CHARACTERIZATION OF INDIGENOUS CHICKEN PRODUCTION, REPRODUCTIVE PERFORMANCES AND EGG QUALITY TRAITS IN EZHA DISTRICT OF GURAGE ZONE, SOUTHERN ETHIOPIA

MSc. THESIS

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JUNE, 2022

WOLKITE, ETHIOPIA

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EXAMINERS' APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Mechal Tessema have read and evaluated his thesis entitled "Characterization of Indigenous Chicken Production, Reproductive Performances and Egg Quality Traits in Ezha District of Gurage Zone, Southern Ethiopia'' and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree of Master of Science in Animal Production.

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DEDICATION

I dedicated this piece of manuscript to my beloved family especially to my wife Weinshet Seifu and my sweet son Bisrat Mechal for their moral, encouragement and sacrifice, to finalize my study.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged through citation. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. This thesis has been submitted in partial fulfillment of the requirements for Master of Science degree at the Wolkite University, Department of Animal Production and Technology, College of Agriculture and Natural Resource. The thesis is deposited in the University Library and is made available to borrowers under the rules of the library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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BIOGRAPHICAL SKETCH

I,the author, was born in Ezha district, Gurage Zone, Southern Nations and Nationalityof Regional state, in 1986 G.C. I had completed elementary education in Yekemene elementary school in 1998 G.C. *I* pursued my secondary education and then completed at Emdiber senior secondary school in 2002 G.C. and I joined Bekoji Agricultural Technical Vocational Education Training College (ATVET). I graduated in 2005 G.C. with a diploma (Animal Science) and then was employed at Ezha district Agricultural office as a development agent.

Simultaneously, I joined Haramaya University, College of Agriculture and Environmental Sciences in 2008 G.C., and graduated with B.Sc. degree in Agriculture (Animal and Rage Sciences) in 2012 G.C. After graduation with B.Sc.I was employed by Ezha district Agricultural and Livestock offices as expert,Team Leader and Head of Ezha district Agriculture and Natural Resources Office. Then I joined Wolkite University to pursue my Master of Science Degree in Animal Production in November 2019 G.C.

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LIST OF ACRONYMS

AH	Albumin Height
ANDPC	Average Number of Days Per Clutch
ANELHY	Average Number of Eggs Laid Per Hen Per Year
ANELPCH	Average Number of Eggs Laid Per Clutch Per Hen
AWCO	Average Weight of Mature Cocks
AWCR	Average Weight of Cockerel
AWH	Average Weight of Mature Hens
AWP	Average Weight of Pullet
CSA	Central Statistics Authority
EW	Egg Weight
EDAO	Ezha District Administration Office
EDANRO	Ezha District Agriculture and Natural Resource Office
EDFEDO	Ezha District Finance and Economic Development Office
EDLFRO	Ezha District Livestock and Fishery Resource Office
FAO	Food and Agriculture Organization
GAIN	Global Agricultural Information Network
GDP	Gross Domestic Product
GZDOFED	Gurage Zone Department of Finance and Economic Development
HU	Haugh Unit
MAC	Market/slaughter Age of Cock
MAH	Market/slaughter Age of Hen
M.a.s.l	Meter above sea level
NCD	New Castle Disease
NGOs	Non-Governmental Organizations
PA	Peasant Associations
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
SNNPRS	Southern Nation Nationalities and Peoples Regional State

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ABSTRACT

The main objective of this study was to characterizes indigenous chicken production, reproductive performances and egg quality traits in Ezha district of Gurage Zone, Southern Ethiopia. Generally, a multistage sampling procedure was applied for the selection of both kebeles and households. From Guraghe Zone, Ezha district was purposively selected based on its potential for indigenous chicken population and accessibility. In the first stage, the district was stratified into two based on agro-ecology i.e highland (3 kebeles) and midland (3 kebeles). In the second stage, representative kebeles were selected from each agro-ecology purposively based on indigenous chicken production potential and transport accessibility. Then, households that have two or more indigenous chickens & have experiences on chickens' husbandry practices were identified and listed. In the third stage, a simple random sampling technique was used to select households from each kebele. Lastly, data on both qualitative and quantitative variables were collected from 318 selected households by using a semi-structured questionnaire. In addition, a total of 120 freshly laid eggs from indigenous village chickens were collected from the selected survey members and transported to Debre-zeit Agricultural Research Center for external and internal eggs quality traits analysis. The collected data were analyzed using SPSS version 21 software. The research finding revealed the main objectives of chicken production in the study area were for both income generation and consumption (50%), while (30.5%) for consumption, and (19.5%) only for immediate income generation. The survey results revealed that about (40.9%) of the respondents constructed separate chicken house, (77.4%) practised of scavenging system with supplementary feeding, (88.4%) provided water for their chicken and (79.5%) of the respondents faced diseases outbreaks. The survey also revealed that the mean number of eggs laid/clutch, numbers of days/clutch/hen, the clutch number/year and annual egg production/hen of local chicken ecotypes were (13.9 eggs, 22.5days, 3.9 clutch number and 53.8 eggs), respectively. The study also revealed that the overall mean age at first mating of male chickens and the age at first egg of female chickens were 5.9 and 6.5 months. This study obtained significantly lower productive and reproductive performances from highland chicken ecotypes. The analysis of the study revealed that egg quality parameters like egg weight, egg length, egg shell weight, egg shape index, albumin weight, albumin width, yolk width and yolk index were significantly different ($P<0.05$) among the two agro-ecologies. These observed variations might be attributed to various factors such as management differences, quality, and quantity of feed, and production environments in which the animals were maintained. So, the productivity of indigenous village chickens could be enhanced by relatively simple changes in management techniques (feeding, housing, and health care) that promote improvement in productivity and reduction in mortality. Therefore, governmental organizations, NGOs, and other stakeholders should play their role in developing producers' knowledge and capacity.

Key words: Agro-ecology, Chicken management, Egg quality traits, Ezha, Indigenous, Productive and Reproductive

1.INTRODUCTION

Agriculture dominates the Ethiopian economy and contributes 40% of the national Gross Domestic Product (GDP) and provides more than 68% of employment (FAO, 2019). Livestock production accounts for about 18.7% to the agricultural GDP, 16-19% to the total foreign exchange earnings of the country (FAO, 2015) and provides livelihood for 65% of the population (Tewodros and Mebrate, 2019). Ethiopia has the highest livestock populations in Africa and the country has 70,291,776 cattle, 42,914,865 sheep, 52,463,535 goats, 2,148,492 horses, 10,791,896 donkeys, 382,784 mules, 8,145,790 camels and 6,986,100 beehives. The total estimated number of domestic birds of Ethiopia is about 56,992,987 million and from the estimated poultry population, around 78.85%, 12.03% and 9.11 %, were reported to be indigenous, hybrid and exotic, respectively, respectively. Similarly, the amount of egg produced from indigenous, hybrid and exotic chickens of Ethiopia is estimated to be about 123.62, 210.60 and 34.61 million of egg from indigenous, hybrid and exotic chicken respectively (CSA, 2021). According to CSA the contribution of indigenous chicken is low in egg production compared to the hybrid amd exotic chicken, because of the facts that the production systems are affected by different constraints which cause low productive and reproductive performance of chickens. The constraints includes poor management practices (poor housing and feeding, diseases, predation and lack of organized markets).

The production performance of indigenous chickens of Ethiopia is low because of their low egg production potential, high chick mortality and longer reproductive cycle and due to their low genetic potential (small sized eggs, slow growth rate, late sexual maturity and broodiness for an extended period). Indigenous chicken flocks are self- propagating, with broody hens laying only 30– 80 small-size eggs per year in 2–4 clutches, and spending longer time between clutches to rear chicks (Mapiye *et al*., 2008 and Fotsa *et al*., 2014). The Ethiopian indigenous chickens are none descriptive breeds closely related to the jungle fowl and vary in color, comb type, body conformation, weight and broodiness is pronounced (Demeke, 2008). There were huge number of indigenous chickens in Ethiopia but its productive and reproductive performance were low and varies in different area.

Eggs are balanced sources of essential amino acids as well as some minerals and vitamins. Egg proteins contain all essential amino acids required for human beings and therefore, egg protein is

used as standard for measuring the nutritional quality of other food products. Both external and internal qualities of eggs are of major importance to the egg industry worldwide (Aberra *et al.,* 2013). External and internal egg quality traits are the determinant factors for the embryonic development of an egg and later for the viability of the new hatched chick. Moreover, some egg quality traits like eggshell thickness and strength are very important to handle the egg during transportation from time of laying up to consumption (Welelaw *et al*., 2018). Furthermore, improving the shell quality is important subject to reduce the economic losses via cracks and the breakings of the egg (Sarica *et al*., 2012). Other egg quality traits like yolk color have valuable influence on the egg market (Fisseha *et al.,* 2010). For this reason, valuable egg quality traits are very important as a measure of reproductive parameter in chicken production industry and breeding strategies. However, they are not being given due attention in the developing world, where the majority of the eggs are coming from free scavenging village chicken, as compared to that of the developed world (Aberra *et al.,* 2013). Understanding the egg quality characteristics of indigenous chickens under their natural breeding tract has a paramount significance in designing and implementing environment friendly and community based holistic genetic and performance improvement strategies in order to ensure improved chicken productivity and, sustainable utilization and conservation of indigenous chicken genetic resources to respond to changes in climate and to meet the ever-increasing demand of chicken products.

In Ethiopia, indigenous chicken's production play crucial roles in the livelihoods of resource poor families and has socio-cultural and economic benefits especially in the rural communities (Gebreegziabher and Tsegay, 2016). According to Minyahel and Mosa (2019), Gurage communities are supporting their livelihoods majorly from cropping, large and small ruminant production, village chickens production and remittance from family members who dwell in urban parts of the country. Besides, a study conducted by Abera and Hussen (2016) in Marako district of Gurage Zone, Southern Ethiopia, indicated that the majority of the farmers kept chickens for the purpose of sale to increase income indicating that chickens and chicken products are among the farm products that generate house income.

According to the information obtained from Ezha District Livestock and Fishery Resource Office (EDLFRO) (unpublished data), indigenous chicken production is one of the main sub-sector among the livestock production for the livelihoods of the smallholder farmers especially for women and children even for youth for multipurpose uses including: as source of income, and means to ensure

food security.Chicken require limited space, feed and capital for investment compared to other domestic animals kept in the area. Thus, indigenous chicken have a unique position in the rural household economy and plays a significant role in the cultural life of the society. However, those important breed, are under risk due to different factors such as poor management practices and indiscriminate crossbreeding. It is, however, important to maximize the use of the existing productivity by improving the current level of production. And also, there is little information and very little research has been done on characterization of indigenous chicken production, reproductive performances and egg quality traits analysis in this district. Moreover, it is difficult to design and implement chicken-based development programs that benefit rural people without considering characterization of the indigenous chicken production. Thus, the present study was conducted in Ezha district of Gurage zone with the following objectives:

1.1.Objective

1.1.1.General objective

- To characterizes indigenous chicken production, reproductive performances and egg quality traits in Ezha district of Gurage Zone, Southern Ethiopia.

1.1.2.Specific objectives

- To characterizes the management practices of indigenous chickens kept in Ezha district of Gurage zone.
- To characterizes the productive performances of indigenous chickens in Ezha district of Gurage zone.
- To characterizes the reproductive performances of indigenous chickens in study area and
- To compare egg quality traits collected from indigenous chickens reared in different agroecologies of Ezha district of Gurage zone.

1.2. Research Questions

The study tries to answer the following major guiding questions:

- What are the management practices of indigenous chickens in Ezia district?
- What are the productive performances of indigenous chickens in different agro-ecologies of Ezia district?
- What are the reproductive performances of indigenous chickens in different agro-ecologies of Ezia district?
- Is there variation in external and internal egg quality traits among indigenous chickens in different agro-ecologies of Ezia District?

2. LITERATURE REVIEW

2.1.Indigenous Chicken Production in Ethiopia

In developing countries, many rural households keep poultry in their farmyard with local chicken ecotypes and low purchased-input (Alemayehu, 2017). Poultry keeping practiced by rural households using family labour is referred to as village poultry keeping. This practice is also called rural poultry or rural family poultry. In most developing countries, village poultry makes up the largest proportion of the national poultry population (Ermias, 2015). Village poultry are significant for their nutritional or economic value, they also play a significant role in human society through their contribution to the cultural and social life of rural people (Aklilu, 2007). Family chicken production is an appropriate system that makes the best use of locally available resources (Emebet, 2015). In rural areas, family poultry production systems generate tremendous opportunities in terms of improving food security and nutrition; it is suitable enterprise for women and poor households due to the small quantity of land needed and low investment costs required to start up and run the operation (FAO, 2019).

Indigenous chicken rearing system in Ethiopia, in general is characterized by extensive scavenging, no vaccination with increased risk to disease and predators, there is no or minimum intervention to maximize their production and characterized by low input with little supplemental feeding, no separate shelters except night shelter with minimal level of bio-security and high levels of mortality (Waktole *et al*., 2018). As such, it does not involve investment beyond the cost of the foundation stock, a few handfuls of local grains and possibly simple night shades, mostly of the family dwellings. Although some hybrids and exotic breeds of chickens are kept by some households under this extensive systems, in most cases households in the country have engaged in raising of indigenous breeds of chickens (Ahmed, 2018).

The indigenous chicken production system in Ethiopia followed the primitive type with 5-20 birds per households, simple rearing in backyard with inadequate housing, feeding and health care. Furthermore, about 83.5% of the national egg and meat production are contributed from indigenous chicken production systems. However, the contribution of the indigenous chicken resource to human nutrition and export earnings is disproportionately small (CSA, 2016).

Similarly, the indigenous chicken productions system of Ethiopia there is no purposive feeding of chickens and scavenging is almost the only source of diet. There is no designed selection and controlled breeding. It is by natural incubation and brooding that chicks are hatched and raised all over the rural Ethiopia (Bushra, 2012). In Ethiopia indigenous chickens are characterized by their small body size and poor production of meat and eggs. The average annual egg production of local genotypes ranges from 30 to 60 under free ranging village management which could be improved up to 100 eggs under improved management conditions (Nigussie, 2011).

2.2.Importance of Indigenous Chicken Production

The importance of indigenous Chicken production in the national economy of developing countries and its role in improving the nutritional status and incomes for livelihoods of many smallholders and landless communities has been recognized by various scholars and rural development agencies for the last few decades (Bushra, 2012; Alemayehu, 2017). For instance, there are about 56.9 million chickens in Ethiopia of which 78.85% are local chickens (CSA, 2021), indicating the significance of indigenous chickens as potential farm animal genetic resources of the country. In most developing countries, including Ethiopia, indigenous chicken make up the largest proportion of the national poultry population. They can be raised by smallholder-farming families, landless laborers and people with an income below the poverty line. Even with low inputs, indigenous chicken production enables farmers to harvest the benefits of high quality protein in the form of eggs and meat from only scavenging feed resources (Habte *et al*., 2017).

Indigenous chicken significantly contributes to the livelihoods of poor households: economically as starter capital, as a means to recover from disasters, as an accessible protein source and for income and exchange purposes, and socio-culturally functions, hospitality and exchange of gifts to strengthen social relationships (Aklilu, 2007). According to Waktole *et al*. (2018), indicates chicken in Ethiopia majorly use for income generation by selling egg and live chicken followed by home consumption, saving and slaughter during festivals.

Ermias (2015) reported that due to their requirement of small feed, space, low cost and high turnover rates, chicken rearing is a suitable activity for the poor and their products are highly marketable and playing important social and cultural roles in the life of rural people. In Ethiopia perspective, chicken rearing activity is one of the most appropriate activities for rural women, landless and poor farmers and it is a source of income, creates employment opportunities and increases the supply of high quality animal protein. Mekonnen (2007), stated that indigenous chicken products are often the only source of animal protein resources for poor households. Eggs are a source of high-quality protein for sick and malnourished children under the age of five. Due to their small size and fast reproduction compared to most other livestock, chicken are more often slaughtered and eaten in the household.

2.3.Indigenous Chicken Management Practices

2.3.1.Housing system

Housing in **i**ndigenous chicken production system is rudimentary and commonly built with locally available materials and the main role of the house in most village systems often is only to provide a night time shelter (Habte *et al*., 2017). In traditional free range production systems, there is no separate poultry house and the chickens live in family dwelling together with human being (Ahmed, 2018). Moges *et al*. (2010), reports that in Bure district, North West Ethiopia, about (22.1%) provided separate poultry house and the remaining (77.9%) of the chicken owners provided only night shelter. According to study made by (Nebiyu *et al*., 2013) in Amaro district, SNNPRS of Ethiopia showed that most (77.5%) of chicken owners constructed a wooden perch for their chickens inside the main house for night shelter, (12.1%) of the owners kept their chickens in a separate room which is encloses in the main house and (10.4%) of the households provided a hand woven basket for their chickens especially for newly hatched chicks and the broody hen. Many authors indicated that they prepared separate overnight house for indigenous chickens. Fisseha *et al*. (2010), reported that from the total chicken owners, only (22.1%) prepared separate overnight houses for village birds, only (22.1%). However, the majority (77.9%) of chicken owners kept birds on various night sheltering places including; perches inside the family house, on the floor covered by bamboo made materials, on ceilings of the house and under locally constructed sitting place.

Lack of attention to indigenous chickens, lack of construction materials, lack of knowledge and awareness, are some of the major reasons mentioned by indigenous chickens owners for not preparing a separate house for indigenous chickens. Similarly, Melkamu and Wube (2013), also indicates that the majority of farmers kept their chickens by sharing the same room with using perch and some of them using by making different sheltering's within the family house and separate building house. Even if; the farmers using the same room with and without perch to housed chickens, they can produce low amount of products. However, they constructed chicken houses to protect chickens from predators, rain and wind during night time.

2.3.2.Feeds, feeding and watering system

In the indigenous chickens production system, chickens almost entirely depend on the scavenging for feed, making it difficult to estimate the amount of consumption and utilization (Habte *et al*., 2017). Family poultry production in Africa survives by scavenging and generally, no supplements provided except that sometimes, household waste fed to birds and in some other circumstances the chickens are supplemented with grain (Ermias, 2015). Similarly, in Ethiopia indigenous chicken production is characterized by keeping under free range system with some amount of supplementary feeds like wheat bran, maize, sorghum, food leftover and where the major feed sources are believed to be insect worms, seed and plant materials (Alemayehu, 2017).

The quantity and quality of the scavenging feed resources vary mainly depending on the season of the year (FAO, 2019). However, the availability of the supplementary feeds reported during the dry season (November to March) following the grain harvest while the grains/grain by-products were in short supply leading to feed scarcity during the rainy season (Alemayehu, 2017). Supplementary feeding at least twice a day (early in the morning and late in evening when chickens are going out and returning from scavenging) helps to improve disease resistance, proper body development and production levels of the birds (Habte *et al*., 2017). According to Fisseha *et al*. (2010), in West Gojam administrative zone of Amhara National Regional State supplementary feed provided by majority (97.5%) of chicken owners. Grains and household leftovers are the major kinds of feed supplemented by farmers. Most of these chicken owners used crop harvest (self-produced grains) as supplementary feed. Wheat, maize and millet are the first, second and third types of grains provided as supplementary feed, respectively. Moreover clean water should also be provided at all times to all birds. Regularly

changing the water and cleaning feed and water containers helps to prevent disease and infections through dirty feed and water (Habte *et al*., 2017).

2.3.3.The major economically important disease of chicken in Ethiopia

The bio-security of indigenous chicken production system is very poor, as scavenging birds live together with people and other species of livestock. Chicken movement and droppings are very difficult to control and -chickens freely roam in the household compound. There is no practice (or even viable means) of isolating sick birds from the household flocks and dead birds are left for either domestic or wild predators (Solomon, 2007). Chickens and eggs are sold on open markets along with other food items. The live bird marketing system represents a significant and potential hazard to both buyers and sellers, yet implementation of bio-security and hygienic practices in such a system is generally difficult (Ahmed, 2018).

