INDIGENOUS CHICKEN FARMERS TRAITS PREFERENCES, BREEDING OBJECTIVES AND MARKETING SYSTEMS IN SEKA CHEKORSA AND KERSA DISTRICTS OF JIMMA ZONE, SOUTHWEST ETHIOPIA

M.Sc. THESIS

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, JIMMA UNIVERSITY COLLEGE OF AGRICULTURE AND VETERINARY MEDICINE

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BY

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I have incorporated the suggestion and modifications given during the internal thesis defense and got the approval of my advisors. Hence, I hereby kindly request the Department to allow me to submit my thesis for external thesis defense.

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Name and Signature of student

We, the thesis advisors, have verified that the student has incorporated the suggestions and modifications given during the internal thesis defense and the thesis is ready to be submitted. Hence, we recommend the thesis to be submitted for external defense.

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Decision or Suggestion of the Department Graduate Council (DGC)

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DEDICATION

This thesis is dedicated to my beloved father Teshome Bekele who passed away and I deeply wish that God might give him peaceful rest forever.

STATEMENT OF AUTHOR

I, the undersigned, hereby declare that the thesis "Indigenous Chicken Farmers Traits Preference, Breeding Objectives and Marketing Systems in Seka Chekorsa and Kersa Districts of Jimma Zone, Southwest Ethiopia" is the outcome of my own work and all sources of materials used for this thesis have been properly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for MSc. degree at Jimma University and is deposited at the University Library to be available to borrowers under rules of the library. I really declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate. I concede copyright of the thesis in favor of the Jimma University, College of Agriculture and Veterinary Medicine.

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BIOGRAPHICAL SKETCH

The author, Fikadu Teshome Bekele, was born on June 23rd 1986 G.C in Marti Bidaru kebele, Seka Chekorsa district, Jimma Zone, Oromia Region. He attended his elementary education from 1 to 6 Grades at Marti Bidaru primary school from1995 to 2000 G.C and grades 7 and 8 at Seka Dilbari primary school. He completed his junior secondary education at Seka Senior Secondary School in 2003-2004G.C. Then, he joined Holeta ATVET College in 2005 G.C and graduated with Diploma in Animal Science on 24th 2007 G.C and after graduation he was employed by the Seka Chekorsa district of livestock development and health care agency. From 2011 to 2012 G.C, he attended his education at Jimma University and graduated with BSc in Animal Science on 19th June, 2012 G.C and returned to Seka Chekorsa district of livestock development and health care agency until he joined Jimma University, school of graduate studies for the degree master of science in Animal Breeding and Genetics in 2014 G.C.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
CSA	Central statistical agency
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus group discussion
GDP	Gross domestic product
HL	Highland
ILRI	International Livestock Research Institute
LL	Lowland
LMP	Livestock Master Plan
ML	Midland
Masl	Meters above sea level
MOA	Ministry of Agriculture
N	Respondent numbers
NCD	Newcastle Disease
NGO	Non- Governmental Organization
PRA	Participatory rural appraisal
RIR	Rhode Island Red
SD	Standard deviation
SE	Standard error
SFRB	Scavenging Feed Resource Base
SPSS	Statistical package for social sciences

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ABSTRACT

A survey with the objectives of studying (trait preference, breeding objectives, management & marketing systems of indigenous chicken) was undertaken in two districts (Seka Chekorsa and Kersa) of Jimma zone which were selected based on their potential for village chickens production. The two districts were stratified into highland (HL), midland (ML) and lowland (LL) agro-ecologies and 385 households, 122 from HL, 155 from ML and 108 from LL were purposively selected for this study. Respondents interview and focus group discussions (FGDs) were employed as surveying techniques and the survey data were analyzed using statistical package for social science (SPSS Ver.20). The overall mean land size, family size and cattle size per household were 0.76±.37 ha, 5.05±.11 and 2.04±.05, respectively. The average chicken size per household were 4.44, 3.24 and 3.70 in HL, ML and LL, respectively and the effective population size ranged from 5.64 to 6.84 with an inbreeding coefficient of 0.08. The average age at first mating (months), age at first egg laying (months), eggs laid per hen per clutch, clutch number per hen per year, clutch length in days, total egg production per year per hen, female and male reproductive life span (years) were 6.16, 6.64, 11.52, 4.11, 24.40, 43.63, 3.19 and 3.52, respectively. Egg production, body weight and adaptability were ranked 1^{st,} 2nd and 3rd preferred traits by farmers across all agro-ecologies with index values of 0.50, 0.15 and 0.13, respectively. Body weight (55.6%), comb type (34.3%) and plumage color (10.1%) for male and body weight (59.7%), finger accommodation between the pelvic bones (25.2%) and plumage colors (8.6%) for female were the major selection criteria of farmers in chicken genetic improvement. The Sick chickens, poor productivity and feather color were farmers culling criteria of chickens in the study area. The urgent need of money in the family (31.4%), time of cultural or religious festivals (31.4%), time of disease outbreak (27.0%) and time of cropping season (10.1%) were reasons for farmers selling chickens. The mean price during ordinary and festivals market for mature cock (121.8, 134.3), mature hen (73.3, 79.9), grower (63.6, 65.0) and egg were (2.1, 2.25) birr, respectively. Disease (39.0%), predators (22.1%), feed resource (19.0%), lack of proper housing (10.1%) and lack of marketing access (9.9%) were the major constraints of chickens' production in the study area. Lack of feeds availability, chicken housing, diseases and predators were factors that hinder the chicken's productivity. Indigenous chicken were high in adaptive trait than exotic but low in productive trait and community based village chicken breeding/genetic improvement could bridge the problems. Health care and diseases control were very low, especially, vaccination given for chickens was weak, that used as precaution for disease preventive, so vaccination for chickens need attention to save flock of chickens from diseases outbreak. Housing system, especially, at night time need improved shelter by properly constructing house to escape chickens from predators and extreme weathers.

Key*words*: Indigenous chicken, reproductive performance, traits preferences, breeding objectives and marketing.

1. INTRODUCTION

Globally, indigenous chicken production system is recognized as a strateg means for capital build up, poverty, malnutrition and hunger reduction among the resources poor households owing to their short reproduction cycles, low inputs production requirements, their good scavenging ability and adaptability to harsh and wide production environments (Besbes, B., 2009).

According to the Central Statistics Agency (2015/6), the total poultry population in Ethiopia is estimated to be about 60.5 million and with regard to breed 94.33%, 3.20% and 2.47% of the total poultry population are reported to be indigenous, hybrid and exotic, respectively. Poultry production is deeply embedded in the Ethiopian society, kept by all strata of society from the landless rural poor to rich (Wilson, 2010).

The village chicken production system in Ethiopia followed a scavenging type of production system using a majority of indigenous chicken ecotypes with only seasonal/conditional feed supplementation (Halima, 2007; Mekonnen, 2007; Fisseha, 2009). The main feed resource in scavenging chicken thought to be insects, worms, seeds, plant materials, etc. with very small amount of grain and table left over supplements from the household and characterized as low input and output.

In Ethiopia, about 95.86% of the total national poultry products (eggs and meat) are contributed by indigenous chickens kept under village management system while the remaining 1.35% is obtained from intensively kept exotic breed of chickens and 2.79% are obtained from hybrids chickens (CSA,2014). The total chicken egg and meat production in Ethiopia is estimated to be about 51,000 and 91,900 metric tons, respectively (LMP, Poultry Roadmap 2015-2020). Production of eggs for consumption is the principal function of chicken production in Ethiopia followed by source of income and meat for home consumption (Halima, 2007; Nigussie, 2011).

The productive performances of indigenous chicken ecotypes were relatively poor. The low egg production performance of indigenous chicken was expressed as slow growth rate, late maturity, produce small sized eggs, small clutch size, broodiness and high mortality of chicks (Bogale, 2008; Fisseha, 2009; Meseret, 2010).

Farmers practice selection to pick breeding and replacement cocks and hens to improve the genetic parts. Efforts to improve the performance of local chickens through cross breeding with exotic breeds were not successful which are attributed to the dissemination of inappropriate technologies without understanding of production environments under which indigenous chickens are raised and the lack of information on breeding objectives and farmers' trait preferences. In Ethiopia, like other developing countries, agro-ecologically based breeding programs for indigenous chicken breeds are lacking (Nigussie et al., 2010).

Though Seka Chekorsa and Kersa districts of Jimma zone have potential for chicken production, there is no or little information on production, local chicken performances, and phenotypic trait preference by farmers, chickens breeding objectives, farmers marketing and management systems, and challenge/constraints in the districts. So, the general objective of this research is to assess indigenous chicken farmers' trait preference, breeding objectives and marketing systems in Seka Chekorsa and Kersa districts of Jimma Zone, Southwest Ethiopia.

Specific Objective

1. To assess production and reproductive performance of indigenous chicken in the districts,
2. To assess farmers traits preferences and breeding objectives of indigenous chickens,
3. To assess management systems and constraints of indigenous chicken in the districts and,
4. To assess marketing systems and consumers demand of indigenous chicken in the district.

2. LITERATURE REVIEWS

2.1. Classification of indigenous chickens

The Ethiopian indigenous chickens are non-descriptive breeds closely related to the Jungle fowl and vary in plumage color, comb type, body conformation and weight. They are characterized by slow growth rate, late sexual maturity and low production as well as reproductive performance (Meserat, 2010). In Ethiopia, limited attention has been given to characterization and classification of indigenous non-descriptive chicken ecotypes and research is at its rudimentary stage for the identification, description (Halima, 2007). Non-described indigenous chickens in Ethiopia are found in huge numbers distributed across different agro-ecology categories under a traditional family-based scavenging management system, (Alemu & Tadelle, 1997).

Only small portion of Ethiopian indigenous chicken were identified and characterized. These includes *Tilili, Horro, Chefe, Jarso* and *Tepi* (Tadelle *et al.,* 2003), *Gelila, Debre-Elias, Melo-Hamusit, Gassay, Guangua* and *Mecha* (Halima, 2007) and *Farta, Konso, Mandura* and *Sheka* (Nigussie, 2011) were the major chicken ecotypes found in different parts of Ethiopia. According to Emebet et al., (2015), about four indigenous chickens ecotypes were identified and characterized, *Dawo, Seden Sodo, Mehale Amba, and Mehurena Aklile* chicken ecotypes were studied in South west Showa and Gurage Zones of Ethiopia.

2.2. Importance of village chicken production

Chicken production in Ethiopia has been contributing a lot to improving nutrition, gender participation and income for rural communities (Mammo and Tsega, 2011). Moreover, social cultures and believes of most of the rural communities have been highly attached and attracted by these morphological variations of the birds in the country. The importance of village poultry production in the national economy of developing countries and its role in improving the nutritional status and incomes of many smallholder farmers and landless communities has been recognized by various scholars and rural development agencies for the last few decades and is significant owing to its low cost of production (Abubakar et al., 2007; Fisseha *et al*., 2010; Abera and Tegene, 2011).

Village based chicken production requires less space and investment and can therefore play an important role in improving the livelihood of the poor village family (Samson and Endalew, 2010). However, the production level of scavenging hens is generally low, with only 40-60 small sized eggs produced per bird per year under smallholder management conditions (Abera, *et al.,*. 2011).

2.3. Indigenous chicken production systems in Ethiopia

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

2.3.1.Large-scale commercial production system

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

2.3.2. Small-scale intensive production system

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

2.3.3. Village/indigenous production system

Village/indigenous production system characterized by little or no inputs for housing, feeding (scavenging is the only source of diet) and health care with minimal level of bio-security, high off take rates and high level of mortality.

As such, it does not involve investment beyond the cost of the foundation stock, a few handfuls of local grains and possibly simple night shades, mostly night time in the family dwellings. Mostly, indigenous chickens are kept although some hybrids and exotic breeds may be kept under this system (Dawit *et al*., 2008).

2.4. Production and reproductive performance of indigenous chickens

The production performances of indigenous chicken ecotypes were relatively poor as compare with exotic breeds. The low production performance of indigenous chicken was expressed as slow growth rate, late maturity, produce small sized eggs, small clutch size, broodiness and high mortality of chicks (Bogale, 2008; Fisseha, 2009; Meseret, 2010).

2.4.1. Age at first egg laying

The age at first egg laying found in central highland of Ethiopia and in three districts of SNNPRs were 24.4 to 32.64 and 28.28 weeks reported by Tadelle (1996) and Mekonnen (2007) respectively. On the other hand, the result is longer than the average age of first egg laying (20 weeks) in Northwest Ethiopia (Hassen H., 2007). According to report of Bogale (2008) mean age of sexual maturity of indigenous chicken in Fogera district were 23.48 and 23.6 weeks for male and female, respectively.

According to Fisseha *et al.* (2010a), the production and reproduction performances of village birds were evaluated under the existing farmer's management condition. The average age of local cockerels at first mating and pullets at first egg were 24.6 and 27.5 weeks, respectively in Bure district, North west Ethiopia. According to Addisu *et al,*. (2013) the overall mean age of sexual maturity were 24.25 and 23.84 weeks for indigenous male and female chickens, respectively.

According to Getu *et al.* (2014), the mean age at first female sexual maturity under traditional production systems was 4.70 ± 0.27, 5.50 ± 0.17 and 6.08 ± 0.20 months with average mean age of 5.43 ± 0.14 months and as well as first male sexual maturity was 4.30 ± 0.27, 4.85 ± 0.14 and 5.13 ± 0.20 with average mean age of 4.76 ± 0.13 months in Necked neck, Gasgie and Gugut chickens, respectively in North Gondar Zone, Ethiopia. Good performance of chicken could be attributed to non-genetic factors such as supplementary feed and care of farmers to their chickens Getu *et al.* (2014).

2.4.2. Number of eggs per hen per clutch

The low production and productivity of the chickens in the area is attributed to the poor management practice of the farmers (Alem, 2014) for local in central Tigray, Northern Ethiopia. According to Melkamu *et al*, (2013) the hen lays about 13 eggs /hen/ clutch in Debsan Tikara Kebele at Gonder Zuria Woreda North Gonder Ethiopia and similarly the average number of total eggs/hen/clutch was 15.7 eggs. This difference might be attributed to presence of better awareness farmers on management of village chicken such as feeding, according to Moges *et al*, (2010) in Bure districts, North West Ethiopia. The average number of eggs (13.3 eggs/hen/clutch) laid by village chicken was 18% lesser than 15.7 eggs/hen/clutch (Fisseha Moges *et al*. 2009) and 16.5% lesser than the 15.5 eggs/hen/clutch (Moreki, 2010) and this might be associated with differences in the breed of chicken and other factors related to feeding and management of chicken.

2.4.3 Clutch length in days

According to Mekonnen (2007) the average number of clutches per year was 3.7 ranged from 2 to 5 with an average clutch length of 26.2 days in Dale, Wonsho and Loka Abaya Weredas of Southern Ethiopia. The difference might be associated with differences in the breed types of chicken and other factors related to feeding and management of chicken under scavenging system. Meserat (2010) reported that the mean clutch length of local hen was 25.29 days under village chicken production in Gomma Woreda. The average number of clutches per year per hen was 3.2 for local hens ranged from 2-5 with an average clutches length of 21.6 days ranged from 15-28 days in central Tigray northern, Ethiopia under rural household managements according to Alem, (2014).

2.4.4 Number of clutch per hen per year

The overall mean egg laying performances of indigenous hens for the first, second and third clutches were 17.0, 20.9 and 24.8 eggs, respectively Tadelle *et al.*, (2003). The average number of eggs laid was 16 (ranged 8-28) eggs laid/clutch in Bure district, North West Ethiopia, Fisseha *et al.*, (2010a) under the existing farmer's management condition. Worku *et al*. (2012), reported, the clutch number of the hens was 3.2 in West Amhara Region of Ethiopia under village chicken production system and the length of time it takes a chicken to mature depends mainly on feed availability.

The average numbers of 4.3 clutches for local chicken was reported by Tsegaw *al*. (2013) under small-scale family poultry production system in North Gonder. The number of clutch per year per hen under village chicken production systems was 4.29 reported by Zewdu *et al*. (2013) in Metekel zone, Northwest Ethiopia.

2.4.5 Egg production

A study carried out by Meseret (2010), Halima (2007), Ayalew & Adane (2013) and Addisu *et al.* (2013) at Gomma wereda of Jimma zone, North West Ethiopia, Chagni town in Awi administrative Zone Amhara and North Wollo zone of Amhara, respectively, revealed that the average egg production of local birds were 43.8 eggs, 18-57 eggs, 27-45 eggs and 49.51 eggs. Aberra and Tegene (2011); Nigussie *et al.* (2010a) has also reported that the production level of scavenging hens is generally low, with only 40-60 small sized eggs produced per bird per year under smallholder management conditions.

Regarding the production potential of indigenous birds, studies carried out at in Western zone of Tigray (Markos *et al.,* 2015) indicated that the average annual egg production of the indigenous chicken was 52.68.Authors reported about 48.98, 54.20 and 54.87 annual average egg production for lowland, highland and midland chicken ecotypes, respectively. The overall number of eggs/hen per clutch of local hen reported by Meseret (2010), Addisu *et al.*(2013), Wondu *et al.* (2013) and CSA (2003) in Gomma wereda, North Wollo Zone North Gondar Amhara region and Ethiopia were 12.92, 12.64, 11.53 (8-15) and 12 (national average of egg yield/hen/clutch).

2.5. Indigenous chickens trait preference of farmers

Farmers practice selection to choose breeding and replacement cocks and hens to improve the productivity and obtain high performing chickens based on five trait categories such as plumage color, live weight, comb type, conformation and breeding ability of chickens of local chicken ecotypes according to Addis, (2014) in Ethiopia. Farmers in the different regions practiced selection on breeding and replacement indigenous chicken males and females based on four trait categories: plumage colour, live weight, comb type and body conformation. Farmers in the Amhara (Farta) and Oromia (Horro) regions give the highest emphasis for plumage colour while in the Southern region (Konso and Sheka) live weight is used as the most important selection criteria.

The emphasis given to each trait category is largely similar across the sexes except that, unlike for males, live weight is most important in Mandura (64%) and almost equally important to comb type in Farta for selecting breeding females. White and red plumage colours were identified as the two important morphological traits used for selection on the basis of body plumage. Red is the most favoured plumage in the Benishangul-Gumuz (Mandura), Oromia (Horro) and Southern Regions (Konso and Sheka) whereas white is the body plumage colour more favoured by the Amhara community (Farta) irrespective of the sex of the birds according to Nigussie (2011).

Number of eggs (37.91%) and plumage color (37.6%) were the two most preferred traits; farmers in high altitude were more likely to prefer number of eggs (36.0%) as primary trait than farmers in mid altitude (33.0%) and low altitude (33.9%) areas according to Addisu *et al*., (2013) in North Wollo, Amhara regional State, Ethiopia. According to the report of Abdelqader *et al*. (2007) the most important traits of farmers were growth rate, disease tolerance, egg yield, body size and fertility.

2.5.1. Egg production trait

The mean annual egg production of the indigenous chicken ecotype was 30-60 eggs (under village condition) and pointed that; this could be improved to 80-100 eggs on station with improved feeding, housing and health care (Nigussie and Ogle, 2000). The total number of eggs produced per hen per year ranges from18-57 (Halima, 2007). Total egg production/hen/year of indigenous hen's ranges from 53-60 within a range of 43.2-46.96gm of egg weight under farmer management condition (Fisseha *et al*., 2010b). The average estimated length of a single egg-laying period per hen is to be 21, 36 and 105 days for local, hybrid and exotic breeds (CSA, 2011). The total number of clutch periods/hen/year was 4 (ranged 2 - 6) with annual egg production performance of 60 eggs/hen (ranged 24 -112) under farmer's management condition (Fisseha *et al.,* 2010a).

2.5.2. Clutch number trait

Mekonnen (2007) reported from Southern Ethiopia, the average number of clutches per year was 3.7 ranged from 2 to 5 with an average clutch length of 26.2 days under the smallholder poultry production system. According to Meserat (2010), the average number of clutches per year recorded from the Gomma Wereda was 3.43 in numbers.

Mogesse (2007) confirmed that productive local hens have on average 9-19 eggs per clutch with a maximum of 2 to 3 clutches/hen/year as a result the total number of eggs produced ranged from 18-57 eggs/year/ hen, which is very low in Northwest Ethiopia. According to Fisseha (2009) reported, the average number of eggs/hen/clutch and the number of total clutches/hen/year were estimated to be 15.7 and 3.83, respectively under the existing farmer's chicken management condition in Bure, North-West Amhara. Nebiyu, *et al.,* (2013), the average number of clutches per village hen per year was 3.8 (95% CI=3.69 –3.92), which ranged from 2 to 6 clutches under scavenging chicken production system in Halaba district of southern Ethiopia.

2.5.3.Adaptability traits

In terms of adaptive traits and consumption the indigenous chickens were considered favorable. Nigussie *et al*. (2010b) reported that most of the respondents claimed that the modern breed is poor in disease and stress tolerance (86%) and ability to escape predators prevalent in their village conditions (96%). The modern breed generally required higher level of management (83%) often hard to afford and are poor scavengers (86%) compared to indigenous chickens. In addition, 77% of the farmers in Horro and 90% in Sheka claimed that hatchability of eggs obtained from the modern breed is inferior to eggs from indigenous chickens. Adaptive traits (specifically disease and stress tolerance, flightiness, and scavenging vigor) in both males and females, growth in males and number of eggs in females, ranked first and equal in importance in low altitudes. In the highlands, adaptation is second in importance to growth (males) and egg production (females). With this regard, the final interest lies in answering the question of what adaptive traits of chicken exists in central of zones Tigray through the participation of the community (Mearg, 2015).

2.6. Farmers breeding objectives

Mengesha *et al*. (2008) reported that the purpose of keeping poultry in Jamma district was mainly for sale (38.1%), followed by home consumption (31.7%) and no defined (16.3%), at last for religious purposes (13.9%). In central highlands of Ethiopia the purpose of keeping poultry was 50%, 27% and 23% for hatching, sale and home consumption, respectively (Tadelle *et al.,* 2003a). In another study conducted by Aberra and Tegene (2007), in Southern parts of Ethiopia, about 71.4% of chickens raised by the rural community were used for egg production while the rest 28.6% were used for meat production purposes.

