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Keywords: *egg production performance/utilization/ simada/ebinat /ethiopia.*

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Egg Production Performance and Consumption in Households Engaged in Rearing Bovans Brown Chicken in Three Altitude Ranges of Simada and Ebinat Districts, Northwest Ethiopia

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Keywords: egg production performance/utilization/ simada/ebinat /ethiopia.

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I. Introduction

The global hen egg production has shown a major dynamic during the past two decades (period 1990 – 2009) (FAOSTAT database, 2014). The rapid global increase in egg production has been very unbalanced. Whereas production has shown a rapid increase in Asian countries (+ 8.6 % per year), the increase in volume of egg production in Africa has been restricted to 3.5 % per year, with countries in Eastern Africa showing an annual increase of 1.2 % annually. Corresponding value for Southern Africa was at 6.1 % per year. Data available for 2009 indicate that Asia is the centre for egg production, contributing about 63 % of global egg volume. In contrast, the contribution of African countries to global egg production is about 3.7 %.

Eggs are an inexpensive source of high-quality protein, essential vitamins, and minerals that are needed for a healthy diet and a healthy life. Annual consumption of eggs determined largely by the country's wealth, ranges from 300 g/person in African countries to 19.1 kg in Japan. Only 9 of 43 sub-Saharan African countries have an average consumption higher than 2 kg while most Asian and American people eat at least twice 2 kg (FAO,2012) .Consumption of eggs in Canada went from 22.0 dozens/capita in 1980 to 17.1 dozens/capita in 1995. But a slow gradual increase in consumption started in 1996 due to a variety of factors including the introduction of designer eggs with omega-3 fatty acids and reached 20.5 dozens/capita in 2012 (Food and Agriculture Canada (FAC), 2013). With under nutrition remaining a significant problem in many parts of the developing world, eggs may be regarded as part of the solution to make up malnutrition (Iannotti *et.al,* 2014). According to report by ((IEC, 2011), the per capita consumption of eggs in most countries varied between 2 to 4 eggs per week.

In African countries the majority of poultry are kept by smallholders in less intensive systems (FAO, 2004; 2006). The advantages of these systems are the low levels of market inputs required and the unique products that they produce. Moreover, poultry and poultry products play an important social and cultural role in the lives of rural communities in Africa (FAO, 2010; Ojwang *et al*., 2010; Thornton *et al*., 2013) with a significant impact on development. The role played by the smallholder poultry production include security of supply of animal-based protein sources coming from poultry meat and hen eggs, and nutrition for health cannot be overemphasized (Alders & Pym, 2009).

Ethiopia is one of the few African countries with a significantly large population of chicken, which is estimated at 56 million (CSA, 2014). In Ethiopia, chickens play a significant role in human nutrition; serve as an income source; and are raised by almost all society, from the landless rural poor to the well off in the urban setting (Nigussie Dana *et al.,* 2010). Village chickens have been reared for a long time for similar purposes. They have contributed to the country's economy. This is not because they are productive but are huge in number. Constraints which restrict the potential of village chickens in Ethiopia include; low inputs of feeding, poor management, the presence of diseases of various natures and lack of appropriate selection and breeding practices (Alemu, 1995; Ashenafi, 2000; Tadelle and Ogle, 2001; Mazengia *et.al.,* 2010).

In recent years attempts are underway to enhance poultry productivity and optimize the contribution of chickens to the national economy. Greater efforts have been made to transform the production system into a more commercialized and intensive large-scale system (Ashenafi, 2000). In addition, exotic breeds and cross-breeds are multiplied in government and private owned poultry farms and distributed to individual farmers via the extension division of the Bureau of Agriculture and Rural Development and non-governmental organizations to be maintained and produced under the backyard management system. This is thought to improve the livelihood and nutrition of poor farmers and further to contribute to the national economy at large (Tadelle and Ogle, 2001).

In this study, nutrition at the center (N@C), which is a multi-sectoral and innovative program designed to improve the nutritional status of women of reproductive age (15-49) and children less than 2 years. N@C recognizes the impact of animal food source and is promoting poultry production to improve the nutritional status of a subgroup of participating households (HHs) in its operational areas. N@C is aiming to address the challenges of poultry production by smallholder farmers through a research based pilot intervention in two phases. The first phase pilot poultry interventions were intended to be implemented in 6 Kebeles with different agro-ecology. Therefore, this study focuses on evaluation of egg production performances of Bovans Brown layer chicken and status of egg consumption in the households in different altitudes of Simada and Ebinat districts of Amhara Regional State, North west Ethiopia.