Even though Ethiopian indigenous chicken breeds are resistant to diseases their egg production, weight gain and egg size are low compared exotic chicken breeds. In Ethiopia, poultry disease is the most important constraint of indigenous chicken production. Among poultry diseases, NCD is the most serious epizootic chicken disease in the world, particularly in developing countries (Ermias, 2015). Similarly, Infectious diseases, such as Newcastle disease, salmonellosis, fowl cholera, coccidiosis and fowl pox, are the major causes of morbidity and mortality in village poultry (Habte *et al*., 2017). NCD, Coccidiosis, Fowl influenza (Infectious Bronchitis), Fowl pox, Fowl typhoid and Salmonella were the major poultry diseases in Jimma Zone of Goma district (Mesert, 2010)

The NCD experience and the attitude of communities to handling sick birds (which are often sold) shows that marketing systems play a considerable role in the dissemination of disease over wide geographical areas in a relatively short period of time. The first recorded case of NCD was in 1970 on a poultry farm near Asmara, Eritrea, from where it spread all over Ethiopia within a short period of time. It is very difficult to apply health and bio-security measures on full day scavenging birds in small flock sizes. Newcastle disease is most widely distributed among the village chicken in Ethiopia (Ahmed, 2018).

Indigenous chicken vaccination particularly against NCD is more important than other management interventions; benefit-cost calculations done for the Tigray region of Ethiopia indicated that NCD vaccination is more economically beneficial than the provision of daytime housing, supplementary

feeding, cross breeding and control of broodiness. Study in village production systems, in different parts of Ethiopia, no vaccination practice against poultry diseases (Moges *et al*., 2010). Fisseha *et al*. (2010) and Habte *et al*. (2017) reported that due to poor extension system associated with poultry production, the level of households' awareness on availability of vaccines is low and the farmers do not have any opportunity of getting their chicken vaccinated against diseases.

2.3.4.Marketing systems of indigenous chickens and egg in Ethiopia

In Ethiopia selling of chickens and eggs is one of the functions of keeping free-range chickens by smallholder farmers. Indigenous chickens and eggs were taken by producer farmers to the local and urban markets and sold to traders (collectors) or directly to consumers depending on the location of the farm dwelling. Aklilu (2007) reported that market access was low with increased distance to the market for poorer households. According to Halima (2007), small holder chicken owner farmers found in different parts of Ethiopia sell chicken and eggs for the objectives of purchase food items, to cover school fees, grain milling services and purchase improved seeds.

The major constraints in indigenous chicken marketing were identified as low price, low marketing output and long distance to reliable markets. As a result, the smallholder farmers are not in position to get the expected return from the sale of chickens in North West Ethiopia (Awol, 2010). Seasonal fluctuation of market for chicken and eggs, low supply (output) of chickens and eggs due to disease and predation, presence of limited market outlets and lack of space for chicken marketing in urban area were market related constraints which affects poultry production (Moges *et al*., 2010).

2.4. Productive and Reproductive Performances of Indigenous Chickens

The productivity of indigenous chicken production systems in general and the free range system in particular is known to be low. This is due to low egg production and high mortality rate (Emebet, 2015). The productive and reproductive performance of indigenous chickens, can be measured by parameters that includes clutch number, average number of eggs laid per clutch, average days per clutch, average number of eggs per hen per year, slaughter age, weight of chickens, Age at sexual maturity,hatchability traits, mortality and survival rate (Matawork, 2018).

2.4.1.Number of clutch per year

A clutch is a group of eggs laid by a hen on consecutive days. Clutch numbers of Ethiopian indigenous chicken is different at different production and management systems (Matawork, 2018). According to CSA (2021) report, the national average clutch number of indigenous chicken of Ethiopia is five per year. However, the study conducted by Melkamu and Andargie (2013) at Enebsie Sar Midir district of Eastern Gojjam, indicated that the average clutch number is four per year. On the other hand, the overall mean clutch number of indigenous chicken in the Gena Bossa District of Dawro Zone is three per year (Matawork *et al*., 2019).

2.4.2.Egg production

Indigenous chicken produces lowest number of eggs per clutch and which is small in size. An indigenous chicken in Ethiopia produces 13 eggs per clutch (CSA, 2021). The average numbers of egg per clutch in Decha, Chena and Gimbo districts of Kaffa zone is 12.3, 12.2, 12.6, respectively(Abiyu, 2019). However, the study report made by Adem and Teshome (2016) in Yeki district, Southwestern Ethiopia, the average numbers of egg per clutch is 14.

According to a study reported by Matawork *et al*., (2019) in the Gena Bossa District of Dawro Zone, the average number of eggs per clutch and average number of days per clutch were significantly different at different agro-ecologies, the average numbers of eggs per clutch were 11.92±0.33, 13.77±0.69 and 12.66±0.15 at highland, midland and lowland agro-ecologies, respectively, indicating, the highest number of eggs (13.77±0.69) was produced at midland agro-ecology.

Indigenous chickens produce 65 small eggs per hen per year at farmers' management conditions in

Ethiopia (CSA, 2021). Different researchers investigated different egg production in terms of reproduction performance of indigenous chicken in different ecologies of Ethiopia (Tamene, 2017). Accordingly, Fisseha *et al*. (2010), who reported an average of 60 eggs per hen per year in Bure district and Zewdu *et al*. (2013) also reported 59.5 eggs per hen per year in Metekel zone of Northwest Ethiopia. However, Hunde (2015) where in rural areas of Bishoftu and Duguma (2009), the average egg production of native chicken was 44.20±9.6 and 45 eggs per year under village condition annually.

Nebiyu (2016) reported that educational level of farmers had effect on average egg production, which implies the higher educational level; the better would be in understanding of farm operation and efficiency. The mean total eggs produced per hen per year was not significantly different at different agro-ecologies. Mean total eggs produced per hen per year is 36.42±1.89, 40.45±0.97 and 38.73±0.85 at highland, midland and lowland agro-ecologies, respectively.

The study conducted by Awol (2010), in the Dale district of sidama Zone, indicated that the mean number of eggs produced by the local birds under smallholders' management system was 58 eggs per annum per bird. This figure is very low when compared to the production potential of exotic breeds which is 250 eggs per annum per bird. This figure (local chickens' egg productivity) can be improved to 100 eggs per annum per bird and ten clutches per annum under semi-intensive management system. However, the input-output ratio of village poultry keeping is minimal, the production system is still economical under the smallholder management condition with virtually minimal or nil input cost.

2.4.3.Average weight of hens and cocks at six months

The average body weight of adult males and females varied significantly among the populations. Females in Mandura, Horro and Sheka populations were significantly heavier than those in Farta and Konso populations. The weight ranges for males, 1.4kg (Konso) to 1.7 kg (Horro), and females, 1.0kg (Konso) to 1.5 kg (Sheka), and for different "plumage colour types" of indigenous chickens of Ethiopia reared under confined management regimens (1.3 to 1.7 kg for males and 1.0 to 1.2 kg for females) (Nigussie, 2011).

Mekonnen (2007), reported that the mean body weight of grower male chicken was 1.05 kg. Moreover, 1.316 kg and 1.18kg of average body weight of local hens were recorded (Bogale, 2008). In addition to this, mature male of (1.812 kg and 1.694 kg) and mature female of (1.37 kg and 1.35 kg) were reported for mid and low altitude, respectively (Alem, 2014). Beside to this, 2.049 kg of cock weight was observed for North West Ethiopia (Halima, 2007).

2.4.4.Market/slaughter age of cocks and hens

Gain (2017), reported that Ethiopian indigenous chickens reach slaughter age at 8 to 12 months in village management system. The mean market or the slaughter age of cocks and hens were 7.87±0.18 and 7.26±0.23 months in the Gena Bossa District of Dawro Zone, respectively (Matawork *et al*., 2019). The market/slaughter age was significantly different for cocks and hens at different agro-ecology. Mean age at slaughter for indigenous male chickens of Gomma district was 8.62 months (Meseret, 2010). Also in western Tigray indigenous chickens reach slaughter age at 4.66 and 4.5 months for male and female chickens, respectively (Shishay *et al*., 2014).

2.4.5.Age at sexual maturity of indigenous chickens

Matawork *et al*. (2019), reported that age at sexual maturity was measured by age at first egg and age at first mate for female and male chickens, respectively. Mearg (2016)reported that indigenous village chicken, in Ethiopia attains sexual maturity at an average of 7 months.Age at sexual maturity in Gena Bossa District of Dawro Zone were 5.63±0.22 and 5.25±0.15 months for pullets and cockerels, respectively (Matawork *et al*., 2019). However, Fisseha *et al*. (2010), in Bure, Fogera and Dale districts of Ethiopia,reported that, the average age of local cockerels at first mating and pullets at first egg lay were 6.15 and 6.88 months, respectively. Sexual maturity depends on management and overall production systems of farmers mainly on feeding, watering and disease control mechanisms. According to Sisay and Ewonetu (2020) variation in age at sexual maturity may be due to the variation in genetic as well as environmental (temperature and nutrition) factors in different parts of the country.

2.4.6.Hatchability traits of indigenous chickens

Natural incubation is the most commonly used method for replacing and increasing the size of flocks by the help of broody hens. Brooding hens use dark and quite place for laying and incubating eggs (Bikila, 2013). Producers adjust appropriate place and makes nest for broody hens which uses clay pot and straw bedding (cartoons) but in some cases uses clay without bedding (broken pot). Farmers are very conscious and concerned for preparation of appropriate place which provide good feed resources and best environment for incubating by broody hens (Matawork, 2018). According to Mearg (2016) indigenous chickens are ideal mothers, good setters, hatching their own eggs, excellent foragers and vigor. They are aggressive, hardy and possess some degree of natural immunity against some diseases. These factors are important ideal requirements for replication and sustaining their generation in scavenging nature. The most important characteristic of indigenous chicken is their broodiness (maternal instinct), which is pronounced for indigenous chickens in Ethiopia.

Adem and Teshome (2016), reported that the average number of eggs placed for hatching in the Yeki district of sheka Zone, South western Ethiopia was 10 eggs and the average number of chicks hatched from placed eggs was eight, indicating the hatchability of local chicken was 80%. Based on the finding by Moges *et al*. (2010) report in Bure district, the hatchability was 85.7%, 84.6% and 76.9%

at highland, midland and lowland agro-ecologies, respectively. The higher percentage hatchability might be due to small number of eggs sited per hen for hatching and preparation of good sitting material prior to incubation. Furthermore, this higher percentage hatchability might be an indication of good fertility and brooding ability of indigenous chickens. However, lower hatchability of indigenous chickens 59.6% and 22% were reported by Melkamu and Andarge (2013) in Enebsie SarMidir district of Eastern Gojjam zone of Ethiopia and by Meseret (2010) in Gomma district of Southern Ethiopia, respectively.

2.4.7.Mortality and Liviability of indigenous chickens

Matawork *et al*. (2019), reported that the survival rate of chicks up to five months of ages was 38.85±1.55%. However, the report of Fisseha *et al*. (2010), indicated that the survival rate of chicks up to five months of ages were 60.5%, 74.3% and 54.2% at Bure, Fogera and Dale districts, respectively. The survival rate of chicks to reach the grower stage of eight weeks was 65.8% for local chickens in both lowland and midland agro-ecological zones of Central Tigray (Alem, 2014).

According to finding of Tadelle *et al.* (2003), the average survival rate of chicks in Ethiopia was 51.3% and about 55.8 % reported by Abraham and Yayneshet (2010) from Northern Ethiopia. Similarly, the reported mean chicks mortality rate of indigenous chickens to the age of 8 weeks was 41% in the Gomma district (Meseret, 2010).Melkamu and Andargie (2013), indicated that, the mortality from hatching to maturity is higher in the early age of hatching and it was about (63%) in the first week hatch, (30%) between 1-5 weeks of age and (7%) at 6-8 weeks of age. The mortality of chick is mostly caused by disease (45%), malnutrition (21.66%) and predators (33.33%). From this, it is suggested that as the age of chicks increase, their adaptability to their environment, capability to withstand the environmental hazards and resistance to disease also increases and they can escape from predators easily.

2.5.Egg Quality Determining Traits of Indigenous Chickens

It is obvious that beneficial egg quality traits have immense importance to chicken breeding industries. In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of the hen (Desalew, 2012). Food products from villages, which are particularly advertised as natural and fresh, are in the focus of consumers' preferences. Besides, the positive effects of eggs which are not produced under suitable conditions are not consumed, when they are consumed can cause severe health problems (Tugcu, 2006). Moreover, eggs which are not produced under suitable conditions, can also harbor various diseases which can be potentially harmful for the consumers alike.

The egg quality is influenced by both genetic and environmental factors. Hens laying substandard eggs should be culled and proper management of hens can help in improving the quality of eggs (Aberra *et al*., 2013). Eggs of unnatural shape and of poor shell quality too are not desired as such eggs usually have poor hatchability and even if the chicks hatch out they rarely survive or grow well (Kejela *et al*.,2019). In this respect, egg quality characteristics are of high importance. In analyzing egg quality, different internal and external egg quality characteristics have to be analyzed. Among the internal egg quality characteristics, thick albumen is quite an important measure for the freshness of an egg. The longer an egg is stored, the more the height of the thick albumen decreases (Mesert, 2010).

2.5.1.External egg quality traits

The external egg quality traits include, the shell thickness and it is a measure of the shell strength mainly for the breeder flock incorporate and this assessed to reduce egg shell breakages (Kejela *et al*., 2019).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, however, few eggs with a shell thickness less than 0.27mm will hatch. One of the main concerns is that eggshell quality decreases as the age of hen increases as the result of an increase in egg weight without an increase in the amount of calcium carbonate deposited in the shells. Differences in eggshell quality, depend on the environmental conditions and the feed quality. Strain of layers and egg weight influences the weight of components of eggs especially egg albumen and yolk. Egg weight is one of the important phenotypic traits that influence egg quality and reproductive fitness of the chicken parents (Desalew, 2012).

Studyin Boricha district by Serkalem *et al*. (2019), revealed that there is significant effect of agro-ecologies and breeds on all of external egg quality traits except for egg shape index. The interaction of agro-ecology by breed in Amhara Regional State also significant for all parameters. Aberra *et al.*,

(2013), reported that eggs collected from midland scavenging chickens had significantly higher egg length and egg width than those of highland and lowland agro-ecological zones. The overall mean egg length and egg width of the local chickens in the Amhara Regional State, Ethiopia were 51.3 mm and 37.5 mm, respectively. Moreover, the overall shape index and the average shell thickness of scavenging local chickens were 73.2% and 0.296 mm, respectively. On the contrary, local chickens reared in the lowland had better external egg qualities (except shell thickness) than those reared in the midland of in Boricha district of Sidama Zone, southern Ethiopia (Serkalem *et al*., 2019).

2.5.2.Internal egg quality traits

Regarding to the internal egg quality characteristics, thick albumen is quite an important measure for the freshness of an egg. Eggs stored for a long period of the time, leads to denaturation of albumin and thus the albumin is usually watery (Meseret, 2010). According to the study made by Kejela *et al*. (2019), the yolk color also have important factor for the consumers. But the consumer preference for yolk colour are highly subjective and vary widely from country to country. The determinant of yolk colour is the xanthophyl (plant pigment) content of the diet consumed. Green grass during scavenging might be responsible for carotenoid deposits in the yolk, which improves the yolk color (Desalew, 2012). The Haugh Unit (HU) proposed by Haugh (1937), is calculated from the height of the inner thick albumen and the weight of an egg and it is considered to be a typical measure of albumen quality. It is generally accepted that the higher the Haugh unit value, the better the quality of the egg.

Based on the finding in Boricha district of Sidama Zone, southern Ethiopia by Serkalem *et al.* (2019), the effect of agro-ecology is significant for all internal egg quality traits except for egg weight and yolk colour. Similarly, the effect of breed was significant forall internal egg quality traits except for Haugh unit. The interaction effect of agro-ecology by breed was highly significant for all traits. Indigenous chickens reared in the midland produced eggs with higher yolk index than those of the exotic chickens.

Aberra *et al*. (2013) reported that, the egg weight obtained from midland scavenging chickens are significantly heavier than those of highland and lowland agro-ecological zones. The yolk height was significantly higher in midland than in highland agro-ecology. The overall average yolk width of indigenous chickens are 36.8 mm whereas yolk height was 16.1 mm resulting 44% of yolk index. The albumen height and HU values are significantly higher in scavenging chickens reared at midland than those of lowland and highland agro-ecological zones. Moreover, chickens from lowland had significantly lower albumen height and HU values than those of both agro-ecological zones. The overall average values of albumen height and HU are 4.51 mm and 73.2, respectively.

3.MATERIALS AND METHODS

3.1.Description of the Study Area

The study was conducted in Ezha district of Gurage zone in Southern Ethiopia. Gurage Zone has 16 Administrative Districts with 412 Peasant Associations (PAs) and 5 town (GZDOFED, 2019). The zone is found in altitudinal range of between 1600 and 3100 masl. Annual rainfall of the zone ranges between 801mm and 1400mm.The average annual temperature of the zone is about 18°C. A total livestock population found in the Gurage zone are 1,058,674 cattle, 360,291 sheep, 139,061 goats, 542,195 chickens, 46,891 horses, 3,942 mules, 12,421 donkeys' and 60,031 beehives (CSA, 2021).

Ezha district lies between 8°3'30''to $8^0$16'30''North latitude and 37° 50' 00''to $38^0$13'00'' East longitude. Agena is the capital of the district and found 42 km to the Eastern direction to the capital of Gurage Zone, Wolkite. It is also found at 197 km from the capital of Ethiopia, Addis Ababa in the southwest direction and 475 km from the capital of Southern Ethiopia, Hawassa, in the northwest direction. The district is bordered by districts of Cheha, Muhir- Aklil, Abeshge, and Gummer and Silti Zone, respectively, in Southern, Northern, Western and Eastern directions (EDAO, 2019). The total land area of the Ezha district is estimated to be 345km^2 and it constitutes 31 kebeles (the lowest administrative unit) of which 28 are rural and three rural town kebeles. The district has an estimated total human population of 127,374 (66,883 are males and 60,491 are females) and of the total the population 4.99% are urban and 95.01% are rural dwellers. The total number of households found in the district are estimated to be about 20,997, of which 17,630 are males and 3,367females households (EDFEDO, 2019).

According to information obtained from Ezha District Agriculture and Natural Resource Office (EDANRO), Ezha district is commonly divided into two major agro-ecological zones with altitudes ranging from 1950 to 3100masl (highland constitutes 53.6% and midland 46.4%). The annual average temperature ranges between 16.5^{0}c to 25^{0}c and the mean annual average rainfall varies from900mm to 1200mm. According to the data obtained from Ezha District Livestock and Fishery Resource Office (EDLFRO) about 74,896 chickens are found, of which 45.5% are indigenous and 54.5% exotic cross breeds.

Agriculture is the major economic basis for the households of Ezha district. The farmer practices mixed farming system where both crop production and livestock rearing are simultaneously under taken. The land use pattern of the district indicate that about 46% of the land is cultivated, 10.5% grazing land, 20% forest land, uncultivated land 14% and 9.5% used for others. The agro-climatic condition of the district is conducive for the production of different animals such as cattle, sheep, goats, horse, donkey etc. and annual food crops mainly barely, wheat, Teff, maize, beans, pea, potatoes and perennial crops such as "Enset", stimulants (coffee, chat), and timber are also grown in considerable amounts. Livestock production is one of the essential component of agricultural activities. It is used as a source of disposable income, selling food, means of transporting and organic fertilizer source. Besides, draught animals provide traction power for plowing (EDFEDO, 2019).

