ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

JUNE 2012
DEBRE ZEIT, ETHIOPIA

ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master in Tropical Animal Production and Health

JUNE 2012
DEBRE ZEIT, ETHIOPIA

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

Board of External Examiners	Signature
1. Prof. Tesfu Kassa	_____
2. Dr. Kelay Belihu	_____
3. Mr. Tesfaye Lemma	_____

Academic Advisors	
1. Prof. Harpal Singh	_____
2. Dr. Tadelle Dessie	_____
3. Dr. Ashenafi Mengistu	_____

ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

JUNE 2012
DEBRE ZEIT, ETHIOPIA

ADDIS ABABA UNIVERSITY
COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

A thesis submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master in Tropical Animal Production and Health

JUNE 2012
DEBRE ZEIT, ETHIOPIA

MANAGEMENT PRACTICES, PRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS OF EXOTIC CHICKENS UNDER VILLAGE PRODUCTION SYSTEM IN EAST SHEWA, ETHIOPIA

BY

DESALEW TADESSE TEGEGNE

Board of External Examiners	Signature
1. Prof. Tesfu Kassa	_____
2. Dr. Kelay Belihu	_____
3. Mr. Tesfaye Lemma	_____

Academic Advisors	
1. Prof. Harpal Singh	_____
2. Dr. Tadelle Dessie	_____
3. Dr. Ashenafi Mengistu	_____

TABLE OF CONTENTS

PAGES

TABLE OF CONTENTS i

LIST OF TABLES iv

LIST OF FIGURES v

LIST OF ANNEXES vi

LIST OF ABBREVATIONS vii

ACKNOWLEDGEMENTS viii

ABSTRACT ix

1. INTRODUCTION 1

2. LITERATURE REVIEW 3

2.1. Poultry production systems 3

2.2. Village /indigenous/scavenging chicken production systems in Ethiopia 4

2.2.1. Housing, feeding and watering under village condition 4

2.2.2. Marketing 5

2.2.3. Use of agricultural extension services 6

2.2.4. Poultry health management 6

2.3. Productive performances 7

2.3.1. Productive performance of local/indigenous chickens 7

2.3.2. Productive performance of improved chickens 8

2.4. Egg quality traits 10

2.5. Socio-economic aspect of rural poultry production 13

2.6. Major Constraints of village chicken production in Ethiopia 13

3. MATERIALS AND METHODS 15

3.1. Description of study areas 15

3.2. Distribution of improved breeds in the study areas **16**

3.3. Study Methodology **17**

3.3.1. Sample size determination 17

3.3.2. Selection of study households 17

3.3.3. Study populations 18

3.4. Data collection **18**

3.4.1. Questionnaire survey 18

3.4.2. Variables Measured 18

3.4.2.1. Mature body weight *18*

3.4.2.2. Evaluation of internal and external egg quality *19*

3.5. Data management and analysis **19**

4. RESULTS **20**

4.1. Household characteristics **20**

4.2. Poultry housing system and facilities **20**

4.3. Feeds and feeding practices **21**

4.4. Watering **22**

4.5. Type and source of improved chicks **23**

4.6. Marketing **23**

4.6.1. Market access for poultry products and production inputs 23

4.6.2. Practice of selling eggs and chicken 24

4.6.3. Selling time and consumer preference 24

4.7. Use of agricultural extension services **25**

4.7.1. Poultry production training 25

4.7.2. Credit services 26

4.8. Poultry health management **26**

4.8.1. Use of vaccination 26

4.8.2. Use of anti-ectoparasites, prophylactic measures and culling practice 27

4.9. Productive performances **27**

4.9.1. Egg production 27

4.9.2. Pullet age at first laying and mature hen body weight 28
4.9.3. Egg quality traits 28
4.10. Constraints 30
4.11. Options suggested by farmers to improve poultry productivity 30
5. DISCUSSION 32
6. CONCLUSION AND RECOMMENDATIONS 39
7. REFERENCES 40
8. ANNEXES 52
9. Signed DECLARATION Sheet 58

LIST OF TABLES

Pages

Table 1: Household characteristics of respondents in Ada'a and Lume districts 20
Table 2: Poultry housing system and facilities used in Ada'a and Lume districts 21
Table 3: Poultry feeds and feeding practices in Ada'a and Lume districts 21
Table 4: Frequency and source of water used for chicken in Ada'a and Lume districts 22
Table 5: Types and source of improved chicks used in Ada'a and Lume districts 23
Table 6: Market access for poultry products and production inputs in Ada'a and Lume districts 23
Table 7: Time of selling and consumer egg preference in Ada'a and Lume districts 25
Table 8: Use of agricultural extension services in poultry production in Ada'a and Lume districts 25
Table 9: Training and credit services provided in Ada'a and Lume districts 26
Table 10: Use of vaccines to control poultry diseases in Ada'a and Lume districts 27
Table 11: Use of anti-ectoparasites, prophylactic and culling practice in poultry in Ada'a and Lume district 27
Table 12: Mean annual egg production of IB, BB and PK type chickens in two districts 28
Table 13: Age at first laying and mature hen body weight of exotic chickens in Ada'a and Lume districts 28
Table 14: Egg quality traits of exotic chickens in Ada'a and Lume districts 29
Table 15: Major constraints of poultry production in order of importance in Ada'a and Lume districts 30
Table 16: Options to improve poultry productivity in Ada'a and Lume districts 30

LIST OF FIGURES

Pages

Figure 1: Map of study areas /East Shewa zone of Oromia Region 16

Figure 2: Practices used for selling of eggs and chicken in Ada'a and Lume districts 24

LIST OF ANNEXES

Pages

Annex 1: Questionnaire Format.....52
Annex 2: Egg yolk color from egg collected during the survey work.....57
Annex 3:Measuring eggshell thickness using digital Caliper.....57
Annex 4: Housing system used with facility of feeding and watering trough at village.....57

LIST OF ABBREVATIONS

AH	Albumin Height
ANOVA	Analysis of Variance
BB	Bovan Brown
CSA	Central Statistical Agency
BN	Bovan Nera
DAs	Development Agents
DB	Dominant Black
DD	Dekalb Delta
DZARC	Debre Zeit Agricultural Research Center
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
HU	Haugh Unit
IB	Isa Brown
PK	Potchefstroom Koekoek
EW	Egg Weight
GDP	Gross Domestic Product
IBD	Infectious Bursa Disease
ILRI	International Livestock Research Institute
JICA	Japan International Cooperation Agency
ND	Newcastle Disease
NGO'S	Non Governmental Organizations
PAs	Peasant Associations
RIR	Rhode Island Red
SPSS	Statistical Package for Social Sciences
WLH	White Leghorn
SD	Standard Deviation
SE	Standard Error
SNNPR	Southern Nations and Nationalities People Region
TSS	Technical Services and Supplies

ACKNOWLEDGEMENTS

The reverence is to the omnipotent "Almighty God" who enabled the author to complete this thesis successfully.

The author avails himself of the opportunity of expressing his sense of appreciation and sincere gratitude to his advisor, Prof. Harpal Singh, Department of Animal Production Studies, Addis Ababa University for his help and advice in carrying out the research and preparation of thesis. The author equally indebted towards his co-advisor Dr. Ashenafi Mengistu for his help and advice during his research and thesis preparation.

The author expresses his deepest sense of gratitude and profound regards to his co-advisor Dr. Tadelle Dessie, Biotechnology Theme, International Livestock Research Institute (ILRI). Your willingness to take me on as a graduate student is something that I appreciate beyond words. Your support and encouragement has helped me to stay focused and to push through this work, giving it all that I possibly can. The author would like to thank ILRI for financial support to complete this piece of work.

The author would like to thank Mekelle University, for sponsoring and permit study leave almost for the last two years.

The author acknowledges his gratefulness to Mr. Dehninet Gezie (PhD candidate) for his invaluable comments during preparation of this thesis work. The author explicit his gratefulness and cordial thanks to Mr. Wondimeneh Esatu (PhD candidate) for his great help during designing the questionnaire.

The author extends his thanks to Rahel Misganaw for facilitating things to start the data collection early, Mekdes Teka and Zewdnesh Asmamaw for their sincere help during the data collection stage of the study. Further, Ada'a and Lume District Agricultural Office staffs, extension agents and interviewed farmers. Special thanks goes to Mr. Misaile Admasu, Mr. Sisay Tufa and Mr. Musa Tune for their great help in coordinating the data collection task.

Finally, the author feels to express his heartiest gratitude to his family, Tesfaye Merawi, Atsed Tesfaye and Zewdu Gessesse for their moral support.

ABSTRACT

A cross sectional study was conducted with the objectives of assessing management practices, evaluate productive performance and egg quality traits of Isa Brown (IB), Bovan Brown (BB) and Potchefstroom Koekoek (PK) under village production system, from November 2011 to May 2012 in Ada'a and Lume districts of East Shewa, Ethiopia. Totally, 180 randomly selected respondents were included in the study from six purposively selected Peasant Associations (PAs) from two districts. The data collected were analyzed using SPSS version 17. In both districts, 97.8% of the respondents provided additional supplement. Over 95% of the respondents used maize and wheat as additional supplements, mostly three times a day. About 96% of respondents in both districts provided water with free access. The 80 % in Ada'a and 71.2% respondents in Lume districts had good market access to procure poultry production inputs and 68.8% in Ada'a and 94.4% respondents in Lume had good market access to sell eggs and chicken. Extension services were used by 41.2% in Ada'a and 53.4% respondents in Lume districts. The 78.8% of respondents did not vaccinate their chicken, in Ada'a, whereas 80% of respondents vaccinate their chicken in Lume districts. Collectively, about 56% of the respondents provided Oxy-tetracycline 20% as prophylactic measures against various poultry diseases. The average eggs laid/year/bird was 276.1, 266.32, and 178.07 eggs for IB, BB and PK, respectively. Average age at first laying was 160.5, 165.5 and 153 days for IB, BB and PK respectively. BB was superior for egg weight, yolk height, albumin height, albumin weight, Haugh Unit and eggshell thickness than IB and PK. IB was found to be superior to BB and PK for yolk weight, whereas PK was superior to IB and BB for yolk colour. Diseases, in adequate veterinary services, feed shortage and predators were listed as major constraints in both districts. Getting improved chicks at affordable price, provision of vaccination, training on poultry rearing, supply of electricity and clean water were mentioned as option to improve chicken productivity in the study areas. In this study, the performance of hybrid layers seems to be over reported by farmers and this requires further study considering the amount of additional feed supplement by farmers' and proper recording on the number of eggs to better conclude on their productive performances.

Key words: *Exotic chicken, village poultry production system, productive performances, egg quality traits*

1. INTRODUCTION

Poultry production has an important economic, social and cultural benefit and plays a significant role in family nutrition in the developing countries. The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world (Delgado *et al.*, 1999). It has been estimated that 80% of the poultry population in Africa is found in traditional scavenging systems (Gueye, 2000). In most tropical countries it is based mainly on scavenging production systems, which makes substantial contributions to household food security throughout the developing world (Muchadeyi *et al.*, 2007).

Indigenous breeds still contribute meaningfully to poultry meat and egg production and consumption in developing countries, where they make up to 90% of the total poultry population. All over the developing world, these low-input, low output poultry-husbandry systems are an integral component of the livelihoods of most of rural, peri-urban, and some urban households and are likely to continue to meet this role for the foreseeable future (Besbes, 2009).

Livestock production covers 40% of agricultural output in Ethiopia, playing an important role in the national economy as it contributes 18% of the total GDP (FAO, 2004). A Central Statistics Agency (CSA) (2005) report revealed that 97.8% of the total poultry population comprises indigenous birds, while 2.2% are exotic breeds. The poultry sector in Ethiopia can be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feed, health, technology, and bio-security. These are large commercial, small scale commercial and village or backyard poultry production system. These production systems have their own specific chicken breeds, inputs and production properties. Each can sustainably coexist and contribute to solve the socio-economic problems of different target societies (Tadelle *et al.*, 2003c).

The backyard (traditional) poultry production system is characterized by low input, low output and periodic destruction of large proportion of the flock due to disease outbreaks (Tadelle *et al.*, 2003b). With the aim of improving poultry productivity, different breeds of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) were imported to Ethiopia since the 1950's. 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 a substantial effort to introduce improved hybrid layer chickens particularly Isa Brown (IB), Bovan Brown (BB) and dual purpose hybrid Potchefstroom Koekoek (PK) to smallholder farmers under backyard management in Ada'a and Lume districts. However, lack of recorded data on the performance of chicken and all aspects of management, lack of regular chicken health program and market information makes it difficult to assess the importance and contributions of the past attempts to improve the sector (Moges *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 layers such as IB, BB and a dual-purpose hybrids (PK) in Ada'a and Lume districts of East Shewa Zone, of Oromia region. The quality of egg laid could be one indication of productivity and the overall care given for improved chicken at village level. As a result, systematic study is required to assess management practices used, determine productive performances, and evaluate egg quality traits of improved poultry chicken under village production system. Thus, the present study was conducted in Ada'a and Lume districts, Eastern Shewa, Ethiopia with the following objectives:

- To asses management practices for exotic chicken under village production system in Ada'a and Lume districts.
- To determine the productive performances and evaluate egg quality traits of different exotic chicken under village production system.
- To identify constraints and suggest possible interventions under village chicken production system in the study areas.

2. LITERATURE REVIEW

2.1. Poultry production systems

The poultry sector in Ethiopia can be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feeding, health, technology and bio-security. These are large scale commercial poultry production system, small-scale commercial poultry production system and village or backyard poultry production system (Bush, 2006).

The large-scale commercial production system is highly intensive production system involves an average of greater or equal to 10,000 birds kept under indoor conditions with a medium to high bio-security level. This system heavily depends on imported exotic breeds that require intensive inputs such as feed, housing, health, and modern management systems. It is estimated that this sector accounts for nearly 2% of the national poultry population. This system is characterized by higher level of productivity where poultry production is entirely market oriented to meet the large poultry demand in major cities. The existence of somehow better biosecurity practices has reduced chick mortality rates to merely 5% (Bush, 2006).

Small-scale intensive production system is characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security. Most small-scale poultry farms obtain their feed and foundation stock from large-scale commercial farms (Nzietchueng, 2008). There are few studies about diseases affecting poultry in this production system. Kinung'hi *et al.* (2004) mentioned coccidiosis as a cause of mortality, reduced weight gain and egg production and market value of affected birds.