II. Materials and Methods

a) Descriptions of the study area

South Gondar Zone is one of the ten zones in Amhara Regional State located 600 km from Addis Ababa to the northwest of Ethiopia. The zone is bordered by north Gondar zone and Lake Tana in the west and north, North Wollo zone to east and west and east Gojam zones in south. The altitude variation in the zone ranges from 1800 to 4120 meter above sea level (masl). Similarly, the mean annual temperature ranges from 9 to 32ºc. 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 1200 to 1500 mm. The main crops grown in the area are maize, barely, wheat and peas. Similarly, barley, wheat, teff, peas, lentils and fababeans are the main crops cultivated during summer. Wheat and barley are the main food crops while pulses are the main cash crops in the area (CSA, 2014).

The study was conducted in two districts in the N@C program area where chicken development is schemed and implemented through distribution of improved high egg laying breeds. These are: Ebinat and Simada districts (Figure 1).

b) Ebinat

Ebinat district is located 660 kms Northwest of Addis Ababa at an altitude range of 1730-2500 masl. The area is classified as mid-altitude or "Woyna Dega" climatic zone, with an annual rainfall ranging from 800-1000 mm. The mean annual minimum and maximum temperature is about 10-32°C, respectively. Majority of the land is black soil (CSA, 2014).

c) Simada

Simada is located 720 kms Northwest of Ethiopia at an altitude range of 1920-3135 masl. The area is classified as highland or "Woyna Dega" climatic zone, with annual rainfall ranging from 1250-1599 mm. The mean annual minimum and maximum temperature is 9.9-21°C, respectively (CSA, 2014).

