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Research Paper

On-Farm Performance Evaluation Of Indigenous Naked Neck And Normal Feathered Chicken At Aira And Golliso Districts Of West Wollega Zone, Oromia, Ethiopia

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On-farm performance evaluation of indigenous naked neck and normal feathered chicken at Aira and Golliso Districts of West Wollega Zone, Oromia, Ethiopia

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The study was conducted to evaluate on-farm performances of indigenous normal feathered (NF) and naked neck (NN) chicken ecotypes in midland and lowland agroecology of west Wollega zone through assessment and monitoring under farmer management conditions. A purposive sampling procedure was applied for the selection of two rural districts and six Kebeles based on agroecology and availability of indigenous chicken ecotypes. Simple random sampling procedure was used to select 150 respondents for interview and 180 INF and NNC ecotypes for monitoring purpose. Data from respondents were collected using a semi-structured questionnaire and from the indigenous chicken were collected using record format. All collected data were analyzed using of SAS 9.3. Least Significant Difference (LSD) test was used to compare means for significant traits. Significant differences were observed between INF and NNC ecotypes in almost all studied performance traits except age at first egg laying, sexual maturity, and slaughter age. Lowland chicken ecotype reached early sexual maturity, slaughter age, and age at first egg-laying than midland chicken. The mean age at sexual maturity and egg-laying of INF and NNC were 6.14±.05, 6.04±.06, and 6.57±.04, 6.46±.05 months, respectively. The mean clutch number, egg laid per clutch, and total egg produced per year of INF and NNC ecotypes were 3.3±. 03,11.52±.10, 40.2±.54, and 3.8±.02, 14.24±.11, 58.3±.41, respectively. In another way, the mean egg per clutch during monitoring for INF and NNC were 12.58±.23 and 15.6±.16, respectively. The mean adult live weight of INF and NNC were 1510±.02; 2100±.03gm and 1540±.05; 1710±.04gm from survey and monitoring, respectively. While growth performance of four, eight, and twelve weeks of age were 130.18±.43; 392.79±.76;509.41±.58 and 143.85±.32; 396.02±1.42, and 523.74±1.34 gm, respectively during monitoring study. The means hatchability of normal feathered and naked neck chickens was 71.04±1.4; 53.01±.55 and 75.98±1.68; 52.36±.5 respectively from survey and monitoring study. The mean survival and mortality rate of normal feathered and NNC was 67.58±.82 and 32.37±.79 and 71.14±1.06 and 28.81±1.07, respectively. Traits preferred were egg production, adaptability, and mothering ability with index value ranked 0.123, 0.098, 0.091(1^{st}, 2nd and 3^{rd}) respectively for both INF and INN chickens. Performance differences between indigenous normal feathered and naked neck chicken ecotypes indicate the genetic and phenotypic diversity exists between both chicken ecotypes and their response to different agroecology was different. Naked neck chicken is superior in terms of clutch/year/hen, egg/clutch/year/hen, live weight/hen/year/. These superior performances suggest that naked neck chicken requires reproducing to have large stock for undertaking future conservation and further performance improvement program.

Keyword: Indigenous, Naked Neck, Normal Feathered, Performance

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INTRODUCTION

Chickens are the most popular poultry species worldwide in terms of their economic importance (Nigussie, 2011; FAO, 2014) which particularly plays important socio-economic roles in developing countries (Kondombo, 2005; Fisseha *et al*., 2010). Chickens are especially important in the rural area of developing country in the capital building up and source of livelihood for the landless family. The reasons that their preference by smallholder farmers particularly by the landless family are due to low input requirements to invest, short generation intervals, scavenging ability, and adaptability to poor management condition (Besbes, 2009; Apuno *et al.,* 2011; Mohammed, 2018). The major objectives of keeping village chickens in developing countries are income generation, meat/egg for home consumption, and religious/cultural considerations (Alders *et al*., 2009; Guèye, 2009; Worku, 2017; Kejela, 2020).

Ethiopia has about 60 million estimated total poultry population of which 90.8 percent, 4.8 percent, and 4.4 percent of them are indigenous, hybrid, and exotic chickens (CSA, 2017). According to CSA (2017) indigenous chickens are huge in numbers and distributed across different agroecology of the country under traditional scavenging management system which is typically known for poor management conditions and poor feed quality (Fisseha *et al*., 2010; Mohammed, 2018; FAO, 2019). Consequently, the involvement of indigenous chickens to support the rural economies is dis- proportional to their huge numbers in the country. Even-though they developed important characteristics like foragers and disease resistant, good broodiness, and adaptation to poor management conditions and poor feed quality, their productive and reproductive performance is extremely low (Halima, 2007; Zewdu*et al.,* 2013; Mohammed, 2018).

The Ethiopian indigenous chickens encompass chickens with a wide range of morphologic or genetic diversity (FAO, 2019). Morphologically, they are diversified in color, comb type, body conformation, weight, and shank feathers (Fulas *et al*., 2018). Among indigenous chicken found in Ethiopia, the *Angete-Melata* (naked neck) chicken ecotype is commonly found in lowland agroecology and it is better in terms of performing and surviving under scavenging production system. It has relatively aggressive behavior, good productive and reproductive performance, and tolerance to common diseases (Getu *et al*. 2014; Dahloum; 2017). Islam and Nishibori (2009) also confirmed the disease resistance nature *Angete-Melata* (naked neck) chicken ecotype, their fast growth rate, better in egg production, egg quality, and in meat yield traits than other strains (normal feathered). According to the report of CSA (2018), indigenous chicken under farmer management condition has 4 clutch numbers per year, 21 clutch length per year, 12 egg per clutch and 40-60 small eggs. While the mean clutch number 3.95 and 3.98 Jahan *et al*. *(*2017) and bodyweight 1.78 and 1.40 kg reported by (Getu and Birhan, 2014) and egg per clutch number and egg produced per year is 14.93 and 67.24 and 15.18 and 70.65 eggs, respectively for indigenous naked neck and normal feathered chicken ecotypes by (Ahmedi *et al*., 2011).

Even though different researchers (Markos *et al*., 2014; Alam T., 2015; Milkias *et al*., 2019) carried out assessment work on the productive and reproductive performance of indigenous normal feathered and naked neck chicken ecotypes in different parts (Western and central Tigray and Gena Bosa Dawro Zone Southern region) of the country, evaluating their actual productive and reproductive performance under extensive management systems through monitoring and chicken production constraints, farmers traits preferences, and breeding objectives are limited in Ethiopia in general and west Wollega zone in particular. Therefore, this research was designed with the objective of on-farm performance evaluation of indigenous normal feathered and naked neck chickens through monitoring under farmer management condition, and current production constraints, and farmer's traits preferences and breeding objectives in Aira and Gulliso districts of western Wollega zone, Oromia, Ethiopia.

Specific objectives

- To evaluate productive performance of naked neck and normal feathered indigenous chicken in study area
- To evaluate the reproductive performance of naked neck and normal feathered indigenous chicken in study area
- To assess management systems and the current chicken production constraints in study area
- To assess farmers traits preferences and breeding objectives in study area

LITERATURE REVIEW

Indigenous/local chicken ecotypes in Ethiopia

The Ethiopian indigenous chickens are non-descriptive ecotype and differ in color, comb type, body conformation, weight and may or may not possess shank feathers (Fulas *et al., 2018)*. The major chicken ecotypes found in a different part of Ethiopia; based on the name of their agro-ecology like: Chef, Jarso, Tilili, Horro, and Tepi (Tadelle *et al.,*2003); Gelila, Debre-Elias, Melo-Hamusit, Gassay, Tilili, Horro, Guangua and Mecha (Halima, 2007) and Farta, Konso,Mandura, Horro, and Sheka (Dana, 2011) and based on their plumage color named as Tikur, Melata (nacked nack), Key, Gebsima, Netch, Serrano, Libework, Teterma, Tikur-Teterma and Key-Teterma (Bogale, 2008; Dana *et al*., 2010; Addis *et al.,* 2014).

Based on feather morphology local chicken ecotypes are characterized as skin color (silky, white, and yellow) based on comp type (single, rose, pea, walnut & duplex) and based on Body shape (blocky, triangular, and wedge) (Dana *et al*., 2010). About ten (10) common indigenous chicken breeds/ecotypes in Ethiopian (DAGRIS, 2007) these known namely Chefe, Gebisma (mixed), Horro, Jarso, Kei (red), Naked neck (malata), Netch (white), Tepi, Tikur (black), and Tilili. However, some classifications are based on plumage color which is difficult to consider as ecotype or breed. Different studies indicated that chicken ecotypes are increased to 17/18 in Ethiopia (Halima 2007; Dana,2010; Addisetal.,2014).

Table 1: Chicken ecotypes/ populations of Ethiopia

Identified Ecotypes	Peculiar(irregular) feature	Dominant location	Authors
Chefe			Tadelle, 2003
Horro	Flat head shape, pea comb type, blocky body, yellow shank color	East Welega	Negussie, 2011and Halima, 2007
Tepi	Naked neck, black eye, single combed red skin	Tepi	Tadelle *et al*., 2003
Jarso	Red plumage color, no black eye color	East Hararghe zone	Eskindier *et al*., 2013& Tadelle *et al*., 2003
Tilili	Pea comb, lack of shank feather	West Gojjam	Halima, 2007
Guangua	Crest and plain head, pea comp, no shank feather, yellow shank	Agew Awi	Halima, 2007
Gelila	Plain head, pea comb, yellow shank color, lack of shank feather	West Gojjam	Halima, 2007
Debre-Elias	Plain head, pea comp, and v-shaped comb, do not have shank feather	East Gojjam	Halima, 2007
Melo-Hamusit	Crest head shape, all ecotypes (57%) pea except strawberry, lack of shank feather yellow shank color	South Gondar	Halima, 2007
Gassay/Farta	Crest head shape, all ecotypes (57%) pea except strawberry, lack ofshank feather yellow shank color	South Gondar	Halima, 2007and Negussie, 2011
Mecha	Plain and crest head shape, pea comp	West Gojjam	Halima, 2007
Mandura	Crest head, pea comb type, blocky body type and yellow shank color	Amahara, Gumuz, Agew and Oromia	Negussie, 2011 and Halima, 2007

Table 2:continuation

Sheka	Flat head, pea comb, blocky body shape, yellow shank color	SNNP region	Negussie, 2011
Angete-melata (Naked neck)	Aggressive, absent of feather at neck	North Gondar	Tadelle, 2003, Halima, 2007&Addis *et al*.,2014
Konso	Flat head shape, pea comb type, blocky body shape, yellow shank	SNNP region	Negussie, 2011
Gugut	muffed, absent of wattle in hen	Tache Armacheho	Addis *et al*.,2014
Gasgie	Long necked and red in color	Alefa	Addis *et al*.,2014

Addis Getu and Aschalew Tadese, 2014

Chicken production systems in Ethiopia

The chicken production system in Ethiopia can be categorized into three main production systems, namely the large-scale commercial, the small-scale commercial, and the village/ backyard poultry production system depending on some selected limitations such as breed, flock size, housing, feed, health, technology and bio-security (Halima, 2007; Alemu *et al*., 2008; Tadesse, 2015; Bush, 2006). In other respects, the Ethiopian chicken production system can be classified into traditional backyard, small scale market-oriented poultry and commercial poultry production system (Emebet and Kidane, 2016).

Village/indigenous production system

It is considered by a few or no inputs for housing, feeding (scavenging is the only source of diet), and health care with a minimal level of bio-security, high off-take rates, and high level of mortality (Dawit *et al*., 2008).More than seventy-seven (77%) of the farmers practiced an extensive/village/indigenous chicken production system which is characterized by the exposes of birds to predators, harsh climatic conditions, disease challenges, uncontrolled breeding, and inadequate and poor-quality feeds across agroecology of Ethiopia (Zemelak *et al*., 2016).

Feed resources and feeding

The major feeding practice is scavenging system with supplementary feeds from home source, purchased grains, and kitchen leftover. While about 94.19% of chicken producers offer supplementary feed mainly composed of grains that about 46.23% obtained from farmers" homein Western Ethiopia (Hundie *et al*., 2019). Similarly, Milkias*et al*. (2020***)*** reported that 92.2% of the chicken producers practice traditional scavenging production system with a supplementary feeding in Gena Bosa Southern Ethiopia. Whereas the most common supplementary feed in Jimma, central Tigray, and Sheka southwestern are crop harvest and purchase from the market (maize, wheat, barley, and millet), households leftovers feed and used left scavenging only without any supplementary feeds. While *Ensete ventricosum* (processed inset) (64.9%), maize (*Zea mays*) and sorghum (53.0%) (Tashome, 2018; Assefa*et al*., 2019; Fitsum, 2016).

The major chicken supplementary feed in Arsi and Bale, Oromia Ethiopia are wheat (82%), household leftover (81%) maize (73%), barley (22%), wheat bran (9.9%), sorghum (7.9%), in most cases, provision of feeds to the chicken is seasonal (Ambaw *et al.,* 2020). However, the amount and type of feed used as supplementary dependent on the type and size of crop production in different Ethiopian agroecology and most of the farmers don't adjust the amount of feed existing according to age and productivity of the chickens (Tsadik *et al*., 2015). Halima *et al*. (2007); 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.

Water provision

According to Bezabih (2017) the farmers in and around Debra Markos are providing water regularly and more than half of producers don't know the amount of water provide for chicks per day and its frequency varied among producers. The study in Bure North West Ethiopiaindicates all the village chicken owners (100%) provided water to their chickens. While about 85.4% of farmers are providing water only during the dry season and 14.3% throughout the year; about (78.9%) of chicken owners used *adlibitium* type (Gebremariam *et al.,* 2017). In another way, the farmer in different parts of rural Ethiopia use rivers, spring, pond, under-ground water and Hund pump as the main sources of water for provision of chickens (Moges *et al.,* 2010; Addis *et al.,* 2014; Fitsum, 2016; Yosefe *et al.,* 2016; Bezabih 2017; Gebremariam *et al.,*2017; Tashome 2018). Additionally, broken clay (*shekila)*, wooden trough, and plastic made trough are the most widely used water trough*(*Gebremariam *et al.,* 2017; Teshome, 2018).

Housing

Housing is one of the most important to chickens as it protects them against predators, theft, rough weather (rain, sun, cold wind, dropping night temperatures) (Getiso *et al.,* 2015). In Ethiopia local chickens are housed either in separate house or dwell together with households in the same house, providing them separate house varies from place to place. For instance, in Gena Bosa, Dawro Zone, about 10.4% Milkias *et al*. (2020*)*;52.5% Assefa *et al*. (2019) Shaka southern; 47.5%, Tashome (2018) in Seka Chokorsa and Karsa Jimma; 65% Fitsum (2016) in central Tigray region provide separate house for their chickens. Additionally, 29.17 % of chicken producers are constructed small attachments outside the family house in Yeki Southwestern (Abegaz and Gemechu, 2016).

In other areas like Kersaeast Hararghe, farmers don't provide any separate poultry house for their chickens (Tagesse, 2016). Therefore, in Southern and central Tigray, the chicken owners sheltered birds in the kitchen, share common night shelter with household members, shelter in the ceiling of the house in a basket made up of wood, and shelter in the house with separate perching with wooden and corrugate iron, stone wall+ grass roof or soil *(*Gebremariam *et al.* 2017; Fitsum, 2016). Additionally, the study of Tashome (2018) indicated that the farmers in Jimma Saka Chokorsa and Karsa have no separate houses for their chickens; while they keep their chickens on various night sheltering places like perches inside the house (35.6%), on ceilings of the house (29.2 %), on the eve of the house (verandah) (28.7%) and the ground (floor) covered by bamboo/crops straw (6.4%) are the night chickens' shelters.

Broody hen management

A broody hen often finds a dark and quiet place in the house for laying eggs. After the eggs collected, farmers adjust different kinds of nest for broody hens, and an important feed resources and favorable environment for growing chicks during the dry seasons. About 90 % of the producers incubate and brood their hen during the dry seasons and 10% of the chicken producers do not have any specific choice of the season for incubation (Ambaw *et al*., 2020; Guteta and Alewi, 2018). According to Abdo *et al*. (2016) at Jigjiga Somali regional state, about 80% of chicken owners allowed the incubating hen to feed and drink every other day and only 20.4 % do the same every day. Although about 63.1 percent mud made, 9.2 percent grass made, 13.9 percent bamboo made, 9.5 percent clay made, and 4.3 percent others are the natural types of incubating materials. About 95 percent of the chicken owners chose dry season to incubate eggs and the remaining 4 percent and 1 percent chose both seasons and the rainy season, respectively. Whereas about 97% of the farmers use bedding material mainly crop residues such as "*Teff*" (*Eragrostis tef*) straw, barley straw, and wheat straw in different agroecological zones of Ethiopia(Aberra *et al.,* 2013)

Similarly, 1 percent clay pots with straw bedding, 15.6 percent ground with soil/sand/ash bedding, 68.8 percent the bin with grasses/straw/cotton seed bedding, 7.8 percent plastic with grasses/soil/sand bedding, 0.3 percent bamboo cages with soil and straw breeding are used as egg setting materials in the western zone of Tigray (Markos *et al.,* 2014). A laying nest for broody hens is prepared from different materials and placed in different manners such as bamboo basket bedded with teff straw, a nest on the ground, and a nest under the bed with changing the bedding materials during incubation practiced by all respondents in Wolayita Southern Ethiopia (Assefa, 2015).