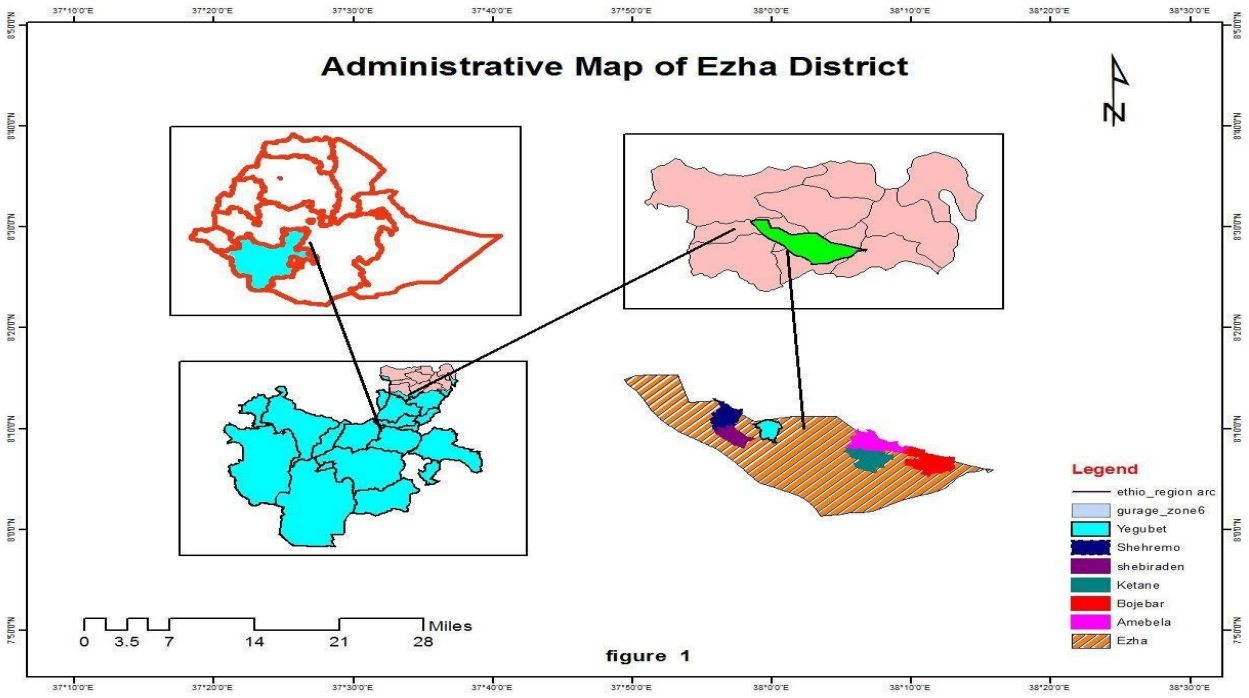

Figure 1. Map of Ezha district with the selected Kebeles

3.2.Research Design

For this study a descriptive survey research design was employed to characterizes indigenous chicken production, reproductivity, performances and egg quality traits in Ezha district of Gurage Zone, Southern Ethiopia. Since the descriptive survey research design helps to have general understanding of the problem by studying the current status, nature of the prevailing conditions, practices and trends through relevant and precise information.

3.3.Sampling Methods and Size

3.3.1.Sampling methods

For the survey part, generally a multistage sampling procedure was applied for the selection of both *kebeles* and households. According to EDLFRO (2020), Ezha district is reported to be one of the districts from Gurage zone where high production of indigenous chicken is practiced. In the first stage the district was stratified into two based on agro-ecology i.e highland (3 kebeles) and midland (3 kebeles). In the second stage, representative *kebeles* were selected from each agro-ecology purposively based on indigenous chicken production potential and transport accessibility. Thus, *Bojebar, Amebele* and *Ketane* PAs from the highland and *Shebiraden, Shehremo* and *Yegubet* PAs from midland agro-ecology were selected. Then, households that have two or more indigenous chickens & have experiences on chickens' husbandry practices were identified and listed. Lastly, a simple random sampling technique was used to select households from each kebele.

To undertake measurement on internal and external egg quality traits, as part of laboratory analysis part, freshly laid eggs from indigenous chickens were collected purposively from the selected households. Before transport maximum care was taken to collect an egg that is being stored not more than a week after being laid. Moreover, the freshness of the eggs were checked by immersing them in water during egg collection process (when an egg was floating in the bowl of water it was considered as old egg, while the egg sinked it was taken as fresh egg). The collected eggs were properly labeled according to agro-ecology. The selected eggs were transported to Debre-Zeit Agricultural Research Centre poultry laboratory to evaluate internal and external egg quality traits.

3.3.2.Sample size determination

The total respondents included in the study were determined according to the formula given by Yamane (1967). According to him, for a 95% confidence level and p = 0.05, size of the sample should be:

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1} + \mathbf{N}\,(\boldsymbol{e}^{\mathbf{2}})}$$

Where,

n =the sample size,

N = the population size and

e = the level of precision (the acceptable sampling error)

Thus, this formula was used for the determination of sample population size, in which N =1559 with ±5% precision. Assuming 95% confidence level and p =0.05, we get the sample size as:

$$\mathbf{n} = \frac{\mathbf{1559}}{\mathbf{1+1559\ (0.05^2)}} \mathbf{= 318}$$

Therefore, based on this formula a total of 318 households; 159 households from each agro-ecology and 53 households from each PA were used in the survey to collect pertinent data be used in the current study.

To analyze internal and external eggs quality traits, a total of 120 freshly laid eggs (60 from each agro-ecology; 20 from each PA) were collected from the selected surveyed households and transported to Debre-zeit Agricultural Research Center.

3.4. Sources and Methods of Data Collection

3.4.1. Sources of data

Both primary and secondary sources of data were used for this study. The primary data were collected from sampled respondents through semi-structured questionnaires to get comprehensive and reliable information and also, labratory egg quality traits analysis. Secondary data were obtained from various sources such as reports from Ezha District Agriculture and Natural Resources Office (EDANRO), Livestock and Fishery Resources Office (EDLFRO), Administration Office (EDAO), previous research finding, internet and others published and unpublished materials.

3.4.2. Methods of data collection

I. Survey Part

A cross sectional survey was carried out for each household to collect information focusing on the management practices, the productive and reproductive performances of indigenous chickens under village condition. The productive performances in terms of number of eggs laid per clutch/hen, number of days per clutch, number of clutches/hen/year, number of egg produced/hen/year, market /slaughter age of indigenous chickens were considered as the core points of the study. Average number of eggs were taken from farmers' estimation of eggs laid/hen/year.

The collected data in respect to reproductive performances includes age at sexual maturity (month), hatchability percentage, weaning age (month), mortality and survivability percentage of chickens.Furthermore, the management practices were assessed through observation of the incorporation of recommended scientific husbandry packages applied for each household. Provision of housing, provision of additional feed, agricultural extension system used, marketing, vaccination practices, were assessed through questionnaire survey. Closer visits of the selected households were also applied in order to obtain first hand observation on all aspects of indigenous chicken production of the district.

II. Laboratory Part

Data were collected using the following two sources & methods:

1. To determine the external egg quality parameters such as egg weight and shell weight were measured by using digital balance (gm). Other external egg quality traits, including egg length, egg width, and shell thickness, were measured using digital caliper to the nearest of 0.05 mm. The egg shell colour was determined using visual observation. Before measuring shell thickness, the shell membranes were removed by hand and then the shell thickness were measured at the three point (Center, broad and tip or end) and calculated average of the three was used as one trait. In addition, Egg Shape Index and Egg Shell Ratio were calculated using the following formula.

$$\textbf{Egg Shape Index (\%)} = \frac{\boldsymbol{Egg\ (mm)}}{\textbf{Egg Length(mm)}} \text{x}100$$

$$\textbf{Egg Shell Ratio (\%)} = \frac{\textbf{Shell Weight}}{\textbf{Egg weight}} \text{x}100$$

2. To determine the internal egg quality parameters, the eggs were carefully broken on to a flat surface. The thick albumen height (AH) was measured at its widest part at a position half way between the yolk and the outer margin. Yolk height was measured at the center of the yolk by using tripod micrometer (mm). The yolk was carefully separated from the albumen. Albumen and yolk weight were determined by weighing with electronic sensitive digital balance separately. Albumen and yolk width were determined by using digital caliper (mm). Yolk height and diameter (width) values were used to compute yolk index of the eggs according to the formula described by Panda (1996).The yolk colour was determined by using the Roche Colour Fan with a standard colorimetric system ranged 1-15.

The estimated yolk ratio (%), albumen ratio (%) and individual Haugh Units (HU) were calculated by using the following formula given by Haugh (1937).

$$HU = 100 \log (AH+7.57 – 1.7*EW^{0.37})$$

Where,

HU = Haugh unit,

AH = Albumen height (mm) and

EW = Egg weight (gm)

$$\text{Yolk Index} = \frac{\text{Yolk height}}{\text{Yolk diameter}} \text{x } 100$$

$$\text{Yolk Ratio (\%)} = \frac{\text{Yolk weight}}{\text{Egg weight}} \text{ x } 100$$

$$\text{Albumen Ratio (\%)} = \frac{\text{Albumen weight}}{\text{Egg weight}} \text{ x}100$$

2.5. Methods of Statistical Analysis

The collected data were coded for analysis. The collected data were analyzed using the statistical package for social sciences (SPSS) version 21 (SPSS, 2016). Statistical variations for categorical data were tested by means of cross tabs and chi-square. While the data for the continuous variable were subjected to analysis of variance using the general linear model procedure of SPSS 21. .Mean comparisons were carried out using Independent Sample T-test and significant differences was declared when $P<0.05$. Model statement regarding the effect of agro-ecological differences on the various productive and reproductive parameters of indigenous village chickens.

$$Yij = \mu + mi + \varepsilon ij$$

Where,

Yij = the chicken performance parameter estimate for bird j in agro-ecology i,

μ = the overall mean of the respective variable,

mi =the fixed effect of agro-ecology (i = 2; Highland and Mid-altitude) and

εij = the residual error.

The data collected from laboratory analysis were analyzed based on the following model statement regarding the effects of agro-ecology on the external and internal egg quality traits.

$$Yij = \mu + mi + \varepsilon ij$$

Where,

Yij = the external and internal egg quality traits the j^{th} indigenous breed in the mi agro-ecology,

μ = the overall mean,

mi =the fixed effect of agro-ecology (i = 2; Highland and Mid-altitude) and

εij = the residual error.

4.RESULTS AND DISCUSSIONS

4.1.Household Characteristics of the Respondents

From household characteristics of interviewed village chicken owners indicated in Table 1, it was found out that 85.5% of the respondent households were male while the remaining 14.5% were female. There was no significant difference ($p>0.05$) concerning the proportion of both sexes of the respondents among the two agro-ecologies. However, the proportion of male households (87.4%, 83.6%) was higher than female households (12.6%, 16.4%) in the study area's midland and highland agro- ecology. This result is comparable with the finding of Shishay *et al*. (2015) in Western Zone of Tigray, Northern Ethiopia and, Gebreegziabher and Tsegay (2016) in Wolaita Zone, Southern Ethiopia who reported that about 83.4% and 84.4% of the total households were male while the remaining 16.6% and 15.6% of the households were female, respectively. On the other hand, contrasting results have been reported from Gomma district of Jimma zone (Meseret 2010), in North West Ethiopia (Halima 2007) and in South West and South Part of Ethiopia (Moreda *et al*., 2013) in which 70%, 74.16% and 79.1% of the households were females and 30%, 25.84%, and 20.9% were males households, respectively, this due to the fact that female were managing the village poultry rearing in most districts. Hence, it is important to empower women through better education as they are the most to contribute a significant role in improving indigenous chicken production systems.

Regarding educational level, 30.5% of the respondents were illiterate while 41.8% of them were found to be capable of reading and writing. About 19.8%, 6%, and 1.9% of respondents achieved primary education, secondary education, and college education. The proportions of educational status of the respondents were significant differences ($p<0.05$) among the two agro-ecology. According to table 1, the highest proportion of respondents in both agro-ecologies had basic educational background where as college and university were followed by the lowest proportion of respondents in both agro-ecologies of the study area. This result indicates that lower illiterate households than reported from South-West Showa & Gurage zone of Ethiopia (Emebet, 2015) and Central Zone of Tigray, Northern Ethiopia (Mearg, 2016) in which (41.5% and 36%), respectively. The reason behind is that there was access to education might contribute to a positive attitude to change and to do things different as business as usual.

However, it is higher than the report from the central Oromia region, Ethiopia (Ermias, 2015), in which very small proportions (6.7%) of the respo.dents were illiterate.The study results also indicated that 100% of the respondents are occupied in agricultural activities of mixed crop-livestock production. Village chicken production is an essential component of the mixed farming system. Crops grown in the study area vary with agro-ecological zone and Enset, cereals (barley, maize, wheat and teff), vegetables, fruits (mainly mango and papaya) and root crops (potato) are the major crops grown in the study area.

Table 1. Sexual and educational characteristics of the respondents in the study areas

Household characteristics	**Agro- ecology of the study area**				
	Midland (N=159)	Highland (N=159)	Total (N=318)	X^2 -test	P-value
Sex of households				**0.915**	**0.339(ns)**
Male	139 (87.4)	133 (83.6)	272 (85.5)		
Female	20 (12.6)	26 (16.4)	46 (14.5)		
Educational status of familY				**15.690**	**0.003(**)**
Illiterate	38 (23.9)	59 (37.1)	97(30.5)		
Basic education	64 (40.2)	69 (43.4)	133 (41.8)		
Primary education	37 (23.4)	26 (16.3)	63 (19.8)		
Secondary education	15 (9.4)	4 (2.5)	19(6)		
College and university	5 (3.1)	1 (0.6)	6(1.9)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The result of survey revealed that the majority (89.9%) of the total respondents in the study areas, as indicated in Table 2, were married, whereas the remaining 2.8%, 3.8% and 3.5% of the respondents were unmarried, widows, and divorced, respectively. The proportion of the married respondents under the current study are lower (97.2%) than the report made by Meseret (2010) from Jimma but higher (82.1%) than the report made by Shishay *et al*. (2015 in the Western Zone of Tigray Northern Ethiopia. The proportion of married respondents under the current study are fairly similar (88%) to the report from Western Amhara administrative region by Alemayehu (2017).

Table 2. Marital status of households

Variable	**Agro-ecology of the study area**				
	Midland (%) (N=89)	Highland (%) (N=99)	Total (%) (N=188)	X^2 -test	P-value
Maritalstatus of the households				**8.490**	**0.037(*)**
Married	146(91.8)	140(88.8)	286(89.8)		
Divorced	1(0.6)	10(6.3)	11(3.5)		
Widow	6(3.7)	6(3.7)	12(3.8)		
Unmarried	6(3.7)	3(1.8)	*9(2.8)*		

**(p<0.05) or significant at P (0.05) ,Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The average age and family size of the study households is presented in Table 3. Generally, the average age of households in the study area was (46.79 ± 8.7) years.The average ages of respondents of household in midland (45.72 ± 9.0years) and highland (47.86 ± 8.2 years) and there was a significant difference (p<0.05) between the two agro-ecologies. This result was lowers than (51 years) reported by Fisseha *et al*. (2010) in Sidama zone of SNNPRS, but higher than (40.9 and 39.4 years) reported by Emebet (2015) in Southwest Showa and Gurage Zones of Ethiopia, respectively. But it is fairly similar with (46.51±12.05 years), reported by Shishay *et al.* (2015) in Western Zone of Tigray, Northern Ethiopia.

The mean family size age ≤ 14 years was not significantly different ($p>0.05$) among the two agro-ecologies (Table 2). However, the mean age of the family between 15 and 30 years was significantly different ($p< 0.05$) among the two agro-ecologies. The mean of family size age ≥31 &≤60 years and >60 years were not significantly different ($p> 0.05$) among the two agro-ecologies.

Overall, the average age of the family in the age groups <14 years, ≥15 - ≤30 years, ≥31 - ≤60 years and age category >60 years were (2.57 ± 1.2, 2.67 ±1.3, 1.99±0.6 and 1.19±0.4), respectively. In general, the overall mean age of the family in the current study was (6.34±2.1). This result was higher than average family size (4.02) per household, reported by Zewdu *et al*. (2013) in Metekel zone of North West of Ethiopia and the reported (5.4) for North West Amhara (Halima, 2007) and average family size of (5.8) in Mezhenger, Sheka and Benchi -Maji zones of south Western Ethiopia by (Yadessa *et al*.,2017), but slightly comparable with the findings of Shishay *et al*. (2015), Alemayehu (2017) and Moges *et al.* (2010) were (6.01±2.35, 6.23±2.264 and 6.19±2.17), respectively. However, this result was lower than average family size (7.6, 6.84 and 6.5 persons) per household, reported by Mekonnen (2007) in Wonsho, Dale and Loka Abaya districts of Southern Ethiopia, respectively.

The overall mean of land holding per household in the study area was (1.15 ± 0.72 hectare). The result was higher (0.58±0.82 ha) than the report from Central Zone of Tigray, Northern Ethiopia by Mearg (2016), but lower (2.95±1.52 ha) than the reports from Western Amhara administrative region by Alemayehu (2017), (1.28 ha) land holding/household of North West Amhara region by Halima (2007) and (1.22 ha) conducted by (Fisseha *et al*., 2010). There was significant difference ($p<0.05$) in farm land size/household between the two agro-ecologies of the study areas. It may be due to the presence of low available arable land and relatively high population pressure in the midlands.

Table 3. Average age, family size and land holding of the respondents

Household characteristics	**Agro ecology of the study area**			
	Midland	Highland	Overall	
	Mean ± SD	Mean ± SD	Mean ± SD	P-value
Average age of the respondent (years)				
	45.72 ± 9.029	**47.86 ± 8.234**	**46.79 ± 8.693**	**0.028(*)**
Family size				
Under 14 years	2.51 ± 1.305	2.63 ± 1.170	2.57 ± 1.236	0.443(ns)
Between 15-30 years	2.95±1.327	2.37±1.169	2.67 ±1.285	0.000(***)
Between 31-60 years	2.02±0.603	1.97±0.597	1.99±0.600	0.448(ns)
Greater than 60 years	1.31±0.479	1.06±0.250	1.19±0.397	0.074(ns)
Total family size	6.59±2.162	6.08±1.952	6.34±2.072	0.028(*)
Average land holding of households (hectare)				
	0.87 ±0 .55	**1.43 ± 0 .77**	**1.15 ± 0.72**	**0.000(***)**

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

*4.1.1.*Livestock holding

The mean values for livestock holding per households is presented in Table 4. The mean flock and herd size per household of chicken, cattle, sheep, goat, horses, mule and donkey in the study area were 4.29, 3.95, 3.39, 2.2, 1.27, 1.0 and 1.06, respectively. Among the large livestock species, cattle were the dominant once in both midland and highland agro ecologies. the majority of the households used cattle as source of income, for milk and draught power. The mean number of sheep per household were significantly different ($p<0.05$), but there was no significantly different ($p>0.05$) in goats species among the two agro-ecologies. This result is much lower than research finding of Shishay (2014) who reported that the overall mean number of sheep (7.13±13.52) and goat (15.73±14.06) in Western zone of Tigray, Northern Ethiopia.

Indigenous chicken production seems to be an important activity in the study areas with an average chicken holding per households in the midland and highland agro ecologies were 4 and 4.58, respectively. The mean number of indigenous chicken per household were significantly different ($p<0.05$) among the two agro-ecologies. It can be understood that the area has a potential of poultry production having a higher proportion than the other livestock species. This result is lower than research finding of Moges *et al.* (2010) in Bure district, North west Ethiopia who reported the overall mean number of cattle and chicken as 4.16 ± 3.6 and 13.1 ± 10, respectively. However, higher than the overall mean number of sheep (2.24), goats (0.25), donkeys (0.25), horses (0.54) and mule (0.02).

Table 4. Average livestock holding of the respondents

Livestock holding	**Agro-ecology of the study area**			
	Midland	Highland	Total	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Cattle	4.02±1.542	3.89±1.209	3.95±1.385	$0.393^{(ns)}$
Sheep	1.72±0.826	3.85±1.404	3.39±1.569	$0.000^{(***)}$
Goats	2.23±1.031	1.5±0.707	2.20±1.026	$0.370^{(ns)}$
Donkeys	1.00±0.000	1.06±.244	1.06±0.234	$0.004^{(**)}$
Horses	-	1.27±0.463	1.27±0.463	-
Mules	-	1.00	-	-
Chicken	4.00±1.650	4.58±1.776	4.29±1.736	$0.003^{(**)}$

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

*4.1.2.*Flock structure and composition of indigenous chickens in the study area

Flock structure is described in terms of the number and proportion of the different age groups and sex in a flock in table 5. Overall, the average number of chicks, pullet, cockerels, layers, cock, and

total flock size per household were 2.97±1.101, 1.81±0.703, 1.37±0.542, 1.67 ±0.813, 1.02±0.153 and 4.30±1.741, respectively. The survey disclosed that the mean indigenous layers and total indigenous flock size per household were significantly varies ($p<0.05$) among the two agro-ecologies, but the mean number of chicks, pullets, cock and cockerels were not significantly different ($p>0.05$).The study revealed that the overall indigenous chicken flock size was *4.30±1.741* per household. This result is lower than the mean chicken flock size/household of 22.37±10.1 in Western Amhara administrative region (Alemayehu, 2017). An average flock size 6.23 indigenous per house hold was also reportedin Gomma Woreda by Meseret (2010).