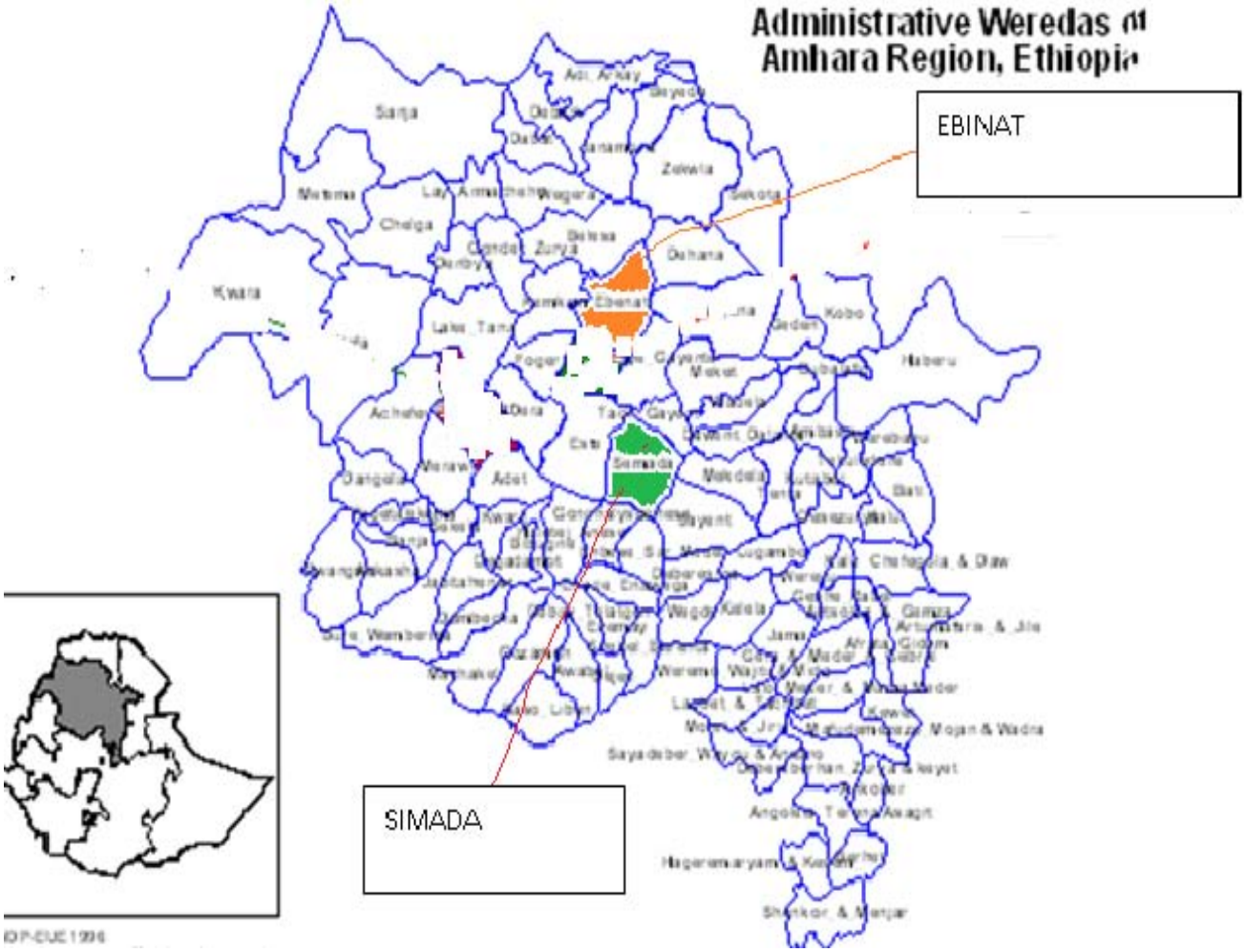

Figure 1: Map of study districts of Amhara region

d) Sample size and sampling methods

From two districts of the zone three kebeles representing each altitude were chosen using purposive sampling techniques.Accordingly, Wonberoch, Selamya and Gelamatebia from Ebinat district, Sergawit, Mindik Hana and Ashera arga were selected and included in Simada district in this study.A multi-stage sampling procedure was employed for this study districts. First the study areas were stratified into three altitude ranges based on altitude as: high altitude (>2200 masl), mid altitude (1700-2200 masl) and low altitude (<1700 masl). This classification was found to be relevant to investigate the variation in egg performance of Bovans Brown to each altitude On-farm monitoring works were taken using randomly selected exotic chicken owners for the purpose of egg production performance and utilization of eggs in the household members in low, medium and high altitude areas of Simada and Ebinat districts. For this purpose 100 household owners (34=Low,34=medium and 32=high altitude ranges) were included for yield and utilization record formats were designed in local language were distributed to be filled by household members.

e) Method of data collection

The record formats were regularly monitored by agriculture extension service experts and local CARE program coordinators and livestock experts. During monitoring/home visits number of eggs laid, no of eggs consumed by under two children, two to five year children, egg consumed by lactating and pregnant women, eggs consumed by other family members were recorded.

f) Data management and statistical analysis

Data were managed both in hard and softcopies. All collected data were entered into Microsoft Excel computer program. SPSS (2011) version 20 was used for analysis. Mean comparisons using Analysis of Variance was used to evaluate egg productivity and utilization among the three altitude ranges. The effects of class variables were expressed as Means ± SD. Tests were considered significant at $p \leq 0.05$.

Considering the average egg size of 50 grams, the FAO database (FAO, 2010b) was used to group countries in terms of weekly egg consumption (≥4

eggs, 2-4< eggs, 1 - 2< eggs and < 1 egg) (FAO,2010b; IEC, 2011).

The following linear models were used during data analysis:

Model statement (1) regarding the effect of altitude areas and district differences on egg production performance and number of laying hens:

$$Yij = \mu + Ai + Bj + Eij$$

Where,

Yij= Chicken egg production performance for in i^{th} altitude areas

μ = The overall mean

Ai = Fixed effect of i^{th} altitude areas (i=3; low altitude, mid altitude and high altitude)

Bj = Districts (j=Ebinat; Simada)

Eij = the residual error.

III. Result

a) Socio-demographic characteristics

The overall mean family size of farmers engaged in chicken raising activity in this study was 4.92± 1.37. Higher family size (4.94±1.43) was found in low altitude areas than medium (4.91±1.38) and high (4.91±1.35) altitude areas. However, there was no any statistically significant difference ($p>0.05$) in mean family size was observed among the three altitude areas. The average family size in Ebinat district (5.18±1.70) was higher than Simada (5.08±1.31) district but no any statistically significant difference ($p>0.05$) in family size was observed between the study districts (Table 1).