The small-scale intensive production system

In Ethiopia, the small-scale intensive chicken production system is quickly rising in the urban and peri-urban areas, mostly run as family productions and considered as vital bases of income and presently plays an important role in the employment of youth (FAO, 2019). The small-scale poultry productions are commonly integrated into mixed production systems with crops and other livestock, and enhancing nutrient utilization and recycling in the environment, contributing

to mixed farming practices, and contributing to women's empowerment, and enabling access to healthcare and education (Alders *et al*., 2017; Thieme *et al*., 2014).

About 28.45%, of the farmers in Southwest Showa and Gurage zones of Ethiopiapractice a semi- extensive/intensive chicken management system (Emebet, 2015). In another way, of the 49% small- scale chicken production in and around Debre Markos about 75.5% run by private producers who initiated by themselves and the remaining 24.5% of the farms were organized by the small and micro-enterprise office (Bezabih, 2017). While in the indifferent agroecology of Ethiopia about 22.1% of the households practiced a semi-extensive form of chicken production system reported (Goraga *et al*., 2016).

The large-scale commercial production system

The highly intensive chicken production, which contains an average of 10,000 chickens kept under an enclosed condition with a standard to high bio-security level. This system seriously depends on an introduced exotic breed that needs intensive inputs such as feed, housing, health, and modern management systems. It is estimated that this sector accounts for nearly 2% of the national poultry population and is characterized by the higher level of productivity where poultry production is completely market oriented to meet the large poultry request in main cities (Bush, 2006).

There are few private large-scale/commercial chicken farms, all of which are located in and around Bishoftu. ELFORA, Alemaya, and Genesis are among the top three largest commercial poultry farms in the country with modern production and processing facilities. The large-scale/commercial chicken farms provide fertile eggs, table eggs, day-old chicks, broiler /meat, and adult breeding stocks to the small-scale poultry farms (FAO, 2008).

Productive and reproduction performance of indigenous chicken

Productive of performance indigenous chicken

The productive performance like the clutch number, average number of eggs laid per clutch, the average number of eggs per hen per year, body weight, and slaughter age of chickens arelow (Milkias *et al*., 2019). Under natural conditions, there are large variances in the productive performance of indigenous chickens in terms of egg number, egg weight, egg mass, body weight, and productivity index at different locations (Mathur, 2003).

Growth performance

Growth performance is an importance and high heritability traits and factor reflecting the production level and economic benefits of the farm (Hanusová *et al*., 2017). It is directly related to body size for local chickens (Ajayi *et al.,* 2014). This parameter depends on the management and overall production systems of farmers mainly on feeding, watering, and disease control mechanisms (Milkias *et al.,* 2019). According to Markos *et al*. (2015) study in Western Tigray the overall mean weight (growth performance) of day old, one week, one month, two months, and three-month-old indigenous chicken chicks raised during the monitoring phase under extensive management are (37.96, 40.19, 144.13, 303.04 and 517.25) gram, respectively.

Naked neck

The mean body weight of males and females of indigenous naked neck chicken in Sheka, South West Ethiopia are 1.64 and 1.35kg, respectively (Assefa and Melesse, 2019). Similarly, Getu*et al.* (2014) reported at Quara north Gondar, the mean body weight of indigenous naked neck chicken was 1.78 kg. According to the study report from Sudan and Nigeria, the mean body weight of free-range indigenous naked neck chicken genotypes is 1.007 and 1.30 kg respectively (Ojang, 2015; Yakubu *et al*., 2008). While the mean average body weight of indigenous naked neck chickens is 2.21kg in Kweneng and Southern Botswana under existing management conditions (Machete *et al*.,2017).

Normal feathered

The mean bodyweight of indigenous normal feathered chicken in Sheka, South West Ethiopiais 1.55kg (Assefa and Melesse 2019). Similarly, Machete *et al*. (2017) in Kweneng and Southern Botswana under existing farmer management condition, the mean average body weight of the normal feathered chickens is 2.07 kg. In another way, the reported mean bodyweight of hens (1.37 and 1.356) kg, cockerels (1.024 and 1.119) kg and pullets (1.021 and 1.064) kg are

reported in lowland and midland agroecology of central Tigray respectively (Tadesse, 2015). According to Getu *et al.* (2014) in Quara north Gondar, the mean body weight of indigenous normal feathered (Gugut) chicken is 1.40 kg. While the mean body weight of free rage of normal feathered chicken genotypes is 1.16 kg in Nigeria. (Yakubu *et al*., 2008).

Clutch number

Naked neck

The mean clutch numbers of indigenous chickens are different in different production and management systems. The mean clutch number of the indigenous naked neck in north Gondar Quara are 3.52 **(**Getu and Birhan, 2014). Idowu *et al*. (2019) study, in Eastern Cape Town South Africa under scavenging conditions indicated that the mean clutch per year for the naked neck chicken are 3.56. According to Jahan *et al*. (2017), the mean clutch number per year is 3.98 for naked neck chicken in Bangladesh under farmer management conditions. Similarly, in Sudan under scavenging conditions, the mean clutch number for indigenous naked neck chicken genotypes are 4 per year (Yousif & Eltaye, 2011).

Normal feathered

The mean the clutch number are 3.7 per year for normal feathered chicken in Eastern Cape Town South Africa under scavenging conditions (Idowu *et al*., 2019). Similarly, Jahan *et al*. (2017) reported that, the mean clutch number per year for normal feathered chicken in Bangladesh under farmer management condition. According to Getu and Birhan (2014), in North Gondar Quara,the mean clutch for the indigenous the normal feathered chicken is 3.97. However, the average clutch for dwarf (normal feathered) 5 per year in Sudan under scavenging conditions (Yousif & Eltaye, 2011).

Egg production

Egg production is the number of eggs attained from poultry during a specific time (Jacob *et al*., 2012). It is one of the most economically important traits besides growth performance in back yard chicken production systems in Ethiopia also (Nigussie, 2011). Indigenous chickens produce the lowest number of eggs and which is small in size and about 12 eggs produced per clutch in Ethiopia (CSA, 2016). Of indigenous chicken in lowland agroecology of Ethiopia the naked neck chicken produces a high number of eggs per year (Getu *et al.,* 2014; Asmamaw, 2016).

Naked neck

The mean egg produced per clutch and year are 16.88 and 60.20 for indigenous naked neck chicken in Quara north Gondar **(**Getu and Birhan**,** 2014). Idowu*et al*. (2019) reported that the mean eggs produced per year of the naked neck chicken are 34.49 in Eastern Cape Town South Africa.In Bangladesh under the existing farmer management condition eggs per clutch of the naked neck chicken is 11.04 and the mean egg produced per clutch and egg per year per hens are 15.18 and 70.65 respectively (Jahan *et al*., 2017; Ahmedi *et al*., 2011). According to Fathi *et al*. (2013) and Yakubu *et al*. (2008) the mean egg laid per clutch of indigenous naked neck chicken is 16.8 and 11.63 respectively in Nigerian.

Normal feathered

According to Jahan *et al*. (2017) in Bangladesh under the existing farmer management condition, the mean number of eggs per clutch for the indigenous normal feathered chicken is 12.46 and the mean egg produced per clutch is 14.93 and 67.24 respectively (Ahmedi *et al*., 2011). Similarly, the mean number of eggs produced per clutch and per year are 13.06 and 55.87 for the normal feathered chicken in north Gondar (Getu and Birhan, 2014).Fathi *et al*. (2013) and Yakubu *et al*. (2008) reported that, the mean an egg laid per clutch is 8.6, and 9.71 for the frizzled local chicken respectively in Nigerian. The mean eggs laid per clutch number and eggs produced year are 12.64, 13.6, 11.52 and 49.51, 43.4, 43.63 of normal feathered chicken in North Wollo, Amhara, Central Tigray, and Jimma, Seka Chekorsa and Kersa respectively (Addisu *et al*., 2013; Alem, 2014; Teshome, 2018).

Market/Slaughter age of chickens

The mean market or slaughter age of cocks and hens are 7.87 and 7.26 months in Gena Bossa District of Dawro zone respectively (Milkias *et al.,* 2019). In different parts of Ethiopia, the average slaughter age of the indigenous chicken

ranges between 8 to 12 months (GAIN, 2017). The overall mean slaughter ages of local male and female chickens are 4.66and 4.50months respectivelyin the Western Tigray, Ethiopia (Markos *et al., 2015*). According to Getiso *et al*. (2017) report in the high land, midland, and lowland agroecology of SNNPR indigenous chickens reach slaughter age at 9.9 months.

Reproductive performance of indigenous chickens

The average reproductive life span of a hen and male chickens (years) are 2.70 and 2.41, respectively and the reproductive cycle takes the longest time for indigenous chickens because they require a long time to reach sexual maturity and replace parent stock traditionally by broody hens which require a long time to recover the reproductive cycle (Brhane *et.al*.,2017). The reproductive cycle of indigenous hens consists of 20 days clutch length, 21- days of incubation, and 56 days of brooding days (Halima, 2007).

The age at first sexual maturity

Naked neck

In northern Gondar, the mean age at first sexual maturity of the indigenous naked neck chicken genotype are 5.05 months in rural and urban areas (Asmamaw, 2016). Although Addisu *et al.* (2014) reported that the mean age of indigenous necked neck chicken at first female sexual maturity are 4.7 months under traditional production systems in North Wollo, North Wollo. According to Jahan *et al.* (2017), the mean age at first sexual maturity of naked neck chicken are 6.2 months in Bangladesh under the farmer management conditions. Similarly, in Sudan, the age at sexual maturity of Sudanese indigenous naked neck chickens' ecotypes are 6.16 months (Yousif & Eltayeb 2011).

Normal feathered

The mean age at first sexual maturity of normal feathered chicken are 6.6 months in Bangladesh under existing farmer management conditions (Jahan *et al.,* 2017). Similarly, Asmamaw (2016) reported that, the mean average age at first sexual maturity normal feathered (Kechere and Yetilku zere) chicken ecotype are 4.96 months in north Gondar from rural and urban areas. Consequently, Addisu *et al*. *(*2014), in north Wollo the mean age at first sexual maturity for normal feathered (Gasgie and Gugut) chickens are 5.5 and 6.08 months. According to the study in Sudan, the mean ages at first sexual maturity for Sudanese dwarf (betwil) chickens' ecotypes are 5.46 months (Yousif & Eltayeb 2011).

Age at first egg-laying

Naked neck

The mean age at first egg-laying of naked neck chicken in Cape Town South Africa, Sudan, and Bangladesh are 4.2; 4.94 and 5.06, 4.9 months respectively (Idowu *et al*., 2019;Ojang ,2015; Faruque *et al*., 2013; Islam *et al*.,2016). According to Teketel (1986) and Halima (2007) study, in the northern part of Ethiopia, the age at first, egg-laying for naked neck indigenous chicken are 5.5 to 7.67 months.

Normal feathered

According to Teketel (1986) and Halima (2007) studies, the mean age for indigenous normal feathered chicken at first egg-laying are 4.8 to 5.367 months in the northern part of Ethiopia. Similarly, the mean age at first egg-laying is 5.30, 4.9, and 4.22 months in Bangladesh and in cap south Africa, respectively (Faruque *et al*., 2013; Islam *et al*.,2016; Idowu *et al*.,2019). Yadessa *et al.* (2017) also reported that in Mezhenger, Sheka, and Benchi-Maji Southern Ethiopia, 5.8 months are the mean age of indigenous chicken at first egg-laying.

Natural brooding of indigenous chickens

Natural brooding is a chick brooding method that involves using a natural mother/hen (Abebe *et al*.,2015). Broodiness is a mutual characteristic of the indigenous chicken, and hen hatched 4 or 5 clutches of eggs every year (Islam, 2006). The natural incubation is the most frequently used scheme for substituting and increasing the size of flocks. According to

the study of Ambaw *et al.* (2020), the broodiness of a given chicken strain is genetically inherited and has to be broody after laying eggs so that it would incubate, hatch the eggs, and raise its young chicks. The brooding time of the laying hens are longer, with many brooding cycles required to compensate under foraging conditions (Halima, 2007). For chickens it takes 21 days for eggs to hatch and eggs should be fresh before incubation (Solomon, 2015). Though weather conditions, the absence of suitable laying nests, and post-management are the main reasons for the letdown of egg habitability (Markos, 2014).

Similarly, broody hen hatching, rearing and caring a little number of chicks (6-8) ceased egg laying throughout the entire incubation and brooding periods of 77 days are the characters of the traditional, production system in Gomma Jimma (Meseret, 2010). About 10.9, 8.17, 2.73 from survey and 10.42, 8.14, 2.24 from monitoring are incubated eggs, hatched chicks, and wasted eggs respectively in Western Tigray (Markos *et al*., 2015). However, according to Zereu and Lijalem, (2016); Brhane (2017); Haile *et al. (*2017); Milkias *et al. (*2019); Abiyu (2019), the number of incubated eggs and hatched chicks per broody hens are different in different parts of Ethiopia.

Hatchability of indigenous chicken

In chicken production, fertility and habitability are characteristics of economic importance for the reason that it has a solid effect on chick productivity and influenced by egg weight, rotating of eggs, storage, humidity, shell strength, egg size, and genetic factors within the chickens (Wolc *et al.,* 2010; Bekuma *et al*., 2020). About 80% habitability of indigenous chicken is normal from natural incubation and 75 to 80 % habitability is satisfactory (Kgwatalala et al., 2013). The habitability percentage of local chickens in different parts of Ethiopia are different (Melkam and Wube, 2013; Markos *et al.,* 2015; Gebremariam *et al*., 2017; Mikias *et al.,* 2019).

Naked neck

The mean habitability percentage of indigenous naked neck chicken under farmer management condition is 76.67 in Bangladesh (Jahan *et al.,* 2017). Similarly, the proportion of habitability of indigenous naked neck chickens are 71.49, 93.1%, and 59.09 in Nigerian and Sudan respectively (Yakubu *et al*., 2008; Ajayi, 2010; Yousif & Eltayeb, 2011). In another way, Osinbowale (2017); Idowu *et al*. (2019); Ahmed *et al*. (2012) reported that 83.50%, 80.26, and 87.4 4 are average habitability of the naked neck chicken in Eastern Cape, South Africa, and Bangladesh under farmer management condition.

Normal feathered

According to Alem (2014), the mean habitability the indigenous normal feathered chicken Central Tigray is 85.8%. Similarly, in Nigerian and Sudan, the mean habitability of normal feathered chickens is 72.13, 45%, and 65.6%, respectively under the farmer management conditions (Yakubu *et al.,* 2008; Ajayi, 2010; Yousif & Eltayeb, 2011). Idowu *et al.* (2019) and Ahmed *et al*. (2012) also reported that the average habitability is 82.49 and 86.98 of the normal feathered chickens, respectively in Eastern Cape Town, South Africa, and Bangladesh. Additionally, about 71.85% of hatchability also reported in Bangladesh under farmer management conditions (Jahan *et al*., 2017).

Mortality and survival rate of indigenous chickens

The studies of different researchers indicated that the scavenging chicken production system is considered by high chick mortality in the first two weeks of life and mostly influenced by predators, Newcastle disease, and the overall management system in Ethiopia (Melesse and Negesse, 2011). High chickens' mortality before 8 weeks of age is the main reason for low productivity in addition to low producers of small-sized eggs under farmer management conditions (Alganesh *et al.,* 2003; Negussie *et al.,* 2003). While the average survival rate was 61.95% in lowland and 69.4% of local chicks in midland agroecology of central Tigray, Ethiopia (Alem, 2015).

Naked neck

The mean mortality and survival percentage of naked neck chicken genotype are 40.8%, 71.77% respectively in Eastern Cape Town South Africa (Idowu *et al*. 2019). In another way, Jahan *et al.* (2017) the survival of naked neck chicken is 61.78% and mortality (28.60%) under farmer management conditions in Bangladesh.

Normal feathered

According to Idowu *et al*. (2019), the mean mortality and survival rate was 70.94, 60.08 for normal feathered chicken in the Eastern Cape region. Similarly, Jahan *et al.* (2017) reported that the survivability of normal feathered chicken is 49.51% in Bangladesh under farmer management conditions. While the mortality rate of normal feathered chicken genotype in Nigeria is 36.85 (Yakubu *et al*., 2008).

Farmers traits preferences and breeding objectives

Farmers' trait preference

Farmers' trait preference is one of the most important information to implement breeding schemes in backyard chicken production systems in Ethiopia (Nigussie, 2011). Similarly, the farmers in Buno Bedele and Ilu Aba-bor South-Western Ethiopia preferred traits of body weight (52.3%), plumage color (27.6%), and comb-type (20.1%) for male chicken and egg production (43%), feather color (35.5%), body weight (8%), size of pelvic bones (7.3%), and white leg color (6.0%) of the farmers for female (Yadeta *et al.,* 2019). Markos *et al*. (2016) also reported the plumage color, egg yield /clutch, and comb-type are the most preferred traits used for the choice of breeding chickens in all agro-ecological zones in western Tigray. In another way, the farmers in North Gondar and north Wollo, select to pick breeding and replacement cocks and hens to improve the performances of chickens based on color, live weight, and comb type, conformation, and breeding ability of chickens (Addisu *et al.,* 2014; Asmamaw, 2016).