Table 5. Flock size and structure of indigenous chickens

Flock Composition	**Agro-ecology of the study area**			
	Midland	Highland	Overall	
	Mean ± SD	*Mean ± SD*	*Mean ± SD*	*P-value*
Chicks (0-8wks)	2.76±1.300	3.07±0.998	2.97±1.101	$0.350^{(ns)}$
Pullet (8-20wks)	1.81±0.690	1.82±0.724	1.81±0.703	$0.864^{(ns)}$
Cockerels (8-20wks)	1.36±0.545	1.40±0.541	1.37±0.542	$0.758^{(ns)}$
Hen/layers (>20wks)	1.40 ± 0.719	1.92± 0.816	1.67 ±0.813	$0.000^{(***)}$
Cock (>20wks)	1.00±0.000	1.04±0.186	1.02±0.153	$0.159^{(ns)}$
Total flock size	*4.00±1.646*	*4.60±1.786*	*4.30±1.741*	$0.002^{(**)}$

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.1.3.Purpose and ownership of chickens' production

The purpose of chicken production and chicken's ownership in the study area is presented in table 6.The result reveals that about half (50%) of the respondents keep chickens for both home consumption and immediate cash income. The analysis of the current study indicates that there was significantly different at ($p<0.05$) in purpose of chicken production, while there was no significantly different at ($p>0.05$) in chickens ownership among the two agro-ecologies of the study area.

The finding of the present study is in line with Halima *et al.* (2007) who indicated that, income generation and household consumption are the main production objectives of keeping village chicken in Ethiopia. This result was in disagreement with the finding of Zewdu *et al*. (2013) in Metekel zone, Northwest Ethiopia who reported that the purposes of chicken production were for cash income (98.6%), household consumption (95.2%), extra farm activity (82.8%), job opportunity (60%), use of chicken for cultural/religious ceremonies (39.3%), and to use them as a gift (20%). This current result was also contrasted with the report of Moges *et al*. (2010) sale of live chicken was the first important function of rearing chicken in Fogera (77.8%) and Dale (43.7%) districts of Ethiopia.

Regarding the ownership of chickens, this study also reveals that from the total respondents 51.6 %, 41.8%, 6.6% of them owned chickens by men, women and children, respectively. This result was higher than the finding of Mekonnen (2007) who reported that men and women had (35% and 24.4%) ownership, respectively in Southern Ethiopian. Contradict finding with the current study conducted by Alem *et al*. (2014) in central Tigray, Ethiopia indicates that 8.1 % chickens were owned by men, 51.2% owned by women, 22.5% owned by both men and women and the rest (18.1%) owned by children. The ownership pattern was usually related to decision making in selling and consumption of chicken and eggs. It was noted that men took the major decision-making role in the sell and consumption of chickens and in purchase of foundation stock.

Table 6. Purpose and ownership of chickens' production

Variable	Agro-ecology of the study area				
	Midland (N=159)	**Highland (N=159)**	**Total (N=318)**	**X^2 –test**	**P-value**
Purpose of chickens production				**36.235**	**0.000**$^{(***)}$
Home consumption	71(44.6)	26(16.3)	97(30.5)		
Sold/ income source	33(20.7)	29(18.2)	62(19.5)		
Replacement	15(9.4)	29(18.2)	44(13.8)		
Both	30(18.8)	75(47.2)	115(31.8)		
Owner of chickens				**2.546**	**0.0280**$^{(ns)}$
Women	64(40.2)	69(43.4)	133(41.8)		
Men	81(50.9)	83(52.2)	164 (51.6)		
Children	14 (8.9)	7(4.4)	21(6.6)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.1.4.Labor division in chicken management activities

Even if the degree of responsibilities and type of job division varies, all family members participate on the chicken management like shelter construction, cleaning chicken house, providing feed and water, and selling of the poultry products in the study area showed in Table 7. The analysis of the study indicated that there was significantly different at ($p<0.05$) in labor division for chicken managements among the two agro-ecologies of the study area. The result revealed that in midland women and children (59.1% and 25.2%), respectively among the family members take the major role in chicken management while in highland the women and all families (50.9% and 21.4 %) play a great roles in chicken management activities.

Overall, the result of survey revealed that majority (55%) of the respondents in (Table 7) in the labor division for chicken management activities covered by women, while (21%) covered by children, (15.4%) covered by all families and (8.5%) covered by men. Even though women had less decision making role in consumption and sell of chicken and eggs, the report from survey indicated that they played major role in management activities related to chicken production. This study shows that except the chicken house construction (arranging roosting material to chicken), which is covered

by men and male youth, women take the lion share in achieving other viewpoints of poultry management activities including cleaning house, provision of supplementary feed , and providing water.

In line with this study Mekonnen (2007) reported that, except in chicken house construction which is left for men (53.1%) and male youth (9.4%), women take the lion share in accomplishing other perspectives of poultry management activities including cleaning of chicken house (74.4%), provision of supplementary feeds (65%) and providing water (73.8%). Similarly, Alem *et al*. (2014) in central Tigray, Ethiopia reported that women take the lion share in doing poultry management activities.

Table 7. Labor division for chicken managements

Variable	**Agro-ecology of the study area**				
	Midland (N=159)	**Highland (N=159)**	**Total (N=318)**	**X^2 –test**	**P-value**
Labor division				**16.670**	**0.005(**)**
Children	40(25.2)	27(17)	67(21)		
Women	94(59.1)	81(50.9)	175(55)		
Men	10(6.3)	17(10.7)	27(8.5)		
All family	15(9.4)	34(21.4)	49(15.4)		

**(p<0.05) or significant at P (0.05),Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.1.5.Experience of chicken production

The present study in table 8 indicates 24.5%, 23.9%, 30.8% and 20.7% village chicken owners had 1-5, 6-10, 11-15 and greater than 15 years of experience with chicken production, respectively.

Table 8. Experience of chicken production

Variable	Agro-ecology of the study area				
	Midland (N=159)	**Highland (N=159)**	**Total (N=318)**	**X^2 –test**	**P-value**
How long started chicken farming				**23.212**	**0.000(**)**
1-5 years	55(34.9)	23(14.5)	78(24.5)		
6-10 years	33(20.7)	43(27)	76(23.9)		
11-15 years	50(31.4)	48(30.2)	98(30.8)		
>15 years	21(13.2)	45(28.3)	66(20.7)		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.1.6.Sources of foundation and replacement stock in the study area

The results obtained for source of procurement of initial chicks stock and replacement chicks' in the study area are given in Figure 2. These results revealed that with an overall average of 44.7% respondents in the study area obtained chicks initially by hatching from nearby local market, small proportions an overall average of 11% were obtained by as gift from parents or relatives and 44.3% obtained by purchasing. The analysis of the study indicated that there was significantly different at ($p<0.05$) in sources of foundation and replacement stock among the two agro-ecologies of the study area in (Figure 2). The current study was disagreement with the finding of (Moreda *et al*., 2013) in South West and South Part of Ethiopia revealed that most of the respondents (91.9%) obtained the initial chicken stock by purchasing and the rest was by hatching (4.4%) and gift (3.7%) from parents or relatives and the source of replacement stocks were also observed as hatching (63.9 %), purchase (31.1 %) and gift (5.1%). Worku (2017) in Tegede District, North Gondar Zone, North West Ethiopia, reported that, the major source of chicken for parent stock is market purchase (56.7%), while family and gift accounts for the remaining percentages.

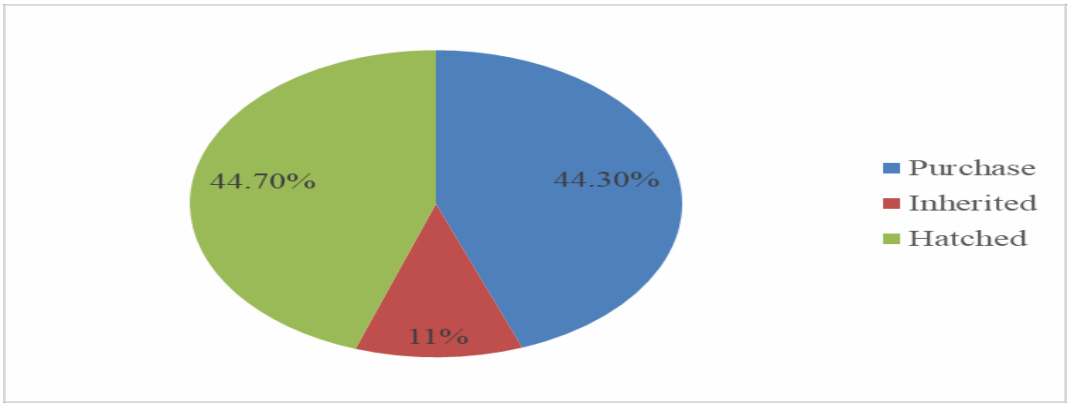

Figure 2. Sources of foundation and replacement stock

4.2.Management Practices of the Indigenous Chickens in the Study Areas

4.2.1.Housing

Housing is essential to chickens as it protects them against predators, theft, rough weather (rain, sun, cold wind, dropping night temperatures), and shelter for egg laying and broody hen. The current study indicated that most (59.1%) of the households don't have separate houses for their chicken but only 40.9% (Table 9). The study's analysis also indicated a significantly different ($p<0.05$) in the proportions of house construction materials among the two agro-ecologies of the study area. Of the total households, 34%, 33.8% and 31.6% of chicken house construction for their chicken were made from mud or blocks, wooden made with the corrugated iron sheet roof and wooden made with thatch covered roof, respectively. This result was much higher than a report of Meseret (2010) in which only (3.6%) respondents in Gomma district constructed separate chicken house. However, the current study result is lower than the result of Zewdu *et al*. (2013), in Metekel zone of Northwest Ethiopia, who reported that 48% of the respondents' constructed separate houses for their birds. Similarly, Bogale (2008) in Fogera district, Amhara Regional State reported that most (59.7%) of the respondents used separate houses constricted exclusively for poultry whereas (37.5%) kept their chickens in the main house. A study conducted in North western part of Ethiopia (Halima, 2007) also revealed that (50.77%) of farmers kept their chicken outside the main house in sheds built for the same purpose.

Table 9. Chicken housing practice

Variable	Agro-ecology of the study area				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Practice of separate chicken house				**1.301**	**0.254$^{(ns)}$**
Yes	70(44)	60(37.7)	130(40.9)		
No	89(56)	99(62.3)	188(59.1)		
Housing constructional material				**13.078**	**0.001$^{(*)}$**
Mud of blocks	30(42.8)	15(25)	45(34.6)		
Iron sheet	14(20)	30(50)	44(33.8)		
Thatch Covered	26(37.2)	15(15)	41(31.6)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

From figure 3 below it can be seen that predators (6.4%), theft (5.8%), lack of experience (51.1%), and lack of capital (36.7%) were the main reasons for not constructing separate poultry houses.

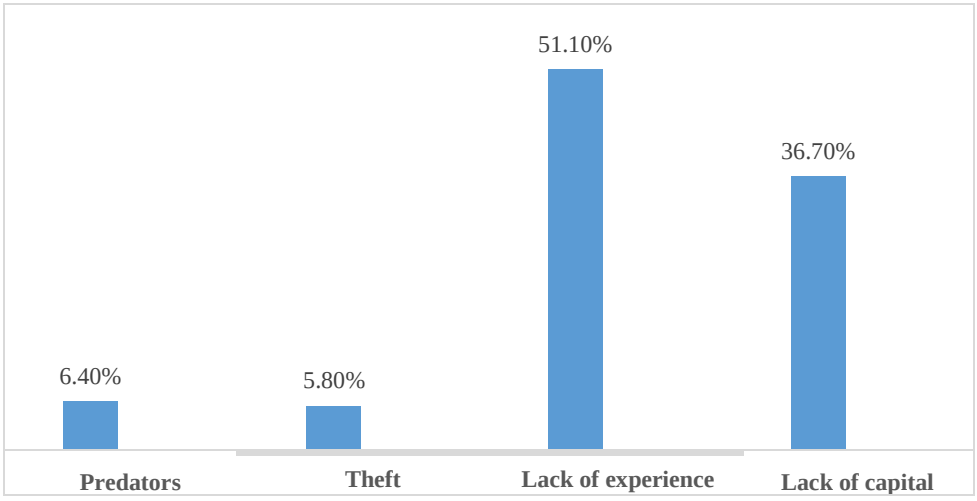

Figure 3. Difficulties in the construction of separate chicken house

The analysis of the study indicated that there was no significantly different at (p>0.05) in chicken shelter at night time among the two agro-ecologies of the study area in (Table 10). Among the households who have no separate poultry houses, about 44.1%, 32.4%, 14.3% and 9.6% of the respondents indicated that their birds' perch in the cattle yard, family dwellings, kitchen and under basket shelter during night time, respectively. This result was in partial agreement with the finding of Abiyu (2019) in Kaffa Zone, South Western Ethiopia who reported that the majority of chickens were kept in the kitchen (60.7%) and main houses (30.7%) during night time. However, it disagrees with the finding of Addisu *et al*. (2013) in North Wollo, Amhara Region, Ethiopia who reported that the majority of chickens were kept in main houses (56.8%), in the kitchen (20.9 %), bamboo cages (16.7%) and under basket (0.33%) during night time.

Table 10. Chicken shelter at night time

Variable	**Agro-ecology of the study area**				
	Midland (%) (N=89)	Highland (%) (N=99)	Total (%) (N=188)	X^2 -test	P-value
Chicken stay at night				**7.763**	**0.101$^{(ns)}$**
Kitchen	9(10.1)	17(17.2)	26(14.3)		
Family dwellings	23(25.8)	38(38.4)	61(32.4)		
Under basket	10(11.2)	8(8)	18(9.6)		
Cattle yard	47(52.8)	36(36.4)	83(44.1)		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

Overall, 76.2% of the respondents clean their chicken house whereas 23.8% households interviewed do not clean their chicken house (Table 11). The same table 10 shows that 41.4%, 34.3%, 17.2%, and 7.1% of the respondents said they clean chicken house once a week, every day, every 2-6 days, and once in two weeks, respectively. This result was contrasting with reported by Emebet (2015) in South-West Showa and Gurage zone of Ethiopia, reported that (55.4% and

10.8%) of the household cleaned their chicken's house every day and once per week, respectively. And also the result contrasts with Mearg (2016), reported the frequency of cleaning chicken house of the total interviewed household cleaned their chicken house (49.6%) daily, followed by weekly (30.3%), in three day (17.6%), monthly (1.7%), and not cleaning (0.8%). The proportions of frequency of cleaning poultry house was significantly different (P<0.05), but practice towards cleaning poultry house was not significant variation at (P>0.05) among the two agro-ecologies. Lack of frequent cleaning of poultry shelter can easily cause diseases and increase morbidity and mortality rate. Thus, raising the farmers' awareness on the need for cleaning of the shelters more frequently is something that all development practitioners should take seriously.

Table 11. Practices and frequency of cleaning chicken house

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Practice of cleaning chicken house				**0.16**	**0.899(ns)**
Yes	53(75.7)	46(76.7)	99(76.2)		
No	17(14.3)	14(13.3)	31(23.8)		
Cleaning frequency of chicken house				**14.123**	**0.003(**)**
Everyday	25(35.7)	9(15)	34(34.3)		
Every 2-6 days	11(15.7)	6(10)	17(17.2)		
Once a week	16(22.8)	25(41.7)	41(41.4)		
Once in two weeks	1(1.4)	6(10)	7(7.1)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The majority (80%) of the respondents used litter materials for rearing chicken (table 12). From the same table 12, it can also be seen that 39.2% of the respondents had the practice of disinfecting chickens' house. The current study also reveals that 30.8%, 26.9%, and 42.3% of the respondents used teff straw, wheat straw and barley straw as the major litter materials in the poultry house, respectively. The analysis of the study indicated that there was significantly different at (p<0.05) in

type of litter materials used among the two agro-ecologies of the study area.

Table 12. Practices and type of litter materials

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
use of litter materials				**0.193**	**0.660$^{(ns)}$**
Yes	57(81.4)	47(78.3)	104(80)		
No	13(18.6)	13(11.7)	26(20)		
Type of litter material				**44.956**	**0.000$^{(***)}$**
Teff straw	31(54.4)	1(2.1)	32(30.8)		
Wheat straw	3(5.3)	25(53.2)	28(26.9)		
Barley straw	23(40.3)	21(44.6)	44(42.3)		
Disinfect chicken house				**17.056**	**0.000$^{(***)}$**
Yes	16(22.8)	35(58.3)	51(39.2)		
No	54(77.2)	25(41.7)	79(60.8)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.2.2.Feed and feeding practice of indginous chicken in the study area

The results obtained on poultry feeds and feeding system used in the study area are indicated in Table 13 below. Most (77.4%) of the survey members do have the practice of providing supplementary feeds to their chickens, while the remaining 22.6% of them didn't. Similar table 13 also shows that 43.1%, 34.7%, 12.5%, 5.6% and 4.2% the indigenous chicken owners said that lack of awareness, high cost of feeds, unavailability of feeds, shortage of time, and lack of finance were the major reasons for not providing supplementary feeds to their chickens.

The present finding was lower than the previous study by Abera and Hussen (2016) in Marako district, Gurage Zone, Southern Ethiopia who indicated that all (100%) of the respondent farmers practiced in providing supplementary feed to their chicken. Also the result of this study disagrees with Meseret (2010) in Gomma district who reported 97.8% of the respondents offer supplementary feeding to their chickens, (99.28%) of farmers in Northwest Ethiopia provided supplementary feeding to their chickens by Halima (2007) and about (100%, 98.6% and 97.5 %) in Gimbo, in Decha and Chena districts of Kaffa Zone, South Western Ethiopia, respectively provide supplementary feeds to their chickens (Abiyu, 2019). Besides, Moges *et al*. (2010) also reported that about 98%, 93%, and 98% of respondents in Bure, Fogera and Dale offer supplementary feeds to their chickens.

Regarding to the frequency of supplementary feeding practiced by chicken owners, from the total respondents providing additional feeding practice in the morning (32.1%), in the afternoon (12.6%), in the evening (8.9%), in the morning and afternoon (21.1%), in the morning and evening (12.6%) and, in the morning, afternoon and evening (12.6%) are the predominant practised feed supplementation times in the study area. The result of this study was contrasting with the finding of Bogale (2008) in which (52.7%) of chicken owners offered supplementary feed to their chicken three times a day (morning, noon and afternoon/ evening), (12.5%) of them provided supplementary feeds four times a day (morning, noon, afternoon and evening), (4.2%) of them provided supplementarily feeds two times a day (morning and evening), (2.8%) of them provided supplementary feeds two times a day (morning, afternoon and afternoon), (23.6%) of them provided supplementary feeds once times a day (morning).

Emebet (2015) reported that (23.6%) chicken owners offered supplementary feed to their chicken three times a day, (44.6%) of them provided supplementary feeds two times a day and (31.7%) of them provided supplementary feeds once a day in the Southwest Showa and Gurage zones of Ethiopia. The finding of the study conducted by Meseret (2010) revealed that (48.3%) of the households offered feed to their chickens in the (morning and afternoon) and (22.2%) of them provided in the (morning, afternoon and evening) while (14.4%, 2.2%, 1.7% and 1.1%) of them offering in the (morning, afternoon, evening and morning & evening, respectively. Generally, the frequency of supplemental feed provision was significantly varied ($P<0.05$) across agroecology.

Table 13. Practices and time of feed supplementation

Variable	Agro-ecology of the study area				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Practice of supplementary feeding				**0.646**	**0.421$^{(ns)}$**
Yes	126(79.2)	120(75.5)	246(77.4)		
No	33(20.8)	39(24.5)	72(22.6)		
Time of feed supplementation				**37.379**	**0.000$^{(***)}$**
Morning	51(40.5)	28(23.3)	79(32.1)		
Afternoon	2(1.6)	29(24.2)	31(12.6)		
Evening	7(5.5)	15(12.5)	22(8.9)		
Morning and afternoon	32(25.4)	20(16.7)	52(21.1)		
Morning and evening	15(11.9)	16(13.3)	31(12.6)		
Morning, evening and afternoon	19(15.1)	12(10)	31(12.6)		
Reason for not supplementing feed				**4.518**	**0.340$^{(ns)}$**
Lack of awareness	11(33.3)	20(51.3)	31(43.1)		
Unavailability of feed	6(18.2)	3(7.7)	9(12.5)		
High cost of feed	12(36.4)	13(33.3)	25(34.7)		
Shortage of time	3(9.1)	1(2.6)	4(5.6)		
Lack of finance	1(3)	2(5.1)	3(4.2)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.2.2.1.Sources and ways of feed supplementation

Table 14 shows that there was a significant difference ($p<0.05$) in the source of feeds in highland and midland agro-ecologies, but there was no significant difference ($P> 0.05$) in the accessibility of the feed resources and ways of supplementation among the two agro-ecologies of the study area. Home available feeds (type of non-conventional supplements like kitchen wastes, enset corn, commercial feeds (purchased from market), home-mixed ration (uses different cereal grains) and both commercial and home available feeds sources were the identified as the major supplemental feeds by 58.5%, 9.3%, 8.5% and 23.6% of the respondents, respectively. From the same table 14, one can see that provision of supplementary feeds to different age classes (22.4%) and together for the whole group (77.6%) were the two major ways of supplementing chickens.

