



**ASSESSMENT OF MANAGEMENT PRACTICES, PRODUCTION  
PERFORMANCES, AND SOME EGG QUALITY TRAITS OF  
CHICKENS REARED IN LOKA ABAYA DISTRICT, SIDAMA ZONE,  
SOUTHERN, ETHIOPIA**

**M.Sc THESIS**

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COLLEGE OF AGRICULTURE**

**HAWASSA, ETHIOPIA  
FEBRUARY, 2019**

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PERFORMANCES, AND SOME EGG QUALITY TRAITS OF CHICKENS  
REARED IN LOKA ABAYA DISTRICT, SIDAMA ZONE, SOUTHERN,  
ETHIOPIA

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A THESIS SUBMITTED TO THE SCHOOL OF ANIMAL AND RANGE  
SCIENCES

HAWASSA UNIVERSITY  
COLLEGE OF AGRICULTURE

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE  
OF MASTER OF SCIENCE IN ANIMAL AND RANGE SCIENCES  
(SPECIALIZATION: ANIMAL PRODUCTION)

**HAWASSA, ETHIOPIA**

**FEBRUARY, 2019**



## **DEDICATION**

This work is dedicated to my beloved father, mother and for the entire family for their endless support and understanding during the study period.

## **STATEMENT OF THE AUTHOR**

I declare that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an M.Sc degree at Hawassa University and is deposited at the University library to be made available to borrowers under rules of the library. I also declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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## **ACRONYMS**

AH	Albumen height
AI	Albumen index
AL	Albumen length
ANOVA	Analysis of variance
AW	Albumen weight
AW	Albumen width
BB	Bovans Brown
CSA	Central statistical agency
<sup>0</sup> C	Degree Celsius
DA	Development agent
EL	Egg length
ESG	Egg specific gravity
EW	Egg weight
EWD	Egg width
FAO	Food and Agricultural Organization of United States
FGD	Focus group discussion
HU	Haugh Unit
ILRI	International livestock Research Institute
M.a.s.l	Meter above sea level
NCD	New Castle Disease

SHI	Shape index
SHTH	Shell thickness
SHW	Shell weight
SPSS	Statistical package for social sciences
TLU	Tropical livestock unit
YC	Yolk color
YH	Yolk height
YI	Yolk index
YW	Yolk weight
YWD	Yolk width

## **ACKNOWLEDGEMENTS**

I would like to express my heartfelt thanks to my major advisor Dr. Mohammed Beyan for his support in commenting the proposal, thesis and strengthening me. My heartfelt appreciations is also forwarded to my co-advisor Dr. Sandip Banerjee for spending his precious time, for regular advice, material assistance and to correct this manuscript from beginning of proposal to end of thesis and visit me during the experiment at Hawassa poultry laboratory.

I would also like to express my gratitude to all development agent and Kebele manager for their willingness and support for the survey work of this study. I would like to express my thanks to all the farmers who participated in this study, for their patience and give me their precious time, and willingness to share their experiences. I wish to acknowledge all my classmates in general and particularly Mr's. Mekiya Bedru, Birhanu Bekele and Mohammed Assen for their all round support.

My deepest thanks also go to my father Mr. Dukako Digassa and my mother Mrs. Worknesh Futunge for their growing me and always with me in prayer. I also thank my family member's Girma Digassa, Daniso Futunge, Abeba Shiferaw, Wondimu Dukako, Fikire Dukako, Bizunesh Dukako and, all other members for their moral support and encouragement. Finally, I extend my special thanks to all my friends Markos Dukamo, Melkamu Tilahun, Workneh Wotaro and Asnake Dilkamo for their moral support and strengthing me till the end of the study.

## TABLE OF CONTENTS

<b>Table of Contents</b>	<b>Page</b>
DEDICATION .....	I
STATEMENT OF THE AUTHOR .....	II
ACRONYMS .....	III
ACKNOWLEDGEMENTS .....	V
LIST OF FIGURES.....	X
List of Tables in Appendices .....	XI
List of Figures in Appendices .....	XII
1. INTRODUCTION.....	1
2. LITERATURE REVIEW .....	6
2.1 Poultry production system in Ethiopia.....	6
2.1.1 Large-scale commercial poultry production (Intensive production system).....	6
2.1.2 Small-scale commercial poultry production (semi intensive production system).....	6
2.1.3 Backyard or traditional poultry production system .....	7
2.2 Importance of village chicken production.....	8
2.3 Chicken husbandry practices.....	10
2.3.1 Feeding system .....	10
2.3.2 Watering system .....	11
2.3.3 Health and disease control measures .....	11
2.4 Productive performance of local or indigenous chickens .....	12
2.5 Egg production and factors affect its quality .....	12
2.6 Egg quality traits .....	14
2.7 Challenges and opportunities of village chicken production in Ethiopia .....	16
3. MATERIALS AND METHODS.....	18
3.1 Description of the study area.....	18
3.2 Data sources and method of data collection.....	19
3.2.1 Data sources.....	19
3.2.2 Methods of data collection .....	20

3.3 Sampling method and sample size .....	21
3.4 Egg quality traits .....	23
3.5 Data management and statistical analysis .....	27
3.5.1 Statistical analysis .....	27
<b>4. RESULTS.....</b>	<b>29</b>
4.1 Household characteristics.....	29
4.1.1 Production system and farming activities.....	30
4.1.2 Composition of livestock species .....	31
4.1.3 Types of chicken reared and source of the breed .....	31
4.1.4 Chicken flock structure and flock size .....	32
4.2 Chicken husbandry practices.....	33
4.2.1 Feeding system and frequency of feeding .....	33
4.2.2 Chicken housing system .....	36
4.2.3 Source of water.....	37
4.3 Cause of mortality among the chickens .....	37
4.3.1 Predator that attack chicken.....	38
4.4 Chicken egg laying interval .....	39
4.4.1 Types of litter material and systems used to reduce broodiness .....	41
4.5 Purpose of chicken rearing.....	41
4.6 Breeding practice .....	42
4.7 Production and reproduction performance of chicken.....	44
4.8 Reproductive traits of scavenging chicken .....	45
4.9 External and internal egg quality parameters.....	46
4.9.1 External egg quality parameters .....	47
4.9.2 Internal egg quality parameters (egg white).....	48
4.9.3 Internal egg quality parameters (egg yolk).....	49
<b>5. DISCUSSIONS .....</b>	<b>50</b>
5.1 Household characteristics.....	50
5.1.1 Production system and farming activities.....	51
5.1.2 Composition of the livestock.....	52
5.1.3 Types of chicken reared and source of the breed .....	52

5.1.4	Chicken flock structure and size.....	53
5.2	Chicken husbandry practices.....	54
5.2.1	Feeding .....	54
5.2.2	Chicken housing system .....	55
5.2.3	Watering of chicken and sources of water .....	56
5.2.4	Farmers breeding practices.....	56
5.3	Causes of mortality among chicken .....	58
5.3.1	Predator that attack chicken.....	59
5.4	Chicken disease and control measure .....	60
5.4.1	Traditional medicines used for chicken treatment.....	61
5.5	Purpose of keeping chicken in the study area .....	62
5.6	Production and reproduction performance of chicken .....	62
5.7	Egg production .....	64
5.8	External and internal egg quality parameters.....	65
5.8.1	External egg quality parameters .....	65
5.8.2	Internal egg quality parameters (Albumin) .....	67
5.8.3	Internal egg quality parameters (Egg yolk).....	67
6.	<b>CONCLUSION AND RECOMMENDATION.....</b>	<b>69</b>
6.1	Conclusion .....	69
6.2	Recommendation.....	70
7.	<b>RIFERENCES.....</b>	<b>71</b>

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
Table 1 Sample of total population and Kebeles .....	22
Table 2 Socio-economic status of the respondents in the study area (%) .....	29
Table 3 Education status of the respondents .....	30
Table 4 Production system, farming activities, land types, and land holding size in the study area (%)	30
Table 5 Composition of livestock holding per household in study area (Mean±SD) .....	31
Table 6 Types of chicken reared and source of the breed under study area.....	32
Table 7 Chicken flock structure and mean flock size per household under study area.....	32
Table 8 Feeding systems, rate of feeding and types of supplementary feed under study area (%).....	34
Table 9 Feeding practices and feeding place for chicken under study area .....	35
Table 10 Chicken housing system in the study area .....	36
Table 11 Source of water, frequency and watering equipment under study area .....	37
Table 12 Traditional medicines when they get sick and name of medicine.....	38
Table 13 Types of predator, severity of attack, attacked age group and means of control in the study area.....	39
Table 14 Chicken egg-laying interval and traditional egg quality measurement ways in the study area	40
Table 15 Types of litter material and systems used to reduce broodiness (%) .....	41
Table 16 Purpose of chicken rearing in the study area .....	42
Table 17 Breeding practice, culling practices, selection character, and color of chicken preferred in the study area .....	43
Table 18 Major chicken constraints in the study area.....	44
Table 19 Production and reproduction performance of chicken .....	45
Table 20 Reproductive traits of chicken in the study area .....	46
Table 21 External egg quality parameters.....	47
Table 22 Internal (Albumen) quality.....	48
Table 23 Internal (yolk) quality parameters.....	49

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
Figure 1 Map of the study area (source of shape file CSA, 2013 Developed from Arc GIS 10.1).....	19
Figure 2 Purposes of egg production .....	46

## List of Tables in Appendices

<b>Table</b>	<b>Page</b>
1. Conversion equivalents of Sub-Saharan Africa Livestock (TLU).....	97

## **List of Figures in Appendices**

<b>Figures</b>	<b>Page</b>
Figure in the appendices 1 -Feeding practices of chicken in the study area.....	95
Figure in the appendices 3- Vernier caliper used to measure yolk width and Albumen .....	95
Figure in the appendices 4- Electronic balance to measure egg weight.....	93
Figure in the appendices 5- Tripod micrometer to measure albumen height and yolk height ..	96

**Assessment of management practice, production performances, and some egg quality parameters of chicken reared in Loka Abaya District, Sidama Zone, Southern, Ethiopia**

*By Hailu Dukako Digassa*

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**Abstract**

*This study was carried out in Loka Abaya District, Sidama Zone of Southern Ethiopia. So far there are limited studies conducted in Loka Abaya targeting comprehensive description of the production performance, associated constraints, management practice, and egg quality traits of backyard chicken in rural communities. The objectives of the study were to assess chicken husbandry practices, production, and reproduction potential and evaluate some egg quality parameters in the study. The agro ecology was arranged systematically, Kebeles were selected purposively, and random sampling was used to select 120 chicken rearing households from two agro ecologies. Household survey, key informant interview, and focus group discussions were employed to draw out appropriate data using pre-tested semi-structured questionnaire, interview schedule, and discussion guide. Concerning egg quality determination, households who have native chicken and cross chicken ecotypes were identified from each agro ecology and, 200 eggs were collected for quality parameters generally. Chi- square test and ANOVA were employed to analyze the statistical difference between two agro ecologies. Accordingly, the result revealed that the mean flock structure of chicks, cockerels, pullet, hens, and cocks, were 5.4 (0.01TLU), 0.9 (0.01TLU), 1.5(0.01TLU), 4.5(0.01TLU) and 0.8 (0.01TLU) heads per household, respectively and mean flock size of chicken 9.4(0.01). The current finding also indicated that the major feed resources were scavenging and supplementary feed (47.5%) and types of supplementary feed was maize and wheat (52.5%). Regarding housing, watering, and chicken constraints; 50.8% of respondents house their chicken with family, 89.2% of respondent provide water freely and predator were major problem followed by disease. Based on survey result the primary purpose of chicken production in the study area was income generation. The current finding also showed that majority of farmers in the study area, purchased veterinary drugs@Oxytetracycline 20% to treat their chicken (47.5%) and also used ethno veterinary medicines (39.2%) and used “Ash “during hatching or egg incubation time to protect eggs from contamination of human hands (90%). The result also indicated that the major determinant factors that affectinfluencing the chicken husbandry practices in the study area include presence of predators, disease, feed shortage, lack of adequate veterinary services and lack of knowledge about modern chicken husbandry practices were identified as the major determinant factors that influence poultry production in the study area. Regarding egg quality parameters; there were difference ( $p<0.05$ ) between egg weight, egg width, albumen height, albumen weight, yolk color, specific egg gravity, and Haugh unit. An understanding of factors influencing the decision of the respondents were associated with improvement in poultry husbandry critical when formulating technologies regarding with husbandry practices that support chicken production.*

**Key words:** Egg quality parameters, Loka Abaya, poultry husbandry

## **1. INTRODUCTION**

Agriculture is the cornerstone of Ethiopian economy, this sector directly or indirectly employs a large section of the society (Hunduma *et al.*, 2010). Livestock sector is an integral part of agriculture contributes about 40% of agricultural GDP and quarter (26.4%) of national GDP (ILRI, 2016).

Large numbers of livestock in general and poultry population in particular, can be expected to contribute significantly to the total agricultural output as well as to improve the living standards of the smallholder farmers (Thomas *et al.*, 2009). This is mainly due to their small size ( when compared to other livestock species), short generation interval, gender friendly and they require relatively low inputs (David, 2010).

Data on poultry population are collected as part of the livestock survey, and the total poultry population at country level is estimated to be about 56.53 million heads with, 94.31%, 3.21% and 2.49 % of the total poultry are reported to be indigenous, hybrid and exotic, types respectively (CSA, 2017).

Native chickens are important sources of earning and nutrition for the resource challenged members of the society and also contribute substantially to the nutrition of the people residing in nutrition deficit countries. They assist in supplying the fast growing human population with high quality protein besides provide additional income to the resource challenged members of the society, including women (Tarekegn *et al.*, 2015).

The egg is one of the cheapest and wholesome foods for human nutrition. They are rich in high-quality protein and an almost complete vitamin and trace mineral source (Sparks, 2006). Thus, it becomes imperative to study the external and internal qualities of eggs are important

to for consumer health and from a marketing perspective. The egg yield and quality are affected by a number of factors, such as the husbandry system (Radu-Rusu *et al.*, 2014).

In Ethiopia, as that of all the countries in the world there is a high demand for animal protein, particularly from poultry. Chicken also most widespread livestock species and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tilahun *et al.*, 2018). However, the performance of chickens in Ethiopia is suboptimal and consequently the demand and supply for chicken products is ever widening (WPSA, 2013). Population of the humans are growing over the decades this is followed by urbanization, and enhancement of per capita income are causes of increased demands for foods of animal origin (Abdullah *et al.*, 2011).

In Ethiopia, availability and cost of feed is one of the major limitations to poultry production. This is partly because most ingredients of poultry feeds are also used for human consumption (Mengasha, 2011). Likewise, Gura (2008) reported that, the competition between feed-foods is expected to make worse price of poultry feeds that force poultry producers to look for alternative and locally available feed sources. Diseases, predators, and poor access for market information are major constraints, which have resulted in low production of poultry and poultry products in the country (Hunduma *et al.*, 2010). Although, substantial studies have been done on poultry management practices many of them ignored potential role of poultry value chain development (Kedir *et al.*, 2016).