The mean number of under-two children (UTC) in study districts was 0.98±0.38. Higher number of UTC was found in low (1.00±0.49) and high (1.00±0.36) altitude areas than medium (0.94±0.24) altitude. The average number of UTC in Ebinat district (1.00±0.07) was higher than Simada district (0.96±0.19).Similarly the mean number of children between two to five years of age in both districts is 0.85±0.78 while it was higher in low altitude areas (1.00±0.78) than medium (0.74±0.79) and high (0.81±0.78) altitude areas. On the other hand, the mean number of lactating women (LW) in the study areas was 0.91±0.29. Higher number of LW were found in medium (1.00±0.00) altitude areas than low (0.85±0.36) and high (0.88±0.34) altitude areas.

The mean number of lactating women (LW) was higher in medium (1.00±0.00) altitude areas than low (0.85±0.36) and high (0.88±0.34) altitude areas. There was statistically significant difference ($p<0.05$) in average number of LW between Simada (0.86±0.35) and Ebinat(0.96±0.19) districts. Similarly, the average number of pregnant women (PW) in study areas was below one. The average PW in both study districts was 0.08±0.27. It was higher in high altitude areas than medium and high altitude areas. The average number of other family members (excluding under two children, between two and five year children, lactating and pregnant women) was 1.6±1.37. Higher number of OFM was found in medium (1.94±1.49) altitude areas than low (1.62±1.30) and high (1.47±1.29) altitude area (Table 1).

b) Egg production performance

The mean number of laying hens in the study districts was 4.11±0.81 whereas mean number of laying hens in medium altitude areas (4.29±0.52) was higher than low (3.76±1.07 and high (4.28±0.63) altitude areas. Moreover, there was significant difference ($p<0.05$) in mean number of laying hens among the three altitude areas. Despite relatively higher mean number of laying hens found in Simada district (4.13±0.34) than Ebinat (4.04±1.03), no statistically significant difference ($p>0.05$) in average number of laying hens was found among the two districts. The mean number of laying hens across study districts was not found uniform, lower than 5 laying hens/ household.

In this study mean number of eggs laid /month/hen was 26.33±0.69. Higher number of eggs per hen was found in low altitude areas (27.22±6.43) than medium (24.82±1.37) and high (26.89±1.07) altitude areas during 30 days. The mean number of eggs laid per hen in Simada district was significantly ($p<0.05$) higher than Ebinat district. Similarly, the mean number of eggs laid in the study period in both districts was 106.79±33.74. Moreover, there was statistically significant difference ($p<0.05$) in average number of eggs collected in high (112.81±27.37), medium (105.26±32.98) and low (102.65±12.64) altitude areas. The mean number of eggs collected per household in Simada district (125.60±12.64) was found higher than that of Ebinat district (87.98±37.66). Moreover, there was high significant difference ($p<0.05$) in mean number of egg collected per household between study districts (Table1).

Table 1: Egg production performance and socio-demographics characteristics of the households in the three attitude areas of Simada and Ebinat districts