The current result is opposed to Meseret (2010) finding, reported that 97.2% of the households provided grain supplementary feeds for different chicken age groups together while 2.8% of them provided feeds for different chicken age categories separately. Bogale (2008) revealed that out of the total respondents, (52.8%) reported that they feed all classes together (make no distinction). On the contrary, (45.8%) of respondents reported giving more supplementary feeds to chicks (1^{st}) followed by hen (2^{nd}), pullet (3^{rd}), cocks and cockerels (4^{th}). Based on this study, providing supplementary feeds to all classes together can create competition among the different age groups of chicken. This competition in turn results in less feed intake for chicks and over feed in take for adults. This unequal feed intake affects overall productivity of chickens. Thus, farmers highly recommend providing their chickens with a well-balanced diet and ample supply water on separate basis of different age categories, breed, and production level to increase production, productivity, and prevent cannibalism among the flock.

Table 14. Sources and ways of feed supplementation

Variable	Agro-ecology of the study area				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Feeds available at home				**11.707**	**0.008(**)**
House leftovers available feeds	73(57.9)	71(59.2)	144(58.5)		
Commercial feeds	13(10.3)	10(8.3)	23(9.3)		
Ration mixed at home	4(3.2)	17(14.2)	21(8.5)		
Both commercial and home	36(28.6)	22(18.3)	58(23.6)		
Ways of supplementation				**0.128**	**0.720(ns)**
Separately to different classes	27(21.4)	28(23.3)	55(22.4)		
Together for the whole flock	99(78.6)	92(76.7)	191(77.6)		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.2.2.2.Basis of feed supplementation and type of feeding trough

The current study reveals that increasing egg yield (67%), meat yield (12.6%), broodiness during incubation (13.8%) and age (6.1%) were reported to be the major objectives or bases of offering supplementary feeds to indigenous chickens as shown in table 15. The current result contrasts with the finding of Alemayehu (2017) reported that the objective of offering supplementary feeds were to increase egg yield, improve growth & health (36.7%), increase egg yield and growth (26.7%), increase egg yield (14.4%) and increase egg yield, improve health, growth and broodiness (13.3%), growth and improve health (5.6%) and increase egg yield and improve health (3.3%).

The reason to provided supplementary feed, to increase egg yield (9.23% of respondents) and increase egg and meat yield (90.77%) were the most important ones (Bogale, 2008). The current survey result indicates no significant variation (p>0.5) observed with regard to type of feeding trough among the two agro-ecologies of the study area (table 15). About 32.5% of respondents in the study area did not use a feeding trough, and they poured the feeds on the ground but more than half (57.5%) of the respondents were using any home available feeding trough and the remaining 9.8% of them were using appropriate chicken feeding materials. The result was contrasting with Bogale (2008) revealed that, of the total respondents, (81.9%) reported not using any form of feeding materials rather than throwing the feed on the ground for chickens to pick from there. Only (16.7%) of respondents reported of using feeding troughs to fed their birds. Throwing feeds on the ground causes feed wastage and causes contamination. Furthermore, the practice of feeding different classes separately and using feeding trough should therefore be among the measures to be taken in order to improve chicken production in the study area.

Table 15. Basis of feed supplementation and type of feeding trough

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Basis of giving supplementary feeds				**35.525**	**0.000(***)**
Egg yield	98(77.8)	68(56.7)	166(67.5)		
Meat yield	21(16.7)	10(8.3)	31(12.6)		
Broodiness	3(2.4)	31(25.8)	34(13.8)		
Age	4(3.2)	11(9.2)	15(6.1)		
Type of feeding trough				**23.720**	**0.000(***)**
Spreading on the ground	25(19.8)	55(45.8)	80(32.5)		
Using home available through	91(72.2)	51(42.5)	142(57.7)		
Using appropriate feeding trough	10(7.9)	14(11.7)	24(9.8)		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed.*

4.2.2.3.Watering system

Water source and watering practice are shoen in table 16.The majority (88.4%) of the respondents have the practice of providing water to their chickens, but 11.6% don't . Accordingly, river water (45.3%), tap water (28.8%), pond water (15.5%) and rain water (10.4%) were indicated to be the major sources of water for village chickens in the study areas. The result was contrast with Abiyu (2019) revealed that all (100%) of the respondents in Gimbo district provide water while (98.6%) and (97.5 %) of them in Decha and Chena districts, respectively provide water for their chickens. About (98.3%) of the respondents gomma woreda reported to provide either river or stream water to their chickens once a day by Meseret (2010).

Table 16 also shows that locally made wooden trough (50.7%), flat plastic container (27%), any broken materials (19.4%), clay trough (2.5%) and stone dish (0.4%) were reported to the main watering troughs in the study areas. There were significant difference ($p<0.05$) in watering practices, water sources and type of waterer among the two agro-ecologies of the study area. This is disagree with the report of Fisseha *et al*. (2010) in Bure district. Attainment of sustainable chicken productivity requires provision and adlib fresh water on clean waterier on the regular basis. Training for chicken producers on the use of water on the chicken productivity there by to increase economic return and ensure food security on small farmers.

Table 16. Water sources and watering practice for chicken

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Provision of water				**4.118**	**0.042(*)**
Yes	145(91.2)	133(83.6)	278(88.4)		
No	14(8.8)	26(16.4)	40(11.6)		
Water source				**33.720**	**0.000(***)**

Rain water	3(2.1)	26(19.5)	29(10.4)		
River	84(57.9)	42(31.6)	126(45.3)		
Tap water	41(28.3)	39(29.3)	80(28.8)		
Pond water	17(11.7)	26(19.5)	43(15.5)		
Type of waterer used				**27.457**	**0.000(***)**
Flat plastic container	44(30.3)	31(23.3)	75(27)		
Locally made wood	58(40)	83(62.4)	141(50.7)		
Stone dish	-	1(0.4)	1(0.4)		
Clay trough	1(0.7)	6(4.5)	7(2.5)		
Any broken material	*42(28.9)*	*12(9)*	*54(19.4)*		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

Regarding frequency of watering, the analysis of the current study indicates that there were significant difference ($p<0.05$) in frequency of watering and cleaning the waterering troughs among the two agro-ecologies of the study area (table 17). It is known that water is essential for chicken like other species of animals. Access to clean and plenty water determines the productivity and the health condition of chickens. As a result, water should be freely available to chickens. However, in the present study overall (68.3%) of the respondents provide water to their chickens once per day, (25.2%) provide water in every other day, (6.1%) provides water twice per day and only (0.4%) provide water with free access to their chicken. About (37.9%) of the respondents provided water for their chicken every others day, (0.7%) adlibitum (free access) and (61.4%) once a day at any time in midland agro ecology while (11.3%) of the respondents give every others day, (12.8%) give twice a day and (75.9%) give once a day at any time in highland agro ecology.

Pertaining to frequency of washing watering materials in table 17 indicates that about 45% of the respondents reported to wash the materials used as watering trough daily, once per week (41%), twice per week (11.9%) and (2.1%) none of the respondents not to wash the waterer. The current study result disagrees with the finding of Worku (2017), indicated that the majority of the respondents (60%) experienced daily cleaning of watering trough and others in varying times per week and depending on the conditions.

Table 17. Frequency of watering and washing watering materials

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Frequencey of watering				**41.174**	**0.000(***)**
Every other day	55(37.9)	15(11.3)	70(25.2)		
Once per day	89(61.4)	101(75.9)	190(68.3)		
Twice per day	-	17(12.8)	17(6.1)		
Adlibitum	1(0.7)	-	1(0.4)		
Frequencey of washing the waterer				**11.493**	**0.009(**)**
Every day	77(53.1)	48(36.1)	125(45)		
Once per week	55(37.9)	59(44.4)	114(41)		
Twice per week	10(6.9)	23(17.3)	33(11.9)		
None	*3(2.1)*	*3(2.5)*	*6(2.1)*		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.2.3.Diseases and health management

The prevalence of chicken diseases in the study area was summarized in table 18. The majority (79.5%) of indiginuos chicken owners had experienced a serious outbreak of diseases. The affected age groups by different type of disease indicated in the study area were chicks (30.4%), layers (22%), growers (13%), adults (9.1%) and all birds 25.3%.

This study was lower than the finding of Moreda *et al*. (2013) in South West and South Part of Ethiopia and Fisseha *et al*. (2010) in Bure and Fogera districts who reported that the prevalence of chicken diseases was an overall mean of (97.6%, 97.5% and 100%), respectively.

Table 18. Diseases and health management in the study area

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Occurrence of serious disease outbreaks				**0.190**	**0.889$^{(ns)}$**
Yes	127(79.8)	126(79.2)	253(79.5)		
No	32(20.2)	33(20.8)	65(20.5)		
Affected classes of chickens				**59.170**	**0.000$^{(***)}$**
Layer	44(17.4)	12(9.5)	56(22.1)		
Grower	21(16.5)	12(9.5)	33(13)		
Chicks	46(36.2)	31(24.6)	77(30.4)		
Adults	6(4.7)	17(13.5)	23(9.1)		
All birds	*10(7.9)*	*54(42.9)*	*64(25.3)*		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The survey results indicated in table 19 from the total respondents when birds are sick an average (68%) of respondents in study area uses traditional treatment for chicken diseases, while consult in veterinarian (25.3%), cull them all immediately (5.1%), slaughter them for home consumption (1.2%) and sell them all immediately (0.4%). Besides, about (47.5%) of the respondents had access to veterinary services. The current study disagrees with the finding of Mekonnen (2007), reported that about (72%) of the respondents treat their chicken by themselves, (14.7%) call veterinarian, (10.5%) sell them immediately and only 10% of them have access to veterinary services. This study also revealed that only (16%) of the respondents vaccinate their birds to prevent and control

infectious diseases in the study area. This result was higher than the finding of Mekonnen (2007), reported that (10.6%) of the respondents vaccinate their birds to prevent and control infectious diseases.Further, only (15.7%) of the respondents used anti-ectoparaciticide and dewormer to control external parasitic infestation.

This study result also reveals that only (16%) of the respondents vaccinate their birds to prevent and control infectious diseases while others (84%) of the chicken owners in the study area do not vaccinate their chicken. The there is no statistically significant difference ($p > 0.05$) in use of vaccines against chicken diseases between the two agro-ecologies. This result is higher than the finding of Mekonnen (2007) who reported that (10.6%) of the respondents vaccinate their birds to prevent and control infectious diseases. Further, only (15.7%) of the respondents used anti-ectoparasites to control external parasitic infestation and (84.3%) of chicken owner in the study area do not used any anti-ecto-parasites and dewormer.

Table 19. Practices of treatment and annual chicken vaccination in the study area.

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2-test	P-value
Measure when chicken are sick				**17.415**	**0.002(**)**
Treat them myself traditionally	87(68.5)	85(67.5)	172(68)		
Call in veterinarian	39(30.7)	25(19.8)	64(25.3)		
Cull them all immediately	-	13(10.3)	13(5.1)		
Slaughter for home consumption	1(0.8)	2(1.6)	3(1.2)		
Sell them all immediately	-	1(0.8)	1(0.4)		
Practice of annual vaccination for chicken				**2.826**	**0.093(ns)**
Yes	31(19.5)	20(12.6)	51(16)		
No	128(80.5)	139(87.4)	267(84)		

Use of antiectoparaciticide				**4.65**	**0.031(*)**
Yes	32(20.1)	18(11.3)	50(15.7)		
No	127(79.9)	141(88.7)	268(84.3)		
Availability of efficient veterinary service				**27.857**	**0.000(***)**
Yes	52(32.7)	99(62.3)	151(47.5)		
No	*107(67.3)*	*60(37.7)*	*167(52.5)*		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The survey result also indicates that controlling the free movements of chickens were significant difference (p<0.05) among the two agro-ecologies (table 20). Overall, about (34.6%) of the respondent control free movement of chickens. This result is higher than from the result of Meseret (2010) who reported that (8.3%) of the households practiced control of free movement of the chickens during disease outbreak. About (45.5%) of the respondents control of the free movement of chickens in order to protect birds from picking and destroying crops, (35.5%) to avoid risk of contagious diseases, (11.8%) to protect from predators attack and (7.3%) to protect from mixing with the village flock. Regarding the with disposal of dead chickens in the study areas the reveals that 66.4%, 30%, 5.6% of the respondents reported that they throw, put pit and burning of dead birds by the respondents, respectively.

Table 20. Practices and reasons of control of the free movement of chicken

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 –test	P-value
Practice of control the free movement of chickens at a time of disease outbreak				**18.013**	**0.000(***)**
Yes	37(23.3)	73(45.9)	110(34.6)		
No	122(76.7)	86(54.1)	208(65.4)		

Reason for control of the free movement				**1.241**	**0.743(ns)**
To protect from predators	6(16.2)	7(9.5)	13(11.8)		
To avoid risk of infection	13(35.1)	26(35.6)	39(35.5)		
To protect flock mixing	2(5.4)	6(8.2)	8(7.3)		
To avoid crop destruction	16(43.2)	34(46.5)	50(45.5)		
Disposal of dead chicken				**8.140**	**0.017(*)**
Throw	95(74.8)	73(57.9)	168(66.4)		
Put pit	29(22.8)	47(37.3)	76(30)		
Burning	*3(2.4)*	*6(4.8)*	*9(5.6)*		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

*4.2.4.*Marketing systems

4.2.4.1.Market access for chicken products

There is no formal poultry and poultry product marketing channel in the Ezha district and informal marketing of live birds and eggs involving open markets is common throughout the study area. The analysis made for market access to buy production inputs and sale poultry products is presented in table 21. The study results indicated that the majority (89.6%) of the respondents in the study areas had market access to buy and sell poultry production inputs and outputs. In general, regarding to the market access and demand of poultry products were significantly different ($p<0.05$) among the two agro-ecologies of the study area. There is better market access in midland (94.9%) than highland (84.3%) because it might be relatively better accessibility of infrastructures (road, market) in midland agro-ecologies.

Table 21. Market access and demand of poultry products

Variable	Agro-ecology of the study area				
	Midland (%) N=159	Highland (%) N=159	Total (%) N=318	X^2 -test	P-value
Availaility of market access				**9.772**	**0.002(**)**
Yes	151(94.9)	134(84.3)	285(89.6)		
No	8(6.1)	25(15.7)	33(10.4)		
Market outlets(customers)				**46.184**	**0.000(***)**
Village market	111(69.8)	109(68.5)	220(69.1)		
Local shopkeepers	11(6.9)	27(16.9)	38(11.9)		
Selling at own doorstep	9(5.7)	12(7.5)	21(6.6)		
Retailer	-	11(6.9)	11(3.4)		
Whole sellers	*28(17.6)*	-	*28(8.8)*		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

2.2.4.2.Prices of indigenous chickens and eggs in Ezha district

The average market prices of egg, pullet, cock and laying hen during the study period is shown in table 22. The result of the current study reveals that the price of egg and laying chickens were significantly different (p<0.05) among the two agro-ecologies of the study areas. The survey result reveals that the mean market prices of egg, pullet, cock and laying hen during the study period were (7.0 ±0.6 birr, 226.5 ±42.1 birr, 263.2 ±86.6 birr and 275.5 ±51.3 birr/chicken, respectively. This result was much higher than the finding of Bikila *et al*. (2015) in Chelliya District, Ethiopia who reported that the average market prices of egg, pullet, cock and laying hen were (1.7±0.02, 35.43±0.76, 79.74±0.86, and 42.83±0.89 birr), respectively.

Table 22. Average market prices of indigenous Chicken and egg (Birr)

Variable	Agro-ecology of the study area			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Current market price of eggs	6.6±0.4	7.4 ±0.5	7.0 ±0.6	$0.000^{(***)}$
Current market price of adult male bird	261.2 ±86.6	265.2 ±86.7	263.2 ±86.6	$0.683^{(ns)}$
Current market price of pullets	226.8 ±35.6	226.2 ±47.9	226.5 ±42.1	$0.905^{(ns)}$
Current market price of laying hen	*267.7 ±40.1*	*283.3 ±59.7*	*275.5 ±51.3*	$0.007^{(*)}$

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05) and N=number of households interviewed,* Birr=*local currency*

4.2.4.3.Eggs and live chicken marketing problems

The results obtained from the survey data on the marketing of chicken and eggs in figure 4 reveals that an overall average of (38.4% and 33.3%), respondents in the study area reported poor sales and unstable price as the most important factors influencing the marketing of live chickens and eggs, respectively. Unstable chicken price (28.9% and 33.3%), poor sales (38.4% and 27.7%), lack of market place (20.7% and 9.1%), poor infrastructure (road, market) (5.7 % and 5%) and lack of information (6.3% and 24.8%) were the major problems influencing the marketing of live chicken and eggs, respectively. A study conducted in North Wollo zone of Amhara Regional State, revealed that unstable chicken price (40.85%), demand seasonality (29.41%) and lack of market place (29.74%) were found to be the most important constraints of marketing chicken products (Addisu *et al.*,2013). Similarly, Meseret (2010) also reported that demand seasonality (42.3% and 41.7%), unstable prices (19.4% and 24.4%) and unstable price and demand seasonality (38.3% and 33.9%) were the problems of live chickens and eggs marketing, respectively, in Gomma wereda of Jimma Zone. In the same way, Halima (2007) also reported that seasonal demand (holidays and fasting seasons), lack of infrastructure, plumage color, size, age, sex, market sites and health status of the chickens had great effect on live chicken prices in North West Ethiopia. Poor infrastructure and lack of information are outlined as the major chicken marketing problems that directly affect the supply chain of chicken and eggs (Shishay *et al*., 2014) in Western Zone of Tigray.

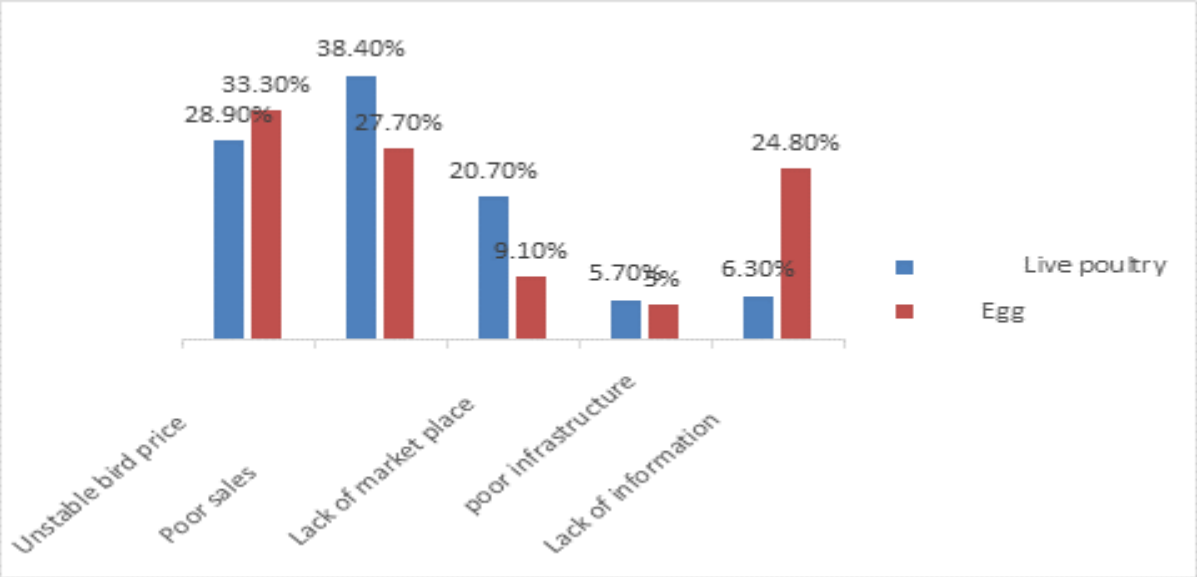

Figure 4. Eggs and live chicken marketing problems

4.2.4.4.Selling time and consumer preference for chicken products

The analysis of the study result indicates that there were significantly different ($p<0.05$) in time of selling and consumer preference of chicken products produced from indigenous and improved breeds among the two agro-ecologies of the study area. The results of the current study reveal that 63.8%, 23.3% and 12.9% of the respondents sell their chicken during time of cash shortage, holidays and considering age of chicken , respectively (table 23). Respondents preferred to sale at higher prices, as the price of eggs and chicken is highly related to holydays and agreed to the report of Halima (2007) and Wilson (2010).Table 22 also shows that egg (77.9%) and meat (69.2%) from indigenous chickens were more preferred than improved breeds.