Nigussie *et al.* (2010b) also reported that, chickens are raised importantly as source of income and egg production for home consumption. Meat production for home consumption is second in importance in Oromia (Horro) and Southern regions but the function of chickens as source of cash income was rated to be as important as (Horro) or more important than egg and meat production in Mandura district (Nigussie *et al.,* 2010b). It is second in importance to egg production in Farta. In Konso, the principal purpose of raising chickens is for home consumption and their value as income source is third in importance.

Based on Nigussie *et al.* (2010b) reports, only 5% of the farmers in Farta and Konso included the cultural–religious role of chickens' rating it fourth in importance. Mengesha *et al*. (2011) reported in Jamma district that egg utilization for consumption in Woinadega (30.6) and in Dega, (33.9%) and egg utilization for gift in Woinadega (10.5%) and in Dega, (6.8%). In some parts of Africa (Gondwe *et al.,* 2004; Muchadeyi *et al.* 2007) indicated that the cultural/religious role of indigenous chicken types is important. Some efforts were done in one district of the study area but in the two districts still remain unexplored initiating investigation as a prior step for the endeavors of poultry production and productivity improvements and sustainable utilization of indigenous chickens.

2.7. Breeding and Selection Practices

Traditional chicken production system is characterized by lacks systematic breeding practice in Gomma district (Meseret, 2010). Furthermore, a study conducted in different parts of Ethiopia revealed that village chicken breeding is completely uncontrolled and replacement stock produced through natural incubation using broody hens (Negussie, 2007; 2011). In another study conducted by Fisseha (2009) revealed that about 92.2% of chicken owner farmers in Bure district had the tradition of selecting cocks for breeding stock. Okeno *et al.* (2011) in Kenya reported that farmers who are confining their flocks do selection of chicken for breeding.

According to Fisseha (2009), plumage color (45.4%) and comb type (8.6%) were some of selection criteria for breeding stock in Bure district. Another study conducted in mid Rift valley of Oromia revealed that 68% of the farmers select productive hen by its body size, 12% by finger accommodation between the pelvic bones and 20% by pedigree performance for replacement (Hunduma *et al.,* 2010).

2.8. Mating System and Culling Practices

According to the report of Nigussie *et al*. (2010b) there was no systematic mating in different regions of Ethiopia. Another study conducted in the three districts of SNNPRS disclosed that the free-range feeding practice attributed to indiscriminate mating of cocks and hens (Mekonnen, 2007). Bogale (2008), who reported that the home consumption, selling (46.5%), old age and poor productivity (25%) and sickness (5.65%) were the main culling ways of chicken from their flock. Another study in Northwest Ethiopia by Halima (2007) also revealed that farmers' cull poor productivity and old age chickens via selling. The breeding practice, mating system and culling practice remain unexplored in the study areas that initiating to investigation these through participating the communities.

Culling poor productive (43.9%) was the first most frequent way of mating control of farmers' flock followed by retaining best cocks and layers for further breeding (36.9%), cull at early age (13.2%) and preventing mate (6%) in Western Zone of Tigray, Northern Ethiopia. Village chicken owners had culling practices of unwanted chickens from their flocks, Shishay et al., (2016), either by poor productivity (47.3%), poor productivity and sickness (22.9%) or poor productivity and old age and sickness (17.7%) were the major determinant factors for culling unwanted chickens from a given flock of village chicken producers in Western Zone of Tigray, Northern Ethiopia.

2.9. Management systems of chicken production in Ethiopia

2.9.1. Feeds and feeding

The majority of farmers in North-west Ethiopia used maize, barley, wheat, finger millet and household waste products as a source of supplementary feeding to their chickens (Halima *et al*., 2007) and the type of grains used as supplementation varied among agro-ecologies, which is related to the type of crops grown, also only 3.4% of the chicken owners provided supplementary feed using feeders. About 97.8% of the farmers provided supplementary feed to rural chickens (Meseret., 2010), broody hens were given priority in case of supplemental feed provision, since chicks are not yet in a position to scavenge feed and the broody hens were mostly being kept inside the house incubating the eggs and do not have enough time to freely scavenge and get their feed in Gomma Wereda of Jimma zone.

Zewdu et al., (2013), reported, scavenging was the major feeding village chicken production system in Metekel zone, Northwest Ethiopia, however, the farmers were found to supplement their chickens occasionally with household refuse and grains (mainly paddy rice, maize and sorghum) during dry (92.5%) and rainy (7.5%) seasons and farmers provide supplementation for chickens in the morning before scavenge, at any time of the day and both in the morning before scavenge and at any time of the day.

2.9.2. Water provision

According to Mekonnen (2007), surveyed report, the water given to chickens was drawn from rivers (37%), pond (35%) and borehole (28%) and about 75% of the farmers provided water for their chicken twice a day usually in the morning and evening and 25% once a day at any time Dale, Wonsho and Loka Abaya Weredas of Southern Ethiopia. According to Moges *et al*. (2010) in Bure, village chicken owners (100%) provided water to village chicken; 85.4% only during the dry season and 14.3 % throughout the year; most chicken producers (78.9%) used adlibtum watering type (making water available every time). According to Dasalew et al., (2013), the majority of the respondents used tap to their chicken, whereas borehole was the major water source and about 96% of respondents provided water with free access in Lume district East Shewa, Ethiopia.

2.9.3. Housing

Housing is essential to chickens as it protects them against predators, theft, and inclement weather (rain, sun, cold wind, dropping night temperatures) and to provide shelter for egg laying and broody hen in Dale Wonsho and Loka Abaya Weredas of Southern Ethiopia (Mekonnen., 2007). In traditional free range, there is no separate poultry house and the chickens live in family dwelling together with humans (Solomon, 2007). In North West Ethiopia, 77.9% of the village chicken owners provide night shelter and only 22.1% provided separate poultry house (Moges *et al*, 2010a).

2.9.4. Health management

Health care is one management aspect of village chicken production. To improve the productivity of chicken they should be kept healthy. The majority of farmers (82%) used traditional medicine to cure chickens when they are infected. Farmers used traditional medicine such as simza, fito, and garlic with feeds.

On the other hand; 18% of respondents applied modern medicine prescribed by veterinarian. Farmers who used modern medicine were small 18%, because low veterinarian accessibility, lack of awareness and inadaptability to use modern medicines (Melkamu *et al*, 2013) in Debsan tikara keble at Gonder zuria woreda, north Gonder, Ethiopia.

(Mammo, 2006), chicken care practices such as avoiding feed contamination and water and also cleaning of poultry house were not performed well by farmers. In village chicken production system, periodic devastation of flock by disease is very high and disease is the major factor for the loss of the flock in village poultry production system (Fisseha, 2009) and (Nigussie *et al,* 2010). Moges *et al*. *(*2010a) suggested that improvement in veterinary and advisory service could help to achieve control of diseases at village level. In different parts of Ethiopia, no vaccination practice against poultry diseases was reported by Moges *et al*.(2010a); Leta and Endalew (2010); Takele and Oli (2011) and Mengesha *et al*.*(*2011).

2.10. Major constraints/challenges of village chicken

Wondu *et al*. (2013) from Northern Gondar who disclosed that diseases (1st), predators (2nd), shortage of supplementary feeds (3rd), poultry housing problems (4th) and lack of veterinary health services (5th) were the most important constraints of village chicken production under urban system. Addisu *et al.* (2013) had also reported that diseases (60.13%), feed shortage (20.59%), predators or theft (19.8%) were the most economically important constraints of chicken production in North Wollo zone of Ethiopia. According to a recent report by Shishay, (2016) from Western Zone of Tigray, Northern Ethiopia, disease and predators were the first and second chicken production constraints in all agro-ecological zones.

2.10.1. Diseases and predators constraints

The major causes of death for village poultry production were commonly disease (mainly New Castle Diseases locally known as "Sombe/Fengil"), followed by predation and high incidence of chicken diseases, mainly Newcastle Disease (NCD), is the major and economically important constraint for village chicken production system (Fisseha *et al.,* 2010). Predators such as birds of prey (locally known as "culullee") (34%), cats and dogs (16.3%) and wild animals (15%) were identified as the major causes of village poultry in rift valley of Oromia, Ethiopia (Hunduma *et al*., 2010).

Meseret, (2010); Alemayehu, (2015) and Shishay, (2016) reported that, Newcastle disease (34.42%), infectious bronchitis (27.92%), infectious bronchitis and external parasites (25.97%) and coccidiosis (11.69%) were the most economically important poultry diseases in Gomma district; Newcastle disease was the most prevalent and economically important disease affecting chicken in Benishangul-Gumuz and Newcastle disease (1st), fowl salmonella (2nd), coccidiosis (3rd), fowl typhoid (4th), fowl cholera (5th), fowl pox (6th) and fowl coryza (7th) were the major and economically important diseases that hinder the expansion of village chicken production in Western Zone of Tigray, Northern Ethiopia, respectively.

2.10.2. Feed resource constraints

In village chicken production systems, it is difficult to estimate the economic and/or physical value of feed resource input because there are no direct methods of estimating the scavenged feed input, according to Hunduma *et al*., (2010) feed shortage mostly occurs from June to August time of the year for village poultry as it is not harvesting season of cereal crops. Fisseha (2010) reported, shortage of supplementing feeds during rainy season makes the chickens more vulnerable to diseases in Ethiopian. According to Bushura (2012), indicated that in Ethiopia, village chicken production systems are usually kept under free range system and the major proportion of the feed is obtained through scavenging. Getu et al, (2014), farmers had no cleared idea in terms of the quality and quantity of supplementary feeds in north Gondar zone, Ethiopia.

2.10.3. Lack of proper housing constraints

Moges *et al* (2010) who reported that only 22.1% of farmers provide separate overnight houses for village chickens. Lack of knowledge and awareness and poor attention to village chicken were some of the reasons for not constructing separate chicken house. Proper housing does not only provide an environment that moderates environmental impact but also provides adequate ventilation for the birds to lay eggs in next boxes, as well as to feed and sleep in comfort and for security purposes (Yakubu., 2010). Housing systems in backyard system is rudimentary and mostly built with locally available materials. In traditional free range, there is no separate poultry house and the chickens live in family dwelling together with humans (Solomon, 2007). Moges *et al.* (2010a) reported that in Bure district, North West Ethiopia 77.9% of the village chicken owners provide only night shelter and only 22.1% provided separate poultry house.

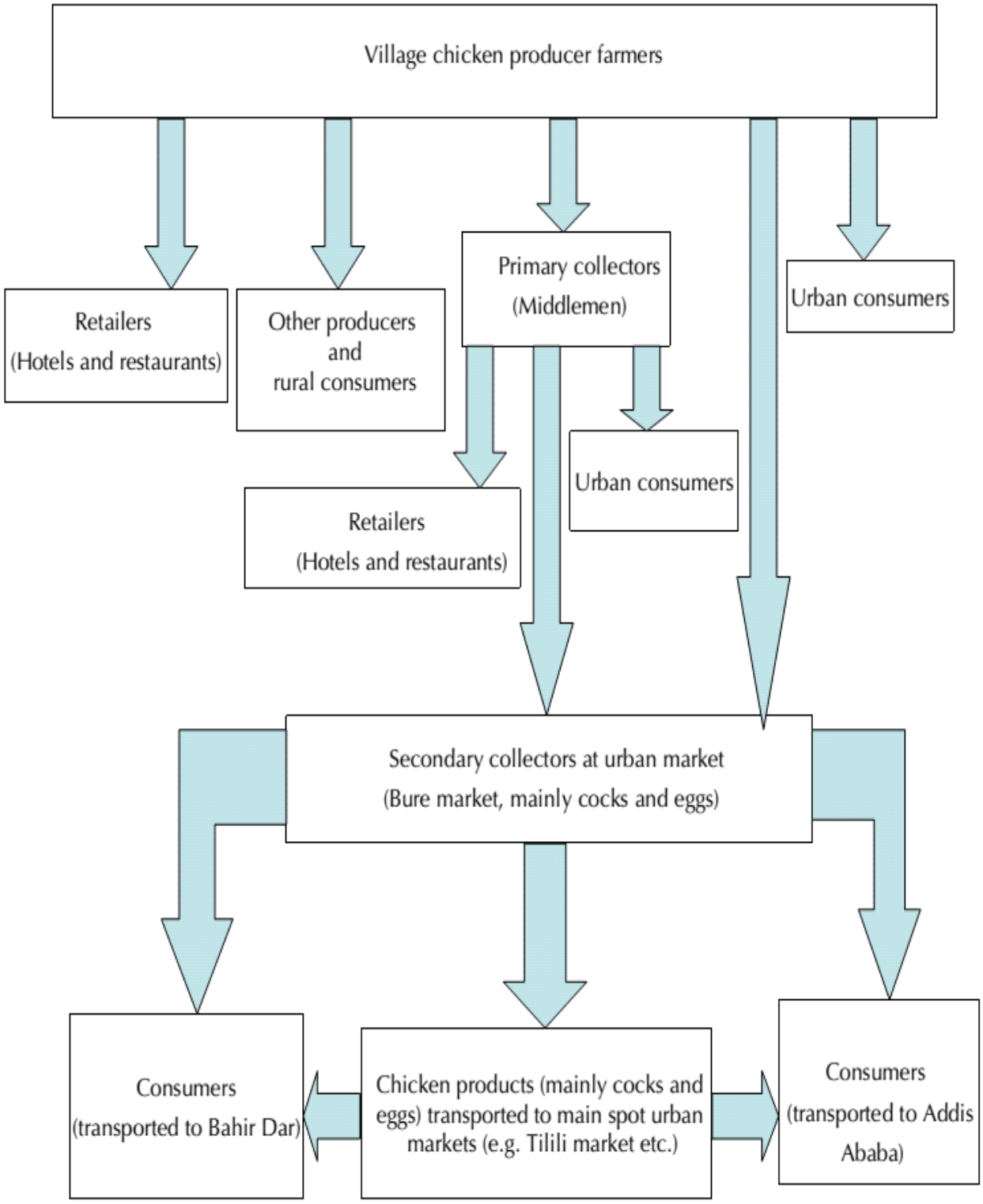
2.11. Marketing systems of village chicken and egg in Ethiopia

The term marketing referred to all activities from the producer to the final consumer including processing and distribution systems. The type and amount of product, the size of producers, the marketing infrastructure and the policy/institutional environments all determine the type of marketing system and the effectiveness with which it operates (ILRI, 1995). Tadelle *et al.* (2001) also reported that few chicken owner farmers, in central highlands of Ethiopia, exchanged their free-range chickens for food and household items. According to Halima (2007), the prices of chicken products was highly related to supply & demand, plumage color, size, age, sex, market site and the health status of the chicken.

Similar to supply & demand, the price of chicken products were not similar throughout the year and found affected by various factors. Some determinant factors affecting prices of chicken products included: demand and supply of chicken products, agro-ecology (highland, mid-altitude and lowland), and product type (sex, age, breed, comb type, etc), season of the year (dry and rainy), market type (urban vs. local markets), market day types (holyday vs. ordinary market days), fasting seasons (e.g. pre-easter fasting season) and the dramatic increase in price of large and small ruminants (sheep, goats and cattle) (Fisseha, 2009).

The price of live chickens is affected by seasonal demand (holidays and fasting seasons) where September to November and March to May were months of high demand for eggs and chickens (Hunduma, 2010) and the price of live birds is often double during holidays and reducers during fasting season. According to Fisseha (2009) reported from the North- west part of Amhara region, households increase and reduce their flocks according to prices, due to the high population of Orthodox Christian religion followers. Village birds 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.

There were a number of key actors involved in village chicken and egg production and marketing. These included producers, middlemen (chicken and egg collectors), traders, retailers, local restaurants/hotels and direct consumers, according to Fisseha, et al., (2010); those actors were important and play key roles in further development of chicken production in the Ethiopia (figure:1).



Source: *Moges et al. (2010a).*

Figure: 1 Marketing channels of chicken and eggs in northwest Ethiopia.

3. MATERIALS AND METHODS

3.1. Description of study area

This study was undertaken in two LIVES poultry commodity intervention districts, i.e., Seka Chekorsa and Kersa of Jimma zone of Oromia Regional State (figure 2). Based on agro-ecology and potential for village chickens production, Seka Chekorsa and Kersa districts were selected for the present study.

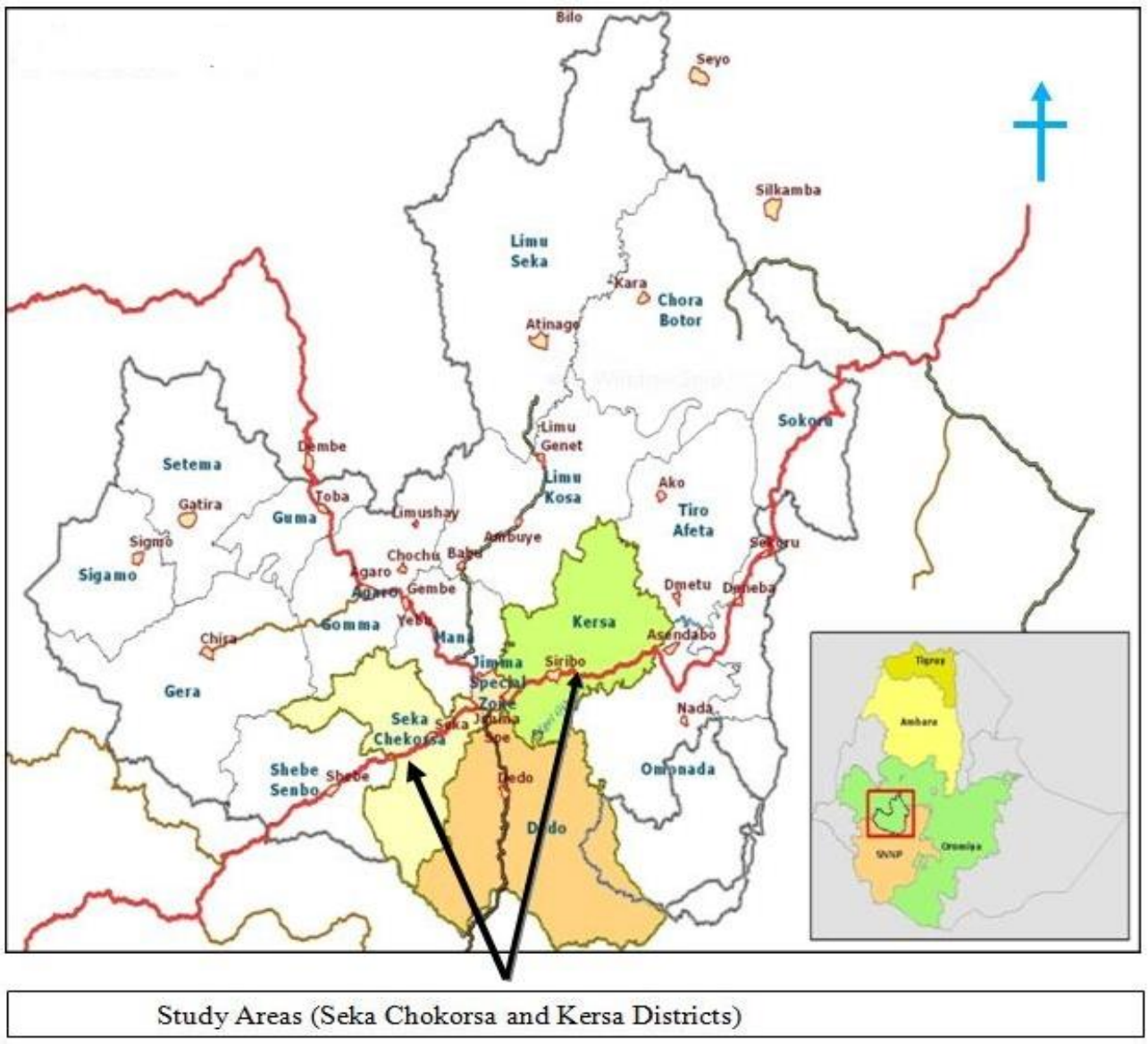


Figure 2.Maps of study areas.

Source: Zonal Diagnosis and Intervention Plan Report for Jimma Zone (LIVES), April 2013.

3.1.1. Kersa district

Kersa district is located at a distance of 346 kms south west of Addis Ababa, capital city of Ethiopia. It is situated at an altitude ranging from 1,450 to 2,550 meters above sea level (masl) and it is bordered by Limmu and Tiro-Afeta districts in the north, in the south by Dedo,Omo Nada in the East and Jimma town in the west.

The area receives an average annual rainfall ranging from about 1,400 to 1,587 mm. The minimum and maximum daily temperatures of the area are 10ºC and 32ºC, respectively. An agro-ecological setting of the district comprised of highlands (10%), midlands (75%) and lowlands (15%). The district is covers an estimated area 678.6 km^2 and district is divided into 30 rural kebeles (lowest administrative unit) and 2 urban (town) kebeles. The district has a livestock population of 139,898 cattle, 61,753 sheep, 24,053 goats, 3,883 horses, 4,812 mule and 3,677 donkeys (CSA, 2013). Concerning chicken population, the district has an estimated population of 104,865 local and 2,458 exotic and the district is highly potential for chicken production (Kersa livestock and fishery development office, 2013). The major crops grown in the district are maize, sorghum, barley, wheat, teff, beans and pea. In addition to these, backyard vegetables and root crops (potato, sweet potato, carrot, cabbages, and red root) are also produced in the district. Rice and chickpea are produced in small quantity. The district has an estimated total human population of 329,629of which 166, 939 are females and 162,690 males and 13% of its population is urban dwellers (CSA, 2013).

3.1.2.Seka Chekorsa district

The district is located at a distance of 364 kms, south west of Addis Ababa, capital city of Ethiopia. It is bounded by Gomma and Manna districts in the north, Gera district in the south, Dedo district and Jimma town in the east and Shabe Sombo district in the west. Currently, the district covers an estimated area of 455 km^2 and is divided into 36 rural kebeles (lowest administrative unit) and 2 urban (town) kebeles. The human population in the district is 206,427 with male 103,895 and female 102,532. It is situated at an altitude ranging from 1,480 to 2,560 masl. An agro-ecological setting of the district comprised of highlands (15%), midlands (67%) and lowlands (18%) and the general indication is that, the district receives good rainfall, ranging from 1,200 – 2,800 mm per annual. In normal years, the rainy season extends from February to October.

The minimum and maximum daily temperatures of the area are 12.6^0C and 29.1^0C, respectively. The district has a livestock population of cattle 187,538, sheep 93,184, horses 6,813, mules 2,156, donkeys 8,849 and goats 31,464 (CSA, 2013). Concerning chicken production, the district consists of indigenous chicken 398,120 and exotic chicken 3,456. The major crops grown in the district are: inset, maize, sorghum, teff, barley and vegetables and the minor crops were: - haricot beans, wheat, potato and sweet potatoes.