Village/indigenous production system characterized by little or no inputs for housing, feeding (scavenging is the only source of diet) and health care with minimal level of bio-security, high off take rates and high level of mortality. As such, it does not involve investment beyond the cost of the foundation stock, a few handfuls of local grains and possibly simple night shades, mostly night time in the family dwellings. Mostly, indigenous chickens are kept although some hybrids and exotic breeds may be kept under this system (Dawit *et al.*, 2008).

2.2. Village /indigenous/scavenging chicken production systems in Ethiopia

In Ethiopia chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tadelle *et* al., 2003a). The country has diverse agro-climatic conditions favoring production of many different kinds of crops, providing a wide range of ingredients and alternative feedstuffs suitable for poultry feeding. Making use of these resources to complement the scavenging resource base promises a considerable potential for success (Dessie and Ogle, 2001).

2.2.1. Housing, feeding and watering under village condition

Housing systems in backyard system is rudimentary and mostly built with locally available materials. In traditional free range, there is no separate poultry house and the chickens live in family dwelling together with humans (Solomon, 2007). Moges *et al.* (2010a) reported that in Bure district, North West Ethiopia, 77.9% of the village chicken owners provide only night shelter and only 22.1% provided separate poultry house. Another study by Mengesha *et al.* (2011) in Jamma district, South Wollo reported that 41.3% and 21.2% of chicken owners share the same room and provided separate poultry house, respectively.

Family chicken production is an appropriate system that makes the best use of locally available resources (Tadelle *et al.*, 2003a). Village chicken also play a role of converting household leftovers, wastes and insects into valuable and high quality protein (Doviet, 2005). Village chicken production systems are characterized by low input low output levels. A range of factors such as suboptimal management, lack of supplementary feed, low genetic potential and high mortality rate are the major causes for the apparent low output level (Tadelle, 2003). Different feeding materials are present for scavenging including crop as visually observed, seeds, plant materials, worms, insects and unidentified materials (Tadelle and Ogle, 2000). Feed supplementation has been reported in various countries as a common practice to promote chicken performance: Malawi (Gondwe, 2004); Ethiopia (Dessie and Ogle, 2001); Burkina Faso (Kondombo *et al.*, 2003). In Ethiopia, 99%, 97.5% and 98% feed supplementation by chicken owners were reported by Halima (2007); Moges *et al.* (2010a); Mengesha *et al.* (2011), respectively. In India, 97.25% backyard chicken owners provide additional supplement (Khandait *et al.*, 2011). To make full use of the productive potential of hybrid layers a feed, which is sufficient in both quality and quantity has to be provided. Ali (2002) found that at least 60g of feed supplementation is needed for the scavenging cross

birds. Scavenging laying hen can find approximately 60 to 70% of their feed requirement (Rahman *et al.*, 1997). It is also reported that free-range scavenging chickens fulfill their nutrient requirements from protein, vitamins, and minerals through scavenging feed resources (Payne and Wilson, 1999; Dessie and Ogle, 2001). However, this is dependent on factors such as available scavenging area per bird, quality of scavenging feed resources, season and production stage (Abdelqader *et al.*, 2007). Maize is always the most preferred food under every form for chicken. This is consistent with choice feeding trial or free-choice feeding (Henuk and Dingle, 2002 and Benvenuti *et al.*, 2012). Wilson (2010) suggested that provision of shelter, regular supplies of clean drinking water and some supplementary feeding would improve growth and reproductive rates and greatly increase survival at village level.

2.2.2. Marketing

Poultry products in most developing countries, especially in Africa, are still expensive. The marketing system is generally informal and poorly developed. Unlike eggs and meat from commercial hybrid birds (derived from imported stock), local consumers generally prefer those from indigenous stocks. The existence of a local market offering good sales opportunities and adequate transport facilities are obvious prerequisites for family poultry development. As most consumers with greater purchasing power live in and around cities, intensification of poultry production should be initiated in peri-urban areas or, at least, in areas having a good road network (Branckaert *et al.*, 2000). Many study results indicated that research in promoting of village chicken production has concentrated on improvements in management while ignoring the potential role of socioeconomic issues, such as marketing. According to Gausi *et al.* (2004), small holder village chicken producers tend to ignore new technology even when it appears to be better than their current practices due to market limitations. This implies that apart from meeting subsistence needs, engagement and level of investment of smallholder farmers in agricultural enterprises responds to existing market opportunities.

It is difficult to design and implement chicken-based development programs that benefit rural people without understanding village chicken production and marketing systems (Pedersen, 2002). The birds usually sold from the village flock are surplus males (cockerels and cocks);

pullets and non-productive hens; large sized birds; old hens and sick birds. Growing chicken are sold just before the onset of the high risk Newcastle Disease (Byarugaba, 2007).

In North West Ethiopia, the price, demand and supply of chicken are highly related to religious festivals, mainly Christian festivals. The egg marketing channel is more or less similar to that of chicken. Eggs are sold at the farm gate to egg collectors, in the open markets to middlemen and consumers and to retail shops, hotels and supermarkets in towns. Eggs pass through a relatively longer chain to reach the consumers than chicken. The main actors in egg marketing are producers, collectors, traders or (wholesalers), local kiosk, shops and supermarkets. Urban markets followed by nearest local market and farm gate are, in order of importance, the preferred outlets for egg marketing by producers (Moges *et al.*, 2010b). Similarly, backyard poultry owners were selling their birds at their own doorstep, to village market, after specific weight gain, to local shopkeeper and middleman in Bhandara district of India (Khandait *et al.*, 2011). The premium for local birds is attributed to better meat flavour and more deeply coloured egg yolks (Dessie and Ogle, 2001). An egg from local chicken is considerably smaller than commercial layers, usually weighing 50 to 66 percent (Sonaiya, 2004).

2.2.3. Use of agricultural extension services

In Ethiopia, agricultural extension service is provided almost solely by the government (ILRI, 2005). A holistic and multi-disciplinary support of services like extension, training, veterinary and credit are critical in supporting village chicken improvement programs (Moges *et al.*, 2010b). Mengesha *et al.* (2011) reported that 50% of chicken owners used agricultural extension services on poultry productivity in south Wollo, Jamma district. Rural women contribute significantly in almost all activities related to poultry production (JICA, 1999). It is also reported that training for both farmers and extension staff focusing on disease control, improved housing, feeding, marketing and entrepreneurship could help to improve productivity of local chicken (Moges *et al.*, 2010b).

2.2.4. Poultry health management

Unlike in commercial set-ups many factors influence the health of smallholder chicken populations. Such complex phenomena make it even more difficult to design improvement strategies to overcome health constraints (Mapiye *et al.*, 2008). High mortality rate is

considered the major constraint to village chicken production systems (Muchadeyi *et al.*, 2004). Newcastle Disease (ND) is among the major causes of mortality. ND is one of the most significant diseases of poultry worldwide and a major constraint to village poultry production (Alders, 2004; Alexander *et al.*, 2004). The effective control of diseases is an essential first step towards improving village poultry production (Ahlers *et al.*, 2009).

Moges *et al.* (2010a) suggested that improvement in veterinary and advisory service could help to achieve control of diseases at village level. The same author reported 96.4% of village chicken owners had no culture of vaccination against poultry diseases in North West Ethiopia. Village chicken vaccination particularly against ND is more important than other management interventions; benefit-cost calculations done for the Tigray region of Ethiopia indicated that ND vaccination was more economically beneficial than the provision of daytime housing, supplementary feeding, cross breeding and control of broodiness (Udo *et al.*, 2001). Effective health coverage and vaccination programmes improved rural chicken performance in Pakistan (Javed *et al.*, 2003). In village production study in different parts of Ethiopia, no vaccination practice against poultry diseases was reported by Moges *et al.* (2010a); Leta and Endalew (2010);Takele and Oli (2011) and Mengesha *et al.*(2011).

2.3. Productive performances

2.3.1. Productive performance of local/indigenous chickens

Less than 5% of domestic birds in Ethiopia are internationally recognized or well known breeds (Wilson, 2010). Each local ecotype/native population/ actually comprised chickens with wide range of morphologic or genetic diversity. The most dominant chicken reared in Ethiopia are local ecotypes, which show a large variation in body position, plumage color, comb type and productivity (Halima *et al.*, 2007). Generally, Tadelle *et al.* (2003a) and Halima (2007) reported that the names of the indigenous chicken groups were being called as chicken-ecotypes and native-chickens, respectively.

The egg production potential of local chicken is 30-60 eggs/year/hen with an average of 38g egg weight under village management conditions, while exotic breeds produce around 250 eggs/year/hen with around 60 g egg weight (Alganesh *et al.*, 2003) in Ethiopia. According to Alganesh *et al.* (2003) and Negussie *et al.* (2003), the low productivity of the

local scavenging hens is not only because they are low producers of small sized eggs and slow growers but also the system is characterized by high chick mortality before they reach around 8 weeks of age. Moreover, the local chickens are the results of uncontrolled breeding between various local chicken ecotypes, which have not been selected by systematic breeding methods.

2.3.2. Productive performance of improved chickens

Poultry production is affected by factors such as breed and strain of chicken used, environmental conditions in poultry house, management practices and feed and feeding management (Bell and Weaver, 2002). The knowledge of performance of economic traits in chicken is important for the formulation of breeding plans for further improvement in production traits. Growth and production traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment (Ahmed and Singh, 2007).

The laying cycle of a chicken flock usually covers a span of about 12 months. Egg production begins when the birds reach about 18-22 weeks of age, depending on the breed and season. Flock production rises sharply and reaches a peak of about 90%, 6-8 weeks later, production then gradually declines to about 65% after 12 months of lay. There are many factors that can adversely affect egg production. Unraveling the cause of a sudden drop in egg production requires a thorough investigation into the history of the flock. Egg production can be affected by feed consumption (quality and quantity), water intake, intensity and duration of light received, parasite infestation, diseases, management and environmental factors (Jacob *et. al.*, 1998).

Different authors reported the effect of breed on egg production; Duduyemi (2005) found no significant effect of breed on egg production, while Majaro (2001) and Yakubu *et al.* (2007) reported significant effect of breed on egg production and mortality rate. Moreover, Gwaza and Egahi (2009) reported significant effect of breed on age at peak egg production in a farm consisting of four strains of layers. Abdel-Rahman (2000) reported that naked neck genotype was superior to full feathered mates in egg production, sexual maturity, mortality rate and feed efficiency.

Altamirano (2005) compared the local breed Criolla in the highland part of Bolivia with the commercially marketed hybrid Harco and reported as Harco had significantly better

production level under all three feeding regimen including in free rage system with supplementation 50 gram maize/day. Harco is a cross of Rhode Island Red × Barred Plymouth Rocks and has been demonstrated to be an excellent layer under free-range condition when supplemented with 50 grams of feed per day (Vries, 1993).

In comparison, the production performance of IB with Dekalb Delta (DD) the egg weight and egg mass from IB were more than that from DD as well as feed efficiency was better for the IB hens (Grobas *et al.*, 2001). Further, a study conducted in Nigeria by Olawumi and Dudusola (2010) showed that IB genotype utilized feeds given more efficiently, produced more eggs and appeared more profitable than Dominant Black (DB) genotype and concluded IB genotype was superior to DB in egg production and feed efficiency but recorded similar values in mortality rate. A recent study in Savannah region of Nigeria by Olawumi, and Dudusola, (2012) indicated 5.96 and 5.84 eggs per hen per week for IB and Bovan Nera (BN) respectively, while DB being the least 5.47 eggs per hen per week. Further, the author recommended IB and BN genotype to be preferred by the poultry farmers. In northern Ethiopia, Lemlem and Tesfaye (2010) reported 173eggs, 185 eggs and 144 eggs /year/ hen for White leghorn, Red Island Red and Fayoumi chicken under village household condition. Demeke (2004) also reported 82 eggs/hen for White leghorn based on evaluation under rural household condition for 20 weeks with additional supplements.

In activity to enhance partnership and change traditional approaches to improve village production by making use of commercialization potentials in suited areas of Ethiopia, Bovan Brown (BB) strain day old chicks were distributed to the farmers in Ada'a, Lume and Akaki districts. In these areas, under village management condition, birds attained egg laying age (5%) at 20 weeks. The annual eggs/bird anticipated within the range of 60-70% of the performance recommended by the breeder company for high standard management system. The same author indicated a very positive prospect of profiting at 20 weeks of egg production (about 40 weeks of bird's age) and identified poultry as a potential source of income for the rural smallholder in Ada'a, Lume and Akaki districts of Eastern Shewa, Ethiopia (Dana *et al.*, 2006).

The hybrids have been carefully selected and specialized solely for the production of either meat or eggs. These end product specialized hybrid strains are unsuitable for breeding purposes, especially for mixing with local village scavenger stock, as they have very low

mothering ability and broodiness (Sonaiya and Swan, 2004). Sørensen and Ssewannyana (2003) describe a programme in which cocks from the brown-egg layer hybrid BB were crossed with local hens under field conditions in Uganda. In a study involving ten farms, chickens with 0.25 or 0.5 percent BB genes were raised to six months of age. The 25 percent Bovan cross was obtained by back crossing the F1 hens to local cocks. The daily gain of the 50 percent Bovan cross proved to be superior to that of the local chicks by 30 percent at one month of age, increasing to 38 percent at three months of age, after which the superiority decreased gradually. The 25 percent Bovan had a 15 percent superior daily gain at one month of age, after which the advantage was gradually lost, with no difference in gain remaining at 6 months of age. No report on reproductive capacity and general fitness of the hens with Bovan genes was obtained in the Uganda study, but observational data indicate a higher mortality rate in the hybrid hens as the project continued.

The Potchefstroom Koekoek (PK) was bred from crosses between the Black Australorp and the White Leghorn and is recognized as a locally South African developed breed. These birds reach sexual maturity at 130 days. They have a characteristic black and white speckled colour pattern, also described as barred, which is present in as many as nine different poultry breeds. The male inherited the bar gene, a sex linked gene and they are easily distinguished, having light grey bars on the feathers, while the females are darker (Van Marle-Koster and Nel, 2000).The average egg weight is 55.7g and the colour of the eggs is brown (Ramsey *et al.*, 2000). This breed is one of the most promising breeds, it is second to white leghorn, Fayoumi in terms of hen-housed egg production per hen and hatchability, respectively (Grobbelaar *et al.*, 2010).

2.4. Egg quality traits

It is obvious that beneficial egg quality traits are of immense importance to poultry breeding industries (Bain, 2005). In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of the hen (Onagbesan *et al.*, 2007). Strains of Leghorn that lay brown eggs in addition to strains that lay white eggs were developed. The brown strains were developed because there was an apparent demand for consumption of brown eggs. Thus, there was interest to use strains of laying hens that lay

better quality eggs. The different strains vary in the different criteria of egg production and quality (Bell and Weaver, 2002).