Pertaining to the consumer preference observed for eggs from indigenous, improved and both indigenous and improved chickens were an average (77.9%, 15.7% and 6.3%) of the respondents in the two agro- ecologies, respectively (table 22). This study also reveals that consumer preference observed for meat from indigenous, improved and both indigenous and improved chickens were an average (69.2%, 17.6% and 10.1%) of the respondents in the two agro-ecologies, respectively. Generally,concerning consumer preference towards eggs and meat produced from indigenous chickens were more preferred by the consumers the reasons it might be better tastes and flavor of meat, and deep yellow yolk color obtained from indigenous chickens. However, a few respondents prefer eggs from commercial chicken due to larger egg size compared to egg from indigenous chicken which considerably smaller than commercial layers.

Table 23. Time of selling and consumer egg preference

Variable	**Agro-ecology of the study area**				
	Midland (%) N=159	Highland (%) N=159	Total (%) N=318	X^2 -test	P-value
Time of selling				**35.707**	**0.000(***)**
Based on weight gain/age of birds	4(2.5)	37(23.3)	41(12.9)		
Cash shortage	122(76.7)	81(50.9)	203(63.8)		
During holidays and festivals	33(20.7)	41(25.8)	74(23.3)		
Consumer egg preference				**30.132**	**0.000(***)**
Eggs from improved breeds	9(5.7)	41(25.8)	50(15.7)		
Eggs from local chicken	144(90.6)	104(65.4)	248(77.9)		
Equally preferred	6(3.8)	14(8.8)	20(6.3)		
Consumer meat preference				**35.142**	**0.000(***)**
Meat from improved breed	10(6.3)	46(28.9)	56(17.6)		
Meat from local chicken	133(83.6)	87(54.7)	220(69.2)		
Equally preferred	*26(16.3)*	*42(13.2)*	*16(10.1)*		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.3.Productive Performances of Indigenous Chickens

4.3.1.Average number of eggs laid per clutch/ hen

The current survey result reveals that all of the production performance parameters of indigenous chicken populations in the study area were significantly different ($p<0.05$) among the two agro-ecologies (table 24). The result of the current survey indicates that the average number of eggs laid per clutch of indigenous chicken ecotypes in the study area was (13.9± 2.9). Significantly lower average number of eggs laid per clutch was obtained from highland chicken ecotypes (12.6 ± 2.2) than midland (15.2 ± 3.0). This difference might be due to farmers providing better management (health care, feed type and feeding frequency) and proper midland agro-ecology weather conditions, which improves chickens egg production performance. This result was in line with the reports of Meseret (2010), Zewdu *et al*. (2013) and Fisseha *et al*. (2013) in which the mean egg number laid per clutch per hen of local chickens in Gomma wereda, Metekel Zone and Fogera district were 12.92, 13.56±0.26 and 13.2 average of egg yield/hen/clutch), respectively. And also this result is comparable to the national average value (13 eggs/hen/clutch) reported by CSA (2021). However, it was lower result than from the reports of Welelaw *et al*. (2018), Alemayehu (2017), Melkamu and Andargie (2013) and Fisseha *et al*. (2010) in which the average number of eggs laid per clutch of local chickens in Metekel Zone of North West Ethiopia, Lume district, Enebsie Sar Midir district and Bure district of Ethiopia were 14.8±3.5 eggs, 15.8 ±3.8 eggs, 17 eggs and 15.7±3.2 eggs, respectively. On the other hand, the current study was higher than the finding of Addisu *et al*. (2013) reported that, average eggs laid/clutch/hens was 11.9 eggs in Tach Annachiho district.

4.3.2.Average number of days per clutch

The survey result also reveals that the overall mean number of days per clutch per hen of indigenous chicken ecotypes was 22.5± 5.7 (table 24). The mean number of days per clutch per hen in the highland (19.6± 3.8) chicken ecotypes was significantly lower than midland (25.3 ± 5.9) chicken ecotypes. This result was comparable with the report of Meseret (2010), Matawork *et al*. (2019) and Fisseha *et al*. (2010) in which the average number of days per clutch of indigenous chickens of Gomma Wereda of Jimma zone, Gena Bossa district and Dale district were 25.29±4.39, 25.27±0.54 and 26.2 days, respectively.

4.3.3.Average number of clutches/hen/ year

Table 24 also shows mean clutch number of indigenous chickens/hen/ years in the current study is (3.9±0.7). A significantly lower mean clutch number of indigenous chickens/hen/ year was obtained from midland chicken ecotypes (3.9±0.7) than highland (4.1 ± 0.7). This result was comparable with Melkamu and Andargie (2013) at Enebsie SarMidir district, Eastern Gojjam and Adem and Teshome (2016) in Yeki in which average clutch number were four per year/hen. However, this result was higher than the reports of Abiyu (2019) in Decha, Chena and Gimbo districts, Meseret (2010) in Gomma wereda, Kaffa Zone, South Western Ethiopia and Welelaw *et al*. (2018) in Bench Maji zone of SNNPR State, Ethiopia in which the mean clutch number of indigenous chickens/hen/year were (3.60±0.2, 3.60±0.2, 3.65±0.21, 3.43 and 3.74 hen/year), respectively. And, also the lower overall mean clutch number of indigenous chickens was recorded in the Gena Bossa District of Dawro Zone was 3.04±0.10 per year (Matawork *et al*., 2019).

On the other hand, this result is lower than the mean clutch number of indigenous chickens/hen/ year in Lume district (4.8±1.4) conducted by (Alemayehu, 2017), in Metekel zone (4.29±0.17) conducted by (Zewdu *et al*., 2013) and CSA (2021) report the national average clutch number of Ethiopia indigenous chicken is five per year. Differences observed between agro ecology regarding the number of clutches per year might be due to genetic and environmental differences between the populations.

4.3.4.Average number of eggs laid per hen/year

The mean annual egg production per hen in the study area was 53.8± 9.3 (table 24). Significantly lower mean annual egg yield per hen was obtained from highland chicken ecotypes (50.7 ±7.8) than midland land (56. 9± 9.7). This result was in close agreement with the mean annual egg yield per hen of indigenous chickens of Fogera district (53 eggs) and in Dale district (55 eggs) conducted by (Fisseha *et al*., 2010) and in Bench Maji Zone (54.6±13 eggs) conducted by Welelaw *et al*. (2018).

However, this result was higher than the reports of Addisu *et al*. (2013) in North Wollo zone of Amhara, Halima (2007) in North West Ethiopia,

Matawork *et al*. (2019) in Gena Bossa district of Dawro Zone and Abiyu (2019) in Gimbo district in which the mean annual egg yield per hen of indigenous chickens were 49.51±0.38 eggs, 18-57 eggs, 38.5±0.1 eggs and 45.6±7.12 eggs, respectively. On the other hand, this result is lower than the mean annual egg yield of indigenous chickens in Bure district (60 eggs) conducted by (Fisseha *et al.*, 2010), in Wonsho district (62.95±2.29 eggs) conducted by (Mekonnen 2007) and in Enebsie SarMidir Wereda of Eastern Gojjam (65 eggs) conducted by (Melkamu and Andargie, 2013).

Alemayehu (2017) and Zewdu *et al.* (2013) also reported that a greater value on the average annual egg production per year per hen of local chickens in Lume district and Metekel Zone of North West Ethiopia were (76.4± 3.4 and 59.51±2.66 eggs), respectively. The reason for this variation is that the farmers' management practices in different areas may be improving from time to time by means of extension services provided by assistant development agents and other concerned bodies. The productivity of the production system can be significantly improved by small supplementation of feed, decreasing mortality rate by introducing day and night time housing, and improving the veterinary service.

4.3.5.Market/slaughter age of cock and hen (months)

Moreover, the overall mean of slaughter age of indigenous male and female chickens were 7.9±0.5 and 7.4± 0.6month, respectively (table 24). Slaughter ages of male and female chickens were significantly varied ($p<0.05$) among the two agro-ecologies in the study area. Significantly maximum marketable age was recorded from highland for cock and hen chickens (8.252±0.5 and 7.6±0.6 months), respectively while lower marketable age was obtained from midland cock and hen chickens (7.6±0.4 and 7.1±0.4 months), respectively. This result was lower than the study conducted by Meseret (2010) in Gomma wereda of Jimma zone and Gebreegziabher & Tsegay (2016) in Wolaita zones of southern Ethiopia, reported that slaughter age of male indigenous chickens under scavenging conditions were (8.62±1.92 and 8.96 months), respectively.However, this study higher than Matawork *et al*. (2019) in Gena Bossa district of Dawro Zone, Ethiopia and Shishay *et al*.(2015)) in Western Zone of Tigray, Northern Ethiopia, the mean slaughter age ofcock and hen chickens were (7.87±0.18 and 7.26±0.23 months) and (4.66±0.03 and 4.50±0.03 months), respectively.

Table 24. Productive Performance of Indigenous Chickens of the study area

Variable	Agro-ecology of the study area			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
ANELPCH	15.2 ± 3.0	12.6 ± 2.2	13.9± 2.9	$0.000^{(***)}$
ANDPC	25.3 ± 5.9	19.6± 3.8	22.5± 5.7	$0.000^{(***)}$
ANCHY	3.9±0.7	4.1 ± 0.7	3.9± 0.7	$0.005^{(**)}$
ANELPY	56. 9± 9.7	50.7 ±7.8	53.8± 9.3	$0.000^{(***)}$
MAC	7.6±0.4	8.2±0.5	7.9±0.5	$0.000^{(***)}$
MAH	*7.1±0.4*	*7.6±0.6*	*7.4± 0.6*	*$0.000^{(***)}$*

**(p<0.05) or significant at P (0.05), N=number of households interviewed, ANELPCH = average number of eggs laid per clutch/ hen, ANDPC = average number of days per clutch, ANCHY = average number of clutches/hen/ year, ANELPY=average number of eggs laid per hen/year, MAC = market/slaughter age of cock (months) and MAH = market/slaughter age of hen (months).*

4.3.6. Body weight of indigenous chickens

The result of the survey indicates that the average body weight of pullets, cockerel, mature females (hens) and males (cocks) were varied significantly ($p<0.05$) among the two agro-ecologies (table 25). The analysis of the study revealed that the average body weight of pullets, cockerel, mature hens and cocks in midland (0.99±0.15, 1.11±0.15, 1.27±0.13 &*1.41±0.11kg)* were significantly ($p<0.05$) higher than highland (0.93±0.13, 1.00±0.23, 1.17±0.13 &*1.30±0.12kg)* indigenous chickens, respectively. The results also show that females chicken are lighter than males in both agro-ecologies. The overall mean weight of indigenous pullets, cockerel, adult females and males were (0.97±0.14, 1.05±0.19, 1.22±0.14& 1.35±0.13kg), respectively.

The current result was lower than the finding of Alem (2014) in Central Tigray, Northern Ethiopia reported that the average body weight of pullets, cockerel, mature hens and cocks were (1.042, 1.071, 1.363 &1.753kg), respectively. It was also lower than Mekonnen (2007) reported that the live body weight of (pullets 1.00±0.86, 1.06±0.07 & 1.43±0.28kg), and (cocks 1.68±058, 1.5±0.54 & 1.58±0.03kg) at farmers' management condition in Wonsho, Loka abaya and Dale districts of Southern Ethiopia, respectively. Habtamu *et al*. (2019) in Benishangul-Gumuz Region, Western Ethiopia indicated that the average body weight of local mature hens and cocks were (1.3±0.30 &1.5±0.62kg), respectively.

However, the current result was higher than the finding of Halima *et al*. (2007) in Northwest Ethiopia reported that the average body weight of mature hens and cocks were (0.847 and 1.259kg), respectively. Another research conducted by Bogale (2008) indicated that the meat production ability and growth performance of indigenous chicken are limited and the indigenous males reach 1.5 kg live weight at 6 months of age and females of about 30% less. These variation and poor performance in body weight of indigenous chickens is might be attributed due to both genetic and non- genetic factors like supplementary feeding, watering and health care in different agro-ecology.

Table 25. Live body weight of indigenous chickens

Variable	**Agro-ecology of the study area**			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
AWP	0.99±0.15	0.93±0.13	0.97±0.14	$0.013^{(**)}$
AWCR	1.11±0.15	1.00±0.23	1.05±0.19	$0.005^{(**)}$
AWH	1.27±0.13	1.17±0.13	1.22±0.14	$0.000^{(***)}$
AWCO	*1.41±0.11*	*1.30±0.12*	*1.35±0.13*	*$0.000^{(***)}$*

**(p<0.05) or significant at P (0.05), N=number of households interviewed, AWP=Average weight of pullet around 6 months of age (Kg), AWCR=Average weight of cockerel around 6 months of age (Kg), AWH=Average weight of mature hens (Kg) and AWCO=Average weight of mature cocks (Kg)*

4.4.Reproductive Performances of Indigenous Chickens

4.4.1.Ages at sexual maturity

The results of the present study indicate that the overall mean age of sexual maturity of indigenous pullets and cockerels were 6.5±0.6and 5.9±0.6 months, respectively as shown in table 26. Ages at sexual maturity of both chicken sexes respect to (age at first egg in females and age at first mating in males) are significantly different ($p<0.05$) among the two agro-ecologies. Significantly highest age at sexual maturity of both pullets and cockerels chickens were obtained from highland (6.8±0.5 and 6.2±0.5 months), while the less age at sexual maturity of both sexes were attained from midland agro-ecologies (6.2±0.5and 5.6±0.6 months), respectively.

This result was comparable with the findings of Meseret (2010) who reported that the females indigenous chicken of Gomma wereda of Jimma Zone attained sexual maturity at (6.33±0.80 months), but differ for males attained sexual maturity at (6.47±0.91 months). Similarly the average age at first egg laying and age at first mating of indigenous chickens were in agreement with the findings of Welelaw *et al*. (2018) in Bench Maji Zones of Ethiopia an average age of (6.45±1.1 and 5.92±0.9 months), respectively.

However, this result was higher than the findings of Matawork *et al*. (2019) and Fisseha *et al*. (2010) indicated that the age of sexual maturity of indigenous chicken female and male were (5.63±0.22 & 5.25±0.15 months) and (5. 9 & 5.9 months) in Gena Bossa district of Dawro Zone, Ethiopia and in Fogera district of Amhara regional state of Ethiopia, respectively. Zewdu *et al.* (2013) also reported lower values on the average age of sexual maturity of indigenous pullets and cockerels in Metekel Zone of North West Ethiopia were (5.2±1.16 and 5.44±1.3 months), respectively. On the other hand, age at first egg laying and age of first mating obtained in the current study were lower than (6.88 months and 6.15 months) reported from Fisseha *et al*. (2010) in Bure district and (6.74±0.05 and 6.23±0.06 months) reported from Hailemichael *et al*.(2015) in Southern Zone of Tigray, Northern Ethiopia, respectively. A different report on the age of chickens at first egg might be due to lack of proper supplementary feeds, availability of scavengable feed resources, disease outbreaks and provision of clean water by the households.

The results of the present study also indicated that the overall mean age of reproductive life span of matured male and female indigenous chicken were 2.7±1.0 and 3.9 ±1.2 years, respectively (table 26). The mean age of reproductive life span of matured male and female indigenous chickens were significantly different ($p<0.05$) among the two agro-ecologies. Significantly higher mean age of reproductive life of matured local male and female chickens were obtained from highland chickens (3.0±1.3 years and 4.3± 1.3years) than midland chickens (2.3±0.5 years and 3.6± 0.9 years), respectively.

The overall mean of this result were higher than the average reproductive life span of females (3.56±0.14 years) and lower than males (3.79±0.15 years) in Metekel Zone of North West Ethiopia (Zewdu *et al.*, 2013). The survey were also indicated higher reproductive life span than the finding of (Fisseha *et al*., 2010) in Fogera district (2.2 years for females and 1.5 years for males). However, the overall mean of this result were lower than the average reproductive life span of males (2.85±0.04 years) in Western Zone of Tigray (Shishay *et al*., 2015).

Table 26. Reproductive performance of indigenous chickens

Variable	**Agro-ecology of the study area**			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Age of pullet at first egg (months)	6.2±0.5	6.8±0.5	6.5±0.6	$0.000^{(***)}$
Age of cockerels at first mating (m)	5.6±0.6	6.2±0.5	5.9±0.6	$0.000^{(***)}$
Reproductive life span of hens (years)	3.6± 0.9	4.3± 1.3	3.9 ±1.2	$0.000^{(***)}$
Reproductive life span of cocks (years)	*2.3±0.5*	*3.0±1.3*	*2.7±1.0*	*$0.000^{(***)}$*

**(p<0.05) or significant at P (0.05) and N=number of households interviewed*

*4.4.2.*Hatchability of indigenous chickens

The overall mean number of incubated eggs, hatched chicks and hatchability percentage per clutch of indigenous chicken ecotypes in the study district were 9.9 ±2.3, 7.6 ±2.0 and 76.4 ±9.4, respectively. The survey result reveals that the overall mean number of incubated eggs and hatched chicks were significantly different ($p<0.05$), but the hatchability percentage of local chicken ecotypes was not significantly different ($p>0.05$) among the two agro-ecologies (table 27).

The result also indicates that the mean of incubated eggs hatched chicks and hatchability percentage per clutch of indigenous chicken ecotypes were higher obtained from midland ecotypes (10.9±2.4, 8.5 ±2.2 and 77.3±9.2) than highland (8.9±1.6, 6.7±1.5 and 75.5±9.5) of indigenous chickens, respectively. This result was lower than the report of Matawork *et al*. (2019) and Hailemichael *et al*. (2015) in which the mean number of incubated eggs, hatched chicks and hatchability percentage per clutch of indigenous chickens were (12.78±0.29, 10.50±0.24 and 81.72±0.99) in Gena Bossa district of Dawro Zone, Ethiopia and (12.60±0.19, 10.50±0.16 and 84.22%) in Southern Zone of Tigray, Northern Ethiopia, respectively. This result is also lower than Zewdu *et al*. (2013) report the average number of eggs set per hen was 14.74±0.25 with a hatchability of (84.7%) in Metekel zone of Northwest Ethiopia and Fissaha *et al*. (2010) report mean number of 13 incubated eggs with hatchability percentage of (82.6% and 89.1%) at Bure and Dale districts of Ethiopia, respectively.

Abiyu (2019) reported somewhat similar values of average number of eggs incubated and eggs hatched per clutch per hen of indigenous chickens in Gimbo district of Kaffa Zone, South Western Ethiopia were (10.0±1.2 and 8.0±1.44), respectively. Likewise, Mesert (2010) reported closer values on the average number of incubated eggs and hatched eggs per clutch per hen of indigenous chickens in the Gomma district of Jimma Zone were (10.13±1.47 and 8.05±1.49), respectively. However, lower results of about (22%) of hatchability were reported from Gomma wereda by Meseret (2010). The number of eggs set per hen depends on availability of eggs, size of eggs and size of broody hen and the maternal instinct of the broody hen. These variations in the hatchability of chicks might be due to storage condition of the egg, incubation materials, quality of eggs, seasonal outbreak of disease, predator attacks, poor nutrition and management, availability of scavenging feed resources and feed supplements.

Table 27. Hatchability of indigenous chickens

Variable	Agro-ecology of the study area			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
No. of eggs per set per hen	10.9±2.4	8.9±1.6	9.9 ±2.3	$0.000^{(***)}$
Number of chicks Hatched per set	8.5 ±2.2	6.7±1.5	7.6 ±2.0	$0.000^{(***)}$
Hatchability (%)	*77.3±9.2*	*75.5±9.5*	*76.4 ±9.4*	$0.093^{(ns)}$

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05) and N=number of households interviewed*

4.4.3.Weaning age and survivability of indigenous chickens

The overall mean weaning age of chicken ecotypes was (3.7±0.7months) in the study area. Significantly earlier mean weaning age (3.4±0.5 months) was obtained from midland chicken ecotypes than highland (4.0±0.8) chicken ecotypes (Table 27). This result was higher than the findings of Meseret (2010) in which the average weaning age of indigenous chickens of Gomma Wereda of Jimma zone was (2.61±0.45 months) and Zewdu *et al*. (2013) in Metekel Zone of North West Ethiopia was (2.13±0.10 months).