Furthermore, the traits of preference in tropically adapted chickens for the choice of breeding stock inclining towards body size, egg number, egg size, and meat taste in Nigeria are reported by (Yakubu *et al.,* 2019). The most important farmer's traits preference in Jordan was growth rate, disease tolerance, egg yield, body size, and fertility (Abdelqader *et al.* 2007), and the most important traits in chicken production in Kenya, eggs yield, mothering ability, and body size (Okeno *et al*., 2011). Similarly, Taddelle (2003) reported that the farmers preferred naked neck chicken to keep, for egg production in the *Tepi*. Ahmed *et al*. (2012) also reported that consumersin Bangladesh prefer the naked neck because of heavier and yields higher meat.

Farmers breeding objectives

The main breeding objectives of chickens are source of income, egg production, home consumption/entertaining guests, hatching/ replacement of the flock, and cultural/religion in different parts of Ethiopia (Fistum, 2016; Tashome, 2018; Milkias *et al*., 2019). Similarly, the farmers keep chicken for the objectives of home consumption (42.2%), income generation (48.5%), and cultural prestige 26% in Jigjiga Somali regional state (Abdo *et al.,* 2016). Furthermore, cash income (48.33%), eggs hatching (39.17%) for replacement home consumptions 12.5% the main reason for keeping chickens in Yeki Southwestern Ethiopia (Abegaz and Gemechu, 2016). In another way, in north Wollo Amhara farmers, kept chickens for the purpose of egg production/clutch (37.91%) and plumage color 37.58% (Addisu *et al.,* 2013).

Breeding and Selection Practices

The traditional chicken production system is characterized by a lack of systematic breeding practice in different parts of Ethiopia (Meseret, 2010; Addisu *et al*.,2013; Fitsum, 2017). Similarly, Nigussie (2011) reported that the village chicken production system is totally uncontrolled and replacement the stock produced through natural incubation by means of broody hens in a different part of Ethiopia. Consequently, the small number of the producers improving their chicken productivity either by purchasing of best cock based on farmer's selection criteria, purchasing exotic fertile eggs incubated, and hatching by a local broody hen (Asmamaw, 2016).

According to Hailu *et al*. (2013), the main selection criteria of chicken in genetic upgrading for both male and female chickens are comb type, plumage color, egg production, and broodiness. The body weight and finger placing between the pelvic bones and plumage color and pedigree performance for replacement are the major selection measures in Jimma zone and mid rift valley of Oromia (Teshome, 2018; Hunduma *et al*., 2010).

Mating System and Culling Practices

Mating System

The proportion of local chicken producers who practiced controlled and uncontrolled natural mating systems are

different across the agroecology of Ethiopia. Markos *et al.* (2016); Addisu *et al*. (2013); Guteta and Alewi (2018) reported that, the majority of the chicken producers in different parts of Ethiopia are practice uncontrolled mating systems as a result of free scavenging chicken production system. Similarly, in Hadiya Southern Ethiopia, the scavenging chicken production system characterized by lack of a systematic breeding program (uncontrolled mating systems), and about (48.9%) the farmers prioritized the performance of the male line, 22.2% of farmers placed the performance the female line and 28.9% both on the male and the female lines (Bekele and Shigute, 2019).

Culling Practices

This method is one of the breeding practices through the less suitable group of chickens removed from the population. According to Bekele and Shigute (2019), about 39.4% and 25% of the chicken owners are culled their chickens based on the level of productivity (for poor production) and health status (when they got sick), 13.6% to the frequency of broodiness. According to Belete *et al*. (2019), low productive (30.25%), absence of broodiness (17.18%), frequent broodiness (30.52%), and diseased (22.05) are the main reasons for culling chicken. the cull farmers. Poor productivity, old age, diseases, feather color, bad body conformation, poor growth and body size and poor productivity, sickness, old age, and frequency of broodiness are among the major culling criteria (Tashome, 2018).

While preventing mate, cull at an early age, or culling poor productive chickens are the main culling methods in the North Wollo Amhara region by (Addisu *et al*. 2013). The main facts for culling chickens are old age (22.2%) low production (1.1%), extra male (7.8%), illness behavior (7.8%) and the earlier rainy season (6.7%) for disease occurrence, an ability to feed, also a hard environment for chickens in Lume, Oromia Ethiopia (Guteta and Alewi, 2018). The farmers are practicing culling of their chickens mostly due to old age of the chicken (98.2%), low production of the egg (66.4%), unwanted plumage color (63.6), disease problem (70.9%), and bad temperament (54.5%) for the purpose of selling (87.3), home consumption (65.5%), and scarifies (44.5) in Mezhenger, Sheka, and Benchi -Maji zones of southwestern Ethiopia (Yadessa *et al*., 2016). Additionally, the village chicken owners are culling unwanted chickens from their flocks, either poor productivity or sickness, old age and sickness for the purpose of selling and for home consumption in different parts of Ethiopia (Markos *et al*., 2016; Goraga *et al*., 2016; Hailu *et al.,* 2019; Bekele and Shigute, 2019).

Major village chicken production constraints

The major chicken production constraints that hindering the productivity of chickens in different parts of Ethiopia are diseases, predators, feed shortage, lack of proper housing, and lack of marketing access (Hailu *et al.,* 2019; Bekuma, 2018; Wondu *et al.,* 2013). In another way, the major constraints for village chicken production systems are diseases and predators in the Western Tigray (Markos, 2016). The scavenging chicken production system characterized by high mortality chicken in the first two weeks of life caused by disease and predators (Aberra, 2011). According to Tashome (2018) the major and economically important disease and predators are fowl typhoid (36.1%), coccidiosis (23.9%), Newcastle (17.7%), fowl cholera (13.5%), fowl salmonella (5.7%), fowlpox (2.3%) and fowl crayza (0.8%) and cats, wild birds, and wild cat locally called “shelmetmate”/ “lotu respectively that responsible for losses in chickens and also reduced the chickens’ productivity in all agroecology.

Diseases are one of the major disadvantages of village chicken production systems and Newcastle disease (NCD) is the most widely distributed among village chicken in Ethiopia, such as Oromia, Amhara, and Southern Nations Nationalities and People Region (SNNP) (Mulisa *et al*., 2014; Terefe *et al*., 2015; Negewo *et al.,* 2018). Similarly, under farmer management conditions in southern Ethiopia, the main village chicken production constraints are disease and predator (Salo *et al.,* 2016). In other ways, through modern and traditional methods, farmers control diseases. Red pepper (Capsicum annum), lemon (Citrus limon), wormwood Artemisia absinthium ('simfa/feto') and garlic (Allium sativum), simza, fito, local alcohol ('Arkie') are the traditional disease control medicines provided by incorporating/adding traditional medicines into regular feeds and providing their chickens with (Tashome 2018; Haile *et al*., 2016; Yitbarek *et al*., 2013; Moges *et al*., 2010). While the major modern disease control measures are proper hygiene, vaccination, spraying, and treatment all through de-worming (Tashome 2018).

MATERIALS AND METHODS

Description of the study area

The study was conducted in two districts of the West Wollega zone, Oromia regional state, Ethiopia, namely, Gulliso and Aira based on agroecology and indigenous chicken’s production potential (Figure 1).

Gulliso District

Gulliso district is located 486 km from Addis Ababa and 60 km from the town of West Wollega (Gimbi) zone. Based on agroecology the district is categorized as 61% midland and 39% lowland, with a maximum 29.5°C and minimum 12°C temperature. The annual rainfall of the district ranges from 1000mm- 1800mm and the altitude range from 1350-1650 masl. The agricultural system of the study area is characterized by a mixed farming system. The livestock populations are 83,436 cattle, 6,281goats, 15,134 sheep, 85,300chickens, 6,825 donkey, 305 mules, and 195 horse (GLFO, 2020). Maize, sorghum, finger millet, and nugi are the major crops grown in the district. Additionally, backyard vegetables and root crops (potato, sweet potato, carrot, cabbages, and red-root) are also produced in the district (GLFO, 2020).

Aira District

Aira District has located 504 km from Addis Ababa and 78 km from the town of West Wollega (Gimbi) zone. Based on agroecology the district is categorized as 75% midland and 25% lowland, with a maximum of 28°C and a minimum of 10°C temperature. The annual rainfall of the district ranges from 1100mm- 2200mm and the altitude range from 1400-1850 masl. The agricultural system of the study area is characterized by a mixed farming system. The livestock reared in the study area is 55,234 cattle, 4.087goats, 14,596 sheep, 68,988 chickens, 6,505donkey, 90 mules, and 266 horses (ALFO, 2020). The major crops grown in the district are maize, sorghum, finger millet, and nugi. In addition to these, backyard vegetables and root crops (potato, sweet potato, carrot, cabbages, and redroot) are also produced in the district (ALFO, 2020).

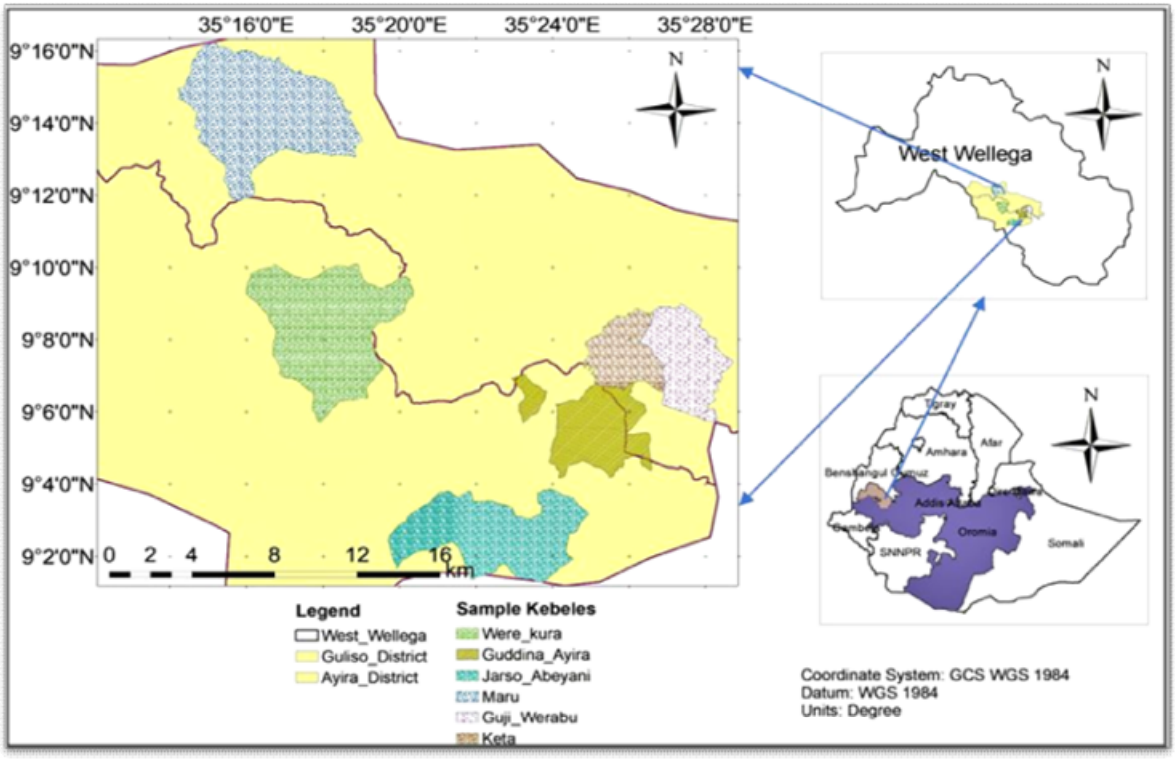

Figure 1: Maps of the study

Sampling Techniques and Sample Size

Sampling Techniques

The two rural districts Gulliso and Aira were selected purposely for this study based on the potential of indigenous naked neck and normal feathered chicken. From the two districts, all Kebeles categorized into two agro ecological zones namely midland and lowland agroecology. Then from midland agroecology four (4) Kebeles, and from lowland

agroecology two (2) Kebeles were selected purposely based on coverage of agroecology and the availability of both indigenous normal feathered and naked neck chicken genotypes. From each selected Kebele farmer who was responsible rearing and not-rearing, both normal feathered and naked neck chicken were identified. From farmers who rearing chicken respondents (sampled farmers) were randomly selected.

Sample size determination

The total sample size for the household was determined by using Cochran (1977) the formula for an infinite population (infinite population **≥** 10,000**).**

$$No = \frac{Z^2(pq)}{e^2}$$

No=Desired sample size according to Cochran's (1977) when population greater than 10,000,
Z^2= standard normal deviation (1.96 for 95% confidence level);
P=0.11 (proportion of population to be included in sample, i.e., 11%)
q = 1-0.11, that is, 0.89; e^2 = degree of accuracy desired (0.05). So, in this finding the sample size was:

$$No = \frac{(1.9)^2(0.11) \times (0.89)}{(0.05)^2} = 150 \text{ households}$$

Methods of Data Collection

Survey data collection method

The survey data was collected from both primary and secondary sources. From a total of 150 randomly selected respondents (100 from midland and 50 from lowland) for the interview, the primary data were collected using a semi-structured questionnaire (which was translated in afaan Oromo) with the support of the development agent (DA) of selected Kebeles. Socio-economic characteristics (sex, age, education level, marital status, and livestock holding) were collected from the selected village chickens' owners in the study area. The data on productive and reproductive performances (clutch per number, egg number per clutch per year, total eggs produced per hen per year, slaughter age/marketing age, and age at sexual maturity, age at first egg laying, clutch length in days, brooding day); management systems and the major chicken production constraints, traits preference considered by producers, breeding objectives, farmers breeding and selection practices of indigenous chicken in the study area were collected from village chicken owners/producer (Appendix individual questionnaire). The secondary data (total livestock population by species, main crop, topography, and climate data (rainfall, temperature) and total human population size of each sample district was collected from the Animal and Fisher Development Office (GLFO and ALFO, 2020) the two districts.

Monitoring Activities

From 150 randomly selected respondents, sixty (60) chickens' owners (40 from midland and 20 from lowland), who have at least each three indigenous normal feathered and naked neck chicken genotypes were selected purposively. From selected farmers one hundred eight (180) adult indigenous chickens were selected randomly for monitoring purposes. From one hundred eight (180) adult chickens, one hundred twenty (120) adults indigenous normal feathered and sixty (60) adult naked neck chicken genotypes were selected. Of the selected one hundred twenty (120) adult normal feathered chicken, sixty (60) from midland, and sixty (60) from lowland agroecology, and from sixty (60) selected adult naked neck chickens, (30) from midland, and (30) from lowland agroecology were selected purposively for evaluation of performance uniformity from both agroecology. Then the selected male and females' chickens were stayed separately from their flock by the selected farmers who have houses for their chickens. However, the farmers who didn't have separate houses for their chickens, stayed the only selected chickens in cattle/sheep and goat house separately and provided water and feed until 10 days. After ten days, the chicken started egg-laying. Then the laid egg was recorded every laying day for individual chicken on record book/chart simply prepared from the paper using local language (afaan oromiffa) at the farmers' level until chicken break down laying the egg. From this activity the functional traits like egg production, incubated egg, hatched chicks, unhatched egg, percent habitability, the mortality of the normal feathered and naked neck chicken genotypes were measured.For the activation of the activities, the farmers have received incentive.

Therefore, all the above parameters, from one hundred eighty (180) indigenous naked neck and normal feathered chickens (120 normal feathered and 60 naked neck chickens) were evaluated through regular monitoring with ten days

interval for three months (December 1, 2019, to March 1, 2020) for confirming trait values obtaining through the survey.

Monitoring of egg production

From the record book/chart simply prepared at the farmers' level until chickens stopped egg-laying. Then the recorded eggs were counted, and how many days it takes to stop egg-laying. So, the number of eggs and clutch length were determined.

Monitoring incubated chicks, unhatched egg, and hatchability percent

After the all-laid eggs were counted, both chickens' ecotypes started to incubate the laid eggs in locally prepared incubating material like guto, wooden box, xuwe with bedding materials such as straw of finger-millet and with materials like old clothes until the chicks were hatched. Then hatched chicks were separated from unhatched eggs, and both parameters (hatched chicks and unhatched eggs) were counted. The percentage of incubated egg, hatched chicks, wasted egg, and habitability was calculated from this activity.

Growth performance monitoring chicks until 12 weeks

The growth performance or live body weights of hatched chicks of four (4), eight (8), and twelve (12) weeks-old of normal feathered and naked neck chicks were taken using weighing balance three times within three months or twelve weeks.