Despite the rapid development of commercial poultry production systems worldwide, it has been estimated that, more than 80% of the global poultry population still relies on traditional family-based production systems and contribute up to 90% of the total poultry products in many countries (Sonaiya and Swan, 2005). In many developing countries, particularly in

Africa, poultry production in rural and per-urban areas is based on traditional scavenging systems. It is estimated that, about 80% of the Africa's poultry population is found in traditional production systems (Branckaert *et al.*, 2000).

The traditional poultry production system comprises of the indigenous dwellings together with human beings (Tarekegn *et al.*, 2015). There is no purposeful feeding of chickens and scavenging is almost the major source of their diet (Mokonnen, 2007). There is no designed selection and breeding is mostly panmictic (Nigussie *et al.*, 2010). It is by natural incubation and brooding that chicks are hatched and raised (Moges *et al.*, 2010). Prevalence of predators in the area, such as birds of prey, pets and some wild animals, can be ascribed to be as the major causes of premature death of chicks in Ethiopia (Mokonnen *et al.*, 2017). Diseases are the most important cause of economic loss since vaccination occurs only in response to an outbreak under the traditional poultry production system (Solomon, 2008).

Traditional production system/s is/are advantageous due to free feed resources in the surrounding environment and kitchen leftovers, use of locally adapted genotypes that are adapted to brood naturally. However, these chickens have poor reproductive performance, suboptimal growth rates, high incidences of diseases, mortality, predation, and low level of literacy among farmers are some of the major constraints in backyard chicken production (Pederson *et al.*, 2002).

The egg production potential of local chicken has been estimated to vary between 30-60 eggs/ hen on an annual basis with an average egg weight of 38g under traditional management conditions, contrary to the same, under improved management the exotic genotypes can produce around 250 eggs annually with egg weight of around 60 g egg weight (Alganesh *et al.*, 2003) in Ethiopia.

In Ethiopia, there is a knowledge gap when it comes to issues related to poultry husbandry, this is besides seasonal variations in feed resources which vary both within and between seasons across agro ecologies, prevalence of diseases (Newcastle, Coccidiosis, etc) and parasites too have been linked as some of the major challenges of village based chicken productions (Moreda *et al.*, 2013).

The overall productivity of the native chickens are quite limited because of the small size, delay in maturity, which can be ascribed to lack of feed (both in quality and in quantity) (Moreda *et al.*, 2013). The eggs of the native chickens are preferred over those of the exotic or crossbred chickens because of their taste and culinary superiority and are an integral part of the Ethiopian cuisine (Alganesh *et al.*, 2003). However, in most of the cases the handling of the eggs are not quite well structured and thus, there are losses in hatchability and in many cases, the quality of the egg deteriorates before it reaches the consumer's (Mokonnen *et al.*, 2017).. The quality and quantity of the eggs laid by the hens are influenced by the genotype of the hens along with the environment where they are reared. To date, there are limited studies conducted in Loka Abaya targeting comprehensive description of the production performance, associated constraints, management practice, and egg quality traits of backyard chicken in rural communities. On the other hand, lack of information with regard to management practices is a major gap or limitation in related to productivity and production improvement of chicken reared in Loka Abaya District, of Sidama zone. Therefore, the current study is expected to encompass the following objectives.

- To assess the chicken husbandry practices in some selected kebeles of Loka Abaya District of SNNPRS.

- To assess the production and reproduction potential of the chickens reared in the selected kebeles.
- To evaluate some external and internal egg quality parameters of the chickens reared in the area

## **2. LITERATURE REVIEW**

### **2.1 Poultry production system in Ethiopia**

The poultry sector in Ethiopia can be characterized in to three major production systems based on some selected parameters with genotype, flock size, husbandry practices and biosecurity among others (Mitiku, 2018). The poultry production system in the country can be further subdivided into:

#### **2.1.1 Large-scale commercial poultry production (Intensive production system)**

This system of production involves the rearing of birds under confinement and therefore large numbers of chickens are reared per unit area (Emebet and Kidane, 2016). These chickens are provided with semi controlled environment to various degree of environmental control, with maximum bio security being provided so as to avoid any external contamination (Atsbaha and Negassi, 2017). Such systems of management are scarce in the country, and limited to only a few farms located around Debre Ziet (Emebet and Kidane, 2016). In the intensive production system, the per unit productivity is quite high with high output per unit of input invested (Meareg, 2014). Such management also requires less labor with higher automation, but the overall control over which operation is uniform (Dawit *et al.*, 2014). The other advantage is that the final products are uniform and therefore are favored by the consumers and processors alike (Aklilu, 2007). However, undert majority of the situation in the country there is no mechanization and therefore the final products are heterogeneous (Meareg, 2014).

#### **2.1.2 Small-scale commercial poultry production (semi intensive production system)**

This type of chicken production system is intermediate between the free ranging production and intensive production system. The deep litter system is one of them, besides the slat system

here the degree of mechanism is less than those of the intensive production system (Atsbaha and Negassi, 2017). The production uses the inputs like processed feed, vaccine, and provision of feeding and watering system (Dawit *et al.*, 2014). The hens are provided with some sort of privacy in laying the eggs in form of egg nests. The bedding in form of sawdust or allied products, this helps the chickens in providing unidentified growth factors besides they have access to dust bath (Matawork, 2016). The flock size under such management varies from 20 to sometimes even 200 or more chickens (Moges, 2009). This system of production assists in providing employment to the youth and those who are interested in the sector. The control over the production is moderate and the qualities of the products (eggs and meat) are acceptable provided some sort of hygiene is maintained at the farm (Yenesew *et al.*, 2015).

### **2.1.3 Backyard or traditional poultry production system**

This is the, most prevalent chicken production system in the country, where most of the chickens reared in the country fall under this system (Meareg, 2014). The flock sizes vary from place to place and across seasons within a location (Aklilu, 2007). The flock size decreases when there are disease outbreaks, shortage of feed and when there are need of cash for meeting the family needs (Aleme and Mitiku, 2015).

The flock sizes vary from 5-20 heads with primitive health services, almost no vaccination, and feed/watering system (Metawork, 2016). As the chickens are exposed to vagaries of nature the overall productivity is low and the products obtained being heterogonous (Atsebaha and Negassi, 2017). The major feed sources for chicken are what they can get off the ground, which mostly consists of seeds, worms, scattered seeds, and food leftovers. Feed if at all is provided is of miniscule amount quality and quantity is often questionable (Dawit *et al.*,

2014). This leads to nutritional imbalance as the feed is often not enough even for meeting the basic requirements of the chickens themselves (Yenesew *et al.*, 2015).

## **2.2 Importance of village chicken production**

According to Bishop (1995), chicken were among the most adaptable domesticated animals and globally more people are directly involved in chicken production when compared to any other single agricultural enterprise. The role in improving the nutritional status, income, food security, and livelihood of many smallholders is significant owing to its low cost of production (Gondwe, 2004).

According to Moreki *et al.* (2001), family chicken are rarely the only means of livelihood and the importance of indigenous chicken is their meat and egg, the egg shells are hard egg with little or no care required for their day to day rearing (Bushra, 2012). Poultry husbandry provides employment and income generating opportunities to many of the people and chickens are an important part of the cuisines during the religious festivals and sacrifices (Dessie and Ogle, 2001). Village chicken also play important roles in converting household leftovers, wastes and insects into valuable and high quality protein (Doviet, 2005). Poultry meat and eggs can contribute around 20–30% to the total animal protein for the low-income and food-deficit countries (Odunsi, 2003).

Indigenous chickens provide major opportunities for protein production and income for smallholders (Emebet, 2015). Chickens have a short generation interval and a high rate of productivity. They can also be transported with ease to different areas, are relatively affordable, and consumed by the rural people as compared with other farm animals such as cattle and small ruminants. Indigenous chickens are good scavengers as well as foragers, are

said to have good levels of disease tolerance, possess good maternal qualities, and are adapted to harsh conditions and poor quality feeds as compared to the exotic breeds (Mokonnen, 2007). In some communities, village chickens are important for livelihood improvement (Emebet and Kidane, 2016).

Ease in rearing and easy acceptability of the products, its minimal association with religious taboos and their complementary role-played in relation to other crop-livestock activities (Muchenje *et al.*, 2000). A range of factors with suboptimal management, lack of supplementary feed, low genetic potential and high mortality rate are some of the major causes for the apparent low output of the chickens in Ethiopia. According to (Tadelle *et al.*, 2003), in Ethiopia, village chicken production systems are characterized by low input–low output levels. However, village chicken production is part of a balanced farming system, plays an important role in the supply of high quality protein to the family food balance, and provides small disposable cash income in addition to the socio-religious functions important in the rural people's lives.

## **2.3 Chicken husbandry practices**

### **2.3.1 Feeding system**

Under the prevailing scavenging production system the chickens are rarely provided any feed, (Desalew, 2012). The supplementary feed if provided are restricted to the times of harvest and the quality of these feed are often questionable as there are mostly contaminated with mycotoxins and other anti nutritional factors (Loretta, 2014). The feed is usually available only during the wet season and season just after the harvest is over (Mekonnen, 2007). The feed comprises usually of seeds of cereals which are shattered at the time of threshing or when they are being transported (Haile and Biratu, 2017). Feed supplementation has been reported in various countries as a common practice to promote chicken performance in several developing countries and in some parts of Ethiopia (Moges, 2009).

Studies by Ali (2002) indicated that depending on the age and stage of laying of eggs the chickens require anything from 40-60g of feed supplementation on a daily basis, this is besides the feed scavenged from the ground .

### **2.3.2 Housing system**

Housing systems in backyard system is mostly primitive and unscientifically constructed from locally available materials (Solomon *et al.*, 2013). In many parts of the country, the chickens share their dwellings with their rearers (Solomon, 2008). They also perch on trees or other similar structures, these houses are also infested with rodents and other ecto-parasites and in most of the cases only provide the basic shelter to the chickens (Solomon and Elsabet, 2010).

### **2.3.2 Watering system**

Desalew *et al.* (2013) revealed that, about 96% of respondents were provided water adlib. However, the quality of the water and the cleanliness of the water are highly compromised (Wayuma *et al.*, 2015). Water is one of the most important nutrients but likewise is also prone to contamination (Tarekegn *et al.*, 2015). Contaminated water can help transmit many diseases and are the breeding ground of many vector borne diseases (WHO, 2014). Studies by Mengesha *et al.* (2011) indicated that many of the farmers provided water to their chickens on a regular basis especially during the dry season when the natural sources of water dry up. The sources of water vary across the different areas varying from tap water in the urban, peri urban areas, to well water in the rural areas. In some places, conserved water too is provided however, in such cases the quality is grossly compromised (Aklilu, 2007). The watering equipments too vary across the areas from watering trough to plastic containers and broken shredded glasses (Teshome and Tesfaye, 2015). The cleanliness of which is rarely a priority of the owners, hence such dirty containers are also one of the major source of contamination (WHO, 2014).

### **2.3.3 Health and disease control measures**

Studies by Melesse and Negesse (2009) reported that, disease were the most important constraint for the village chicken production in southern parts of Ethiopia. Newcastle disease (NCD) was the most prevalent and economically important disease problem affecting free-range birds and it is reported to be the first major causes of chicken death/loss (Moges *et al.*, 2010). Similarly, Desalew (2012) reported that, the major causes of death for local birds were seasonal outbreaks of diseases, specifically NCD. The prevalence of the NCD and mortality of chicken were higher at the start of rainy season, mainly on April and May (Melesse and

Negesse (2009) NCD was one of the major infectious diseases affecting productivity and survival of village chickens in central highlands of Ethiopia (Mekonnen, 2007).

An ethno veterinary medicine was the major type of treatment used by majority of free-range chicken owners against NCD (Adem and Teshome, 2016). Accordingly, provision of a mixture of local alcohol ('*Arekie*'), lemon, and onion were provided to the sick birds against NCD (Tekalegn *et al.*, 2016). Other common types of traditional treatments observed were; use of some herbs like 'semiza' (*Justitia schemperina*) and 'endod' (*Phytolacca dodecandra*) and use of tetracycline capsule (Moges *et al.*, 2010).

## **2.4 Productive performance of local or indigenous chickens**

The most dominant chicken reared in Ethiopia are local ecotypes, which show a large variation in body position, plumage color, comb type and productivity (Wilson, 2010).

The annual egg production potential of local chicken was 30-60 eggs /hen with an average weight 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 Negussie *et al.* (2003), the low productivity of the local scavenging hens is because not only they are low producers of small sized eggs and slow growers but also the system is characterized by high chick mortality. Moreover, the local chickens are the results of panmictic breeding between various local chicken ecotypes, which have not been selected by systematic breeding methods (Habte *et al.*, 2015).

## **2.5 Egg production and factors influencing the egg quality**

Poultry eggs are a cheap source of animal protein fulfilling the nutritional requirement of the consumers (Dayanidhi *et al.*, 2016). Generally, consumers prefer eggs with better external and

internal quality, which are two important factors for acceptability of eggs (Stadelman, 1977). Good quality of eggs also fetches better economical returns to the investors and the farmers alike. Various factors like rearing of chickens, relative humidity, ambient temperature, and season of production may adversely influence the egg quality. Previously from analysis of nutritive value of egg clearly signifies that it is a cheap and rich source of several vitamins and minerals with a calorific value of 163 calories /100g (Haq and Akhtar, 2002). These significant features led the consumers to demand for some internal and external qualities in this nutrient (Ulucock, 1995).

Production oriented market demands for maintenance of optimum egg quality, which will fetch better return to the enterprises (Sreenivas *et al.*, 2013). The quality of egg and their stability during storage are, largely determined by their physical structure and chemical composition (Seidler, 2003). Assessment of egg quality includes both external and internal quality. Again, external quality had many parameters like soundness of shell, texture, shape, cleanliness, and color. Internal quality constitutes of quality of yolk and albumen (Sreenivas *et al.*, 2013). Albumen quality can be identified by its shape, viscosity, and consistency (Haq and Akhtar, 2002). Yolk quality is defined by its strength, firmness, size of air cell and presence of meat and blood spot. When eggs were stored for longer period, there is deterioration of yolk quality due to absorption of moisture through shell pores, which leads to yolk rupture (Dayanidhi *et al.*, 2016). This absorption also makes the albumen watery and transparent due to loss of carbon dioxide from the eggshell (Benton *et al.*, 1996). The yolk integrity also depends on the strength of vitelline membrane, which is inversely proportional to the duration of storage (Jones and Musgrove, 2005). Studies by Dayanidhi *et al.*, (2016) native chickens indicated that native chickens are better suited for egg production because these chicken

generally had better disease resistance, heat tolerance, better meat, and egg qualities (Seidler, 2003).

## **2.6 Egg quality traits**

Egg weight influences the weight of components of eggs; especially egg albumen and yolk (Aygün and Yetisir, 2010). The relationship between weight, length and width of eggs has been reported by Danilov, (2000) who 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).

Further, under smallholder farmers condition in northern Ethiopia, egg weight was recorded as 52.5g, 52.1g, and 43 g for Rhode Island Red, White leghorn and Fayoumi, chickens respectively (Lemlem and Tesfaye, 2010). Hen age has also been shown to enhance yolk weight (Van den Brand *et al.*, 2004) and 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 color is highly subjective and varies widely from country to country.