3.2. Research design, sampling and data collection

3.2.1. Data sampling procedure and sample size

The kebeles in the two districts were stratified into three altitude zones, i.e.: low lands<1500masl, midlands 1,500 - 2,300masl and high lands >2300masl (MOA, 2000). Data showed that in Seka Chekorsa district 11, 13 and 10 kebeles fell in highland, midland and lowland agro-ecological zone, respectively. One kebele was selected from each of the three agro-ecological zones, namely Bake Gudo (HL), Deto Kersu (ML) and Ushane Koche (LL). The Kebeles were purposively selected on the basis of village chickens production potential.

Likewise, in Kersa district 9 Kebeles fell in the HH, midland (12 kebeles) and lowland (11 kebeles). One kebele from each of the three agro-ecological zones, i.e.: Gora Sariti (HL), Ankaso (ML) and Dogoso (LL) were selected based on village chickens production potential. In total, 6 Kebeles, i.e., 2 in HH, 2 in ML and 2 in the LLs were included in the study.

Totally, 385 households were purposively selected who owned four or more chicken from the total number of house-holds in the six kebeles. The total number of households per altitude zone (122 in HL, 155 in ML and 108 in LL) was determined using the proportionate sampling technique for the present study (because all farmers didn't participate in chicken production and marketing) (table 1). Sample size for the proportion was developed by Cochran (1963) is frequently preferred strategy for large population (**infinite population or >50,000**).

$$\mathbf{N_o = [\underline{Z^2 pq}] / e^2}$$

Where $N_{o=}$ required sample size, $.Z^2$ =is the abscissa of the normal curve that cuts off an area at the tails (1 - α equals the desired confidence level, e.g., 90%, 95%, 99% confidence level) and the Z values for most commonly used confidence level (90%=1.645; 95%=1.96 and 99%=2.576), e = is the margin of error (e.g. ±0.05% margin of error for confidence level of 95%), p = is the degree of variability.

For the survey the required sample size of respondents (local chicken owners) with 95% confidence level was calculated as, $N_o = [Z^2pq] / e^{2,} = [(1.96)^2 \times (0.5)\ (0.5)]/ (0.05x0.05) = [3.8416 x0.25]/ (0.0025)=0.9604/0.0025=385$ farmers.

The number of respondents (farmers) per single selected kebeles was determined by proportionate sampling technique as follows:

$W = [A/B] \times N_o$, where

A=Total number of households living per a single selected kebeles,

B=Total sum of households living in all selected sample kebeles and

N_o = the total required calculated sample size.

Table 1: Number of households selected per six kebeles

Woreda	Agro-ecologies	Names of selected kebeles	Total no. of HH possessing Chickens	Respondents selected from each kebeles
Seka Chekorsa	HL	Bake Gudo	912	62
	ML	Deto Kersu	1245	84
	LL	Ushane Koche	814	55
	Sub total		2971	201
Kersa	HL	Gora Sariti	878	60
	ML	Ankaso	1048	71
	LL	Dogoso	778	53
	Sub total		2704	184
		From two districts		
Total	HL		1790	122
	ML		2293	155
	LL		1529	108
	Overall		5675	385

3.3 Data sources and collection methods

Both primary and secondary data were used to achieve the objectives of the study. Secondary data was obtained from reports of Zonal and districts livestock and fishery development office, NGOs and other published and unpublished materials. In order to collect primary data, the Participatory Rural Appraisal (PRA) specifically Focus Group discussion (FGD) was used to undertake informal discussion with groups composed of key informants like; development agents, Expert in Rural Development of the respective districts. Based on the information generated through PRA, the questionnaire was developed for the formal interview. Then, the primary data was collected from sampled respondents through structured questionnaire.

Pre-testing of the questionnaire was made as a pilot survey, and on the basis of information obtained during pre-testing, modification was made on the questionnaire. Single-visit-multiple-subject formal survey method (ILCA, 1992) was employed to collect data on various aspects of indigenous chickens' production and marketing system. The enumerators were recruited from each selected study areas and made acquainted with the questions, trained on methods of data collection and interviewing techniques.

3.3.1. Survey of village chickens production system

Household data on socio-economic characteristics (sex, age, family size, education level, marital status, land size and livestock holding), village chickens production systems, marketing of village chickens (reason of selling, marketing channels, season of marketing, participants and modes of transportation) were collected from selected village chickens owners in the study area. The data on production and reproductive performances (age at first mating, age at first egg laying, number of eggs per hen per clutch, number of clutch per hen per year, clutch length in days, total eggs production per hen per year, hens and cocks reproductive life span); and chickens constraints and husbandry systems and also ranking of traits preference considered by producers, breeding objectives (purpose of chickens rearing and egg production) and farmers chickens culling criteria of indigenous chicken in the study area were be collected from interviewed village chicken owners/producer (Appendix A).

3.4. Data management and data analysis

All data were managed by using Microsoft Excel computer program and statistical package for social science (SPSS) version 20 (SPSS Inc., Chicago, Illinois, USA, 2007).

3.4.1.Descriptive statistics

Descriptive statistics like percentages, averages, ranges, mean, standard deviation, standard error and frequency distribution were used to describe the household characteristics in the study areas and also pair-wise comparison of the means was made by employing one way ANOVA and chi-square to see for significant differences. These included family size and composition, age group, land holding, livestock herd size and composition, chicken management and constraints of chicken production and also chicken performance parameter (reproductive life span, age at first egg laying, number of eggs hen per clutch, number of clutch per hen per year, clutch length in days, total eggs production per hen per year).

3.4.2. Ranking and index

The farmer traits preference for indigenous chickens: egg production trait, feather colour trait, mothering ability trait (broodiness and hatchability of eggs), adaptability trait resistant to diseases and harsh climate, comb types and body weight traits; chickens breeding objectives/purpose of chickens rearing: meat for consumption, egg for consumption, for cultural/religious, for source of income and for flock replacement. Purposes of egg production: for home consumption, for cultural/religious, for source of income and hatching chickens; and farmer's chickens culling criteria were analyzed under index method with ranking. An index would be calculated to provide overall ranking the traits used for choosing chicken according to the formula (Kosgey 2004; Chambers, 1994; Bhandari, 2003 and Gizaw et al, 2010).

Index = sum of [(3 x number of household rank first) + (2 x number of household rank second) + (1 x number of household rank third)] for a particular cause divided by sum of [(3 x number of household rank first) + (2 x number of household rank second) + (1 x number of household rank third)] for all causes in an agro ecology.

3.4.3. Inbreeding coefficients

The rate of change in inbreeding per generation was calculated using the data for effective number of breeding animals assuming each household flock is closed.

Average change in percentage of inbreeding per generation was estimated as:

$$\Delta F = 1 / (2\,Ne)$$ (Falconer and Mackay, 1996), Where,

ΔF = Rate of change in inbreeding per generation and

Ne = the effective population size

$$Ne = [4\,(Nm \times Nf)] / (Nm + Nf),$$ Where,

Nm = number of breeding male and

Nf = number of breeding female

3.4.4. Inferential statistics

1. Model statement regarding the effect of agro ecological differences on various performances parameter of local chicken was generalized by inferential statistics.

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

Yij = Observation of i^{th} bird in j^{th} agro ecology,

μ= the overall mean,

mi = fixed effect of i^{th} agro ecology ($i = 1, 2, 3$) and εij = the residual error.

4. RESULTS AND DISCUSSION

4.1. General Socio Economic Characteristics

The results of the general socio economic characteristics across the 3 agro-ecologies were presented in table 2. The majority of the households covered in the current study were female headed in the 3 agro-ecologies of the two districts. The male and female headed households were 33.5% and 66.5%, respectively. This result agrees with the reports of Meseret (2010), from the total interviewed village chicken owners, and 30% and 70% was male and female headed households in Gomma woreda of Jimma zone.

The majority of the households of the study area were married (93.5%) followed by single 4.9%, widowed 1.3% and divorced 0.3% and the majority of the household heads were 48.3%, in the age group of 31-40 years whereas the households in the age range of 20-30 years, 41-50 years and 51-60 years were15.4%, 30.6%, and 5.7%, respectively. These results were somewhat similar with that reported from the same zone by Meseret (2010), the majority of the respondents (97.2%) were married and the largest proportion (82.8%) of the respondents were within the age groups of 31-60 years in Gomma woreda of Jimma zone. The respondents with age group from 31-40 years were highly participated in chickens production and those age of farmers were producing crops for their family consumption, also leftover crops was used for their chickens feeds.

Concerning to the educational background of the interviewed farmers, about 39.7% read and write, 29.1%, 9.4% and 0.3% of the respondents had learned primary first cycle (1-4), primary second cycle (5-8) and high school (9-10) respectively, and about 21.6% of the respondents were illiterate in the study area. There was lack of awareness on chickens' production and management system (feeding, housing and health), especially the illiterate farmers considered their chickens as scavenger of cereal and food refusals but not as an asset. The family size per household showed significant ($p < 0.05$) differences between HL and LL agro-ecologies. Within different agro-ecologies, there was different changing in climate. Areas with good climates tend to be densely populated as there is enough rain and heat to grow crops. The average family sizes identified in the study districts (5.05) were comparable with the 5.5 persons were reported from Oromia (CSA, 2013). The averages land size per household in HL (0.83 ha) was larger in ML (0.75 ha) and in LL (0.70 ha).

Table 2: Households characteristics of the respondents in Kersa and Seka Chekorsa districts

Households Character	Agro ecologies							
	HL(N=122)		ML(N=155)		LL(N=108)		Total(N=385)	
	N	%	N	%	N	%	N	%
Sex of respondent								
Male	39	32.0	53	34.2	37	34.3	129	33.5
Female	83	68.0	102	65.8	71	65.7	256	66.5
Age of respondents								
20-30	15	12.3	37	23.9	7	6.5	59	15.4
31-40	61	50.0	76	49.0	49	45.4	186	48.3
41-50	35	28.7	41	26.5	42	38.9	118	30.6
51-60	11	9.0	1	0.6	10	9.3	22	5.7
Marital status of house hold								
Married	113	92.6	143	92.3	104	96.3	360	93.5
Single	6	4.9	11	7.1	2	1.9	19	4.9
Divorced	1	0.8	0	0.0	2	1.9	3	0.8
Widowed	2	1.6	1	0.6	0	0.0	3	0.8
Educational status of household								
Illiterate	17	13.9	35	22.6	31	28.7	83	21.6
Reading and writing	44	36.1	70	45.2	39	36.1	153	39.7
Grade 1-4	45	36.9	32	20.6	35	32.4	112	29.1
Grade 5-8	15	12.3	18	11.6	3	2.8	36	9.4
Grade 9-10	1	0.8	0	0.0	0	0.0	1	0.3
Religion of respondents								
Orthodox	3	2.5	11	7.1	8	7.4	22	5.7
Muslim	113	92.6	140	90.3	98	90.7	351	91.2
Protestant	6	4.9	4	2.6	2	1.9	12	3.1
Family size/HH (Mean ± S E)	5.09±0.20[a]		3.54±0.20[b]		5.42±0.15[a]		5.05±0.11	
Land size/HH (ha.) (Mean ± S E)	0.83±0.42[a]		0.75±0.35[b]		0.70±0.33[b]		0.76±0.37	

HL=highland, ML=midland, LL=lowland, N=number of respondents

The 0.76 ha was the averages land size per house in all agro ecologies of the study area. The land size owned per household was significant difference between HL and LL agro-ecologies and between HL and LL agro-ecologies and non-significant differences land size per household between ML and LL. This variation may be affected by climates of each agro-ecology. Highland and midland (high and moderate rain fall) agro-ecologies was preferable for crop production, animals productions and abundance by animal feeds (high grass biomass) than lowland (low rainfall) agro-ecologies.

This result (0.76 ha) was comparable with Mekonnen, (2007), the average farmland holdings were 0.86 ha ranged from 0.13 to 3 hectares in Dale, Wonsho and Loka Abaya Woreda of Southern Ethiopia. The average land per household in the study area was smaller (0.76ha) than that of the national average of 1.18 ha (CSA, 2011). This variation may be due to the population lived on unit square of land because of types of agricultural activities, cattle producer farmers may be used larger land than crops producer farmers.

4.2. Farming activities in the study area

The results of the farming activities in the study area are presented in table 3. This table shows that all respondents across the different agro-ecologies of the study area (Seka Chekorsa and Kersa districts of Jimma zone) were following mixed crop-livestock farming system. The major crops produced in the study area were 57.4%, 16.1%, 10.6%, 8.8%, 7.0% and 3.6% maize, wheat, teff, barley, sorghum, and bean, respectively.

Table 3: Farming activities and major crops in the study area

Farming activities	**Agro-ecologies**			
	HL (N=122)	**ML (N=155)**	**LL (N=108)**	**Total (N=385)**
Mixed livestock crop production	122 (31.7)	155 (40.3)	108 (28.1)	385 (100.0)
Major crops cultivated (%)				
Barley	28 (23.0)	1 (0.6)	5(4.6)	34 (8.8)
Wheat	35 (28.7)	24 (15.5)	3 (2.8)	62 (16.1)
Maize	54 (44.3)	97 (62.6)	70 (64.8)	221 (57.4)
Sorghum	0 (0.0)	16 (10.3)	11 (10.2)	27 (7.0)
Teff	5 (4.1)	17 (11.0)	19 (17.6)	41 (10.6)
Bean	14 (11.5)	0 (0.0)	0 (0.0)	14 (3.6)

HL=highland, ML=midland, LL=lowland, N=number of respondents

4.3. Livestock population of the study area

The average holding of cows, oxen, heifers, sheep and goats (table 4) were significantly ($p < 0.05$) affected by the agro-ecologies while the average holding of calves, donkeys, horses and mules did not show variations in the study areas. The three agro-ecologies showed different trends in the livestock size per house-hold with cows, oxen, heifers, sheep and goats. The cows, oxen and heifers per household were highest in LL than HL and ML agro-ecologies. The sheep per household was highest (5.59) in HL and lowest (1.33) in LL areas.

Generally, the average livestock holding per household was 2.04 cattle, 2.97 sheep and 2.64 goats in the study area. There was significant difference (P<0.05) in the average of livestock size per household among the three agro-ecologies. Those variations may be affected by the farmers breeding objectives and availability of feeds resources. The overall mean of chickens per house hold was 4.05 chickens in the study area. The number of chickens was (highest in highland (4.51) but lowest (3.61) in midland) and medium size in lowland (4.03) per household.

Table 4: Livestock holding per household in 3 agro-ecologies of Kersa and Seka Chekorsa districts (Mean ± S E)

	Agro-ecologies				
Parameters	**HL=(122)**	**ML=(155)**	**LL=(108)**	**Total**	**P-value**
Livestock population					
Cows	2.65±0.12[a]	2.08±0.11[b]	3.16±0.12[c]	2.58±0.07	0.001
Oxen	2.48±0.08[b]	2.14±0.06[b]	2.79±0.09[a]	2.43±0.05	0.001
Heifers	1.84±0.09[b]	1.50±0.07[c]	2.02±0.08[a]	1.79±0.05	0.001
Calves	1.38±0.06	1.28±0.05	1.38±0.06	1.34±0.03	0.156
Cattle per household	2.08	1.75	2.33	2.04±0.05	
Sheep	5.59±0.27[a]	2.04±0.16[b]	1.33±0.22[c]	2.97±0.15	0.001
Goats	2.02±0.28[a]	3.24±0.12[b]	2.65±0.23[a]	2.64±0.12	0.010
Donkeys	0.75±0.00	1.03±0.02	1.05±0.03	0.94±0.01	0.652
Horses	1.06±0.03	0.85±0.03	0.65±0.06	0.85±0.02	0.878
Mules	1.11±0.06	1.00±0.00	1.07±0.07	1.08±0.04	0.533
Chickens per household	4.51	3.61	4.03	4.05	

L=highland, ML=midland, LL=lowland, SE=Standard error

Same superscript indicate non-significant differences (column), Different superscript indicate significant differences at P<0.05 level (column).

There was significant (P<0.05) difference in average chicken per household between (HL and ML), (HL and LL) and also between (ML and LL) agro-ecologies, this may be possibly due to the differences of feeds availability, diseases and predators among agro ecologies. There may be high feeds sources in HL than in ML and LL areas. This result contradicts with the report of Habte et al., (2015), the average livestock holding per household was 3.13 cattle, 0.47 sheep, 2.57 goats and 2.04 chickens in Amaro district, SNNPRS of Ethiopia.

4.4. Chicken production systems of the study area

The chicken production systems in the study area are presented in figure 3. The most dominant chicken production system in the study area was the traditional (49.4%), where chickens feeding system depend only on free range scavenging.

The second production systems was scavenging seasonal/conditional supplementation production system (33.2%), this production system was practiced by farmers gave feeds for their chickens during crop harvesting when sufficient feeds availability in the house hold level. The third was semi-scavenging production systems (scavenging + regular supplementation); farmers provided feeds for their chickens regularly, at least once a day. Only about 2.1% farmers followed intensive chicken production systems. Chicken production systems in Africa and Ethiopia include the free-range system or traditional village system; the backyard or subsistence system; the semi intensive system and the small-scale intensive system (Bessei, 1987; Sonaiya, 1990a; Kitalyi, 1998; Branckaert and Gueye, 2000, Gueye, 2000a) and Alemeyehu *et al*., (2015).

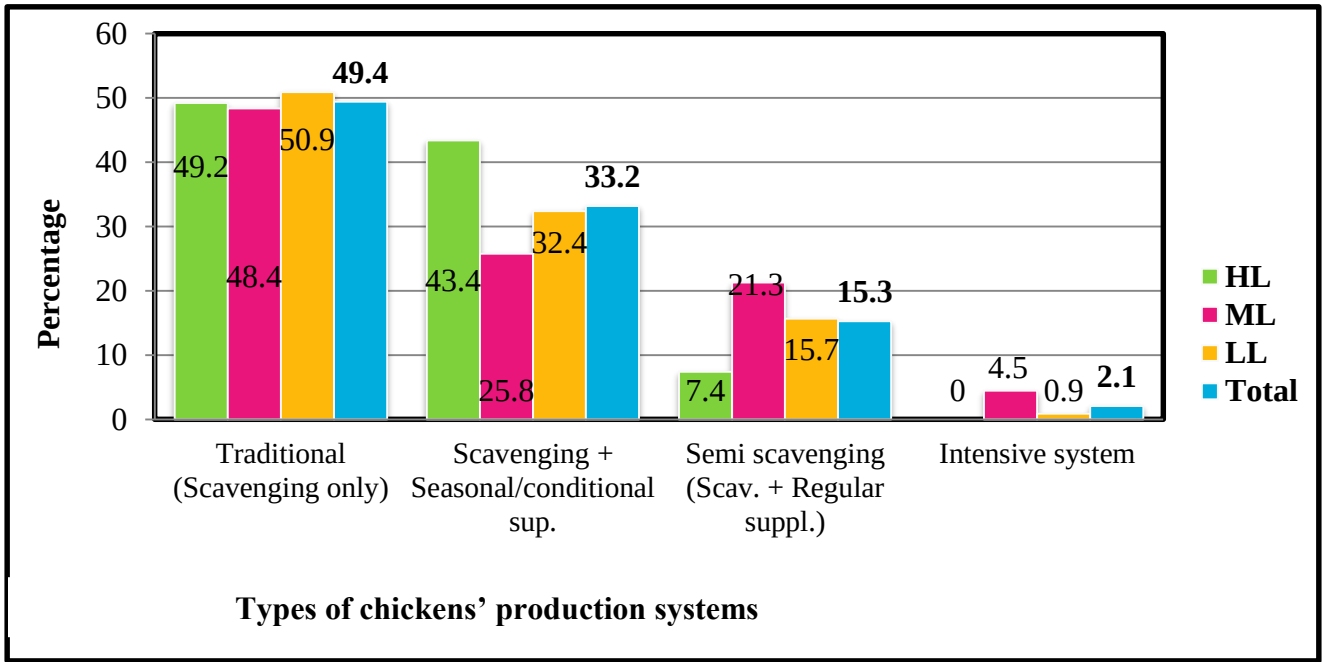


Figure 3: Types of chickens' production systems of the study areas

4.5 Production and reproductive performance of indigenous chickens

4.5.1 Age at first mating (local cockerel)

The average age at first mating of local cockerels was 6.32, 6.07 and 6.10 months for HL, ML and LL, respectively, and the overall average age at first mating of local cockerels of the three agro-ecologies were 6.16 months and there was a significant difference ($P<0.05$) on cockerel sexual maturity among agro-ecologies (Table 5). The sexual maturity of local cockerels was faster in ML than HL and LL.

This might be associated with better management practices like feeding, housing and health care of the farmers in ML than in HL and LL agro-ecologies of the two districts were highly produced cereal and stalk crops like wheat and maize. Sexual maturity of chickens always depends on chicken management systems and overall production systems of the households mainly on feeding and disease management practices. In relation to the other agro-ecologies, may be fewer diseases outbreaks, less predators' and better housing management were perceived in lowland agro-ecology. This report (6.16 month) was in agreement with the findings of Fisseha et al., (2010) who reported faster age of sexual maturity of cockerels, i.e., 6.15 months (24.6 weeks) in North West Ethiopia. The result was also similar with the 6.1 months for local cocks reported by Worku *et al.***,** (2012) in West Amhara Region of Ethiopia. This age (6.1) was faster than that reported by Alem, (2014) from central Tigray, an average age at first mating of cockerels was 6.5 months (26 weeks) for local and this age difference might have occurred due the farmers management system (feeding, housing and health care) of the study areas.

4.5.2 Age at first egg laying (pullet)

The average age at first egg laying of local pullet was 6.86, 6.53, and 6.55 months for HL, ML and LL, respectively where as the average age (overall mean) at first egg laying of local pullet of the three ecologies was 6.64 months and there was a significant difference ($P<0.05$) on age at first egg laying of local pullet among the different agro-ecologies (table 5). The variation in age at first egg laying may be caused due to different agro-ecological effect and due to management practices like feeding, housing and health care of the farmers. There may be high feed resource and also best management practice in ML than HL and LL in the study area. This result (6.64 months) was comparable with 6.6 months for local female breeds reported by Worku *et al.***,** (2012) in West Amhara Region of Ethiopia.