Parameter	Ebinat (Mean±SD)				Simada (Mean±SD)				Overall (Mean±SD)			
	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=34)	Medium (n=34)	High (n=32)	Total (n=100)
Av. family size	4.71(1.10)	4.94(1.75)	4.63(1.45)	4.76(1.44)	5.18(1.70)	4.88(0.93)	5.19(1.22)	5.08(1.31)	4.94(1.43)	4.91(1.38)	4.91(1.35)	4.92(1.37)
Av. no. of laying hens	3.24(1.15)	4.47(0.51)	4.44(0.81)	4.04(1.03)	4.29(0.68)	4.12(0.48)	4.13(0.34)	4.18(0.52)	3.76(1.07)	4.29(0.52)	4.28(0.63)	4.11(0.81)
Av. no. egg laid/household/month	75.12(37.24)	86.71(36.99)	103.00(35.49)	87.98(37.66)	130.18(15.42)	123.83(11.94)	122.63(8.89)	125.60(12.64)	102.65(39.60)	105.26(32.98)	112.81(27.37)	106.79(33.74)
Av. no. of eggs laid / hen/month	23.84(7.34)	19.44±(8.14)	24.21(7.71)	22.46(7.89)	27.61(2.67)	29.21(2.11)	28.42(0.51)	28.41(1.99)	27.22(6.43)	24.82±1.37	26.02±1.07	25.45.33±0.69
Av. no. of UTC	1.12(0.60)	0.88(0.33)	1.00(0.49)	1.00±0.07	0.88(0.33)	1.00(0.00)	1.00(0.00)	0.96(0.19)	1.00(0.49)	0.94(0.24)	1.00(0.36)	0.98(0.38)
Aver.no.2 to 5 yr children	1.35(0.78)	0.82(0,95)	1.25(0.77)	1.14(0.86)	0.65(0.61)	0.65(0.61)	0.38(0.50)	0.56(0.58)	1.00(0.78)	0.74(0.79)	0.81(0.78)	0.85(0.78)
Aver. no. of LW	0.82(0.39)	1.00(0.00)	0.75(0.45)	0.86(0.35)	0.88(0.33)	1.00(0.00)	1.00(0.00)	0.96(0.190	0.85(0.36)	1.00(0.00)	0.88(0.34)	0.91(0.29)
Aver. no. of PW	0.00(0.00)	0.12(0.33)	0.25(0.45)	0.12(0.33)	0.12±0.08	0.00(0.00)	0.00(0.00)	0.04(0.19)	0.06(0.24)	0.06(0.24)	0.13(0.34)	0.08(0.27)
Aver. no. of OFM	1.41(1.37)	2.53(1.46)	1.19(1.33)	1.72(1.48)	1.82(1.24)	1.35(1.32)	1.75(1.24)	1.64(1.26)	1.62(1.30)	1.94(1.49)	1.47(1.29)	1.6(1.37)

c) Egg Consumption

The mean monthly egg consumption by UTC in the study area was 25.93±19.89 However, there was no any statistically significant difference ($p>0.05$) among low (26.79±19.88) medium (27.59±19.04) and high (23.29±20.64) altitude areas. However, there was statistically significant difference ($p<0.05$) in egg consumption of UTC between Simada (39.76±17.91) and Ebinat (12.11±8.43) districts. Similarly, mean monthly egg consumption by children between two and five years old was 17.41±17.42 .However, no any statistically significant difference ($p>0.05$) in egg consumption by UTC among the three altitude areas was observed. The mean monthly egg consumption between two and five year old children in Ebinat (15.33±11.57) was lower than Simada (19.30±21.73) district. On the other hand, the mean monthly egg consumption by LW and PW in the study areas were 19.39±10.13 and 1.84±7.80 respectively. There was statistically significant difference ($p<0.05$) in egg consumption of both for LW and PW among the three altitude areas. Similarly, the mean monthly egg consumption by OFM and AFM were 10.06±9.58 and 21.10±9.74 respectively. However, there was no any statistically significant difference ($p>0.05$) among the three altitude areas on mean number of eggs consumed both OFM and AFM. However, the mean number of egg consumed by OFM and AFM showed statistically significant difference ($p<0.05$) between study districts. The mean monthly eggs sold for generating income by household members in the three altitude areas was 21.11±19 and it was higher in high (23.06±16.21) altitude areas than that of low (18.85±22.89) and medium (21.53±10.08) altitude areas. The mean monthly eggs sold were higher in Simada district (26.44±8.16) than Ebinat district ±18.86 (22.08). Multivariate analysis showed that district, altitude and interaction of district and altitude have significant effects on egg production performance and consumption (Table 2).

Table 2: Monthly egg consumption among family members in the three altitudes areas of Simada and Ebinat districts