The determinant of yolk color is the xanthophylls (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 also improves the yolk color. Among feed ingredients, only supplemented yellow maize contributes to improved color intensity of the yolk. Thus, if a hen has access to green grass or supplemented feed ingredients containing carotenoid/xanthophylls, it will be enough to give the yolk the color preferred by consumer (Zaman *et al.*, 2004). Ethiopian consumers have a strong preference for eggs with deep yellow

yolk color. Very small sized eggs from the scavenging local chicken with deep yellow yolk color 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 quality of the egg. 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.

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 the hatchability declines as the egg shell gets thinner(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 for 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 eggshell quality is given through 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 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 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.* (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 when compared to the barn system, while Van de Brand *et al.* (2004) did not find differences between free range and battery cage.

## **2.7 Challenges and opportunities of village chicken production in Ethiopia**

The most striking problem in village chicken production systems is the high mortality rate, which could reach as high as 80–90% within the first few weeks after hatching, due to diseases and predation (Melesse and Negesse, 2009). It has been reported that Newcastle disease (NCD) is highly infectious and causes more losses than any other poultry diseases in the tropics. The disease spreads rapidly through the flock and mortality could reach up to 100%. Among the infectious diseases, NCD, salmonellosis, coccidiosis and fowl pox are considered as the most important causes of mortality in local chicken while predators are an additional causes of loss. According to (Dessie and Ogle, 2001), 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. Adane and D.F (1996) has also reported that, Newcastle disease (ND), Infectious Bursal disease (IBD) or Gumboro, Marek's disease (MD), Fowl typhoid, Cholera, Mycoplasmosis and Coccidiosis are major diseases that have been predominantly identified in different commercial poultry and small scale intensive poultry farms in Ethiopia (Desalew *et al.*, 2013). These persuaded the small-scale intensive producers to sell chicken with the lower price at the beginning of rainy season and purchase chickens with higher prices during the dry seasons. To this effect abundant number of chickens were observed during rainy season favoring the consumers and scarcity of chicken number and their products during the dry season (Emebet and Kidane, 2016).

The other major limiting factor of village chicken production is feed, in terms of both quantity and quality (Hailu *et al.*, 2012). The nutritional status of local laying hens from chemical analysis of crop contents indicated that protein content in the consumed feed was below the requirement for optimum egg production and the deficiency is more serious during the short rainy and dry seasons (FAO, 2014). In addition to the above mentioned constraints, other vital problems affecting the productivity of village chicken including; low productivity of local chicken (attributed to their genetic potential, disease and poor chicken management practices), poor extension services and inadequate credit facilities, lack of organized marketing system, seasonal fluctuation of price and lack of processing facilities (Aklilu, 2007).

### **3. MATERIALS AND METHODS**

#### **3.1 Description of the study area**

The study was conducted at Loka Abaya District, situated in Sidama Zone, of SNNPRS. The District is mostly semi-arid. It is located east of Lake Abaya at 6<sup>0</sup>14'-7<sup>0</sup>18'N latitude and 37<sup>0</sup>92'-39<sup>0</sup>14'E longitude and the total area of the District is about 1,190 km<sup>2</sup> and its altitude ranges from 1001-2000 meter above sea level (m.a.s.l). Loka Abaya District has a total population of 110,917 inhabitants. Only 1,059 or 1.07% of its population is urban dweller. It has minimum of mean annual temperature 17.6 and maximum of 25 degree <sup>0</sup>C. The annual rainfall ranges between 1001-1400mm. There are a considerable large number of livestock in the study area. According to the present report of District office of Agriculture and Development, , the livestock population of the District was: nativecattle 209,132 heads, exotic cattle 152 heads, exotic bulls 42 heads, local chickens 413,283 heads, exotic chickens, 338,046 heads, oxen 10799 heads, sheep 50,814, goats 123,607, donkeys 18,065, mules 192 and horses 82 heads respectively (LAWADO, 2017,unpublished data).

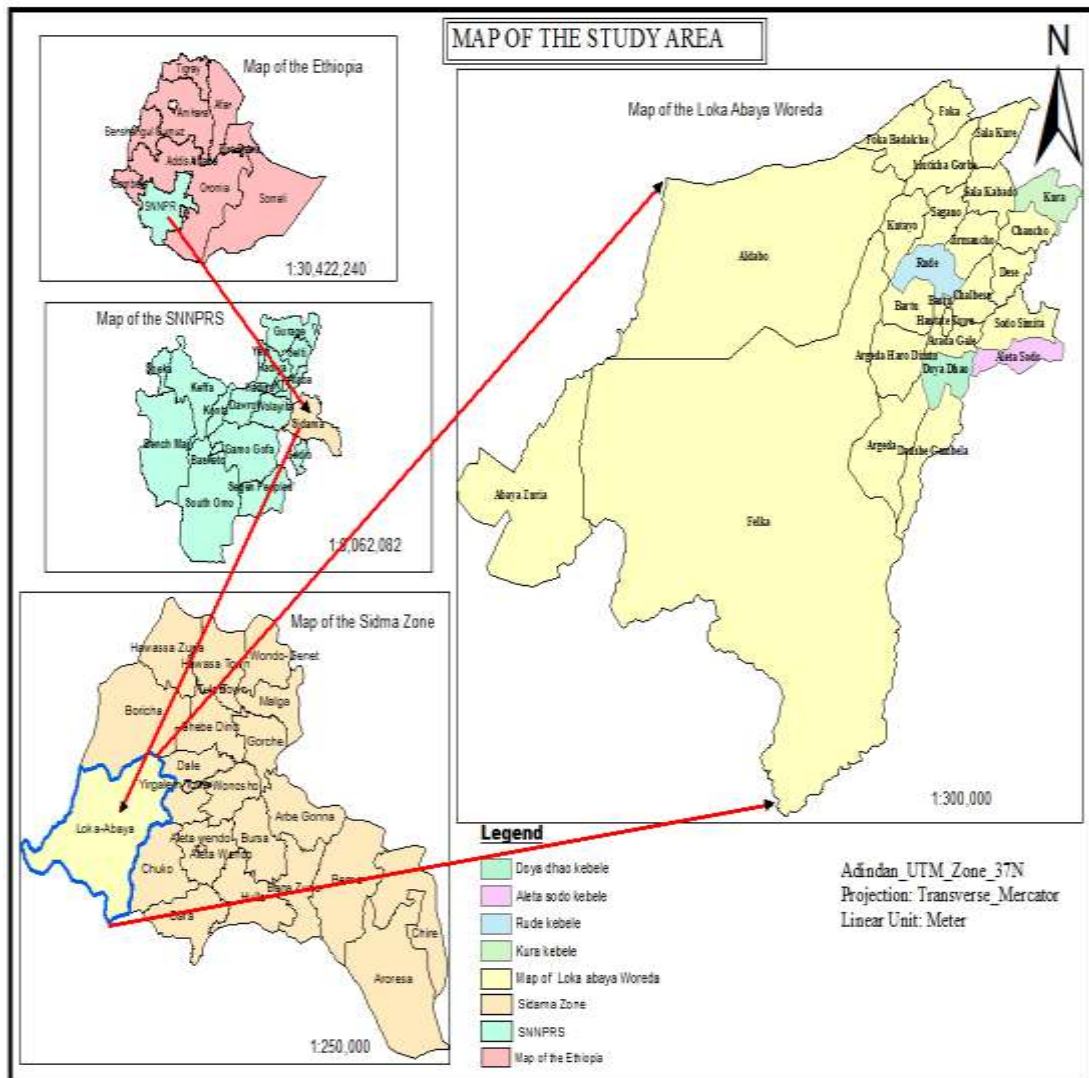


Figure 1 Map of the study area (source of shape file CSA, 2013 Developed from Arc GIS 10.1)

### 3.2 Data sources and methods of data collection

#### 3.2.1 Data sources

Primary and qualitative data was collected by using semi-structured questionnaires. The data was collected through personal and house-to-house interviews and appraisals mainly transect walks. Secondary data, which were assumed to supplement the primary data, were obtained

from the District agricultural office and reports maintained at the peasant association development agent's office.

### **3.2.2 Methods of data collection**

The primary quantitative and qualitative data was collected by using household survey, focus group discussion, and key informants.

#### **3.2.2.1 Household survey**

A semi structured questionnaire was prepared and households from both agro ecologies were interviewed about information on social demography, livestock and poultry demography, various aspects of poultry husbandry, poultry diseases, production (numbers of eggs laid/ clutch, numbers of clutches/hen/ year, annual numbers of eggs/ hen/ year etc.) and reproduction (age at first egg lay, hatchability % etc), important diseases of the chickens and their treatments and if there is use of ethno veterinary medicines, the names of the herbs etc were recorded. The traits used to select the pullets and cockerels across the two studied agro ecologies were recorded. The questionnaire was pre- tested among 20 (10 from each agro ecology) randomly selected households from non-sampled kebeles. Data collection was carried out through interview between the researcher and the farmers.

#### **3.2.2.2 Focus group discussion**

Focus group discussion was conducted for different factors associated with the poultry husbandry and business so that the lacunas of poultry husbandry and the potential methods to improve the same can be identified. Both male and female farmers containing different age groups, with different education level and different wealth groups were selected from each

sampled kebeles. Totally eight FGD were conducted on (two FGD in each kebele with six participants in each FGD).

### **3.2.2.3 Key informants**

Regards key informants, the interview was carried out with a total of eight (8) interviewees which include four DAs (one from each kebeles), four elders who were/are associated with poultry husbandry practices the of the region. They provided important information's on the traits considered to select the hens and the roosters during the begone era, important ecotypes in the region, and the ethno veterinary treatments.

### **3.3 Sampling methods and sample size**

Loka Abaya District has 25 kebeles. From these four kebeles were purposively selected based on agro ecology and poultry production potential. Accordingly, two agro ecologies were selected representing midland and lowland.

Sample size (120 households) was determined from each kebele administrations using probability proportional to size (PPS) method. Stepwise purposive followed by random selection technique was used to identify the potential respondents . In the process, sampling frames (the list of all household heads), were taken from each kebele offices. The sample households were drawn for each from the list of names after a certain sampling interval ( $K$ ) that was determined by dividing the total number of households by the predetermined sample size of each kebele;

$$K = \frac{NHH}{n} = \frac{2520}{120} = 21, \text{ where } NHH \text{ is total households from each kebele, } n \text{ is sample size}$$

of the selected kebeles and  $K$  is the sampling interval at which the sample is drawn

Next, a number was selected between one and the sampling interval (K) which is called the random start using lottery method and was used as the first number included in the sample. Then, every K<sup>th</sup> household head after that first random start was taken until reaching the desired sample size for each; Israel, (1992).

Subsequently, Aleta Sodo and Kura kebeles (situated in the midlands) were represented by 35 and 27 respondents, respectively. While Doya Dao and Rude kebeles situated in the lowlands were represented by 25 and 33 respondents respectively. The kebeles were so selected that there is no security concern and are accessible through all weather condition. In the selected kebeles the farmers who own local chickens and have experience in rearing them for at least 5 years were purposively identified and from the identified respondents 20% were randomly selected.

Table 1 Total residents and the sampling frame in the selected kebeles

Sample Kebles	Agro ecology	Total population	Sample size n=NHHs/K
Aleta Sodo	Midland	735	735/21=35
Doya Dao	Lowland	525	525/21=25
Kura	Midland	567	567/21=27
Rude	Lowland	693	693/21=33
Total		2520	120

Source: Israel (1992)

### **3.4 Egg quality traits**

Based on the ecotypes of the chickens found in the area, 200 fresh eggs (120 eggs from lowland) and (80 eggs from midland) were collected from the different identified ecotypes of chickens. These eggs were brought to the Hawassa University poultry section for assessment of the external and internal egg quality parameters. These different egg quality traits were determined as follows

#### **Egg weight (g)**

The egg weight (EW) was measured with an electronic balance to the nearest 0.01g (Gilbert *et al.*, 1978).

#### **Egg Length (mm)**

The egg length, which was also referred to as the long border of an egg, was measured with the help of vernier calipers with minimum unit reading up to 0.01 mm (Doyon *et al.* (1986)

#### **Egg Width (mm)**

The egg width, which was also referred to as the shorter portion of an egg, was measured with vernier calipers with minimum unit reading up to 0.01 mm (Doyon *et al.* (1986)

#### **Shell Weight (g)**

The shell was washed air dried and individually weighed in the weighing balance (Gilbert *et al.*, 1978).

#### **Albumen Weight (g)**

Albumen weight was recorded according to Gilbert *et al.* (1978).

Albumen Weight (g) = Egg weight - (Shell weight + Yolk weight)

**Yolk height (mm):**

Height of albumen was taken as the averages of readings at 3 or 4 locations (Anderson *et al.*, 2004)

**Albumen length (mm)**

Albumen was measured by vernier calipers (Gilbert *et al* (1978).

**Yolk Width (mm)**

This was measured as the maximum cross sectional diameter of the yolk using a pair of automated vernier caliper (Doyon *et al.* (1986)

**Yolk Weight (g)**

An egg separator was used to separate the yolk from the albumen and then weighed using a sensitive electronic balance (Doyon *et al.* (1986)

Yolk color (YC): Yolk color was determined by Roche color fan (Anderson *et al.*, 2004)

**Yolk Index (%)**

This was calculated using the following formula as described by Doyon *et al.* (1986)

$$YI = \frac{YH * 100}{YW}$$

Where: YI = Yolk index

YH = Yolk height

YW = Yolk width

### **Shape Index (%)**

The shape index was calculated using the following formula (Anderson *et al.*, 2004):

$$SI = \frac{W}{L} * 100$$

Where: W = Width of egg

L = Length of egg

### **Albumen Height (mm)**

The albumen height were measured using tripod micrometer with 0.01mm accuracy in a flat dish (Anderson *et al.*, 2004)

### **Albumen Width (mm)**

This was measured as the maximum cross section of the thick albumen using a digital vernier caliper (Anderson *et al.*, 2004)

### **Albumen Index (%)**

This was calculated with the following formula (Doyon *et al.*, 1986):

$$AI = \frac{AH}{(AL + AW)/2} * 100$$

Where; AI= Albumen index

AH=Albumen height

AL= Albumen length

AW= Albumen width

### **Egg shell thickness (mm)**

Thickness was measured after removing the internal membranes of the eggshell. A precision micrometer will be used to the nearest 0.01mm. Measurements were taken at the three regions of the shell and the means were calculated (Anderson *et al.*, 2004)

### **Egg specific gravity determination**

The assessment of the eggs' specific gravity was based on Archimedes' principle. The eggs were weighed in air on a Mettler scale. The weight of the water displaced by the eggs will be determined by submerging the eggs in a beaker water on the same teared scale (Valkonen *et al.*, 2008). Egg specific gravity was then determined using the equation:

**Specific gravity** = Egg weight in air/displaced water weight

### **Haugh Unit (HU)**

This was calculated per replicate from the values obtained from the albumen height and egg weight using the formula as given by Oluyemi and Robert (2007);

Haugh unit=  $100\log (H+7.57-1.7W^{0.37})$

Where;

H= Observed albumen height in (mm).