Egg weight influences the weight of components of eggs especially egg albumen and yolk (Zhang *et al.*, 2005; Aygun and Yetisir, 2010). The relationship between weight, length and width of eggs has been reported by Danilov (2000) who also noted the proportion of yolk, albumen and shell that contribute to the egg weight increases with hen's age, reaching a plateau by the end of the laying cycle. Thus, egg weight is one of the important phenotypic traits that influence egg quality and reproductive fitness of the chicken parents (Islam *et al.*, 2001; Farooq *et al.*, 2001). Anderson (2002) provided detailed information on the differences in egg production and quality between different white and brown egg strains and reported the egg weight from brown hens (61.1g) was more than that of white hens (58.3g). Tixier-Boichard *et al.*, (2006) recorded weight of 42.8 g for Fayoumi eggs and 58.8 g for IB eggs. Higher weight of egg from commercial strains is not a surprise since such strains submitted to important breeding pressure for egg weight improvement (Hocking *et al.*, 2003). Further, under smallholder farmers condition in northern Ethiopia, egg weight was recorded as 52.5g, 52.1g and 43 g for Rohde island Red, White leghorn and Fayoumi, respectively (Lemlem and Tesfaye, 2010). Hen age has also been shown to increase yolk weight (Van den Brand *et al.*, 2004) albumen weight (Suk and Park, 2001).

Yolk color is a key factor in any consumer survey relating to egg quality (Okeudo *et al.*, 2003). Consumer preference for yolk colour are highly subjective and vary widely from country to country. The determinant of yolk colour is the xanthophyl (plant pigment) content of the diet consumed (Silverside *et al.*, 2006). Green grass during scavenging might be responsible for carotenoid deposits in the yolk, which improves the yolk color. Among feed ingredients, only supplemented maize contributes to improved color intensity of the yolk. Thus, if a hen has access to green grass or supplemented feed ingredients containing carotenoids/xanthophylls, it will be enough to give the yolk the colour preferred by consumer (Zaman *et al.*, 2004). Ethiopian consumers have a strong preference for eggs with deep yellow yolk colour. Very small sized eggs from the scavenging local chicken with deep yellow yolk colour fetch much higher prices compared to larger eggs of improved strains with pale yolk (Tadelle *et al.*, 2003a).

The Haugh Unit (HU) proposed by Haugh (1937), is calculated from the height of the inner thick albumen and the weight of an egg and it is considered to be a typical measure of albumen quality. It is generally accepted that the higher the Haugh unit value, the better the quality of the egg. It is also important that all eggs being evaluated at the same internal temperature. Age of the hen and season of the year can also affect Haugh unit values. Rajkumar *et al.* (2009) reported that brown egg layers produced eggs with higher HU. Research has shown in UK that there is consumer resistant to purchase eggs which have HU's below 60, the actual HU figure where resistance to the product determined later by market researchers. Some of the large supermarkets chains in the UK set minimum acceptable level of 70 HU on regular documented tests (TSS, 1999).

The eggshell thickness is an important trait for hatchability. For best result of hatchability egg shell thickness should be between 0.33 and 0.35 mm and few eggs with a shell thickness less than 0.27mm will hatch (Khan *et al.*, 2004). One of the main concerns is a decrease in eggshell quality as the hen ages, due to an increase in egg weight without an increase in the amount of calcium carbonate deposited in the shells. For this reason, the incidence of cracked eggs could even exceed 20% at the end of the laying period (Nys, 2001).The egg shell quality is given throw the weight and the percentage of shell, thickness and the strength. The differences in eggshell quality depend on the environmental conditions and the feed quality and also of strain of layers (Zita *et al.*, 2009). On the other hand, Khan *et al.* (2004) reported no significant effect of breed on eggshell thickness under semi scavenging condition.

In comparison, strains used for production of white and brown eggs, Silversides and Scott (2001) reported that eggs from IB hens had better percentage of shell than those form Isa-White hens. Several authors reported variable results about the influence of the rearing systems on shell thickness. Leyendecker *et al.*, (2001, 2005) reported thicker shells in free range eggs when compared to conventional cage and aviary systems (Leyendecker *et al.*, 2001), and to conventional and furnished cages (Leyendecker *et al.*, 2005). On the other hand, Tumova and Ebeid (2003) noticed thicker shells in battery cage compared to barn system, while Van de Brand *et al.* (2004) did not find differences between free range and battery cage.

2.5. Socio-economic aspect of rural poultry production

The impact of village chicken in the national economy of developing countries and its role in improving the nutritional status, income, food security and livelihood of many smallholders is significant owing to its low cost of production (Abubakar *et al.*, 2007). Chicken provide major opportunities for increased protein production and incomes for smallholder farmers because of short generation interval and high rate of productivity. Further, the ease with which its products can be supplied to different areas, the ease with which its products can be sold due to their relatively low economic values, its minimal association with religious taboos and its complementary role played in relation to other crop–livestock activities (Muchenje *et al.*, 2000).

According to Sonaiya (2004), smallholder-farming families, landless labourers and people with incomes below the poverty line are able to raise chicken with low inputs and harvest the benefits of eggs and meat via scavenging feed resources. Family chicken meat and eggs contribute 20–30% to the total animal protein supply in low-income and food-deficit countries. According to Moreki *et al.* (2001), family chicken are rarely the sole means of livelihood for the family, but is one of a number of integrated farming activities contributing to the overall well-being of the households. Chicken are widespread in Ethiopia and almost every rural family owns chicken, which provide a valuable source of family protein and income (Tadelle *et al.*, 2003a). It provides employment and income generating opportunity and is a priority animal for holyday and religious sacrifices (Sonaiya, 2000; Dessie and Ogle, 2001; Gueye, 2003).

2.6. Major Constraints of village chicken production in Ethiopia

Under village poultry production, prevailing diseases, predators, lack of proper health care, poor feeding and poor marketing information were reported as constraint by Moges *et al.* 2010a; Dinka *et al.* 2010 and Mengesha *et al.* 201. The high mortality of chicks under village chicken production in the central highlands of Ethiopia is due to diseases, parasites, predation, lack of feed, poor housing and insufficient water supply (Tadelle, 2001). Among the infectious diseases, Newcastle disease, salmonellosis, coccidiosis and fowl pox are considered the most important causes of mortality in local chicken while predators are an additional causes of loss (Eshetu *et al.*, 2001).

The widely acknowledged constraint to village chicken production in Africa and Asia appears to be ND (Permin and Pederson, 2002). ND is highly infectious and causes more losses than any other diseases in the tropics. Several recent surveys in Africa showed high rates of sero-positivity in the absence of vaccination. In developing countries, ND occurs every year and kills an average of 70 to 80 percent of the unvaccinated village hens (Branckaert *et al.*, 2000). Other authors reported as mortality could reach up to 100% (Nigussie *et al.*, 2003; Serkalem *et al.*, 2005). Despite diseases as major constraints for village poultry, the veterinary service has remained irregular, unevenly distributed and poorly organized at village level (Takele and Oli, 2011).

3. MATERIALS AND METHODS

3.1. Description of study areas

Mojo (Lume) district is located at 70km from Addis Ababa in East Shewa zone of Oromia Region, Ethiopia. Lume is bordered on the south by the Koka reservoir, on the west by Ada'a Chukala, on the northwest by Gimbichu, on the north by the Afar Region and on the east by Adama. Mojo is the capital of the district; other towns and cities include Ejere, Ejersa and Koka. Most of this District altitude ranges from 1500 to 2300 meters above sea level (m.a.s.l), except for a small portion in the northern part, which is over 2300 m.a.s.l in altitude. The mean monthly temperature of the area ranges from 22°C to 34°C. A survey of the land in this district shows that 54.3% is arable or cultivable, 3% pasture, 2% forest, and the remaining 20% is considered degraded or otherwise unusable. Vegetables are an important cash crop of the area (CSA, 2005).

Ada'a district is located at 47km east from Addis Ababa. This district has an altitude ranging from 1500-2250 m.a.s.l. Mixed crop livestock production is the predominant production system in which *Teff* (*Eragrostis teff*) and wheat are the main crops cultivated, plus, especially chickpea is grown in the bottomlands and on residual moisture in selected areas (ILRI, 2005). Mean monthly minimum air temperature ranged from 11.2-13.5 C°, while the maximum mean monthly air temperature varied 21.6-31.5 C°. The area has two rainy seasons; the minor one extending from February to April and the major one between June and September. The annual rainfall is about 877.2mm (DZARC, 2006).

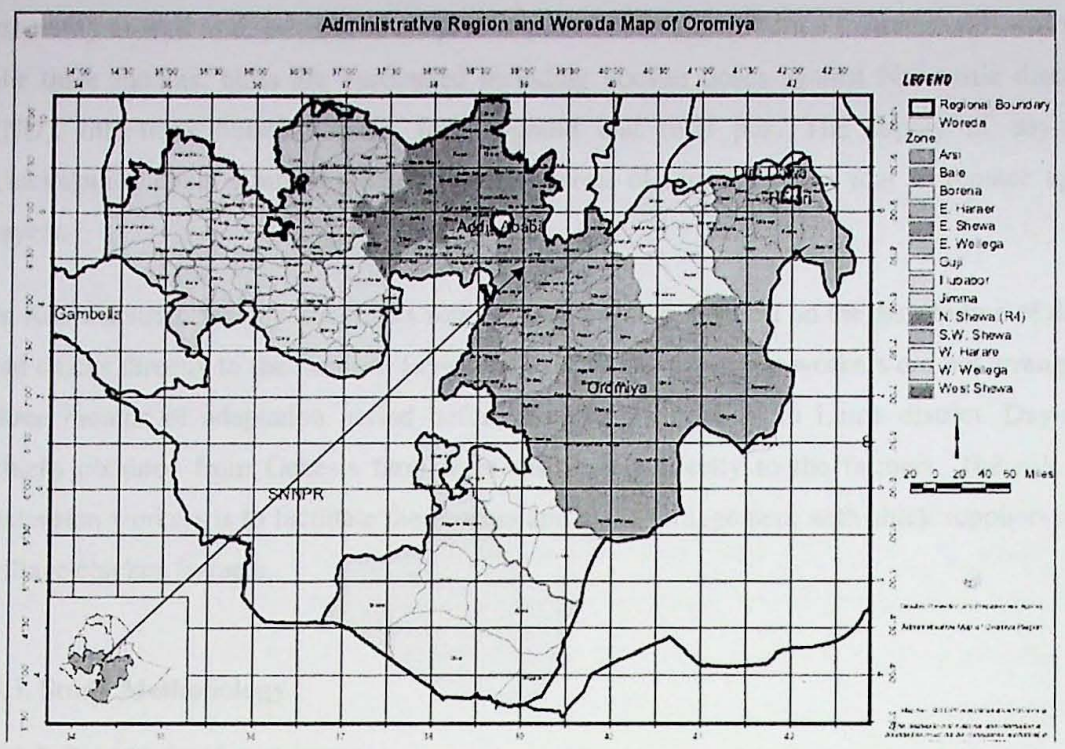


Figure 1: Map of study areas /East Shewa zone of Oromia Region

Source: (ILRI, 2005).

3.2. Distribution of improved breeds in the study areas

In the past many decades, genetic improvement programs for increasing chicken productivity in Ethiopia mainly focused on use of imported temperate breeds. Many exotic breeds of chicken (White and brown Leghorns, Rhode Island Red, Bovan, New Hampshire, Cornish, Australoup and Light Sussex) were introduced over the years (DZARC, 1991). The current extension package in Ada'a and Lume districts were based on the distribution of hybrid layers (IB and BB) and dual-purpose chicken (PK) from large scale poultry importers based at Debre Zeit. The purpose of supplying these hybrid chicks was solely for egg production under improved village management systems.

In Lume district, Development agents (DAs) collect money from interested farmers for the cost of feeding, housing and health care (vaccination) of day-old chick until they reach to pullet age for three months at model poultry farms at the district main town, Mojo. The purpose of this approach is to provide vaccination for major diseases and to decrease chick

mortality as well as to provide an adaptation period before distribution to households. During the three months, birds are vaccinated including booster doses against Newcastle disease (ND), infectious bursal disease, fowl typhoid and fowl pox. The supply of day-old chicks/pullet chain continues based on the interest of farmers every year to replace aged layers.

In Ada'a district, the day-old chicks supply chain package is based on the distribution of day-old chicks directly to the farmers. Livestock experts and extension workers did not arrange a three months of adaptation period before supplying chicks as in Lume district. Day-old chicks obtained from Genesis farm were distributed directly to the farmers. The role of extension workers is to facilitate the process and make arrangement with chick suppliers and village chicken farmers.

3.3. Study Methodology

3.3.1. Sample size determination

The total households included in the study were determined according to the formula given by Arsham (2002).

$N=0.25/SE,^2$ Where, N= Sample size, SE= Standard error

Thus, using the standard error of 0.038 with 95% confidence level, 180 households were included in the study.

3.3.2. Selection of study households

Three Peasant Associations (PAs) from each district which have been participating in improved poultry extension package at least in the last one and more years were selected purposively based on the extent and intensity of improved chicken distribution. The list of households, which adopted improved layer chickens from each PAs was used as sampling frame. From the total of 215 households who adopted improved poultry extension package in three PAs (Momoshoki, Byobiskie and Jogogudedo) in Lume district, 90 households were selected using systematic random sampling. Similarly, from the total of 203 households who adopted the improved poultry extension package in three PAs (Denkaka, Kurkuradenbi and Godino) in Ada'a district, 90 households were selected using systematic random sampling.

Therefore, the total sample size was 180 with the contribution of 90 households from each district.

3.3.3. Study populations

The populations studied were three different improved hybrid chicken adopted in Ada'a and Lume districts, which includes IB in majority of the households in Lume district and BB and PK in Ada'a district.

3.4. Data collection

3.4.1. Questionnaire survey

The questionnaires were pre-tested before the actual data collection. In addition to questionnaire data collection, general inspection regarding housing, feeding and health of poultry were carried out. A cross sectional survey was carried out for each household to collect information focusing on status of keeping improved chicks, use of extension packages and its constraints from member(s) of the households directly responsible for management and care of chickens. Moreover, the productive performances interms of number of egg produced/hen/year, pullet age at first laying and husbandry practices were also the core points considered in the process. Average number of eggs were taken from farmers' estimation of eggs laid/hen/year. Furthermore, the management practices were assessed through observation of the incorporation of recommended scientific husbandry packages applied for each household. Provision of housing, provision of additional feed, agricultural extension system used, marketing, vaccination practices and use of modern medication were assessed through questionnaire survey.