4.5.3 Number of eggs lay per hen per clutch

The average number of eggs laid per hen per clutch was 10.93, 11.78 and 11.81 eggs for HL, ML and LL respectively, and the overall average numbers of eggs laid per hen per clutch for local chickens in the 3 agro-ecologies was 11.52 eggs in the study area. Eggs produced per clutch was lower in HL (10.98) than in ML (11.78) and in LL (11.81) agro ecologies. Higher number of egg laid per clutch in LL (11.81) and in HL (10.93) and there was a bit difference egg laid per clutch per hen between in M and LL areas.

There was a significant difference (P<0.05) on number of eggs laid per hen per clutch of local chickens among the 3 agro-ecologies (Table 5). Management level of the farmers and chickens genetic factors may create difference in the production potential of the chickens. The low production and productivity of the indigenous chickens was attributed to the poor management practice of the farmers, according to Alem, (2014) in central Tigray, Northern Ethiopia. These results were in agreement with the reports of Habte *et al.* (2013) who reported the number of eggs produced/clutch/hen of indigenous chicken was 11.23 in Nole Kabba Woreda, western Wollega. Nevertheless, the average eggs laid per clutches reported in the current study was low as compared with Melkamu *et al.*, (2013), Gonder zuria woreda, the hen laid about 13 eggs /hen/ clutch.

Table 5: Production and reproductive performances of local chickens in the study districts (Mean±SD)

	Agro-ecologies				P-
Parameters	**HL=(122)**	**ML=(155)**	**LL=(108)**	**Total**	**value**
Age at first mating (cockerel) in month	6.32±0.64^{a}	6.07±0.32^{b}	6.10±0.55^{bc}	6.16±.52	0.001
Age at first egg laying (pullet) in month	6.86±0.67^{a}	6.53±0.38^{bc}	6.55±0.53^{bc}	6.64±0.55	0.001
Number of eggs per hen per clutch	10.93±2.44^{a}	11.78±2.23^{b}	11.81±1.98^{bc}	11.52±2.26	0.002
Number of clutch per hen per year	4.11±2.50	4.19±4.18	3.99±0.79	4.11±3.03	0.419
Clutch length in days	24.39±5.57	24.52±3.22	24.25±2.59	24.40±3.98	0.095
Total eggs production per hen per year	40.74±7.44^{a}	44.27±5.95^{b}	45.99±6.29^{ba}	43.63±6.88	0.001
Reproductive life span of hens in year	3.36±0.52^{a}	3.17±0.37^{b}	3.00±0.41^{bc}	3.19±0.46	0.001
Reproductive life span of cocks in year	3.77±0.79^{a}	3.40±0.34^{b}	3.39±0.39^{bc}	3.52±0.56	0.001

HL=highland, ML=midland, LL=lowland, SD= standard deviation

Same superscript indicate non-significant differences, Different superscript indicate significant differences at P<0.05 level (column).

4.5.4 Number of clutch per hen per year

The average number of clutch per hen per year was 4.11, 4.19 and 3.99 for HL, ML and LL, respectively, and the average number of clutch per hen per year for local chickens in the three agro-ecologies was 4.11clutches in the study area. The number of clutches in the study was show a non-significant difference between in all agro-ecologies (Table 5). This study was similar with the mean clutches reported (4.3) by Tsegaw *et al.*, (2013) in North Gonder and also similar with the number of clutch per year of 4.29 reported by Zewdu *et al.*, (2013) from Metekel zone, Northwest Ethiopia.

4.5.5 Clutch length in days

The clutch length for local chickens was 24.39, 24.52 and 24.25days for HL, ML and LL, respectively and the mean clutch length in days for local chickens in the3 agro-ecologies was 24.40 days. There was no significant difference ($P<0.05$) on the average clutch length in days among the 3 agro-ecologies of the study areas (Table 5). This result was somewhat similar with that reported by Meseret (2010), where the mean clutch length was 25.29 days in Gomma Woreda. This was less than that reported by Yamane *et al*., (2013) and Mekonnen (2007), in Halaba and Wonsho and Loka Abaya Woredas of southern Ethiopia the average clutch length were 26.0 days and 26.2 days respectively. This variation might be associated with the availability of feed resources for scavenging, supplementation, and ecotype of indigenous chickens.

4.5.6 Total egg production per hen per year

The egg production per hen per year was 40.74, 44.27 and 45.99 for HL, ML and LL, respectively and the mean egg production per year per hens was 43.63for local hens in the study area (Seka Chekorsa and Kersa districts). There was a significant difference ($P<0.05$) in number of eggs produced per year per hen among HL, ML and LL agro-ecologies (Table 5). There was a high egg production in LL than ML and HL in the study area. This egg production variation among agro-ecologies might be attributed to the difference in management practice, particularly the lack of proper health care, poor nutrition and housing for the chickens. Furthermore, feeds of chickens in the HL and ML of study area depend mainly on scavenging and there was a conditional feed supplementation in LL for layer chickens by the farmers.

This result (44 eggs) was in agreement with the report of Alem (2014), where the average egg production per year per hen was 43.4 eggs for local hen in central Tigray, Northern Ethiopia and also this study agreed with the report of Meseret (2010), the mean annual egg production of the indigenous chicken was reported to be 43.8 eggs in Gomma Woreda. According to Worku et al. (2012), there was moderately high eggs laid by local hens, as relatively compared with the current study (44 eggs), the number of eggs produced by a hen per clutch and year was 14.1 and 45.7, respectively in west Amhara region of Ethiopia.

4.5.7 Reproductive life span of local female

The mean reproductive lifespan age of female chickens were 3.36, 3.17 and 3.00 years for HL, ML and LL, respectively and the overall average reproductive lifespan age of local female chicken was 3.19 years in the 3 agro-ecologies of the study area. There was a significant difference at ($P<0.05$) on average reproductive age for local female chickens across the 3 agro-ecologies of the study area (table 5), this shows the reproductive life span age of hen was longest, medium and shortest in HL, ML and LL, respectively. This difference could be due to the effect of agro-ecologies and weather conditions. This means the highest reproductive age in HL (cold temperature), medium age in ML (medium temperature) and lowest age in LL (hot temperature). This result (3.19 years) was shorter than the reproductive life span age of 3.56 years reported by Zewdu*et al*., (2013) from Metekel zone, Northwest Ethiopia and those differences may be caused by agro-ecologies (temperature) effects.

4.5.8 Reproductive life span local male

The mean reproductive life span age of male chickens for HL, ML and LL was 3.77 years, 3.40 years and 3.39 years, respectively and the overall mean reproductive life span age for local male chicken was 3.52 years in the 3 agro-ecologies of the study area. Data (table 5) showed, the reproductive lifespan age in LL, ML and HL were shortest (3.39 years), medium (3.40) years and longest (3.77 years), respectively. There was a significant difference at ($P<0.05$) on average reproductive age for local female chickens between in (HL and ML) and in (HL and LL) but no significant difference between ML and LL agro-ecologies of the study area (table 6), and this difference could be due to the effect of agro-ecologies and temperature. The high or low temperature may create variations on reproductive age among the 3 agro-ecologies of the study area. This result was (3.52 years) similar with the 3.79 years reproductive life span age reported by Zewdu *et al.,* (2013) from Metekel zone, Northwest Ethiopia.

4.6 Farmers' trait preference for local hen

The farmer's trait preference for local hens is presented in table 6. Egg production and body weight were ranked first and second preferred traits by farmers across all agro-ecologies with an index of 0.48, 0.47 and 0.56 for egg production and 0.15, 0.17 and 0.13 for body weight in HL, ML and LL areas, respectively. The adaptability trait (diseases, harsh climate and predator) ranked third with an index value of 0.13 and 0.11 in ML and LL, respectively.

The average index values of traits preferred by the respondents were 0.50, 0.11, 0.09, 0.13, 0.02 and 0.15 for egg production, feather color, mothering ability (broodiness and hatchability of eggs), adaptability (diseases, harsh climate and predators), comb types and body weight in the study area, respectively. In HL, egg production followed by body weight and feather color ranked first, second and third (0.48, 0.15 and 0.13, respectively) by the farmers. In ML, egg production, body weight and adaptability traits were ranked first, second and third with index of 0.47, 0.17 and 0.13, respectively.

However in LL, egg production, body weight and adaptability traits ranked first, second and third with index values of 0.56, 0.13 and 0.11, respectively. The egg production, body weight and adaptability traits were preferred traits that ranked first, second and third to be improved by respondents of the study area (Table 6). This result was similar with the reports of Addisu *et al.*, (2013); Shishay, (2016), the mean egg laid/clutch (egg production/hen) (1^{st}), body weight (meat yield) (2^{nd}) and adaptations (disease resistance) (3^{rd}) were the major preferred traits to be improved through breeding in North Wollo and Tigray region.

Table 6: Farmers' trait preference for local hen

Farmers trait preference for local hen	Agro-ecologies												Overall
	HL(122)				ML(155)				LL(108)				
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	I
Egg production,	17.1	13.0	14.5	0.48	22.6	14.3	16.1	0.47	20.8	9.4	13.0	0.56	0.50
Feather colour	2.1	8.1	2.9	0.13	1.6	7.2	6.9	0.11	0.5	7.2	4.7	0.10	0.11
Mothering ability	2.3	1.8	2.9	0.08	5.2	3.9	2.9	0.11	0.8	3.4	2.9	0.07	0.09
Adaptability	4.4	2.3	4.7	0.12	7.3	3.4	2.1	0.13	2.4	4.4	3.6	0.11	0.13
Comb types	0.8	2.1	1.6	0.04	0.5	0.8	0.5	0.01	0.3	0.8	0.3	0.03	0.02
Body weight	4.9	4.4	5.2	0.15	3.1	10.5	11.8	0.17	3.4	2.9	3.6	0.13	0.15

R1= first rank, R2=second rank, R3= third rank, I= index

***Index** = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular trait divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all traits.*

Farmers of all agro-ecologies preferred egg production as primary trait, eggs serve as source of income (buying the educational materials for children), also used for home consumption and for flock replacement (hatching chickens) by the respondents. Adaptability trait was the ability to escape themselves from predators and resistant to disease and harsh climate of the area. White feather chickens were easily attacked by predators because of white color was easily visible from the distance area.

Double comp chickens were the most preferred than single comb and double comp was considered as high meat and eggs producer chicken by farmers and body weight is the most important criteria to decide the marketing price of the chickens (high weight more costly than low weight).

4.7. Chicken flocks composition and sexes in the study area

In the study area, there were significant differences ($P<0.05$) in flock sizes among the agro-ecologies for all chickens sex (hens, cocks, pullets, cockerels and young chickens) owned by the households. The average ownership of hens, cocks, pullets, cockerels and young chickens per household in the HL were 7.02, 2.25, 4.59, 3.72 and 4.96, in ML and LL of hens, cocks, pullets, cockerels and young chickens were 5.47, 1.90, 3.95, 2.98, 3.73 and 6.51, 2.32, 3.69, 3.86, 3.75, respectively. The mean flock size per household in HL, ML and LL agro-ecologies were 4.51, 3.61 and 4.03 chickens, respectively (table 7).

The overall chickens flock size in the in HL (4.51) was relatively higher than in the ML (3.61) and LL (4.03) agro-ecologies, this may be due to surplus crops production that used for chicken's feeds in the HL areas. The overall mean of chickens flock size in the study area was 4.05 chickens. This results was smaller than that reported by Mekonnen, (2007); Meserat, (2010) and Moges *et al.*, (2010), the overall mean flock size per household was 9.2 in Dale, Wonsho and Loka Abaya districts of SNNPRS; 6.23 chicken number in Gomma Woreda; the average for 3.3 hens, 1.2 cocks, 3 pullets, 0.9 cockerels and 5.6 young chicks in Bure district, North West Ethiopia.

The chicken population varied across all agro-ecologies of the study area and these variations were due to flock size variation with seasons mainly due to the availability of feed, the occurrence of diseases, the presence and predators in the study area (table 7). According to Mogesse, (2007); the flock size varied between seasons mainly due to the availability of feed, the occurrence of diseases, the presence of predators as well as the economic status of the owners in North West. The cock to hen ratio of the study area was 1: 3.12, 1: 2.88 and 1: 2.81 for the HL, ML and LL, respectively. The overall cock to hen ratio of the study area was 1: 2.94. This result was less similar with a total flock size of 13 birds and a cock to hen ratio of 1:3.7 as reported by Moges *et al*., (2010) reported from Bure district, North West Ethiopia.

The cock to hen ratio was far below the recommended ratio of 1:8-10 for mating and this could be attributed to the lack of knowledge on chicken management and breeding by rural farmers. The cocks were underutilized and there is the need to eliminate some by either selling or consuming them to ensure proper utilization of cocks.

Table 7: Chicken flocks composition and sexes in the study districts

Chickens categories	Agro ecologies								P-value
	HL (122)		ML (155)		LL (108)		Total (385)		
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	
Hens	7.02±2.63	2-16	5.47±2.14	1-15	6.51±2.16	3-13	6.33±2.40	1-16	0.001
Cocks	2.25±1.16	1-6	1.90±1.00	1-6	2.32±.90	1-6	2.16±1.04	1-6	0.003
Pullets	4.59±1.84	1-10	3.95±1.15	1-9	3.69±1.41	1-9	4.08±1.60	1-10	0.001
Cockerels	3.72±2.07	1-10	2.98±1.35	1-10	3.86±1.17	1-6	3.52±1.64	1-10	0.001
Young chickens	4.96±3.67	1-20	3.73±2.18	1-16	3.75±2.19	1-12	4.15±2.85	1-20	0.001
Chickens per household	4.51±2.27	1-12	3.61±1.56	1-11	4.03±1.6	1-9	4.05±1.91	1-12	
			Ranges				1.2-10.93		
cock : hen	1: 3.12		1: 2.88		1: 2.81		1: 2.94		
HL=highland,			*ML=midland,*				*LL=lowland,*		

4.8. Effective population size and level of inbreeding of chickens in different agro-ecologies

The effective population size (Ne) is influenced by actual number of breeding males and females in the flock at a given time and thus subject to change due to variation in the flock size, and type of rearing practice. The rate of inbreeding coefficient per generation changes with any change in the effective population size. The average numbers of breeding males owned by farmers were 2.25, 1.90, and 2.32 in HL, ML and LL, respectively and 7.02, 5.47 and 6.51 were the average breeding females' numbers for HL, MLs and LL respectively in the study area (Table 8).

The effective population size ranged from 5.64 to 6.92 with an inbreeding coefficient of 0.08. The effective population size (Ne) estimated in HL, ML and LL altitudes were 6.92, 5.64, and 6.79, respectively whereas the rate of inbreeding per generation (ΔF) was 0.07, 0.09 and 0.07, respectively. From the overall, 2.16, 6.33, 6.45 and 0.08 were breeding males, females, effective population size (Ne) and rate of inbreeding per generation (ΔF) in the study area, respectively.

The effective population size gave an idea as to the level of inbreeding in the chicken populations in all agro-ecologies using the flocks of farmers who possessed their own breeding males. With this, it was realized that HL (6.92) and LL (6.79) had the highest effective population size followed by (5.64) ML agro-ecology. The effective population size for the local chicken populations obtained in the study was higher (5.64 to 6.92) than that reported by Nigussie *et al*., (2010) who found values in the range of 3.19 and 5.22 for local chickens in Ethiopia.

The effective population size ranged from 11.3 to 13.3 with an inbreeding coefficient of 0.04 according to Hagan (2013) reported from Ghana. The variations of effective population size among finding reports were due to, the ratio of males to females in the flocks that possessing by the farmers, longevity of the chickens (productive and living for long time) number of flock contributing genetic material into the next generation and variation in flock size.

According to this result (Ne = 6.45) the number of breeding individuals is very small in the study area. Due to the possibility of the absence of breeding males in some households and the uncontrolled manner of natural mating among village chickens, the estimates on the effective population size as well as the rate of inbreeding might not be accurate, i.e. farmers those didn't possessing their own cocks and used neighbors cock (common cocks) for mating the female chickens and variations of flocks size become reduced due inbreeding during uncontrolled mating ; the estimation of effective population and also the rate of inbreeding obtained may not be exact.

Table 8: Effective population size and level of inbreeding of chickens in different Agro-ecologies in average (mean)

Agro-ecology	Nm	Nf	Ne	(ΔF)
High Land	2.3±1.2	7.0±2.6	6.92	0.07
Mid Land	1.9±1.0	5.5±2.1	5.64	0.09
Low Land	2.3±0.9	6.5±2.2	6.79	0.07
Overall	2.1±1.0	6.3±2.4	6.45	0.08

ΔF = 1 / (2 Ne) (Falconer and Mackay, 1996), *Ne=4 Nm × Nf/ Nm + Nf,*

ΔF = Rate of change in inbreeding per generation *Nm = number of breed males*

Nf = number of breed females *Ne = the effective population size*

4.9. Farmers' major selection criteria for productive local chickens

The criteria pertaining to selection of male and females are presented in table 9. The body weight (55.6%), comb type (34.3%) and plumage color (10.1%) were the major selection criteria of farmers in genetic improvement for male chickens in the study area. The body weight was the major selections criteria ranked 1st in HL (54.9%) and ML (68.4%) while comb type was ranked 1st for male chickens in LL agro-ecology. There was significant difference among agro-ecologies (HL, ML and LL) of the study area. Those variations were due to farmers preference (e.g., chickens with double comb was high market price and single comb low price) and chickens breeding objectives (meat, eggs and dual purpose). This result was not in agreement with the finding of Addisu *et al*., (2013) which was about half of the respondents in mid agro-ecological zones considered comb type as selection criteria of male chicken while 29.2% respondents in high altitude and 31.6% respondents in low altitude considered plumage color and comb type as a selection criterion, respectively.

The result reported from different study areas were show variations, this may be, due to the farmer's trait preference and chickens breeding objectives. The body weight and double comb were factors considered by farmers those produced chickens for market (meat) and chickens with white feather was not preferred in the area where there was no plant coverage, because of white chickens were easily visible and attached by predators like wild birds. Also, the major selection criteria of farmers for productive females was significant difference among the three (3) agro-ecologies ($P<0.001$) (Table 9). This difference was due to farmer's chicken traits preference and breeding objectives, i.e., body weight was ranked the 1st during female selection criteria in the HL, ML and LL agro-ecologies. Similarly, a selection by finger accommodation between the pelvic bones, plumage colors were ranked second and third for female chickens in all agro-ecologies, but farmers used different selection criteria in all agro-ecologies of the study areas.

The body weight (59.7%), finger accommodation between the pelvic bones (25.2%) and plumage color (8.6%) were the major selection criteria of farmers in selection for female chickens in the study area. This result was in line with the finding of Meseret (2010), from Gomma woreda, where about 50% of the respondents use the selection criteria of body size, plumage cover and previous hatching history.

Table 9: Farmers' major selection criteria for productive local chickens

Major selection criteria	Agro ecologies								P-value
	HL=(122)		ML=(155)		LL=(108)		Total		
	N	%	N	%	N	%	N	%	
Male chickens									
Comb type	39	32.0	37	23.9	56	51.9	132	34.3	0.001
Plumage color	16	13.1	12	7.7	11	10.2	39	10.1	
Body weight	67	54.9	106	68.4	41	38.0	214	55.6	
Female chickens									
by body weight	81	66.4	86	55.5	63	58.3	230	59.7	0.032
by pedigree performance	5	4.1	2	1.3	1	0.9	8	2.1	
by finger accommodation between the pelvic bones	17	13.9	63	40.6	17	15.7	97	25.2	
Plumage colors	14	11.5	4	2.6	15	13.9	33	8.6	
Comb types	5	4.1	0	0.0	12	11.1	17	4.4	

HL=highland, ML=midland, LL=lowland, N=Number of respondents

Another study conducted in mid Rift valley of Oromia revealed that 68.0% of the farmers selected productive hens by body size, 12.0% by finger accommodation between the pelvic bones and 20% by pedigree performance for replacement (Samson and Endalew, 2010). According to Shishay (2016) plumage color (1st), egg yield /clutch (2nd) and comb type (3rd) were the most preferred traits used for selection of breeding chickens in Western Zone of Tigray, Northern Ethiopia. The farmers' reports show variations on female's selections criteria among different study areas; due to difference among farmers breeding objectives in the study areas.

Generally, farmers in the study area used body weight and comb types as major selection for male chickens while body weight and by finger accommodation between the pelvic bones for reproductive females. These selection criteria affect the prices of chickens in the market and also for reproductive traits; i.e. chicken with high body weight and double comp were given high price in the market.

4.10 Ranking of local chickens culling criteria by farmers

Disease was ranked first as the major criteria for culling local chicken in HL and ML ago-ecologies which was followed by poor productivity as in the case of ML and LL (table 10) and feather color in the highland.

Chicken with poor productivity and sick were 1st and 2nd culling criteria in the low land. This result partially agree with of Meseret (2010) who reported that sickness (36.1%), frequent broodiness (22.8%), sickness and old age (12.2%), lack of broodiness (8.3%), old age (7.2%) and lack of broodiness and frequent broodiness (5.6%) were the major factors for culling unwanted chickens from the flocks of farmers in Gomma Wereda of Jimma zone.

According to the study of Bogale (2008), who reported the reasons of culling chicken from their flock, were poor productivity (46.5%), old age and poor productivity (25.0%) and sickness (5.7%) in Fogera area. Desalew (2012) reported poor productivity, old age and disease to be the reasons for culling by 27.8%, 51.1% and 21.1%, in Ada'a and by 46.7%, 38.9% and 14.4% in Lume district, respectively. Shishay (2016) reported that all respondents had culling practices of unwanted chickens from their flocks either by poor productivity (47.3%), poor productivity and sickness (22.9%) or poor productivity and old age and sickness (17.7%) in Western Zone of Tigray, Northern Ethiopia.