Parameter	Ebinat (Mean±SD)				Simada (Mean±SD)				Overall (Mean±SD)			
	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=34)	Medium (n=34)	High (n=32)	Total (n=100)
Average no. of eggs consumed/UT C /month	11.76(8.50)	13.53(11.06)	10.97(8.89)	12.11(8.43)^{a}	41.76(17.48)	41.65(14.32)	35.63(21.84)	39.76(17.91)^{b}	26.79(19.88)^{c}	27.59(19.04)^{c}	23.29(20.64)^{c}	25.93(19.89)
Av no. of eggs consumed / 2-5 yr/month	14.91(10.04)	9.88(9.11)	22.18(12.56)	15.53(11.57)^{a}	28.59(19.82)	22.17(22.18)	14.88(23.79)	19.30(21.73)^{a}	17.75(15.74)^{c}	16.03(17.82)^{c}	18.53(19.08)^{c}	17.41(17.42)
Avr. no. of eggs consumed /LW/month	16.88(13.09)	14.41(8.39)	23.31(16.25)	18.10(13.19)^{a}	18.41(8.23)	20.76(2.19)	21.94(4.11)	20.68(5.47)^{a}	18.15(10.84)^{c}	17.59(6.85)^{c}	22.62(11.68)^{c}	19.39(10.13)
Avr. no. of eggs consumed per PW /month	0.00(0.00)	0.00(0.00)	7.38(14.31)	2.36(8.69)^{a}	3.88(11.63)	0.00(0.00)	0.00(0.00)	1.32(6.90)^{a}	1.94(8.33)^{c}	0.00(0.00)^{c}	3.69(10.64)^{c}	1.84(7.80)
Av. no. of eggs consumed/ OFM/month	8.54(8.40)	9.34(5.83)	14.47(17.42)	10.71(11.57)^{a}	9.70(6.77)	8.29(7.88)	10.25(6.89)	9.40(7.10)^{b}	9.12(7.53)^{c}	8.82(6.85)^{c}	12.36(13.20)^{c}	10.06(9.58)
Av. no. of eggs consumed/ AFM/month	14.20(6.35)	12.07(4.81)	21.36(9.95)	15.76(8.17)^{a}	26.44(8.30)	27.70(8.53)	25.08(7.94)	26.44(8.16)^{b}	20.32(9.57)^{c}	19.88(10.46)^{c}	23.22(9.06)^{c}	21.10(9.74)
Aver no. of eggs sold/month	13.29(21.92)	23.12(23.65)	20.25(20.64)	18.86(22.08)a	24.41±5.61	19.94(23.12)	25.88(9.990	23.36(15.72)^{b}	18.85(22.89)^{c}	21.53(10.08)^{c}	23.06(16.21)^{c}	21.11(19.20)

$^{a, b, c}$ *means with different superscript letters across a raw are significantly different at $p<0.05$*

The weekly egg consumption results presented in Table 3 show more family members had consumption of at least 2 eggs per week than for lactating women who consumed below 1 egg per week in the study period. The highest weekly egg consumption per week was found in under two children (UTC) 6.48±4.97) followed by all family member (1.33±0.55), two to five children (4.35±4.35), lactating women (4.85±2.53), other family members (2.51±2.39). In this study altitude range was found to have any statically significant difference ($p>0.05$) on weekly egg consumption. However, district has statically significant difference ($p<0.05$) on weekly egg consumption for UTC and all family members weekly egg consumption.

Table 3 : Comparison of Weekly Egg Consumption in the Three Altitudes Areas of Simada and Ebinat Districts

Parameter	Ebinat Mean (SD)				Simada Mean (SD)				Overall Mean (SD)			
	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=17)	Medium (n=17)	High (n=16)	Sub-total (n=50)	Low (n=34)	Medium (n=34)	High (n=32)	Total (n=100)
Avr. no. of eggs consumed/ UT C /week	2.94(2.12)	3.38(2.76)	2.74(2.22)	3.03(2.36)[a]	10.44(4.37)	10.41(3.58)	8.91±5.46	9.94(4.48)[b]	6.69(5.09)[c]	6.90(4.76)[c]	5.82(5.16)[c]	6.48(4.97)
Av no. of eggs consumed / two to five children /week	3.73(2.51)	2.47(2.28)	5.55(3.14)	3.88(2.89)[a]	515(4.96)	5.54(5.55)	3.72(5.95)	4.83(5.43)[a]	4.44(.93)[c]	4.01(4.46)[c]	4.63(4.77)[c]	4.35(4.35)
Avr. no. of eggs consumed /Lactating women/week	4.22(3.27)	3.60(2.10)	5.83(4.06)	4.52(3.30)[a]	4.85(2.06)	5.19(0.55)	5.48(1.03)	5.17(1.37)[a]	4.54(2.71)[c]	4.40(1.71)[c]	5.66(2.92)[c]	4.85(2.53)
Avr. no. of eggs consumed per pregnant women /week	0.00(0.00)	0.00(0.00)	1.84(3.58)	0.59(2.16)[a]	0.97(2.91)	0.00(0.00)	0.00(0.00)	0.33(1.72)[a]	0.49(2.08)[c]	0.00(0.00)[c]	0.92(2.66)[c]	0.46(1.95)
Av. no. of eggs consumed/ OFM/month	2.14(2.10)	2.34(1.46)	3.62(4.36)	2.68(2.89)[a]	2.43(1.69)	2.07(1.97)	2.56(1.72)	2.35(1.78)[a]	2.28(1.88)[c]	2.21(1.71)[c]	3.09(3.340)[c]	2.51(2.39)
Av. no. of eggs consumed/ AFM/month	1.71(0.59)	1.76(0.56)	1.44(0.73)	1.64(0.63)[a]	1.06(0.24)	1.00(0.00)	1.00(0.00)	1.02(0.41)[b]	1.38(0.55)[c]	1.38(0.55)[c]	1.22(0.55)[c]	1.33(0.55)

