicated that sex had significant ($p< 0.01$) effect on body weight and other linear body measurements. From the current investigation males was significantly ($P<0.01$) influenced and main source of variation in all traits than females except keel length. Therefore, the fixed effect of sex was the main cause of variations of the measurable traits from the population mean. This might be the attribute of the stronger foraging behavior and over computation nature of males than females (Tadelle et al., 2003). In similar reasons sex effects on body weight and other measurable traits obtained in this result was a good agreement with the report of (Tadelle et al., 2003; Halima et al., 2007; Aberra and Tegene, 2011; Nigussie, 2011) who stated that male chickens had better performance than females.

Ecotype effect: It had a significant ($p<0.001$) interaction effect on body weight and linear body measurements among the three local chicken ecotypes. Indeed Necked neck ecotype had largely oriented in bodyweight and liner body measurements than Gasgie and Gugut ecotypes as presented in Table 4.1. Whereas, Gasgie ecotype was significantly ($p<0.01$) longer with interaction effect of keel length among the others. Except shank circumstance, smaller body weight and linear body measurements were obtained from the effect of Gugut chicken ecotype than the other. Results from this study showed significant variation from the interaction effect between different ecotypes on body weight and linear body measurements are consistent with other previous reports from Ethiopia and elsewhere in the tropics (Tadelle et al., 2003) who reported that there were many ecotypes of indigenous chickens showed that variation effect from their adapted production environments to reflect their performance.

Sex by ecotype interaction effect: This finding showed highly significant ($p<0.01$) sex by ecotype interaction effects on comb width, wattle length, wattle width, super length, shank circumstance and keel length of matured chicken ecotype (Table 4.1). However, there was no significant ($P>0.05$) sex by ecotype interaction effects on wingspan, shank length, body length, comb length and beak length among the three breeds. The other quantitative traits had significant ($P<0.05$) effects and this implies the significant variation were indicted that stable parameters were highly associated or governed by genotype rather than environmental effects.

CONCLUSIONS

From this investigation some traits are showed independently significant variation. However, some traits are non significant at their interaction level like wingspan, shank length, body length, comb length and beak length which are not depend on environment. Generally traits are showed significant variation at the interaction level is governed by gene and not depend on environmental factors. The result categorized traits that affected by genes and environments.

RECOMMENDATIONS

- Special emphases on awareness creations of farmers and experts need to be placed for environments and gene governed traits to arrange the production system with associated traits.

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