Table 10: Ranking of culling criteria for local chickens

Chickens culling Criteria	Agro ecologies												Over all
	HL(122)				ML(155)				LL(108)				
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	I
Poor productivity	4.7	3.9	6.0	0.15	8.9	8.4	8.4	0.22	8.1	8.7	8.9	0.30	0.22
Old age	0.8	1.8	1.3	0.04	5.5	5.5	5.8	0.14	2.6	2.9	3.7	0.10	0.09
Diseases	14.7	13.1	12.6	0.44	13.1	13.4	13.9	0.32	7.9	7.3	7.1	0.27	0.34
Feather color	6.0	5.8	4.7	0.18	6.0	6.8	5.8	0.16	4.7	4.2	3.9	0.16	0.18
Bad body conformation	2.9	4.2	4.2	0.11	3.4	3.1	2.6	0.08	1.8	2.1	1.8	0.06	0.08
Poor growth	1.3	1.8	1.3	0.05	2.4	2.1	2.6	0.06	2.1	2.4	2.1	0.08	0.06
Body size	1.0	0.8	1.3	0.03	0.8	0.8	1.0	0.02	1.0	0.8	0.8	0.03	0.03

R1= first rank, R2=second rank, R3= third rank, I= index

***Index** = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular criteria divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all culling criteria*

4.11. Breeding objectives of chicken and purposes of egg production

The ranking of breeding objectives by farmers across agro-ecologies was similar (Table 11). Thus, source of income ranked first (0.64, 0.60 and 0.60) in HL, ML and LL respectively. Production of eggs for consumption (0.15, 0.35 and 0.21) was second purpose of chickens rearing.

Cultural/religious purpose (slaughtering during Christian and Muslims holly day also for ceremony like, weeding) was ranked third with an index value 0.80, 0.70 and 0.70 in HL, ML and LL agro-ecologies respectively.

Source of income was primary followed by home consumption and cultural/religious (2^{nd}) and (3^{rd}) were purpose of egg production in HL agro-ecologies, likewise ML and LL was showed the similar rank with highland which was home consumption, cultural/religious, source of income and hatching chickens with estimated index value 0.25, 0.05, 0.62, 0.08 and 0.17, 0.06, 0.69, 0.08 for ML and LL respectively.

Table 11: Breeding objectives of chicken rearing and egg production.

Parameters	Agro ecologies												Over all
	HL (122)				M (155)				LL(108)				
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I	I
Purpose of chickens rearing													
Meat (consumption)	1.6	2.9	4.4	0.08	2.1	2.1	3.1	0.04	0.5	4.2	0.8	0.06	0.06
Egg (consumption)	2.1	6.8	8.1	0.15	11.9	10.1	12.2	0.35	3.1	11.7	3.9	0.21	0.24
Cultural/religious	3.4	2.1	1.6	0.08	2.6	3.1	2.6	0.07	1.3	1.8	1.6	0.07	0.06
Source of income	22.6	19.0	16.9	0.64	21.6	24.2	20.5	0.60	21.6	9.6	18.4	0.60	0.60
Flock replacement	2.1	1.0	0.8	0.05	2.1	0.8	1.8	0.05	1.6	0.8	3.4	0.06	0.04
Purpose of eggs production													
home consumption	6.2	7.5	7.3	0.22	9.1	11.2	11.9	0.25	3.9	5.7	4.9	0.17	0.21
Cultural/religious	3.4	3.1	2.1	0.09	1.3	2.3	2.9	0.05	1.3	2.3	2.3	0.06	0.07
Source of income	20.8	19.2	19.2	0.64	27.3	22.9	21.8	0.62	20.8	17.7	17.4	0.69	0.65
Hatching chickens	1.3	1.8	3.1	0.05	2.6	3.9	3.6	0.08	2.1	2.3	3.4	0.08	0.07

R1= first rank, R2=second rank, R3= third rank, I= index

***Index** = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular objective divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all objectives.*

The overall index value study showed that source of income ranked (1st), home consumption (2nd), hatching chickens and cultural/religious were ranked (3rd) purposes of egg production with index value 0.65, 0.21 and 0.07 respectively. This report was similar with Fisseha *et al*. (2010); Addisu et *al*. (2014) and Shishay (2016). However, there is variability in ranking the other purpose of rearing chickens and egg production. In Bure district, hatching (breeding) (45%), and home consumption (44%), ceremony (36.4%) and egg production (40.7%) were the 2^{nd} to fifth ranking purposes of rearing chickens;

home consumption (30.4%), replacement (23.18%) and market reasons (18.1%) were the second, third and fourth main rearing purposes of chickens in north Wollo and Recently, it was reported sales for income (1^{st}) and ceremony (2^{nd}) were the first two prioritized breeding objectives of village chickens production in Western zone of Tigray, Northern Ethiopia.

Generally, farmers in the study area earn money from the sale of chickens and eggs which are used to purchase food for home consumption, to cover educational expenses for children (books, pen, pencils, school uniforms and immediate cash requirements at school) and to purchase clothes and agricultural inputs. This indicates the important role village chicken production plays in supporting food security and financial contribution to support schooling of children.

4.12 Chickens management systems

4.12.1. Feeds and feeding

About (63.9%) of the farmers provided supplementary feed for their chickens while 36.1% of the chicken owners did not give any supplementary feeds for chickens, due to lack of feeds resource availability, farmers awareness on feeding and attentions to their chickens were some of farmers gaps in providing supplementary feeds. Farmers gave supplementary feeds for their chickens mainly from July to December months in all agro-ecologies while there was variation in providing feeds in the HL (January to March) and April to June in MLs and LLs. There was somewhat feeds availability between July to September and October to December all agro-ecologies because of the crops harvesting time during those seasons (Table 12). These results are in line with the findings of Moges *et al.* (2010), supplementary feed was provided by majority (97.5%) of chicken owners, while 84.3% of them did this between the months of July to September.

Regarding the sources of the supplementary feeds, the majority of chickens owners, crop harvest or self-produces the feed (72.5 %), harvest and purchase (21.5%) and purchased from market (6.1%). Grains constitute the major kinds of chicken feeds, i.e., 63.2% (maize 37.7%, wheat 24.7%, barley 0.5% and millet 0.3%). About 12.2% of the households provide leftovers as supplemental feed to chickens while 24.7 % of the chicken owners used left scavenging only without any supplementary feeds.

Provision of supplementary feeds depended on seasons (dry or wet) and availability of feed resources of the chicken owner. In the HL, wheat (41.8%) was highly used, because it is produced in abundance by farmers, in ML and LLs maize constituted around 34.2% and 40.7%, respectively of the supplemental feed as these areas high producers of maize. These results agree with the report of Meseret (2010), where cereal grains (maize and sorghum) and household scraps were indicated to be the major supplementary feeds offered, the amount of each being dependent on seasons of the year and the quantity and availability of the resources at the household level in Gomma Woreda.

Halima (2007) also reported that 99.3% of the chicken owners in north-west Amhara region provided supplementary feeds to village birds. Scavenging was the major feeding system, however, the farmers were found to supplement their chickens occasionally with household refuse and grains (mainly paddy rice, maize and sorghum) during dry (92.5%) and rainy (7.5%) seasons in Metekel zone, Northwest, Ethiopia (Zewdu *et al.* 2013).

Concerning the amounts of feeds supplemented, 43% of the farmers gave a handful of feeds for chickens during those months of discussed above and 57 % of the chicken owners did not know the amounts of feeds supplemented to their chickens in the area. According to the response of the chicken owners, the frequencies of supplemental feeding were every day, every other day, every 3 days and unknown for 22.8%, 29.3%, 19.5% and 28.5% of the respondents, respectively. These results did not match with whose reported by Mekonnen, (2007), about 45.6% of the respondents supplemented their chickens twice a day (usually morning and evening), 40.6% of the respondents supplement their chicken once in a day and while the rest 13.8 % of them provide trice a day in Dale, Wonsho and Loka Abaya woredas of Southern Ethiopia.

According to the interviewed respondents, the majority (50.5 %) used plastic made materials as chickens' feeders and followed by locally available materials (21.0 %), wooden trough (20.0%) and earthen pot (8.6 %) in the study area. This was not in agreement with that reported by Halima et al. (2007) and Worku et al. (2012) who reported that only 3.4% of the chicken owners in north-west Ethiopia provided supplementary feed using feeders while the remaining spread the feed on the ground.

They also indicate that only 16.3% of the households used feeding equipment to provide supplementary feed while the rest 83.7% spread the feeds simply on the ground for all chicken groups in west Amhara Region of Ethiopia.

Table 12: Chickens management systems of the study area

Feeds and feeding	Agro-ecologies							
	(N=122)		ML(N=155)		LL(N=108)		Total	
	N	%	N	%	N	%	N	%
Do you provide supplementary feed for your chicken?								
Yes	104	85.2	87	56.1	59	54.6	247	63.9
No	18	14.8	68	43.9	49	45.4	138	36.1
Season provide additional feed mostly								
July – Sep	40	39.6	28	32.2	32	54.2	100	40.5
Oct. – Dec	26	25.7	26	29.9	15	25.4	67	27.1
Jan. – March	20	19.8	9	10.3	1	1.7	30	12.1
April – June	15	14.9	24	27.6	11	18.6	50	20.2
Sources of supplementary feed								
Crop harvest (Self produced)	89	87.3	46	53.5	44	74.6	179	72.5
Purchased from market	1	1.0	12	14.0	2	3.4	15	6.1
Harvest and Purchase	12	11.8	28	32.6	13	22.0	53	21.5
Type of supplementary feed								
Grains	100	81.9	85	54.8	58	53.6	243	63.2
Maize	48	39.3	53	34.2	44	40.7	145	37.7
Wheat	51	41.8	31	20.0	13	12.0	95	24.7
Barley	1	0.8	0	0.0	1	0.9	2	0.5
Millet	0	0.0	1	0.6	0	0.0	1	0.3
House hold left over	7	5.7	25	16.1	15	13.9	47	12.2
Left scavenging only	15	12.3	45	29.0	35	32.4	95	24.7
Amount of supplemental feed								
Hand full	41	40.6	36	41.4	25	43.1	105	43.0
Unknown	60	59.4	51	58.6	33	56.9	142	57.0
Frequency of providing supplementary feeds								
Every day	13	12.9	36	41.9	7	11.9	57	22.8
Every other day	30	29.7	21	24.4	21	35.6	72	29.3
Every 3 days	28	27.7	6	7.0	14	23.7	48	19.5
Unknown	30	29.7	23	26.7	17	28.8	70	28.5
Type of feed trough								
Plastic made (old plastics)	27	73.0	18	42.9	8	30.8	53	50.5
Earthen pot	4	10.8	3	7.1	2	7.7	9	8.6
Wooden trough	0	0.0	13	31.0	8	30.8	21	20.0
local available materials	6	16.2	8	19.0	8	30.8	22	21.0

HL= highland, ML= midland, LL= lowland, N= numbers of respondent

4.12.2 Water provision

As presented in table 13, water was provided during the dry season (56.7%), rainy season (2.9%) and all seasons in the years (40.4%). This result was in agreement with the findings of Worku *et al*. (2012) who reported that (86.2%) provided water during the dry season, (3.6%) rainy season and (10.2%) year round in north-west Ethiopia. The major sources of water for chicken in the area were river (30.4%), spring (28.5%), locally made underground water (21.4%) and pipe water (19.7%) in West Amhara Region of Ethiopia.

Table 13: Chickens watering system in study the areas

Watering system	Agro-ecologies							
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)	
	N	%	N	%	N	%	N	%
Do you provide water to your chicken?								
Yes	88	72.1	103	66.5	84	77.8	275	71.4
No	34	27.9	52	33.5	24	22.2	110	28.6
Season of the year								
Dry (Bega)	64	72.4	45	43.3	48	57.1	156	56.7
Wet (Kiremit)	1	1.1	6	5.8	1	1.2	8	2.9
All season	23	26.4	52	51.0	35	41.7	111	40.4
Source of water								
Spring water	23	26.4	65	62.5	42	50.0	130	47.3
River	59	67.8	22	21.2	25	29.8	106	38.5
Wale (underground water)	5	5.7	17	16.3	17	20.2	39	14.2
Type of watering trough								
Plastic made (old plastics)	56	65.1	46	44.2	17	20.7	119	43.8
Earthen pot	2	2.3	3	2.9	2	2.4	10	4.6
Wooden trough	2	2.3	16	15.4	24	29.3	42	13.4
local available material	26	30.2	39	37.5	39	47.6	104	38.2
Frequent of watering								
Once a day	16	18.4	23	22.1	25	29.8	64	23.3
Twice a day	35	40.2	29	27.9	13	15.5	77	28.0
Freely (ad-libtum)	36	41.4	52	50.0	46	54.8	134	48.7

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

In the HL areas, majority of chicken owners used river water (67.8%) while spring water was major water source that farmers used in ML (62.5%) and LL (50.0%) agro-ecologies. The overall results showed that, spring (47.3%), river water (38.5%) and underground water (14.2%) were water sources that farmers used in the study area.

This report agree with Moges et al., (2010) and Addis et al., (2014), river (30.4%, 56.67%), spring (28.5%, 26.67%), underground water (21.4%, 3.33%), and pipe water (19.7%, 13.33%) were the major sources in Bure district and Gondar Zone, respectively.

About 43.8% of farmers use plastic made waterier equipment while 38.2%, 13.4% and 4.6% of respondents were utilize local available material (broken materials like, broken plastics, "Galii" or "shekla"), wooden trough and earthen pot waterier, respectively. This result disagreed with reports of Moges et al., (2010) and Worku et al., (2012), the broken clay material, wooden trough and plastic made trough were the most widely used types of watering troughs in Bure; and west Amhara, respectively. Regarding the frequency of watering, 48.7% of chicken owners gave freely, while 28.0 % and 23.3 % of respondents were provided water twice a day and once a day in all agro-ecologies respectively

4.12.3. Housing system of village chicken

Of the sampled households, only 47.5% of the farmers prepared separate overnight houses for their birds (table 14). This current result was smaller than that reported by (Fisseha *et al*., 2010) from Fogera district, Ethiopia, which was, 59.7% of the respondents provide separate overnight houses for their chicken, while only 22.1% and 2.4% of the respondents in Bure and Dale do so, respectively. These variations may be, due to chicken owners' awareness for their chickens, (i.e. some farmers didn't give priority for chicken as other animals), severity of theft and predators risk (may be high or low), flock size owned by farmers (small or large flocks) and the purpose of chicken rearing of the farmers.

About 86.2%, 59.4% and 60.7% of the chicken owners had separate house which was constructed by wooden made with grass roof in HL, ML and LL, respectively. There are also other types of houses made of wooden with corrugated iron sheet, wooden with grass roof houses and houses were constructed from locally available materials, like waste materials (sacks, cartons, plastics, clothes and insect leafs). However, about (52.5%) of respondents had no separate houses and they kept chickens on various night sheltering places.

The perches inside the house (35.6%), on ceilings of the house (29.2 %), on the eve of the house (verandah) (28.7%) and on the ground (floor) covered by bamboo/crops straw (6.4%) were night chickens shelters in the study areas.

These results agree with that documented by Moges *et al*. (2010), (77.9%) of farmers kept birds on night sheltering places. Perches 45.7%), the house floor 27.1%, ceilings of the house (3.6%) and locally constructed sitting place (1.4%) were chickens night sheltering in Bure district, North west Ethiopia.

Table 14: Chicken housing system in the study area

Types of house and housing materials	Agro-ecologies							
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)	
	N	%	N	%	N	%	N	%
Do you have a separate house for your chicken								
Yes	58	47.5	64	41.3	61	56.5	183	47.5
No	64	52.5	91	58.7	47	43.5	202	52.5
Chicken housing system								
Wooden made with grass roof	50	86.2	38	59.4	37	60.7	125	68.3
Wooden made with corrugated iron sheet	7	12.1	22	34.4	21	34.4	50	27.3
local available materials	1	1.7	4	6.2	3	4.9	8	4.4
Chicken keep at night								
Night perch inside the house	35	53.8	25	27.8	12	25.5	72	35.6
On ceilings of the house	6	9.2	30	33.3	23	48.9	59	29.2
On the ground (floor)	3	4.6	6	6.7	4	8.5	13	6.4
On the eve of the house (verandah)	21	32.3	29	32.2	8	17.0	58	28.7

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

4.13. Major constraints of chickens' production in the study districts

The major constraints of chicken production are presented in table 15. Among the reported constraints of chicken production prioritized by the respondents in the study area were disease (39.0%), predators (22.1%), feed shortage (19.0%), lack of proper housing (10.1%) and lack of marketing access (9.9%). The result of the current study was similar to that of Wondu *et al*. (2013) from Northern Gondar who disclosed that diseases (1st), predators (2nd), shortage of supplementary feeds (3rd), poultry housing problems (4th) and lack of veterinary health services (5th) were the most important constraints of village chicken production under urban system. According to a recent report by Shishay, (2016) from Western Zone of Tigray, Northern Ethiopia, disease and predators were the first and second chicken production constraints in all agro-ecological zones.

4.13.1 Diseases

According to the sampled households, seasonal and recurrent disease outbreak was the major cause of chickens' loss in the study districts (Table 15). The Newcastle disease (35.2%) was the major disease that losses and hindered the chickens' productivity, followed by Coccidiosis (30.3%) and Fowl typhoid disease (15.6%) in the HL. While Fowl typhoid (54.8%, 32.4%) and Coccidiosis diseases (18.1%, 25.0%) were in ML and LL agro-ecologies respectively, nevertheless Fowl pox diseases signs was never showed in HL agro-ecology.

The overall results showed that, Fowl typhoid (36.1%), Coccidiosis (23.9%), Newcastle (17.7%), Fowl cholera (13.5%), Fowl salmonella (5.7%), Fowl pox (2.3%) and Fowl crayza (0.8%) diseases were the major and economically importance diseases that responsible for losses in chickens and also reduced the chickens' productivity in all agro-ecologies. This current studies was not in agreement with Meseret, (2010) ; Alemayehu, (2015) and Shishay, (2016) reported that, Newcastle disease (34.42%), infectious bronchitis (27.92%), infectious bronchitis and external parasites (25.97%) and coccidiosis (11.69%) were the most economically important poultry diseases in Gomma district,Newcastle disease was the most prevalent and economically important disease affecting chicken in Benishangul-Gumuz and Newcastle disease (1st), fowl salmonella (2nd), coccidiosis (3rd), fowl typhoid (4th), fowl cholera (5th), fowl pox (6th) and fowl coryza (7th) were the major and economically important diseases that hinder the expansion of village chicken production in Western Zone of Tigray, Northern Ethiopia, respectively.

According to chickens owners interviewed, major causes of chickens' infections was weather conditions or temperature (hot or cold) 38.0%, from market chickens 13.1% ,when farmers could buying new chickens from market which may infected by diseases and entered in to normal chickens flocks, from neighbors chickens (9.2%) that infected by diseases, toxicities/contaminated feeds 6.5% (killed rats body that was by toxic, drinking water that stagnant for long times and some chickens were eating snakes and other worms that may be toxic in natures) and 4.5% hygiene (chickens house and around chickens house like, toilet house) was cause of chickens infectious and the remaining sources of chickens infections was unknown (28.8%) by the chickens owners.

This result was somewhat comparable with the findings of (Shishay, 2016),which the infections of chickens were from market (26.2%), chickens from neighbors (2.9%) ,both chicken from market and neighbors (2.3%), contaminated feeds (1%), fluctuations of temperature and cold (0.5%), both chickens from market and contaminated feeds (1%) and dirty poultry house and non-chemical spraying properly (0.5%) while the remaining 64.7% of the respondents replied those chickens' infections arose unknowingly in Western Zone of Tigray, Northern Ethiopia.

Table 15: Major chickens' constraints, common diseases, causes of infectious, age groups affected and seasons of year diseases outbreaks

Major constraints	Agro-ecologies							
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)	
Major poultry production constraints	N	%	N	%	N	%	N	%
Diseases	47	38.5	61	39.4	42	38.9	150	39.0
Predators	27	22.1	34	21.9	24	22.2	85	22.1
Lack of feed resource	6	4.9	46	29.7	21	19.4	73	19.0
Lack of proper housing	18	14.8	8	5.2	13	12.0	39	10.1
Lack of marketing access	24	19.7	6	3.9	8	7.4	38	9.9
Common diseases in area								
Fowl typhoid	19	15.6	85	54.8	35	32.4	139	36.1
Coccidiosis	37	30.3	28	18.1	27	25.0	92	23.9
Newcastle disease	43	35.2	6	3.9	19	17.6	68	17.7
Fowl cholera	16	13.1	17	11.0	19	17.6	52	13.5
Fowl salmonella	6	4.9	14	9.0	2	1.9	22	5.7
Fowl pox	0	0.0	4	2.6	5	4.6	9	2.3
Fowl crazy	1	0.8	1	0.6	1	0.9	3	0.8
Causes of diseases infectious								
Weather conditions/ temperature	33	27.5	59	38.3	53	49.1	145	38.0
Unknown causes	25	20.8	50	32.5	35	32.4	110	28.8
Market	19	15.8	21	13.6	10	9.3	50	13.1
Neighbors chickens	18	15.0	12	7.8	5	4.6	35	9.2
Contaminated feeds	15	12.5	7	4.5	3	2.8	25	6.5
Hygiene	10	8.3	5	3.2	2	1.9	17	4.5
Age groups of chicken affected								
Young	58	47.5	85	54.8	56	51.9	199	51.7
Adult	1	0.8	2	1.3	0	0.0	3	0.8
Both age group	63	51.6	68	43.9	52	48.1	183	47.5
Seasons of year diseases outbreaks								
Dry (Bega)	1	0.8	0	0.0	1	0.9	2	0.5
Wet (Kiremit)	104	85.2	13	92.3	99	91.7	346	89.9
All season (dry and wet)	17	13.9	12	7.7	8	7.4	37	9.6

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

4.13.1.1 Chickens disease control measures

According to, the majority of farmers (48.6 %) used modern control measures followed by traditional methods (36.6%) and the remaining did not use any control measure (14.8 %) in the study area (table 16). Among the modern control measures de-worming, proper hygiene, vaccination, spraying and treatment measure were used by 19.5%, 14.5%, 10.9%, 2.1%, and 1.6% of chickens' owners in the study area.

Concerning to the traditional disease control medicines such as red pepper (*Capsicum annuum*), lemon (*Citrus limon*), wormwood *Artemisia absinthium* ("simfa/feto") and garlic (*Allium sativum*) were used 27.0 %, 22.7 %, 24.8 %, and 25.5 % of farmers to prevent diseases and also for treat the sick chickens by incorporating/adding traditional medicines within regular feeds and providing for their chickens. This result was similar with the repot of Yitbarek et al., (2013), farmers used traditional medicine such as simza, fito, and garlic with feeds in Gonder zuria woreda, north Gonder, Ethiopia. Moges et al., (2010), a traditional treatment (ethno-veterinary) was the major type of treatment used by majority of village chicken owners (95%) against Newcastle disease in Bure district, North West Ethiopia.