[a, b, c] means with different superscript letters across a raw are significantly different at $p<0.05$,
** Calculation of egg consumption based on a 50 gram egg, adapted from FAO (2010b).*

The results presented in Table 4 show the proportion of family members on the bases of weekly egg consumption categories (> 4 eggs, 2-4< eggs, 1 - 2< eggs and < 1 egg). In this study, 57% of under-two children in the categories of were found consuming weekly egg consumptions > 4 eggs . However, greater percentage of UTC in the categories of 1-2 eggs and <1 egg weekly were 28% and 72% respectively. There were statistically significant difference ($p>0.05$) in weekly egg consumption categories of 1-2 eggs and <1 eggs between districts. However, there was no any statistically significant differences ($p>0.05$) in weekly egg consumptions by UTC among altitude ranges. On the other hand, 47 % of children between two and five years were found to consume > 4 eggs weekly and 35% and 14% of them were found to less than 1 egg per week and 1-2 egg per week respectively.. Similarly, 72 % of LW was found to consume > 4 eggs weekly and 11% and 13% of them were found to less than 1 egg per week and 1-2 egg per week respectively. In this study 94% of pregnant women were found to consume <1 egg per week whereas 38% of other family members were found consumed 2-4 egg per week. Similarly, the 71% of the total family members were found consumed >4 eggs per week. In this study district and altitude were found have statistically significant ($p<0.05$) effects on weekly egg consumption for under two children, lactating women and total family members.

Table 4: Percentage of family members based on weekly egg consumption categories in the three altitudes areas of Simada and Ebinat districts

Category weekly egg consumption	Ebinat				Simada				Overall			
	Low	Medium	High	Sub-total	Low	Medium	High	Sub-total	Low	Medium	High	Total
Under Two Children	17	17	16	50	17	17	16	50	29	31	25	100
>4 eggs	4	6	3	13	15	16	13	44	19	22	16	57
2-4 eggs	7	4	7	18	0	0	0	0	7	4	7	18
1-2 eggs	3	5	2	10[a]	0	0	0	0[b]	3	5	2	10
< 1 egg	3	2	4	9[a]	2	1	3	6[b]	5[b]	3[b]	7[b]	15
Two to five children	17	17	16	50	17	17	16	50	25	20	20	100
>4 eggs	8	5	9	22	10	10	5	25	18	15	14	47
2-4 eggs	5	4	5	14	0	0	0	0	5	4	5	14
1-2 eggs	2	1	1	4	0	0	0	0	2	1	1	4
< 1 egg	2	7	1	10[a]	7	7	11	25[a]	9[c]	14[c]	12[c]	35
Lactating women	17	17	16	50	17	17	16	50	11	13	4	100
>4 eggs	8	4	12	24[a]	15	17	16	48[b]	23[c]	21[c]	28[c]	72
2-4 eggs	4	9	0	13	0	0	0	0	4	9	0	13
1-2 eggs	2	2	0	4	0	0	0	0	2	2	0	4
< 1 egg	3	2	4	9	2	0	0	2	5	2	4	11
Pregnant women	17	17	16	4	17	17	16	2	2	0	4	100
>4 eggs	0	0	3	3	2	0	0	2	2	0	3	5
2-4 eggs	0	0	1	1	0	0	0	0	0	0	1	1
1-2 eggs	0	0	0	0	0	0	0	0	0	0	0	0
< 1 egg	17	17	12	46[a]	15	17	16	48[a]	32[c]	34[c]	28[c]	94
Subtotal												
Other family members	17	17	16	34	17	17	16	36	25	24	21	100
>4 eggs	3	2	6	11	3	2	2	7	6	4	8	18
2-4 eggs	6	5	3	14	7	8	9	24	13	13	12	38
1-2 eggs	2	7	0	9	4	0	1	5	6	7	1	14
< 1 egg	6	3	7	16[a]	3	7	4	14[a]	9[c]	10[c]	11[c]	30
Total family members	17	17	16	28	17	17	16	1	12	12	5	100
>4 eggs	6	5	11	22[a]	16	17	16	49[a]	22[c]	22[c]	27[c]	71
2-4 eggs	10	11	3	24	1	0	0	1	11	11	3	25
1-2 eggs	1	1	2	4	0	0	0	0	1	1	2	4
< 1 egg	0	0	0	0	0	0	0	0	0	0	0	0