W= Observed egg weight in grams.

### **Equipment**

For economy in time and preservation of the product, the following equipment were available to persons engaged in breaking eggs for the purpose of measuring albumen height and observing yolk and albumen condition (Kilpatrick *et al.*, 1958).

- A flat glass surface approximately 10" x 10" or larger. The glass should be placed on a metal stand having adjustable legs for leveling. A mirror of approximately the same size as the glass was needed for observing the underside of the egg. The stand was set on a table of such height that the dial of the micrometer in use were at eye level.
- A standard individual egg scale, which indicates the weight in grams per egg. A test weight was used to check the scale at the start of the breaking operation and any time the scale were moved.
- A knife and breaking tray for egg-breaking equipment is very convenient for opening the eggs.
- A micrometer mounted on a tripod is satisfactory to measure the height of the thick albumen. It was graduated to read in tenths of a millimeter.
- A calculator is necessary to convert the micrometer readings and egg weight into Haugh units.

### **3.5 Data management and statistical analysis**

The collected data were analyzed using descriptive statistics such as mean, percentage, standard error, minimum, maximum using SPSS (V 20, 2007). The data was now divided into qualitative and quantitative traits. The qualitative traits were analyzed using non-parametric (Chi square) methods while the quantitative traits were assessed using the descriptive statistics while the means were compared using one and two way ANOVA's.

#### **3.5.1 Statistical analysis**

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

$Y_{ij}$  = Observation on the husbandry practices and egg quality traits

$\mu$  = Population mean

$a_i$  = Effect of agro-ecology on egg quality and poultry husbandry parameters

$b_j$  = effect of genotypes

$e_{ijk}$  = Random error

## 4. RESULTS

### 4.1 Household characteristics

The household characteristics of village chicken owner are presented in (Table 2). Most (75.8%) of the respondents in the study were males, with most (51.7%) of them being of the middle age group, the findings being consistent in both agro ecologies. The study further indicates that there is a variation among the family size of the respondents in both the studied agro ecologies.

Table 2 Socio-economic status of the respondents in the study area (%)

Response	Lowland	Midland	Overall	X <sup>2</sup>
Male	78.3	73.3	75.8	0.409
Female	21.7	26.7	24.2	
<b>Age of respondent</b>				
<35	33.3	23.3	28.3	1.639
36-45	46.7	56.7	51.7	
>46	20	20	20	
<b>Average family size/hh (Mean±SD)</b>	5.5±1.7	7.3±1.9	6.4±2.0	

*X<sup>2</sup> = Chi-Square*

The findings from table 3 indicate that most of the respondents residing in the midlands can barely read and write, followed by those who were educated at a secondary school level the findings being consistent even in the midlands.

Table 3 Education status (%) of the respondents in the study areas

Response	Lowland	Midland	Overall
Illiterate	10	24	17
Read and write	19	42	30.5
Primary	12	25	18.5
Secondary and above	19	29	24

#### 4.1.1 Production system and farming activities

The findings as indicated in Table 4 indicate that, all respondents in the study area practice both crop and livestock husbandry. The study also indicated that irrespective of the study locations most of the land was devoted to agrarian activities followed by those of grazing and other communal activities. .

Table 4 Production system, farming activities, land types, and land holding (ha) of the respondents in the study area (%)

Variables	Lowland	Midland	Overall	X <sup>2</sup>
<b>Production system</b>				
Backyard	100	100	100	
<b>Farming activities</b>				
Crop and livestock	100	100	100	
<b>Land type</b>				
Cultivated land	90	90	90	0.277
Grazing land	6.7	5	5.8	
Communal land	3.3	5	4.2	
<b>Land holding size/hh/ha(mean±SD)</b>				
	0.8±0.4	0.6±0.5	0.7±0.5	

#### 4.1.2 Composition of livestock species

The findings as presented in Table 5 is indicative of the fact that among all livestock species the chickens which have the highest population, this is followed by goats in the lowland and cattle in the midlands. However, there were no differences in the livestock population (in TLU) across the study locations.

Table 5 Composition of livestock holding per household in the study area (Mean±SD)

Livestock species	Lowland	Midland	Overall
Cattle	3.1±2.1	3.6±2.3	3.3±2.2
Sheep	0.95±1.7	2.0±1.6	1.4±1.6
Goat	3.6±2.9	3.0±2.6	3.3±2.7
Equine	0.45±0.6	0.3±0.6	0.37±0.6
Chicken	9.3±3.2	9.4±3.5	9.37±3.3
<b>TLU</b>	<b>3.36±2.5</b>	<b>3.8±2.6</b>	<b>3.59±2.6</b>

#### 4.1.3 Types of chicken reared and source of the breed

Table 6 shows that irrespective of the agro ecology the population of the native chickens predominated over the other genotypes followed by the crossbreds. The study further shows that irrespective of the agro ecology the chickens were raised under the backyard system of management and were home hatched.

Table 6 Types of chicken reared and source of the genotypes under study area

<b>Breed</b>	Lowland	Midland	Overall	X <sup>2</sup>
Local	9.4±2.8	8.3±2.6	8.8±2.7	
Cross	0.6±0.8	1.8±1.4	1.2±1.3	
Exotic	0.2±0.4	0.3±0.5	0.2±0.5	
<b>Source of breed (%)</b>				
Purchased from government	22.5	19.2	41.7	0.54
Hatching of eggs naturally at home	27.5	30.8	58.3	

#### 4.1.4 Chicken flock structure and flock size

Table 7 shows that chicks were the dominant chickens followed by hens and pullets

Table 7 Chicken flock structure and mean flock size per household under study area

<b>Flock Structure</b>	Lowland	Midland	Overall	Min	Max
Chicks	5.0±2.2	5.7±3.3	5.4±2.7	0	10
Cockerels	0.8±1	0.9±1	0.9±1	0	4
Pullet	1.4±1.2	1.7±1.3	1.5±1.2	0	5
Hen	4.2±1.4	4.8±2.2	4.5±1.9	0	9
Cock	0.8±0.8	0.8±0.8	0.8±0.8	0	3
<b>The average chicken flock size per household (mean±SD)</b>					
	9.4±3.5	9.3±3.2	9.4±3.4	4	24

## **4.2 Chicken husbandry practices in the study areas**

### **4.2.1 Feeding system and frequency of feeding among the chickens in the study areas**

Table 8 shows that, in scavenging followed by scavenging and supplementary feed predominate in both the study locations. In the lowlands, scavenging predominate over scavenging and supplementary feed, while in the midlands the scavenging followed by supplementation and supplementation alone were reported. The study further indicates that in the midlands, the supplementary feed is offered thrice a day (morning, afternoon and evening). The study also indicates that, the supplementary feed comprises of maize and wheat, besides the same, many of the respondents provides wheat bran along with the two mentioned grains.

Table 8 Feeding systems, rate of feeding and types of supplementary feed available in the under study area (%)

Response	Lowland	Midland	Overall	X <sup>2</sup>
<b>Source of feed</b>				
Scavenging	48.3	11.7	30	21.544
Scavenging with supplement	30	65	47.5	
Purchased feed	11.7	10	10.8	
Homemade feed	10	13.3	11.7	
<b>Frequency of supplementation</b>				
Morning and evening	13.3	15	14.2	35.34
Morning and afternoon	10	25	17.5	
Morning_ afternoon- evening	16.7	50	33.3	
Scavenging only	60	10	35	
<b>Did you provide supplementary feed</b>				
Yes	100	98.3	99.2	1
No	—	1.7	0.8	
<b>Types of the supplementary feed</b>				
Not given	11.7	1.7	6.7	13.5
Maize	3.3	1.7	2.5	
Wheat	—	1.7	0.8	
Wheat bran	20	6.7	13.3	
Maize and wheat	41.7	63.2	52.6	
Wheat and wheat bran	—	1.7	0.8	
Wheat bran and maize	3.3	3.3	3.3	
Maize, wheat and wheat bran	20	20	20	

#### 4.2.1.1 Feeding practices of the chickens in the study areas

More than half (51%) of the respondents exercised the practice of feeding their chickens in groups where as 30%, 10% and 7.5% of the survey members had a practice of feeding their chicken separate feeding by production, age and breed, respectively (table 9).

The same table 9 also shows that the majority (82.5%) of the respondents practiced feeding their chickens on the ground but only 17.5% of them used feeding trough.

Table 9 Feeding practices and feeding materials for chicken in the study area

Response	Lowland	Midland	Overall	X <sup>2</sup>
	(%)	(%)	(%)	
Separate by age	15.0	6.7	10.8	3.43
Group feeding	53.3	50.0	51.7	
Separate by breed	5.0	10.0	7.5	
Separate by production	26.7	33.3	30.0	
<b>Place of feed provision</b>				
On the trough	18.3	16.7	17.5	0.058
On the ground	81.7	83.3	82.5	

#### 4.2.2 Chicken housing system

As presented in Table 10, most (78.3%) of the respondents did not provide shelter to their chickens; however, the shelter (if provided) is quite basic in most of the times. The chickens primarily share the dwellings with their owners and seldom-separate housing is provided, even if it is so then they share the night shelter with other species of the livestock.

Table 10 Chicken housing system in the study area

Response	Lowland (%)	Midland (%)	Overall %	$\chi^2$
<b>Did you construct chicken house</b>				
Yes	15.0	28.3	21.7	3.14
No	85.0	71.7	78.3	
Share the same house with people	23.4	27.5	50.9	4.18
Different shelter for night enclosure in the same roof	10.8	4.2	15.0	
Separate house entirely constructed for chicken	5.0	5.8	10.8	
Separate house with other animals	10.8	12.5	23.3	

### 4.2.3 Source of water

The result of the current study indicates that water is provided by most (85%) of the respondents, while pipe water is the major (76.7%) source of water. The study result further indicates that water is provided adlib by most (89.2%) of the respondents (table 11). The same table 11 shows that most (70%) of the respondents provided water using plastic containers followed by clay pots (22%).

Table 11 Source of water, frequency, and types of equipments in the study area

Response	Lowland (%)	Midland (%)	Overall (%)	X <sup>2</sup>
<b>Do you provide water</b>				
Yes	81.7	88.3	85.0	1.04
No	18.3	11.7	15	
<b>Source of water</b>				
Bore well	11.7	8.3	10.0	0.37
River	13.3	13.3	13.3	
Pipe water	75.0	78.3	76.7	
<b>Frequency of water provision</b>				
Free access	90.0	88.3	89.2	0.15
Morning only	5.0	6.7	5.8	
Morning and afternoon	5.0	5.0	5.0	
<b>Types of watering trough</b>				
Plastic (plate)	68.3	71.7	70.0	1.97
Wooden	5.0	10.0	7.5	
Clay pots	26.7	18.3	22.5	

### 4.3 Cause of mortality among the chickens

The findings pertaining to the prevalence of diseases and also the usages of ethno veterinary medicine is presented in Table 12 indicates that mortality among the chicken flocks were common across both the areas studied. While, ethno veterinary practices were prevalent among the rearers of the midlands while the converse was true among the respondents from the lowlands. The study also indicates that among the traditional medicines is the herb locally

known as Argisa, followed by the concoction of tobacco leaves (*Nicotiana latissima mill*) and lemon juice (*Cirus limon*).

Table 12 Ethno veterinary medicines and their usages in the study areas

Variables	Lowland	Midland	Overall	X <sup>2</sup>
<b>Did you use traditional medicine</b>				
Not know name of herbs	—	1.7	0.8	9.10
Yes	38.3	63.4	50.9	
No	61.7	35	48.3	
<b>Names of medicine</b>				
Argisa (local herb name) before scavenging	40.0	38.3	39.2	0.49
Lemon ( <i>Citrus limon</i> )	36.7	40.0	38.3	
Croton ( <i>Croton macrostachyus</i> )	6.7	8.3	7.5	
Tobacco ( <i>Nicotiana latissima mill</i> )	11.7	10.0	10.8	
Fenugreek ( <i>Trigonellafoenum-graecum</i> )	5.0	3.3	4.2	

#### 4.3.1 Predator that attack chicken

The prevalence of predators in the areas is presented in Table 13. The respondents in the lowlands reported that the most important predator in the areas was wildcat (*Felissilvestris*), followed by hawk (*Buteogallus anthracinus*) and wild fox (*Vulpesvulpes*). While, in the midlands the major predators are the wild fox (*Vulpes vulpes*) and the hawk (*Buteogallus anthracinus*). Predator attack is quite common in the study areas with the chicks being most vulnerable followed by all the age categories of the flock. The method to control the same was by killing off the predators and by constructing houses under the tree, which is an effective strategy against the birds of prey.

Table 13 Types of predators and methods to control them in the study areas

<b>Variables</b>	Lowland	Midland	<b>Overall</b>	<b>X<sup>2</sup></b>
<b>Types of predator</b>				
Wild fox ( <i>Vulpes vulpes</i> )	25	40	32.5	4.88
Hawk ( <i>Buteogallus anthracinus</i> )	26.7	23.3	25	
Cat ( <i>Shreber</i> )	13.3	16.7	15	
Wild cat ( <i>Felissil vestris</i> )	35	20	27.5	
<b>Level of predator attack</b>				
Very high	58.3	41.7	50	5.62
High	8.3	21.7	15	
Medium	26.7	31.7	29.2	
Low	6.7	5	5.8	
<b>Attacked age group</b>				
Chicks	30	55	42.5	8.08
Adult Local	23.3	11.7	17.5	
Adult cross	18.3	13.3	15.8	
All age group	28.3	20	24.2	
<b>Local practices to control predator attack</b>				
Protecting in the house and under shade	41.7	26.7	34.2	5.24
Killing by different means	28.3	28.3	28.3	
House construction	8.3	16.7	12.5	
No suggested control	16.7	16.7	16.7	
Surrounding cleaning	5	11.7	8.3	

#### 4.4 Chicken egg laying interval

The findings as indicated in Table 14 show that most of the chickens lay egg regularly and in most of the cases daily and many of them indicate that the eggs are laid twice in three days. The study further indicates that most of the hatchings are carried out during the dry season. In the lowlands, many of the respondents (only in the lowlands) also preferred incubation of the eggs to proceed in the wet season as well, indicating that the season preferred for incubation was irrespective of any season. In order to avoid contamination of the eggs from (insects and possible pathogen) most of the respondents use ash as a disinfectant. The study further indicates that the respondents prefer to select the eggs that they use for hatching; they do so by

shaking the eggs and by observing the eggs against the sun. This was observed across both the areas studied.