Table 16: Chickens disease control measures (modern and traditional control measures)

Diseases control methods	Agro-ecologies							
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)	
	N	%	N	%	N	%	N	%
Modern control measures	**67**	**54.9**	**69**	**44.5**	**51**	**46.8**	**187**	**48.4**
Vaccination	22	18.0	15	9.7	5	4.6	42	10.9
Spraying	4	3.3	3	1.9	1	0.9	8	2.1
De-worming	34	27.9	24	15.5	17	15.7	75	19.5
Proper hygiene	6	4.9	24	15.5	26	24.1	56	14.5
Treatment	1	0.8	3	1.9	2	1.9	6	1.6
Traditional control	**42**	**34.4**	**53**	**34.2**	**46**	**42.6**	**141**	**36.6**
Red pepper (*Capsicum annuum*)	15	35.7	13	24.5	10	21.7	38	27.0
Lemon (*Citrus limon*)	10	23.8	12	22.6	10	21.7	32	22.7
Wormwood (*Artemisia absinthium)*	12	28.6	12	22.6	11	23.9	35	24.8
Garlic (*Allium sativum*)	5	11.9	16	30.2	15	32.6	36	25.5
No control measure used	**13**	**10.7**	**33**	**21.3**	**11**	**10.2**	**57**	**14.8**

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

4.13.2. Predators

Prevalence of predators was the second pronounced constraints of village production in the study area (Table 17). The major predators for chicken in the study districts were cats, wild birds and wild cat locally called "shelmetmate"/"lotu". This results was somewhat similar with the findings of Hunduma *et al*. (2010) and Shishay (2016), whose reported that, birds locally called "culullee" (34%), cats and dogs (16.3%) and wild animals (15%) were identified as the major causes of village chicken mortality in Oromia rift valley of Ethiopia and birds of prey (Blackkite,Milvus migrans locally known "Shilla" and Augur buzzard, Bueteo rufofuscus, locally known as "Chilfit"), the Abyssinian Genet, Genetta Abyssinica locally known as "Silhlohot"), Abyssinian cat (locally called "Mutsu"), domestic cats, dogs, snakes and rats (locally called"Anchiwa Eimer") were the commonly important predators that cause losses of village chickens in western zone of Tigray, Northern, Ethiopia.

Table 17: Major predator, age groups and seasons of predators affected chickens in the study area

Major constraints	Agro-ecologies							
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)	
	N	%	N	%	N	%	N	%
Major predators attacking chicken								
Cats	66	54.1	58	37.4	47	43.5	171	44.4
Wild birds (eagle etc...)	44	36.1	49	31.6	48	44.4	141	36.6
Wild cat (shelmetmate/ lotu)	7	5.7	44	28.4	11	10.2	62	16.1
Dogs	5	4.1	3	1.9	2	1.9	9	2.3
Fox	0	0.0	1	0.6	0	0.0	2	0.6
Age groups of chicken affected								
Young	106	86.9	132	85.2	86	79.6	324	84.2
Adult	4	3.3	0	0.0	0	0.0	4	1.0
Both age group	12	9.8	23	14.8	22	20.4	57	14.8
Seasons of predators affecting chickens								
Dry (bega)	12	9.8	16	10.3	20	18.5	48	12.5
Wet (Kiremit)	36	29.5	68	43.9	42	38.9	146	37.9
All season (dry and wet)	74	60.7	71	45.8	46	42.6	191	49.6

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

The prevalence of predators was chronic on chicken, especially on young aged birds during all seasons in all agro-ecological zones of the study area (Table 17).

About 84.2% of the young chickens (between 1-12 weeks age), 1.0% of adult chickens (above 12 weeks age) and 14.8% of both age groups (young and adult) chickens were affected during dry season (bega) (12.5%), wet season (Kiremit) (37.9%) and both season (dry and wet seasons) (49.6%) and this finding is in agreement with that of Abera (2000) who reported that, wild birds (eagle, hawk, etc) and wild cat (locally called "Shelmetmate") were the most common chicken predators during the dry and rainy seasons, respectively in the southern part of Ethiopia. Nebiyu *et al*. *(*2013) reported most farmers ranked predators (hawks, foxes and wild cats) as the main constraint of poultry production in Halaba district of southern Ethiopia.

4.13.3. Feeds and feeding Constraints

The feeding system of chickens was mainly based on scavenging the backyard. Feeds constraints was ranked third followed by diseases and predators in the study area (table 16).

Table 18: Major constraints, causes of chickens feed scarcity, seasons of feeds scarcity, lack of proper housing and chicken marketing

Major constraints	Agro-ecologies							
	HL(N=122)		ML(N=155)		LL(N=108)		Total(N=385)	
	N	%	N	%	N	%	N	%
Feeds								
Seasons of feeds scarcity								
Dry (bega)	6	4.9	9	5.8	2	1.9	17	4.4
Wet (Kiremit)	107	87.7	126	81.3	96	88.9	329	85.5
All season (dry and wet)	9	7.4	20	12.9	10	9.3	39	10.1
Causes of chickens feed scarcity								
farmers knowledge	60	49.2	72	46.5	37	34.3	169	43.9
Availability of feeds	55	45.1	58	37.4	49	45.4	162	42.1
High price of feeds	7	5.7	25	16.1	22	20.4	54	14.0
Houses								
Reason for not having separate house								
Lack of knowledge (awareness)	42	66.7	36	39.6	16	33.3	94	46.5
Lack of attention to poultry	20	31.7	45	49.5	28	58.3	93	46.0
Lack of construction materials	1	1.6	7	7.7	3	6.2	11	5.4
Less of predators risk	0	0.0	2	2.2	1	2.1	3	1.5
Less of thief risk	0	0.0	1	1.1	0	0.0	1	0.5
Constraints in chicken marketing								
Demand seasonality	51	41.8	49	31.6	42	38.9	142	36.9
Disease out break	15	12.3	39	25.2	36	33.3	90	23.4
Instable chicken price	17	13.9	25	16.1	14	13.0	56	14.5
Lack of marketing information	23	18.9	21	13.5	11	10.2	55	14.3
Lack of market place	16	13.1	21	13.5	5	4.6	42	10.9

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

According to result (table 18) that surveyed from sampled farmers, majority of them were reported, about 85.4% of chickens' feeds scarcity faced during wet (rainy) seasons, especially, July to September months and also small number of farmers reported, there was feeds deficient during dry (bega) 4.4% and 10.2% both season (dry and wet) in all agro-ecologies of the study area. This result was similar with Fisseha (2010), shortage of supplementing feeds during rainy season makes the chickens more vulnerable to diseases in Ethiopian.

About 43.9% of farmers' were less knowledge and awareness on chickens feeds and feeding system, similar 42.1% of farmers reported that, feeds availability (grains like, maize, wheat.. etc) were varies with seasons (feeds availability was high during dry seasons and low in wet or rainy seasons) and 14.0 % of chicken owners were indicating that high market costs of feeds were sources of feeds scarcity in the all agro ecologies of the study area.

4.13.4. Housing Constraints

From sampled respondents, about 52.5% had no separate chickens' house during days and nights (table 15). They keep chicken in perch inside the house, on ceilings of the house, on the ground (floor) covered by straw, grass or bamboo and on the eve of the house (veranda) at night time and these problems were faced chicken to suspect attacked by predators, theft, bad weather (rain, sun, wind and temperatures) in all agro-ecologies.

The overall results showed that, lack of knowledge or awareness (46.5%), lack of attention to poultry (46.0), lack of construction materials/availability and cost (5.4%), less of predators' risk (1.5%) and less of thief risk (0.5%) were the main reasons why farmers did not constructed the separate house for their own chickens in the study area (Table 18). This results was similar with the reports (Moges et al., 2010) and (Fisseha et al., 2010), lack of attention to village birds (34.6%), lack of construction materials (25%), lack of knowledge and awareness (19.6%), risk of predators (12.1%) and shortage of labour and time (5.4%) in Bure district, North west Ethiopia; and the small flock size per household (34.6%), lack of construction materials (25%), lack of knowledge (19.6%), risk of predators (12.1%) and shortage of labour and time (5.4%) were some of the reasons that farmers didn't constructing a separate house for their chicken in Fogera district respectively.

4.14 Chickens marketing system of the study area

4.14.1 Chickens market characteristics of the study area

Saturday, Sunday, Tuesday and Thursday were the fixed markets days. “Bake” and “Sariti” markets were the local market in highland areas and “Kersu” was the only local markets in midland agro-ecology whereas “Seka” and “Serbo” were the urban marketing of the study area. In both agro-ecology there was no separate market place for chicken and egg marketing, except Seka and Serbo markets had their common place for selling and purchasing chickens and eggs in the study area. In other markets, chickens and eggs place were mixed with the other products like cereals, vegetables, ropes, inset butter and cheese in the study area. Chickens producers, individual consumer, general consumers (hotels), village collectors and retailer were some of the major actors involved in the system for selling and purchasing of chickens and chickens products in the study area. Selling and purchasing of chickens and eggs takes place at producer village (at home), road sides and customer’s home like restaurants, hotels and kiosks in additional normal market place.

4.14.2. Places where farmers sold their products

According to the overall result of the study area (Table 19), about (61.0%) of farmers sold chickens and eggs at local market, at their home (32.2%), at regular market (6.2%) and the rest (0.5%) to breakfast house. Producers in all agro-ecologies of the study used and practiced the same marketing places to sell their chickens products. This results was not in agreement with (Alem and Yayneshet, 2013), about 82.5% of the households sold their chicken products at urban market, 15% at local market and 2.5% of the households sold at home in central Tigray, Northern Ethiopia. This variation may have occurred due to the accessibility of marketing for selling and purchasing and also there was price variation products at local market less than price at regular market.

4.14.3. Chickens and egg buyers

Majority of farmers in the HL and LL sold their chickens’ products for individual consumer (48.4%, 48.1%) and to village collectors (43.4%, 40.7%), while in ML (67.1%) sold chickens and eggs for village collectors (table 19). The overall study show that, about 52.2% of chicken owners sold the chicken products (live chickens and eggs) for village collectors, 37.4% for individual consumer, 9.1% for retailer and 1.3% of respondents were sold for general consumers (hotels) in the study area.

This was somewhat similar with (Fisseha, 2010), village chicken producers, consumers, middle men (egg and chicken collectors) and local restaurants/hotels are the main actor involved in chicken and egg marketing in Bure district.

Table 19: Market customer and places of market where farmers sold their products

Parameters	Agro-ecologies								P-Value
	HL (N=122)		ML (N=155)		LL (N=108)		Total (N=385)		
	N	%	N	%	N	%	N	%	
Places where farmers sold their chickens products									
At their home (to village collector	39	32.0	38	24.5	47	43.5	124	32.2	
To shops (breakfast h,kiosks)	0	0.0	2	1.3	0	0.0	2	0.5	
To local market	71	58.2	108	69.7	56	51.9	235	61.0	.027
To regular market	12	9.8	7	4.5	5	4.6	24	6.2	
Chicken and eggs buyers (actors)									
To individual consumer	59	48.4	33	21.3	52	48.1	144	37.4	
To general consumers (hotels)	0	0.0	1	0.6	4	3.7	5	1.3	.001
To village collectors	53	43.4	104	67.1	44	40.7	201	52.2	
To retailer	10	8.2	17	11.0	8	7.4	35	9.1	
Mode of transport of chickens									
Embracing by hand	115	94.3	139	89.7	104	96.3	358	93.0	
Hanging upside down	3	2.5	10	6.5	2	1.9	15	3.9	.001
Other mechanism	4	3.3	6	3.9	2	1.9	12	3.1	
Mode of transport of eggs									
Eggs with straw	115	94.3	139	89.7	104	96.3	358	93.0	
Eggs within grain	3	2.5	10	6.5	2	1.9	15	3.9	.199
Using any container	4	3.3	6	3.9	2	1.9	12	3.1	

HL=highland, ML=midland, LL=lowland, N=Number of respondents

4.14.4 Mode of transport of chickens and eggs

The modes of chicken transportation by farmers in all agro-ecological showed in (table 19). Chickens transportation were, on foot carrying the chicken usually (93.0%) embracing by hand for one or two birds, for more than two birds farmers used a stick to carry the chickens hanging upside down on their shoulder (3.9%) and 3.1% putting in the basket (bag). In addition when traders' collect chickens from adjacent districts they used car as means of transportation, hanging the chickens upside down on the upper part both sides of the car. For egg transportation, 93.0% of the farmers used straw, 3.9 % grain placing in any container to protect the eggs from breakage and 3.1% used any container without any bedding material. Egg collectors (middlemen) collect the egg and fill in a cartoon to transport from market to market.

This was somewhat similar with (Fisseha, 2009), the majority of chicken owners (66.4%) used hand carrying (using piece of cloths with grains/straw) to transport eggs to urban & local markets in Bure Woreda, North-West Amhara

4.14.5 Chickens and eggs marketing channels

The major marketing channels linking producers with end users were identified (figure-4) in the present study. These different channels represent the full range of available outlets through which chickens products (chickens and eggs) move from the different collection points in major producer areas to bring markets to meet end-users needs.

Channel 1	**Producer → Individual consumer**
Channel 2	Producer → Village collector → General consumer
Channel 3	Producer → General consumer
Channel 4	Producer → Village collector → Individual consumer
Channel 5	Producer → Village collector → Retailer → Individual consumers
Channel 6	Producer → Retailers → General consumer

Figure 4: Marketing channels of chickens and eggs

4.14.6. Reasons for selling chickens

According to chicken owners interviewed, chickens were sold, when there was an urgent need of money in the household (38.5%), at time of cultural and religious festivals (32.8 %), at time of disease outbreak (18.9%) and during farm season or cropping seasons (9.8%) in the HL. In the ML, 38.7% of farmers sold chickens at time of festivals, 29.7% at time of disease outbreak, 25.8% when they need money and 5.8 % of farmers were sold during farm season (figure 5). The diseases outbreak time (32.4%), money need for expenditure (31.5%), time of festivals (19.4%) and farm seasons (16.7%) were farmers' reasons for sold their chickens in LL agro-ecologies.

The overall result revealed that, about 31.4% of farmers from all agro-ecologies were sold chickens when urgent need of money in their family and at time of cultural and religious festivals, 27.0% at time of disease outbreak and 10.1% of farmers sold during farm season (figure 5).

This results was similar with (Alem and Yayneshet, 2013), an instant need of money (50% and 47.5%), at time of cultural and religious festivals (25% and 31.2%), during onset of disease outbreak (16.2% and 8.75%) and at time of cropping season (8.75% and 12.5%) were reasons those farmers selling of live birds in lowland and midland agro-ecologies zones of central Tigray, Northern Ethiopia.

4.14.7. Market information

Sources of farmers' information about the marketing price of the chickens and eggs were almost similar across 3 agro-ecologies of the study area (figure 5). As the results of overall study, the majority of farmers got information of chickens and eggs marketing from market visit (53.0%), from others farmers those lived with their neighbors (17.9%), from extension workers (15.8%) and Medias like radio (13.2%) in 3 agro ecologies of the study area. This result not similar with the reports of Mekonnen, (2007); Alem and Yayneshet, (2013), only 35% chicken owners get price information which either obtains information from their neighbors (43.3%) or after they reach to market (56.7%) in the Dale, Wonsho and Loka Abaya Weredas of SNNPRS and about 58.8% of the male headed households have got information from other farmers referring the price of last week market day whereas 62.5% of the female headed households have got information by visiting the market from central Tigray, Northern Ethiopia.

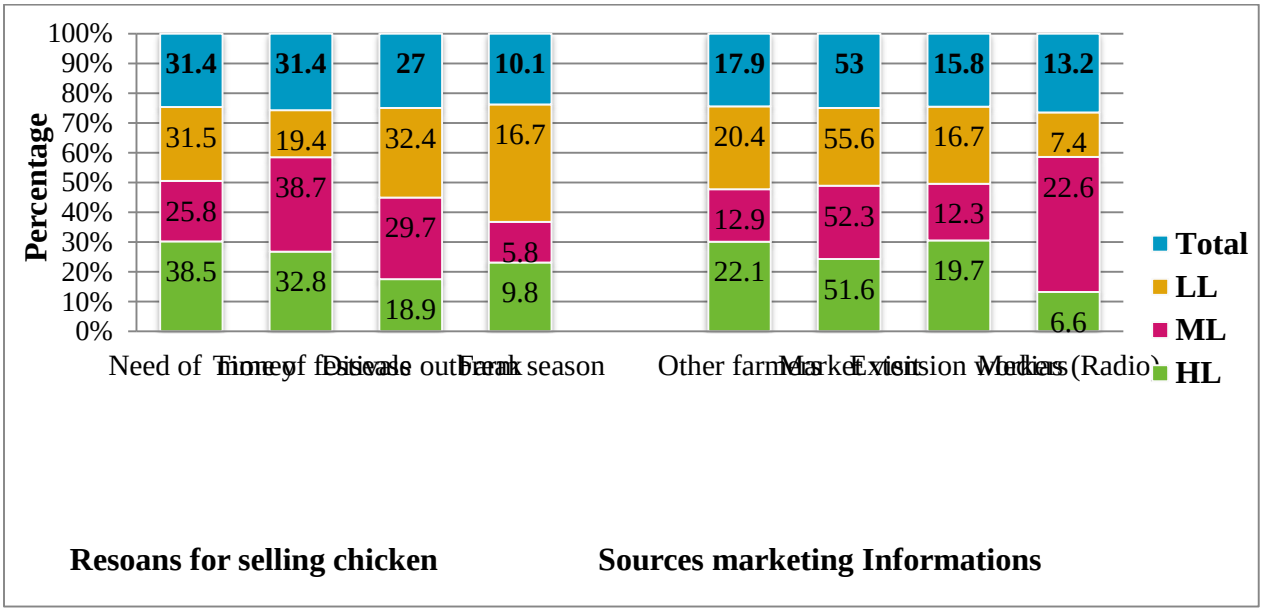


Figure 5: Reason of selling and market information of chickens in three agro ecologies

4.14.8. Chicken and egg marketing constraints of the study area

According to the current study, seasonality of demand (36.9%) was the most marketing constraint, that related with the religious/cultural holydays (Christians fasting seasons) and this implies that, high increasing the prices of chickens and eggs during holly days and low price at normal marketing day (table 18). Disease outbreak (23.4%) was ranked 2nd constraint, diseases transmissions was high at rainy seasons and farmers were sold all flocks of chickens to market and buyers also refused by doubt to chickens and eggs. Instable of chicken price (14.5%) was also problems that affected chickens price market, this related with seasons of the years (rainy and dry) and buyer/consumer preferences (for breeding, meat during holly day), marketing time (even market and holly day market).

Lack of marketing information (14.3%) and lack of market place (10.9%) were also bottleneck during rainy seasons, at this time, farmers couldn't go market every weeks and they were lost information about marketing prices and, village collector (chickens and eggs) were buying eggs and also chickens at the times of holly day during dry seasons and didn't bought chickens during wet seasons. This was match with Moges et al. (2010) finding, the seasonal fluctuation in prices of chicken and eggs, low supply (output) of chicken and eggs due to disease and predation, presence of only few/limited market outlets (urban market are found very far from resident areas for many village chicken producers), lack of chicken and egg price information, lack of space for chicken marketing and lack of credits and capital to expand chicken production and marketing activities urban markets.

4.14.9. Prices of chickens and eggs at regular market and at different holly day in the study area

The farmers' estimation of live chickens and eggs averages price at different holidays and regular markets were presented in table 20. According to farmers interviewed, the prices of chickens were different with seasons (different Holly days,fasting seasons), chickens types (sex and ages of chickens) and also prices of eggs were different with the seasons (holly days). The average price of mature male, mature female, growers (pullets & cockerels) and price of one egg were 134.5 birr, 79.5 birr, 64.4 birr and 2.21 birr during Ethiopian New Year festivity respectively

According to result obtained from study area, during "Meskel" (September 30), the average price was 138.3 birr, 79.8 birr, 66 birr and 2.2 birr for mature male, mature female, growers (pullets & cockerels) and egg respectively. During the X-mass ("Gena"),the average prices mature male (cock) was highest followed by mature female and growers (pullets & cockerels) which was the 137.9 , 80.6 and 66.6 birr respectively and also average price of one egg was 2.3 in birr (table 20). During Easter ("Fasika") festivity, 139.0 and 82.6 birr was the average price for mature male (cock) and mature female (hen), while growers (pullets & cockerels) and price of one egg was 67.8 and 2.3 birr respectively.

Similarly, the average prices of mature male, mature female, growers (pullets & cockerels) and one egg was 134.3, 76.2, 62.0 and 2.3 birr during the Muslim holly festivity respectively in the study area (table 20). The marketing prices of mature male (cocks) was highest and lowest during Easter (Fasika) and Muslims Festivity which the average prices was 139.2 birr and 134.3 birr (the difference average was 4.9 birr/cock). The average marketing price of mature females was also highest during Easter (Fasika) holly day festivity (67.8 birr/hen) and lowest price during Muslims holly day festivity (62.0 birr/hen) in the study areas.

Relatively, the price of the all ages and sexes of chickens were highest during Easter (Fasika) holly day festivity than all other holly day festivity (Ethiopian New Year (Sept. 11), "Meskel" (September 30), X-mass ("Gena") and Muslim festival) in three agro ecologies (table 20). This result showed that there was higher demand of chickens' consumer during the Easter (Fasika) holly day festivity than others other religious as well as cultural festivity. In cases of eggs, the changed in price (price fluctuation) was less in the study areas. This result was revealed with the reports of (Halima, 2007; Fisseha, 2009; Wilson, 2010; Dinka et al., 2010), which was the price, demand and supplies of chicken products were highly related with religious festivals, mainly Christian festivals.

According to the survey data from all studied area, the average price in birr of one matured male during holidays and normal days were 134.3 (ranging 100-180) and 121.8 (ranging 85-150) respectively in the study area and 79.9 birr (ranging 55-110) and 73.3birr (ranging from 50-105) for mature female during holidays and normal days respectively. The average price of growers (pullets & cockerels) were 65.0 (ranging from 40-100) and 63.6 (ranging from 30-80) during holidays and normal days respectively.

The average price of one egg during holidays and normal days were 2.25 (ranging from 2-2.5) and 2.10 (ranging from 1.25-2.25) birr respectively in the study area (table 20). This result were greater than result reported by Alemayehu *et al*, (2015) where the average unit prices of matured male during holidays and normal days were 105.5 (ranging from 60-250) and 75.8 (ranging from 35-230) Ethiopian birr, respectively.