Mortality rate chicks less than 12 weeks

Within three months of monitoring phase, from hatched chicks, the survived and died of four (4) weeks to twelve (12) weeks were recorded. Then the percent survival of survived chicks and percent mortality of dead chicks for four-week-old, eight-week-old and twelve-week-old were calculated. Therefore, all the above parameters, from one hundred eighty (180) naked neck and normal feathered chickens (120 normal feathered and 60 naked neck chickens) were evaluated through regular monitoring with ten days interval for three months (December 1, 2019, to March 1, 2020) for confirming trait values obtaining through the survey.

Statistical Analysis

The qualitative data on household characteristics or all survey data were analyzed using descriptive statistics such as frequency procedures and cross-tabulation by Statistical Package for Social Sciences (SPSS Version 20). The General Linear Model (GLM) procedure of SAS 9.3 (2014) was used to analyze the effects of genotypes (genotypes) and agroecology difference on productive and reproductive trait performance of indigenous normal feathered and naked neck chickens' ecotypes. Mean separation was carried using the LSD test for the traits that were statistically different across the genotypes and agroecology in the analysis.

The following statistical model was used to analyze the data.

$$\gamma_{ij} = \mu + \alpha_i + \beta_{j+} (\alpha\beta)_{ij} + €_{ij}$$

Where: Y_{ijk} =is the chicken performance parameter estimate for i^{th} agroecology and j^{th} genotype, μ = Overall mean, $\alpha_{i=}$ the effect, i^{th} agroecology t (i=2, lowland, and midland)
β_j = the effect, j^{th} genotype (j=2, indigenous naked neck, and normal feathered chicken genotypes), αi*βj= effect due to interaction between i^{th} agro-ecology and j^{th} genotype,
$€_{ij}$ = random term.
For farmers' trait preferences and breeding objective index were used. The index was done using the following formula:
Index =Σ (n x number of households ranked 1^{st}) + (n-1) x number of households ranked 2^{nd}) + …+ 1 x number of households ranked last) for one trait divided by the Σ (n x number of households ranked 1^{st} + (n-1) x number of households ranked 2^{nd} +…. +1x number of households ranked last) for all traits in both agroecology.
Where: n = number of traits under consideration. The variable with the
highest index value was the highest economically important trait (Gizaw *et al*, 2010).

RESULTS AND DISCUSSIONS

Household Characteristics of the Respondents

The general demography of the respondent's in the study area is presented in (Table 2). According to the report of chicken producers, about 72 percent of them were males while the remaining 28 percent were females in both midland and lowland agroecology. The result was comparable with the report of Yosefe *et al*. (2016) that in Kafa and Bench-Maji about 79 percent and 21 percent; Zereu and Lijalem (2016) 85.9% and 14.1% in Walita; Milkias *et al.* (2019) 57.2% and 42.8% in Gena Bossa and Bekuma (2018) 90%, and 10% in Gimbi West wollega for male and feme chicken owners respectively. Concerning the age of the respondents, about 40.7%; 29.3%, and 30% of farmers were within the range age of 20-30; 31-40- and 41-65-years old age respectively. The range of age between twenty (20) to thirty (30) years-old chicken owners were relatively high. This indicated that, the youngest generation involved in the chicken production activity to generate immediate income. The educational status of the respondent's in the study area composes 1-6 grade (26%), 7-10 grade (20%), (32%) 11 and above grade, and illiterate (22%) in the study area. Regarding to marital status, the majority of the respondents in the study area were about (86%) married followed by (10%) widows and (4%) divorced. The existence of (86%) married respondents in the study area were in line with Yosefe *et al*. (2016) (89%) married respondents in Kafa and Bench-Maji.

In midland and lowland agroecology, according to this report, the mean family size was 4.75±.25 and 4.25±.29 per household respectively with an overall mean of 4.5±.19 in the study area. This result was close to the national average household size of 4.6 people (CSA, 2011). Although the average family size is 5.97in Kersa, 6.29 in East Hararghe; 6.2 central Tigray, and 5.86 Kaffa (Tagesse, 2016; Fitsum, 2016; Getu *et al.,* 2014; Abiyu, 2019). In midland and lowland agroecology, the mean land-hold per household was 1.11±.07 and 1.29±.07ha respectively with an overall mean of 1.17±.05ha in the study area. The result was almost similar to the national average size of 1.18 ha of land for each household (CSA, 2011). However, the result was higher than Tagesse (2016) and Fitsum (2016) who reported 0.48 and 0.58 ha in Kersa East Hararghe and central Tigray respectively.

Table 3. General characteristics of the household respondents in Gulliso and Aira districts

Households profiles'		Agroecology		
		Midland (N=100)	Lowland (N=50)	Mean (N=150) %
Sex of respondents	Male	71(71)	37(74)	108 (72)
	Female	29(29)	13(26)	42 (28)
Age	20-30	40(40)	21(42).	61(40.7)
	31-40	29(29)	15 (30)	44 (29.3)
	41-65	31(31)	14 (28)	45(30)
Educational status	Illiterate	20 (20)	13 (26)	33(22)
	1-6	28 (28)	11 (22)	39(26)
	7-10	17 (17)	13 (26)	30(20)
	11 and above	35 (35)	13 (26)	48(32)
Marital status	Married	84 (84)	45 (90)	129(86)
	Widows	12 (12)	3 (6)	15(10)
	Divorced	4 (4)	2 (4)	6(4)
	Family size	4.75±.25	4.25±.29	4.5±0.19
	Land/household/heck	1.11±.07	1.29±.07	1.17±.05

N=number of respondents

Livestock ownership per households

Flock and herd Size composition

The survey data indicated that the mean size of flock and herd per household was 11.04±.22 for chickens, 1.26±.16 for goats, 2.26±.17 for sheep, 1.95±.09 for cows, 1.42±.06 for oxen, 0.92±.07 for heifers, 1.79±.1for calves, 1.17±.07 for donkeys 0.62±.06 for horses, and 0.48±.05 for mules as shown in the study area (Table 3). In the current finding, cattle are dominant in midland and lowland agroecology among the livestock population due to their extreme value for plowing, manure as fertilizer, and milk in the midland and lowland agroecology. The overall mean cattle holding/household was 6.58 and 5.07 in midland and lowland agroecology respectively. Furthermore, the mean small ruminants (sheep and goat) holding per household was 2.3. According to this result, the production of village chicken remains a considerable

activity, with a high average household chicken holding of 11.36±.30 and 10.41±.29 for midland and lowland agroecology with an overall mean of 11.04±.22. This result was nearly comparable to Yadassa *et al.* (2017), who in southwestern Ethiopia reported 11.22 chicken flock size per households.

Table 4. Land per house hold and livestock population in the study (Means ±SE)

Livestock per household	Agroecology		
	Midland	Lowland	Overall mean
Cow	2.12±.11	1.61±.18	1.95±.09
Oxen	1.46±07	1.3±.13	1.42±.06
Heifers	1.03±.09	0.71±.11	0.92±.07
Calve	1.97±.12	1.45±.19	1.79±.10
Sheep	2.36±.21	2.06±.30	2.26±. 17
Goats	0.59±.59	2.59±.36	1.26±. 16
Donkey	1.25±.08	1±.13	1.17±.07
Horses	0.60±.07	0.67±.11	0.62±.06
Mules	0.56±.07	0.31±.08	0.48±.05
Chickens	11.36±.30	10.41±.29	11.04±.22

Chicken flock size and structure

The mean value of chicken flock size and structure in the study area is presented in (Table 4 and Fig 2). The mean chicken flock structures per household were hens (1.95), rooster (1.11), pullets (2.11), cockerels (1.39), and young chickens (3.85). A significant (P<0.05) difference was observed between the two genotypes of chicken except in the rooster. This result is similar to Asmamaw (2016) overall mean flock size per household for hen, rooster, pullets, cockerels, and chicks was 1.93, 0.97, 2.01, 1.08, and 7.35 in north Gondar; Tagesse (2016) 3.34, 1.09, 1.58, 0.81 & 3.09 in Kersa, east Hararghe and Yadassa*et al.* (2017) reported that the mean flock sizes were 5.95±1.38, 1.99±0.55, 0.80±0.42, 0.33±0.21 3.71±1.30 per household respectively. These variations may be attributed to species diversity between the normal feathered and naked-neck chicken populations of indigenous people (Assefa and Melesse, 2018).

Table 5. Chicken flock composition based on chicken ecotypes in the study area (Means ±SE)

Parameter	Genotypes			Agroecology		
	Normal feathered	Naked neck	P-value	Midland	Lowland	P-value
Hen	2.36±.09	1.70±.06	<.0001	1.95±.09	2.06±.07	0.3592
Cocks	1.09±.03	1.04±.02	0.1410	1.11±.03	1.03±.02	0.0233
Pullets	2.32±.07	1.68±.06	<.0001	2.11±.08	1.94±.05	0.0754
Cockerels	1.34±.04	1.10±.05	<.0001	1.39±.06	1.16±.04	0.0003
Chicks	5.61±.27	3.89±.19	<.0001	3.85±.27	5.17±.19	0.0001

Figure 2: Indigenous chicken flock in the study area

Management systems and the current chicken production constraints

Management systems in the study area

According to this finding, the most dominant chicken production system in both midland and lowland agroecology was about (89.33 percent) traditional or extensive systems in which feeding system was mainly focused on scavenging with seasonal supplementary feeding. Around 10.67% of the farmers, however, adopted semi-scavenging production systems (scavenging with daily supplementation feeds for their chickens (Table 5 and fig 3). Whereas in the study area, the intensive chicken production method was not familiar. This result was similar to Yadessa*et al.* (2017); Bekuma (2018); Asmamaw (2016) who reported the majority of the chicken production systems are the traditional/village chicken production system with scavenging and occasional supplementation of feed such as cereal crops in different parts of the country. The overall proportion of 71.55 percent and 28.45 percent of respondents in the Southwest Showa and Gurage had extensive and semi-extensive management systems respectively (Emebet, 2015).

Figure 3: Local chicken scavenging in the backyard area

Feeds and feeding system

In chicken production system the most effective methods or practices were chicken feeding and feed system, So, based on the data obtained from village chicken producers in the study area about (90.67perent), in both midland and lowland agroecology supplement their chicken with feed. While the remaining (9.33 percent) of the chicken, owners did not have any supplementary feeds for chickens, due to shortage of feeds resource, lack of feeding knowledge, and attention to their chickens (Table 5&7). A similar result was also reported by Milkias *et al*. (2020) 92.2% in Gena Bossa southern; Abegaz and Gemechu (2016) 94.2% in Yeki district; Addisu *et al*. (2013) 89.87% in Amhara North Wollo and Emebet et al. (2013) 96.3% in Dawo and Seden Sodo Southern are practiced scavenging production system with supplementary feeding. Majority of the farmers in the lowland supplement feed for their chickens than farmers in the midland agroecology of the study area.

In another way, maize (35.33 %), sorghum (26%), finger millet (20%), and household leftover (18.67%) were used as the main supplementary feed in both midland and lowland agroecology. Additionally, about 38 percent and 26 percent maize and finger millet respectively were used in the lowland and the remaining about 27% sorghum and 22% household leftover highly used in midland agroecology. This was comparable to Yadassa *et al.* (2017) who reported, wheat (35.5%), (11.9%) barley, (92.7%) maize, (90%) sorghum, and (88.2%) household wastes for their chickens as a supplementary feed in Mezhenger, Sheka, and Benchi-Maji South Ethiopia. In Gimbi West Wollega, Amanuel (2018) research has found that about (64.4 percent), (25.6 percent) and (10 percent) of farmers supplement their chickens by maize, wheat, and house-leftover feeds.

Farmers mainly obtained around (37.33 percent) from crop harvesting (produced by farmers), (32.67 percent) from harvesting and purchasing, and (30 percent) bought from the market with regard to supplementary feed sources. This result was in agreement with Tashome (2018) study in Saka Chokorsa and Kersa Jimma, around (72.5%) crop harvest or self-produced feed, (21.5%) harvest and purchase, and (6.1%) purchased from the market. Even if the majority (90.67percent) of the chicken owners in the study area supplement feed to their chicken, it is not possible to say adequate in quantity and quality because most of the chicken owners spread feed on the ground (without measuring) for

their chickens and the others about 39.33 percent used local feeders. From local available feeders, about 39.33 percent about 12.66 percent plastic made (old plastics), 10 percent earthen pot, 8.67 percent wooden trough, and 8 percent another locally important materials. The result was also similar to Fitsum (2016) who reported that about (93.4%) farmers did not use feed trough and simply spread the grain on the ground and only about (6.6%) farmer's uses plastic made, earthen plot, wooden and stone made materials to feed their chickens in the central Tigray.

Housing

Houses are one of the most important factors that influence the health conditions, protection, and productivity of chickens. According to this study, about 83.33% of the farmers were not having a separate house for their chickens (Table 5). This result was in line with Asmamaw (2016) who reported about 84.5 percent in north Gondar; Gebremariam *et al.* (2017) (53.9 percent) in Southern Tigray and Milkias *et al.* (2020) 89.6 percent in Gena Bossa reported that the farmers don't have a separate chicken house. In addition, most of the farmers in both midland and lowland agroecology had no separate house for their chicken. As result, they provided night shelter that about 50 percent of the household had night perch inside the house, 21 percent in the ceiling of the house, 18.67 percent on the ground (floor), and 11 percent on the eve of the house (verandah) used in midland agroecology as a shelter for chicken.

Although about 40%, 12%, 20%, and 28% of farmers have night shelter with night perch inside the house with relatives, shelter in the ceiling of the house and on the ground (floor), and the eve of the house (verandah) used in lowland agroecology as a shelter for chicken respectively. This result was comparable with Tashome (2018); Fitsum (2016); Gebremariam *et al*. (2017) who reported that the farmers in different parts of Ethiopia provide various night sheltering places, the perches inside the house, on ceilings of the house, on the eve of the house (verandah), and the ground (floor) covered by bamboo/crops straw night chickens for their chickens.

Water *provision*

Water plays an important role in transportation of nutrient, metabolic reactions, and waste management as a whole. Thus, according to this finding, the most important components related to the water supply were water sources, the water supply season, and the water trough presented in (Table 5). The majority (66 percent) of the respondent's farmers in the study area provided water for their chicken and the remaining 34 percent of the farmers did not provide their chicken with water. Farmers in the lowland agroecology provided chickens with high water ad-libitum than in midland agroecology, which means around 78% and 60% respectively. According to Milkias *et al*. (2020), about 78.8 percent and 83.9 percent of farmers are providing water for their chickens in midland and lowland provided water free access. The principal sources of water in the study area were river water (50 percent), spring water (33.33 percent), underground water (16.67 percent). The majority of farmers in the lowlands supply their chickens with river water. The result was comparable to Tagesse (2016) that farmers are used as the water supply for the chickens mentioned in various agroecology of Kersa, east Hararghe, around spring (40 percent), river (11.7 percent), underground water (45 percent), rainwater (0.8 percent), and pond water (2.5 percent).

With regard to the provision of seasonal water, the farmers in the study area provided water for their chickens during the dry (bega) season, wet (kiremit), and all-season 50 percent, 30 percent and 20 percent, respectively (Table 5). According to this study in the dry (Bega) season, most farmers provided water for their chickens in both lowland and midland agroecology. This result agrees with the report of Tashome (2018) in Saka Chokorsa and Kersa of Jimma (56.7%) of the farmers are providing water for their chickens during the dry (Bega) season. While plastic made (old plastics 41.33%), earthen pot (*xuwe* 31.33%), and wooden trough (16.67%) were used as water trough and the remaining (10.67%) of respondents had no watering troughs. This result is comparable with the result of Haile *et al.* (2017),andMoges *et al*. (2010) broken clay(*shekila)*, wooden trough, and plastic made trough was the most widely used water trough in Bure north West Ethiopia.