Table 14 Egg-laying interval, hatching and traditional assessment of egg quality parameters in the study area

Responses	Lowland	Midland	Overall	X <sup>2</sup>
<b>Is there laying interval between chickens</b>				
Yes	63.3	66.7	65.0	0.14
No	36.7	33.3	35.0	
<b>Egg laying interval</b>				
Daily	63.3	50.0	56.7	2.17
Two successive lay and one day rest	36.7	50.0	43.3	
<b>Is there seasonal variation for hatching</b>				
Yes	88.3	91.7	90.0	0.37
No	11.7	8.3	10.0	
<b>Preferred season for hatching</b>				
Wet	18.3	11.7	15	22.19
Dry	45.0	83.3	64.2	
Both	36.7	5.0	20.8	
<b>Do you have mechanism to protect contamination of hatching eggs</b>				
Yes	90.0	90.0	90.0	
No	90.0	90.0	90.0	
<b>If yes what mechanism do you have</b>				
Ash	90.0	90.0	90.0	0.00
Not have any mechanism	10.0	10.0	10.0	
<b>Traditional ways to measure egg quality</b>				
Yes	71.7	56.7	64.2	2.93
No	28.3	43.3	35.8	
<b>Do you have practice of measuring egg quality</b>				
Yes	90.0	90.0	90.0	
No	10.0	10.0	10.0	
<b>If yes, what kind of practice do you have</b>				
Not practice	6.7	6.7	6.7	1.38
Shaking	46.7	48.3	47.5	
Seeing in the sun	31.7	36.7	34.2	
Putting in the water	15.0	8.3	11.7	

#### 4.4.1 Types of litter material and methods used to minimize broodiness

The results as indicated in Table 15 show that the respondents use litter during the process of hatching/ incubation. The respondents use old clothes and other materials to provide some warmth to the broody chickens and to provide a sense of security for the birds. The results also show that many of the respondents move the broody hens to the neighboring houses or at times, they tie the hens so that they do not move away from the homestead or are able to move about.

Table 15 Types of litter material and methods used to minimize broodiness (%)

Responses	Lowland	Midland	Overall	$\chi^2$
<b>Did you use litter</b>				
Yes	50.0	60.0	55.0	1.21
No	50.0	40.0	45.0	
<b>Litter material</b>				
Teff straw	26.7	21.7	24.2	1.3
Wheat straw	—	1.7	0.8	
Old cloths and kancha (local name)	73.3	76.7	75.0	
<b>Systems used to reduce broodiness</b>				
Moving hen nearby house	23.3	36.7	30.0	5.37
Tie the hen	21.7	18.3	20.0	
Hanging upside down	11.7	6.7	9.2	
Distributing the nests	5.05	5.0	5.0	
Spraying water on hens body and place	—	3.3	3.3	
Tie the tail of the hen with plastic rope	38.3	30.0	34.2	

#### 4.5 Purpose of chicken rearing

The findings as indicated in Table 16, most of the respondents indicated that the chickens are reared primordially (across the study areas) as a source of income, eggs and most of all as a medium of saving.

Table 16 Purpose of chicken rearing in the study area

Purpose of chicken rearing	Lowland		Midland	
	Rank	Index	Rank	Index
Income	1 <sup>st</sup>	0.29	1 <sup>st</sup>	0.26
Egg	3 <sup>rd</sup>	0.2	2 <sup>nd</sup>	0.24
Meat	4 <sup>th</sup>	0.18	3 <sup>rd</sup>	0.2
Saving	2 <sup>nd</sup>	0.24	4 <sup>th</sup>	0.19
Social function	5 <sup>th</sup>	0.08	5 <sup>th</sup>	0.11

#### **4.6 Breeding practices of chickens in the areas studied**

The findings as presented in Table 17, breeding is primarily for egg production. However, the respondents prefer to select both the roosters and hens, which is carried out through their phenotypic conformation. Many of the respondents also indicated that culling too was carried out on a regular basis. The fundamental reason for culling was assessed to be poor productivity of the hens, followed by culling the sick chickens. The hens and the roosters are selected based on their egg production and body weight, which was observed across both the studied location. The study further indicates that irrespective of the study areas the preferred plumage colors of the roosters and hens are red followed by golden.

Table 17 Breeding practice, culling practices, traits preferred for selection, and plumage color of chickens reared in the study areas

Responses	Lowland	Midland	Overall	X <sup>2</sup>
<b>Did you practice controlled mating</b>				
Yes	4.2	4.2	8.3	0.000
No	45.8	45.8	91.7	
<b>Sex preferred by households</b>				
Rooster/cockerel	2.5	1.7	4.2	0.31
Hen/pullet	3.3	4.2	7.5	
Both	44.2	44.2	88.3	
<b>Did you practice culling</b>				
Yes	90.0	96.7	93.3	2.14
No	10.0	3.3	6.7	
<b>Reason for culling</b>				
Not cull	10.0	—	5.0	27.04
Poor productivity	48.3	90.0	69.2	
Old age	18.3	8.3	13.3	
Sickness	23.4	1.7	12.5	
<b>Selection base</b>				
Color	15.0	10.0	12.5	1.64
Egg production	51.7	51.7	52.5	
Body weight	28.3	26.7	27.5	
All combination	5.0	10.0	7.5	
<b>Color of chicken needed</b>				
No need	—	6.7	3.3	14.61
Red	36.7	48.3	42.5	
Black	18.3	5.0	11.5	
White	8.3	—	4.2	
Golden	36.7	40.0	38.3	

Table 18 shows that, predator was identified as the major constraint in all agro ecologies of the study area followed by disease, feed shortage, inadequate vet services and knowledge related to husbandry practices .

Table 18 Major constraints of chicken production in the study areas

Chicken constraints	Lowland		Midland	
	Rank	Index	Rank	Index
Predator	1 <sup>st</sup>	0.27	1 <sup>st</sup>	0.25
Disease	2 <sup>nd</sup>	0.25	2 <sup>nd</sup>	0.24
Lack of feed	3 <sup>rd</sup>	0.22	3 <sup>rd</sup>	0.22
Vet service	4 <sup>th</sup>	0.17	4 <sup>th</sup>	0.16
Lack of knowledge	5 <sup>th</sup>	0.09	5 <sup>th</sup>	0.12

#### **4.7 Production and reproduction performances of chicken reared in the study areas**

The findings as presented in Table 19, most of the traits included as production and reproduction parameters showed differences across the genotypes reared. The study also shows that age at first mating of the cockerel and the pullets, age at first egg lay and average numbers of clutches were higher among the native chickens. The study also indicated that the numbers of eggs and average length of the clutch were more in case of the exotic chickens vis-à-vis those of the native birds.

Table 19 Production and reproduction performance of chickens in the areas studied

<b>Responses</b>	<b>Breed</b>	<b>Lowland</b>	<b>SD</b>	<b>Midland</b>	<b>SD</b>
Age of the cockerels at first mating (months)	Local	6.0 <sup>a</sup>	0.5	5.5 <sup>a</sup>	1.3
	RIR	4.6 <sup>b</sup>	0.3	4.5 <sup>b</sup>	0.3
	BB	4.6 <sup>b</sup>	0.3	4.6 <sup>b</sup>	0.3
Age of pullet at first mating(months)	Local	6.0 <sup>a</sup>	0.6	5.5 <sup>a</sup>	0.5
	RIR	5.0 <sup>b</sup>	0.2	4.7 <sup>b</sup>	0.2
	BB	5.0 <sup>b</sup>	0.3	4.7 <sup>b</sup>	0.3
Age of the pullets at first laying(months)	Local	6.3 <sup>a</sup>	0.5	6.0 <sup>a</sup>	0.2
	RIR	4.5 <sup>b</sup>	0.2	4.6 <sup>b</sup>	0.2
	BB	4.6 <sup>b</sup>	0.3	4.7 <sup>b</sup>	0.3
Average number of eggs/clutch(nos)	Local	15.0 <sup>b</sup>	1.3	17.8 <sup>c</sup>	3.2
	RIR	30.2 <sup>a</sup>	5.8	34.0 <sup>b</sup>	5
	BB	32.2 <sup>a</sup>	5.9	37.9 <sup>a</sup>	7.1
Average number of clutch/year/hen(nos)	Local	4.6 <sup>a</sup>	0.7	4.6 <sup>a</sup>	0.5
	RIR	3.1 <sup>b</sup>	1	3.6 <sup>b</sup>	0.5
	BB	2.2 <sup>c</sup>	0.4	3.5 <sup>b</sup>	0.5
Average length of single clutch period(days)	Local	20.2 <sup>b</sup>	4.4	22.6 <sup>b</sup>	3.7
	RIR	29.2 <sup>a</sup>	5.1	33.8 <sup>a</sup>	4.5
	BB	29.3 <sup>a</sup>	6	35.4 <sup>a</sup>	4.8

<sup>a,c</sup>  $P < 0.05$  values across column ( for a trait) vary significantly ,RIR ( Rhode Island Red), BB ( Bovans Brown)

#### 4.8 Reproductive traits of scavenging chicken

The findings as presented in Table 20 indicate that the numbers of eggs set, numbers of chicks hatched and hatchability percentages were higher among the native chickens reared in the lowlands.

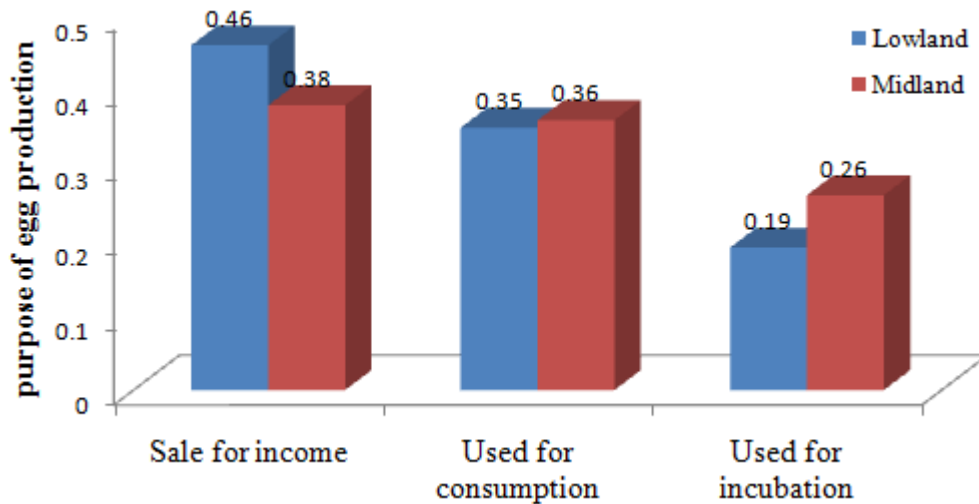
Table 20 Reproductive performances of chickens in the study area

Responses	Lowland	SD	Midland	SD	Overall	SD
Number of egg set	12	0.5	10.4	0.6	11.2	1
Number of chicks hatched	7.8	0.9	6.1	0.8	7.0	1.2
Percent of hatchability (local)	65.2	8.2	58.8	8.5	62	9

Figure 2 Purposes of egg production as indicated by the respondents

As presented in (Figure 4), majority of the respondents irrespective of the studied agro ecologies the eggs are produced for income, home consumption followed by those reared for incubation. However, the numbers of eggs sold for income was more in the lowlands while the reverse was true for the other two parameters.

Figure 3 Purposes of egg production as reported by the respondents in the present study



#### 4.9 External and internal egg quality parameters

The findings pertaining to the external and internal egg quality traits of local and exotic chickens as presented in Table 21 shows that egg weight was higher among the Bovans Brown ( BB) hens followed

by those of the Rhode Island Red (RIR). The egg weight of the BB and RIR was similar in the midlands while it did differ in the lowlands. The study also shows that the egg length, shape index, shell weight and shell thickness too were higher among the exotic chickens (BB and RIR) irrespective of the agro ecologies. The egg width too followed similar trend as that of the egg length, however the egg width of the RIR was higher than those of BB, and however, the values were lowest among the eggs from the local chickens.

#### 4.9.1 External egg quality parameters across different genotypes reared in the study areas

Table 21 External egg quality parameters ( Mean± SD) across the different genotypes reared in the study areas

Variable	Genotypes	Lowland	SD	Midland	SD
Egg weight (g)	Local	40.8 <sup>c</sup> ±4.7	4.7	42.5 <sup>b</sup>	4.1
	RIR	52.2 <sup>a</sup>	5.7	49.2 <sup>a</sup>	5.6
	BB	49.2 <sup>b</sup>	5.6	51.3 <sup>a</sup>	7.1
Specific gravity	Local	0.15 <sup>c</sup>	0.02	0.16 <sup>b</sup>	0.02
	RIR	0.19 <sup>a</sup>	0.03	0.18 <sup>a</sup>	0.04
	BB	0.18 <sup>b</sup>	0.03	0.2 <sup>a</sup>	0.03
Egg length (mm)	Local	50.5 <sup>b</sup>	2.6	51.7 <sup>b</sup>	2.1
	RIR	54.6 <sup>a</sup>	2.8	54.1 <sup>a</sup>	1.9
	BB	54.2 <sup>a</sup>	2.9	54.1 <sup>a</sup>	2.8
Egg width (mm)	Local	37.6 <sup>c</sup>	2.1	38.3 <sup>b</sup>	2
	RIR	41.4 <sup>a</sup>	2.8	40.1 <sup>a</sup>	1.8
	BB	40 <sup>b</sup>	1.6	40.9 <sup>a</sup>	1.8
Shape index (%)	Local	74.5 <sup>a</sup>	4.5	74.2 <sup>a</sup>	3.2
	RIR	75.9 <sup>a</sup>	4.5	74.2 <sup>a</sup>	3.5
	BB	73.8 <sup>a</sup>	3.5	75.7 <sup>a</sup>	2.5
Shell thickness (mm)	Local	0.36 <sup>a</sup>	0.1	0.28 <sup>a</sup>	0.1
	RIR	0.35 <sup>a</sup>	0.1	0.27 <sup>a</sup>	0.1
	BB	0.37 <sup>a</sup>	0.1	0.28 <sup>a</sup>	0.1
Shell weight (g)	Local	3.72 <sup>b</sup>	0.6	3.75 <sup>b</sup>	0.7
	RIR	4.67 <sup>a</sup>	0.7	4.53 <sup>a</sup>	0.5

BB 4.7<sup>a</sup> 0.5 4.67<sup>a</sup> 0.5

<sup>a-c</sup> Means with different subscript across a column are significantly ( $p<0.05$ ) different; RIR=Rhode Island Red; BB=Bovans Brown; SD= Standard deviation

#### 4.9.2 Internal egg quality parameters of different genotypes reared in the study areas

The findings as presented in Table 22 shows that the albumen height, albumen width and albumen weight of the from the exotic chickens (RIR and BB) were higher ( $P<0.05$ ) when compared to the native chickens. The study further indicates that there was variation between agro ecology for the traits studied. The findings also show that while, the albumen height, albumen length, albumen width and albumen weight was higher ( $P<0.05$ ) among the RIR vis-à-vis BB reared in the lowlands there were no differences in the trait among the two breeds reared in the midlands.