3.4.2. Variables Measured

3.4.2.1. Mature body weight

Live weight recoding of laying hens was carried out with weighing meter/balance to evaluate body weight performance under rural village conditions. Farmers were told in advance to keep their chicken at their house to make body weight measuring easy. Accordingly, mature body weights of IB, BB and PK were recorded.

3.4.2.2. Evaluation of internal and external egg quality

A total of 137 fresh eggs were collected from adult laying hens in Ada'a and Lume districts during the survey for evaluating egg quality traits of IB, BB and PK. The eggs were evaluated at Debre Zeit Agricultural Research Institute (DZARC) laboratory. External egg quality traits such as egg weight were measured using digital balance (g) and shell thickness (mm) using an electronic Digital Caliper (Mitutoyo, Japan). The shell thickness was measured at three different points in the equatorial shell and the calculated average of the three was used as a trait. To determine the internal egg quality traits, eggs were broken onto a flat surface. The thick albumen height (AH) was measured at its widest part at a position half way between the yolk and the outer margin. Yolk height was measured using Tripod Micrometer (TSS, England). The yolks were carefully separated from the albumen. Albumen and yolk weight were determined by weighing with electronic sensitive balance separately. The yolk colour was determined using the Roche Colour Fan (Printed in Switzerland); a standard colorimetric system ranged 1-15. Individual Haugh Units (HU) were calculated from the two parameters; height of albumen (AH) and egg weight (EW) using the formula: $HU=100\log (AH-1.7\ EW^{0.37} + 7.6)$ (Haugh, 1937), where HU=Haugh Unit, AH=Albumen height and EW=Egg weight.

3.5. Data management and analysis

The data were entered using Microsoft excel spreadsheet and analyzed using SPSS (Version, 17). Descriptive statistics were employed for describing management practices in each district. Differences in productive performances and egg quality traits were compared using means generated from one-way ANOVA.

4. RESULTS

4.1. Household characteristics

The household characteristics of respondents (Table 1) revealed that the proportion of female respondents were higher than males in both districts. The average age of respondents was 36.9 years in Ada'a and 37.7 years in Lume districts. The analysis for educational status disclosed that 24.4% in Ada'a and 33.4% of the respondents in Lume were illiterates. Others can write and read and involved in formal education such as elementary school, high school and College/ University in both districts. Total landholding /household was 1.1±1.26 and 1.4±1.25ha. in Ada'a and Lume districts, respectively. The proportions of landless respondents were 13.9% in Ada'a and 17.8% in Lume districts.

Table 1: Household characteristics of respondents in Ada'a and Lume districts

Variable	Ada'a (N=90)	Lume (N=90)
Sex of respondents (%)		
Male	34.4	30
Female	65.6	70
Average age of the respondents (years)	36.9	37.7
Educational status of respondents (%)		
Illiterate	24.4	33.4
Read and write	24.4	32.2
Elementary school	36.6	20
High school	13.4	11
College/ University	1.2	3.4
Average family size/household	5.5	5.3
Land holding/household (ha)		
Total land holding (Mean±SD)	1.1±1.26	1.4±1.25
Landless households (%)	13.9	17.8

4.2. Poultry housing system and facilities

The results of poultry housing and facilities assessment are presented in Table 2. The highest proportion of the respondents, 91.11% in Ada'a and 95.6% in Lume districts, constructed a separate house entirely for poultry, whereas from total respondents who constructed separate poultry house only 35.6% and 25.6% constructed based on recommended extension package in Ada'a and Lume districts, respectively. No respondent in Lume and 4.4% in Ada'a districts kept their birds with other animals. In both districts, only 4.4% of the respondents share the same house with their chicken.

Table 2: Poultry housing system and facilities used in Ada'a and Lume districts

Poultry housing system and facilities	Districts					
	Ada'a N=90		Lume N=90		Cumulative N=180	
Poultry Housing system	Freq.	%	Freq.	%	Freq	%
Separate house constructed for poultry	82	91.11	86	95.6	168	93.3
Share the same house with people	4	4.44	4	4.4	8	4.4
Separate house with other animals	4	4.44	0.0	0.0	4	2.2
Constructed based on recommended package	32	35.6	23	25.6	55	30.6
Housing facilities						
Provision of electric city	24	26.7	12	13.3	36	20
Provision of adequate ventilation facility	80	88.9	67	74.4	147	81.7
Litter material used	20	22.2	9	10	29	16.1

Electricity was provided in poultry house by 26.7% and 13.3% respondents in Ada'a and Lume, districts, respectively. Adequate ventilation facilities in poultry house were provided by 88.9% and 74.4% in Ada'a and Lume districts, respectively. Only 22.2% and 10% of the respondents in Ada'a and Lume districts, respectively, used litter for rearing chicken.

4.3. Feeds and feeding practices

In both districts, 97.8% of the respondents were using scavenging with additional supplements and only 2.2% used only scavenging with no additional feed supplements for chicken (Table 3). From 88 (97.8%) respondents who practiced scavenging with additional supplement, 3(3.4%) respondents in Ada'a and 2 (2.3%) respondents in Lume district were using purchased commercial feeds.

Table 3: Poultry feeds and feeding practices in Ada'a and Lume districts

Feeds and feeding practices			District		Cumulative	
	Ada'a, N=90		Lume, N=90		N=180	
Feeding system	Freq.	%	Freq.	%	Freq.	%
Only scavenging	2	2.2	2	2.2	4	2.2
Scavenging with additional supplement	88	97.8	88	97.8	176	97.8
Purchased feed	3	3.4	2	2.3	5	2.8
Additional feed type: Wheat and maize	85	96.6	86	97.7	171	95
Kitchen waste	90	100	90	100	180	100
Wheat bran	1	1.1	2	2.2	3	1.7
Limestone	2	2.2	2	2.2	4	2.2
Frequency of feeding: Three times a day	73	81.1	69	76.7	142	78.9
Two times a day	17	18.9	21	23.3	38	21.1

All respondents provide kitchen waste as supplement in both districts. Approximately, 97% of the respondents provide maize and wheat as additional supplements, while, 1.1% and 2.2% used wheat bran as supplement in Ada'a and Lume districts, respectively. Provision of mineral supplement was practiced only by 2.2% of respondents in both districts. Regarding frequency of feeding, 81.1% and 76.7% of the respondents in Ada'a and Lume districts, , feed their chicken three times per day respectively, while 18.9% and 23.3% provide two times per day in the same order.

4.4. Watering

Information recorded for frequency of watering (Table 4) revealed that about 96% of respondents provide water with free access in both districts. Only 1.1% in Ada'a and none of the respondents in Lume districts provide water in morning only. A few respondents 2.2 % and 4.4% in Ada'a and Lume provide water both in morning and evening. Regarding source of water, tap water was a major source in Ada'a (72.2%) than in Lume (37.8%), whereas borehole accounts for the rest of the proportion as water source in Lume district. Other sources of water in Ada'a district include, canal water (13.3%) and river water (1.1%), while, Lume district, 1.1% used pond water and none of the respondents used canal and river water.

Table 4: Frequency and source of water used for chicken in Ada'a and Lume districts

Source and frequency of watering	District			
	Ada'a		Lume	
	Frequency	%	Frequency	%
Frequency of watering				
Free access	87	96.7	86	95.6
Morning only	1	1.1	0.0	0.0
Morning and evening	2	2.2	4	4.4
Water sources				
Tap water	65	72.2	34	37.8
Borehole water	12	13.3	55	61.1
Pond water	0.0	0.0	1	1.1
River water	1	1.1	0.0	0.0
Canal water	12	13.3	0.0	0.0

4.5. Type and source of improved chicks

The survey result showed that the majority of the respondents (Table 5) in Lume district used IB chicken as layer and a small number of the respondents used BB, while 72.2% and 27.8% of the respondents in Ada'a district used BB and PK chicken layers, respectively. None of the respondents used IB in Ada'a and PK in Lume districts.

Table 5: Types and source of improved chicks used in Ada'a and Lume districts

Type and Sources of chicks	District			
	Ada'a		Lume	
	Frequency	%	Frequency	%
Improved chicken used				
Isa Brown (IB)	0.0	0.0	86	95.6
Bovan Brown (BB)	65	72.2	4	4.4
Potchefstroom Koekoek (PK)	25	27.8	0.0	0.0
Source of chicks				
Purchased from private hatcheries	76	84.4	72	80
Naturally hatched at home	14	15.6	18	20

The majority of the respondents, 84.4% in Ada'a and 80% in Lume districts purchased chicks from private hatcheries. However, only 15.6% and 20% respondents hatched fertile eggs naturally at home in Ada'a and Lume districts, respectively.

4.6. Marketing

4.6.1. Market access for poultry products and production inputs

The analysis made for market access to buy production inputs and sale poultry products (Table 6) indicated that 80 % in Ada'a and 71.2% of the respondents in Lume districts, had good market access to procure poultry production inputs. However, 20% in Ada'a and 28.8% respondents in Lume district had poor market access to buy poultry production inputs.

Table 6: Market access for poultry products and production inputs in Ada'a and Lume districts

Districts	*N*	Market Access for production inputs		Market Access for Eggs and Chicken	
		Good access	Poor access	Good access	Poor access
Ada'a	90	72 (80%)	18 (20%)	62 (68.8%)	28 (31.2%)
Lume	90	64 (71.2%)	26 (28.8%)	85 (94.4%)	5 (5.6%)
Total	180	136 (75.6)	44 (24.4%)	147 (81.7%)	33 (18.3%)

Results obtained for market access to sale chicken and eggs indicated that 68.8% of the respondents had good market access to sale eggs and chicken in Ada'a district, while 31.2% respondents had poor market access. However, in Lume district, majority of the respondents had good market access and only 5.6% had poor market access to sale eggs and chicken.

4.6.2. Practice of selling eggs and chicken

The practice of selling of eggs and chicken (Figure 2) indicated that higher proportion of the respondents, 34.4% in Ada'a and 50% in Lume district were selling their eggs and chicken to local shopkeepers, and 21.1% of the respondents in both districts were selling their eggs and chicken at village market. Selling at doorstep was practiced by 17.8% and 13.3% of the respondents and to retailers by 20% and 15% in Ada'a and Lume districts, respectively. In Ada'a district, 6.7% of the respondents sell eggs and chicken to wholesalers.

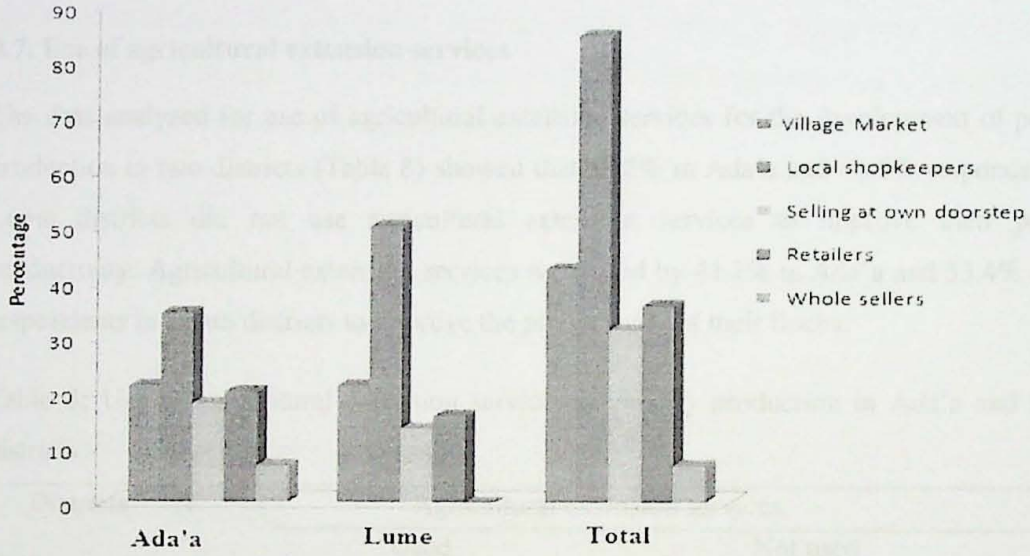


Figure 2: Practices used for selling of eggs and chicken in Ada'a and Lume districts

4.6.3. Selling time and consumer preference

The results obtained for selling time and consumer preference (Table 7) revealed that mostly (73.3%) selling time was according to their personal money requirement in both districts. However, 24.4% and 23.3% respondents sold their chicken and eggs during festivals and holydays in Ada'a and Lume districts, respectively. A small number of respondents in both districts were selling their birds based on weight gain and age of the bird. Consumer preference observed for eggs from local, improved and both local and improved chicken

were 77.8%, 17.8% and 4.4% respondents in Ada'a and 87.8%, 7.8% and 4.4%, in Lume districts, respectively.

Table 7: Time of selling and consumer egg preference in Ada'a and Lume districts

selling time and consumer preference	Districts					
	Ada'a		Lume		Cumulative	
Time of selling	Freq.	%	Freq.	%	Freq.	%
Specific weight gain/age	1	1.2	3	3.4	4	2.22
Personal money requirement	66	73.3	66	73.3	132	73.33
During holydays and festivals	22	24.4	21	23.4	43	23.9
Egg selling only for hatching	1	1.2	0.0	0.0	1	0.55
Consumer egg preference						
Eggs from improved chicken	16	17.8	7	7.8	23	12.8
Eggs from local chicken	70	77.8	79	87.8	149	82.8
Equally preferred	4	4.4	4	4.4	8	4.4

4.7. Use of agricultural extension services

The data analyzed for use of agricultural extension services for the development of poultry production in two districts (Table 8) showed that 58.8% in Ada'a and 46.6% respondents in Lume districts did not use agricultural extension services to improve their poultry productivity. Agricultural extension services were used by 41.2% in Ada'a and 53.4% of the respondents in Lume districts to improve the productivity of their flocks.

Table 8: Use of agricultural extension services in poultry production in Ada'a and Lume districts

Districts	N	Agricultural extension services	
		Used	Not used
Ada'a	90	37 (41.2%)	53(58.8%)
Lume	90	48 (53.4%)	42 (46.6%)
Total	180	85 (47.2%)	95 (52.8%)

4.7.1. Poultry production training

Information collected on training and credit services provided to respondents on poultry production in two districts disclosed that 28.9% in Ada'a and 37.8% respondents in Lume districts were provided training on improved poultry production practices (Table 9).