Table 20: Prices of chicken and egg in ordinary market and different holly day in the study area (Mean±SD)

Marketing time	Chicken types and egg	Agro-ecologies (in birr)				P-value
		HL=(122)	ML=(155)	LL=(108)	Total	
Ordinary market days	mature male	123.8 ± 7.5	122.7±14.6	118.5 ± 13.3	121.8±12.5	0.003
	mature female	70.0 ± 9.4	72.0 ± 7.2	77.9 ± 10.2	73.3± 9.5	0.001
	Growers (pul.& cock)	61.6 ± 9.8	63.5 ±10.6	65.8 ± 10.3	63.6 ± 10.4	0.008
	Price of one egg	1.9 ± .4	2.1 ± .2	2.2 ± .2	2.1 ± .3	0.001
RANGE (in birr)	mature male	mature female		Growers		Egg
	85-150	50-105		30-80		1.25-2.25
Eth. New year (Sep. 11)	mature male	125.5±13.0	135.9 ± 7.1	142.5 ± 10.5	134.5 ± 12.2	0.001
	mature female	75.5 ± 8.0	81.1 ± 8.7	81.5 ± 10.7	79.5 ± 9.5	0.001
	Growers (pul.& cock)	54.5 ± 8.2	67.9 ± 8.1	70.5 ± 10.7	64.4 ± 11.2	0.001
	Price of one egg	2.1 ± .2	2.2 ± .20	2.23 ± .38	2.2 ± .27	0.001
Sept 30 ("Meskel")	mature male	129.6 ± 7.9	140.5 ±8.0	144.6 ± 9.8	138.2 ±10.5	0.001
	mature female	75.5 ± 9.4	80.3 ± 8.8	83.6 ± 11.5	79.7 ± 10.3	0.001
	Growers (pul. & cock)	56.6 ± 7.9	69.6 ± 9.5	71.3 ± 10.4	66.0 ± 11.3	0.001
	price of one egg	2.2 ± .20	2.2 ± .18	2.2 ± .18	2.22 ± .19	0.003
X-mass ("Gena")	mature male	127.9 ± 7.2	140.8 ± 8.8	145.0 ± 10.4	137.9 ±11.2	0.001
	mature female	77.7 ± 10.6	81.5 ±11.4	82.5 ± 11.7	80.5 ± 11.4	0.003
	Growers (pul. & cock)	54.7 ± 7.8	69.7 ±10.6	75.3 ± 13.4	66.5 ± 13.6	0.001
	price of one egg	2.21 ± .20	2.3 ± .17	2.3 ± .17	2.3 ± .19	0.001
Easter ("Fasika")	mature male	131.2 ± 7.8	139.6 ±6.8	147.6 ± 9.8	139.2 ±10.2	0.001
	mature female	74.1 ± 7.3	87.1 ± 8.4	85.4 ± 11.2	82.6 ± 10.7	0.001
	Growers (pul. & cock)	55.6 ± 9.1	72.9 ± 8.6	74.0 ± 11.4	67.7 ± 12.7	0.001
	Price of one egg	2.2 ± .2	2.3 ± .18	2.3 ± .19	2.3 ± .20	0.015
Muslim festival	mature male	130.4 ± 6.2	134.7 ±5.3	137.9 ± 7.6	134.3 ± 6.9	0.001
	mature female	74.5 ± 8.6	76.1 ± 7.8	78.2 ± 8.5	76.2 ± 8.4	0.003
	Growers (pul. & cock)	53.3 ± 7.2	64.5 ± 6.6	68.2 ± 7.4	62.0 ± 9.3	0.001
	Price of one egg	2.25 ± .2	2.25 ± .18	2.25 ± .16	2.25 ± .19	0.812
	Average price in birr					Range
Overall means (Holly days)	mature male	128.0	135.7	139.4	134.3	85- 180
	mature female	75.5	81.8	82.1	79.9	50- 105
	Growers (pul.& cock)	56.0	68.1	70.8	65.0	40– 100
	Egg	2.3	2.25	2.25	2.25	2.0 -2.5

HL=highland, ML=midland, LL=lowland, SD =Standard deviation

On the other hand, the average unit prices of matured female during holidays and normal days were 75.7 (ranging from 30- 220) and 60.7 (ranging from 15-205) birr, respectively and the average unit prices of eggs from local chickens were 2.2 and 1.8 birr during holidays and normal days, respectively from Benishangul-Gumuz, Western Ethiopia. There was significance difference ($P<0.05$) on the price of chickens and eggs during all the public's holly day festivity in the all agro ecologies of the study areas, except eggs prices during Muslims holly day festivity. These variations of chickens and eggs price were due to the distances of farmers from market. (Far from town, the low prices and the nearest to town, highest price) and the demands of consumers to be used in the study area was difference during the holly days festivity.

4.14.10. Preferences for plumage color and comb type of chickens in chickens marketing

This showed that the consumer's preference of male (cock) chickens during ordinary and different holly day markets (table 21). According to interviewed respondent, plumage colour and comb type (single and double) played an important role in determining the marketing price of chickens.

During ordinary market days, the averages price of cocks was 127.5 birr and 113.8 birr for double and single cocks (the difference between cocks was 13.7 birr) and the average prices of double, single cocks and the difference between double and single comp cocks in birr was (132.7, 115.9, 16.8) birr, (131.6, 113.5, 18.1) birr, (131.7, 114.4, 17.3) birr, (132.4, 114.6, 17.8) birr and (131.6, 113.7, 17.9) birr during Ethiopian New Year, Meskel (Sep.30), X-Mss, Easter and Muslims Holly festivity respectively. During the survey, various types of plumage were obtained in different study area red, grayish mixture (gebsima) and black and white (wossera) were most preferred colours by producers and consumers in the study area.

The selection of plumage colors was attributed to; attractiveness by the public (presence of high demand) and high sale price in marketing. Concerning to comb type, double comb was more advantageous (preferable) than single comb types in terms of market price and demand (producers and consumers) (table 21). According to interviewed farmers, the average prices of cocks (double and single comp) of red (kei), white (netch), grayish mixture (gebsima) , black and white (wossera) and black (tikur) were 133 birr, 116.2 birr, 126 birr, 125 birr and 113 birr respectively.

The price difference (additional price) of cocks during Ethiopian New Year, Meskel (Sep.30), X-Mss, Easter and Muslims Holly festivity were 3.1 birr, 4.4 birr, 3.6 birr, 4.1 birr and 4.2 birr respectively.

Generally, comb types and plumage colours were the most determined the price of cocks during ordinary market and holly day market in the study area. This results was similar with the reports of (Alem and Yayneshet, 2013) and Fisseha et al,(2010) which was most chicken owner farmers considered plumage color and comb type as main determinant factors in selection of birds for production, consumption and marketing purposes in central Tigray, Northern Ethiopia and most respondents in Bure and Fogera Weredas considered plumage colour and comb type as the main determinant factors in selection of chicken for production, consumption and marketing respectively.

Table 21: Market prices of matured male with different plumage colors and comb types in ordinary market and holly market days of the studyarea (Mean ±SE)

Type of matured males		Ordinary market days	Price in birr of male mature birds (by market type, plumage color and comb type)				
			Market days of eves of festivals				
Plumage color	Comb type		New Year	Meskel	X-Mss	Easter	Muslims Holyday
Red (Kei)	Double	131.6 ±.53	141.5±.55	145.0±.44	144.8 ±.41	144.2±.46	143 ±.44
	Single	116.5 ±.63	125.7±.45	125.0 ±.41	126.6±.38	125.9±.44	123.5±.39
	Mean(birr)	124	133.6	135	135.7	135	133
White (Netch)	Double	121.9 ±6.47	124.5±.56	119.9 ±.60	125.7±.41	123.9±.39	124.8±.59
	Single	107.9 ±.52	107.7±.50	103 ±.75	108.5±.51	107.7±.43	107.5±.60
	Mean(birr)	114.9	116	111.45	117	115.8	116.2
Grayish mixture (Gebsima)	Double	129.4 ±.48	142.9±.51	143.2 ±.56	133±.62	139.55±.67	134.8±.52
	Single	121.4 ±5.6	122.9±.44	125.1 ±.46	116.6±.77	119.3±.67	117.0±.56
	Mean(birr)	125.4	132.9	134.15	124.8	129.4	126
black and white (Wossera)	Double	133.8 ±.40	135.7±.66	131.9 ±.64	136±.43	132.1±.57	133.6±.42
	Single	117.2 ±.45	119.2±.44	115.4 ±.57	119±.47	114.5±.76	116.4±.43
	Mean(birr)	125.5	127.4	123.65	127.5	114.5	125
Black (Tikur)	Double	121.0 ±.74	118.9±.66	118 ±.58	118.95±.46	122±.86	122±.51
	Single	106 ±.73	104±.67	98.9 ±.65	101.3±.54	105.5±1.03	104±.56
	Mean(birr)	113.5	111.4	108.45	110.1	113.75	113
Total Mean	Double	127.5	132.7	131.6	131.7	132.4	131.6
	Single	113.8	115.9	113.5	114.4	114.6	113.7
	Difference	13.7	16.8	18.1	17.3	17.8	17.9
Overall means (birr)		120.7	124.3	122.5	123.0	123.5	122.7

SE=Standard Error

4.14.11. Major determinant factors that affect the price of chicken and eggs in the study area

Those are some of determinant factors that were affecting prices of chicken products in the study area (table 22). According to surveyed report obtained from the study area, there were some factors that determined (control) the price of chickens and eggs. From the major factors, fasting seasons (e.g. Pre-Easter fasting season) was high shared with 28.6 % followed by demand and supply of chicken products and product type (sex, age, breed, comb type, etc) with 26.5 % and 16.9 % respectively.

Market day types (holyday vs. ordinary market days), market type (urban vs. local markets), season of the year (dry and rainy) and agro-ecology (HL, ML and LL) were also contribute with 10.9%, 7.5% , 7.3% and 2.3 % in determining the price of chickens and eggs respectively (table 22). The price of chicken and egg, demand and supply of chicken products were highly related with religious festivals, mainly during Christian festivals. For example; the price, supply and demand of chickens increased in the high-sale periods like Easter ('Fasika') and Christmas ('Gena'). On the other hand, periods of low prices occur at the same time with times of low sales (demand) such as, the pre-Easter fasting period. With regard to agro-ecological location, the lower prices of chicken products were reported from village chicken producers living in the in far areas from market.

Relating to season, lower prices of chicken products were recorded in rainy seasons as compared to that of dry season. This was highly correlated with the demand and supply of chicken products in different seasons. Due to the negative impact of diseases and predators, the supply of chicken products during the beginning of the rainy season was very high and that reduces the demand and price of products. Product type (sex, age, color, comb type, etc) played an important role in market price of village chickens of the study area.

In addition, most chicken owner considered plumage color and comb type as main determinant factors in selection of birds for production, consumption and marketing purposes. This was revealed with (Fisseha, 2009), demand and supply of chicken products, agro-ecology, product type, season of the year, market type (urban vs. local markets), market day types (holyday vs. ordinary market days), fasting seasons were some determinant factors affecting prices of chicken products in the Bure Woreda, North-West Amhara.

Table 22: Major determinant factors that affect the price of chicken and eggs in the study area

Major determinant factors	Agro-ecologies							
	HL (122)		ML (155)		LL (108)		Total (385)	
	N	(%)	N	(%)	N	(%)	N	(%)
Demand and supply of chicken products	47	38.5	38	24.5	17	15.7	102	26.5
Agro-ecology (HL, ML and LL)	2	1.6	3	1.9	4	3.7	9	2.3
Product type (sex, age, breed, comb type)	13	10.7	30	19.4	22	20.4	65	16.9
Season of the year (dry and rainy)	9	7.4	12	7.7	7	6.5	28	7.3
Market type (urban & local markets)	12	9.8	12	7.7	5	4.6	29	7.5
Market day types (holyday & ordinary market)	14	11.5	11	7.1	17	15.7	42	10.9
Fasting seasons (pre-Easter fasting season)	25	20.5	49	31.6	36	33.3	110	28.6

HL=highland, ML=midland, LL=lowland, N=Numbers of respondent

5. SUMMARY, CONCLUSION AND RECOMMNEDATIONS

5.1. Summary and Conclusion

This study was conducted in Seka Chekorsa and Kersa districts of Jimma Zone of Oromia Regional State, Ethiopia to characterize village chickens production and marketing systems in their production environment based on agro ecology (HL, ML and LL) of the areas.

Seka Chekorsa and Kersa districts were selected for this study based on potential for village chickens production. The methodology of the study included interviewing selected individual local chickens producer and focus group discussion.

The most dominant chicken production system in the study area was the traditional (49.4%), where chickens feeding system depend only on free range scavenging.

The overall average land size per house hold was 0.76±.37 ha while high land size in HL than in ML and LL agro-ecologies and the 4.05 was the overall means of chicken owned per household in the study area.

Average age at first mating (months), age at first egg laying (months), eggs number laid per hen per clutch, clutch numbers per hen per year, clutch length in days, total egg production per year per hen, female and male reproductive live span (years) were 6.16, 6.64, 11.52, 4.11, 24.40, 43.59, 3.19 and 3.52, respectively and those chickens performances varied with across agro-ecologies of the study area.

Egg production and body weight were ranked first and second traits that were preferred by farmers across all agro-ecologies. The adaptability trait (diseases, harsh climate) was ranked third in all agro-ecologies.

The effective population size gave an idea as to the level of inbreeding in the chicken populations in the all agro-ecologies using the flocks of farmers who possessed their own breeding males. With this, it was realized that HL and LL had the highest effective population size followed by ML agro-ecology

The comb type, plumage colour and body weight were the major selection criteria of farmers in genetic improvement for male chickens in all agro-ecologies. Also body weight, pedigree performance, touching by hand (by finger accommodation between the pelvic bones), plumage colors and comp types were the major selection criteria of farmers in genetic improvement for female chickens in the study area.

Farmers primary reason of culling was sicken chickens followed by culling chickens with poor productivity and feather color (white and black). Furthermore, old age, bad body conformation, poor growth and small body size were reasons of culling chickens.

Sale for income (1st), egg for home consumption (2nd), cultural/religious ceremony and meat for home consumption were the purposes for which farmer rear chickens. Source of income ranked (1st), home consumption (2nd), hatching chickens and cultural/religious (3rd) were purposes of egg production, respectively.

The majority of the chicken owners provided supplementary feeds during July to September of months; grains and house hold leftovers were feed that given for chickens. Farmers reported different sources of water to drink their birds such as springs, river and wale or underground water in the study area.

Only 47.5% of the farmers prepared separate overnight houses for village birds and chickens housing systems was constructed by using wooden made with grass roof, wooden made with corrugated iron sheet and from local available materials.

Disease, predators, feed resource, lack of proper housing and lack of marketing access were the major constraints that affected the chickens' productivity in the area. The Fowl typhoid, Coccidiosis and Newcastle disease were the major disease followed by Fowl cholera, Fowl salmonella, Fowl pox and Fowl crazy diseases which impeded the productivity of the chickens in the study area.

Cats, wild birds (eagle), wild cat “shelmetmate” (“lotu”), dogs and fox were major predators that affected chickens in the study area. Lack of attention to village chickens, lack of knowledge and awareness, less risk of predators and theft, lack of facility to construct and shortage of labor and time were some of the major reasons why farmers didn’t prepare a separate house for village birds.

The majority of farmers reported that about 85.4% of the chickens’ feeds scarcity acquired during wet (rainy) seasons, especially, July to September months in all agro ecologies of the study area. Seasonality of demand, disease outbreak, instable of chicken price, lack of marketing information and lack of market places were bottlenecks of chickens productions that was reported by farmers in the study area.

Most farmers sold their chicken products at local market and also to village collector, at regular market and the rest to breakfast houses. Factors likes fasting seasons, demand and supply of chicken products, product type, market day types, market type, season of the year and agro-ecology were factors that control chickens and eggs prices of the study area.

5.2. Recommendation:

1. Indigenous chicken have high adaptability and low in productivity in all agro ecological zones. It needs to match those conditions, community based village chickens breeding/genetics improvement must be done by all stockholders.
2. Chickens health care and diseases control were very low, especially, vaccination given for chickens was weak, that used as precaution for disease preventive, so vaccination for chickens need attention to save flock of chickens from diseases outbreak.
3. Chickens housing system, especially, at night time need improved shelter by properly constructing house to escape chickens from predators and extreme weathers.
4. In chickens marketing system, particularly, transportation systems (transportation tools) and modes of transportations were affecting chickens productivity through stress caused by improper carting/carrying to marketing places. So transportation systems and modes of transportation need attitudinal change by creating awareness of chickens owner and use of appropriate transportation facilities.

5.3. Future research:

- On farm/on station village chickens performance evaluation is needed to perceive effect of agro-ecological zones on productive (egg size laid per clutch or per year growth rate) and reproductive (age at sexual maturity) of indigenous chickens.

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7. APPENDIXES

7.1 Appendix A: Individual Questionnaires

Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) School of Graduate Studies

Indigenous Chicken Performances, Farmers Trait Preference, Breeding Objectives and Marketing System Questioner

1. General information

1.1. PA (Kebele) _____1.2. Village (Got) _____

1.2. Agro ecology 1. Dega ---------- 2. W/dega---------- 3. Kolla----------

1.4. Altitude _____ masl

1.5. Questionnaire Number _____ Name of Respondant ----------

1.6. Name of Innumerator ----------

Signiture _____ Date _____

2.House-hold Characterstics

2.1. Type of Respondant 1. HH Head 2. Non HH Head

2.2. Sex of Respondant 1. Male 2. Female

2.3. Age of Respondant **1** =<20 **2**= (20-30) **3**= (30-40) **4**= (40-50) **5**= (50-60) **6**=>60

2.4. Sex of Household Head 1. Male 2. Female

2.5.Marital Status 1. Married 2. Single 3. Divorced 4. Widowed

2.6. Education Status of Household Head

1. Illiterate 2. Reading and Writting 3. Grade 1-6 4. Grade 7-12 5. Other (Specify)------

3.Farm Characterstics

3.1. Total Farm Size _____hek.

3.2. Back yard (home stead) _____hek.

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

4. Family size of Household.

Household Head		**children under 1 years old**		**Age b/n 16-30**		**Age b/n 31-45**		**Above 46 years old**		**Family Size**
Husband	Wife	Male	Female	Male	Female	Male	Female	Male	Female	

5. Livestock holding in the area (House hold)

No	Livestock type	Amount (Number)
1	Cattle	
	- Cows	
	- Oxen	
	- Heifers	
	- Calves	
2	Sheep	
3	Goats	
4	Equines	
	- Donkeys	
	- Horses	
	- Mules	
5	Chicken	
	- Hens	
	- Cocks	
	- Pullets	
	- Cockerels	
	- Young chicken	
	Total	

6. Chicken Productivity and Reproductivity

6.1 How do you start chicken rearing (Source of knowledge for chicken rearing)?

1. Learning from my parents 2. From my own interest

3. From colleagues and neighbors 4. Training 5. Others (Specify) _____

6.2 What type of poultry production system do you practice?

1. Traditional (Scavenging only)
2. Scavenging + Seasonal/conditional supplementation
3. Semi scavenging (Scavenging + Regular supplementation)
4. Intensive system

6.3 Do you have your own Cock? 1. Yes ☐ 2. No ☐

6.4 If yes which breed? 1. Local Cock 2. Cross Breed 3. Pure Exotic Cock

6.5 If yes, where is the source of your cock?

1.Market purchase 4. Agricultural office

2.Hatched and grown in the house 5. Other (specify)

3.Purchased from neighbors

6.6 If no, where do you get a cock for your hen?

1. From neighbors

2. I do not need a cock for my hen 3. Other (specify) _____

6.7 What is the average age of a Local breed cockerel at first mating in your management?

6.8 What is the average age of a Local breed pullet at first egg laying in your management?

6.9 How frequent hens lay eggs until the end of the clutch period?

I. Local Hen

A. During feed surplus season

1. Daily 2. Every other day

3. Every 3 days 4. No egg (Stop laying)

B. During feed Shortage season

1. Daily 2. Every other day

3. Every 3 days 4. No egg (Stop laying)

6.10 How many clutch periods are there in a year, if a hen does not hatch eggs of local hen?

6.11 What is the average number of eggs layed per clutch for local hen?

6.12 What is the total average egg production per year per bird under the existing local chickenmanagement condition? *(No of clutch periods * Av.No of eggs/clutch)*

6.13 Do you have any local practices used to avoid broodiness? 1. Yes 2. No

6.14 If yes, what type of practices you used? (Put in order of preference and applicability)

1st. _____ 3rd. _____

2nd. _____

6.15 What method do you use for brooding and rearing chicken?

1. Broody hen (natural methods)

2. Hay box brooder 3. All methods

6.16 Do you have a culture of culling chicken?

1. Yes 2. No

6.17 Do you purposely cull cocks?

1. Yes 2. No

6.18 If yes, for what purpose do you cull cocks? What is the fate of culled cocks?

1. consumption 2. sold

3. cultural ceremony 4. other; specify

6.19 Which birds are culled primarily?

1. _____ 2. _____ 3. _____

6.20 If it is due to age factors, at what average age do you cull cocks? _____Years.

6.21 local chicken Productive and reproductive in months/days

No.	Reproduction and production Performance	local chicken	
		Cock	**Hen**
1	Age at first mating (cockerel) in month		
2	Age at first egg laying (pullet) in month		
3	Number of eggs per hen per clutch		
4	Number of clutch per hen per year		
5	Clutch length in days		
6	Total eggs production per hen per year		
7	Reproductive life span of hens in year		
8	Reproductive life span of cocks in year		

7.1.5.1. What is the major chicken feather color types found in your area?

1st. _____ 2nd _____ 3rd_____

4th... _____5th_____6th. _____

7.1.5.2.Which color do you prefer more?

1st. _____

2nd. _____

3rd. _____

Why? 1. _____

2. _____

7.1.5.3. What is the comb type of your birds?

1. Netela 2. Dimdim 3. Netela and Dimdim 4. Others (Specify) _____

7.1.5.4. Which comb type do you prefer most? Why?

1. Netela (Single comb) 2. Dimdim (double)

3. Both Netela and Dimdim 4. Others (Specify) ----------

7.1.5.5. Why Netela (Single comb)?

1. _____

2. _____

7.6.1.2.Why double (Dimdim)? 1. _____

2. _____

8 Chicken breeding objectives of indigenous chickens

8.1. How farmers selected productive hens for egg production?

A. By body size C. by finger accommodation between the pelvic bones

B. By pedigree performance for replacement D. Comp types E. Others ----------

8.2. The major selection criteria of farmers in genetic improvement for male chickens.

A. comb type B. plumage color C. Body weight D. Others-------

8.3.The major selection criteria of farmers in genetic improvement for female chickens.