Table 6. Chicken management system in the study area n=150

Chicken Production and management system	Agroecology Midland (N=100)		Lowland (N=50)		Overall (N=150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Production system						
Traditional (extensive)	88.00	88.00	46.00	92.00	134.00	89.33
Do you provide supplementary feeds to your chickens?						
Yes	88.00	88.00	48.00	96.00	136.00	90.67
No	12.00	12.00	2.00	4.00	14.00	9.33
Feeds used as supplementary feeds						
Maize	34.00	34.00	19.00	38.00	53.00	35.33
Sorghum	27.00	27.00	12.00	24.00	39.00	26.00
Finger millet	17.00	17.00	13.00	26.00	30.00	20.00
Household left over	22.00	22.00	6.00	12.00	28.00	18.67
Source of supplementary feeds						
Crop harvest (Self-produced)	36.00	36.00	20.00	40.00	56.00	37.33
Harvest and Purchase	37.00	37.00	12.00	24.00	49.00	32.67
Purchased from market	27.00	27.00	18.00	36.00	45.00	30.00
Methods of feed provision						
Spread on the ground	65.00	65.00	26.00	52.00	91.00	60.67
Using local feeders	35.00	35.00	24.00	48.00	59.00	39.33
Type of feed trough						
Plastic made (old plastics	12.00	12.00	7.00	14.00	19.00	12.67
Earthen pot	11.00	11.00	4.00	8.00	15.00	10.00
Wooden trough	9.00	9.00	4.00	8.00	13.00	8.67
Another material	7.00	7.00	5.00	10.00	12.00	8.00
Do you have a separate house for your chicken?						
Yes	19.00	19.00	6.00	12.00	25.00	16.67
No	81.00	81.00	44.00	88.00	125.00	83.33
Night shelter (housing system)						
Night perch inside the house with family	50.00	50.00	20.00	40.00	70.00	46.67
shelter in the ceiling of the house,	21.00	21.00	6.00	12.00	27.00	18.00
On the ground (floor)	18.00	18.00	10.00	20.00	28.00	18.67
On the eve of the house (verandah	11.00	11.00	14.00	28.00	25.00	16.67
Do you provide water to your chicken						
Yes	60.00	60.00	39.00	78.00	99.00	66.00
No	40.00	40.00	11.00	22.00	51.00	34.00
Source of water						
Springwater	34.00	34.00	16.00	32.00	50.00	33.33
River	48.00	48.00	27.00	54.00	75.00	50.00
underground water	18.00	18.00	7.00	14.00	25.00	16.67
Season of the year						
Dry (Bega)	49.00	49.00	26.00	52.00	75.00	50.00
Wet (Kiremit)	29.00	29.00	16.00	32.00	45.00	30.00
All-season	22.00	22.00	8.00	16.00	30.00	20.00
Type of watering trough						
Plastic made (old plastics)	32.00	32.00	15.00	30.00	47.00	31.33
Earthen pot	18.00	18.00	8.00	16.00	26.00	17.33
Wooden trough	8.00	8.00	8.00	16.00	16.00	10.67
No watering trough	32.00	32.00	15.00	30.00	47.00	31.33

N =number of respondents; % =percentage

Broody hen managements

The place for incubation and brooding hen management in the study area was presented in (Table 6). According to this result, 70 and 58 percent of the lowland and midland farmers were given water once a day for their broody hens, respectively. The typical types of incubating materials were clay pots (xuwe), wooden box, Guto, in the study area. Separate positions with straw bedding and other locally available materials on the floor and farmers used finger millet straw as bedding materials during hen incubation.Similarly, Abdo *et al.* (2016) reported thatthe common types of incubating materials are mud made (63.1%), grass made (9.2%), bamboo made (13.9 %), clay made (9.5%) and others (4.3%) by using about 97% Teff straw, barley straw, and wheat straw as bedding material. The main incubation season in the lowland and midland was 70% and 66% during dry season respectively. Although about 21.33% and 11.33% rainy season and in both seasons respectively in both agroecology. In the dry season, about 95 percent of farmers preferred to incubate eggs, while 4 percent during both seasons and only 1 percent during the rainy season in various Ethiopian agroecological zones reported by Ethiopia (Aberra *et al*., 2013).

Table 7. Broody hen management system in the study area n=150

Parameters	Agroecology					
	Midland (N=100)		Lowland (N=50)		Overall (N=150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Water &feed provision						
Not provided	58.00	58.00	35.00	70.00	93.00	62.00
Once a day	29.00	29.00	12.00	24.00	41.00	27.33
Twice a day	13.00	13.00	3.00	6.00	16.00	10.67
Common bedding materials						
Clay pot(xuwe) with straw bedding	42.00	42.00	26.00	52.00	68.00	40.67
Wooden box with straw bedding	13.00	13.00	6.00	12.00	19.00	12.67
Gutoo in local name	30.00	30.00	10.00	20.00	45.00	30.00
A separate place with straw bedding	15.00	15.00	8.00	16.00	25.00	16.67
Incubation season						
During dry season	66.00	66.00	35.00	70.00	101.00	67.33
Rainy season	21.00	21.00	11.00	22.00	32.00	21.33
In both season	13.00	13.00	4.00	8.00	17.00	11.33

N =number of respondents, %=percentage

The major village chicken production constraints and disease control measures

The major village chicken production constraints

The main village chicken production constraints which hindering the chicken productivity were predators (37.33 percent), disease (25.33 percent), lack of adequate housing (21.33 percent), and feed shortages (16 percent presented in (Table 7). This result was similar to Milkias *et al*. (2020) who reported, predators, diseases, feed shortages, market access, robbers, lack of veterinary facilities, lack of knowledge of scientific management methods, and lack of time as major village chicken production constraints in Gena Bosa. However, Tashome (2018) in Jimma; Bekuma (2018) in Gimbi West Wollega; Markos (2016) in Western Tigray disagreed that disease (1st), predators (2nd), feed scarcity (3rd), lack of adequate housing (4th) with chicken, husbandry was the important constraints affecting the chicken productivity.

Predators

The result of survey data indicated that predators were the first obvious constraints of chicken production presented in (Table 7). A similar result was reported by Bezabih (2013) in north Gonder; Milkias *et al*. (2020) in Gana Bosa Southern Ethiopia, where predators are the first village chicken production constraint. About 43.33percent wild birds (local name *coroffee, cululle*), 24.67 percent wild cat or locally (muuno*, adala*), 14percent dog (*Saree*), 10 percent rats (especially ate chicks less than eight weeks), 6percent fox and 2 percent hap were well-known predators. The result was in line with Teshome (2018) report where the main predators for chicken Saka Chokorsa and Karsa of Jimma are wild birds and wild cats locally called "shelmetmate"/"lotu. According to the report of Abdo*et al. (*2016), hawk (Buteo jamaicensis) (local

name Risa), cat-like wild animal (*Nasua nasua*) (local name Hama), small-sized but cat like a wild animal (local name chure), kite (Elanus caerules), ownerless domestic cats (Felis catus) and foxes (Canis aureus) (local name Jedelo) are the most common and important predators in Jigjiga. Hunduma *et al.* (2010) reported that, the bird's prey (locally known as "culullee"), cats and dogs, and wild animals are recognized as predators.

In addition, in both midland and lowland agroecology, the village chicken production, and their productivity were highly affected by wild bird and wildcat predators in the study area. Consequently, in each agroecology the affected chickens, about (50 percent) young, (22 percent) adults and 28 percent in both age groups. Around 50 percent and 48 percent of young chickens during dry (Bega). Although, in addition to wild birds and cats in the study area, hap (qamale) and rat (hantuuta) were also recognized as predators of young developing chicks. The predator reduces chicken production performance due to improper housing and extensive scavenging production system of feeding and watering.

Diseases

The major seasonal and periodic disease outbreaks cause' loss of chickens. The majority of the farmers in the study area don't know the disease name even if identified in their symptoms listed in (Table 7). Newcastle (qufaa) diseases, coccidiosis (*loss of eggs production, dhiga garaa kaasaa*) and chronic respiratory diseases (*kurruufsisaa or qufaa*) (44.67 percent), (32.67 percent) and (22.66 percent) are the second economically relevant diseases responsible for losses in production and productivity of poultry in both midland and lowland agroecology, according to the present finding. This result was similar to Addisu*et al. (*2013) where, Newcastle Disease (NCD) (locally called "*fengile*") and cannibalism (locally called "*melalat*") is also observed as a constraint in mid-altitude (3.0%) and low altitude (17.14%) in North Wollo Amhara Ethiopia. According to Milkias*et al*. (2020) in Gena Bosa in southern Ethiopia of different agroecology Newcastle disease is a very common disease outbreak.

In another way, the main sources of infectious diseases in the chicken were (36%) from weather conditions, (23.33) neighboring chicken, (18%) infected/contaminated feeds, (13.33%) unknown causes, and (9.33%) hygiene in both midland and lowland agroecology of the study area. The result was comparable with Tashome (2018) who reported that the major sources of infectious disease in Saka Chokorsa and Karsa, Jimma are around 38.0 percent weather conditions (hot or cold), 13.1 percent market chickens, (9.2 percent) neighborhood chickens, 6.5 percent feed toxicity/contaminated and 4.5 percent hygiene and (28.8 percent) unknown sources. This study was revealed that about (50%) young chicks less than eight-week, (30%) adult chicks, and (20%) both age groups were affected age group (31.33%), (48.67%) and (20%) during the dry season, wet (kiremit), and all the season of the year respectively affected by infectious diseases in the study area. The majority of chicken in both lowland and midland agroecology were affected by disease outbreaks during the Wet (Kiremit) season. According to information from respondents, the most affected chicken genotype by disease outbreak was normal feathered than naked neck chicken. This indicated that naked neck chicken has the ability to resist disease outbreak in the study area. This was supported by Getu *et al*. (2014); Mwacharo *et al. (2007*) that naked neck chicken had excellent resistance ability against certain common disease outbreak.

Table 8. Major chicken's production constraints in study area n=150

Village chicken Production constraints	Agroecology					
	Midland (N=100)		Lowland (N=50)		Overall (N=150)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Major poultry production constraints						
Predators	38.00	38.00	18.00	36.00	56.00	37.33
Diseases	24.00	24.00	14.00	28.00	38.00	25.33
Lack of proper housing	21.00	21.00	11.00	22.00	32.00	21.33
Lack of feed resource	17.00	17.00	7.00	14.00	24.00	16.00
Major predators attacking chicken						
Wild birds (coroffee, cululle)	45.00	45.00	20.00	40.00	65.00	43.33
Wild cat (muuno, Adala/iyyaa/	22.00	22.00	15.00	30.00	37.00	24.67
Dog	17.00	17.00	4.00	8.00	21.00	14.00
Rats	8.00	8.00	7.00	14.00	15.00	10.00
Fox	6.00	6.00	3.00	6.00	9.00	6.00
Hap	2.00	2.00	1.00	2.00	3.00	2.00
Age groups of chicken affected						
Young	49.00	49.00	26.00	52.00	75.00	50.00

Table 9. continuation

Adult	23.00	23.00	10.00	20.00	33.00	22.00
Both age group	28.00	28.00	14.00	28.00	42.00	28.00
Seasons in which chickens affected						
Dry (Bega)	48.00	48.00	25.00	50.00	73.00	48.67
Wet (Kiremit)	30.00	30.00	17.00	34.00	47.00	31.33
All season (dry and wet)	22.00	22.00	8.00	16.00	30.00	20.00
Common diseases in area						
Newcastle disease(*qufaa*)	41.00	41.00	26.00	52.00	67.00	44.67
Coccidiosis (*dhiga gara kaasaa*)	35.00	35.00	14.00	28.00	49.00	32.67
chronic respiratory disease(*kuruufsisaa*)	24.00	24.00	10.00	20.00	34.00	22.66
Causes of diseases infectious						
Weather conditions/ temperature	34.00	34.00	20.00	40.00	54.00	36.00
Neighbors chickens	24.00	24.00	11.00	22.00	35.00	23.33
Infected/Contaminated feeds	19.00	19.00	8.00	16.00	27.00	18.00
Unknown causes	13.00	13.00	7.00	14.00	20.00	13.33
Hygiene	10.00	10.00	4.00	8.00	14.00	9.33
Age groups of chicken affected						
Young	49.00	49.00	26.00	52.00	75.00	75.00
Adult	29.00	29.00	16.00	32.00	45.00	45.00
Both age group	22.00	22.00	8.00	16.00	30.00	30.00
Seasons of year diseases outbreaks						
Dry (Bega)	30.00	30.00	17.00	34.00	47.00	31.33
Wet (Kiremit)	48.00	48.00	25.00	50.00	73.00	48.67
All-season (dry and wet)	22.00	22.00	8.00	16.00	30.00	20.00

N=Number of respondents

Feeding Constraints

The main reason of feeding constraints in the study area is shown in (Table 8 According to this report, the main season for feeding shortages was about 58.67 percent, 26.00 percent and 15.33 percent for wet (Kiremit), dry (bega) and all-season of the year (dry and wet) respectively in the study area. This result was comparable to Fisseha (2010) where the shortage of supplementing feeds during the rainy season makes the chickens more susceptible to diseases in Ethiopia. According to information from sampled respondents during the survey, the naked neck tolerates high feed scarcity that occurred in midland and lowland agroecology. Feed scarcities due to lack of training power and extension service.

Housing Constraints

According to the above table 5, that about 83.33% had no separate chickens' house during days and nights. Nevertheless, provided night shelter for their chicken in perch inside the house, on ceilings of the house, on the ground (floor) covered with straw, and on the eve of the house (veranda) at night-time. The comparable result was reported by Tashome (2018), where the main reasons for chicken house constraints in Jimma Sake Chokorsa and Kersa were lack of knowledge or awareness (46.5 percent), lack of attention to poultry (46.0), lack of construction materials/availability and cost (5.4 percent), less predator risk (1.5 percent), and less thief risk (0.5 percent). In lowland and midland agroecology, these were the main challenges that expose chicken to attack by predators, bad weather (rain, sun, wind, and temperature) (Table 8). With about 78 percent, 22 percent, and 70 percent, 30 percent of farmers in the midland and lowland respectively, farmers in the study, region pay attention, and lack of construction materials for the chicken house.

Chickens disease control measures (modern and traditional control measures

Traditional chicken disease control measures were used by the majority of farmers in the study area and a small number of them followed modern disease control measures presented in (Table 8). In addition, the present study also showed that around (56 percent) respondents followed traditional chicken disease control measures in midland and lowland agroecology and the remaining (44 percent) followed modern disease control measures. In the study area, Araqe (local

alcoholic drink), Lemon (Citrus limon), local name qullubi (Garlic), Red pepper (Capsicum annuum) respectively were about (20.67, 16.67, 10.66, 8) percent of the major traditional disease control methods in the study area. The majority of village chicken owners used local alcohol ('Arkie'), lemon, and onion for the most commonly used sick birds (a traditional treatment against Newcastle disease (NCD) in Bure North West and Jimma Ethiopia) were similar to (Haile *et al.,* 2016; Tashome, 2018).

In another way, a small number of farmers in the study area followed modern disease control methods. About (15.33%) vaccination, (10.67%) spraying, (3.33%) deworming, (6.67%) proper hygiene, and (8%) respondent treatment was used in the study area as modern disease control.This result was comparable with the modern disease control measures reported in Jimma, which measure 19.5 percent, 14.5 percent, 10.9 percent, 2.1 percent, and 1.6 percent respectively, de-worming, proper hygiene, vaccination, spraying, and treatment (Tashome, 2018).

Table 10. Chickens feeding and housing constraints and disease control measures (modern and traditional control measures) in the study area

Feeding and Housing chicken production constraints	**Agroecology**					
	Midland (N=100)		**Lowland (N=50)**		**Overall (N=150)**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Feed scarcity seasons						
Dry (Bega)	25.00	25.00	14.00	28.00	39.00	26.00
Wet (Kiremit)	60.00	60.00	28.00	56.00	88.00	58.67
All-season (dry and wet)	15.00	15.00	8.00	16.00	23.00	15.33
Reasons of feed scarcity						
Lack of training and extension service	75.00	75.00	26.00	52.00	101.00	67.33
Shortage of available feed	15.00	15.00	19.00	38.00	34.00	22.67
High price to buy feed	10.00	10.00	5.00	10.00	15.00	10.00
Housing constraints						
Lack of attention to chickens	78.00	78.00	35.00	70.00	113.00	75.33
Lack of construction materials	22.00	22.00	15.00	30.00	37.00	24.67
Disease control measures						
Traditional control	55.00	100.00	29.00	100.00	84.00	56.00
Lemon (Citrus limon)	16.00	29.77	9.00	31.04	25.00	16.67
Araqe (local alcoholic drink)	21.00	36.90	10.00	34.48	31.00	20.67
local name qullubi (Garlic)	10.00	19.04	6.00	20.69	16.00	10.66
Red pepper (Capsicum annuum)	8.00	14.29	4.00	13.79	12.00	8.00
Modern control measures	45.00	100.00	21.00	100.00	66.00	44.00
Vaccination	15.00	34.84	8.00	38.10	23.00	15.33
Spraying	10.00	24.25	6.00	28.60	16.00	10.67
De-worming	4.00	7.57	1.00	4.70	5.00	3.33
Proper hygiene	8.00	15.16	2.00	9.50	10.00	6.67
Treatment	8.00	18.18	4.00	19.10	12.00	8.00

N= number of the respondents

Productive and reproductive performance chickens from survey

Productive performance chickens

Clutch number

From survey data, the mean clutch number of indigenous normal feathered and naked neck chicken ecotypes were 3.3±.03 and 3.8±.02 respectively (Table 9). The mean clutch number was significant (P<0.05) difference between two chicken ecotypes in the study area. The result was in line with Jahan *et al. (*2017) who reported 3.95 and 3.98 mean clutch numbers per year of normal feathered and naked neck chicken respectively in Bangladesh under rural conditions. However, the reported result of Getu and Birhan (2014)3.97, and 3.52; Idowu *et al*. (2019) 3.7 and 3.56; Yousif and Eltaye *(*2011), 5 and 4 relatively different for normal feathered and naked neck chicken in north Gondar Quara, Eastern Cape South Africa and in Sudan under scavenging conditions. In another way, based on the agroecology the mean

clutch number was 3.08±.05 and 3.41±.03 for indigenous normal feathered chicken in lowland and midland respectively, which was lower than the mean clutch number was 3.9±.04 and 3.75±.02 for indigenous naked neck in lowland and midland agroecology respectively. Then the effect of genotypes and agro-ecology and their interaction on mean clutch number of indigenous normal feathered and naked neck chicken was significant (P<0.05) different.