Table 9: Training and credit services provided in Ada'a and Lume districts

Training and frequency to see DA's	Districts			
	Ada'a		Lume	
	Frequency	%	Frequency	%
Training provided	26	28.9	34	37.8
Before starting poultry production	23	25.6	32	35.6
After starting poultry production	3	3.3	2	2.2
Training not provided	64	71.1	56	62.2
Credit service provided	12	13.4	0.0	0.0
Purpose of credit service				
To buy day old chicks	12	13.4	0.0	0.0
To buy house equipment	0.0	0.0	0.0	0.0
To buy poultry feed	0.0	0.0	0.0	0.0

From those respondents who received training, 25.6% and 35.6% of respondents provided poultry production training before starting poultry rearing in Ada'a and Lume districts, respectively. However, 71.1% in Ada'a and 62.2% of the respondents in Lume districts did not get any training on poultry production.

4.7.2. Credit services

Credit service was provided to 13.3% in Ada'a district solely to buy day old chicks while credit service was not provided for any purpose in Lume district.

4.8. Poultry health management

4.8.1. Use of vaccination

The data analyzed for health management (Table 10) revealed that while majority of the respondents (78.8%) in Ada'a district did not vaccinate their chicken, most of the respondents (80%) in Lume district vaccinated their chicken against Newcastle disease, infectious bursal disease, fowl typhoid and fowl pox. Accordingly, 21.2% respondents vaccinate their chicken in Ada'a and 20% respondents did not vaccinate their chicken in Lume district. The chi-square analysis indicated a statistical significant difference ($p<0.05$) in use of vaccines against poultry diseases between the two districts.

Table 10: Use of vaccines to control poultry diseases in Ada'a and Lume districts

Variables	N	Vaccinated	Not vaccinated	χ^2	*P*
Districts				62.43	<0.05
Ada'a	90	19 (21.2%)	71(78.8%)		
Lume	90	72 (80%)	18(20%)		
Total	180	91(50.6%)	89(49.4%)		

4.8.2. Use of anti-ectoparasites, prophylactic measures and culling practice

The use of anti-ectoparasites was practiced by 41.1% and 23.3% of the respondents in Ada'a and Lume districts, respectively. Approximately, 56% of the respondents practiced prophylactic measures against various poultry diseases in both districts (Table 11).

Table 11: Use of anti-ectoparasites, prophylactic and culling practice in poultry in Ada'a and Lume district

Health practices	Districts					
	Ada'a		Lume		Cumulative	
	Freq.	%	Freq.	%	Freq.	%
Application of anti-ectoparasite	37	41.1	21	23.3	58	32.2
Prophylactic measures	50	55.6	51	56.7	101	56.1
Culling practice	90	100	90	100	180	100
Reasons for culling:						
Poor productivity	25	27.8	42	46.7	67	37.2
Old age	46	51.1	35	38.9	81	45
Diseases	19	21.1	13	14.4	32	17.8

Culling was practiced by all respondents in both districts due to various reasons. Poor productivity, old age and disease were claimed as reasons for culling by 27.8%, 51.1% and 21.1% in Ada'a and 46.7%, 38.9% and 14.4% in Lume district, respectively.

4.9. Productive performances

4.9.1. Egg production

Information on egg production performance of different types of chicken reared in the districts is presented in Table 12. There was statistically significant difference ($p<0.05$) among IB, BB and PK on average number of eggs laid under village production system.

Table 12: Mean annual egg production of IB, BB and PK type chickens in two districts

Improve chicken	*N*	*Number of eggs laid/ hen/year*	
		Mean	SD
Isa Brown	86	276.1[a]	11.03
Bovan Brown	69	266.32[b]	8.7
Potchefstroom Koekoek	25	187.04[c]	13.49
Total	180	259.97	31.52

Means in column with no common superscripts differ significantly ($p<0.05$).

4.9.2. Age at first laying and mature hen body weight

The information collected on age at first laying (Table 13) disclosed that the mean ages at first laying were 160.5±13.5, 165.5±13.2, and 153.5±6 days for IB, BB and PK, respectively. There was no significant difference between IB and BB strains on age at first laying. However, a significant difference ($p<0.05$) was observed between PK and IB, and between PK and BB on pullet age at first laying. The adult female body weights were 1.54 kg, 1.55 kg and 1.64 kg for IB, BB and PK chicken groups, respectively. There was no statistically significant difference among the three layer hens in adult live body weight.

Table 13: Age at first laying and mature hen body weight of exotic chickens in Ada'a and Lume districts.

Improved chicken	*N*	*Age at first laying (days)*	*Mature Hen body weight (Kg)*
		Mean±SD	Mean±SD
IB	86	160.5±13.5[a]	1.54±0.17
BB	69	165.6±13.2[a]	1.55±0.26
PK	25	153.3±6[c]	1.64±0.31
Total	180	161.4±13.2	1.56±0.23

Means in column with no common superscript differ significantly ($p<0.05$)

4.9.3. Egg quality traits

Different egg quality traits were measured and are presented in Table 14. The measured parameters (egg weight, yolk height, albumin height, yolk weight, yolk color, albumin weight, Haugh unit and shell thickness) and the analytical results are presented subsequently.

Table 14: Egg quality traits of exotic chickens in Ada'a and Lume districts.

Traits	*Improved chicken*		
	Isa Brown , N=57 Mean ±SD	Bovan Brown, N=56 Mean ±SD	Koekoek, N=24 Mean ±SD
Egg weight (g)	58.75 ±7.29[a]	60.27 ±6.03[b]	48.84 ±6.77[ab]
Yolk height, (mm)	17.41 ±1.52	17.84 ±1.67	17.84 ±0.81
Albumin height (mm)	6.30 ±1.85	6.92 ±1.62[a]	5.64 ±1.55[a]
Yolk weight (g)	16.14 ±1.89	15.97 ±1.77	15.90 ±3.57
Yolk colour	9.74 ±3.13[a]	7.77 ±3.15[ab]	10.79 ±1.98[b]
Albumin weight (g)	33.37 ±5.85[a]	34.54 ±5.67[b]	25.54 ±3.94[ab]
Haugh Unit	77.78 ±13.28	81.68 ±11.28	76.57 ± 12.18
Shell thickness (mm)	0.31 ±0.05[a]	0.33 ±0.037[ab]	0.29 ±0.026[b]

Means in a row with common superscripts differ significantly ($p<0.05$)

The data showed that egg weight recorded for IB was not significantly different from that of BB. However, the average egg weight recorded for PK (48.84 ±6.77g) is significantly lower than that of IB (58.75±7.29g) and BB (60.27±6.03g). The mean yolk heights were the similar (17.84 mm) for BB and PK, whereas it was slightly lower for IB (17.41 mm). However, there was no statistically significant difference among IB, BB and PK for yolk height. Average albumin heights were 6.3 ±1.85 mm, 6.92 ±1.62 mm and 5 .64±1.55mm for IB, BB and PK, respectively and there was not statistically significant except between BB and PK on albumin height ($p<0.05$). There was no statistically significant difference ($p<0.05$) among the three improved chickens on average value for yolk weight.

Based on the values recorded PK had the highest yolk color value (10.79±1.98) followed by IB (9.74 ±3.13) which were significantly higher than yolk color value of BB (7.77±3.15) and with the exception of IB and PK, statistical significant differences ($p<0.05$) were found among other chicken groups on yolk color. The average albumin weights IB was not statistically different from BB, while PK was statistically lower ($p<0.05$) than IB and BB groups on average albumin weight. The mean Haugh units were 78.78, 81.68 and 76.57 for IB, BB and PK, respectively and there was not significantly different on Haugh unit. The average eggshell thickness measured for IB, BB and PK were 0.31±0.05 mm, 0.33±0.037mm and 0.29±0.026mm, respectively. The eggshell thickness of BB was significantly higher than IB and PK groups ($p<0.05$).

4.10. Constraints

Information collected on constraints in poultry production (Table 15) in the study area revealed that disease was the most important problem affecting poultry productivity in Ada'a (43.3%) and in Lume (31.1%) districts. On the other hand, the available veterinary service was considered inadequate at village level by 20% in Ada'a district and 23.3% respondents in Lume districts standing second from the list of constraints. The third constraint claimed by 20 % in Ada'a and 23.3% respondents in Lume districts was feed shortage at village level. The fourth and fifth major constraints were attack of predators and lack of modern poultry rearing knowledge.

Table 15: Major constraints of poultry production in order of importance in Ada'a and Lume districts

Constraints	*District*			
	Ada'a, N=90		Lume , N=90	
	Frequency	%	Frequency	%
Presence of diseases	39	43.3	30	33.3
Inadequate veterinary services	18	20.0	21	23.3
Feed shortage	17	18.9	19	21.1
Predators problem	10	11.1	11	12.2
Lack of modern poultry rearing knowledge	6	6.7	9	10
Total	90	100	90	100

4.11. Options suggested by farmers to improve poultry productivity

In order to improve the existing state of poultry productivity farmers' suggested (Table 16) getting day old chicks at affordable price from government, continued provision of vaccination against major diseases, getting training on improved poultry production, supply of electricity and to be organized as association of poultry farmers.

Table 16: Options to improve poultry productivity in Ada'a and Lume districts

Suggested options	*Districts*			
	Ada'a, N=90		Lume, N=90	
	Frequency	%	Frequency	%
Cost of improved chicks should be affordable	39	43.3	37	41.1
Government should provide vaccination	25	27.8	21	23.3
Training on poultry rearing practices	17	18.9	21	23.3
Supply of electricity and clean water	8	8.9	11	12.2
Poultry farmers associations(Cooperatives)	1	1.1	0.0	0.0

Majority of the respondents 43.3% in Ada'a and 41.1% in Lume districts suggested that government should supply day-old chicks at affordable price. Others seek provision of annual vaccination for their chicken. Getting training on modern poultry rearing technologies was suggested as an option to improve poultry productivity. Some other respondents indicated that there is a need for a supply of electricity and clean water for efficient poultry production at a village level.

5. DISCUSSION

Higher proportion of female respondents than males reflected to the fact that village poultry rearing is mainly managed by females, as it was also reported by Upton (2004); Muchadeyi *et al.* (2007) and Khandait *et al.* (2011). The average age of respondents 36.9 years in Ada'a and 37.7 years in Lume were similar to those reported by Moges *et al.* (2010a) in North West Ethiopia. Education status observed under the present study was much better than to those reported by Halima (2007) and Moges *et al.* (2010a). The average family size per household was 5.5 in Ada'a district, whereas in Lume district, it was nearly similar to the national average of 5.2 (CSA, 2003). Total landholding per household in Ada'a (1.1±1.26 ha) and Lume (1.4±1.25) were comparable with that reported by Moges *et al.* (2010a). The landless respondents were 13.9% and 17.8% in Ada'a and Lume districts, respectively and chicken can be a source of eggs and meat with low inputs for landless chicken owners (Sonaiya and Swan, 2005). According to Moreki *et al.* (2001), family chicken are rarely the sole means of livelihood for the family.

Majority of the respondents, 91.11% in Ada'a and 95.6% in Lume districts, constructed a separate house entirely for poultry, which is significantly higher than the findings of Moges *et al.* (2010a) and Mengesha *et al.* (2011) who reported 22.1% and 21.2% village chicken owners provided separate poultry house in Bure district, North West Ethiopia and Jamma district, South Wollo, respectively. This significant variation might be due to farmers' awareness to the importance of poultry housing in Ada'a and Lume districts. Similarly, Khandait *et al.* (2011) in Bhandara district of India, reported 90% of backyard chicken owners provided separate poultry house. However, in the present study, from 91.11% in Ada'a district 35.6% and from 95.6 % in Lume district 25.6% of the respondents constructed poultry house based on recommended extension package for improved layers. Generally, it was also observed that few households residing near the town and main road provided electricity and litter material in poultry house. The majority of respondents did not follow the recommended housing based on extension packages, claimed poor economic status as a reason for not having a separate poultry house and wished to have it when their economic status permit.

Feeds are a major input in poultry production systems, in both districts, 97.8% of the respondents provided additional feed supplements to their chicken. Similarly, 99%, 97.5% and 98% feed supplementation by chicken owners were reported by Halima (2007); Moges *et al.*, (2010a); Mengesh *et al.*, (2011), respectively. In India, 97.25% backyard chicken owners provide additional supplement (Khandait *et al.*, 2011). Approximately, 97% of the respondents in both districts provided maize and wheat as feed supplements at frequency of three times/day at morning, midday (noon) and evening. As scavenging laying hen can find approximately 60 to 70% of their feed requirement Rahman *et al.* (1997); providing supplementary feeds three times/day could help to express the laying potential of chickens at village level.

In both districts, farmers well understood the importance of providing water for productivity of their chicken and about 96% of respondents in the present study areas provided water to their chicken with free access. Majority of respondents used tap (clean water) in Ada'a to their chicken, whereas borehole was the major water source in Lume district. Higher number of respondents used tap water in Ada'a than in Lume district; this could indicate the availability of better water infrastructure development in Ada'a than Lume district. Similar, watering practices were reported by Moges *et al.* (2010a); Mengesha *et al.* (2011).

As hybrid layer chicken, most of the respondents used IB in Lume and BB and PK in Ada'a districts. In both districts, majority of the respondents purchased layer chicks from private hatcheries; this could be due to lack of self-replacing and brooding/mothering ability of such hybrid layers. However, in the past decades, chicken productivity in Ethiopia mainly focused on use of imported temperate breeds such as White and brown Leghorns, Rhode Island Red, New Hampshire, Cornish, Australoup and Light Sussex (DZARC, 1991). The present change to the type of chicken used in these study areas could be due to the availability of hybrid layer chicks at large commercial farms located at Debre Zeit.

There was a good market access for poultry production inputs in Ada'a than in Lume districts, such difference could be due to the presence of more poultry production input suppliers in Ada'a district main town, Debre Zeit. However, higher number of respondents had good market access to sell their eggs and chicken in Lume than in Ada'a district, this might be the presence of market competitor for supplying egg and chicken at Ada'a district main town, Debre Zeit. Majority of the respondents sell eggs and chicken according to their

has been reported by Aklilu *et al.* (2007); Moges *et al.* (2010a) and Takele and Oli (2011), but still availability of credit service is limited for village chicken owners.

Vaccination has been significantly practiced in Lume than in Ada'a district. This is due to tremendous and coordinated effort of livestock experts, DAs and field veterinarians of Lume district. In both districts, about 56% of respondents used prophylactic measures against poultry diseases. None of the chicken owners practiced vaccination and prophylactic measures against poultry diseases in studies conducted by Moges *et al.* (2010a); Leta and Endalew (2010); Mengesha *et al.* (2011) and Takele and Oli (2011). Culling was practiced by all respondents due to poor productivity, old age and disease and similar culling practice was reported by Moges *et al.* (2010a).