The overall mean of the number of weaned chicks per clutch and survival rate (%) of the indigenous chicken ecotypes were 5.0±1.2and 56.6±13.4, respectively in the study area. significantly least number of weaned chicks per clutch was obtained from highland chicken ecotypes (4.6 ±1.1) whereas the highest number of weaned chicks per clutch was recorded from midland chickens (5.4±1.3). However, least survival rate was obtained from midland chicken ecotypes (51.6±11.6%) while highest survival rate was attained from highland chicken ecotypes (61.5±13.3%). These results reflect high chick mortality rates of (48.4% and 38.5%) in midland and highland agro-ecologies, respectively. The current result was lower than with the findings of Fisseha *et al*. (2010) in Bure and Fogera districts in which the average number of weaned chicks (6.7 &7.6) and survive rate were (60.5% &74.3%), respectively. Alem (2014) reported that chicks reached grower stage 8 weeks of age (survival rate) were (65.8%) for indigenous chickens in different agro-ecological zones of Central Tigray. However, it was higher than with the findings of Mesert (2010) in Gomma wereda of Jimma zone in which the average number of weaned chicks (2.82±0.92) and the finding of Welelaw *et al*. (2018), Matawork *et*

al.(2019) and Abiyu (2019) in which the survival rate of indigenous chickens was (48.8±13%, 38.8±1.55% and 49.8±10.3%), respectively. The actual high chick loss implied in the present study might have been caused by diseases, predators and other factors.

Table 28. Weaning age and survivability of indigenous chickens

Variable	**Agro-ecology of the study area**			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Weaning age (months)	3.4±0.5	4.0±0.8	3.7±0.7	0.000(***)
Number of chicks weaned	5.4±1.3	4.6 ±1.1	5.0±1.2	0.000(***)
Percentage of Chicks weaned (%)	64.4±13.4	69.9 ±12.7	67.2 ±13.3	0.000(***)
N. of chicks surviving to adult hood	4.3±1.0	4.0±1.0	4.1 ±1.0	0.032(*)
Survivability (%)	51.6±11.6	61.5±13.3	56.6±13.4	0.000(***)

**(p<0.05) or significant at P (0.05) and N=number of households interviewed*

4.5. Brooding and Incubation

The current study reveals that the mean value of length of brooding period was significantly different ($p<0.05$) across the two agro-ecologies. More than half (54.1%) of the respondents in midland replied that a hen stays in brooding for three weeks, however in highland (43.6%) of the respondents replied a hen stays in brooding for two weeks (table 29). There is no systematic mating in any of the two studied agro-ecology. Thus, breeding indigenous chickens is completely uncontrolled and replacement stock is produced through natural incubation using broody hens. Whereas only (14.5%) of the total number of respondents left broody hens to stop this behavior naturally, the remaining majority(85.5%) of respondents practiced different methods to stop broodiness behavior, in times when incubation was not desired and the hens were required to restart laying faster.

Table 29. Duration of brooding and practice of breaking broodiness

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Length of brooding period				**83.206**	**0.000(***)**
One week	5(3.1)	24(15.1)	29(9.1)		
Two weeks	16(10.1)	69(43.4)	85(26.7)		
Three weeks	86(54.1)	58(36.5)	144(45.3)		
Four weeks	52(32.7)	8(5)	60(18.9)		
Use of different mechanisims to avoid broodiness				**22.874**	**0.000(***)**
Yes	121(76.1)	151(94.9)	272(85.5)		
No	*38(23.9)*	*8(5)*	*46(14.5)*		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The result of this survey also indicated that, (85.5%) of the total interviewed households used different traditional methods of breaking broodiness in (figure 5) was significantly different ($p<0.05$) across the two agro-ecologies. Some of the most popular methods reported were: tied outside of the house (31.6%), moving the hen to neighbor house (29.1%), tied by hanging down (20.6%), tied two of their wing (12.9%) and tied two of their legs together (5.8%). The purpose of such practices was to disturb the broody bird and to cause a hormonal shift so that it starts to lay eggs. This result was slightly similar with the finding of Alemayehu (2017) reported that methods to break broodiness in hens includes tied to outside of house (30%), physically moving the bird to nearby house for a couple of days tied two legs together, put the feather in noise and disturbing from place (15.6%) sole physically moving the bird to nearby house for a couple of days (11.1%), tied two legs together and put in side house (6.7%) and disturbing the sitting nest-boxes (5.6%), tied two legs for three day (3.3%), put the feather in the noise (3.3%) and not do any (2.2%). Likewise, a report from North Wollo zone revealed that (96.73%) of the village chicken owners had an experience of breaking broodiness behavior through either hanging upside down (65.2%), sending to neighbors (27.36%), feed restriction (4.73%) or showing broken egg (2.7%) by (Addisu *et al*., 2013).

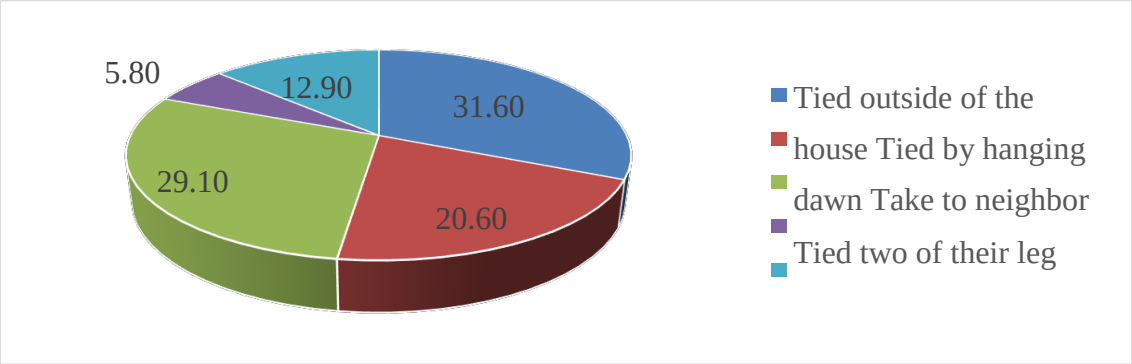

Figure 5. Type of local practices used to avoid broodiness

The survey showed that 92.1% of the respondents had practices selection of broody hen before incubation in the study area (table 30). The character consider chicken for brooding hens selection were based on body weight (31.7%), mothering ability (37.3%) and family history (31%). This result was in partially agree with the findings of Meseret (2010) which revealed that farmers selected hens for incubation based on either of large body size (21.1%), ample plumage /feather cover (3.3%), previous hatching history (6.7%), broodiness (19.4%) or large body size, ample plumage and previous hatching history (49%) in Gomma wereda of Jimma zone. The survey also revealed that (93.7%) of the respondents had practices of selection of eggs before incubation in the study area in (Table 29). The character consider selecting the source of egg for hatching were productivity of mother hen (50.7%), age of mother hen (13.4%) and size of egg (35.9%) in the study area. The analyses of character consider chicken for breeding, selection broody hens for incubation and criteria for selecting the source of egg for hatching were significantly different ($p<0.05$) among the two agro-ecologies. This study was contrasting with the finding of Shishay *et al*. (2014) in Western Zone of Tigray who reported that farmers selected eggs based on egg type (9.9%), egg size (0.3%), egg age and type (19.2%), egg age, egg type and season (month) of egg laying (4.9%), egg age, egg type and size (3.1%) or egg type and size (0.8%). However, none of the households had selected eggs for incubation based on egg color. In his study in Fogera district, Bogale (2008) also reported that (84.7%) of the farmers selected large eggs followed by medium eggs (9.7%) and small sized eggs (1.4%) for incubation.

Table 30. Criteria for selection of brooding hens and source of egg for hatching

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Practice of brooding hen selection				**3.516**	**0.061(ns)**
Yes	151(95)	142(89.3)	293(92.1)		
No	8(5)	17(10.7)	25(7.9)		
Criteria for selection of brooding hens				**13.306**	**0.001(**)**
Body size	36(23.8)	57(40.1)	93(31.7)		
Mothering ability	70(46.3)	9(27.5)	109(37.3)		
Previous history	45(29.8)	46(32.4)	91(31)		
Practice of selecting the source of egg for hatching				**0.213**	**0.644(ns)**
Yes	148(93.1)	150(94.3)	298(93.7)		
No	11(6.9)	9(6.7)	20(6.3)		
Criteria's used to selecting the source of egg for hatching				**58.999**	**0.000(***)**
Productivity of mother hen	104(70.3)	47(31.3)	151(50.7)		
Age of mother hen	22(14.8)	18(12)	40(13.4)		
Size of egg	*22(14.8)*	*85(56.7)*	*107(35.9)*		

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

Farmers seems to have good practices of using egg-setting materials, which aimed at providing comfortable incubation environmental conditions for broody hens. The result of this survey indicates that the egg-setting or brooding materials used for incubation was significantly different ($p<0.05$) across the two agro-ecologies (table 31). From the total, 40.8%, 13.5%, 14.2% and 31.5% of the survey members used cartoon box, clay soil made baskets, plastic with grasses and under any corner

on the ground (putting some bedding materials like worn clothes, grass) were the major bedding materials used during incubation, respectively.

This result is in disagreement with the finding of Shishay *et al*. (2014) in Western Zone of Tigray who reported that farmers used either of ground with soil/sand/ash/cow dung/chopped grasses bedding (15.6%), bin with grasses, feather of brooding hen, clothes/cow dung &straw/ bedding (68.8%), plastic with grasses (straw)/soil (sand) /soil or sand/ bedding (7.8%), bamboo cages with soil and straw/teff straw/ bedding (0.3%),bin with grasses /straw/ bedding during rainy season & with sand bedding during dry season (3.9%), cartoon with grasses and clothes bedding (0.8%), dish with soil or clothes bedding (0.5%), ground / bin or dish with grasses bedding (0.3%) or plastic and bin with grasses /soil/ clothes bedding alternatively (1%) as egg setting materials.

Table 31. Types of bedding materials used for incubation

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Bedding materials used for brood				**57.125**	**0.000(***)**
Cartoon box	80(55.2)	50(49.5)	130(40.8)		
Clay soil made baskets	12(8.3)	31(30.7)	43(13.5)		
Plastic with grasses	14(8.8)	31(19.5)	45(14.2)		
Under any corner	53(36.5)	47(29.5)	100(31.5)		

**(p<0.05) or significant at P (0.05), Number in bracket is referred to percentage of respondents and N=number of households interviewed*

The information recorded for culling of chickens presented in table 32 is significantly different ($p<0.05$) among the two agro-ecologies. About 74.8% of the respondents cull chicken due to different reasons. The main reasons for culling recorded were due to old age (40.3%), sickness (19.7%), lack of broodiness (18.1%), frequent broodiness (12.6%), and poor productivity (9.2%). This result contrasts with the finding of Alemayehu (2017) revealed that determined factors of culling are old age (22.2%), poor production (1.1%), surplus male (7.8%), sickness behavior (7.8%) and before rainy season (6.7%) because of disease outbreak at rainy season, an able to feed, also climate difficult for chickens. Another study reported by Emebet (2015) determine factors of culling were due to poor productivity (31.8%),

old age (26.7%), before rainy season (13.5%) and the outbreaks of disease (19.6%) and lack of capacity to manage large number of bird (8.4%) as major determining factors in culling and reducing the number of chickens.

Table 32. Practice and reasons of culling.

Variable	**Agro-ecology of the study area**				
	Midland (%)	Highland (%)	Total (%)	X^2 -test	P-value
Practice culling of chickens				**8.084**	**0.004(**)**
Yes	108(67.9)	130(81.8)	238(74.8)		
No	51(32.1)	29(18.2)	80(25.2)		
Reasons for culling				**26.289**	**0.000(***)**
Poor productivity	11(10.2)	11(8.5)	22(9.2)		
Old age	60(55.5)	36(27.7)	96(40.3)		
Sickness/disease case	20(18.5)	27(20.7)	47(19.7)		
Lack of broodiness	11(10.2)	32(24.6)	43(18.1)		
Frequent broodiness	*6(5.5)*	*24(18.5)*	*30(12.6)*		

**(p<0.05) or significant at P (0.05),Number in bracket is referred to percentage of respondents and N=number of households interviewed*

4.6.Egg quality Traits of Indigenous Chickens

A variety of egg quality parameters were considered and analyzed for this specific study and presented in table 33 and table 34. Some of these external and internal egg quality parameters included in this study were: egg weight, shell thickness, shell weight, egg length, egg width, shape index, shell ratio, shell color, yolk color, Haugh unit, albumen height, albumen weight, yolk ratio, yolk index, yolk weight and yolk height.

4.6.1.External egg quality traits for indigenous chickens

The mean of external egg quality traits were presented in table 33. The average egg weight and shell weight for indigenous chickens were 44.64± 6.33 and 5.48±0.87gm, respectively. The study revealed that the average egg weight and shell weight were statistically significant different (P<0.05) between

the two agro-ecologies in which better quality of the parameters was observed in midland agro-ecology. These differences might be due to different management practices, age of egg laying production stage and agro-ecological factors like temperature and humidity. The overall mean egg weight obtained from the current study was higher than the findings of Aberra *et al.* (2013) in which (39.6 gm) for scavenging indigenous chickens reared in three agro-ecological zones of Amhara Regional State, Ethiopia. The mean egg weight of scavenging local chickens in Lume district (44.9±0.51gm) reported by Alemayehu (2017) is most similar to the current result.

The overall mean egg length and egg width of the indigenous chickens in the current study was (49.87±4.86mm and 37.38±3.30mm), respectively. In addition, the length of egg from midland was significantly higher than highland ($p<0.05$). While the average mean of egg width were no statistically significant different ($P>0.05$) in which (37.66 and 37.10 mm) in midland and highland agro-ecologies of the study area, respectively. These results were disagreement with the report of Demssu (2020) in Western Ethiopia who reported that the average mean of egg length amd egg width were (51.76±0.21 mm and 36.74±0.14 mm) in Horro chicken, respectively. In agreement with the present finding, Kejela *et al*. (2019) reported average egg length and egg width of (50.39 mm and 37.86 mm), respectively for Yirgalem local chickens. Another finding conducted by Moges *et al*. (2010) reported that an average egg length and egg width of (50.83 mm and 37.23 mm) for scavenging local chickens of Bure district of western Ethiopia which is consistent with the current findings.

Regarding values of shell thickness of an egg in the current study, there are no significant differences observed between agro-ecological zones, but in values of shell thickness in midland (0.48±0.13 mm) slightly greater than in highland (0.47±0.15mm) agro-ecologies, respectively. The difference might be due to agro-ecological variation as well as feed type which affects egg shell thickness. Among external egg quality traits, shell thickness, as a measure of shell strength, is an important bio-economic trait that primarily breeder of egg laying flock incorporate in their breeding programmes to reduce egg shell breakages.

The average shell thickness values obtained from the current study (0.47±0.14mm) was in close agreement with the findings of Fisseha *et al*. (2010) for Fogera district, Ethiopian scavenging local chickens was (0.45mm). However, the current study was higher than the finding of Demssu (2020) in Western Ethiopia who reported that the average mean egg shell thickness was (0.36±0.04 mm). Shell thickness of (0.296 mm) was reported by Aberra *et al*. (2013) for Amhara Regional State, Ethiopia. A low shell thickness value of (0.19 mm) was also reported by Kejela *et al*. (2019) for Yirgalem local chickens. However, the current study was lower than the report of Halima (2007) in which the mean egg shell thickness of (0.77mm) in Debre- Elias hens under intensive management conditions in (Andassa Livestock Research Center).These variations in shell thickness observed in different regions could be attributed to the quality, quantity and nutrient composition of scavengable feed resources available in different localities.

Egg shape is an important parameter in the poultry industry for uniformed package of eggs during transportation over long distances by reducing possible breakage of eggs. The shape index of eggs among the two agro-ecologies is significantly different ($P<0.05$). The average shape index percentage in the present study was 75.11±5.66. The highest mean shape index and shell ratio (76.73±6.26 and 12.43±2.12) respectively, were recorded in the highland chickens' egg compared to the midland (73.49±4.49 and 12.35±1.43) chickens' egg. This result was not agreement with the report of Aberra *et al*. (2013) the overall shape index of scavenging indigenous chickens was (73.2%). In line with the present findings, Alemayehu (2017) reported an average shape index of (74.5%) for scavenging local chickens found in Lume district. However, Serkalem *et al*. (2019) reported an average shape index of (69.75%) for indigenous chickens of Boricha district, which is much lower than found in the present study.

Table 33. External egg quality traits for indigenous chickens

Egg quality parameters	Agro-ecology of the study area			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Egg weight (gm)	46.25±5.49	43.04±6.73	44.64± 6.33	$0.005^{(**)}$
Egg length (mm)	51.2467±4.49	48.49±4.85	49.87±4.86	$0.002^{(**)}$
Egg width (mm)	37.66±3.77	37.10±2.76	37.38±3.30	$0.363^{(ns}$
Egg shell weight (gm)	5.68±0.72	5.28±0.96	5.48±0.87	$0.011^{(*)}$
Egg shell thickness (mm)	0.48±0.13	0.47±0.15	0.47±0.14	$0.702^{(ns)}$
Egg shape index (%)	73.49±4.49	76.73±6.26	75.11±5.66	$0.002^{(**)}$
Shell ratio (%)	*12.35±1.43*	*12.43±2.12*	*12.39±1.80*	$0.805^{(ns)}$

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05) and N=number of households interviewed*

*4.6.2.*Internal egg quality traits for indigenous chickens

Internal egg quality characteristics of indigenous chicken ecotypes is presented in table 34. The mean internal egg quality traits like albumen weight, albumen width, yolk index and yolk width were significantly (P<0.05) affected by agro-ecology. However, albumen height, albumen ratio, yolk weight, yolk height, HU, yolk color and albumen ratio did not show a significant difference (p<0.05) among the two agro-ecologies. The current study recorded better albumen weight, albumen width, albumen height, yolk weight, yolk height, yolk width, and HU in the midland than highland. While other parameters like yolk index, yolk colour, albumin ratio and yolk ratio were reported slightly higher value in the highland than midland agro-ecologies.

In the current study the overall average of yolk width for indigenous chickens was (35.96±3.99 mm) whereas yolk height was (18.05±1.74) mm resulting (50.79±7.54%) of yolk index. This study was higher yolk height than the finding of Kejela *et al*. (2019) for Yirgalem indigenous chickens (15.90mm), Fisseha *et al*. (2010) for Bure local chickens (15.1mm) and Welelaw *et al*. (2018) for Bench Maji Zone indigenous chickens (14 mm). However, the study revealed that lower yolk width than the finding of Kejela *et al.* (2019) in Yirgalem and Hawassa (38.70 and 40.91mm), respectively. The present study was also higher than the research conducted by Serkalem *et al*. (2019) in Boricha district and Aberra *et al*. (2013) in Amhara Regional State, in which yolk index values of (45.2% and 44%) for indigenous chickens, respectively. The storage conditions of eggs might cause the variations observed in yolk quality of various regions before they are assesse for quality traits.

The other most important internal egg quality trait considered in this study was yolk color; estimated using roach color fun (range 1–15). It is a key factor in any consumer survey relating to egg quality. Consumer preferences for yolk color are highly subjective and vary widely from country to country. The average yolk color value observed in the present study (11.16) was higher than that of Moges *et al*. (2010) in Bure district, Welelaw *et al*. (2018) in Bench Maji Zone, Amanuel *et al*.(2019) in Dedo District, Jimma Zone, South West Ethiopia and Emebet (2015) in Gurage Zone local chickens in which (8.6,10.9,9.6 and 8.9), respectively . Hence, the higher yolk color score obtained from the current study might be because of scavenging feed resource base of the study area is rich in xanthophylls, which is responsible for deep yellow color eggs collected from scavenging indigenous chickens.

Average albumin weight were observed as (22.62±3.26 and 20.62±4.71gm) for midland and highland, respectively and there were statistically significantly different ($p<0.05$) between the two agro-ecologies. The reason might be due to difference in egg weight indicating that size of eggs affect the weight of egg components. However, the average yolk weight were observed as (15.74±2.68 and 14.98±2.52gm) for midland and highland, respectively and there were not statistically significantly different ($p>0.05$) between the two agro-ecologies.

In the present study the overall average values of albumen height and HU were (5.59±0.85 mm and 79.63±4.86), respectively. Kejela *et al*. (2019) reported higher HU values (82.55) for indigenous chickens than the current finding, but Amanuel *et al*. (2019) in Dedo District, Jimma Zone, South West Ethiopia, reported lower HU values (45.46) for village chickens than the current finding. The albumen height and HU values of local chickens reported by Moges *et al*. (2010) and Fereja *et al*. (2016) were (4.1 mm and 66.5) and (4.37mm and 69.13), respectively, which were also lower than those of the current findings.HU determines the albumen quality; higher HU means better albumen quality.