A. egg production B. broodiness performance C. Body weight

8.4. When do you consume (eat) eggs mostly?

1. Every time (when available) 2. During religious/cultural holidays

3. When being sick 4. Others (Specify) _

8.5.When do you consume Chicken mostly?

1. Every time (when available) 2. During religious/cultural holidays

3 When being sick 4. Others (Specify) ____

8.6.Presence of any cultural or religious belief to rear a special type of chicken

1. Yes 2. No

8.7. If yes; specify the type of cultural/religious belief to rear a special type of chicken

---

8.8.Presence of any cultural or religious belief not to eat chicken meat and eggs

1. Yes 2. No

8.9. If yes; specify the type of cultural/religious belief not to eat chicken meat & eggs

---

8.10. Presence of any cultural or religious belief not to sell chicken and eggs

1. Yes 2. No

8.11. If yes; specify the type of cultural or religious belief not sell chicken and eggs

9. Chicken and Egg Marketing system

9.1. For farmers (Producers)

9.1.1.Do you sale chicken? 1. Yes 2. No

9.1.2. If yes, Where do you sale your chicken? (use as 1st, 2nd, 3rd, 4th,)

1. to trader 3. To local market
2. to hotel 4. to regular market

9.1.3. To whom do you sale your chicken (use as 1st, 2nd, 3rd, 4th,)

1. To individual consumer 3. To trader
2. To hotels 4. To trailer

9.1.4. . How do you transport chicken to local and urban markets (use as 1st, 2nd, 3rd, 4th,)

1. By man power 3. by animals packing
2. By vehicles 4. By others----------

9.1.5. Have you ever faced death of birds during transportation to markets?

1. Yes 2. No

9.1.6. Do you sale eggs?

1.Yes 2. No

9.1.7. If yes, Where do you sale your Eggs ? (use as 1st, 2nd, 3rd, 4th,)

1. to trader 3. To local market
2. to hotels 4. to regular market

9.1.8. To whom do you sale your Eggs? (use as 1st, 2nd, 3rd, 4th,)

1. To individual consumer 3. To trader
2. To hotels 4.To retailer

9.1.9. How do you transport eggs to local and urban markets? (use as 1st, 2nd, 3rd, 4th,)

1. By man power 3. by animals packing
2. By vehicles 4. By others------

9.1.10. What is your major Source of information about the price of chicken and eggs?

1. Other farmers 2. Market visit
3. Extension workers 4. Medias (Radio, etc)

What is the average selling price of chicken and eggs (unit price)?

	Sale price (Birr)							
	Matured male		Matured Female		Growers (Pul & Cock.)		Price of one egg	
	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit
Price in Birr/bird								

9.1.11. Market prices of live chicken and eggs in ordinary market days and market days on eves of four different festivals in woreda, Ethiopia (2006/2007production year)

No	**Market time**	**Price of chicken (by age and sex) and eggs (Birr/unit)**			
		Matured Male	Matured Female (Birr)	Growers (Birr)	Price of one egg
1	Ordinary weekly market day				
2	Market days of eves of festivals				
2.1	Eth. New year (Sep. 11)				
2.2	“Meskel” (Sept 30)				
2.3	X-mas (“Gena”)				
2.4	Easter (“Fasika”)				
2.5	Muslim festival				

9.1.12. Market selling prices of matured male chicken with different feather colors and comb type atordinary market days and market days on eves of four different festivals in woreda, Ethiopia (2007/2008 production year)

No	Market time	Price of mature male chicken (Birr/unit)									
		Kei (red)		Netch (white)		Gebsima (grayish mixture)		Wossera (black and white)		Tikur (black)	
		Sing	Dob	Singl	Doub	Single	Doub	Singl	Dou	Singl	D
1	Ordinary weekly market day										
2	Market days of ev es of festivals										
2.1	Eth. New year (Se p. 11)										
2.2	"Meskel" (Sept 30)										
2.3	X-mas ("Gena")										
2.4	Easter ("Fasika")										
2.5	Muslim festival										

9.1.13. What are the major determinant factors that affect (control) the price of chicken and eggs during the dry season (Bega)?

1. ---------- 3. ----------
2. ---------- 4. ----------
5.----------

9.1.14. What are the major determinant factors that affect (control) the price of chicken and eggs during the rainy season (Kiremit)?

1.---------- 3. ----------
2. ---------- 4. ----------
5.----------

10. Chicken Management

10.1. Chicken Feed and Feeding

10.1.1. Do you provide supplementary feed for your chicken?

1. Yes 2. No

10.1.2. If yes, which season do you provide additional feed most frequently?

1. July – Sep 2. Oct. - Dec 3. Jan. – March 4. April – June

10.1.3. What type of supplementary feed you provide mostly? Rank accordingly;

No	Type of Feed	Rank
1	Grains	
	Maize	
	Wheat	
	Barley	
	Millet	
	Oats	
2	House hold left over	
3	Left scavenging only	

10.1.4. How do you provide the feed?

1. By feeder 2. Spreading on the floor 3. Other feed (specify) _____

10.1.5. What amount of supplemental feed you provide per bird?

1. Hand full 2. Unknown 3. Other (specify) _____

10.1.6. How do you provide the feed to the birds (Status of the feed)?

10.1.7. For adult chickens (Pullets, Cockerels, Hen and Cocks)

1. The grain itself 2. Crushed (ground feed)

3. Socked in water 4. Other (specify) ____

10.1.8. For young chickens

1. The grain itself 2. Crushed (ground feed)

3. Socked in water 4. Other (specify) _ _____

10.1.9. Which breed of chicken gets supplementary feeding most frequently?

1. Local breed 2. Cross breed 3. Exotic breed 4. All breeds

10.1.10. What is the frequency of providing supplemental feed For local breeds during the above season listed?

i/ For local breeds

1. Every day 2. Every other day 3. Every 3 days 4. Unknown

10.1.11. Which age group of chicken given priority for feeding? Rank

No	Age Group	Rank	Reasons
1	Young Chicken		
2.	Pullets and Cockerels		
3	Laying Hen		
4	Cocks		

10.1.12. Where do you get the supplementary feed?

1. Crop harvest (Self produced) 2. Purchased from market

3. Harvest and Purchase 4. Other (specify)_____

10.1.13. Do you have feeding trough (feeder)? 1. Yes 2. No

10.1.14. If yes, what type of feed trough you have?

1. Plastic made 2. Earthen pot 3. Wooden trough

4. Stone made 5. Other (Specify) _____

10.2. Watering

10.2.1. . Do you provide water to your chicken? 1. Yes 2. No

10.2.2. If yes, which season of the year you provide water?

1. Bega 2. Kiremit 3. All season (Bega and Kiremit)

10.2.3. How frequent you provide water to your chicken during the above season?

1. Once a day 2. Twice a day 3. Adlibitum (freely)

10.2.4. What is the source of your water?

1. Spring water 2. River 3. Wale (under ground water)
4. Rain water 5. Pond water

10.2.5. Do you have watering trough (Waterer)? 1. Yes 2. No

10.2.6. If yes, what type of Watering trough you have?

1. Plastic made 2. Earthen pot 5. Other (Specify) _____
3. Wooden trough 4. Stone made

10.3. Poultry Housing

10.3.1 . Do you have a separate house for your chicken? 1. Yes 2. No

10.3.2 If yes, what type of poultry house do you have?

1. Stone wall + grass roof
2. Stone made with corrugated iron sheet
3. Wooden made with grass roof
4. Wooden made with corrugated iron sheet
5. Other (specify)_____

10.3.3. If no, why not you construct a house for your chicken?

1. Lack of knowledge (Awareness)
2. Lack of attention to poultry
3. Lack of construction materials (Availability and Cost)
4. Less of predators risk
5. Less of thief risk 6. Other (specify) _____

10.3.4. . If no, where do you keep your chicken at night?

1. Night perch inside the house
2. On ceilings of the house
3. On the ground (Floor) covered by bamboo or grass made material
4. On the eave of the house (Barandah) 5. Other (specify) _____

10.4. **Chicken Health Care**

10.4.1. Is there any poultry disease in your area? 1. Yes 2. No

10.4.2. If yes, what is the most prevalent disease affecting chicken in the area?

1. Newcastle disease (*fengil*) 2. Other disease, specify _____

10.4.3. What used Control measures

1. Traditional methods 2. Vaccination 3. Spraying 4. De-worming

5. Proper hygiene 6. Treatment 7. No control measure used

10.4.4. What type of traditional control measures (Indigenous knowledge) you used to prevent the risk of Newcastle disease (*Fengil*)?

1._____2. _____ 3. _____

10.4.5. Do you ever vaccinate your chicken? 1. Yes 2. No

10.4.6. If yes, to which breed you get vaccine?

1. Local 2. Cross 3. Exotic 4. All breed

10.4.7. Have you ever treated your sick birds? 1. Yes 2. No

10.4.8. If yes, to which breed you get treatment?

1. Local 2. Cross 3. Exotic 4. All breed

10.4.9. If not, what is the reason? _____

10.4.10. What is the fate of sick chicken? _____

11. Major poultry production constraints in your area

No	Constraint type	Preventive mechanisms
1	Diseases and Predators	
2	Feed Resource	
3	Lack of proper housing	
4	Lack of Marketing Access	

11.1. Predators

11.2. Is there any predator problem in your locality? 1. Yes 2. No

11.3. If yes what is the major predator (wild and domestic animal attacking chicken)?

1st. _____ 2nd. _____3rd. _____

4th. _____ 5th. _____

11.4. If yes, in which season is the problem worst?

A. Eagle ("Chilfit") attack 1.Bega 2.Kiremit

B. Other Predators attack 1.Bega 2.Kiremit

11.5. Which age groups of chicken are attacked more?

A. Eagle ("Chilfit") attack 1.Young chickens 2. Adult chicks

B. Other Predators attack 1.Young chickens 2. Adult chicks

11.6. Which breed groups of chicken are attacked (affected) more?

1. Local chicken 2. Cross breeds

3. Pure exotic chicken breed 4.All breeds are affected

11.7. Diseases

11.7.1. List common diseases in area?

1. ---------- 2. ---------- 3. ---------- 4. ----------

11.7.2. Which age groups of chicken affected by disease?

11.7.3. Which seasons of the year diseases are occurred?

1. Bega 2. Kiremit 3. All season (Bega and Kiremit)

11.8. Feed resources

11.8.1. Is there lack of feed resource in the area? Yes No

11.8.2. If yes what is the causes of scarcity?

A. farmers knowledge B. Availability of feeds C. high price of feeds

11.8.3. which seasons the feed scarcity is occurred?

1. Bega 2. Kiremit 3. All season (Bega and Kiremit)

11.9. Housing constraints

11.10. lack Chickens of proper housing

10.10.1. Is there lack of chicken housing in the area? Yes No

10.10.2. If yes what is the lack of proper housing ?

A. Lack of attention to village birds

B. lack of knowledge and awareness

C. less risk of predators and theft

D. lack of facility to construct

E. shortage of labor and time

11.11. Marketing contraints

11.11.1. List major contraints in chicken and eggs marketing

A. ----------

B. ----------

C. ----------

D. ----------

E. ----------

F. ----------

G. ----------

12. Farmers' trait preference

No	Farmers' trait preference	Ranking
1	Egg production,	
2	Feather colour	
3	Mothering ability,	
4	Adaptability	
5	Comb types	
6	Body weight	

13. Chicken breeding objectives (rank)

13.1. Purpose of keeping chicken

No	Purpose of chicken	Rank
1	Meat (home consumption)	
2	Egg (home consumption)	
3	Cultural/Religious	
4	Source of income	
5	Flock replacement	

13.2. purpose of Eggs production (rank)

No	Purpose of Eggs	Rank
1	home consumption	
2	Cultural/Religious	
3	Source of income	
4	Hatching chickens	
No	**Culling Criteria**	**Rank**
1	Poor productivity	
2	Old age	
3	Diseases	
4	Feather color	
5	Bad body conformation	
6	Poor growth	
7	Body size	

7.2. Appendix B: ANOVA Tables

Appendix Table 1. Sex of Respondent					
Sources variation	Sum of Squares	Df	Mean Square	F-value	P-value
Model	.042	2	.021	.094	.910
Error	85.734	382	.224		
Total	85.777	384			
Appendix Table 2. Age of Respondent					
Sources variation	Sum of Squares	Df	Mean Square	F-value	P-value
Model	15.145	2	7.572	13.012	.000
Error	222.299	382	.582		
Total	237.444	384			
Appendix Table 3. The marital status of house hold					
Sources variation	Sum of Squares	Df	Mean Square	F-value	P-value
Model	.202	2	.101	.703	.496
Error	54.796	382	.143		
Total	54.997	384			
Appendix Table 4. Religion of respondent					
	Sum of Squares	Df	Mean Square	F-value	P-value
Model	.129	2	.064	2.140	.119
Error	11.497	382	.030		
Total	11.626	384			
Appendix Table 5. Education Status of Household Head					
Sources variation	Sum of Squares	Df	Mean Square	F-value	P-value
Model	10.358	2	5.179	6.391	.002
Error	309.548	382	.810		
Total	319.906	384			

Appendix Table 6. Cow population per household					
Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	90.399	3	30.133	18.302	.000
Error	599.316	364	1.646		
Total	689.715	367			
Appendix Table 7. Oxen population per household					
Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	33.536	3	11.179	14.266	.000
Error	296.194	378	.784		
Total	329.730	381			
Appendix Table 8. Heifer population per household					
Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	14.997	3	4.999	7.383	.000
Error	213.975	316	.677		
Total	228.972	319			

Appendix Table 9. Calve population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	7.423	3	2.474	8.037	.000
Error	102.217	332	.308		
Total	109.640	335			

Appendix Table 10. Sheep population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	195.331	3	65.110	12.226	.000
Error	1432.610	269	5.326		
Total	1627.941	272			

Appendix Table 11. Goat population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	44.950	3	14.983	5.888	.001
Error	455.487	179	2.545		
Total	500.437	182			

Appendix Table 12. Donkey population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	.210	3	.070	2.251	.085
Error	4.627	149	.031		
Total	4.837	152			

Appendix Table 13. Horse population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	.077	3	.026	.505	.680
Error	4.663	92	.051		
Total	4.740	95			

Appendix Table 14. Mule population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	.240	3	.080	1.092	.362
Error	3.446	47	.073		
Total	3.686	50			

Appendix Table 15. Age of local cockerel at first mating (AFMM)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	4.729	2	2.364	9.225	.000
Error	97.905	382	.256		
Total	102.634	384			

Appendix Table 16. Age at first egg laying (AFEL)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	8.587	2	4.293	15.371	.000
Error	106.698	382	.279		
Total	115.285	384			

Appendix Table 17. Number of egg laid per hen per clutch (NEHPC)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	62.930	2	31.465	6.309	.002
Error	1905.174	382	4.987		
Total	1968.104	384			

Appendix Table 18. number of clutch per hen per year (NCPHY)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	1.095	2	.547	.873	.419
Error	239.539	382	.627		
Total	240.634	384			

Appendix Table 19. Clutch length in days (CLD)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	47.510	2	23.755	2.369	.095
Error	3831.124	382	10.029		
Total	3878.634	384			

Appendix Table 20. Total egg production per hen per year (TEPPHPY)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	1686.144	2	843.072	19.598	.000
Error	16433.217	382	43.019		
Total	18119.361	384			

Appendix Table 21. Female reproductive life span (FRLS)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	7.656	2	3.828	20.222	.000
Error	72.315	382	.189		
Total	79.971	384			

Appendix Table 22. Male reproductive lifespan (MRLS)

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	11.487	2	5.743	20.008	.000
Error	109.653	382	.287		
Total	121.140	384			

AFMM = Age of local cockerel at first mating
AFEL = age at first egg laying
FRLS = female reproductive span life
CLD = clutch length in days
NEHPC= Number of eggs hen/clutch
NCPHY= number of clutch/hen/year
TEPPHPY = Total eggs production/hen/ year
MRLS = male reproductive lifespan

Appendix Table 23. Hen population per household

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	172.984	2	86.492	16.168	.000
Error	2043.577	382	5.350		
Total	2216.561	384			

Appendix Table 24. Cock population per household

Source of variation					
Model	12.823	2	6.411	6.050	.003
Error	383.599	362	1.060		
Total	396.422	364			

Appendix Table 25. Pullet population per household

Source of variation					
Model	155.691	2	77.845	36.513	.000
Error	778.176	365	2.132		
Total	933.867	367			

Appendix Table 26. Cockerel population per household

Source of variation					
Model	93.913	2	46.957	19.208	.000
Error	858.067	351	2.445		
Total	951.980	353			

Appendix Table 27. Young chicken population per household

Source of variation					
Model	174.250	2	87.125	11.369	.000
Error	2582.573	337	7.663		
Total	2756.824	339			

Major selection criteria by Agro-ecology

Appendix Table 28. Male chicken selection criteria for genetic improvement

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	21.761	2	10.880	13.548	.000
Error	306.774	382	.803		
Total	328.535	384			

Appendix Table 29. Female chicken selection criteria for genetic improvement

Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Model	14.704	2	7.352	8.463	.000
Error	331.857	382	.869		
Total	346.561	384			

Appendix Table 30. Places where farmers sold their products

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Model	7.473	2	3.737	3.655	.027
Error	389.516	381	1.022		
Total	396.990	383			

Appendix Table 31. Chicken and eggs buyers

Model	21.670	2	10.835	9.875	.000
Error	418.015	381	1.097		
Total	439.685	383			

Appendix Table 32. Mode of transport of chickens					
Model	3.184	2	1.592	7.022	.001
Error	86.376	381	.227		
Total	89.560	383			
Appendix Table 33. Mode of transport of eggs					
Model	.497	2	.249	1.621	.199
Error	58.552	382	.153		
Total	59.049	384			

Appendix Table 34. Price of chickens and Egg during Ordinary market						
Parameters	**Source of variation**	**Sum of Squares**	**df**	**Mean Square**	**F-ratio**	**p-value**
Mature Male	Model	1824.482	2	912.241	5.948	.003
	Error	58585.258	382	153.365		
	Total	60409.740	384			
Mature Female	Model	5156.857	2	2578.428	33.045	.000
	Error	29806.520	382	78.028		
	Total	34963.377	384			
Grower (pullets and cockerel)	Model	1030.644	2	515.322	4.871	.008
	Error	40411.953	382	105.790		
	Total	41442.597	384			
Egg	Model	6.110	2	3.055	42.153	.000
	Error	27.683	382	.072		
	Total	33.793	384			
Appendix Table 35. Price of chickens and Egg during Eth. New year (September 11)						
Parameters	**Source of variation**	**Sum of Squares**	**Df**	**Mean Square**	**F-ratio**	**p-value**
Mature Male	Model	17216.822	2	8608.411	81.661	.000
	Error	40269.282	382	105.417		
	Total	57486.104	384			
Mature Female	Model	2812.490	2	1406.245	16.806	.000
	Error	31963.744	382	83.675		
	Total	34776.234	384			
Growers (pullet and cockerel)	Model	17806.956	2	8903.478	111.562	.000
	Error	30486.550	382	79.808		
	Total	48293.506	384			
Egg	Model	1.752	2	.876	12.914	.000
	Error	25.908	382	.068		
	Total	27.660	384			

Appendix Table 36. Price of chickens and Egg during "Meskel" (September 30)

Parameters	Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Mature Male	Model	14150.681	2	7075.341	96.559	.000
	Error	27990.877	382	73.275		
	Total	42141.558	384			
Mature Female	Model	3842.749	2	1921.374	19.940	.000
	Error	36808.810	382	96.358		
	Total	40651.558	384			
Growers (pullet and cockerel)	Model	15722.013	2	7861.006	89.819	.000
	Error	33432.922	382	87.521		
	Total	49154.935	384			
Egg	Model	.402	2	.201	5.870	.003
	Error	13.079	382	.034		
	Total	13.481	384			

Appendix Table 37. Price of chickens and Egg during X-mass ("Gena")

Parameters	Source of variation	Sum of Squares	Df	Mean Square	F-ratio	p-value
Mature Male	Model	18858.990	2	9429.495	119.755	.000
	Error	30078.673	382	78.740		
	Total	48937.662	384			
Mature Female	Model	1514.080	2	757.040	5.952	.003
	Error	48590.855	382	127.201		
	Total	50104.935	384			
Grower (pullet and cockerel)	Model	26868.977	2	13434.489	116.382	.000
	Error	44095.958	382	115.434		
	Total	70964.935	384			
Egg	Model	.932	2	.466	14.312	.000
	Error	12.437	382	.033		
	Total	13.369	384			

Appendix Table 38. Price of chickens and Egg during Easter ("Fasika")

Parameters	Source of variation	Sum of Squares	df	Mean Square	F-ratio	p-value
Mature Male	Model	15468.112	2	7734.056	118.817	.000
	Error	24865.265	382	65.092		
	Total	40333.377	384			

Parameters	Source of variation	Sum of Squares	df	Mean Square	F-ratio	p-value
Mature Female	Model	12775.809	2	6387.905	78.770	.000
	Error	30978.476	382	81.095		
	Total	43754.286	384			
Growers (pullet and cockerel)	Model	26505.094	2	13252.547	142.320	.000
	Error	35571.140	382	93.118		
	Total	62076.234	384			
Egg	Model	.341	2	.171	4.242	.015
	Error	15.369	382	.040		
	Total	15.710	384			

Appendix Table 39. Price of chickens and Egg during Muslim festival

Parameters	Source of variation	Sum of Squares	df	Mean Square	F-ratio	p-value
Mature Male	Model	3325.326	2	1662.663	41.591	.000
	Error	15271.037	382	39.977		
	Total	18596.364	384			
Mature Female	Model	796.568	2	398.284	5.787	.003
	Error	26290.705	382	68.824		
	Total	27087.273	384			
Grower (pullet and cockerel)	Model	14430.172	2	7215.086	144.834	.000
	Error	19029.828	382	49.816		
	Total	33460.000	384			
Egg	Model	.015	2	.007	.209	.812
	Error	13.544	382	.035		
	Total	13.558	384			

Compiler Name: ----------

Signature: ----------

Date: ----------

Duration: Starting time ---------- Ending time ----------