Significant difference ($p<0.05$) was observed among IB, BB and PK on average number of eggs/hen/year; this could be attributed to difference in genetic potential of different strains used. This is in line with the reports of Majaro (2001) and Yakubu *et al.* (2007). The average number of eggs/year/hen reported in this study was higher than to those reported by Lemlem and Tesfaye (2010) for White leghorn, Rhode Island Red and Fayoumi chicken under village household condition; this might be attributed to the differences in genotype used and environment. In addition, it was significantly higher than local chickens, which lay 55-80 eggs per year (Dessie and Ogle, 2001). This good performance of hybrid layers with supplementation of maize and wheat can be supported by the findings of Vries (1993); Altamirano (2005) who have observed that Harco commercial hybrid layer found to be excellent layer in free-range system with supplementation of 50 g maize/day in the high land parts of Bolivia.

Age at sexual maturity is important trait from the economic stand point. In the present study, PK had the shortest age at first egg. Significance differences ($p<0.05$) were recorded between PK and IB as well as PK and BB for average age at first egg under village management condition. This observed differences in age at first egg of three strains under the present study could be due to genotype and environmental differences, which is in agreement with the reports of Demeke (2004); Fasill *et al.* (2010) and Lemlem and Tesfaye (2010).

As the laying hen body weight increased, egg production decreased and egg weight and feed consumption increased, because heavy birds consume more feed and lay larger egg with

large egg yolk than light hens (Leeson *et al.*, 1997). In the present study, there was no significant difference recorded among IB, BB and PK laying hens on adult live body weight. However, evaluation result of eggs from these chicken indicated that the eggs were within the range of to be ranked a good quality (>70HU), suggesting better productive performance with the current live body weight recorded under village production system.

The average egg weight of PK is significantly lower ($p<0.05$) than average egg weights of IB and BB. Such difference could be expected since IB and BB commercial strains developed for egg weight improvement (Hocking *et al.*, 2003). The present findings agree with the observations of Tixier-Boichard *et al.* (2006). The average egg weight recorded for IB and BB under village level were relatively higher than average egg weight reported by Tulin and Ahmet (2009) for village/scavenging production system (52.24g). The difference observations on egg weight among different strains of chicken in the present study could be genetic differences.

In the present study, no significant differences were recorded among three chicken groups on yolk height; this is disagreed with the report of Niranjan *et al.* (2008) who reported significant difference on albumin height for chicken under backyard management. There was significant difference between BB and PK on albumin height. However, higher yolk and albumin height was recorded in the present study than recorded for local chicken reported in Ethiopia by Moges *et al.* (2010b) and in Tanzania by Nonga *et al.* (2010). This reflects the superiority of hybrid layers for albumin and yolk height.

The average yolk weight of the three chicken groups in this study was not significantly different. This finding was in agreement with report of Tulin and Ahmet (2009) for eggs produced under village management system. The average yolk colour recorded for BB was significantly lower than from IB and PK. Similar yolk color values recorded in Bure and Fogera districts for local chicken by Moges *et al.* (2010b) indicating yolk color is a function of feed not breeds (Demeke, 2004). However, in the present study, the highest yolk color value in PK might indicate good scavenging ability of PK being an indigenous hybrid and could get enough green grass required to bring the higher yolk colour value.

The average albumin weight in PK was significantly lower than IB and BB; this observed significant differences might be due to low egg weight in PK, since egg weight influences the

weight of components of eggs especially egg albumen and yolk. These results agreed with the findings of Zhang *et al.* (2005); Aygun, and Yetisir (2010). The Haugh Unit (HU) is an expression relating egg weight and the height of thick albumen. The average HU was not significantly different among IB, BB and PK. The present finding on HU was lower than the observation of Tulin and Ahmet (2009) who reported HU of 85.82 for village chicken eggs.

There was no significance difference observed between IB and BB on eggshell thickness, this could be due to these hybrid layers developed for egg quality improvement, as it is also reported by Hocking *et al.* (2003). The average eggshell thickness in PK was only significantly lower than BB. The difference in eggshell thickness in the present study could be layer strain difference; this is in agreement with Khan *et al.* (2004) and Zita *et al.* (2009) who reported the effect of layer type difference, environmental conditions and feed quality on eggshell thickness.

In the present study areas, diseases were reported as first major problem, where ND was number one constraint of village chicken productivity in Ada'a and Lume districts; followed by inadequate veterinary services, feed shoretage, predators and lack of modern poultry rearing knowledge. Similarly, Moges *et al.* (2010a) reported ND as economically important diseases in North West Ethiopia. Limited veterinary services for village chickens were also reported by Moges *et al.* (2010a); Leta and Endalew (2010); Takele and Oli (2011) and Mengesha *et al.* (2011) in different parts of Ethiopia. According to respondents view, the third major constraint claimed was feed shortage at village level, pronounced particularly in none harvesting season. Attack of predators were mentioned as fourth major constraint as it is common problem in other parts of Ethiopia such as Central highlands of Ethiopia (Dessie and Ogale, 2001), North west Ethiopia Moges *et al.* (2010a), Walaita Zone of Southern Ethiopia (Takele and Oli, 2011). Lack of modern poultry rearing knowledge through extension service and training was the other constraint in both districts as it is also reported by Moges *et al.* (2010a) in Ethiopia and Khandit *et al.* (2011) in India.

As an option to enhance poultry productivity respondents seek to get affordable cost of improved chicks, regular vaccination, training and electricity supply. Majority of the respondents in both districts purchased improved chicks from private hatcheries at high cost and majority of respondents seek to get improved chicks at affordable price. Significant number of respondents consider as an option to get regular vaccination of chicks against

important diseases at village level for increasing the productivity and profitability of their chicken, as it is suggested by Dessie and Ogale (2001). In addition, respondents seek to get adequate training on different aspects of modern poultry rearing. Some other respondents consider supply of electricity as a heat source with other improved management practices as an important option to enhance survival and growth of day old chicks during brooding. Very few respondents in Ada'a district consider working in association, with the objective to access easily poultry production inputs and other facilities from providers.

6. CONCLUSION AND RECOMMENDATIONS

The performance of exotic chickens under village production system could be increased through improved housing, feeding and health management. Farmers are aware that these hybrid layers can produce more eggs if they are fed and looked after carefully. The annual eggs/hen/year for hybrid layers seems to be over reported by farmers and this requires further study considering the amount of additional feed supplement by farmers' and proper recording on the number of eggs to better conclude on their productive performances.

In view of the above, the following recommendations are suggested:

- Government, research and developmental organizations should give attention to village poultry sector and its development.
- There should be adequate supply of improved hybrid chicks to the farmers, since exotic chicken lacks self-replacing ability at village level.
- Training for farmers and extension staffs focusing on diseases control, improved housing feeding, proper data recording system should be arranged to be successful in hybrid layer chicken under village production system.
- Government should train community chicken vaccinators to provide wide spread vaccination against major poultry diseases in the study areas.

7. REFERENCES

Abdelqader, A., Wollny, C. and Gauly, M. (2007): Characterization of local chicken production systems and their potential under different levels of management practice in Jordan. *Trop. Anim. Health Prod.*, **39**:155-164.

Abdel-Rahman, A. (2000): Effect of naked neck gene (Na) and housing system on egg production performance of Sharkasi chickens under subtropical conditions. *Egypt. Poult. Sci. J.*, **20** (4): 905- 926.

Abubakar, M., Ambali, A. and Tamjdo, T. (2007): Rural chicken production: Effects of gender on ownership, and management responsibilities in some parts of Nigeria and Cameroon. *Int. J. of Poult. Sci.*, **6** (6):413–416.

Ahlers, C., Alders, R., Bagnol, B., Cambaza, A., Harun, M., Mgomezulu, R., Msami, H., Pym, B., Wegener, P., Wethli, E. and Young, M. (2009): Improving village chicken production: A manual for field workers and trainers. ACIAR Monograph No. **139**. Australian Centre for International Agricultural Research, Canberra. http://www.aciar.gov.au/publication/MN139.

Ahmed, M. and Singh, P. (2007): Estimates of genetic parameters for some economic traits in White Leghorn. *Indian Poult. Sci.*, **42**:311-312.

Aklilu, H., Almekinders, C., Udo, H. and Van der Zijpp, A. (2007): Village poultry consumption and marketing in relation to gender, religious festivals and market access. *Trop. Anim. Health Prod.*, **39** (3):165-177.

Alders, R. (2004): Poultry for profit and pleasure. FAO. Diversification Booklet **3**. FAO, Rome.

Alexander, D., Bell, J. and Alders, R. (2004): Technology Review: Newcastle disease with special emphasis on its effect on village chickens. FAO Animal Production and Health Paper No. 161. Rome, FAO. pp. 63.

Alganesh, T., Matewos, B. and Gizaw, K. (2003): Survey on traditional livestock production system. Proceeding 11th Annual Conference of Ethiopian Society of Animal production, Addis Ababa, Ethiopia, August 28-30, 2003. pp. 141-150.

Ali, S. (2002): Study on the effect of feed supplementation to laying hen under the rural condition of Bangladesh. MSc thesis. Department of Animal Science and Animal Health and Network for Smallholder Poultry Development, The Royal Veterinary and Agricultural University, Dyrægevej, 1870 Frederiksberg C., Denmark.

Altamirano, W. (2005): Egg production of two breeds and three diets in the highland of Bolivia. The Royal Veterinary and Agricultural University, Copenhagen. (MSc. Thesis).(Available.at.http://www.poultry.life.ku.dk/Information_resources/References/Poultry_References).

Anderson, K. (2002): First cycle report. North Carolina layer performance and management test., **34**:1-35.

Arsham, H. (2002): Descriptive Sampling Data Analysis. *Statistical Thinking for Managerial Decision Making.* Retrieved November 30, 2011, from http://ubmail.ubalt.edu/harsham/Business-stat/opre504.htm#rwhyrssm

Aygun, A. and Yetisir, R. (2010): The relationships among egg quality characteristic in different hybrid layers to forced molting programs with and without feed withdrawal. *J. Anim. Vet. Adv.*, 9 (4):710-715.

Bain, M. (2005): Recent advances in the assessment of egg shell quality and their future application. *World's Poult. Sci. J.*, **61**:268-277.

Bell, D. and Weaver, W. (2002): Commercial Chicken Meat and Egg Production. 5th ed. Cambridge, Massachusetts. Kluwer Academic Publisher.

Benvenuti, M., Lorella, G., Carlo, P., Domenico, G. and Marco, B. (2012): Buckwheat bran (Fagopyrum esculentum) as partial replacement of corn and soybean meal in the laying hen diet. *Ital J Anim. Sci.*, **11**:2.

Besbes, B. (2009): Genotype evaluation and breeding of poultry for performance under suboptimal village conditions. *World's Poult. J. Sci.*, **65**:260-269.

Branckaert, R., Gaviria, L., Jallade, J., and Seiders, R. (2000): Transfer of technology in poultry production for developing countries. SD dimension. FAO http://www.fao.or/sd/cddirect/cdre0054.htm.

Bush, J. (2006): The Threat of Avian Flu Predicted Impacts on Rural Livelihoods in Southern Nation, Nationalities and Peoples Region (SNNPR), Ethiopia. The Food Economy Group, May 2006.

Byarugaba, D. (2007): The Structure and Importance of the Commercial and Village based Poultry Systems in Uganda. FAO -Consultancy Report.

CSA. (2003): Ethiopian Agricultural Sample Enumeration, 2001/2002. Statistical report on farm management practices, livestock and farm implements part II, Addis Ababa, Ethiopia. pp. 233.

CSA. (2005): Agricultural Sample Survey 2004/05. Central Statistical Authority No.**2.** Report on Livestock and livestock characteristics. Statistical Bulletin. PP. 331.

Dana, N., Duguma, R., Teklewold, H. and Aliye, S. (2006): Transforming village poultry systems into small agro-business ventures: a partnership model for the transfer of livestock technologies in Ethiopia. *Lives. Res. for Rural Dev., **18:169.*** Retrieved March 15, 2012, from http://www.lrrd.org/lrrd18/12/dana18169.htm

Danilov, R. (2000): Effect of hens' age on quality of hatching eggs and embryonic development. *Proceeding 21st World's Poult. Congress.* Montreal, Canada.

Dawit, A., Tamrat, D., Stotaw, F., Nzietcheung, S. and Roy, D. (2008): Overview and background paper on Ethiopia's poultry sector. Relevance for HPAI Reseasrch in Ethiopia. www.hpai-reserach net. Accessed 06 April 2011.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C. (1999): Livestock to 2020: The next food revolution. Food, Agriculture and the Environment Discussion Paper **28**. ILRI (International Livestock Research Institute), Nairobi, Kenya. PP.72.

Demeke, S. (2004): Egg production performance of local and White Leghorn hens under intensive and rural household conditions in Ethiopia. *Lives. Res. for Rural Dev., **16:9.*** Retrieved on May 29, 2012, from http://www.lrrd.org/lrrd16/2/deme1602.htm.

Dessie, T. and Ogle, B. (2001): Village poultry production system in the Central Highlands of Ethiopia. *Trop. Anim. Health and Prod.*, **33**:521-537.

Dinka, H., Regassa, C., Fufa, D., Endale. B. and Leta, S. (2010): Major Constraints and Health Management of Village Poultry Production in Rift Valley of Oromia, Ethiopia. American-*Eurasian J. Agric. Environ. Sci.*, **9** (5): 529-533.

Doviet, M. (2005): Effect of supplementation, breed, season, and location on feed intake and performance of scavenging chickens in Vietnam. PhD thesis, Swedish University of Agricultural Sciences. pp.45

Duduyemi, O. (2005): Evaluation of the egg laying performance of two strains of Bovan chicken (Bovan Brown and Bovan Nera) in the Tropics. Proc. 1st Nigeria. International Poultry Summit. February 20- 25, 2005, Ota, Nigeria. pp35-38.

DZARC (Debre Zeit Agricultural Research Center), (2006): Unpublished Metrological Data

DZARC (Debre Zeit Agricultural Research Centre), (1991): Annual Research Report. Debre Zeit, Ethiopia.

Eshetu, Y., Mulualem, E., Ibrahim, H., Berhanu, A. and Aberra, K. (2001): Study of gastro-intestinal helminthes of scavenging chickens in four rural districts of Amhara region, Ethiopia. *Rev. Sci. tech. Off. Int. Epiz.*, **20** (3):791-796.