These observed variations could be attributed to various factors such as management differences (poor handling and storage of the eggs), age of the birds, quality and quantity of feed and production environments in which the animals were maintained. In general, egg quality traits of indigenous chickens reared in the midland agro-ecology was relatively better than highland agro- ecologies in the study area.

Table 34. Internal egg quality traits for indigenous chickens

Egg quality parameters	**Agro-ecology of the study area**			
	Midland (N=159)	Highland (N=159)	Total (N=318)	
	(Mean±SD)	*(Mean±SD)*	*(Mean±SD)*	*p-value*
Albumin weight (gm)	22.62±3.26	20.62±4.71	21.62±4.16	0.008$^{(**)}$
Albumin height (mm)	5.73±1.01	5.44±0.61	5.59±0.85	0.064$^{(ns)}$
Albumin width (mm)	60.36±6.66	48.87±11.65	54.62±11.07	0.000$^{(***)}$
Albumin ratio (%)	49.07±4.07	49.60±6.10	48.33±5.22	0.125$^{(ns)}$
Yolk weight (gm)	15.74±2.68	14.98±2.52	15.36±2.61	0.109$^{(ns)}$
Yolk height (mm)	18.24±1.66	17.86±1.82	18.05±1.74	0.234$^{(ns)}$
Yolk width (mm)	37.34±2.94	34.58±4.43	35.96±3.99	0.000$^{(***)}$
Yolk ratio (%)	34.03±4.47	35.20±6.05	34.61±5.33	0.230$^{(ns)}$
HU	79.85±5.63	79.41±3.99	79.63±4.86	0.623$^{(ns)}$
Yolk colour (RCF1-15)	11.08±1.38	11.23±1.57	11.16±1.47	0.579$^{(ns)}$
Yolk index	*49.07±5.36*	*52.50±8.94*	*50.79±7.54*	*0.012$^{(**)}$*

**(p<0.05) or significant at P (0.05), ns (P>0.05) or not significant at P (0.05) and N=number of households interviewed, RCF = Roche Colour Fan, HU = Haugh unit*

5.CONCLUSIONS AND RECOMMENDATIONS

5.1.Conclusions

Comparable to most parts of the country, indigenous chickens in different agro-ecologies of Ezha district plays a great role and occupies a unique position in terms of its contribution to the provision of high quality protein foods and additional income to rural smallholder farming families of the study district. This is mainly because of indigenous chicken production requires less space and investment, its complementary role in relation to other crop-livestock activities and play an important role in improving the livelihood of the poor rural family.

The research finding revealed that the purposes of chicken production in the study area were reared mainly for both income generation and consumption. The study revealed that compared to the other flock structure high mean number of chicks per household was observed followed by pullet. The survey result indicated that women's play the major role in the management of chicken production. The study also revealed that more than half of the respondents provide night time shelters other than separate chicken house. Lack of experience , lack of capital, predators and theft were the main reasons for not constructing separate poultry houses in the study areas. Most of the respondents practice of scavenging system with supplementary feeding, provided water for their chicken and face occurrence of serious diseases outbreaks. The management practices of indigenous chicken identified in this study was traditional with different shortcomings. Therefore, need awareness creation on management system of chicken for stockholders and concerning body.

In this study, significantly lower productive and reproductive performances were obtained from highland chicken ecotypes. The analysis of the study also revealed that from egg quality parameters like egg weight, egg length, egg shell weight, egg shape index, albumin weight, albumin width , yolk width and yolk index were significantly different among the two agro-ecologies.. These observed variations might be attributed to various factors such as management differences, quality and quantity of feed and production environments in which the animals were maintained.

5.2.Recommendations

Based on the result of this study, the following recommendations are forwarded:

- The Productive and reproductive performances of indigenous chicken were very low ,thus improvement of indigenous chicken performance through within breed selection and improving the management conditions such as feed supplementing, housing, watering and health care for indigenous chicken should be given due attention. Therefore, governmental organizations, NGOs and other stakeholders should play their role to develop knowledge and capacity of producers.
- Special focus should be done to improve farmers raising a small number of chicken to increase their chicken number under scavenging to improve chicken production and productivity. In general, in scavenging chicken production, as the number of chicken increased per household the chicken production also get attention and chicken managements were improved.
- List cost housing should be constructed and provided the day time to protect young chicks from predators attack since only 4% of successfully hatched chicks transform into fully grown chickens.
- Selection and mating of superior chicks should be taken in to account with improving the management practices.
- There is a strong need for appropriate intervention in disease and predator control activities so as to reduce chicken mortality and improve productivity. Control of diseases, mainly NCD, could be achieved through improvement in veterinary and advisory services.
- Chickens should be provided with scientific management, the egg quality of the chicken can improve significantly.

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7.APPENDIX

Appendix 1. Questionnaire used in the data collection

Questionnaire Format for the research entitled "Assessment on Management Practices, Productive and Reproductive Performances and, Egg Quality Characteristics of Indigenous village Chickens in Ezha District of Gurage Zone, Southern Ethiopia".

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 your name, 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.

5. For closed question, circle or mark (x) and for open questions fill the households' response precisely in the blank space where necessary.

General Information

1. Questioner code_____Date of interview_____

2. Study area: - Region_____District_____Kebele_____

3. Farmer's Name_____Enumerator's Name_____

4. Agro-ecology: - A. Mid-altitude B. Highland

A. Socio-economic characteristics of the respondent

1. Sex of the respondent: - A. Male B. Female

2. Age of the respondent: - _____

3. Major occupation: -A. Farmer B. Merchant C. Government worker D. Carpenter

4. Educational level of the respondent: -A. Illiterate B. Read & write (Basic education) C. Elementary education (grade 1-8) D. Secondary education (9-12)

E. College and university education

5. Marital status of HH: - A. Married B. Divorced C. Widow /widower D. Unmarried

6. Economic status of family: - A. Low B. Medium C. High income

7. Type of farming system: - A. Livestock production B. Crop production C. Mixed

8. Major crops grown in the area: -1st _____ 2nd _____ 3rd _____ 4th _____

9. Land size of HH:-

Type of land	In Hectare (ha)	In local measurement
Cultivated land		
Grazing land		
Uncultivated land		
Forest land		
Total		

10. Family size and composition:

Age group	**Male**	**Female**	**Total**
Under 14 years			
Age between 15 and 30 years			
Age between 31 and 60 years			
Age above 60 years			
Total			

11. Livestock holding, Owner and Purposes

Type of animals	**Number of animals**	**Owner**			**Purpose of production**		
		Women	Men	Children	Consumed	Sold	For both purposes
Cattle							
Sheep							
Goats							
Donkeys							
Horses							
Mules							
Chickens							

B.Production system

1. How long since you started chicken farming?

A. 1-5years B. 6-10years C. 11-15years D.>15yrs

2. What is the objective of poultry production system? (Rank)

A. Income source B. Home consumption C. Both income source and home consumption
D. Other (specify) _____

3. Flock size and structure of chickens (age, type etc)?

Chicken types	**No. of chickens**			**Local**	**Cross**	**Exotic**
	M	F	T			
Chicks (0- 8wks)						
Pullets (8-20wks)						
Cockerels(8-20wks)						
Hens (breeding hen)						
Cocks (breeding male)						
Total						

4. What is Sources of foundation or replacement stock?

A. Purchase B. Inherited C. Hatched D. other specify_____

5. Describe the family members based on activities for chicken?

Activity type	**Responsible family members**			
	Children	Women	Men	All families
Chicken management and marketing				
Shelter construction				
Cleaning chicken house				
Supplementary feeding				
Providing water				
Selling chicken				
Selling eggs				
Treatment of sick birds				
If any				

C. Indigenous chicken management practices

I. Housing condition

1. Do you have separate poultry house? A. Yes B. No

2. If your answer for question number one is yes, the house is made from
A. Mud of blocks and thatch B. Iron sheet roof & wood C. Thatch covered with perch
D. other_____

2. If your answer to question number one is no, what is a problem in the construction of separate Poultry house (Prioritize them)? A. Prevalence of predator's B. Fear of theft C. Lack of experience D. Lack of capital E. Others specify _____

3. If your answer to question number one is no, where does your birds stay at night?

A. In the kitchen B. Family dwellings C. Perch on trees D. Under basket
F. Cattle yard H. Others specify _____

4. Do you believe that constructing separate poultry house is advantageous? A. Yes B. No

5. If your answer to question 4 is yes, state the advantages of separate poultry house:
A._B._____

6. If they rest in a separate house, do you practice cleaning of poultry house? A. Yes B. No

7. If your answer to question 6 is yes, how often you clean poultry house?

A. Every day B. Every 2-6 days C. Once a week D. Once in two weeks E. Never clean

8. Do you provide litter material in the poultry house? A. Yes B. No

9. If your answer to question 8 is yes, what type of litter material do you use?

A. Teff straw B. Wheat straw C. If others (specify) _____

10. Did you disinfect the chicken house? A. Yes B. No

II. Feed Resources and Feeding Strategy

1. Do your birds scavenge? A. Yes B .No

2. Do you practice supplementary feeding of your chicken? A. Yes B. No

3. If your answer to question 2 is yes, when do you usually offer the supplement?

4. In the morning before they go out for scavenging B. In the afternoon If your answer to question 2 is no, what is the reason?

A. Lack of awareness about supplementary feeding B. Unavailability of feed and feed ingredients

C. High cost of feed and feed ingredients D. Shortage of time

E. Lack of financial resource F. others, specify_____

5. If your answer to question 2 is yes, what type of feeds did you supplement for them?

A. Home available feeds B. Commercial feeds

C. Home mixed ration D. both commercial and home available feeds

6. If you use home available feeds, put them orderly starting from the major one

A._____B._____C._____D._____

7. Are the commercial poultry feeds accessible? A. Yes B. No

8. Is the price of commercial poultry feeds affordable? A. Yes B. No

9. What is the basis of your giving supplements?

A. Egg yield B. Meat yield C. Broodiness (during incubation) D. Age

E. other, specify_____

10. How did you offer the feed for your chicken?

A. Spreading the feed on the ground B. using any home available feeding trough

C. Using appropriate chicken feeding trough D. other, specify_____

11. How did you provide the supplementation to your chicken?

A. Separately to different classes B. Together for the whole group

12. Do you give water to your birds? A. Yes B. No (why) _____

If you give water for the chickens, where do you get the water from? A.Rain water

A. B. River C. Tap water D. Pond water E. Other, specify_____

13. If you give water for the chickens, what type of waterer do you use to supply water?

A. Flat plastic container B. locally made wood C. Stone dish

D. Type of water trough E. Any broken material

14. If you give water for the chickens, how frequent do you wash the container? (Per week) -----

15. If you give water for your chickens, how frequently do you provide water to the chicken?

A. Every other day B. Once per day C. twice per day D. adlibitum

III. Health and disease control

1. Do you experience serious disease outbreaks? A. Yes B .No

2. Which classes of birds were more affected? A. Chicks B. Growers C. layers D. Adults F. all

3. If your answer to question 1 is yes, describe the common diseases you have experienced in your flock? (Rank 1-5 orderly)

A. Newcastle (Fengil) B. Infectious coryza C. Salmonellosis D. Fowl pox E. Coccidiosis f. other, specify_____

4. Do you get efficient veterinary service for your chicken? A. Yes B. No

5. What do you do when birds are sick?

A. Treat them myself with traditional treatment B. Call in veterinarian/ development agents

C. Cull them all immediately D. Slaughter them all immediately for home Consumption

E. Sell them all immediately F. Others Specify ----------

6. Do you practice annual vaccination of your chicken? A. Yes B. No

7. If your answer to question number 6 is Yes, What type of vaccine (Type of disease)?

_____

8. Do you control the free movement of chickens all the times? A. Yes B. No

9. If your answer to question number 8 is yes, would you mention the reason? A. To protect from predators attack B. To avoid risk of contagious diseases

C. To protect from mixing with the village flock

D. To protect birds from picking and destroying crops/ vegetables

10. Do you control the free movement of chickens at a time of disease outbreak? A. Yes B. No

11. Do your chickens scavenge mixed with that of your neighbors? A. Yes B. No

12. What do you do with dead birds? A. throw B. put pit C. burning D. other_____

13. Do you use anti-ectoparasites? A. Yes B. No

14. Do you practice deworming? A. Yes B. No

15. How is the mortality of birds due to diseases? A. High B. Low

16. How is the mortality of birds due to predation? A. High B. Low

17. What are the most common predators found in your locality? Put them in their order of importance_____,_____,_____, _____

D. Productive and Reproductive Performances of Indigenous Chickens

1. State the productive performance of your birds in the following table

Parameters	Indigenous Chickens
Average number of eggs laid per clutch/ hen	
Average number of days per clutch	
Average number of clutches/hen/ year	
Average number of eggs laid per hen/year	
Market/slaughter age of cock (months)	
Market/slaughter age of hen (months)	
Average weight of pullet around 6 months (Kg)	
Average weight of cockerel around 6 months (Kg)	
Average weight of mature hens (Kg)	
Average weight of mature cocks (Kg)	

2. State the reproductive performance of your birds in the following table

Parameters	**Indigenous Chickens**
Age at sexual maturity (month)	
-Age of pullet at first egg (months)	
-Age of cockerels at first mating (months)	
Reproductive life span of hens (years)	
Reproductive life span of cocks (years)	
Number of eggs per set per hen	
Number of chicks Hatched per set	
Hatchability (%)	
Number of times the hen hatches per year	
Weaning age (months)	
Number of chicks weaned	
Percentage of Chicks weaned (%)	
Number of chicks surviving to adult hood	
Survivability (%)	

3. How long a hen stays in brooding? A. One week B. Two weeks C. Three weeks D. Four weeks

4. Do you have any local practices used to avoid broodiness? A. Yes B. No

5. If your answer to question number 4 is yes, what type of practices you used? (Put in order of preference and applicability)

A. Tied outside of the house_____B. Tied by hanging dawn_____C. Take to neighbor_____D.Tied two of their leg_____
E. Others_____

6. Do you practice brooding hen selection? A. Yes B. No

7. If your answer to question number 6 is yes, what are the criteria for selection?

A. Body size B. Mothering ability C. Family history

8. How many brooding hens do you have? _____

9. Do you practice selecting the source of egg for hatching? A. Yes B. No

10. If your answer to question number 9 is yes, what criteria's do you use?

A .Productivity of mother hen, B. Age of mother hen C. Size of egg

F. If others specify _____

11. Where your birds do brood on eggs and what are the bedding materials used?

A. Cartoon box B. wooden box C. woven cage D. under any corner

12. What do you think about the trend of the clutch period as the age of the bird increases?

A. Increase B. Decrease C. No change

13. At which clutch period does the hen supposed to set eggs for hatching chicks_____?

14. Do you practice culling of birds? A. Yes B. No

15. If your answer to question number 14 is yes, what are the reasons for culling? A. Poor productivity B. Old age C. Sickness D. Lack of broodiness E. frequent broodiness F. Others (specify) _____

16. If you culled old age birds, at what age of the bird do you decide to cull it? _____

E. Marketing (Products and production input)

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

2. Where do you buy poultry production inputs?

A. NGO B. Government C. Private companies D. If others (Specify) _____

3. Do you have market access for your poultry products? A. Yes B. No

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

A. Specific weight gain/age of birds B. Personal money requirement

C. During holydays and festivals D. If others (specify) _____

5. To whom are you selling your poultry products?

A. Village market B. Local shopkeepers C. Selling at own doorstep

D. Retailer E. Whole sellers F. If others (specify) _____

6. Which breed type meat is most preferred by consumers?

A. Meat from improved breed B. Meat from local chicken C. Equally preferred by consumers

7. Write your reasons for Q.6 responses? _____

8. Which breed type egg is most preferred by consumers?

A. Eggs from improved breeds B. Eggs from local chicken C. Equally preferred

9. Write your reasons for Q.8 responses? _____

10. What is the current market price of eggs? ----------

11. Which of the followings is the major determinant of market price of egg in your locality? ((Use rank 1^{st}, 2^{nd}, 3^{rd})

A. Shell color _____ B. Size of egg_____ C. Yolk color _____

12. Which of the followings is the major determinant of market price of live chickens in your locality? (Use rank 1^{st}, 2^{nd}, 3^{rd},4^{th}, 5^{th})

A. Feather color_____B. Comb type_____C. Shank color_____

D. Body weight_____E. Sex _____

13. What is the current market price of adult male bird? _____

14. What is the current market price of pullets? _____

15. What is the current market price of laying hen? _____

16. How far the market place from the residence area? ---------- (m or km)

17. What are the problems relating to live poultry marketing in your experience?

A. Unstable bird price B. Poor sales (demand seasonality) C. Lack of market place D. Poor infrastructure (road, market) E. Lack of information F. Others, specify_____

18. What are the problems relating to egg marketing in your experience?

A. Unstable egg price B. Poor sales (demand seasonality) C. Lack of market place
D. Poor infrastructure (road, market) E. Lack of information F. Others, specify_____

F. Extension service

1. Have you ever discussed your poultry production and related problems with extension agents?

A. yes B. No

2. If you say No for Q.1, state the reasons? A. Have no heard of them B. There is no need to contact the agents C. cannot easily reach them D. If others (specify) _____

3. How frequently do you contact the extension agent?

A. Once in a week B. Once in two weeks C. Once in a month D. Not Seen

4. Have you ever heard about improved chicken production practices? A. Yes B. No

5. Have you ever got any training on poultry production? A. Yes B. No

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

7. Did you get credit service when you start poultry business? A. Yes B. No

8. If yes, for Q.7 for what purpose did use the credit? A. Day old chicks' B. Poultry feed C. Poultry equipment D. If others (specify) _____

F. What do you suggest to improve your poultry production?

_____

_____

_____

Thank you very much for your cooperation!!

Appendix 2. Productive Performance Recording Format of Indigenous chickens in different Agro-ecology of Ezha District

Parameters	Agro-ecology of study area		
	Midland	Highland	Average
Egg number per hen/clutch			
Clutch length/hen(days)			
Clutch number per hen/year			
Total egg number per hen/year			
Market/slaughter age of cock/m			
Market/slaughter age of hen/m			
Average weight of pullet at 6 months (Kg)			
Average weight of cockerel at 6 months (Kg)			
Average Weight of mature hen (kg)			
Average Weight of mature cocks (kg)			

Appendix 3. Reproductive Performance Recording Format of Indigenous chickens in different Agro-ecology of Ezha District

Parameters	Agro-ecology of study area		Average
	Midland	Highland	
Age of pullet at first egg (mths)			
Age of cockerels at first mating (mths)			
Reproductive life span of hens (years)			
Reproductive life span of cocks (years)			
Number of eggs per set per hen			
Number of chicks hatched			
Hatchability (%)			
Number of chicks weaned			
Percentage of Chicks weaned (%)			
Number of times the hen hatches per year			
Weaning age(months)			
Number of chicks survived			
Survivability (%)			

Appendix 4. External Egg Quality Traits Recording Format of Indigenous chickens in different Agro-ecology of Ezha District

Egg Quality Traits	Measurements	Agro-ecology of study area		Average
		Midland	Highland	
Egg weight (g)	using digital balance			
Egg length (mm)	measured by using digital caliper			
Egg width (mm)	measured by using digital caliper			
Shell thickness (mm)	using digital caliper			
Shell weight	using digital balance			
Egg shell color	visual observation			
Egg shape index (%)	calculated as: (egg width/egg length)*100			
Shell ratio (%)	calculated as: shell weight/egg weight*100			

Appendix 5. Internal Egg Quality Traits Recording Format of Indigenous chickens in different Agro-ecology of Ezha District

Egg Quality Traits	Measurements	Agro-ecology of study area		Average
		Midland	Highland	
Albumin weight (g)	using digital balance			
Albumin height (mm)	using tripod micrometer			
Albumen width(mm)	using digital caliper			
Yolk height (mm)	using tripod micrometer			
Yolk weight (g)	using digital balance			
Yolk width(mm)	using digital caliper			
Haugh Unit	Calculated by using albumen height and egg weight			
Yolk index	Yolk height/Average yolk diameter*100			
Yolk colour	using color fun, ranged 1-15			
Yolk ratio (%)	Yolk weight/egg weight*100			
Albumen ratio (%)	Albumen weight/egg weight*100			