Egg production

The mean eggs per clutch and total egg produced per year for both indigenous normal feathered and naked neck chicken ecotypes were 11.52±.10; 40.2±.54 and 14.53±.11; 58.3±.41 respectively presented in (Table 9). There were significantly (p<0.05) differences between the two chicken ecotypes in the study area for both parameters. This result was in line with Ahmedi *et al*. (2011) who reported that, 14.93; 67.24 and 15.18; 70.65 were the mean eggs per clutch and egg produced per year in Bangladesh under rural condition for indigenous normal feathered and naked neck chicken respectively. A similar result also reported in Nigerian that the mean eggs per clutch of the naked neck and normal feathered chickens were 9.71 and 11.63 respectively (Yakubu *et al*., 2008). Although the mean eggs per clutch and eggs produced per year are 13.06; 55.87, and 16.88 ;60.20 for indigenous normal feathered and naked neck chicken in north Gondar Ethiopia **(**Getu and Birhan, 2014). In another way, based on agroecology, the mean egg per clutch and total eggs produced per year in both lowland and midland agroecology for normal feathered and naked neck chicken was presented in (Table 9). According the survey, the mean eggs per clutch, and eggs produced per year of the naked neck chicken was higher than the normal feathered chicken in both lowland and midland agroecology with significant (p<0.05). So, this result agrees with Asmamaw (*2016*) who reported that the egg production performance of indigenous necked neck genotype was better than the other chickens in terms of hot agroecology and in traditional production systems. Therefore, the effect of genotypes, agro-ecology and the interaction of genotype and agroecology on egg per clutch of indigenous normal feathered and naked neck chicken was significant (P<0.05) different.

Live body weight

The result of survey data indicated that, the mean live weight/bodyweight of the adult normal feathered and naked neck chicken was (1510±.02 and 2100±.03) gm respectively presented in (Table 9). This result was significantly (p<0.05) different between both chicken ecotype. The result agrees with Assefa and Melesse (2018) in Sheka 1.55 and 1.64 kg; Getu *et al. (*2014) in Quara north Gondar 1.4 and 1.78 kg; Machete *et al*. (2017) in Kweneng and Southern Botswana 2.07and 2.21 kg, and Yakubu *et al*. (2008) 1.16 and 1.30 kg for the normal feathered and naked neck chicken respectively. According to this finding, the mean live bodyweight of indigenous normal feathered and naked neck chicken was (1380±.03and 2300±.06) gm and (1570±.04 and 1770±.04) gm in the lowland and midland agroecology respectively in the study area. The effect of genotypes and agro-ecology and their interaction on egg per clutch of indigenous normal feathered and naked neck chicken was significant (P<0.05) different. This may be due may be related to individual feed conversion ability. Besides the genetic differences causing variation in growth rates of indigenous chicken's genotypes and non-genetic factors like management and environment affect the live weight of the chicken (Teketel, 1986*;* Islam and Nishibori*,* 2009).

Slaughter Age/marketing age

According to the result from survey data, the mean slaughter age/marketing age of normal feathered and naked neck chicken genotypes was presented in (Table 9). Even if the mean slaughter/marketing age of normal feathered and naked neck was not significant(p>0.05) different, the naked neck chicken reached slaughter /marketing age earlier than the normal feathered chickens with mean 5.9±.07 and 6.06±.06 respectively. Likewise, based on agroecology, in lowland and midland agroecology, the mean slaughter age/marketing age of indigenous normal feathered and naked neck chicken was 5.71±.09 and 5.67±.12, and 6.25±.07 and 6.1±.08 months, respectively. Similarly, the result in the lowland and midland agroecology indicated that, the naked neck chicken reached slaughter age/ marketing age earlier than normal feathered chicken. Therefore, the effect of agroecology, on slaughter age/marketing age was significant (p<0.05) different. This may be due to non-genetic variables because in the midland than in lowland agroecology, the naked neck chicken requires more energy to regulate their body temperature. As a result, bodyweight increased earlier in the bare neck chickens (Patra *et al*. 2002).

Reproductive performance from indigenous chickens

Age at sexual maturity

The survey results revealed that the mean age of indigenous normal feathered and naked neck chicken genotypes at sexual maturity were 6.14±.05 and 6.04±.06 months, respectively (Table 9). This result is in line with Getu and Birhan (2014) and Asmamaw (2016) who reported that, for indigenous naked neck chicken and normal feathered (Gasgie and Gugut) chicken respectively, the mean age at sexual maturity is 4.5; 5.39 and 4.96; 5.05 months. Faruque *et al.* (2013) and Yousif & Eltaye (2011), however, reported that in Bangladesh and Sudan the high mean age at sexual maturity for normal feathered (hilly or dwarf (Betwil) than naked neck chicken with a mean of 5.2; 6.16 and 5.03; 5.46 months, respectively. The mean age at sexual maturity of indigenous normal feathered and naked neck chicken was 5.97±.08 and 5.61±.07 and 6.25±.07 and 6.37±.06 months respectively in lowland and midland agroecology.This result indicated that the indigenous naked neck reaches earlier age at sexual maturity than indigenous normal feathered chicken in lowland agroecology with significant (P<0.05) difference. These maybe due to feeding ability (efficiently utilizing feed), management, and overall production systems of farmers mainly on feeding, watering and disease control mechanisms, and also the feed they eat directly converted to growth than maintaining midland agroecology, which is why lowland agroecology is preferable for chicken growth (Patra *et al.* 2002). The more feeding ability indicates the fast-growing ability.

Age at first egg-laying

The survey data indicated that, the mean age at first egg-laying of indigenous normal feathered and naked neck chickens were 6.57±.04 and 6.46±.05 months respectively presented in (Table 9). Even if there was no significant (P>0.05) difference observed between two genotypes on age at first egg-laying, the naked neck chicken in the study area reached the age at first egg-laying earlier than indigenous normal feathered chicken. The result was contradicting the report Talukder *et al.* (2016) in Bangladesh that the mean age at first egg-laying for indigenous normal feathered and naked neck chicken was4.9 and 5.3 months respectively. Ojang (2015) also reported that the mean age of first egg-laying of naked neck chicken was 4.94 months in Sudan. The study revealed that in the lowland agroecology, the mean age of indigenous naked neck and normal feathered chickens at first egg-laying was 6.08±.06 and 6.39±.07 months, respectively, with significant (p<0.05) different. This difference might be due to the weather condition and the feeding ability that affect the age at first egg-laying.

Mean Brooding Day

Broodiness is a condition of physiology or maternal behavior displayed by hens who want to be mothers. The results of the survey showed that the mean brooding days for indigenous normal feathered and naked neck chicken genotypes were 75.4±1.07, and 60.68±.87 days respectively in (Table 9). The mean brooding days were significant (P<0.05) different between the two chicken genotypes. According to this survey data, the naked neck chicken known by shorter brooding days than normal feathered chicken. This result is in line with Idowu *et al.*(2019) who reported that, 56.47 and 56.09 mean brooding days for the normal feathered and naked neck chicken genotype in Eastern Cape Town South Africa. Similarly, the naked neck chicken was recognized in both lowland and midland agroecology by shorter brooding than fully feathered chicken with a significant difference (P<0.05) difference presented in (Table 9). The effect of genotype, agroecology and the interaction between genotypes and agroecology on mean brooding day of both normal feathered and naked neck chicken was significant (P<0.05) different. This short brooding activity observed in naked neck chicken describes the high number of clutch and egg produced per year (Idowu *et al.,* 2019). Therefore, this showed that the effect of genotypes and agroecology on the mean brooding day of the normal feathered and naked neck chicken was significant (P<0.05) different.

Clutch Length

The results of the survey data showed that, the mean clutch length of indigenous normal feathered and naked neck chicken was 18.46±.28 and 20.63±.31 days per year respectively, presented in (Table 9). The mean clutch length was significant (P<0.05) different between the two chicken genotypes.This result was comparable to Yousif & Eltaye (2011) in Sudan for the dwarf (normal feathered) and bare neck chickens under scavenging management conditions was 14.44 and 20.04 days respectively. Peter (2019), however, reported that in Eastern Cape Town South Africa, the relatively low mean clutch length was 16.79 and 16.69 days for indigenous normal feathered and naked neck chickens, respectively.

According to this finding, the naked neck chicken was known by long longer mean clutch length in days than normal feathered chicken in both lowland and midland agroecology presented in (Table 9). Then the effect of genotype, agroecology and the interaction between genotypes and agroecology clutch length of both normal feathered and naked neck chicken was significant (P<0.05) different. This finding was comparable to Alem (2015) who reported that in central Tigray, 21.6- and 21.7-days for indigenous chicken in midland compared to lowland agroecology. Clutch numbers per year may also be determined by this parameter (Idowu *et al.,* 2019).

Incubation and hatch of indigenous chickens

Natural incubation is the most commonly used method of replacing and increasing the size of the flock chicken. A hen often finds a dark and silent place to lay eggs in the family home. According to this finding, the mean incubated egg hatched chicks and unhatched egg were 11.52±.10; 8.18±.20; 3.34±.15 and 14.24±.11; 7.55±.09; 6.69±.1 respectively for normal feathered and naked neck chicken genotypes during survey data, presented in (Table 9).This result was significant (P<0.05) different between two chicken genotypes. From this survey data the normal feathered chickens were known by high hatched chicks than naked neck chickens. Consequently, unhatched eggs were high for naked neck chickens in the study area. This may be due to the egg mass, a high number of eggs and incubation ability.In another ways, in both lowland and midland agroecology, the mean incubated egg, hatched chicks and unhatched egg for both chicken ecotypes were presented in (Table 9). For normal feathered chicken, the mean waste egg was comparatively lower in both midland and lowland than naked neck chicken, based on the table below. This may be due to egg size, weather condition (hot climate), and overall management. The effect of genotype, agroecology and the interaction between genotypes and agroecology incubation and hatch of both normal feathered and naked neck chicken was significant (P<0.05) different. These results were in line with the overall mean number of incubated eggs, hatched chicks and unhatched eggs per clutch of indigenous chicken ecotypes were 10.9; 8.17and 2.73 from the survey in Western Tigray respectively (Markos *et al.*,2015).

Figure 4: Incubation and hatch of indigenous chickens

Hatchability

The survey results showed that for indigenous normal feathered and naked neck chicken ecotypes, the mean hatchability (percent) was 71.04±1.4 and 53.01±.55, respectively, reported in (Table 9). The mean hatchability was significant (p<0.05) different between both chicken ecotypes. The normal feathered chickens were known to have a

higher mean hatchability percentage than naked neck chickens, according to the data from chicken producers. This result is agreed with Yousif & Eltayeb (2011), who in Sudan reported (65.6 percent) and (59.09 percent) the mean hatchability under scavenging conditions for indigenous dwarf and the naked neck chickens respectively. In Nigerian, Yakubu *et al*. (2008) and Osinbowale (2017) also reported higher mean hatchability with 72.13 and 71.49 and 89.69 percent and 83.50 percent respectively for indigenous normal feathering than naked neck.But this result contrasted with the average hatchability recorded in Nigeria by indigenous normal feathered and naked neck chickens (45%) and (93.1%) (Ajayi, 2010).

Similarly, in the midland agroecology, indigenous normal feathered chicken is known to have high hatchability compared to indigenous naked neck chicken in midland agroecology (Table 9). Though, in lowland agroecology, the mean hatchability of naked neck chicken was higher than regular feathered chicken. Based on this data, hatchability may vary across different seasons and nutrition has an effect on indigenous chickens' hatchability levels and naked neck laid the large-sized egg and high in numbers so that all the eggs together cannot be accommodated by their body conformation (Idowu *et al.,* 2019). In general, the effect of genotype and agroecology and the interaction between genotypes and agroecology on the mean percentage of hatchability of indigenous normal feathered and naked neck chicken ecotypes in the study was significant (P<0.05) different.

Survival and mortality rate

The survey data showed that the mean survival and mortality rate of normal feathered and naked neck chicks presented in the indigenous (Table 9). The mean survival and mortality rate for two chicken ecotypes was significant (p<0.05) different. The mean survival rate of the naked neck chicken was higher than the normal feathered chickens with a mean number of 71.14±1.06, in this finding. Similar to Yakubu *et al*. (2008) in Nigeria, the average mortality of the feathered chicken genotype (36.85 percent) which was higher than the naked neck chicken (28.60 percent). This result disagrees with Idowu *et al.* (2019) reported in Eastern Cape South Africa that, the survival and mortality rate of the normal feathered and naked neck chicken was 77.1, and 60.08 and 40.84 and 70.94 respectively. With regard to agroecology, the mean percentage of the normal feathered and naked neck chicken survival rate in lowland and midland agroecology was 57.2±1.04; 85.6±1.06 and 62.8±.72; 71.7±.74; respectively in the study area. For normal feathered chicken, the mean mortality rate was 28.3±.69 in midland, which was lower than for naked neck chicken.The opposite in lowland agroecology was relevant for the indigenous naked neck chicken. The effect of genotypes and agroecology and their interaction on the survival and mortality rate of normal feathered and naked neck chicken indigenous chicken was significant (P<0.05) difference. According to information from chicken owner's mortality of chickens highly caused by disease next to predators. Likewise, Survivability is dependent on changes in mortality rates, robbery variables, disease infection and is critical across various breeds (Idowu *et al*., 2019).

Table 11. Productive and reproductive performance collected through survey in the study area (Mean±SE)

Paramets	Genotypes			Agroecology				P-value	G*Agro
	Normal feathered	Naked neck	P-value	Normal feathered LL	Normal feathered ML	Naked neck LL	Naked neck ML		
Productive performance									
CN	3.3±. 03	3.8±.02	<.0001	3.08±.05^{d}	3.41±.03^{c}	3.9±.04^{a}	3.75±.02^{b}	<.0001	<.0001
ECN	11.52±.10	14.53±.11	<.0001	10.4±.16^{c}	11.2±.11^{b}	14.4±.19^{a}	14.13±.13^{a}	<.0001	<.0001
TEPY	40.2±.54	58.3±.41	<.0001	35.2±.81^{d}	42.7±.57^{c}	60.2±.69^{a}	57.3±.49^{b}	<.0001	<.0001
LW (gm)	1510±.02	2100±.03	<.0001	1380±.03^{d}	1510±.04^{c}	2300±.06^{a}	1770±.04^{b}	<.0001	<.0001
S/Age	6.06±.06	5.9±.07	NS	5.71±.09^{c}	6.25±.07^{a}	5.67±.12^{c}	6.1±.08^{b}	<.0001	NS
Reproductive performance									
ASM	6.14±.05	6.04±.06	NS	5.97±.08^{c}	6.25±.07^{b}	5.61±.07^{d}	6.37±.06^{a}	<.0002	NS
AEL	6.57±.04	6.46±.05	NS	6.39±.07^{c}	6.69±.06^{b}	6.08±.06^{d}	6.81±05^{a}	<.0001	NS
MBD	75.4±1.07	60.68±.87	<.0001	72.9±1.7^{b}	78.4±1.3^{a}	56.2±1.1^{d}	64.7±1.1^{c}	0.0033	<.0001
CL	18.46±.28	20.63±.31	<.0001	17.34±.5^{c}	19.8±.33^{b}	18.64±.3^{b}	22.4±.39^{a}	<.0001	<.0001

Table 12.continuation

ANIE			<.000			14.14±.1			NS
	11.52±.10	14.24±.11	1	11.4±.17^{c}	12.7±.11^{b}	7^{a}	13.3±.14^{a}	<.0001	
ANHC			0.007						NS
	8.11±.20	7.55±.09	8	6.10±.12^{d}	11.1±.12^{a}	8.72±.15^{b}	8.43±.09^{c}	<.0001	
UHE			<.000						NS
	2.04±.15	5.69±.1	1	5.32±.08^{c}	1.57±.05^{d}	5.42±.16^{b}	4.87±.11^{a}	<.0001	
HTBLT			<.000						<.0001
	71.04±1.4	55.93±.55	1	53.5±.57^{b}	76.5±.41^{a}	63.6±.83^{b}	55.3±.54^{c}	0.0148	
SR			0.007	57.2±1.04		85.6±1.0			<.0001
	67.58±.82	71.14±1.06	7	^{d}	71.7±.74^{b}	6^{a}	62.8±.72^{c}	<.0001	
MR			0.007	42.6±1.03					<.0001
	32.37±.79	28.81±1.07	1	^{a}	28.3±.69^{c}	14.3±1.1^{d}	37.1±.73^{b}	<.0001	

G=Genotypes, Agro. =Agroecology; SE=*standard error*;***ML*** *=midland;* ***LL****=lowland;* ***ASM*** *=Age at first sexual maturity;* ***AEL****=Age at first egg laying;* ***CL****=clutch length;* ***MBD*** *=Mean brooding days;* ***ANIE****=Average number of incubated eggs;* ***ANHC****= Average number of hatched chicks;* ***UHE****=unhatched egg,* ***HBLT****=Hatchability;* ***SR****=survival rate;* ***MR****= mortality rate;* ***CN****=clutch number,* ***E/CN****=egg per clutch,* ***TEPY****=total egg per year,* ***LW/gm****=live weight per gram,* ***S/Age****=slaughter age, NS=Non-significant*

Productive and reproductive performance chickens from monitoring

Egg per clutch

The result from monitoring data indicated that, that the mean egg per clutch was 12.58±.23 and 15.6±.22 respectively for the ecotype of indigenous normal feathered and naked neck chicken presented (Table 10). The mean egg per clutch was significant (P<0.05) different between the two chicken ecotypes. Therefore, as reported in the study, the naked neck chicken produced a large number of eggs per clutch than the normal feathered chicken (Hoque *et al.* 2003). In another way, based on agroecology, the mean number recorded egg per clutch in lowland and midland agroecology was higher for indigenous naked neck than indigenous normal feathered chicken with significant (P<0.05) difference. The effect of genotype, agroecology and their interaction on egg per clutch of both chicken ecotypes during monitoring was significant (P<0.05) different. This result was supported by Yushimura *et al*. (1997) who reported that the naked neck chicken is superior in terms of egg production in hot and humid weather. This maybe because in midland agroecology, naked neck chicken needs high energy to maintain their body temperature as a result of which they can lay a high egg per clutch than indigenous normal feathered chicken (Ajayi, 2010). In general, in the table, the results of the survey and monitoring parts in the study area differed figuratively (9 and 10).