FAO. (2004): Livestock sector brief: Ethiopia. Food and Agriculture Organization of the United Nations. Livestock information, sector analysis, and policy branch AGAL. 2004. Rome.

FAO. (2010): Chicken genetic resources used in smallholder production systems and opportunities for their development, by P. Sørensen. FAO Smallholder Poultry Production Paper No. 5. Rome.

Farooq, M., Mian, M., Ali, M., Durranim, F., Asquar, A. and Muqarrab, A. (2001): Egg traits of Fayoumi bird under subtropical conditions. *Sarad. J. Agri.*, **17:**141-145.

Fasill, B., Hans, M., Gjoen J., Tormod, A. and Girma, A. (2010): Production performance of dual purpose crosses of two indigenous with two exotic chicken breeds in sub tropical environment. *Inter. Poult. Sci.*, **9**:702-710.

Gausi, J., Safalaoh, A., Banda, J. and Ng'ong'ola, D. (2004): Characterization of the smallholder poultry marketing systems in rural Malawi: Extension case study. *Lives. Res. for Rural Dev.*, **16** :(12). http://www.lrrd.org/lrrd16/12/gaus16097.htm.

Gondwe, T. (2004): Characterization of local chicken in low input-low output production systems: is there scope for appropriate production and breeding strategies in Malawi? (PhD thesis, Georg-August-Universität Göttingen, Germany).

Grobas, S., Mendez, J., Lazaro, R., de Blas , C. and Mateos, G. (2001): Influence of source and percentage of fat added to diet on performance and fatty acid composition of egg yolks of two strains of laying hens. *Poult. Sci.*, **80**:1171-1179.

Grobbelaar, J., Sutherland, B. and Molalakgotla, N. (2010): Egg production potentials of certain indigenous chicken breeds from South Africa. *Anim. Genet. Resour.*, **46:**25-32.

Gueye, E. (2000): The role of family poultry in poverty alleviation, food security and the promotion of gender equality in rural Africa. *Outlook on Agri.*, **29 (2)**: 129-136.

Gueye, E. (2003): Gender issues in family poultry production systems in low-income food-deficit countries. *Amer. J. Alternative Agri.*, **18** (4):185-195.

Gwaza, D. and Egahi, J. (2009): Genotype by environment interaction on egg laying performance of four layer breeds in the derived Southern Guinea Savannah region of Nigeria. 34th Annual Conference, Nigeria Society of Animal Production (March 15th 18th, 2009) held at University of Uyo, Nigeria. PP. 143-145.

Halima, H. (2007): Phenotypic and Genetic Characterization of Indigenous Chicken Populations in Northwest Ethiopia. PhD Thesis; University of the Free State, Bloemfontein, South Africa, p. 186.

Haugh, R. (1937): The Haugh unit of measuring egg quality.*US egg Poult. Magazine*, **43**:552-555.

Henuk, Y. and Dingle, J. (2002): Practical and economic advantages of choice feeding systems for laying poultry. *World's Poult. Sci.* J., **58**:199-208.

Hocking, P., Bain, M., Channing, C., Fleming, R . and Wilson, S. (2003): Genetic variation for egg production, egg quality and bone strength in selected and traditional breeds of laying fowl. *Br. Poult. Sci.*, **44**:365-373.

ILRI, (2005): Ada'a Liben Wored Pilot Learning site Diagnosis and Program Design in Addis Ababa, Ethiopia, **63**:6-11.

Islam, M., Bulbul S., Seeland, G. and Islam, A. (2001): Egg quality of different chicken genotypes in summer and winter. *Pakistan. J. Biol. Sci.*, **4:** 1411-1414.

Jacob, J., Wilson, H., Miles, R., Butcher, G. and Mather, B. (1998): Factors Affecting Egg Production in Backyard Chicken fact sheet PS-35, Institute of Food and Agricultural Sciences, University of Florida. Original publication date April 1998. Reviewed March, 2011. Visit the EDIS website at http://edis.ifas.ufl.edu.

Javed, K., Farooq, M., Mian, M., Durrani, F. and Mussawar, S. (2003): Flock size and egg production performance of backyard chicken reared by rural woman in Peshawar Pakistan. *Lives. Res. for Rural Dev.,* **15** (11), Retrieved from one may 26, 2012 from:(http://www.cipav.org.co/cipav/pubs/index.htm).

JICA, (1999): Countrywide Profile (Pakistan). Japan International Cooperation Agency. Planning Department, Islamabad.

Khan, M., Khatun, M. and Kibria, A. (2004): Study the Quality of eggs of Different genotypes of chicken under scavenging system at Bangladesh. *Pak. J. Biol. Sci.*, **7** (12):2163-2166.

Khandait, V., Gawande, S., Lohakare, A. and Dhenge, S. (2011): Adoption Level and Constraints in Backyard Poultry Rearing Practices at Bhandara District of Maharashtra (India). *Res. J. of Agri. Sci.*, **2** (1):110-113

Kinung'hi, Safari, M. ,Getachew, T., Hafez, M., Moges, W., Moses, K., Matthias G. and Maximillian, B. (2004): Assessment of Economic Impact Caused by Poultry Coccidiosis in Small and Large Scale Poultry Farms in Debre Zeit, *Ethiopia Int. J. Poult. Sci.,* **3** (11):715-718.

Kondombo, S., Nianogo A., Kwakkel, R., Udo, H. and Slingerland, M. (2003): Comparative analysis in village chicken production in two farming systems in Burkina Faso. Trop. *Anim. Health and Prod.,* **35**:563-574.

Lemlem, A. and Tesfay, Y. (2010): Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. *Live. Res. for Rural Dev., 22:133.* Retrieved from: http://www.lrrd.org/lrrd22/7/leml22133.htm.

Leeson, S., Caston, L., Summers, J. (1997): Layer performance of four strains of leghorn pullets subjected to various rearing programs. *Poult. Sci.;* **76**:1–5.

Leta, S. and Endalew, B. (2010): Survey on Village Based Chicken Production and Utilization System in Mid Rift Valley of Oromia, Ethiopia. *Global Veterinaria,* **5** (4):198-203,

Leyendecker, M., Hamann, H., Hartung, J., Kamphues, J., Ring, C., Glunder, G., Ahlers, C., Sander, I., Neumann, U. and Distl, O. (2001): Analysis of genotype environment interactions between layer lines and hen housing systems for performance traits, egg

quality and bone breaking strength. 2nd communication: egg quality traits. *Zuchtungskunde*, **73** (4):308-323.

Leyendecker, M., Hamann , H., Hartung, J., Kamphues, J., Neumann, U., Surie, C. and Distl, O. (2005): Keeping laying hens in furnished cages and an aviary housing system enhances their bone stability. *British Poult. Sci.*, **46** (5):536-544.

Majaro, O. (2001): Response of layers of two genotypes to dietary regimes for reducing egg production during glut in egg market. *Trop. Vet.*, **19:**48-51.

Mapiye, C., Mwale, M., Mupangwa1, J., Chimonyo, M., Foti1, R. and Mutenje1, M. (2008): A Research Review of Village Chicken Production Constraints and Opportunities in Zimbabwe. *Asian-Aust. J. Anim. Sci.*, **21** (11):1680-1688.

Mengesha, M., Tamir, B. and Dessie, T. (2011): Village Chicken Constraints and Traditional Management Practices in Jamma District, South Wollo, Ethiopia. *Lives. Res.for Rural Dev., 23 (37).* Retrieved from:http://www.lrrd.org/lrrd23/2/meng23037.htm.

Moges, F., Abera, M. and Tadelle, D. (2010a): Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. *African J. Agri. Res.*, **5** (13):1739-1748.

Moges, F., Azage, T. and Tadelle, D. (2010b): Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper **24:** Nairobi, Kenya, ILRI.

Moreki, J., Petheram, R. and Tyler, L. (2001): A study of small-scale poultry production systems in Serowe-Palapye sub-district of Botswana. In: Bour M (ed), Proceedings INFPD workshop, Senegal, 9–13 December 1997. pp. 206-246.

Muchadeyi, F., Sibanda, S., Kusina, N., Kusina J. and Makuza, S. (2004): The village chicken production system in Rushinga District of Zimbabwe. *Lives. Res. Rural Dev.* **16**(40). http://www.cipav.org.co/lrrd/lrrd16/06/much16040.htm. Acessed: 02/11/2005.

Muchadeyi, F., Wollny, C., Eding, H., Weigend, S., Makuza, M. and Simianer, H. (2007): Variation in village chicken production systems among agro-ecological zones of Zimbabwe. *Trop. Anim. Health and Prod.*, **39**:453-461.

Muchenje, V., Manzini, M., Sibanda, S. and Makuza, S. (2000): Socio-economic and biological issues to consider in smallholder poultry development and research in southern Africa in the new Millennium. A paper presented at the regional conference on animal agriculture and crisis mitigation in livestock dependent systems in southern Africa, 30 October to 1 November 2000, at Malawi Institute of Management, Lilongwe, Malawi. pp. 134–144.

Nigussie, D., Alemu, Y., Tadelle, D. and Samuel, W. (2003): On-station and on-farm evaluation of the 'hay-Box chick brooder' using different insulation materials at Debre Zeit Agricultural Research Center and Denbi village, Adaa woreda. In: Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP), August 21–23, held in Addis Ababa, Ethiopia. pp. 211–216.

Niranjan, M., Sharma, R., Rajkumar, U., Reddy, B., Chatterjee R. and Battacharya, T. *(2008):* Comparative Evaluation of Production Performance in Improved Chicken Varieties for Backyard Farming. *Int. J. Poult. Sci.*, 7(11):1128-1131.

Nonga, H., Kajuna F., Ngowi, H. and Karimuribo, E. (2010): Physical egg quality of free-range local chickens in Morogoro municipality, Tanzania. *Lives. Res. Rural Dev., 22(218).* Retrieved May 30, 2012, from http://www.lrrd.org/lrrd22/12/nong2221.htm.

Nys, Y. (2001): Recent developments in layer nutrition for optimising shell quality. In: Proceedings of 13th European Symposium of Poultry Nutrition. Blankenberge, Belgium, 45–52.

Nzietchueng, S. (2008): Characterization of poultry production systems and potential pathways for the introduction of highly pathogenic avian influenza in Ethiopia. Draft Report. International Livestock Research Institute.

Okeudo, N., Onwuchekwa, C. and Okoli, I. (2003): Effect of oil treatment and length of storage on the internal quality, organoleptic attributes and microbial profile of chicken eggs. *Trop. Anim. Prod.*, **6**:63-70.

Olawumi, S. and Dudusola, I. (2010): Effects of Genotype and Housing on Reproductive Performance of Two Strains of Commercial Layers in the Derived Savannah Zone of Nigeria, *Publication of Nasarawa State University, Keffi,* **6** (1):102-109.

Olawumi, S. and Dudusola, I. (2012): Part-Term Performance Traits of Commercial Layer Strains in the Derived Savannah Zone of Nigeria. *Anim. Sci. J. Adv.*, **2**(3.2):332-337.

Onagbesan, O., Bruggeman, V., Desmit, L., Debonne, M., Witters, A., Tona, K., Everaert, N. and Decuypere, E. (2007): Gas Exchange During Storage and Incubation of Avian Eggs:effects on Embryogenesis, Hatchability, Chick quality and Post-hatch Growth. *World's Poult. Sci. J.*, **63**: 557-573.

Payne, W. and Wilson, R., (1999): An introduction to Animal Husbandry in the tropics. Blackwell Science Ltd, pp. 447-484.

Pedersen, C. (2002): Production of semi-scavenging chickens in Zimbabwe. PhD thesis. Royal Veterinary and Agricultural University, Copenhagen, Denmark. pp. 213.

Permin, A. and Perdersen G. (2002): The need for a holistic vie on disease problem in free range chickens.In:Characterstics and parameters of family poultry production in Africa. IAEA, Vienna, pp. 9-13.

Rahman, M., Sorensen, P., Jensen, H. and Dolberg, F. (1997): Exotic hens under Semi-scavenging condition in Bangladesh. *Livestock Research for rural Development*, **9**:3. Retrieved from:http://www.cipav.org.co/ilrrd/ilrrd931.htm.

Rajkumar, U., Sharma, R., Rajaravindra, K., Niranjan, M., Reddy, B., Bhattacharya, T. and Chatterjee, R. (2009): Effect of Genotype and age on egg quality traits in naked neck chicken under tropical climate from India. *Int. J. Poult. Sci.*, **8**:115-1155.

Ramsey, K., Harris, L. and Kotze, A. (2000): Landrace Breeds: South Africa's indigenousand locally adapted developed farm animals. Ed. Ramsey, Harris and Kotzé. Farm Animal Conservation Trust, Pretoria.

Serkalem, T., Hagos, A. and Zeleke, A. (2005): Sero-prevalence study of Newcastle disease in local chickens in central Ethiopia. *Inter. J. Appl. Res. Vet. Med.*, **3**:1.

Silversides, F. and Scott, T. (2001): Effect of storage and layer age on quality of eggs from two lines of hens. *Poult. Sci.*, **80**:1240-1245.

Silversides, F., Scott, T., Korver, D., Afsharmannesh, R. and Hruby, M. (2006): A study on the interaction of xylase and phytase enzymes in wheat based diets fed to commercial white and brown laying hens. *Poult. Sci.*, **85:**297-305.

Solomon, D. (2007): Suitability of hay-box brooding technology to rural household poultry production system. *Lives. Res. Rural Dev.*, **19 (1):** Retrieved May 8, 2012, from http://www.lrrd.org/lrrd21/8/dugu21116.htm.

Solomon, D. (2008): Ethiopia: Poultry sector country review. FAO, Rome, Italy. ftp://ftp.fao.org/docrep/fao/011/ai320e/ai320e00.pdf.

Sonaiya, E. (2000): Family poultry and food security: Research requirements in science, technology, and socioeconomics. Proceedings XXI World's Poultry Congress, Montreal, Canada. pp. 20–24.

Sonaiya, E. (2004): Direct assessment of nutrient resources in free-range and scavenging systems. *World's Poult. Sci. J.*, **60** (4): 523-535.

Sonaiya, E. and Swan S. (2004): Small-scale poultry production, Technical guide, Manual, FAO, Rome, Italy.

Sonaiya, E. and Swan, S. (2005): Small-scale poultry production, technical guide manual. FAO Animal Production and Health. No.1. Food and Agriculture Organization (FAO), Rome, 2004, http://www.fao.org/docrep/008/y5169e/y5169e00.HTM.