Table 22 Internal (Albumen) quality

Parameter	Genotypes	Lowland	SD	Midland	SD
Albumen height (mm)	Local	4.75 <sup>b</sup>	0.9	4.45 <sup>a</sup>	1
	RIR	5.27 <sup>a</sup>	1.4	4.73 <sup>a</sup>	1.7
	BB	4.72 <sup>b</sup>	1.1	4.82 <sup>a</sup>	1.2
Albumen length (mm)	Local	139 <sup>b</sup>	11	138 <sup>b</sup>	14
	RIR	146 <sup>a</sup>	9.1	146 <sup>a</sup>	9.8
	BB	141 <sup>ab</sup>	15	147 <sup>a</sup>	12
Albumen width (mm)	Local	111 <sup>b</sup>	16	116 <sup>b</sup>	12
	RIR	122 <sup>a</sup>	12	125 <sup>a</sup>	13
	BB	115 <sup>b</sup>	12	126 <sup>a</sup>	11
Albumen weight (g)	Local	21.8 <sup>c</sup>	3.9	23.8 <sup>b</sup>	2.5
	RIR	31.5 <sup>a</sup>	5.2	28.5 <sup>a</sup>	4.4
	BB	28.3 <sup>b</sup>	4.2	29.5 <sup>a</sup>	5.5
Albumen index (%)	Local	0.96 <sup>a</sup>	0.2	0.89 <sup>a</sup>	0.2
	RIR	0.99 <sup>a</sup>	0.3	0.88	0.3
	BB	0.93 <sup>a</sup>	0.3	0.9 <sup>a</sup>	0.3

<sup>a-c</sup> Means with different subscript across a column are significantly ( $p<0.05$ ) different; RIR=Rhode Island Red; BB=Bovans Brown; SD= Standard deviation

### 4.9.3 Internal egg quality parameters of the different genotypes reared in the study areas

Regarding the internal egg quality, there was a significant difference between genotypes and within genotypes ( across the study areas) in observed egg quality parameters. The results as indicated in Table 23, shows that while yolk height, yolk color and haugh unit did not vary across the three genotypes reared in the midlands agro ecology. However, the findings show that the specific gravity of the eggs from the local hens was lower ( $P<0.05$ ) than those of the exotic breeds. The study further indicates that the yolk weight and yolk width too was lower ( $P<0.05$ ) among the eggs laid by the local chickens when compared to those laid by the exotic chickens. The study also indicates that the specific gravity of the eggs laid by the RIR hens reared in the lowlands had a higher ( $P<0.05$ ) than those of the BB hens.

Table 23 Internal (yolk) quality parameters of the eggs across the different genotypes reared in the study areas

Variable	Genotypes	Lowland	SD	Midland	SD
Yolk height (mm)	Local	16.2 <sup>a</sup>	1.09	16.5 <sup>a</sup>	0.94
	RIR	16.5 <sup>a</sup>	1.25	16.6 <sup>a</sup>	1.74
	BB	16.1 <sup>a</sup>	1.05	16.8 <sup>a</sup>	1.63
Yolk width (mm)	Local	37.4 <sup>b</sup>	2.1	39.2 <sup>b</sup>	2.82
	RIR	39.3 <sup>a</sup>	2.19	40.5 <sup>ab</sup>	2.94
	BB	39.5 <sup>a</sup>	3	42.0 <sup>a</sup>	3
Yolk weight (g)	Local	15.3 <sup>a</sup>	2.83	15.0 <sup>b</sup>	2.81
	RIR	16.0 <sup>a</sup>	2.75	16.2 <sup>ab</sup>	2.15
	BB	16.2 <sup>a</sup>	3.13	17.2 <sup>a</sup>	2.52
Yolk color	Local	11.8 <sup>a</sup>	1.58	10.4 <sup>a</sup>	1.6
	RIR	10.6 <sup>b</sup>	1.55	10.3 <sup>a</sup>	2.41
	BB	10.4 <sup>b</sup>	1.61	10.7 <sup>a</sup>	1.42
Yolk index (%)	Local	43.6 <sup>a</sup>	3.64	42.3 <sup>a</sup>	3.89
	RIR	42 <sup>ab</sup>	3.95	41.1 <sup>a</sup>	4.69
	BB	41.0 <sup>b</sup>	4.19	40.2 <sup>a</sup>	4.2
Haugh unit	Local	74.4 <sup>a</sup>	7.54	70.8 <sup>a</sup>	9.48
	RIR	72.9 <sup>ab</sup>	10.5	69.0 <sup>a</sup>	13
	BB	69.8 <sup>b</sup>	10.5	69.8 <sup>a</sup>	9.6

## **5. DISCUSSIONS**

### **5.1 Household characteristics of the respondents in the study areas**

The findings as presented in Table 2 show that most of the respondents were males, which is typical of those from the tropical countries where the society is male dominated and prefer the strangers not to speak to the famine members of the households (Tsegay *et al.*, 2017). However, this is not preferred when studies pertain to livestock are concerned as studies by (Adem and Teshome, 2016) have indicated that the contribution of the feminine folk are quite significant especially when it comes to the management of the chickens are concerned. The findings as obtained in this study are however, in close accordance with the results of (Moges *et al.*, 2010) in Bure District, North West, Ethiopia. The findings also indicate that most of the respondents belonged to the age category of 36-45 years of age.

People of this age group are both physically active and are expected to have a good experience in the activity they perform (WHO, 2015). People of this age category are also usually fairly good learners in comparison to the elders who are often reluctant to changes offered through livestock extension services (Morton and Richard, 1996). The average family size as reported in the study is higher than those reported by (Getu and Birhan, 2014) from North Gondar Zone, Ethiopia.

The findings however indicate that the family of the respondents had fewer inhabitants when compared with the observations of Tekalegn *et al.*, (2016) in Sidama Zone. Smaller family size is a boon for chicken rearers as such families are expected to have a higher amount of money at their disposal (when compared to members who have larger family) and can procure much needed feed and medicaments (Sharmeen *et al.*, 2014). As the numbers of children's within a household are expected to be few, hence the eggs produced by the hens can be

provided occasionally to the children and also the sick, old and infirm thus ensuring their nutritional requirements (Dayanidhi *et al.*, 2016)

The results from Figure 2, shows that most of the respondents were able to read and write and who had secondary education, the numbers were more than those who were illiterate, similar observations were also recorded by (Melese and Melkamu, 2014) from East Gojam Zone, Amhara Regional State, Ethiopia. The respondents who are literate have an advantage as they can record the progress made in the farm and can maintain primary records of the farms. The literate respondents can also read livestock husbandry related literatures and manuals provided by the development agents besides could effectively take part in the training programs organized in the sector (Kibreab *et al.*, 2015). However, for the holistic development of the sector, it is imperative to develop specific poultry husbandry related training programs aimed at people who are illiterate so that they are also able to improve their livelihood through introduction of exotic poultry breeds in the region (Wondmeneh, 2015).

#### **5.1.1 Production system and farming activities as observed in the study areas**

The results as presented in Table 4 show that all the respondents practiced mixed farming system, which is also in close accordance with the findings of (Ayele, 2012), Mixed farming system is practiced by most of the farmers in the tropics where the crop and livestock husbandry complement each other (Melese and Melkamu, 2014). In doing so, the waste product of one is used as the raw material for the other (Ayele, 2012). The shattering of the seeds from the crops also leads to the availability of feed materials for the chickens (Deepak Shah, 2009). The land holding of the respondents did not vary across the study locations and

the amount of land is quite less to rear different types of livestock and under such conditions rearing of chickens.

### **5.1.2 Composition of the livestock as reported by the respondents in the study areas**

The study also indicates (Table 5) that the chickens are reared in large numbers in the study areas, which is also in close accordance with the observations of (Desalew, 2012) from East Shewa, Ethiopia. This may be because the chickens are easier to rear and cheaper when compared to other livestock species (Alemayehu *et al.*, 2015). They also have high rate of reproduction and have a shorter generation interval, besides they are also gender friendly (Duguma, 2009). Studies by (Desalew, 2012) have also indicated that the respondents to meet their daily expenses usually sell the eggs and that the chickens are easy to be sold (Kedir, 2016) when compared to other livestock.

### **5.1.3 Types of chicken reared and source of the genotypes as reported by the respondents**

The study from Table 6 indicates that most of the chickens reared are of native ecotypes, which are also in close accordance with the observations of (Alem, 2014) in Central Tigray, Northern Ethiopia. This may be ascribed to the fact that the native chickens are better adapted to the local agro system and are able to thrive well on the scarce feed (Alem, 2014). The native chickens are also able to tolerate the adversities diseases and parasites better than those of the exotic chickens (Mekonnen, 2007) besides findings of studies by (Haftu, 2016) have also indicated that the local chickens are able to escape well from the predatory attacks when compared to the exotic counterparts. The more numbers of native chickens as observed may also be attributed to the fewer numbers of exotic chickens distributed by the different developmental agencies and their adaptability (Haftu, 2016).

The study also indicates that most of the chickens reared by the respondents were home hatched and in that case there are chances of inbreeding within the flock (Mahendra, 2016). Inbreeding leads to decrease in reproduction potential and thereby the hatchability (Dessie *et al.*, 2013) also that the inbred birds are smaller than the non-inbred counterparts (Solomon *et al.*, 2013). While, in house chicks have an advantage as the respondents need not depend on external agencies every time when they need to replenish their flock or increase the numbers (Farell, 2000). However, in such cases the respondents need to be made aware of the problems associated with inbreeding and how to avoid the same especially under the village conditions (Nigussie *et al.*, 2010).

It has also been reported that many of the respondents have obtained chicks from the different developmental agencies. Findings by (Desalew, 2012) indicate that most of the developmental agencies do not carry out adaptability trails for the chickens supplied and that the complete package and practices pertaining to the chicken husbandry (related to the chicks supplied) are rarely disseminated to the beneficiaries. Therefore, it has to be ensured that prior to distribution of the chickens to the beneficiary's at least basic husbandry, feed and breeding techniques corresponding to the genotype be imparted (Haftu, 2016).

#### **5.1.4 Chicken flock structure and size as reported by the respondents in the area studied**

The findings indicate that most of the flock usually comprised of the chicks followed by the hens, these observations are in close accordance with the observations of (Ochieng *et al.*, 2013) in western Kenya. The more numbers of hens are also indicative to the fact that the hens are reared for egg purpose which is a source of cheap protein and required for hatching purpose or/ the interest of the farmers for increased egg production and using laying hens as

parent stocks for hatching as the sources of the replacement or breeding (Asefa, 2007) in Awassa zuria. The numbers of roosters being very few will inevitably lead to high inbreeding within the flocks ( as indicated ahead), thereby the respondents need to be appraised about rooster rotation among the community and also other easy and similar techniques to minimize the ill effects of inbreeding (Farell, 2000)

## **5.2 Chicken husbandry practices in the study areas**

### **5.2.1 Feeding management as practiced among the respondents in the study areas**

Lack of feed supplementation is one of the characteristics of a free-ranging backyard poultry production (Aman *et al.*, 2015). The genetic potential of the exotic chickens cannot be fully realized through scavenging alone as the quality and the quantity of the scavenged feed vary significantly across locations and between seasons within a study area (Haftu, 2016). The study also indicates that many of the respondents have realized the importance of supplementation and regularly provide some sort of supplementary feeds to the chickens reared by them; these observations are also in close accordance with those of (Aman *et al.*, 2017). However, the qualities of the feed supplements too are questionable at times, which may be ascribed to the presence of mycotoxins (toxic secondary metabolites produced by fungus) in the feed (Loretta, 2014). The study also indicates that most of the supplements are energy feeds with very low quantity of protein; the observations are in close accordance with the findings of (Adem and Teshome, 2016).

#### **5.2.1.1 Rate of feeding as reported by the respondents in the study areas**

Many of the respondents provide the feed supplement once/twice /thrice a day, while in the modern poultry husbandry practices the feed need to be made available adlib, which can

facilitate the consumption as and when desired (Feleke *et al.*, 2015; Adis and Malede, 2014). Scattering the supplementary feed over the ground leads to wastage and attracts the vermin's and other rodents which can be predators or/and can harbor several diseases and pests (Zemene, 2011). Thus, the respondents need to be made aware of all these adversities and encouraged to provide feed in feeding troughs, which need to be cleaned with appropriate materials and on a regular basis (Feleke *et al.*, 2015).

#### **5.2.1.2 Feeding practices of the chickens raised in the study areas**

The study further indicates that most of the respondents prefer feeding the chickens in groups, which is not a good practice in the sense that the chicks and old chickens usually are unable to compete with the roosters and hens (Feleke *et al.*, 2015 ) thereby adversely affecting their growth. Therefore the respondents need to be appraised about preparation of poultry feed using locally available feed materials which can at least take care of the minimum dietary requirements of the different classes of the chickens (Mohamed A. *et al.*, 2016).

#### **5.2.2 Chicken housing system as prevalent in the study areas**

The findings from Table 9 indicate that most of the respondents do not provide separate housing for their chickens and allow them to reside in the dwellings of their owners. Provision of proper housing is one of the basic husbandry requirements and in doing so help in protecting the birds against vagaries of nature, pest, predators, diseases and thefts alike (Salo *et al.*, 2016). The housing should be made up of locally available materials and should be easy to clean and repair (Yadessa *et al.*, 2017). Most of the chickens are housed along with their owners and in doing so there are chances of zoonotic diseases like avian influenza (Moges *et al.*, 2010). This is besides the fact that the chickens may themselves be uncomfortable if the

chicken perches over the places where the cooking takes place. Many of the respondents also house the chickens along with other livestock, which too are in close accordance with the findings of (Alemayehu *et al.*, 2015). Keeping several species of livestock together can have both beneficial effects (optimum usages of space) however, the chances of cross infection still remains (Moges *et al.*, 2010).

### **5.2.3 Watering of chicken and sources of water as prevalent in the areas studied**

The results as indicated in Table 10, show that water is provided to their chickens by most of the respondents, the findings of which are in close accordance with the reports of (Birtukan *et al.*, 2014 ) in Ethiopia. However, studies by (Wayuma *et al.*, 2015) have indicated that water is seldom provided to the chickens reared in Rural Areas of Bishoftu, Ethiopia of the country. Water is one of the most essential of all the nutrients and play vital role in several physiological and metabolic processes (Aman *et al.*, 2015; Mekonnen, 2007). The water however, is also to be clean and safe for drinking otherwise it can be a major source of contamination and can result in large-scale fatalities (WHO, 2014). The study further indicates that the water is mostly available through well-laid pipelines and this may be minimizing the chances of contamination (Tarekegn *et al.*, 2015). However, the respondents who are not using the tap water need to be cautioned about the contamination and also appraised about methods (use of boiled water or water sanitizing tablets) to minimize the risk associated with the contamination

### **5.2.4 Chicken breeding practices as reported by the respondents**

The findings as indicated that, chickens are an integral part of the agrarian activities in the study areas these observations are in close accordance with those of (Adisa and Akinkunmi,

2012). The chickens are mostly raised for home consumption besides are important sources of earnings especially during festivities and socio cultural events (Aklilu, 2007). Chickens are also used in many parts of the country for faunal medicines (Alves and Alves, 2011).

The chickens are raised for socio cultural purposes and hence there is an importance given to the plumage color, the respondents preferred rearing chickens, which were having reddish plumage, which was observed across both the agro ecologies, (Hunduma, 2010) reported similar observations. The study also indicates that the chickens in Ethiopia are primarily selected based on their plumage which is contrary to the observations of , Muchadeyi *et al.* (2009) who reported that, poultry farmers in Zimbabwe traditionally selected compact and adult birds rather than tallish ones as breeding stocks though they attached no emphasis to plumage color.