Adult live weight (Body weight)

During monitoring data, the mean live weight/bodyweight of adult indigenous normal feathered and naked neck chicken ecotype was 1540±.05 and 1710±.04 gm, respectively, presented in (Table 10 and fig..5). Significant (P<0.05) difference was recorded between two chicken ecotypes. The naked neck chicken was known from this result by superior bodyweight than normal feathered chickens. The mean live bodyweight was 2140±.08 and 1260±.05gm for the naked neck and the normal feathered chicken, respectively. The indigenous naked neck chicken was considered to have greater live bodyweight in both lowland and midland agroecology than the normal feathered chickens.This may be because the feed conversion efficiency of the naked neck chicken was significantly higher than the normal feathered genotypes. The effect of genotype, agroecology and their interaction on liveweight of both chicken ecotypes during monitoring was significant (P<0.05) different. The result was comparable with Singh *et al.* (1998), which in both winter and summer seasons recorded significantly higher performance of naked neck birds. Even if both survey data and monitoring data were in line, elevated liveweight were reported in the monitoring data.

Figure 5: The live weight of the naked neck and normal feathered

Growth performance of chicks

The mean growth performance from monitoring data of the normal feathered and naked neck chicks were 130.18±.43; 143.85±.32 gm for four weeks, 396.02±1.42; 392.79±.76 gm per eight weeks, and 509.41±.58; 523.74±1.34 gm for twelve weeks, respectively (Table 10). This result was significantly ($p<0.05$) different between chicken ecotypes. This parameter was significant ($p<0.05$) different between chicken ecotypes with age. Additionally, there was a rapid increase in body weight gain of both genotypes at the early growth phase (between 4 and 8 weeks) with an extreme average daily body weight gain of 9.4 to 4.2 and 9 to 4.6 g/day of indigenous normal feathered and naked neck chicken respectively. This result was in line with Oleforuh-Okoleh *et al.* (2017) in Nigerian that quickly increased body weight gain of both indigenous normal feathered and naked neck chicken at the early growth phase (between 4 and 8 weeks) with maximum average daily gain of 22.13 and 19.90 g/day respectively. This may be due to exciting temperature difference between both midland and lowland agroecology. Significantly highest mean weights of one-three-month-old the naked neck chickens were attained from lowland chicken than midland agroecology. However, except for naked neck chickens in one-month-old midland agroecology, midland agroecology reached the maximum mean weight of two-three-month-old normal feathered chickens than lowland agroecology. The effect of genotype, agroecology and their interaction on growth performance of both chicken ecotypes during monitoring was significant ($P<0.05$) different. This may be attributable to hereditary disparity and other variations in the degree of management. The result was compared to the report of Markos *et al*. (2015) in western Tigray during the monitoring period of 144.13gm, 303.04 gram, and 517.25 gram, respectively, of local chicken raised under extensive management during one month, two months, and three months of age.

Clutch length

The result of monitoring data within three months showed that indigenous normal feathered and naked neck chicken had a mean clutch length of 17.31±.33 and 20.75±.32 days, respectively (Table 10). A significantly ($P<0.05$) difference was clutch length recorded between two chicken genotypes. The mean clutch length of the naked neck chicken was longer than normal feathered chickens. In other words, in both lowland and midland agroecology of the study region, naked neck chicken was known to have a longer mean clutch length than indigenous normal feathered chicken based on agroecology. The effect of genotype, agroecology and their interaction on clutch length of both chicken ecotypes during monitoring was significant ($P<0.05$) different. This difference may be due to the number of eggs laid and nutrition factors.

Incubation and hatch of chicks

According to the monitoring data, the means incubated eggs hatched chicks and unhatched eggs for indigenous normal feathered and naked neck chickens within three months was 11.51±.17;8.75±.25; 2.76±.18 and 15.26±.25;7.99±.17; 7.27±.12 respectively presented in (Table 10). Significant (P<0.05) differences were recorded regarding the means of incubated eggs hatched chicks and unhatched eggs between both chicken genotypes. The effect of genotype, agroecology and their interaction on incubated egg and hatched chicks of both chicken ecotypes during monitoring was significant (P<0.05) different. This result was similar with the characteristics of indigenous chicken genotypes monitored in Western Tigray for the overall mean of incubated eggs, hatched chicks, and unhatched eggs per clutch, respectively, of 10.42, 8.14, and 2.24. (Markos *et al.,* 2015). In the current finding the mean incubated and unhatched eggs for indigenous naked neck chicken genotype in lowland and midland agroecology was higher than for indigenous normal feathered chicken genotype with significant (P<0.05) difference. Nevertheless, in midland agroecology, the mean hatched chicks for indigenous normal feathered chicken in midland are higher than naked neck chicken with a significant difference (P<0.05). In another way, the waste of eggs for indigenous normal feathered chicken genotypes is not highly observed in the lowland agroecology.

Hatchability

The monitoring data indicated that the mean hatchability percentage of indigenous normal feathered and naked neck chicken genotype was 75.98±1.68 and 52.36±.5 respectively shown in (Table 10). Significant (P<0.05) differences were recorded on hatchability between both chicken genotypes in the study area. The higher mean hatchability percentage for indigenous normal feathered chicken ecotype in midland than indigenous naked neck chicken was recorded based on agroecology with significant (P<0.05) difference. Generally, the effect of genotype and agroecology on hatchability of indigenous normal feathered and naked neck was significant (P<0.05) different. The recorded hatchability of indigenous normal feathered from this finding was higher than the naked neck chicken ecotype. This may be due to genetic and non-genetic variables such as ecotypes of chicken, feeding, condition of temperature or storage, egg size. The result from monitoring in Table 10 agreed with 9 from the survey that the mean hatchability percentage of indigenous naked neck and normal feathered chicken in both agroecology and genotypes with significant (P<0.05) differences.

Mortality

The mean survival and mortality rate of indigenous normal feathered and naked neck recorded from within three months chicks was 69.45±.84and 72.81±1.27 and 30.51±.85and 27.18±1.26 respectively in (Table 10). Higher mortality chicks recorded from the hatched chicks of the normal feathered chicken than naked neck chicken. So, significant (p<0.05) differences were recorded on survival and mortality percentage between two chicken ecotypes. This indicated that the naked neck known by low mortality than normal feathered chicken. This may be due to maintained higher disease resistance. This is similar to Adomako *et al*. (2009)the naked neck gene had significantly lower mortality than normal feathered chickens.Regarding agroecology, the mean average survival percentage of indigenous normal feathered and naked neck chicken chicks recorded in midland was 79.53±1.2 and 66.61±.89 respectively within three months with significant (p<0.05) different. However, in lowland, the mean survival rate of indigenous naked neck and normal feathered chicks was 77.43±1.2 and 61.30±1.3 respectively with significant (p<0.05) difference. The effect of genotype, agroecology and their interaction on mortality of both chicken ecotypes during monitoring was significant (P<0.05) different. This was similar to the fact that the indigenous ecotype of naked neck chicken can adapt, live, perform and reproduce better than the normal feathered birds under poor management conditions (Yakubu et al., 2008). Strong mortality rate for indigenous normal feathered and naked neck chicken ecotypes from lowland and midland within the first four to eight weeks. In this study area the recorded chicken mortality mainly due to predators (coroffee, adala, hantuuta (rat) followed by disease.

Table 13. Productive and reproductive performance collected through monitoring in the study area (Mean±SE).

Paramets	Genotypes			Agroecology				P-value	G*A
	Normal feathered	Naked neck	P-value	Normal feathered		Naked neck			
				LL	ML	LL	ML		
Productive performance									
E/CN	12.58±.23	15.6±.22	<.0001	11.1±.21^{c}	11.58±.26^{c}	16.87±.39^{a}	15.22±.29^{b}	<.0001	<.0001
A LW(g)	1540±.05	1710±.04	0.0106	1260±.05^{d}	1450±.05^{c}	2140±.08^{a}	1640±.03^{b}	<.0001	<.0001
4 Wks(g)	130.18±.43	143.85±.32	<.0001	130.81±.69^{c}	129.52±.53^{c}	144.63±.65^{a}	143.12±.34^{b}	<.0001	<.0001
8 Wks(g)	392.79±.76	396.02±1.42	0.0271	387.7±1.63^{c}	392.78±.72^{b}	411.38±.64^{a}	385.8±.88d^{c}	<.0001	<.0001
12Wks(g)	509.41±.58	523.74±1.34	0.0012	503.15±.48^{c}	510.33±.65^{b}	528.8±1.35^{a}	503.99±.32^{c}	<.0001	<.0001
Reproductive performance									
CL	17.31±.33	20.75±.32	<.0001	16.53±.47^{d}	18.07±.41^{c}	20.03±.44^{b}	21.48±.42^{a}	<.0001	<.0001
ANIE	11.49±.17	15.03±.25	<.0001	11.1±.21^{c}	11.5±.24^{c}	16.3±.36^{a}	14.2±.29^{b}	<.0001	NS
ANHC	8.75±.25	7.99±.17	0.0140	6.30±.19^{d}	10.2±.23^{a}	9.57±.26^{b}	7.43±.16^{c}	<.0001	NS
UHE	2.74±.18	7.03±.12	<.0001	4.80±.12^{b}	1.27±.06^{c}	6.70±.19^{a}	6.77±.15^{a}	<.0001	NS
HTBLT	75.98±1.68	52.36±.5	<.0001	56.55±1.0^{c}	89.10±.46^{a}	58.80±82^{b}	52.38±.45^{d}	<.0001	<.0001
SR	69.45±.84	72.81±1.27	0.0270	61.30±1.3^{d}	79.53±1.2^{a}	77.07±.90^{b}	66.61±.89^{c}	<.0001	<.0001
MR	30.57±.85	27.07±1.26	0.0202	38.70±1.3^{a}	20.17±1.1^{d}	23.27±.95^{c}	33.13±.91^{b}	<.0001	<.0001

***E/CN**=Egg per clutch number, **ALW** =Average liveweight; **CL**=Clutch Length in Day, **ANIE**= Average Number of Incubated Egg, **ANHC**=Average Number of Hatched Chicks, **UHE**=Unhatched Egg, **HBLY** =Hatchability, **SR**=Survival Rate., **MR**=Mortality Rate **LL**=Lowland, **ML**=Midland, G=Genotypes, A=Agroecology, g =gram*

Farmers traits preferences and breeding objectives

Farmer's traits preferences

The preferences of the farmer's traits and their meaning from indigenous normal feathered and naked neck chicken ecotypes were presented in (Table 11). The 1st, 2nd, and 3rd preferred traits of indigenous normal feathered by farmers in midland and lowland agroecology with average index values of 0.123, 0.096 and 0.091 were ranked according to the present findings of egg production adaptability, and mothering capacity respectively**.** Whereas the 4th, 5th, and 6th preferred traits with average index values of 0.08, 0.069, and 0.057 were ranked through body weight, plumage color, and comb types. This result is in line with Tashome (2018) who reported that egg production, feather color, mothering ability (broodiness and hatchability of eggs), adaptability (diseases, harsh climate, and predators), comb types and bodyweight with index values 0.50, 0.11, 0.09, 0.13, 0.02, and 0.15 respectively in Jimma**,** Saka Chokora, and Karsa.

Additionally, the farmers in lowland and midland agroecology, egg production, adaptability (diseases, harsh climate and predators), mothering ability was ranked 1st, 2nd, and 3rd as preferred traits of indigenous naked neck chicken with index average value 0.123, 0.096 and 0.091 respectively. This result is similar to Taddelle (2003) that the farmers preferred naked neck chicken to keep, for egg production in the *Tepi*. Ahmed *et al*. (2012) also reported that consumersin Bangladesh prefer the naked neck because of heavier and yields higher meat. In current finding farmers in midland and lowland, agroecology preferred traits of egg production as the 1st rank from indigenous normal feathered and naked neck with average index values of 0.1 and 0.117 respectively.

Similarly, in the 2nd the rank of indigenous normal feathered and naked neck chicken, mothering ability, and adaptability (diseases, harsh environment, and predators) were favored characteristics, and body weight is the third important traits. For the agroecology of both chicken ecotypes, plumage color and comb types were ranked 5th and 6th

importance traits. The majority of the lowland farmers favored indigenous naked neck chicken for egg production and adaptability traits. The result is agreed with Tashome (2018) who reported that egg production, body weight, and adaptability traits were ranked first, second and third with an index value of 0.47, 0.17, 0.13, and 0.56, 0.13, 0.11respectively in midland and lowland of Jimma Saka Chokorsa and Karsa. Addisu *et al.* (2013) and Markos (2016) reported that the mean egg laid/clutch (egg production/hen) (1st), body weight (meat yield) (2nd), and adaptations (disease resistance) (3rd) were the major preferred traits to be improved through breeding in North Wollo and Tigray region

Table 14. Farmers' trait preference for local chickens in the study area (n=150)

Farmer's trait preference for indigenous chickens	Agroecology																Average Index
	In midland chicken owner								In lowland chicken owner								
	Rank								Rank								
	1	2	3	4	5	6	Sum	Index	1	2	3	4	5	6	Sum	Index	
For indigenous normal feathered chicken																	
Egg production	33	28	19	8	3	4	217	0.056(1)	28	12	10	7	5	4	159	0.041(1)	0.097(1)
Mothering ability	21	35	18	6	5	3	212	0.054(2)	10	22	12	6	4	2	146	0.037(2)	0.091(2)
Bodyweight	16	19	28	9	4	2	206	0.053(3)	9	4	19	5	2	3	122	0.031(3)	0.084(3)
Adaptability	10	12	6	20	3	8	195	0.051(4)	3	2	5	11	3	6	113	0.029(5)	0.08(4)
Plumage color	6	7	3	7	15	3	150	0.039(5)	2	4	6	3	10	5	120	0.03(4)	0.069(5)
Comb types	4	3	1	5	6	10	123	0.032(6)	0	2	1	4	5	8	96	0.025(6)	0.057(6)
For indigenous naked neck chicken																	
Egg production	38	20	16	11	6	5	230	0.059(1)	28	17	22	14	8	4	248	0.064(1)	0.123(1)
Mothering ability	14	20	11	7	2	5	161	0.041(2)	10	26	8	5	4	7	176	0.045(3)	0.086(3)
Bodyweight	7	4	19	9	5	3	151	0.038(3)	12	18	23	7	3	2	172	0.044(4)	0.082(4)
Adaptability	10	8	6	17	4	2	144	0.037(4)	12	12	16	20	5	8	237	0.061(2)	0.098(2)
Plumage color	6	7	3	10	12	1	135	0.035(5)	2	4	6	3	15	5	145	0.037(5)	0.072(5)
Comb types	5	6	5	7	3	10	123	0.032(6)	1	3	2	4	6	9	113	0.029(6)	0.061(6)

N=Number of respondents, % =percentage

Farmers breeding objectives

The main breeding objectives of chickens in the study area are presented in (Table 12). Based on the information obtained from the chicken producers, sources of income,flock replacements, meat, and egg for home consumption and cultural/religious ceremony were the main breeding objectives of chicken with average index values 0.28, 0.287, 0.279 and 0.154 respectively. The result is similar to Addis (2014) review that, the chickens are kept for egg and meat production for home consumption and income generation, selling live chicken, and cultural/religious contribution within the overall index values of 0.30, 0.22, 0.21 & 0.27 respectively. Fitsum (2015) also reported that, cash income, meat/ egg for consumption, for replacement, brooding, spiritual/religious, ceremony, cultural and manure with an index values of 0.101, 0.092, 0.115, 0.120, 0.242, 0.093, 0.046, 0.018 and 0.003 respectively in the centralTigray.