Sorensen, P. and Ssewannyana, E. (2003): Progress in SAARI chicken breeding project – analyses of growth capacity. In *Proceedings of the Livestock Systems Research Programme Annual Scientific Workshop, held March 2003, Kampala, Uganda,* pp. 172-178. 2003. DANIDA's Agricultural Sector Research Programme (ASPS) and National Agricultural Research Organisation (NARO) Uganda.

SPSS. (2007): Statistical Package for Social Sciences SPSS for windows. User's guide: Statistics version **17**. Inc. Cary, NC.

Suk, Y. and Park, C. (2001): Effect of breed and age of hens on the yolk to albumen ratio in two different genetic stocks. *Poult. Sci.*, **80**:855-858.

Tadelle, D. and Ogle, B. (2000): Nutritional status of village poultry in the central high lands of Ethiopia as assessed by analyses of crop contents. *Eth. J. Agri. Sci.*, **17**:47-57.

Tadelle, D. (2001): The role of scavenging poultry in integrated farming systems in Ethiopia. Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia. Livestock feed resources within 55 integrated farming systems. pp. 377–399. (Available from http://www.fao.org/Ag/againfo/resources/documents/frg/conf96pdf

Tadelle, D. (2003): Phenotypic and genetic characterization of chicken ecotypes in Ethiopia. PhD thesis. Humboldt University, Germany. PP.208.

Tadelle, D., Kijora, C. and Peters, K. (2003a): Indigenous chicken ecotypes in Ethiopia: growth and feed utilization potentials. *Int. J. of Poult. Sci.*, **2**:144-152.

Tadelle, D., Million, T., Alemu, Y. and Peters, K. (2003b): Village chicken production systems in Ethiopia: 1. Flock characteristics and performance; *Lives. Res. for Rural Dev. 15(1).*Retrieved May 26, 2012, from http://www.lrrd.org/lrrd15/1/tadea151.htm.

Tadelle, D., Million, T., Alemu, Y. and Peters, K. (2003c): Village chicken production systems in Ethiopia: 2. Use patterns and performance valuation and chicken products and socio-economic functions of chicken. Lives. Res. for Rural Dev. **15** (1). http://www.lrrd.org/lrrd15/1/tadeb151.htm (accessed 19 May, 2012).

Takele, T. and Oli, W. (2011): Uses and flock management practices of scavenging chickens in Wolaita Zone of southern Ethiopia. *Trop. Anim. Health Prod.*, **44:**537-544.

Tixier-Boichard, M., Joffrin, D., Gourichon, A. and Bordas, C. (2006): Improvement of yolk percentage by crossbreeding between a commercial Brown-egg layer and a local breed, the Fayoumi. **In**: 8th World congress on genetics applied to livestock production. Belo Horizonte, MG., Brasil.

TSS, (1999): Technical Services and Supplies, QCD instrument Range Manual.York, England, Version 2.1- Release 27E7.

Tulin, C. and Ahmet, K. (2009): Comparison of village eggs and commercial eggs in terms of quality. *J. Anim. and Vet advances,* **8**:2542-2545.

Tumova, E. and Ebeid, T. (2003): Effect of housing system on performance and egg quality characteristics in laying hens. *Scientia Agriculturae Bohemica.* **34** (2):73-80.

Udo, H., Asgedom, A. and Viets, T. (2001): Modeling the impact of intervention in village poultry productions. Livestock Community and Environment. Proceeding of the 10th Conference of the Association of Institution for Tropical Veterinary Medicine Copenhagen, Denmark. Mekele University College, Ethiopia.

Upton, M. (2004): The Role of Livestock in Economic Development and Poverty Reduction Online.Rome(Italy).FAO.http://www.fao.org/ag/againfo/projects/en/pplpi/docarc/wp10.pdf> Accessed 2012 March 10.

Van Marle-Köster, E. and Nel, H. (2000): Genetic characteristics of native Southern African populations: evaluation and selection of polymorphic microsatellite markers. *South African J. of Anim. Sci.,* **30**:1-6.

Van Den Bran, D., Parmentier, H. and Kemp, B. (2004): Effects of housing system (outdoor *vs* cages) and age of laying hens on egg characteristics. *British Poult. Sci.,* **45** (6):745-752.

Vries, H. (1993): Hybrid layers on free range in Southwest Zambia. *World Animal Review*, 74-75:1–2.

Wilson, R. (2010): Poultry production and performance in the Federal Democratic Republic of Ethiopia. *World's Poult. Sci. J.*, **66**.

Yakubu, A., Salako, A. and Ige, A. (2007): Effects of genotype and housing system on the laying performance of chickens in different seasons in the Semi Humid Tropics. *Int. J. of Poult. Sci.*, **6** (6): 434-439.

Zaman, M., Sorensen, P. and Howlider, M. (2004): Egg production performance of a breed and three crossbreds under semi-scavenging system of management. *Lives. Res. for Rural dev.*, **16** (8). www.cipav.org.co/lrrd/lrrd16/8/zama16060.htm.

Zhang, L., Ning, Z., Hu, G., Hou Z. and Yang, N. (2005): Heritabilities and genetic and phenotypes correlations of egg quality traits in brown-egg dwarf layers. *Poult. Sci.*, **54**:1209-1213.

Zita, L., Tumova, E. and Stolc, L. (2009): Effects of genotype, age and their interaction on egg quality in brown-egg laying hens. *Acta Vet.*, **78**:85-91.

8. ANNEXES

Annex 1: Questionnaire Format

Remainder to enumerators

1. Make brief introduction to each farmer before starting any question, get introduced to the farmers (greet them the local way) get his name, tell him yours, the institution you are working for, and make clear the purpose and objectives of your question.
2. Please ask each question so clearly and patiently until the farmer understands.
3. Please fill up the questionnaire according to the farmers replay (do not put your opinion).
4. Please try not to use technical terms while discussing with farmers and do not forget the local unit.

Enumerator's Name_____**Date** _____**Code no**_____

A. Demographic Characteristics of the Households in the Study Area

1. Name of Village/*Peasant Association* _____

2. Name of household head: _____Sex: _____Age_____

3. Family size? 1. Male_____2. Female_____3. Total_____

4. Level of education of the household head? 1. Illiterate 2. Read and write

3. Elementary School 4. High School 5. College and University education

5. Land size? Please indicate the available land in the following table.

No.	Land type	Land unit	
		Hectare (ha)	Local measurement
1	Arable land		
2	Grazing land		
3	Unutilized land		
	Total		

B. Breeds Adopted

*Source of breed:

1. Purchased from Govt./Pvt. Hatchery 2. Provided from agriculture research center
3. Provided from NGO's 4. Hatching of eggs naturally at home

C. Housing condition

1. Management system used? 1. Backyard 2. Semi-intensive 3. Others_____

2. Available housing condition ? 1. Share the same house with people

2. Provision of night shelter only 3. Separate house entirely constructed for poultry

4. Separate house with other animals 5. Provision of electricity 6. Ventilation facility

3. Did you construct poultry house based on recommended extension packages?

1. Yes 2. No

4. If no in Q.3, specify the reasons_____, _____, _____

5. Do you provide litter material in the poultry house? 1. Yes 2. No

6. If yes Q.5. What type litter martial do you use? 1. *Teff* straw 2. Wheat straw

3. If others (specify) _____

D. Feeding and Watering

1. How do you feed your birds? 1. Scavenging only 2. Scavenging with supplement 3. Purchased feed 4. Homemade feed (readymade feed)

2. When do you feed your chickens? 1. Morning and evening 2. Morning and afternoon 3. Morning, afternoon and evening 4. Only scavenging

3. Do you provide supplementary feed? 1. Yes 2. No

4. If yes in Q.3., specify the type of supplement? 1.Maize and wheat 2. Furshika 3. Others

5. Do you provide water for your bird? 1. Yes 2. No

6. If yes Q.5. what is the source of water? 1. hole water 2. River 3. Tap water 4. Pond water 5. If others (specify) _____

7. How frequent do you provide water? 1. Free access 2. Morning only 3. Morning and evening only 4. If other (specify) _____

E. Egg production Performance

No	Parameters	Chicken types adopted		
		BB	BB	PK
1	Pullets age at first egg (weeks)			
2	Total number of eggs laid per hen/year			

1. Do you practice culling of birds? 1. Yes 2. No

2. If yes, reasons for culling? 1. Poor productivity 2. Old age 3. Sickness

3. Specify (if others)_____,_____, _____

G. Marketing (Products and production input)

1. Do you have market access to buy poultry production inputs? 1. Yes 2. No

2. Where do you buy poultry production inputs? 1. NGO 2. Government

3. Private companies 4. If others (Specify) _____, _____

3. Do you have market access for your poultry products? 1. Yes 2. No

4. When do you sell your poultry products? (Time of selling)

1. Specific wt. gain/age of birds 2. Personal money requirement

3. During holydays and festivals 4. If others (specify) _____

5. To whom are you selling your poultry products? 1. Village market 2. Local shopkeepers 3. Selling at own doorstep 4. Retailer 5. Whole sellers

6. If others (specify) _____

6. Which breed type meat is most preferred by consumers? 1. Meat from improved breed 2. Meat from local chicken 3.Equally preferred by consumers

7. Write your reasons for Q.7 responses? _____

_____

9. Which breed type egg is most preferred by consumers? 1. Eggs from improved breeds

2. Eggs from local chicken 3. Equally preferred

10. Write your reasons for Q.9 responses?_____

H. Poultry Health

1. Do you practice annual vaccination of your chicken? 1. Yes 2. No

2. Against which diseases vaccinate your chicken? 1. Newcastle diseases

2. Marek's Disease 3. Fowl thiphoid 4. Gumboro (infectious bursa disease)

5. Infectious bronchitis

3. Do you use anti-ectoparasites? 1. Yes 2. No

4. Do you practice deworming ? 1. Yes 2. No

I. Extension service

1. Do you have access to the extension service? 1. Yes 2. No

2. If you say No for Q.1, state the reasons? 1. Have no heard of them 2. cannot easily

reach them 3. There is no need 4. If others (specify) _____

3. How frequently do you see the extension agent? 1. Once in a week 2. Once in two weeks 3. Once in a month 4. Not Seen

4. Do you discuss your production problems with extension agents? 1. Yes 2. No

5. Have you ever got any training on poultry production? 1. Yes 2. No

6. If yes, for Q. 5. When? 1. Before starting the business 2. After the business started

7. Did you get credit service when you start poultry business? 1. Yes 2. No

8. If yes, for what purpose did use the credit? 1. Day old chicks 2. Poultry feed

3. Poultry equipment 4. If others (specify) _____

J. List Major Constraints

A. What are constraints in adoption of improved breeds? (Rank 1-8)

1. Presence of disease
2. Shortage of feed from surrounding
3. Attacks of predators (which age group is affected) _____
4. Thieves
5. Lack of market
6. Lack of time due to farm work activities
7. Improper service of veterinary doctors at village level
8. Lack of knowledge about scientific poultry management practices
9. Any other, if any_____

K. What do you suggest to improve your poultry business?

_____

_____

_____

_____

_____

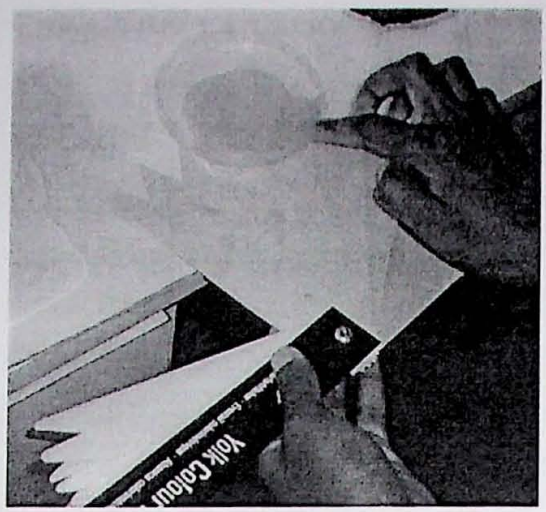
L. Performance Parameters Recording Format

Live weight at various ages

Age category	**Live weight (Kg) according to breed type**		
	Bovan Brown	Isa-Brown	Kockock
2. Laying hen (>20 months) (Kg)			

Laboratory egg quality recording format

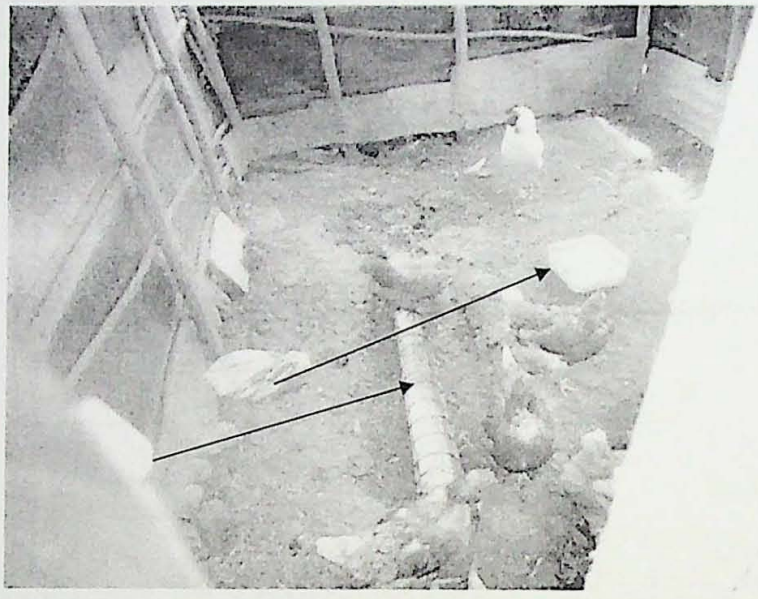
Egg quality traits	Chicken types		
	IB	BB	PK
Egg weight (g)			
Yolk height, (mm)			
Albumin height (mm)			
Yolk weight (g)			
Yolk colour			
Albumin weight (g)			
Haugh Unit			
Shell thickness (mm)			



Annex 2: Egg yolk colour from eggs collected during survey at village



Annex 3: Measuring eggshell thickness using digital Caliper



Annex 4: Housing system used with facility of feeding and watering trough at village

9. Signed DECLARATION Sheet

I the under signed, declare that this thesis is my original work has not been presented for a degree in any university and all sources of material that are used for this thesis have been duly acknowledged.

Name _____

Signature_____

Date of submission _____

This thesis has been submitted for examination with our approval as university advisors.

1._____

2._____