The study further indicates that there was no special emphasis on the selection of the roosters or hens, which may be responsible for the poor productivity of the birds. Studies by (Deneke *et al.*, 2014) have indicated that the selection was more effective for the roosters when compared to the hens, which may be because of the fertility of the roosters, are higher than those of the hens. However, in such cases care has to be taken to ensure that the flock is not inbred and the rooster has been selected based on predefined objectives (Muir, 2003) (Table 18).

However, the primordial cause of such discrepancies between the genotypes studied can be ascribed to poor or no recording system as it prevails in the country. Thus, recording mechanisms have to be devised and the development agents should be trained (by the

researchers) to impair the recording system among the poultry reared in the study areas (Yenesew *et al.*, 2015).

The study further indicate that culling was practiced in both the agro ecologies , culling is an essential farm practice where poor producing animals are identified and removed from the flock ( FAO, 2004). In doing so, it saves a lot of precious farm input, which can be allocated to other higher producing animals (Lee I. Chiba, 2014; Haile and Biratu, 2017). The observations in this study are in close accordance with the findings of (Moges, 2009). However, as recording system does not exist in the flock, it may be possible that the poor/high producing birds are not properly identified and thus the culling will usually be faulty. Thus, strengthening of the recording system has to be carried out to ensure proper selection/culling (Desalew, 2012).

Egg production is considered as a primordial trait and that egg is considered as a wholesome food and has a good market because of above average keeping quality is considered as a yardstick for selecting the chickens (Dayanidhi *et al.*, 2016). Birds with suboptimum productivity, high broodiness, small clutch size are the ones which are not preferred by the rearers, the observations are in accordance with the findings of (Solomon *et al.*, 2013).

### **5.3 Causes of mortality among chicken as reported by the respondents**

The study as presented in Table 12 indicates that most of the respondents have encountered deaths among their flocks, which was also in close accordance with the observations of (Moges, 2014). This may be ascribed to high incidences of parasites and diseases, besides predatory attacks (Solomon *et al.*, 2013). The study further indicates that while ethno veterinary method of treating sick birds were reported by the respondents from the midland

agro ecology, which may be ascribed to the availability of herbs in the areas and maybe the virulence of the diseases and parasites are less due to relatively cooler climate (Kedir, 2016). This may also be attributable to the presence of well-established veterinary facilities in the lowlands when compared to the areas in the midlands, similar (Desalew, 2012) has also reported differences in the veterinary facilities.

### **5.3.1 Predator that attack chickens as reported by the respondents in the area**

The findings from Table 13, is indicative that predator followed by diseases were the major constraints in the study areas. The attack of wild cats (*Felissil vestris*) and hawk (*Buteogallus anthracinus*) attacked the chicks. In addition to fox (*Vulpes vulpes*) locally called “Yedala”, Hawk (*Buteogallus anthracinus*) locally called “Tilallo”, wildcat (*Felissil vestris*) locally known as "Ganchara" and wild Cat (*Lynx rufus; Shreber*), called” Basu” in the native language were the other economically important predators affecting village chicken production in the study area. (Habte *et al.*, 2015) too reported similar observations in Amaro district, SNNPRS of Ethiopia. The attack on the chicks can be minimized through providing protective net and keep the chicks under protection by covering them under baskets (Mekonnen *et al.*, 2017). This was followed by diseases which affect the birds leads to large scale deaths among the flocks, many of the diseases in this case is vaccine preventable and hence regular vaccinations have to be provided as per schedule (Teshome and Tesfaye, 2015).

Many of the diseases can be prevented (at least to a greater extent) through proper hygiene and management of the chicks besides providing appropriate antihelmenthics (Alam *et al.*, 2014). The respondents also need to be trained about the feeding quality of the locally available feedstuffs and also how to properly conserve them so that the nutritive values are not lost

(Tsegay *et al.*, 2017). Formulation of ration for a particular age category of birds too needs to be carried out from these ingredients (Ahmed, 2018). Here the Universities and Research centers can play a pivotal role in formulation of feed and its efficacy on the flock , once standardized the local youth or NGO's operating in the area can be provided with the technologies, so that proper utilization of the locally available resources carried out and local employment created (Odemero and Oghenesuvwe, 2016). However, in all these cases the involvement of the research centers, universities and financial institutions have to be there as stakeholders.

#### **5.4 Chicken disease prevalent in the study areas and the control measures taken by the respondents**

The findings indicated that, most of the diseases, which have been reported in the present study, are vaccine preventable and similar to those reported by other authors (Melesse and Negese, 2009). New Castle disease is one of the most important diseases in the area, which too are in close accordance with the findings of (Moges *et al.*, 2010). The other diseases prevailing in the area Gumboro, fowl typhoid etc too are vaccine preventable diseases. Thus, regular vaccination has to be carried out in the area based on the vaccination calendar provided by the competent authorities (Yenesew *et al.*, 2015). The development agents need to train the respondents about methods of maintaining hygiene among the chickens especially in the dwellings, quarantine, and disposal of dead birds as all these factors can significantly or adversely influence the chicken husbandry in the region.

#### **5.4.1 Traditional medicines used for chicken treatment in the study areas**

Ethno veterinary medicines play an important role in the treatment of farm animals and chickens being no exception (Giday and Ameni, 2003). This form of treatment relies on age-old practices and also the acumen of the rearers and their understanding of the surrounding flora and fauna (Habte and Debele, 2015). Farmers have a practice of using traditional medicines for chicken treatments. There are several types of flora or plants, which are used for the treatment of different ailments. Herbal medicines used for smallholder chicken treatment was showed in (Table 12).

Some of the herbs like “*Argisa*” are localized to the area and respondents believe that; this herbs given to the chicken before chickens go to scavenging; the reason is why it is not functional to the chickens. While lemon juice (*Citrus limon*) is also used by the respondents in large number, lemon juice is a rich source of Vitamin C which can help in enhancing the immunity for the chickens (Tarekegn *et al.*, 2015). The concoction from tobacco (*Nicotiana latissima mill*) leaves are a rich source of nicotine, which too is commonly used, nicotine is also a potent drug if used carefully (Chandravanshi, 2017). While, the author reported that, the leaves of croton (*Croton macrostachyus*) are rich in alkaloids, amino acids, vitamin C, besides having antimicrobial properties and Fenugreek (*Trigonella foenum-graecum*) while medicinal properties of the plant too are well known and the seeds and leaves are used to treat various ailments and are also known to have medicinal properties (Tarekegn *et al.*, 2015).

Most of these medicinal plants were used to treat diarrhea, respiratory disease, and influenza besides ailments caused by unknown and unexplained causes (Tekalegn *et al.*, 2016). The ways of preparation of the treatment were by squeezing, grinding, or both and it can be administered with water or feed and either through mouth or nostrils. However, the ethno

veterinary medicines are generally provided to the birds by their age old knowledge however without any proper scientific formulations (Teklehaymanot and Giday, 2007). This can often lead to under or over dosages, which can at times be fatal. Hence it is advised that the bio diversity institute alongside other allied organic/ herbal pharmaceutical research organizations can work in tandem with the Universities to develop proper pharmaceutical combinations and dosage recommendations so that the above problems are taken care of (Tarekegn *et al.*, 2015).

### **5.5 Purpose of rearing chickens as reported by the respondents in the study area**

The purposes of keeping chicken by households as indicated in (Table 18) were for different reasons across the study area. Majority of the respondents give highest priority for sale for both eggs and chickens in lowland and midland and saving in lowland. This might be in lowland the farmers believed that, chicken as cash money rather than large ruminants during the requirement of money. Meat is for both agro ecology the third option; this might be they need chicken for meat only during festivity. Occasionally, they use chicken for social function in lowland and midland respectively. This result was slightly accordance with the report of (Feleke *et al.*, 2015), who reported that the main function of chickens for farmers were provision of eggs and chickens respectively, followed by egg for incubation and chickens for reproduction.

### **5.6 Production and reproduction performance of chicken reared in the areas studied**

The findings as presented in Table 20 indicated that, age at first mating of the cockerels, age at first egg lay, age at first mating of the pullets, average numbers of eggs per clutch and average length of the single clutch was higher ( $P < 0.05$ ) among the exotic chickens when compared to

their native counterparts, the findings are in close accordance with the findings of (Alem, 2014). The reproductive traits are influenced by several non-genetic factors. This is because of the agro ecological differences across locations and that there can be differences due to type of feed, diseases and predators. The age at first mating of the exotic, cockerels as observed in the study are in close accordance with the findings of (Yadessa *et al.*, 2017). The values are lower than those reported by (Moges *et al.*, 2010).

However, (Alem, 2014) too has reported higher values for the trait in a study. While, the age at first mating of the native cockerels are in close accordance with the observations of (Feleke *et al.*, 2015). However, higher ages at first mating of the native cockerels were also in close accordance with the studies of (Adem and Teshome, 2016). The study further indicates that in spite of the fact that the numbers of eggs laid by the exotic chickens are higher than their native counterparts which, is also in close accordance with the findings of (Alem, 2014). However, the numbers of eggs laid by RIR and BB are far below the values as reported by (Desalew *et al.*, 2013), this may be ascribed to the type of management, and the feed provided (Alem, 2014). Poor management of the chickens adversely affect the reproductive and production potential of the chickens and hence in order to exploit the genetic potential of the birds (Yadessa *et al.*, 2017).

The study further indicates that the average numbers of annual clutch was lower among the exotic chickens when compared to the local birds, which may be because the maintenance requirements (nutrition) of the exotic chickens are higher due to high body weight of the exotic chickens (Alem, 2014 ). The hens start to produce eggs only when they have accumulated enough body reserves and due to erratic feed supply associated with scavenging it become difficult for the exotic chickens to accumulate enough body reserves to have a

consistent clutch size (Feleke *et al.*, 2015). Therefore, in spite of all the attributes it is necessary that the exotic chickens be provided with formulated feed in both quality and quantity so that the appropriate genetic potential of the birds are realized (Desalew *et al.*, 2013).

### **5.7 Egg production of the different genotypes of chickens reared in the study areas**

The findings from Table 21 indicated that the average numbers of egg set for hatching are quite appropriate with the body size of the exotic chickens but the numbers may be high for the native chickens. The numbers of eggs set for incubation should be in tandem with the body size and weight, so that the heat provided are uniform across all the eggs (Mekonnen, 2007). If some of the eggs lie exposed (away from the body) the hatchability will be adversely affected (Pederson, 2002). Therefore, the respondents need to provide proper nest for the broody hens and also ensure that the bedding material is such that it has a shock absorbing capacity and also can retain the body heat (Alem, 2014).

The average hatchability is correlated with the profitability of rearing hens especially under the smallholder production system (Moges *et al.*, 2010). The average hatchability is also correlated with the quality of the nest provided and the nesting material (Ukuwu *et al.*, 2013). The average hatchability can also vary across seasons with the incidences of parasites (lice, ants) which can disturb the broody hens (Solomon and Elsabet, 2010). While, low and high humidity during the process of hatching the eggs can also adversely affect the hatchability as in both the cases the hatchability is adversely affected, in the former due to lack of moisture within the eggs the later facilitates the growth of fungus and mold and affects the respiration of the growing embryo (Moges, 2014).

The average hatchability as reported in this study are in close accordance with the findings of (Pederson, 2002) while lower hatchability too has been reported by (Moges *et al.*, 2010). The study also indicates that there is ample scope for improving the trait and the respondents need to be appraised about the method to prepare the nests using locally available materials and the importance of providing feed and water to the broody hens (Desalew *et al.*, 2013). The methods to control the diseases and parasites too need to be included in the training programs so that the hens are comfortable to incubate the eggs (Mekonnen, 2007; Feleke *et al.*, 2015).

## **5.8 External and internal egg quality parameters of different genotypes of chickens**

### **5.8.1 External egg quality parameters of the different genotypes**

The egg weight (Table 21) is an important parameter, which is associated with the genotypes, age of the hens, and stage of egg lay besides the nutrition received by them (Ashraf *et al.*, 2016). The average egg weights of the exotic chickens are higher than those of the native chickens, the findings being in close accordance with those of (Haftu, 2016). The egg weight of the RIR and BB as obtained in this study is in close accordance with the findings of (Halima, 2007). However, (Mudhar, 2011) has also reported lower values for the trait from Basrah City, Iraq. The egg weight also has an implication on hatchability as underweight that is less than 50 grams and overweight that is more than 55 grams (for exotic chickens) have poor hatchability.

However, the weight of the eggs from the native chickens are usually low and hence these weight values (of the exotic chickens) usually do not hold true for the native chickens (Conny Maatjens, 2012). The optimum egg weight of the native chickens as reported in this study is in

close agreement with the findings of (Desalew *et al.*, 2013). However, the weight of the eggs of the native chickens as recorded in the study is also in close agreement with the findings of (Dayanidhi *et al.*, 2016).

The findings pertaining to the specific gravity of the eggs as presented in Table show that the value was higher among the eggs from the exotic (RIR and BB) chickens vis-à-vis those of the native chickens. Specific gravity of the eggs is also closely linked with the egg weight. However, the specific gravity of the eggs changes with age and eggs, which are old usually, have lower specific gravity. Thus, specific gravity of the eggs can be taken as a yardstick for freshness of the eggs. The specific gravity of the eggs from the native hens as obtained in this study is in close accordance with the findings of (Vivian *et al.*, 2017).

The egg width and the egg length are correlated with the egg weight, the eggs with narrow width or long are not preferred as such eggs have poor hatchability (Conny Maatjens, 2012). Besides the same a study by Hristakieva *et al.*, (2017) and they have also indicated that weak chicks are usually hatched out from the misshapen eggs. The egg length of the eggs from the exotic chickens is in close accordance with the findings of (Rath *et al.*, 2015).

The shape index values indicate the proportionality of the eggs, eggs that have a proper length: width ratios are proportional are preferred for hatching. The shape index as obtained in the study are more or less similar across all the genotypes and are in close accordance with those of (Bekele *et al.*, 2009; Moges *et al.*, 2009).

The thickness of the shell did not vary across the genotypes, while the trait is correlated with the transportation of the eggs, the shell thickness has to be uniform and eggs with poor shell quality have poor hatchability (Kumar *et al.*, 2014). This is because the eggs with poor shell

quality have high moisture losses and thus it gives rise to mortality of the growing embryo (Conny Maatjens, 2012). The shell weight of the eggs are also correlated with the egg weight (Ashraf *et al.*, 2016). The shell weight was more for the eggs from the exotic hens as these hens have higher weight (Haftu, 2016).