In another way, flock replacements, sources of income, meat& egg home consumption, and cultural/religious ceremony with index value 0.193, 0.178, 0.154&0.081 respectively the main breeding objectives chicken in midland agroecology. Similarly, the chicken in lowland agroecology, kept for meat and egg home consumption, sources of income, andcultural/religious ceremony are the major breeding objectives with index values 0.125, 0.102, 0.094, and 0.073respectively. The result is in line with Abegaz and Gemechu (2016) and Tagesse and Negassi (2016) who reported sale of live chickens and eggs for cash income and eggs hatching for replacement in different parts of Ethiopia.The main importance of rearing chicken about (77.8%) of the respondent in Fogera and (43.7%) Dale districts was for the sale of live chicken for cash income, home-consumption, cultural/religious ceremonies, job opportunity, and egg production (Moges *et al*., 2010).

The farmers in the study area produced egg for hatching/replacement, home consumption, sources of income, and cultural/religious ceremony with average index values 0.293**,** 0.275**,** 0.249 & 0.183 respectively presented in (Table 12). Consequently, farmers in midland used eggs for hatching/replacements, sources of income, home consumptions, and during cultural/religious ceremony with an index value 0.188, 0.157, 0.114 and 0.108 respectively**.** Although, in lowland

mainly use egg for home consumptions, sources of income, hatching/replacements, and cultural/religious ceremony with index values 0.135, 0.119, 0.105 & 0.075 respectively. This result was similar with Moges *et al*. (2010) who reported hatching egg for chick's replacement (51%) and sale for income (43.5%) home-consumption, cultural/religious ceremonies, a job opportunity are the main purpose of egg in Bure. Additionally, the farmers used egg for income generation (57.8%), home consumption (24.4%) and religion/cultural or holiday (64.4%), (93.3%) respectively in Lume (Guteta & Alewi, 2018).

Table 15. Purpose of chickens rearing village chicken and producing eggs in the study area

Parameters	Agroecology												Average Index
	In midland						In lowland						
	Rank						Rank						
	1	2	3	4	Sum	Index	1	2	3	4	Sum	Index	
Objectives of keeping chicken													
Sources of income	44	28	23	11	213	0.178	27	12	9	11	122	0.102	0.28
Flock replacements	25	40	27	9	231	0.193	7	24	6	10	113	0.094	0.287
Meat& egg home consumption	22	24	30	6	184	0.154	12	9	28	9	150	0.125	0.279
Cultural/religious ceremony	9	8	5	14	96	0.081	4	5	7	13	87	0.073	0.154
Purpose of egg													
Hatching	41	27	19	13	185	0.188	22	11	7	8	103	0.105	0.293
Sources of income	26	43	22	4	154	0.157	15	24	10	6	117	0.119	0.275
egg home consumption	22	20	26	6	112	0.114	9	13	21	7	133	0.135	0.249
Cultural/religious ceremony	11	8	5	16	106	0.108	4	5	8	12	74	0.075	0.183

Breeding and Selection Practices

Breeding practice and farmers' judgments on the selection of male and female indigenous chicken varies at midland and lowland agroecology in the study are presented in (Table 13). The majority of the farmer's practiced selection their indigenous chicken for breeding in midland than in lowland with about 73% and 68% respectively. Similar results are reported by Melkias *et al*. (2020) in lowland (47.8%), midland (64.8%), and highland (66.7%) agroecology. According to this finding the farmers were considered both morphological and production traits for chicken selection criteria. Consequently, the selection criteria used for selecting indigenous female chicken for breeding were mothering ability, growth performance, egg production, hatchability, and plumage colors 49.33%, 21.33%, 12%, 10.67%, and 6.67respectively. Whereas the selection methods were about 58% and 42% by weighing body weight and finger accommodation between the pelvic bones respectively. The information obtained from the farmers indicated that the chicken body weight ranked as the1st and finger accommodation between the pelvic bones as 2nd for female selection criteria with (56, 44) % and (62, 38) % in midland and lowland agroecology respectively. A similar result with Tashome (2018) who reported that body weight (59.7%), finger accommodation between the pelvic bones (25.2%), and plumage color (8.6%) were the major selection criteria in selection for female chicken.

In another way, bodyweight, plumage color, and comb type with 38.67%, 32.67, and 28.66 respectively used as the main criteria for the selection of breeding cock/male chicken. In the midland and lowland agroecology about 42percent, 33percent, 25percent, and 4percent, 36 percent, 24percent of the farmers selected male chicken based on good body performance plumage color, and comb types respectively. While the sources of male and female chickens from their family, purchase (neighbors), and market with about 20.67%, 41.33%, and 38% respectively. This result was similar to the study inBuno Bedele and Ilu Aba bora South-Western Ethiopia that about 52.3, 27.6 and 20.1% of the farmers select male chicken based on body weight, plumage color, and comb type respectively (Yadeta *et al*., 2019).

Table 16. Major selection criteria for productive local chickens in the study area (n=150)

Selection criteria	Agroecology				Overall (N=150)	
	Midland (N=100)		Lowland (N=50)			
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Selection practices						
Yes	73.00	73.00	34.00	68.00	107.00	71.33
No	27.00	27.00	16.00	32.00	43.00	28.67
For females						
Mothering Ability	49.00	49.00	25.00	50.00	74.00	49.33
Number of Egg production	22.00	22.00	10.00	20.00	32.00	21.33
Hatchability	10.00	10.00	8.00	16.00	18.00	12.00
Growth performance	11.00	11.00	5.00	10.00	16.00	10.67
Plumage colors	8.00	8.00	2.00	4.00	10.00	6.67
How to select female						
by body weight	56.00	56.00	31.00	62.00	87.00	58.00
Finger accommodation between the pelvic bones	44.00	44.00	19.00	38.00	63.00	42.00
For males						
Growth performance	42.00	42.00	20.00	40.00	58.00	38.67
Plumage color	33.00	33.00	18.00	36.00	49.00	32.67
Comb types	25.00	25.00	12.00	24.00	43.00	28.66
Sources of chickens						
Family	25.00	25.00	6.00	12.00	31.00	20.67
Purchase from Neighbors	43.00	43.00	19.00	38.00	62.00	41.33
Market	32.00	32.00	25.00	50.00	57.00	38.00

N=number of respondents

Mating System and Culling Practices

Mating System

According to the survey data, the majority of the farmers used uncontrolled natural mating in the study area shown in (Table 14). About 86.67% of chicken owners in the study area used an uncontrolled natural mating system and 13.3% of them followed control mating system practices. This result is in line with Addisu *et al. (*2013) who reported that about 89.2% of village chicken owners had uncontrolled natural mating system while 10.79% of them had practiced mate control of their flocks through either retaining best indigenous or exotic cocks with layers (52.79%) in the North Wollo Amhara region. Similarly, the studies conducted in a different part of Ethiopia indicated that the breeding of village chicken is completely uncontrolled and replacement stock produced through natural incubation using broody hens (Nugusie, 2010; Milkia *et al.,*2020). Consequently, the majority of the farmers in lowland agroecology followed uncontrolled and controlled mating practices with 92% and 8 % respectively in the study area. While about 84% of the farmers in midland agroecology followed uncontrolled and 16% controlled mating methods.

Culling Practices

Culling is one of the breeding practices through the elimination of a less fitting group of chickens from the population. Reduction of production, poor growth performance, old age, disease, and unwanted feather color was the major culling criteria 32%, 26%, 22.67, 17.33% and 4.67 respectively in the study area (Table 14). These results similar to Bekele and Shigute (2019); Guteta & Alewi (2018); Emabet (2013); Zemelak (2016) who reported that the level of productivity (for poor production), health status (when they got sick) the major cause of culling chicken in different parts of Ethiopia. In another way, about 58% and 42% of the chicken owners used selling of chicken as culling and home consumption as chicken culling method This result was similar to that the farmers culled chicken by selling and for home consumption (Assefa *et.al.* 2019; Yadessa *et al*., 2017).

Table 17. Major culling criteria for local chickens in the study area

Parameters	Agroecology				Overall mean (N=150)	
	Midland (N=100)		Lowland (N=50)			
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Mating system						
Controlled	16.00	16.00	4.00	8.00	20.00	13.33
Uncontrolled	84.00	84.00	46.00	92.00	130.00	86.67
Culling criteria						-
Reduction of production	32.00	32.00	16.00	32.00	48.00	32.00
Old age	26.00	26.00	13.00	26.00	39.00	26.00
Poor growth performance	20.00	20.00	10.00	20.00	34.00	22.67
Disease	18.00	18.00	8.00	16.00	26.00	17.33
Unwanted feather color	4.00	4.00	3.00	6.00	7.00	4.67
Methods of culling chickens						
Selling	51.00	51.00	37.00	74.00	88.00	58.67
Home consumption	49.00	49.00	13.00	26.00	62.00	41.33

N=Number of respondents

CONCLUSIONS

The current finding showed thatthose indigenous chickens have the potential to be used for production purposes in both midland and lowland agroecology. Different from the common viewpoint, from the two indigenous chicken ecotypes, the indigenous naked neck chickens had better potential than normal feathered chicken in terms of live weight, clutchnumber, egg production in both lowland and midland agroecology. However, based on hatchability normal feathered chicken are better than naked neck chickens in both agroecology. These performance differences indicate that the genetic and phenotypic diversity existences between the two chicken ecotypes that will serve as raw material for indigenous chickens' genetic potential improvement through appropriate breeding programs. Majority of the chicken production system in the study area were traditional chicken production system with feeding system scavenging in which chickens were affected by predators and diseases due to shortage of feed and lack of proper house. Since farmers identified and ranked the major important traits (egg production, mothering ability, body conformation, adaptability, plumage color, and comb type) in both midland and lowland agroecology, during designing of any breeding or conservation strategies these traits have to be given more emphasis.

RECOMMENDATIONS

Based on the results from the current study, consideration should be given to the following points.

- indigenous naked neck chicken should be included in the breeding stratagem and reproducing to have large stock for undertaking future conservation and further improvement strategy,
- the naked neck chicken should be included in the further molecular study to identify their genetic distance from indigenous normal feathered chickens
- the farmers should have to improve management conditions (feeding, housing, watering, and health care practice).

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APPENDIX

Questioners

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

On-farm performance evaluation of indigenous naked neck and normal feathered chicken in West wollega Oromia Ethiopiaquestionnaires:

1. **General information**

1.1. Name of respondent ----------
a. Sex: male_____female_____
b. Age of respondent _____
c. Marital Status1. Married 2. Single 3. Divorced 4. Widowed

2. **Family size of hose hold**

Male ------, Females----------, Total ----------

3. Education Status of Household Head

Literate				Illiterate
Grade 1-6	Grade 7-8	Grade 9-12	Other (Specify)	

4. **Farm characteristics**

4.1. **Land per household --------hek**
4.2. Mixed farming system

5. **Livestock holding in the area (House hold)**

No	**Cattle**						Equines			Chickens			
	COW	Oxen	Heifers	Calves	Sheep	Goat	Donkeys	Horses	Mules	Hens	Cocks	Cockerels	Young chicken
Amount													
Total													

6. Chicken flock and structure

No	Hen	Cocks	Pullets	Cockerels	Young chicken
Amount					
Total					

7. **Chicken production system**

7.1. What type of chicken production system do you practice?
7.1.1. Traditional (Scavenging only) _____
7.1.2. Semi scavenging (Scavenging + Regular supplementation)
7.1.3. Intensive system_____

8. Data collected from recollection by owners or from available records on traits that require

8.1. Indigenous chicken Productive and reproductive in months/days

No	Reproduction and production performance	local chicken	
		Naked neck	Normal-feathered
1	Broodiness (usual/sometimes/rare/other)		
2	hatchability (%)		
3	Age at first egg (months)		
4	Age at sexual maturity		
5	Mean brooding day		
6	Clutch Length		
8	Annual egg production_		
9	Slaughter ages /Markating age		
10	Clutch size_____		
11	Slaughter weight		

9. Chicken breeding objectives of indigenous chickens

9.1. How farmers selected productive hens for egg production?
A. By body size____ B. By pedigree performance for replacement _____ C. by finger accommodation between the pelvic bones _____D. Comp types E. Others

9.2. The major selection criteria of farmers in genetic improvement for male chickens.
A. comb type B. plumage color C. Body weight D. Others-------

9.3. The major selection criteria of farmers in genetic improvement for female chickens.
A. egg production B. broodiness performance C. Body weight

9.4. When do you consume (eat) eggs mostly?
1. Every time (when available) 2. During religious/cultural holidays
3. When being sick 4. Others (Specify) _

9.5. When do you consume Chicken mostly?

1. Every time (when available) 2. During religious/cultural holidays
3 When being sick 4. Others (Specify) ____

Breeding objective and farmer's trait preference

No	**Farmers' trait preference**	**Ranking**	
		Naked neck	normal feathered
2	Egg production traits		
2	Feather color		
3	Mothering ability		
4	Adaptability		
5	Comb types		
6	Body weight		

10. Chicken breeding objectives

10.1. Purpose of keeping chicken

No	Meat (home consumption	Egg (home consumption)	Cultural/Religious	Source of income	Flock replacement
Rank					

10.1.2. Purpose of egg

No	Home consumption	Cultural/Religious	Source of income	Hatching chickens
Rank				

Culling Criteria

No	Poor productivity	Old age	Diseases	Feather color Bad	body conformation	Poor growth	Body size
Rank							

11. Chicken Management

11.1. Chicken Feed and Feeding

11.1.1. Do you provide supplementary feed for your chicken?

11.1.1. Yes ____2. No _____

11.1.2. In which season

Bega_____ 2. Kiremit_____ 3. All season (Bega and Kiremit) ____

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

	Types of feeds				
No	Grains			Household left over	Left scavenging only
	Maize	Millet	Sorghum		
Rank					

How do you provide the feed?

1. by feeder _____ 2. Spreading on the floor_____ 3. Other feed (specify) _____

1. The grain itself_____ 2. Crushed (ground feed) _____ 3. Socked in water _____. 4. Other (specify) _____

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

1. Local ecotype _____2. Cross breed_____ 3. Exotic breed _____4. All breeds

12.1.9. What is the frequency of providing supplemental feed for local ecotype during the above season listed?

i/ For local ecotype

Every day_____ 2. Every other day _____3. Every 3 days _____4. Unknown

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

Age group	Young chicken	Pullets and cockerels	Laying hen	Cocks
Rank				
Reason				

Where do you get the supplementary feed? Why it is important?

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

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

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

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

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

4. Stone made 5. Other (Specify) _____

13.1. Watering
13.2.1. Do you provide water to your chicken? 1. Yes 2. No
13.2.2. If yes, which season of the year you provide water?
1. Bega_____ 2. Kiremit_____ 3. All season (Bega and Kiremit) ____
13.2.3. How frequent you provide water to your chicken during the above season?
1. Once a day_____ 2. Twice a day _____3. Adlibitum (freely) _____
What is the source of your water? 1. Spring water; 2. River;3. Wale (underground water)
13.2.5. Do you have watering trough (Waterer)? 1. Yes 2. No
13.2.6. If yes, what type of Watering trough you have?
1. Plastic made; 2. Earthen pot; 3. Wooden trough;4. Stone made;5. Other (Specify)

13.2. Poultry Housing

13.3.1. Do you have a separate house for your chicken? 1. Yes 2. No
13.3.2 If yes, what type of poultry house do you have? Yes, or No
13.3.3. 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) _____
13.3.4. 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)
4. on the cave of the house (Barandah) _____5. Other (specify) _____

13.4. **Chicken Health Care**
13.4.1. Is there any poultry disease in your area? 1. Yes 2. No
13.4.2. If yes, what is the most prevalent disease affecting chicken in the area?
1. Newcastle disease (*garaa kaasaa*) 2. Other disease, specify _____
13.4.3. What used Control Measures?
1. Traditional methods list the traditional disease control measures.
2. Modern: Vaccination., Spraying, De-worming, Proper hygiene, Treatment

14. Major poultry production constraints in your area
14.1. Predators
14.2. Is there any predator problem in your locality? 1. Yes 2. No
14.3. If yes what is the major predator (wild and domestic animal attacking chicken)?
1st. _____ 2nd. _____3rd. _____ 4th. _____5th. _____
14.4. 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_____
10.5. 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
10.6. Which breed groups of chicken are attacked (affected) more?

14.7. Diseases
10.7.1. List common diseases in area? 1. ---------- 2. ---------- 3. -------- 4. --------
10.7.2. Which age groups of chicken affected by disease?
10.7.3. Which seasons of the year diseases are occurred?
1. Bega 2. Kiremit 3. All season (Bega and Kiremit)

14.8**. Feed resources**
10.8.1. Is there lack of feed resource in the area? Yes No
10.8.2. If yes what is the causes of scarcity?
A. farmer's knowledge B. Availability of feeds C. high price of feeds
10.8.3. Which seasons the feed scarcity is occurred?
1. Bega 2. Kiremit 3. All season (Bega and Kiremit)

14.9. Housing constraints

10.9.1. Lack Chickens of proper housing
10.9.2. Is there lack of chicken housing in the area? Yes No
10.9.3. 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