(Calculation of egg consumption based on a 50-gram egg, adapted from FAO (2010b)

IV. Discussion

This study discloses some of the most important aspects of egg production performance and egg consumption in selected districts the Amhara region, particularly in Simada and Ebinat districts. The overall mean flock size of exotic chickens was 4.92 per household, is lower than the reports of Brihane Gebremariam *et al.* (2015) in southern Tigray, who also reported a mean flock size of exotic chicken about 13.86 per household. Similarly, Gueye (1997) also reported that a flock size per African village household generally ranges from 5 to 20. Moreover, an average flock size of 16 birds per household was also reported in some villages in Ethiopia and Kenya (Tadelle *et al*., 2003; Njenga, 2005).

The mean number of laying hens across study districts was not found to be uniform, lower than five laying hens/ household. This is attributed to failure in sex identification of pullets during distribution by livestock promotion and marketing experts.

The mean number of eggs/month/hen (26.33±0.69) reported in this study was higher than those reported by Lemlem and Tesfaye (2010) for White Leghorn, Rhode Island Red and Fayoumi chicken under village household condition; the reason for higher egg yield in this study might be attributed to the differences in genotype of the bird and feeding management used and the period lapsed for data collection. The higher egg production performance in this study was significantly higher than local chickens, which lay 55 to 80 eggs/year (Dessie and Ogle, 2001). On the other hand, the average number of eggs laid per hen/month in this study (25.45.33±0.69) clearly showed that Bovan brown layers kept under rural household conditions were superior in egg production to local layers kept under similar conditions. This result is in agreement with the reports of Desalew *et.al* (2013), Majaro (2001) and Yakubu *et al.* (2007).

The overall weekly egg consumption per week (6.48±4.97) in under-two children in this study is in agreement with the report of (FAO, 2007) which indicated egg consumption in period's between 2003 to 2005 in 31 out of 65 countries. On the other hand, the percentage of family members consumed >4 eggs per week from UTC, two to five children, lactating women were 57%,47% and 72% respectively. This finding is also similar with the report of Guyonnet (2013). On the other hand, 94% of pregnant women in the study areas were found consuming <1 egg per week. This finding is lower than the per capita consumption of eggs in most countries which varied between 2 to 4 eggs per week (IEC, 2011). The low consumption of egg per week in pregnant women might be attributed to lack of awareness on the nutritional value of egg for health of the pregnant women and growth of the fetus.

V. Conclusions and Recommendations

The first phase pilot poultry development interventions which was implemented in 6 *kebeles* with three altitude ranges of south Gonada, aprticulaly of Simada and Ebinat districts showed promising output. The result of this study clearly showed that Bovan Brown hens performed better than local hens, under semi-intensive production systems, in terms of egg production. There seems an economic and nutritional justification for keeping high egg yielding Bovans brown layer chickens in the rural households of South Gondar Zone of Amhara Regional State with close supervision of livestock production and animal health experts. Moreover this study reveals altitude ranged do not have any significant effects on the egg production performance as well as egg consumption as far as the chickens are distributed after grown in satellite brooding centers and distributed at the age of above 3 months. This study results show that egg consumption increases in the households excepting for pregnant women in the study communities.

The results of this study are inciting and accordingly the following points are strongly recommended.

- Awareness creation and changing the attitudes of pregnant women towards egg consumption should be implemented by local GOs and NGOs.
- Further studies should be conducted on the attitudes, perceptions and behaviors of household members towards egg consumption and egg sale.
- It would be timely to explore how to sustain and scale up this effort.
- Any endeavor towards poultry development and research in the study area should include the consumption and nutritional aspects of poultry products at household level.

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