### **5.8.2 Internal egg quality parameters of the different genotypes reared in the study areas**

The results as indicated in Table 22 show that the albumin height, albumin length, albumin width and albumin weight were higher for eggs from local chicken than the eggs from the exotic chickens. The findings are in close accordance with the observations by (Melesse *et al.*, 2012; Rath PK *et al.*, 2015; Hussain *et al.*, 2013). Albumin (length, width, and height) influences the albumin weight and consequently the egg weight (Emllia *et al.*, 2015). The albumin height, width and the length as reported in the study are in close accordance with the findings of (Emllia *et al.*, 2015) for Rhode Island Red hens and Rath *et al.*, (2015) for White Leghorn breed. Higher albumin width and length is usually correlated with watery albumin, which is also an indication of poor egg quality and stale eggs (Hussain *et al.*, 2013). The albumin heights across genotypes as recorded in this study are in close accordance with the findings of (Melesse *et al.*, 2012). While, the albumin height as reported by (Dayanidhi *et al.*, 2016) is higher than those reported by (Vivian *et al.*, 2017) for laying hen strains

### 5.8.3 Internal egg quality parameters (Egg yolk) of the different genotypes reared in the study areas

The findings pertaining to the egg yolk parameters (Table 23) shows that the egg yolk height did not vary across the genotypes, yolk height and width are closely related to the hatchability (Okuedo *et al.*, 2003). Eggs with suboptimum height and width usually have suboptimum yolk weight and therefore the hatchability of the eggs are compromised

(Hristakieva *et al.*, 2017). Yolk is the source of nutrition for the growing embryo; this egg with small yolk, no yolk usually lead to poor hatchability (Conny, 2012).

The yolk height, width, and weight are influenced by the genotype, age of the birds and the nutrition received by the chickens (Okuedo *et al.*, 2003). The yolk height as recorded in this study are in close contrast with the findings of (Melesse *et al.*, 2012) while lower values were reported by (Do, 2013). The yolk color is more of an aesthetic value rather than nutritive value (Okuedo *et al.*, 2003). The people in the tropics give high importance to brightly colored yolk and eggs of such yolk colors are preferred (Tadelle *et al.*, 2003a). The yolk color as obtained in the study is in close accordance with the findings of (Melesse *et al.*, 2012). The high yolk color value observed in this findings might be attributed to the period of the experiment (dry season) where there was shortage of green plant materials for the scavenging chickens.

The Haugh index is correlated with the protein quality of the eggs (Haugh, 1937). The results from the study shows that irrespective of the genotypes they all fall under category “A” where the albumin is somewhat less thick or viscous than a firm white (Rajkumar *et al.*, 2009). The findings are in close agreement with the results from studies by (Melesse *et al.*, 2012; Fayeye *et al.*, 2005) while higher values of the index have also been reported by (Melesse *et al.*, 2010) for Ethiopian necked neck chickens. The Haugh index is also influenced by the nutrition received by the chickens and the age of the eggs (Rajkumar *et al.*, 2009). The trait is also influenced by the genotypes and the index values are usually higher among the intensively reared chickens when compared to those reared under extensive system (Haugh, 1937).

## **6. CONCLUSION AND RECOMMENDATION**

### **6.1 Conclusion**

The result of the study indicated that chicken production supplements other agrarian activities in the study areas. The chickens are reared as a source of income and the eggs are both consumed and used of hatching. However, the productivity of the chickens is much below the potential of the flock. This may be ascribed to several factors viz., disease, feed shortage, and poor livestock extension services prevalent in the study area.

The study further indicates that most of the respondents prefer feeding the chickens in groups, which is not a good practice in the sense that the chicks and old chickens usually are unable to compete with the roosters and hens. The husbandry mechanisms too are largely wanting with primitive housing and poor quality of supplementary feed. Water is provided adlib and many of the respondents still depend on traditional ethno veterinary system of medicines. The chickens were exposed to several diseases most of which were vaccine preventable and this may be ascribed to poor veterinary services besides the extension services too are quite weak and erratic.

The eggs are mostly used for hatching and the hatchability is quite low, indicating that there is scope for improving the husbandry system. The results from the egg quality traits indicate that, most of the internal and external egg quality traits were superior for the exotic chickens. It may be attributed to the genotypic effects. However, among the production parameters too the favored the exotic chickens with non-significant variation between the two genotypes studied. However, the numbers of annual clutch was higher among the native chickens.

## **6.2 Recommendation**

- ✓ The livestock extension services need further strengthening.
- ✓ The exotic chickens should only be distributed after proper adaptation trails are carried out.
- ✓ Feeding the chickens in groups, which is not a good practice in the sense that the chicks and old chickens usually are unable to compete with the roosters and hens.
- ✓ The feed quality and quantity need assessment has to be carried out and based on the results the respondents need to be properly trained about methods how to prepare feeds using locally available feed materials.
- ✓ The veterinary services need further strengthening and local youth be provided para veterinary training.
- ✓ The marketing system needs further restructuring and if possible the cooperatives should be developed to assist the same.

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## 8. APPENDICES

### 8.1 Appendix I: Survey 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** -----

#### 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?
5. Age of the respondent (<35, 36-45, >45 and above)

#### 6. Educational background

1=Illiterate

2=Read and write

3=Primary

4=Secondary and above)

#### 7. What is your family size?

#### 8. Farming activities of respondent

1=Crop production

2=Livestock production

3=Both

**9. Land holding size/HH/ha**

**10. Land type of household (1=Cultivated 2=Grazing 3=Communal)**

**What are the populations of livestock that you reared currently?**

Cattle	Goat	Poultry	Equines	Sheep
Cow	Kids	Local	Donkey	Lambs
Bull	Bucks	Exotic	Horse	Ewes
Oxen		Cross	Mule	
Heifer				
Calves				

**11. Source of chicken breed**

1= Purchased from government

2=provided from agriculture research center

3=provided from nongovernmental organizations

4= Hatching of eggs naturally at home

**Which breed ecotypes do you have? A) Local B) Cross C) Exotic**

**12. Which age of chicken is mostly affected (1=Young chicks, 2=Adult, 3=All age group)**

**13. Are they recently introduced or reared for a long time (1=Long time 2=recently)**

**14. Do you practice selection of breeding chicken (1=Yes 2=No)**

**15. Which phenotypic characteristics do you prefer (1=Male 2=Female 3=both)**

**16. Production system (1 = Backyard 2=Semi-intensive 3=Intensive) (DA)**

**17. What is your available housing condition?**

1=Share the same house with people

2= Different shelter for night enclosure in the same roof

3=Separate house entirely constructed for chicken

4=Separate house with other animals

**18.** Did you construct poultry house based on recommended extension packages (1= Yes 2= No)

**19. If no in question, specify the reason**

1. Lack of awareness,
2. To construct their houses, their number is limited,
3. Time scarcity due to other work,
- 4=Lack of money)

**20. Do you provide litter material in the chicken house** (1 = Yes 2 =No)

**21. If yes, what type of litter material do you use?**

- 1 = Teff straw
- 2= Wheat straw
- 3=Old cloths and Kancha

**21. How do you provide feed your birds?**

- 1= Scavenging only
- 2= Scavenging with supplement
- 3=Purchased feed
- 4= Homemade feed

**22. When do you provide feed for your birds?**

- 1 = Morning and evening
- 2=Morning and after noon
- 3=Morning\_after noon\_ evening
- 4= Scavenging only

**23. What feeding practices do you use?**

- 1=Separate by age
- 2=Group feeding

3=Separate by breed

4=Separate by production

**24. Where do you provide feed for your chicken?**

1=on trough

2=on the ground

**25. Do you provide supplementary feed (1= Yes 2= No)**

**26. If yes, specify the type of the supplement**

0=No

1 = Maize

2=Wheat

3= Frushika

4= Maize and wheat

5=Wheat and frushika

6=Frushika and Maize

7= Maize, wheat and frushika

**27. Do you provide water for your bird (1= Yes 2= No)**

**28. If yes, what is the source of water?**

1=Hole water

2=River

3=Pond water

4=Pipe water

**29. How frequent do you provide water?**

1= Free access

2= Morning only

3=Morning and afternoon

30. Watering equipment

1=Plastics (plate)

2=Wooden

3=Clay

**32. Did you know your chicken laying interval (1= Yes, 2=No)**

**33. Do you know traditional ways to evaluate or measure your egg quality (1= Yes 2=No)**

**34. If your answer is yes, what are ways you use?**

0=No

1=Shaking

2=seeing in the sun

3=Putting egg in the water

**35. Do you know hatching practices (1=Yes 2=No)**

**36. What is preferred season for hatching?**

1=Wet

2=Dry

3=Both

**36. Do you know the traditional systems that you use during hatching or to protect contamination (1=Ash 2=No)**

**37. What method you use, if your hen becomes brood**

1= Moving chicken nearby house

2=Tie the hens

3=Hanging hen upside down

4=Distributing the nests

5=Spraying the water on hens body and its place

6=Tie plastics on the hens tail

**37. Do you practice culling of birds (1= Yes 2=No)**

**38. If yes, reason for culling**

0. No

1. Poor productivity

2. Old age

3. Sickness

**39. Do you have market access to buy chicken production inputs (1=Yes 2=No)**

40. Where do you buy chicken production inputs (feed) (1=Not buy 2=Shop keepers)

**41. Do you have market access for your chicken products (1=Yes 2=No)**

**42. When do you sell your chicken or time of selling?**

1= Specific weight gain or age of birds

2=Personal money requirement

3=During holydays and festivals

**43. Against which diseases you vaccinate your chicken (Question 43 and 44 are raised for Development agent (DA)).**

1= Newcatle disease

2=Marek's didsease

3=Fowl thyphoid

4=Gumboro or infectious bursa disease

5=Infectious bronchitis

**44. What are the main chicken diseases you encountered during chicken rearing?**

a. Bird flu

b. Newcastle disease (Fengil)

c. Not known

**45. What do you do when your chicken get sick?**

- a. No
- b. Get treated at public vet clinics
- c. Treated them by buying modern drugs from the market,
- d. Treat them using traditional medicines,
- e. Sell them

**Marketing system of chicken**

- a. When do you sell your chicken or time of selling?
- b. Do you have market access to sell your chicken products?
- c. Where do you buy chicken production inputs (feed)
- d. Do you have market access to buy chicken production inputs?
- e. To whom are you selling your poultry products?

**46. If you treat your sick chicken by using modern drugs, where do you get the drugs you use for chicken treatment?**

0=No

1=Buy from private vet clinics

2=Buy from public vet clinics

3=Buy from groceries

4=Use traditional medicines

**47. Please list the name of the drugs you buy from the market?**

1=No,

2=Ashoxy(20%)

3=Tetracycline

**48. Have you encountered chicken deaths due to disease last year (1=Yes 2=No)**

**49. Do you use traditional medicines for your chicken when they get sick (1=Yes, 2=No)**

If yes, what is provision of medicine?

1=Argisa (local herb name), before scavenging

2=Lemon

3=Croton

4=Timbaho

5=Awishe

**50. Do you have access to the extension service (1=Yes 2=No)**

**51. If you say no, state the reason?**

1= Have no heard of them

2=cannot easily reach them

3= There is no need

**52. How frequently do you see the extension agent?**

1=Once a week

2=Once in two weeks

3=Once in a month

4=Not seen

**53. Do you discuss your poultry production problems with extension agent (1= Yes 2=No)**

**54. Have you ever got any training on poultry production (1=Yes 2=No)**

**55. What do you suggest to improve your chicken business?**

1=Feed,

2=House,

3=Vet service,

4=Training related with chicken production

**56. What are types of predators for your chicken?**

1=Wild fox

2=Hawk

3=Wild cat

4=Shelemimat

**57. What is severity of attack by predators?**

1=Very high,

2=High,

3=Medium,

4=Low

**57. What is means of control you use to save your chicken from predator?**

1=Protecting in the house and under shade,

2=Killing by different means,

3=House construction,

4=No suggested control,

5=Surrounding cleaning

**58. What is mostly attacked age group of your chicken?**

1=Chicks

2=Adult Local

3=Adult cross

4=All age group

**59. What are selection characters of your chicken?**

1=Color,

2=Egg production,

3=Body weight,

4=All combination

**60. What color of chicken you need?**

0=No

1=Red

2=Black

3=White

4=Golden

**61. Sex of chicken (1=Male 2=Female 3=both)**

63. What are the causes of the chicken constraints in the area/start from more severe

1=Lack of house,

2=Lack of knowledge,

3=Lack of money

4=Lack of feed both in quantity and quality

**64. In which season the disease severity is happen/occur?**

1. Summer

2. Winter

3. Spring time

4. All season

**65. What are the average flock structure of your chicken (1=Chick, 2=Pullet, 3=Cockerels, 4=Hens, 5=Cocks)**

**66. What is the average flock size of your chicken?**

**Breed performance**

Age of cockerel at first mating (month)

Age of pullet at first laying (month)

Age of pullet at first mating (month)

Average number of eggs/clutch (no)

Average number of clutch/year/hen (no)

Average length of single clutch period (days)

**67. Egg storage time and hatchability**

Egg storage time for incubation

Egg set per hatching

Number of chicks hatched

Hatching percent of local chicken

**68. For what purpose do you rear chicken?**

1=Income,

2=Egg production,

3=Meat,

4=Saving

5=Social function

**69. What is purpose of egg production?**

1=Sale for income,

2=Used for incubation,

3=Used for consumption

**70. Poultry production constraints**

1. What are the main poultry production constraints you have encountered in poultry rearing? (Possible to give more than one answer)

1.1. Disease

1.2. Predator

1.3. Feed shortage

1.4. Lack of adequate vet service (lack of personnel and vet clinics nearby)

1.5. Distant poultry market places

1.6. Low market prices

1.7. Lack of money

1.8. Lack of labor

1.9. Theft

1.10. Water shortage

1.12. Lack of modern poultry production knowledge

## 8.2 Appendix II: Pictures captured from field observation and experiment

Figure in the appendices 1 Feeding practices of chicken in the study area



Figure in the appendices 2 Vernier caliper to measure yolk width and Albumen



Figure in the appendices 3 Electronic balance to measure egg weight



Figure in the appendices 4 Tripod micrometer to measure albumen height and yolk height

### 8.3 Appendix III: Conversion equivalents of Sub-Saharan Africa livestock

Table in the appendices 1 Conversion equivalents of Sub-Saharan Africa Livestock (TLU),  
FAO, 2007

<b>Livestock species</b>	
Ox /bull	0.1
Cow/local	0.8
Heifer	0.5
Immature male	0.6
Calves	0.2
Goat	0.1
Sheep	0.1
Mule /horse	0.8
Donkey	0.5
Chicken	0.01

## **9. BIOGRAPHICAL SKETCH**

The author was born in Hawassa city Sidama Zone in February 2, 1983 E. C. He attended his primary school in Hawassa tabor primary and secondary school from 1993-2000 E.C. Then after, he attended his secondary and preparatory school in Hawassa tabor secondary and preparatory school from 2001-2004 E.C. He then joined Axum University College of Agriculture in 2005 E.C and graduated with B.Sc degree in Animal production and technology in 2007 E.C. Then after he served for one year in Bensa district Sidama Zone in bureau of livestock and fishery until he joined Hawassa University for his Msc study. He joined school of graduate studies of Hawassa University, Hawassa College of Agriculture in 2009 E.C to pursue M.sc degree in Animal production. Currently author had not married.